To: LisaP Jackson/DC/USEPA/US@EPA[]
Cc: Gina McCarthy/DC/USEPA/US@EPA;[david.wright@psc.sc.gov]; david.wright@psc.sc.gov>;"O'Connell, Erin" [eoconnel@icc.illinois.gov]; O'Connell, Erin" [eoconnel@icc.illinois.gov]; Fox, Jeanne" [Jeanne.Fox@bpu.state.nj.us]; Gardner, Jim (PSC)" [Jim.Gardner@ky.gov]; Charles Gray" [cgray@naruc.org]; James Ramsay" [jramsay@naruc.org]
From: "Robin Lunt"
Sent: Mon 6/25/2012 11:37:53 AM
Subject: NARUC Comments in GHG-NSPS
12 06 25 NARUC GHG NSPS Comment Letter FINAL.pdf

Dear Administrator Jackson:

Attached please find comments of the National Association of Regulatory Utility Commissioners in the Proposed Rule for the Standards of Performance for Greenhouse Gas Emissions for New Stationary Sources: Electric Utility Generating Units. These were also filed via Regulations.gov.

Warm regards,

Robin

Robin J. Lunt

Assistant General Counsel

National Association of Regulatory Utility Commissioners

202-898-1350 (direct)

202-898-1559 (fax)

N A R U C
National Association of Regulatory Utility Commissioners

June 25, 2012

VIA ELECTRONIC MAIL and REGULATIONS.GOV

Administrator Lisa P. Jackson
U.S. Environmental Protection Agency
Mail Code 2822T
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460

Re: Docket ID No. EPA–HQ–OAR–2011-0660

Dear Administrator Jackson:

The National Association of Regulatory Utility Commissioners (NARUC) appreciates the opportunity to comment on this proposed rule. Please see our comments below.

If you have any questions, you can reach me at 202-898-1350 or rlunt@naruc.org.

Sincerely,

/s/

Robin J. Lunt
Assistant General Counsel

cc: Regina A. McCarthy, Assistant Administrator EPA Office of Air and Radiation
David Wright, Commissioner, NARUC President
Erin O'Connell Diaz, Commissioner, NARUC Electricity Committee Chair
Jeanne Fox, Commissioner, Chair NARUC Energy Resources and the Environment Committee
James Gardner, Commissioner, Chair NARUC Task Force on Environmental Regulation and Generation
Charles Gray, NARUC Executive Director
James Bradford Ramsay, NARUC General Counsel

Comments of the National Association of Regulatory Utility Commissioners
Standards of Performance for Greenhouse Gas Emissions for New Stationary Sources: Electric Utility Generating Units

The National Association of Regulatory Utility Commissioners (NARUC) represents the State public service commissioners who regulate essential utility services throughout the country. Our members are charged with protecting the public and ensuring that regulated utilities provide reliable service at fair, just, and reasonable rates. NARUC appreciates the opportunity to comment on the *Standards of Performance for Greenhouse Gas Emissions for New Stationary Sources: Electric Utility Generating Units* (Proposed Rule) (77 Fed. Reg. 22392, April 13, 2012) (Proposed NSPS for GHGs).[1]

NARUC Guiding Principles

Representing the State public service commissioners who regulate the nation's power providers, NARUC's perspective on this rule involves its impact on the utilities we regulate and, by extension, their consumers. During our 2011 Winter Committee Meetings we adopted the following recommendations, urging EPA in its implementation of power sector regulations to:

- Avoid compromising energy system reliability;
- Seek ways to minimize cost impacts to consumers;
- Ensure that its actions do not impair the availability of adequate electricity and natural gas resources;
- Consider cumulative economic and reliability impacts in the process of developing multiple environmental rulemakings that impact the electricity sector;
- Recognize the needs of States and regions to deploy a diverse portfolio of cost-effective supply-side and demand-side resources based on the unique circumstances of each State and region;

[1] *Available at* http://www.gpo.gov/fdsys/pkg/FR-2012-04-13/pdf/2012-7820.pdf.

- Encourage the development of innovative, multi-pollutant solutions to emissions challenges as well as collaborative research and development efforts in conjunction with the U.S. Department of Energy;

- Employ rigorous cost-benefit analyses consistent with federal law, in order to ensure sound public policy outcomes;

- Provide an appropriate degree of flexibility and timeframes for compliance that recognizes the highly localized and regional nature of the provision of electricity services in the U.S;

- Engage in timely and meaningful dialog with State energy regulators in pursuit of these objectives; *and*

- Recognize and account for, where possible, State or regional efforts already undertaken to address environmental challenges.

NARUC understands the significant impact the Proposed NSPS for GHGs and other finalized and pending environmental regulations will have on the power sector. To this end, during our annual Summer Meeting in July 2011, the Association expanded on the principles articulated in the earlier resolution. This new policy stresses the need for flexibility in compliance requirements, coordination among generating plants, and continued dialogue with federal and State utility and environmental regulators to ensure that compliance with these regulations does not hinder system reliability and minimizes cost impacts on consumers. Both resolutions are attached as appendices to these comments.

<u>Proposed NSPS for Green House Gases Background</u>

The Proposed NSPS for GHGs will limit carbon dioxide emissions from new fossil-fuel fired power plants to 1,000 lbs CO_2/MWh per year. The rule arises under Clean Air Act section 111, which governs pollution from stationary sources such as power plants that have been deemed by the EPA Administrator as a category of sources that "causes, or contributes significantly, to, air pollution which may reasonably be anticipated to endanger public health or welfare." CAA §111(b)(1)(A). The standard for emissions is defined as "best system of emissions reductions, (taking into account the cost of achieving such reduction and any nonair quality health and environmental impacts and energy requirements) the Administrator determines has been adequately demonstrated" CAA §111(a)(1) (BSER). The Proposed NSPS for GHGs is subject to a settlement agreement[2] where States and environmental entities challenged EPA's failure to address GHG emissions in the 2006 Electric Utility Steam Generating Units NSPS.[3]

EPA proposes to combine coal fired power plants and natural gas combined cycle power plants into a single category for the Proposed NSPS for GHGs.[4] The emission limit established for this new combined source category is based on the demonstrated performance of natural gas combined cycle units (NGCC) "which are currently in wide use throughout the country, and are likely to be the predominant fossil fuel technology for new generation in the future." 77 Fed. Reg. at 22,394.

While the Clean Air Act applies NSPS to new and modified sources, the Proposed NSPS for GHGs does not propose a standard for modifications, stating that "sources not subject to the new source performance standards would be treated as existing sources subject to section 111(d)."

The Proposed NSPS for GHGs excludes transitional sources, defined as "a coal-fired power plant that has received approval for its completed PSD [Prevention of Significant Deterioration] preconstruction permit… and that commences construction within 12 months of

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[2] Settlement between the States of New York, California, Connecticut, Delaware, Maine, New Mexico, Oregon, Rhode Island, Vermont, and Washington, the Commonwealth of Massachusetts, the District of Columbia, and the City of New York (collectively "State Petitioners"); and (2) Natural Resources Defense Council (NRDC), Sierra Club, and Environmental Defense Fund (EDF)(collectively "Environmental Petitioners"), and Respondent, the U.S. Environmental Protection Agency ("EPA").
Available at http://www.epa.gov/airquality/cps/pdfs/boilerghgsettlement.pdf. entered into in December 2010. Hereinafter, Settlement Agreement.
[3] 71 Fed. Reg. 9,866 (Feb. 27, 2006).
[4] Boilers and IGCC units are currently included in the Da category while combined cycle natural gas units are Currently in the KKKK Category. The rule combines Da and KKKK Categories into a new TTTT Category.

the date of this proposal." 77 Fed. Reg. at 22,422. EPA estimates that there are 15 sources that may qualify as transitional sources. The rule also excludes reconstructions from the Proposed NSPS for GHGs.

The Proposed NSPS for GHGs does not provide guidance to the States for promulgating requirements for existing sources, under Clean Air Act 111(d), but the Proposal anticipates future standards for existing sources,[5] and the Settlement Agreement that catalyzed this NSPS directs EPA to issue guidance for existing affected generating units. [6]

COMMENTS

NARUC does not take a position on the merits of this or any other EPA regulation at this time. The Proposed NSPS for GHGs, however, raises concerns regarding resource diversity, consumer costs, and uncertainty for existing sources. These concerns must be viewed in light of the suite of EPA rules that have been or will be proposed that will all have an impact on electric generation.

Diversity of Resources

NARUC has encouraged EPA to recognize the needs of States and regions to deploy a diverse portfolio of cost-effective supply-side and demand-side resources based on their own unique circumstances and characteristics. The proposed NSPS for GHGs combines two otherwise distinct categories, electric-steam generating units and combined-cycle generating units based on the fact that they "serve the same function,

[5] "EPA anticipated that modified sources would become subject to the requirements the EPA would promulgate at the appropriate time, for existing sources under 111(d)" 77 Fed Reg. at 22,421.
[6] http://www.epa.gov/airquality/cps/pdfs/boilerghgsettlement.pdf.

that is to serve baseload and intermediate demand." 77 Fed. Reg. at 22,398. This may create a challenge to resource diversity.

The Proposed NSPS states that "in light of a number of economic factors, including the increased availability and significantly lower price of natural gas, energy industry modeling forecasts uniformly predict that few, if any, new coal-fired power plants will be built in the foreseeable future." 77 Fed. Reg. at 22,395. EPA "recognize[s] that some owners/operators may nevertheless seek to construct new coal-fired capacity. This may be beneficial from the standpoint of promoting energy diversity and today's proposal does not interfere with construction of new coal-fired capacity." 77 Fed. Reg. at 22,395

The rule asserts that it does not preclude the development of coal-fired capacity, but it bases its NSPS on the emissions rates for natural gas combined cycle plants rather than maintaining separate categories and standards for coal and natural gas plants.

> NGCC qualifies as the ''best system of emission reduction'' (BSER) that the EPA has determined has been adequately demonstrated because NGCC emits the least amount of CO_2 and does so at the least cost. We propose that a NGCC facility is the best system of emission reduction for two main reasons. First, natural gas is far less polluting than coal. Combustion of natural gas emits only about 50 percent of the CO_2 emissions that the combustion of coal does per unit of energy generated. Second, new natural gas-fired EGUs are less costly than new coal-fired EGUs, and as a result, our Integrated Planning Model (IPM) model projects that for economic reasons, natural gas-fired EGUs will be the Facilities of choice until at least 2020….

77 Fed. Reg. at 22,398.

The Proposed GHG NSPS recognizes that some power suppliers may want to build coal plants for resource diversity and suggests a 30 year averaging alternative for coal plants that may exceed the 1,000 lbs CO_2/MWh in the first ten years, and then make up these emissions through reducing emissions below threshold for the next 20 years to meet the BSER standard by averaging those 30 years. NARUC supports flexibility such as that provided in the 30 year averaging mechanism.

The decision to combine coal and natural gas combined cycle categories for the purpose of the Proposed NSPS for GHGs and basing the BSER on the combined cycle emissions favors natural gas fired plants. The Proposed GHG NSPS indicates that, "The best performing subbituminous-fired EGU has maintained a 12-month emissions rate of 1,730 lb CO_2/MWh." Even the best performing coal units cannot meet the NSPS without CCS. The Proposed NSPS for GHG goes on to state that "we are not proposing that CCS, including the 30-year averaging compliance option, does or does not qualify as the BSER adequately demonstrated" but solicits comments on that decision. 77 Fed. Reg. 22,420. A commitment to resource diversity would encourage a separate NSPS BSER for coal fired plants and natural gas combined cycle units, keeping the categories separate as they have been historically.

Cost to Consumers

NARUC commissioners are primarily economic regulators who are charged by State law to protect the public interest in affordable and reliable electric service. The Proposed NSPS for GHGs identifies the current trend of low natural gas prices. The price of natural gas, however, like any commodity, can be volatile—the more dependent a system is on a particular fuel, the more risk to the consumer from this volatility. Additionally, depending on natural gas-fired plants increases concerns around gas and electric interdependencies that need to be addressed in order to ensure the continued reliability of the electric grid.[7] Further, while the NSPS for GHGs estimates that it has no cost because the models suggest that all generation developers will build

[7] For an overview of issues surrounding gas and electric dependencies, see Federal Energy Regulatory Commission Docket No. AD12-12-000 and NARUC Comments *available at* http://www.naruc.org/Testimony/NARUC-FERC_Gas_and_Electric_Interdependencies-Comments.pdf

natural gas combined cycle units, in the case that someone builds coal for resource diversity or other purposes, there will be increased costs (probably because of CCS) associated with coal. The Proposed NSPS for GHGs recognizes this cost and suggests that government subsidies are necessary for building coal with CCS. *See, e.g.* 77 Fed. Reg. 22,418 and 22,422 (discussing the six transitional sources that will install CCS and have DOE loan guarantees or grants to do so).

<u>Uncertainty for Existing Sources</u>

In many regions, State commissioners are currently reviewing significant cost recovery requests for power plant compliance plans with the Mercury and Air Toxics Standard (77 Fed. Reg. 9,304) and other rules. The investment decisions may be impacted by the Proposed NSPS for GHGs, but the impact the rule will have on these existing sources remains uncertain.

The proposed NSPS reiterates the established approach that installation of pollution control equipment, such as those required under MATS, does not count as a modification that would trigger the NSPS. *See* Proposed NSPS for GHG at 22,401 and 40 CFR 60.14(e)(5).

EPA has gone further and excluded all modifications and reconstructions from the NSPS. While NARUC does not have a position on EPA's approach, we are concerned that this may raise legal challenges and extend uncertainty for existing sources. Further, the statute, the settlement agreement, and the Proposed NSPS for GHGs indicate that a NSPS standard promulgated under 111(b) would lead to a standard under 111(d) for existing sources that would be covered by the NSPS as if they were new sources. The proposed NSPS for GHGs itself states that "EPA anticipates that [it will] promulgate at the appropriate time, [standards] for existing sources under 111(d)." at 22,421. Uncertainty about these 111(d) requirements will complicate retrofit investment and cost recovery decisions. No one wants to pour millions of dollars into retrofitting a plant to see it close down based on NSPS for GHG standards for existing sources.

Other Rules

In addition to this Proposed Rule, several other rules will impact the Utility Sector, including the Mercury and Air Toxics Standard, 77 Fed. Reg. 9304 (Feb. 16, 2012), the Cross-State Air Pollution Rule: "Federal Implementation Plans: Interstate Transport of Fine Particulate Matter and Ozone and Correction of SIP Approvals," 76 Fed. Reg. 48208 (Aug. 8, 2011) Stayed by the DC Circuit Court of Appeals); the Coal Combustion Residual proposed rule 75 Fed. Reg. 35127 (June 21, 2010); the National Pollution Discharge Elimination System, Clean Water Act 316(b) proposed rule 76 Fed. Reg. 22174 (April 20, 2011). These rules must be evaluated in concert when making investment decisions and cost calculations.

CONCLUSION

NARUC appreciates the opportunity to comment on the Proposed NSPS for GHGs and encourages EPA to consider the principles outlined in our resolutions which are attached, with a specific focus on resource diversity, consumer costs, and the challenges of uncertainty for existing sources when finalizing the NSPS for GHGs.

ATTACHMENTS

Resolution on the Role of State Regulatory Policies in the Development of Federal Environmental Regulation[8]

WHEREAS, The National Association of Regulatory Utility Commissioners (NARUC) recognizes that the U.S. Environmental Protection Agency (EPA) is engaged in the development of public health and environmental regulations that will directly affect the electric power sector; *and*

WHEREAS, EPA is expected to promulgate regulations to be implemented by State environmental regulators concerning the interstate transport of sulfur dioxide and nitrogen oxides, cooling water intake, emissions of hazardous air pollutants and greenhouse gases, release of toxic and thermal pollution into waterways, and management of coal combustion solid waste; *and*

WHEREAS, NARUC at this time takes no position regarding the merits of these EPA rulemakings; *and*

WHEREAS, Such regulations under consideration by EPA could pose significant challenges for the electric power sector, with respect to the economic burden, the feasibility of implementation by the contemplated deadlines and the maintenance of system reliability; *and*

WHEREAS, EPA is expected to provide opportunities for public comment and input with respect to forthcoming regulations; *and*

WHEREAS, Compliance with forthcoming environmental regulations will affect consumers differently depending upon each State's electricity market and the nature of the decisions made by State regulators; *and*

WHEREAS, Addressing compliance with multiple regulatory requirements at the same time may help to reduce overall compliance costs and minimize risk assuming reasonable flexibility with respect to deadlines; *and*

WHEREAS, State utility regulators are well positioned to evaluate risks and benefits of various resource options through policies that appropriately account for and mitigate the risks arising from compliance with pending regulations; *and*

WHEREAS, Cooperation between utility commissions and environmental regulators can promote greater policy coordination and integration and improve the quality and effectiveness of electricity sector regulation; *and*

WHEREAS, State utility regulators, by working with the power sector and State and federal environmental regulators, can help to facilitate least-cost compliance with public health and environmental goals; *and*

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[8] Based upon Resolution on Implications of Climate Policy for Ratepayers and Public Utilities, adopted by NARUC Board of Directors on July 18, 2007

WHEREAS, State utility regulators can help to minimize environmental risk as well as uncertainty regarding reliability and customer rate impacts by requesting regulated utilities with fossil generation to develop plans that evaluate all relevant environmental rulemakings at U.S. EPA; *now, therefore, be it*

RESOLVED, That the Board of Directors of the National Association of Regulatory Utility Commissioners, convened at its 2011 Winter Committee Meetings in Washington D.C., urges the EPA to ensure that, as it develops public health and environmental programs, it will:

- Avoid compromising energy system reliability;
- Seek ways to minimize cost impacts to consumers;
- Ensure that its actions do not impair the availability of adequate electricity and natural gas resources;
- Consider cumulative economic and reliability impacts in the process of developing multiple environmental rulemakings that impact the electricity sector;
- Recognize the needs of States and regions to deploy a diverse portfolio of cost-effective supply-side and demand-side resources based on the unique circumstances of each State and region;
- Encourage the development of innovative, multi-pollutant solutions to emissions challenges as well as collaborative research and development efforts in conjunction with the U.S. Department of Energy;
- Employ rigorous cost-benefit analyses consistent with federal law, in order to ensure sound public policy outcomes;
- Provide an appropriate degree of flexibility and timeframes for compliance that recognizes the highly localized and regional nature of the provision of electricity services in the U.S;
- Engage in timely and meaningful dialog with State energy regulators in pursuit of these objectives; *and*
- Recognize and account for, where possible, State or regional efforts already undertaken to address environmental challenges; *and be it further*

RESOLVED, That NARUC urges State utility regulators to actively engage with State and federal environmental regulators and to take other appropriate actions in furtherance of the goals of this resolution.

Sponsored by the Committees on Electricity and Energy Resources and the Environment
Adopted by the NARUC Board of Directors February 16,

Resolution on Increased Flexibility for the Implementation of EPA Rulemakings

WHEREAS, The Board of Directors of the National Association of Regulatory Utility Commissioners (NARUC) adopted a resolution on the *Role of State Regulatory Policies in the Development of Federal Environmental Regulations* on February 16, 2011; including the following statements:

- **WHEREAS**, NARUC at this time takes no position regarding the merits of these EPA rulemakings; *and*

- **WHEREAS**, Such regulations under consideration by EPA could pose significant challenges for the electric power sector and the State Regulatory Commissions with respect to the economic burden, the feasibility of implementation by the contemplated deadlines and the maintenance of system reliability; *and*

WHEREAS, NARUC wishes to continue to advance the policies set forth in the resolution as it relates to the proposed EPA rulemakings concerning the interstate transport of sulfur dioxide and nitrogen oxides, cooling water intake, emissions of hazardous air pollutants and greenhouse gases, release of toxic and thermal pollution into waterways, and management of coal combustion solids; *and*

WHEREAS, NARUC recognizes that a reliable energy supply is vital to support the nation's future economic growth, security, and quality of life; *and*

WHEREAS, There are many strategies available to States and utilities to comply with EPA regulations, including retrofits and installation of pollution control equipment, construction of new power plants and transmission upgrades to provide resource adequacy and system security where needed when power plants retire, purchases of power from wholesale markets, demand response, energy efficiency, and renewable energy policies – the collection of which can be implemented at different time frames by different interested parties and may constitute lower-cost options that provide benefits to ratepayers; *and*

WHEREAS, A retrofit timeline for multimillion dollar projects may take up to five-plus years, considering that the retrofit projects will need to be designed to address compliance with multiple regulatory requirements at the same time and requiring several steps that may include, but are not limited to: utility regulatory commission approval, front-end engineering, environmental permitting, detailed engineering, construction and startup; *and*

WHEREAS, Timelines may also be lengthened by the large number of multimillion dollar projects that will be in competition for the same skilled labor and resources; *and*

WHEREAS, NARUC recognizes that flexibility with the implementation of EPA regulations can lessen generation cost increases because of improved planning, selection of correct design for the resolution of multiple requirements, greater use of energy efficiency and demand-side resources, and orderly decision-making; *and*

WHEREAS, Some generators that will be impacted by the new EPA rulemakings are located in constrained areas or supply constrained areas and will need time to allow for transmission or new generation studies to resolve reliability issues; *and*

WHEREAS, The North American Electric Reliability Corporation (NERC) and regional RTOs will need time to study reliability issues associated with shutdown or repowering of generation; *and*

WHEREAS, NARUC recognizes that flexibility will allow time for these needed studies*, and*

WHEREAS, The Federal Energy Regulatory Commission (FERC), through its oversight of NERC, has authority over electric system reliability, and is in a position to require generators to provide sufficient notice to FERC, system operators, and State regulators of expected effects of forthcoming health and environmental regulations on operating plants to allow an opportunity for meaningful assessment and response to reliability claims; *now, therefore be it*

RESOLVED, That the Board of Directors of the National Association of Regulatory Utility Commissioners, convened at its 2011 Summer Committee Meetings in Los Angeles, California, supports efforts to promote State and federal environmental and energy policies that will enhance the reliability of the nation's energy supply and minimize cost impacts to consumers by:

- Allowing utilities to coordinate the closure and/or retrofitting of existing electric generating units in an orderly manner that will ensure the continued supply of electricity and that will allow power generators to upgrade their facilities in the most cost effective way, while at the same time achieving attainable efficiency gains and environmental compliance; *and*

- Allowing regulatory options for units that are necessary for grid reliability that commit to retire or repower; *and*

- Allowing an EPA-directed phasing-in of the regulation requirements; *and*

- Establishing interim progress standards that ensure generation units meet EPA regulations in an orderly, cost-effective manner; *and be it further*

RESOLVED, That Commissions should encourage utilities to plan for EPA regulations, and explore all options for complying with such regulations, in order to minimize costs to ratepayers; *and be it further*

RESOLVED, That FERC should work with the EPA to develop a process that requires generators to provide notice to FERC, system operators, and State regulators of expected effects of forthcoming EPA regulations on operating plants to allow an opportunity for meaningful assessment and response to reliability issues; *and be it further*

RESOLVED, That NARUC and its members should actively coordinate with their environmental regulatory counterparts, FERC, and the electric power sector ensuring electric system reliability and encourage the use of all available tools that provide flexibility in EPA regulation requirements reflecting the timeline and cost efficiency concerns embodied in this resolution to ensure continuing emission reduction progress while minimizing capital costs, rate increases and other economic impacts while meeting public health and environmental goals.

Sponsored by the Subcommittee on Clean Coal and Carbon Sequestration and the Committees on Electricity and Energy Resources and the Environment
Adopted by the NARUC Board of Directors July 20, 2011

To: Michael.Brune@sierraclub.org[]
Cc: []
Bcc: CN=Janet McCabe/OU=DC/O=USEPA/C=US@EPA;CN=Joseph Goffman/OU=DC/O=USEPA/C=US@EPA;CN=Jim Jones/OU=DC/O=USEPA/C=US@EPA;Brenner.Rob@EPA.GOV[]; N=Joseph Goffman/OU=DC/O=USEPA/C=US@EPA;CN=Jim Jones/OU=DC/O=USEPA/C=US@EPA;Brenner.Rob@EPA.GOV[]; N=Jim Jones/OU=DC/O=USEPA/C=US@EPA;Brenner.Rob@EPA.GOV[]; renner.Rob@EPA.GOV[]
From: CN=Gina McCarthy/OU=DC/O=USEPA/C=US
Sent: Tue 6/28/2011 1:26:04 AM
Subject: Priorities
priorityregs.6.27.550pm.docx
Court Ordered Priorities 062711.xls

Michael - As a follow up to our call last week I am forwarding two related documents, One is the draft list of 2011-2012 OAR rule priorities that I am also sharing with the other Green Group members for feedback. I have call scheduled with the Group tomorrow at 5 your time. The other document is a list of legal commitments that we have to manage over this same time horizon. To be honest with you, I believe the Club is a litigant on only some of these actions (mostly toxic rules) but I will clarify which ones for you within the next few days. I just thought it best to send this your way rather than hold it up any longer.

Thanks for thinking about this and would love to know what you think are the best next steps.

FY 2011-2012 Priorities

1. Mercury and Air Toxics Rule. This action proposed a NESHAP for new and existing electric utility steam generating units (EGUs) as well as an NSPS for new units. This rule will significantly reduce emissions of many air toxics including mercury, and have co-benefit reductions in emissions of SO2 and fine particles.

2. Transport Rule. The Transport Rule, sometimes referred to as the CAIR replacement rule, will reduce SO2 and NOx emissions from power plants in 27 eastern states (proposed) starting in 2012, with tighter caps in 2014, to help states meet their national ambient air quality standard obligations for PM2.5 and ozone.

3. Light Duty Vehicle Rule. Working with NHTSA, set further standards to improve fuel efficiency and reduce GHG emissions from light-duty vehicles for model years 2017 through 2022.

4. Heavy Duty Vehicle Rule. Working with NHTSA, finalize first-time ever fuel economy and GHG emission standards for heavy-duty vehicles, which are the transportation sector's second largest contributor to oil consumption and GHG emissions.

5. PM 2.5. This action will review and propose retaining or revising the NAAQS for particulate matter.

6. Ozone Reconsideration. This final action completes the reconsideration of the 2008 Ozone NAAQS.

7. Oil and Gas NSPS and NESHAP. This proposal will review the NESHAP and NSPS for the Oil and Natural Gas Sectors.

8. EGU GHG NSPS. This action will amend the EGU NSPS and establish GHG emission requirements for this sector.

9. Tier 3. Set new light-duty vehicle control standards (Tier 3), including tighter NOx and PM standards, for gasoline vehicles. Tier 3 standards would also include lower limits for sulfur in gasoline to enable tighter emission standards by allowing more efficient after-treatment.

10. Iron and Steel NSPS and NESHAP. EPA is currently reviewing the NSPS and NESHAP for this sector following a voluntary remand of the NESHAP for major source Integrated Iron and Steel facilities and a voluntary remand of the NESHAP rule for Electric Arc Furnaces.

11. Petroleum Refineries NSPS and NESHAP. This action will review a number of NSPS and NESHAP regulations affecting refineries and develop standards that will address

toxic, criteria, and GHG emissions, as appropriate, from this sector. This action will also incorporate the Uniform Standards (see below) into rules affecting this sector.

12. Uniform Standards. Organic chemical processing industries such as Oil and Gas, Petroleum Refining, and Chemical production have similar emission sources that are often required to be controlled to similar levels by the same type of control devices and work practice standards. The air pollution control regulatory requirements for these sources have evolved and improved as different NSPS and MACT have been developed over the years. This has resulted in requirements that are different and in many cases insufficient especially with respect to ensuring continuous compliance. This action will develop and consolidate state-of-the-art uniform standards that will then become applicable when they are referenced in future regulatory actions, including new and revised Control Technique Guidelines documents, NSPS technology reviews, and MACT Risk and Technology reviews for these industries.

13. SSM General Provisions Rule. The DC Circuit Court of Appeals vacated the startup, shutdown, and malfunction exemptions of the part 63 General Provisions. These amendments would establish emission standards for some SSM events for certain NESHAP standards that would be affected immediately by the vacatur.

14. Chemical sector rules. This action will review and update the HON (Hazardous Organic NESHAP) and MON (Miscellaneous Organic NESHAP) regulations. The Agency will clarify and consolidate many requirements in these rules, including references to the uniform standards for emission sources common to the refining and chemical sectors. These emissions sources include: cooling towers, equipment leaks, wastewater, closed vent systems and control, and storage vessels.

15. PVC. This action will revise the NESHAP for Polyvinyl Chloride and Copolymers Production that was originally promulgated on 7/10/2002 and vacated by the D.C. Circuit on 6/18/2004. This action, as proposed, will establish MACT standards for vinyl chloride, total organic HAP, hydrogen chloride, and dioxins/furans from several types of emission points at PVC plants.

16. CO NAAQS Review. This rule completes the NAAQS review for CO.

17. NOx SOx secondary Standard. This action will consider a revision to the secondary standard for NOx and SOx.

18. Tribal NSR. This action finalized federal regulations governing preconstruction permitting of minor stationary sources throughout Indian country and major stationary sources of air pollution in nonattainment areas in Indian country.

19. Wood Heaters NSPS. This action will update the 1988 NSPS for Residential Wood

Heaters to reflect significant advancements in wood heater technologies and design, broaden the range of residential wood heating appliances covered by the regulation, and improve and streamline implementation procedures.

20. GHGRR – Stage 2. This notice provides the public another opportunity to comment on the proposed confidentiality determinations for the data elements contained in the GHG reporting rules finalized at the end of 2010.

21. Methyl Bromide Phase Out. Rulemakings to implement the critical use exemptions authorized by the Montreal Protocol Meeting of the Parties.

22. Protective Action Guides (PAGs) for Radiological Incidents. Provides EPA guidance related to action levels for radiation in numerous environmental media for nuclear power plant emergencies, terrorist events, and other radiological incidents. Updates the 1992 EPA Manual of Protective Action Guides and Protective Actions for Nuclear Incidents.

23. Uranium Extraction Facilities (40 CFR 192) – Revisions to standards for protection of the public health, safety, and environment from radiological and nonradiological hazards associated with uranium ore processing and disposal of resulting waste materials

24. NESHAP (Subpart W) Amendments for Operating Uranium Mill Tailings (40 CFR 61). Updates regulations that protect human health and the environment by setting radon emission standards and work practices for operating uranium mill tailings impoundments

25. Uranium Fuel Cycle and Nuclear Power Operations (40 CFR 190). Revisions to standards for Nuclear Power Operations to update them based on new developments in radiation protection and new technologies.

26. Waste Disposal Guidance for Radiological Incidents. Waste disposal guidance for nuclear power accidents and radioactive dispersal devices.

27. Nuclear Power Plant Spent Nuclear Fuel/High Level Waste Regulations. Review of rules applicable to spent nuclear fuel/high level wastes to reflect recent experiences and reflecting recommendations from the Blue Ribbon Commission.

Reconsiderations

1. Boiler MACT. EPA has set a schedule for issuing updated air toxics standards for boilers and certain waste incinerators. The Agency will propose standards for by the end of October 2011 and issue final standards by the end of April 2012.

2. Cement MACT Reconsideration. In this action, we will first issue a notice stating how we plan to respond to the petitions. If our response includes any rule amendments, we

will propose and finalize those amendments as additional stages of this action. The action may also include any corrections and clarifications discovered to be necessary after promulgation of the September 2010 amendments. We do not anticipate any significant changes in rule stringency as part of this action.

Category or Project Name	Settlement, Court-Ordered or Other Status	Category Type	Proposal	Promulgation
Agriculture and Forest Products				
Forest Products Manufacturing				
Pulp and Paper MACT RTR	Court- Ordered	MACT	12/15/2011	7/31/2012
Chemical Production and Distribution				
Generic Chemical Production Rules				
National Uniform Emission Standards for Equipment Leaks and Ancillary Systems	Supports Court-Ordered Chemical & Refinery Sector Rules	MACT & NSPS	8/22/2011	8/25/2012
National Uniform Emission Standards for Wastewater Operations	Supports Court-Ordered Chemical & Refinery Sector Rules	MACT & NSPS	8/22/2011	8/25/2012
Inorganic Chemical Production				
Nitric Acid Plants	Court- Ordered	NSPS	9/30/2011	2/16/2012
Organic Chemical Production				
Ethylene Processes	Court- Ordered	MACT	11/30/2011	11/30/2012
Miscellaneous Organic NESHAP (MON)	Court- Ordered	MACT	11/30/2011	11/30/2012
Hazardous Organic NESHAP (HON)	Integral Part of Chemical Sector	MACT	11/30/2011	11/30/2012
Vinyl Chloride	Integral Part of Chemical Sector	MACT	11/30/2011	11/30/2012
Pesticide Active Ingredient	Court- Ordered	MACT	11/30/2011	11/30/2012
Polycarbonates	Court- Ordered	MACT	10/31/2012	10/31/2013
Acrylic and Modacrylic Fibers	Court- Ordered	MACT	10/31/2012	10/31/2013
Polyvinyl Chloride and Copolymer Production	Court- Ordered	MACT	4/15/2011	1/31/2012
Polyether Polyols	Court- Ordered	MACT	11/30/2011	11/30/2012
Polymers and Resins Production				
Polymers and Resins I	Court- Ordered	MACT	9/14/2010	3/31/2011
Poymers and Resins III	Court- Ordered	MACT	10/31/2012	10/31/2012
Polymers and Resins IV	Court- Ordered	MACT	11/30/2011	11/30/2012

Category or Project Name	Settlement, Court-Ordered or Other Status	Category Type	Proposal	Promulgation
Consumer and Commercial Products Manufacturing				
Flexible Polyurethane Foam Production	Court- Ordered	MACT	10/31/2012	10/31/2013
Aerospace NESHAP	Court- Ordered	MACT	8/31/2011	6/29/2012
National Emission Standards for Shipbuilding and Ship Repair (Surface Coatings)	Court- Ordered	MACT	12/3/2010	10/31/2011
Furniture Manufacturing				
Wood Furniture Surface Coatings	Court- Ordered	MACT	12/3/2010	10/31/2011
Electric Utilities				
Coal Preparation & Processing NSPS	Petition for reconsideration and judicial review	NSPS	3/14/2012	
EGU NSPS GHG	Court- Ordered	NSPS	9/30/2011	7/28/2012
Utility MACT	Court- Ordered	MACT	3/16/2011	11/16/2011
Iron and Steel Production				
Iron and Steel Production				
Ferroalloys Production Facilities	Court- Ordered	MACT	10/31/2011	6/29/2012
Stainless & Non-stainless Steel Manufacturing: Electric Arc Furnaces (EAF)	Voluntary Remand to address mercury	MACT	Feb, 2012	Dec, 2012
Integrated Iron and Steel Reconsideration	Voluntary Remand to address MACT	MACT	Aug, 2012	Aug, 2013
Steel Pickling	Court- Ordered	MACT	9/14/2012	8/15/2012
Mineral Processing				
Clay Products Manufacturing				
Brick & Structural Clay Products	Proposal to Address Court Vacature	MACT	3/30/2012	
Fibrous Minerals Production				
Mineral Wool	Court- Ordered	MACT	10/31/2011	6/29/2012
Wool Fiberglass	Court- Ordered	MACT	10/31/2011	6/29/2012
Phosphate Rock Processing				

Category or Project Name	Settlement, Court-Ordered or Other Status	Category Type	Proposal	Promulgation
Phosphate Fertilizer Production Plants	Court- Ordered	MACT	10/31/2012	10/31/2013
Phosphoric Acid Manufacturing Plants	Court- Ordered	MACT	10/31/2012	10/31/2013
Non-Ferrous Metal Production and Electroplating				
Electroplating				
Chrome Electroplating: Decorative, Hard, Chromic Acid Anodizing	Court- Ordered	MACT	9/14/2010	8/15/2012
Chrome Electroplating: Decorative, Hard, Chromic Acid Anodizing	Court- Ordered	MACT	9/14/2010	8/15/2012
Non-Ferrous Metals Production				
Primary Aluminum	Court- Ordered	MACT	10/31/2011	6/29/2012
Primary Lead Smelting	Court- Ordered	MACT	1/31/2011	10/31/2011
Secondary Aluminum Production	Court- Ordered	MACT	11/30/2011	8/31/2012
Secondary Lead Smelters	Court- Ordered	MACT	4/29/2011	12/16/2011
Petroleum Refining and Distribution				
Petroleum Refining				
Petroleum Refineries	Court- Ordered	NSPS	12/10/2011	11/10/2012
Petroleum Refineries I	Court- Ordered	MACT	12/10/2011	11/10/2012
Petroleum Refineries II	Court- Ordered	MACT	12/10/2011	11/10/2012
SPPD Cross-Cutting Sector Activities and Infrastructure				
Monitoring for Regulatory Programs				
Startup, Shutdown and Malfunction Amendments to Certain MACT Standards	Proposal to address court vacature	MACT	2/3/2012	2/3/2013
Waste Management				
Incineration				
Landfill Municipal Waste Treatment and Disposal				
Offsite Waste and Recovery RTR	Court- Ordered	MACT	10/31/2012	10/31/2013
Oil & Gas				
Oil & Gas NSPS & MACT	Court- Ordered	MACT & NSPS	7/28/2011	2/28/2012

To: Ex. 6 - Personal Privacy
Perciasepe/DC/USEPA/US@EPA;Gina
McCarthy/DC/USEPA/US@EPA ina
McCarthy/DC/USEPA/US@EPA Ex. 6 - Personal Privacy
Ex. 6 - Personal Privacy
Ganesan/DC/USEPA/US@EPA; rvin
Ganesan/DC/USEPA/US@EPA; Ex. 6 - Personal Privacy
Ex. 6 - Personal Privacy
From: "Altman, Pete"
Sent: Thur 5/24/2012 8:18:22 PM
Subject: NRDC's Killer Summer Heat report
Chicago Tribune
Cleveland Plain Dealer
Cleveland Leader
Columbus Dispatch
Detroit Free Press
Michigan Live/Detroit
Lansing State Journal
Boston Globe
Minneapolis Star Tribune
Dallas Morning News
http://www.nrdc.org/globalwarming/killer-heat/
paltman@nrdc.org
http://switchboard.nrdc.org/blogs/paltman/
http://www.nrdc.org

FYI –As part of our ongoing efforts to document the health impacts of climate change in support of EPA's carbon pollution standards, NRDC released this week a new report "Killer Summer Heat" which projects that rising temperatures will cause an additional 150,000 heat-related deaths this century. The report has generated strong news interest, including an exceptional article by Reuters picked up by the Chicago Tribune and many other outlets. Outlets in key states also covered the report, including the Cleveland Plain Dealer, the Cleveland Leader and the Columbus Dispatch in Ohio, the Detroit Free Press, Michigan Live/Detroit and the Lansing State Journal in Michigan, and other major market outlets including the Boston Globe, the Minneapolis Star Tribune and the Dallas Morning News. We are continuing to track more print coverage, and radio coverage is showing up as well including in the above states.

The report and associated materials are posted here: http://www.nrdc.org/globalwarming/killer-heat/.

Thanks,

Pete

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Peter Altman

Climate and Clean Air Campaign Director

Natural Resources Defense Council

Phone: 202-289-2435

Email: paltman@nrdc.org

Blog: http://switchboard.nrdc.org/blogs/paltman/

Web: http://www.nrdc.org

To: "'Brian (ENRD) Lynk'" [Brian.Lynk@usdoj.gov]
Cc: Joseph Goffman/DC/USEPA/US@EPA[]
From: "Michael J. Myers"
Sent: Mon 3/12/2012 1:36:17 PM
Subject: PM

Brian, I would like to call Joe Goffman, cc'd here, directly to get a better understanding of EPA's position in the deadline suit case re. settlement (and as it relates to the position the agency took in the D.C. Circuit in response to our mandamus petition). After thinking more over the weekend about EPA's change in position, I'm frankly a bit troubled and was hoping that Joe could shed some further light on the agency's position. I'm not going to attempt to do any actual negotiating with Joe (not that he couldn't hold his own in that respect). I'm sending this e-mail to satisfy any obligation I may have under NY's Code of Professional Conduct. If you would rather be on the call yourself, that's fine. I would like to call Joe today as I will be out on vacation, as you know, starting tomorrow afternoon.

Following up on Friday's call, I have a call with the other States this afternoon, so will plan to get back to you re. your transfer of venue question either at the end of the day or tomorrow morning. Thanks.--Mike

To: "'Michael.Myers@ag.ny.gov'" [Michael.Myers@ag.ny.gov]
Cc: Joseph Goffman/DC/USEPA/US@EPA;John Hannon/DC/USEPA/US@EPA;Steven Silverman/DC/USEPA/US@EPA[]; ohn Hannon/DC/USEPA/US@EPA;Steven Silverman/DC/USEPA/US@EPA[]; teven Silverman/DC/USEPA/US@EPA[]
From: "Lynk, Brian (ENRD)"
Sent: Mon 3/12/2012 1:54:15 PM
Subject: Re: PM (request for follow-up call with Joe Goffman)

Mike,

I am copying John Hannon and Steve Silverman of EPA OGC, since it was they who conveyed to you on Friday EPA's position with respect to the negotiations. In view of that, I would prefer John and/or Steve participate in any follow-up call, so why don't we try to pick a time today when we're all available. I am available to join the call from home before 11AM, or from the office after 12PM ET.

With regard to litigation procedure, you should call Paul Cort as well since he filed his motion as an application for preliminary injunction, meaning we have to respond by March 19th and an argument hearing is supposed to be scheduled by March 29th.

Brian
(202) 514-6187 (office)
(202) 532-3131 (remote)

Sent Using U.S. DOJ/ENRD BES 5 Server

From: Michael J. Myers [mailto:Michael.Myers@ag.ny.gov]
Sent: Monday, March 12, 2012 09:36 AM
To: Lynk, Brian (ENRD)
Cc: 'Joseph Goffman' <Goffman.Joseph@epamail.epa.gov>
Subject: PM

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Cc: Joseph Goffman/DC/USEPA/US@EPA;John Hannon/DC/USEPA/US@EPA;Steven Silverman/DC/USEPA/US@EPA[]; ohn Hannon/DC/USEPA/US@EPA;Steven Silverman/DC/USEPA/US@EPA[]; teven Silverman/DC/USEPA/US@EPA[]
From: "Michael J. Myers"
Sent: Mon 3/12/2012 2:23:32 PM
Subject: RE: PM (request for follow-up call with Joe Goffman)

thanks. I'm available today 11-12:30, 1:30-2 and 3:45-6.

From: Brian (ENRD) Lynk [mailto:Brian.Lynk@usdoj.gov]
Sent: Monday, March 12, 2012 9:54 AM
To: Michael J. Myers
Cc: 'Goffman.Joseph@epamail.epa.gov'; 'hannon.john@epamail.epa.gov'; 'silverman.steven@epamail.epa.gov'
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To: Vickie Patton [vpatton@edf.org]
From: Vickie Patton
Sent: Tue 3/27/2012 8:06:17 AM
Subject: Cleaner Power for a Stronger America
Settlement Agreement
United States Global Change Research Program
http://www.edf.org/sites/default/files/state-ghg-standards-03132012.pdf
http://www.carbonprinciples.org/

Dear Journalist,

EPA is expected to shortly propose the first nationwide greenhouse gas emission standards for new coal and natural gas fired power plants; the clean air standards are anticipated to halve the carbon pollution from a new coal-fired power plant over its lifetime. Fossil fueled power plants are the single largest source of carbon pollution in our nation. The historic clean air standards will help protect Americans' health while strengthening our Made in the U.S.A clean energy economy.

The EPA national limits on carbon pollution are long overdue and are urgently needed. The power sector is responsible for a staggering 40% of U.S. heat-trapping carbon dioxide. EPA's action is required under a Settlement Agreement with Environmental Defense Fund, NRDC, Sierra Club and numerous states including New York, California, Connecticut, Delaware, Maine, New Mexico, Oregon, Rhode Island, Vermont, and Washington, the Commonwealth of Massachusetts, the District of Columbia, and the City of New York.

The solutions are at hand to meet our nation's energy needs by using our electricity more wisely through efficiency measures that save families and businesses money and create jobs, by deploying clean energy solutions such as wind and solar and strengthening our global competitiveness in these growing markets, and by reducing the dangerous carbon pollution from natural gas and coal fired power plants through rigorous national emission standards. The law requires EPA's emissions standards to be performance based. EPA does not mandate technologies to meet the standards and a broad range of energy sources may comply.

Clean Air Standards for Power Plants are Urgently Needed to Protect Public Health, Our Communities, and Our Prosperity

Climate scientists at the Scripps Institute of Oceanography warned—in 1957—that the rapid accumulation of climate-destabilizing gases in the atmosphere was the equivalent of conducting a geophysical experiment with the planet. Climate impacts are already affecting American communities.

The United States Global Change Research Program has determined that if carbon pollution is not reduced, it is likely that American communities will experience increasingly severe climate impacts, including:

· Rising levels of dangerous smog in cities — which will lead to an increased risk of respiratory infections, more asthma attacks, and more premature deaths;

· Increased risk of illness and death due to extreme heat;

· More intense hurricanes and storm surges;

· Increased frequency and severity of flooding;

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- Increases in insect pests and in the prevalence of diseases transmitted by food, water, and insects;
- Reduced precipitation and runoff in the arid West;
- Reduced crop yields and livestock productivity; and
- More wildfires and increasingly frequent and severe droughts in some regions.

These impacts would impose unacceptable costs on Americans—taking lives and destroying homes and livelihoods. In the first six months of 2011, data from Munich Re show that the U.S. experienced ten climate disasters causing more than a billion dollars of damage, including two major river floods in the Upper Midwest and the Mississippi River, drought and wildfires in the Southwest, a blizzard that paralyzed the Midwest and Northeast, and Hurricane Irene which threatened the coastal cities of the East Coast and led to the devastating flooding in the Northeast. Although any single storm or wildfire cannot be directly connected to climate change, changes in the frequencies of these events can be connected, and the disasters of 2011 are precisely the type of impacts projected to affect American communities with increasing frequency and severity as climate-destabilizing emissions continue to accumulate in the atmosphere. Following the most damaging year of climate disasters in U.S. history, insurance regulators in California, Washington, and New York instituted a requirement that all major insurance companies assess and publicly disclose the climate-change related risks they face.

We Cannot Afford Further Delay in Addressing the Dangerous Carbon Pollution from the Power Sector

The power sector is the largest source of greenhouse gas emissions in the United States—and one of the largest sources in the world. Power plant infrastructure is extraordinarily long-lived: the average retirement age of a coal plant is 50 years. Some of the power plants in use today were built before WWII. Building just one inefficient, emission-intensive plant today locks us into millions of tons of future carbon pollution—or the expensive after the fact shuttering of built infrastructure. The Oak Grove power plant in Texas, commissioned in 2010, emits over 9 million tons of CO_2 each year—and will emit 450 million tons of CO_2 emissions over the course of an average lifetime. Just five new coal plants like this one would discharge enough carbon pollution over an average lifetime to entirely erode the vital pollution reductions under the landmark Phase II of the Clean Cars Standards. Our nation cannot effectively address climate-destabilizing emissions without addressing the pollution emitted by the power sector.

States are Leading the Way

States across the nation have adopted performance-based greenhouse gas emission standards for new fossil fuel fired power plants to dramatically reduce emissions and spur innovation in low-carbon energy generation. From Oregon and Washington to Minnesota, Montana and California to New York, states are putting in place policies to reduce climate-destabilizing emissions from the new fossil fuel power plants—providing a strong foundation for national action. A summary of these state clean air programs is available at: http://www.edf.org/sites/default/files/state-ghg-standards-03132012.pdf

The Greenhouse Gas Emission Standards Will Provide Power Companies with the Certainty to Build 21st Century Infrastructure

Since 2007, six major banks (including Bank of America, Wells Fargo, Citi, and JP Morgan Chase) have required enhanced due diligence in financing capital intensive coal-fired power plant projects. Finance applicants are required to evaluate less polluting alternatives given the financial risks associated with major sources of climate destabilizing emissions. (The Carbon Principles, available at http://www.carbonprinciples.org/.) Power companies have long said that what they need is regulatory certainty so that they can make prudent long-term investment

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decisions. New emission standards for carbon pollution will provide utilities with this certainty—so they can invest now-sidelined resources, building an efficient, cleaner, internationally competitive energy sector and putting Americans to work.

The solutions we need to protect America's health and strengthen our economy are at hand.

I would warmly welcome the opportunity to discuss these issues.

Sincerely yours,

Vickie Patton, General Counsel, Environmental Defense Fund (720) 837-6239

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To: Joseph Goffman/DC/USEPA/US@EPA[]
From: "Doniger, David"
Sent: Tue 3/27/2012 1:20:34 PM
Subject: Blog: Cleaner Power Starts Today: EPA Proposes Carbon Pollution Standard for New Power Plants
David Doniger's Blog
staggering health costs
increasingly extreme weather
here
here
here
Supreme Court found
agreed to enforce these legal requirements
they aren't planning to build new coal plants
mercury, soot, and smog pollution
saving tens of thousands of lives
jointly set standards for new cars and light trucks
save consumers thousands of dollars
helping bring back America's auto industry
best defense against high gas prices
click here
ddoniger@nrdc.org
www.nrdc.org
http://switchboard.nrdc.org/blogs/ddoniger/

David Doniger's Blog

Cleaner Power Starts Today: EPA Proposes Carbon Pollution Standard for New Power Plants

Posted March 27, 2012

The Environmental Protection Agency is taking another important step forward today to protect Americans' health and well-being from the carbon pollution that is driving dangerous climate change.

Today EPA is expected to propose the first national limits on carbon dioxide emissions from new electric power plants.

Doctors, nurses, scientists, and other experts tell us that carbon pollution imposes staggering health costs. It causes more severe heat waves and worsens smog pollution, which triggers more asthma attacks and other serious respiratory illnesses. It contributes to increasingly extreme weather, including more devastating storms and floods, rising sea levels, and many other threats to life, limb, and property. See what EPA and the nation's top public health organizations say, here and here.

Power plants are the nation's largest source of dangerous carbon pollution. More than 1500 power plants across the country release a whopping 2.3 billion tons of carbon dioxide into the air each year. (Check out how much pollution comes from your nearby power plants, here.)

The Clean Air Act requires EPA to set standards that assure new power plants are as clean as can be, and to start cutting dangerous carbon pollution from the existing fleet of power plants too. The Supreme Court found that it's EPA's job under the Clean Air Act to curb power plants' carbon pollution. Two years ago, EPA agreed to enforce these legal requirements by setting standards for both new and existing plants.

The "new source performance standard" to be proposed today is a critical step towards cleaning up and modernizing our power plant fleet. Each new plants will need to meet a specified emissions rate that is technically feasible and economically reasonable. The next step will be to set standards to cut carbon pollution from the aging fleet of existing plants.

America's power companies have the tools they need to meet the standard announced today. The Department of Energy, utility executives, and industry analysts all forecast that the nation's needs for new electricity supplies over the next decade will be met by a combination of natural gas plants, renewables such as wind and solar, and possibly nuclear energy – all of which can meet the standard.

Power companies also can meet this standard with coal-fired plants that use carbon capture and storage (CCS) technology. A few years ago, it looked like there would be a boom in new coal plant construction. But nearly all of those proposals died on the drawing boards. Today's utility companies will tell you that they aren't planning to build new coal plants, largely due to the availability of low-cost natural gas, strong growth in wind and solar power, and big opportunities to improve energy efficiency. The new standard reinforces what most power company executives and investors already understand – that carbon pollution and climate change are serious concerns, and that if and when new coal plants make a comeback, they will need to be designed with CCS.

The standard being proposed today is another important step that EPA has taken under President Obama to clean up and modernize the nation's two most polluting sectors – the power plants that provide our electricity, and the motor vehicles that move us around.

· EPA set standards last year to cut mercury, soot, and smog pollution from old power plants, saving tens of thousands of lives and preventing hundreds of thousands of asthma attacks, heart attacks, and hospital visits.

· And EPA and the Transportation Department have jointly set standards for new cars and light trucks. By 2025 new vehicles will average nearly 55 miles per gallon and spew out only half the carbon pollution of the cars most of us own now. Those standards will save consumers thousands of dollars at the pump, and are helping bring back America's auto industry. They are America's best defense against high gas prices.

Today's action, of course, is only a proposal and not yet a sure thing. Factions of the coal and power industries, together with climate-change-denier groups and ultra-conservative politicians, will try to derail EPA's new standard. So it's critical that concerned citizens step up to voice their support for cleaning up power plants, in the public comment period and public hearings later this Spring.

You can click here to send EPA a message of support. Tell EPA that you support its standards to cut the carbon pollution from America's new power plants. And urge EPA to act swiftly to cut the dangerous carbon pollution coming from our existing power plants too.

David D. Doniger

Policy Director, Climate and Clean Air Program

Natural Resources Defense Council

Please note our new address:

1152 15th Street, NW, Suite 300

Washington, DC 20005

Phone: (202) 289-2403

Cell: (202) 321-3435

Fax: (202) 289-1060

ddoniger@nrdc.org

on the web at www.nrdc.org

read my blog: http://switchboard.nrdc.org/blogs/ddoniger/

To: Joseph Goffman/DC/USEPA/US@EPA[]
From: "Doniger, David"
Sent: Tue 3/27/2012 1:22:15 PM
Subject: Blog: Cleaner Power Starts Today: EPA Proposes Carbon Pollution Standard for New Power Plants
http://switchboard.nrdc.org/blogs/ddoniger/cleaner_power_starts_today_epa.html
David Doniger's Blog
staggering health costs
increasingly extreme weather
here
here
here
Supreme Court found
agreed to enforce these legal requirements
they aren't planning to build new coal plants
mercury, soot, and smog pollution
saving tens of thousands of lives
jointly set standards for new cars and light trucks
save consumers thousands of dollars
helping bring back America's auto industry
best defense against high gas prices
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David Doniger's Blog

Cleaner Power Starts Today: EPA Proposes Carbon Pollution Standard for New Power Plants

Posted March 27, 2012

The Environmental Protection Agency is taking another important step forward today to protect Americans' health and well-being from the carbon pollution that is driving dangerous climate change.

Today EPA is expected to propose the first national limits on carbon dioxide emissions from new electric power plants.

Doctors, nurses, scientists, and other experts tell us that carbon pollution imposes staggering health costs. It causes more severe heat waves and worsens smog pollution, which triggers more asthma attacks and other serious respiratory illnesses. It contributes to increasingly extreme weather, including more devastating storms and floods, rising sea levels, and many other threats to life, limb, and property. See what EPA and the nation's top public health organizations say, here and here.

Power plants are the nation's largest source of dangerous carbon pollution. More than 1500 power plants across the country release a whopping 2.3 billion tons of carbon dioxide into the air each year. (Check out how much pollution comes from your nearby power plants, here.)

The Clean Air Act requires EPA to set standards that assure new power plants are as clean as can be, and to start cutting dangerous carbon pollution from the existing fleet of power plants too. The Supreme Court found that it's EPA's job under the Clean Air Act to curb power plants' carbon pollution. Two years ago, EPA agreed to enforce these legal requirements by setting standards for both new and existing plants.

The "new source performance standard" to be proposed today is a critical step towards cleaning up and modernizing our power plant fleet. Each new plants will need to meet a specified emissions rate that is technically feasible and economically reasonable. The next step will be to set standards to cut carbon pollution from the aging fleet of existing plants.

America's power companies have the tools they need to meet the standard announced today. The Department of Energy, utility executives, and industry analysts all forecast that the nation's needs for new electricity supplies over the next decade will be met by a combination of natural gas plants, renewables such as wind and solar, and possibly nuclear energy – all of which can meet the standard.

Power companies also can meet this standard with coal-fired plants that use carbon capture and storage (CCS) technology. A few years ago, it looked like there would be a boom in new coal plant construction. But nearly all of those proposals died on the drawing boards. Today's utility companies will tell you that they aren't planning to build new coal plants, largely due to the availability of low-cost natural gas, strong growth in wind and solar power, and big opportunities to improve energy efficiency. The new standard reinforces what most power company executives and investors already understand – that carbon pollution and climate change are serious concerns, and that if and when new coal plants make a comeback, they will need to be designed with CCS.

The standard being proposed today is another important step that EPA has taken under President Obama to clean up and modernize the nation's two most polluting sectors – the power plants that provide our electricity, and the motor vehicles that move us around.

- EPA set standards last year to cut mercury, soot, and smog pollution from old power plants, saving tens of thousands of lives and preventing hundreds of thousands of asthma attacks, heart attacks, and hospital visits.

- And EPA and the Transportation Department have jointly set standards for new cars and light trucks. By 2025 new vehicles will average nearly 55 miles per gallon and spew out only half the carbon pollution of the cars most of us own now. Those standards will save consumers thousands of dollars at the pump, and are helping bring back America's auto industry. They are America's best defense against high gas prices.

Today's action, of course, is only a proposal and not yet a sure thing. Factions of the coal and power industries, together with climate-change-denier groups and ultra-conservative politicians, will try to derail EPA's new standard. So it's critical that concerned citizens step up to voice their support for cleaning up power plants, in the public comment period and public hearings later this Spring.

You can click here to send EPA a message of support. Tell EPA that you support its standards to cut the carbon pollution from America's new power plants. And urge EPA to act swiftly to cut the dangerous carbon pollution coming from our existing power plants too.

David D. Doniger

Policy Director, Climate and Clean Air Program

Natural Resources Defense Council

Please note our new address:

1152 15th Street, NW, Suite 300

Washington, DC 20005

Phone: (202) 289-2403

Cell: (202) 321-3435

Fax: (202) 289-1060

ddoniger@nrdc.org

on the web at www.nrdc.org

read my blog: http://switchboard.nrdc.org/blogs/ddoniger/

To: CN=Joseph Goffman/OU=DC/O=USEPA/C=US@EPA;"Michael Myers" [Michael.Myers@ag.ny.gov]; Michael Myers" [Michael.Myers@ag.ny.gov]; Alan Belensz" [Alan.Belensz@ag.ny.gov]; Morgan Costello" [Morgan.Costello@ag.ny.gov]
Cc: CN=Patricia Embrey/OU=DC/O=USEPA/C=US@EPA;CN=John Millett/OU=DC/O=USEPA/C=US@EPA[]; N=John Millett/OU=DC/O=USEPA/C=US@EPA[]
From: CN=Andrea Drinkard/OU=DC/O=USEPA/C=US
Sent: Tue 3/27/2012 4:15:04 PM
Subject: Re: link
http://epa.gov/carbonpollutionstandard/

Hi all- here's the invite for the 1pm call.

EPA Proposes First Carbon Pollution Standard for New Power Plants
Today the U.S. Environmental Protection Agency (EPA) proposed the first Clean Air Act standard for carbon pollution from new power plants. EPA's proposed standard reflects the ongoing trend in the power sector toward building cleaner plants that take advantage of modern technologies to limit harmful carbon pollution to help provide the critical health protections American families deserve.

EPA is taking another step to address greenhouse gas pollution from the largest uncontrolled sources. On Wednesday, March 21st at 1:00 p.m., you are invited to participate in a special stakeholder briefing with Administrator Lisa P. Jackson and Assistant Administrator for the Office of Air & Radiation, Gina McCarthy for this important Clean Air Act regulation announcement.
Please see the information below for joining this call.
Join Us...
Date: Tuesday, March 27, 2012

Time: 1:00 p.m. EDT

Toll-Free Dial-In Number: [redacted]

Conference ID: [redacted]

From: Joseph Goffman
Sent: 03/27/2012 12:09 PM EDT
To: "Michael Myers" <Michael.Myers@ag.ny.gov>; "Alan Belensz" <Alan.Belensz@ag.ny.gov>; "Morgan Costello" <Morgan.Costello@ag.ny.gov>
Cc: Patricia Embrey; Andrea Drinkard; John Millett
Subject: Re: link

Adding Comms.

From: "Michael J. Myers" [Michael.Myers@ag.ny.gov]
Sent: 03/27/2012 12:06 PM AST
To: Joseph Goffman; Alan Belensz <Alan.Belensz@ag.ny.gov>; Morgan Costello <Morgan.Costello@ag.ny.gov>
Cc: Patricia Embrey
Subject: RE: link

Thanks. If you could also send along the info for the conf. call with states and enviros, I'll pass along to our state AG group.

From: Joseph Goffman [mailto:Goffman.Joseph@epamail.epa.gov]
Sent: Tuesday, March 27, 2012 11:09 AM
To: Alan Belensz; Morgan Costello; Michael J. Myers
Subject: Fw: link

Joseph Goffman
Senior Counsel to the Assistant Administrator
Office of Air and Radiation
US Environmental Protection Agency
202 564 3201

----- Forwarded by Joseph Goffman/DC/USEPA/US on 03/27/2012 11:07 AM -----

From: Andrea Drinkard/DC/USEPA/US
To: Joseph Goffman/DC/USEPA/US@EPA
Date: 03/27/2012 11:06 AM
Subject: link

http://epa.gov/carbonpollutionstandard/

Andrea Drinkard
U.S. Environmental Protection Agency
Office of Air and Radiation
Email: drinkard.andrea@epa.gov
Phone: 202.564.1601
Cell: 202.236.7765

To: Joseph Goffman/DC/USEPA/US@EPA;Michael Goo/DC/USEPA/US@EPA[]; ichael Goo/DC/USEPA/US@EPA[]
From: "Doniger, David"
Sent: Tue 3/27/2012 5:23:11 PM
Subject: Congrats! But help me out here...
ddoniger@nrdc.org
www.nrdc.org
http://switchboard.nrdc.org/blogs/ddoniger/

This is really terrific. You've seen our positive reax by now.

The comment about "no plans" for existing sources is kicking up a storm among reporters. Being taken as repudiation of the settlement.

Can you please clarify that you are not walking away from the settlement, that you are continuing to negotiate with a goal of coming to a solution?

David D. Doniger

Policy Director, Climate and Clean Air Program

Natural Resources Defense Council

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Washington, DC 20005

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To: Vickie Patton [vpatton@edf.org]
From: Vickie Patton
Sent: Tue 3/27/2012 3:00:07 PM
Subject: Cleaner Power for a Stronger America
Settlement Agreement
United States Global Change Research Program
http://www.edf.org/sites/default/files/state-ghg-standards-03132012.pdf
http://www.carbonprinciples.org/

Dear Journalist,

EPA is expected to shortly propose the first nationwide greenhouse gas emission standards for new coal and natural gas fired power plants; the clean air standards are anticipated to halve the carbon pollution from a new coal-fired power plant over its lifetime. Fossil fueled power plants are the single largest source of carbon pollution in our nation. The historic clean air standards will help protect Americans' health while strengthening our Made in the U.S.A clean energy economy.

The EPA national limits on carbon pollution are long overdue and are urgently needed. The power sector is responsible for a staggering 40% of U.S. heat-trapping carbon dioxide. EPA's action is required under a Settlement Agreement with Environmental Defense Fund, NRDC, Sierra Club and numerous states including New York, California, Connecticut, Delaware, Maine, New Mexico, Oregon, Rhode Island, Vermont, and Washington, the Commonwealth of Massachusetts, the District of Columbia, and the City of New York.

The solutions are at hand to meet our nation's energy needs by using our electricity more wisely through efficiency measures that save families and businesses money and create jobs, by deploying clean energy solutions such as wind and solar and strengthening our global competitiveness in these growing markets, and by reducing the dangerous carbon pollution from natural gas and coal fired power plants through rigorous national emission standards. The law requires EPA's emissions standards to be performance based. EPA does not mandate technologies to meet the standards and a broad range of energy sources may comply.

Clean Air Standards for Power Plants are Urgently Needed to Protect Public Health, Our Communities, and Our Prosperity

Climate scientists at the Scripps Institute of Oceanography warned—in 1957—that the rapid accumulation of climate-destabilizing gases in the atmosphere was the equivalent of conducting a geophysical experiment with the planet. Climate impacts are already affecting American communities.

The United States Global Change Research Program has determined that if carbon pollution is not reduced, it is likely that American communities will experience increasingly severe climate impacts, including:

· Rising levels of dangerous smog in cities — which will lead to an increased risk of respiratory infections, more asthma attacks, and more premature deaths;

· Increased risk of illness and death due to extreme heat;

· More intense hurricanes and storm surges;

· Increased frequency and severity of flooding;

- Increases in insect pests and in the prevalence of diseases transmitted by food, water, and insects;
- Reduced precipitation and runoff in the arid West;
- Reduced crop yields and livestock productivity; and
- More wildfires and increasingly frequent and severe droughts in some regions.

These impacts would impose unacceptable costs on Americans—taking lives and destroying homes and livelihoods. In the first six months of 2011, data from Munich Re show that the U.S. experienced ten climate disasters causing more than a billion dollars of damage, including two major river floods in the Upper Midwest and the Mississippi River, drought and wildfires in the Southwest, a blizzard that paralyzed the Midwest and Northeast, and Hurricane Irene which threatened the coastal cities of the East Coast and led to the devastating flooding in the Northeast. Although any single storm or wildfire cannot be directly connected to climate change, changes in the frequencies of these events can be connected, and the disasters of 2011 are precisely the type of impacts projected to affect American communities with increasing frequency and severity as climate-destabilizing emissions continue to accumulate in the atmosphere. Following the most damaging year of climate disasters in U.S. history, insurance regulators in California, Washington, and New York instituted a requirement that all major insurance companies assess and publicly disclose the climate-change related risks they face.

We Cannot Afford Further Delay in Addressing the Dangerous Carbon Pollution from the Power Sector

The power sector is the largest source of greenhouse gas emissions in the United States—and one of the largest sources in the world. Power plant infrastructure is extraordinarily long-lived: the average retirement age of a coal plant is 50 years. Some of the power plants in use today were built before WWII. Building just one inefficient, emission-intensive plant today locks us into millions of tons of future carbon pollution—or the expensive after the fact shuttering of built infrastructure. The Oak Grove power plant in Texas, commissioned in 2010, emits over 9 million tons of CO_2 each year—and will emit 450 million tons of CO_2 emissions over the course of an average lifetime. Just five new coal plants like this one would discharge enough carbon pollution over an average lifetime to entirely erode the vital pollution reductions under the landmark Phase II of the Clean Cars Standards. Our nation cannot effectively address climate-destabilizing emissions without addressing the pollution emitted by the power sector.

States are Leading the Way

States across the nation have adopted performance-based greenhouse gas emission standards for new fossil fuel fired power plants to dramatically reduce emissions and spur innovation in low-carbon energy generation. From Oregon and Washington to Minnesota, Montana and California to New York, states are putting in place policies to reduce climate-destabilizing emissions from the new fossil fuel power plants—providing a strong foundation for national action. A summary of these state clean air programs is available at: http://www.edf.org/sites/default/files/state-ghg-standards-03132012.pdf

The Greenhouse Gas Emission Standards Will Provide Power Companies with the Certainty to Build 21st Century Infrastructure

Since 2007, six major banks (including Bank of America, Wells Fargo, Citi, and JP Morgan Chase) have required enhanced due diligence in financing capital intensive coal-fired power plant projects. Finance applicants are required to evaluate less polluting alternatives given the financial risks associated with major sources of climate destabilizing emissions. (The Carbon Principles, available at http://www.carbonprinciples.org/.) Power companies have long said that what they need is regulatory certainty so that they can make prudent long-term investment

decisions. New emission standards for carbon pollution will provide utilities with this certainty—so they can invest now-sidelined resources, building an efficient, cleaner, internationally competitive energy sector and putting Americans to work.

The solutions we need to protect America's health and strengthen our economy are at hand.

I would warmly welcome the opportunity to discuss these issues.

Sincerely yours,

Vickie Patton, General Counsel, Environmental Defense Fund (720) 837-6239

To: Vickie Patton [vpatton@edf.org]
From: Vickie Patton
Sent: Wed 3/28/2012 4:15:50 PM
Subject: Chandra's Story Losing A Son To Asthma Moms Clean Air Force.htm

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Moms Clean Air Force

Chandra's Story: Losing A Son To Asthma

Posted on March 27, 2012 by Moms Clean Air Force|Posted in: African-American Community, Asthma, Environment, Guest Bloggers, Motherhood, Politics, Pollution, Social Justice|

This post was written by: Chandra Baldwin-Woods:

An asthma attack turned my world upside just less than two years ago, and it has never been the same since. After returning home from football practice on a typical hot, muggy August day, my 16-year-old son Jovante suffered an asthma attack that rendered him unconscious from anoxic brain injury. Jovante's father and I spent the next four days by his side in the hospital praying for his recovery, which was not to be.

I do not have adequate words to describe the pain of losing a child. It's something no parent should ever have to experience. Knowing that we will never watch Jovante graduate high school, attend college or experience the joy of starting a family is a pain we must live with every day.

Jovante idolized Jerome "The Bus" Bettis for his courage to never let asthma stand in his way on or off the field. With proper treatment, Jovante's doctor was confident that he could continue to pursue his passion for athletics, especially football, which runs deep in our family. Not only do I play on a women's full contact football team, but Jovante's father Ickey was a fullback for the Cincinnati Bengals. Both Ickey and I had asthma growing up and fully expected Jovante would someday grow out of it just as we thought we had.

When I hear those who undoubtedly know better—corporate polluters and even politicians in Congress—minimizing the serious health consequences caused by air pollution, my heart breaks all over again. How these people have the audacity to callously deny what is common information among those in the medical community—air pollution causes asthma attacks and cuts short the lives of those we love most—is beyond me.

By fighting for air alongside the American Lung Association and Moms Clean Air Force, we are passionate about building a future where every child has healthy air to breathe. Cleaning up power plant pollution, tailpipe emissions and other air pollution sources will prevent thousands of asthma attacks every year while giving other children the chance to fulfill their dreams. It is through this work that the best memories of our wonderful, loving child live on.

We are also proud of the foundation and scholarship program we started in our son's name to help fund the critical work of Cincinnati Children's Asthma Research Division in addition to building organ donor awareness. To learn more about the Jovante Woods Foundation and the 3.8 to be Great Scholarship, please visit: www.jovantewoodsfoundation.org.

I am truly glad to call you my mom
I really appreciate in hard times the way you make ends meet
I love you with all my heart and you're the bomb
You taught me to work hard and never cheat

In past times, we've had our share of fights
Sometimes I may say your name followed by a swear
But still you've always encouraged me to reach new heights
I'm so sorry my asthma attacks gave you a scare

Without you, I would not be here
When I'm upset, you've always kept calm
With a house filled with six kids you found time to care
This is why I'm glad you are my mom

–Jovante Woods 1994-2010

Words can not express how sad we are for your loss, Chandra. Thank you for sharing your story with MCAF.

READ MORE ABOUT ASTHMA

PLEASE TAKE ACTION WITH MOMS CLEAN AIR FORCE

Posted in: African-American Community, Asthma, Environment, Guest Bloggers, Motherhood, Politics, Pollution, Social Justice|

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- Posted on March 28, 2012 by Alexandra Zissu| Posted in: Environment, Pollution, Science| Clean Air From The Inside Out

- Posted on March 27, 2012 by Dominique Browning| Posted in: African-American Community, Asthma, Mercury Poisoning, Motherhood, Politics, Pollution, Social Justice| Black With Asthma

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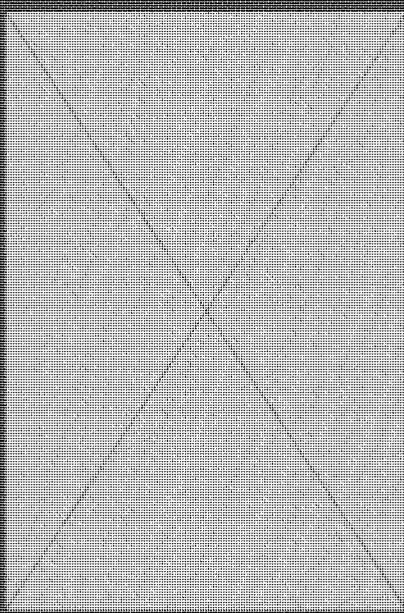

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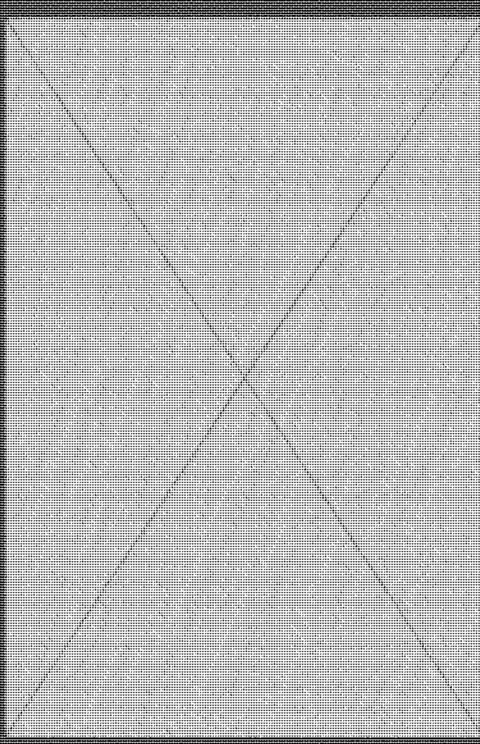

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But still you've always encouraged me to reach new heights
I'm so sorry my asthma attacks gave you a scare

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With a house filled with six kids you found time to care
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–Jovante Woods 1994-2010

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For further information, please contact the EPA Call Center at (866) 411-4EPA (4372). The TDD number is (866) 489-4900.

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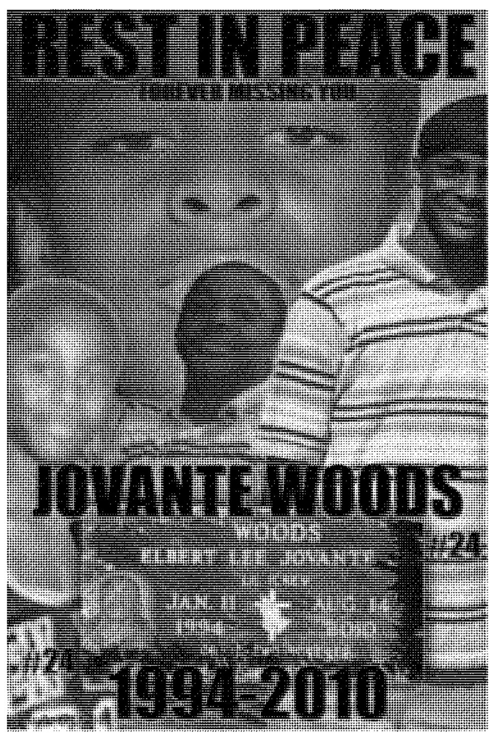
REST IN PEACE
FOREVER MISSING YOU
JOVANTE WOODS
#24
1994-2010

To: Gina McCarthy/DC/USEPA/US@EPA;Janet McCabe/DC/USEPA/US@EPA;Joseph Goffman/DC/USEPA/US@EPA;Lorie Schmidt/DC/USEPA/US@EPA[]; anet McCabe/DC/USEPA/US@EPA;Joseph Goffman/DC/USEPA/US@EPA;Lorie Schmidt/DC/USEPA/US@EPA[]; oseph Goffman/DC/USEPA/US@EPA;Lorie Schmidt/DC/USEPA/US@EPA[]; orie Schmidt/DC/USEPA/US@EPA[]
From: Vickie Patton
Sent: Tue 3/27/2012 11:25:35 PM
Subject: Fw: Bennet Statement on EPA's Proposed Carbon Pollution Standard
Adam Bozzi
Laura Brandon

fyi

From: Babington, Sean (Bennet) [mailto:Sean_Babington@bennet.senate.gov]
Sent: Tuesday, March 27, 2012 07:18 PM
Subject: FW: Bennet Statement on EPA's Proposed Carbon Pollution Standard

Friends,

Please see Senator Bennet's statement below

Best,

Sean

From: Brandon, Laura (Bennet)
Sent: Tuesday, March 27, 2012 7:01 PM
Subject: Bennet Statement on EPA's Proposed Carbon Pollution Standard

U.S. SENATOR MICHAEL BENNET

Member: Agriculture, HELP, Banking and Aging Committees

FOR IMMEDIATE RELEASE

Tuesday, March 27, 2012
CONTACT: Adam Bozzi – 202-224-5852

Laura Brandon – 202-573-5350

Bennet Statement on EPA's Proposed Carbon Pollution Standard

Washington, DC – Colorado U.S. Senator Michael Bennet released the following statement after the U.S. Environmental Protection Agency (EPA) proposed the first Clean Air Act standard for greenhouse gas emissions from new power plants.

"Colorado is already leading the way in generating electricity from cleaner sources that release less industrial carbon pollution. Today's announcement of Clean Air Act standards for new power plants reflects the growing trend toward cleaner electricity generation and is a welcome step toward an energy future that protects public health and begins to address dangerous climate change."

# # #

To: Vickie Patton [vpatton@edf.org]
From: Vickie Patton
Sent: Wed 3/28/2012 2:07:43 PM
Subject: Fw: FYI: ENVIRONMENT: Udall Responds to EPA's Proposed Clean Air Standards for Carbon Pollution from New Power Plants
http://www.epa.gov/carbonpollutionstandard/actions.html
national RES
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fyi

From: Hague, James (Mark Udall) [mailto:James_Hague@MarkUdall.senate.gov]
Sent: Wednesday, March 28, 2012 10:00 AM
To: Hague, James (Mark Udall) <James_Hague@MarkUdall.senate.gov>
Subject: FYI: ENVIRONMENT: Udall Responds to EPA's Proposed Clean Air Standards for Carbon Pollution from New Power Plants

FYI. Senator Udall's statement on EPA's proposed carbon pollution standard for new power plants.

From: Press (Mark Udall) [mailto:press@markudall.senate.gov]
Sent: Tuesday, March 27, 2012 8:03 PM
To: Hague, James (Mark Udall)
Subject: ENVIRONMENT: Udall Responds to EPA's Proposed Clean Air Standards for Carbon Pollution from New Power Plants

U.S. SENATOR MARK UDALL

Armed Services, Energy and Natural Resources, Intelligence and Aging Committees

Udall Responds to EPA's Proposed Clean Air Standards for Carbon Pollution from New Power Plants

Looks Forward to Public Comment Period, Reviewing the New Standards

Today, Mark Udall released the following statement on a proposed standard put forward by the Environmental Protection Agency (EPA) to curb the amount of carbon pollution emitted by new power plants. The rule would incentivize the use of modern pollution control technologies and encourage the use of cleaner-burning fuels such as natural gas.

"I commend the EPA for proposing these limits on carbon pollution. Moving our country toward a clean energy future will help stabilize energy prices, create new jobs, diversify the energy sources on which we depend, and make our country more secure. It is crucial that we begin to reduce our dependence on the dirty fuels of the last century and curb the effects of climate change. The benefits of clean air are numerous and profound to Colorado's public health and economy.

"While I would prefer to see a legislative solution that includes a comprehensive energy policy for America and focuses on clean, domestic sources of energy, the proposed standard can serve as an important backstop to Congressional inaction and put a price on carbon pollution. I look forward to reviewing the proposal in detail in the coming weeks and months to determine how it will affect Coloradans."

The EPA standard, while setting limits on the amount of carbon pollution allowed by new plants, provides flexibility in how power plants meet the standard, including the use of fuels such as natural gas or alternative technologies that reduce the pollution from burning coal. The rule was developed following a public vetting and information-gathering process, and it will be open to review and comment by the public for 60 days after being published in the Federal Register. The rule does not apply to any existing power plants or those scheduled to be built in the next 12 months. For more information on the ruling, click here:
http://www.epa.gov/carbonpollutionstandard/actions.html.

Udall has been an outspoken advocate to increase energy independence and reduce reliance on dirty fuels. In 2004, he championed Colorado's Renewable Electricity Standard (RES) that requires 30 percent of the state's electricity to come from renewable sources by 2020. Many power plants have already begun to transition to cheaper, more efficient and cleaner fuels to generate energy, and Xcel Energy recently committed to transforming its Denver-area plants to burn natural gas. Last year, Udall introduced legislation to enact a national RES that would require 25 percent of the nation's energy come from solar, wind, and other renewable sources.

Please contact Tara Trujillo at 202-224-4334.

###

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To: Vickie Patton [vpatton@edf.org]
From: Vickie Patton
Sent: Wed 3/28/2012 4:15:50 PM
Subject: Chandra's Story Losing A Son To Asthma Moms Clean Air Force.htm

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Mercury Poisoning
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Moms Clean Air Force

Chandra's Story: Losing A Son To Asthma

Posted on March 27, 2012 by Moms Clean Air Force|Posted in: African-American Community, Asthma, Environment, Guest Bloggers, Motherhood, Politics, Pollution, Social Justice|

This post was written by: Chandra Baldwin-Woods:

An asthma attack turned my world upside just less than two years ago, and it has never been the same since. After returning home from football practice on a typical hot, muggy August day, my 16-year-old son Jovante suffered an asthma attack that rendered him unconscious from anoxic brain injury. Jovante's father and I spent the next four days by his side in the hospital praying for his recovery, which was not to be.

I do not have adequate words to describe the pain of losing a child. It's something no parent should ever have to experience. Knowing that we will never watch Jovante graduate high school, attend college or experience the joy of starting a family is a pain we must live with every day.

Jovante idolized Jerome "The Bus" Bettis for his courage to never let asthma stand in his way on or off the field. With proper treatment, Jovante's doctor was confident that he could continue to pursue his passion for athletics, especially football, which runs deep in our family. Not only do I play on a women's full contact football team, but Jovante's father Ickey was a fullback for the Cincinnati Bengals. Both Ickey and I had asthma growing up and fully expected Jovante would someday grow out of it just as we thought we had.

When I hear those who undoubtedly know better—corporate polluters and even politicians in Congress—minimizing the serious health consequences caused by air pollution, my heart breaks all over again. How these people have the audacity to callously deny what is common information among those in the medical community—air pollution causes asthma attacks and cuts short the lives of those we love most—is beyond me.

By fighting for air alongside the American Lung Association and Moms Clean Air Force, we are passionate about building a future where every child has healthy air to breathe. Cleaning up power plant pollution, tailpipe emissions and other air pollution sources will prevent thousands of asthma attacks every year while giving other children the chance to fulfill their dreams. It is through this work that the best memories of our wonderful, loving child live on.

We are also proud of the foundation and scholarship program we started in our son's name to help fund the critical work of Cincinnati Children's Asthma Research Division in addition to building organ donor awareness. To learn more about the Jovante Woods Foundation and the 3.8 to be Great Scholarship, please visit: www.jovantewoodsfoundation.org.

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But still you've always encouraged me to reach new heights
I'm so sorry my asthma attacks gave you a scare

Without you, I would not be here
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With a house filled with six kids you found time to care
This is why I'm glad you are my mom

–Jovante Woods 1994-2010

Words can not express how sad we are for your loss, Chandra. Thank you for sharing your story with MCAF.

READ MORE ABOUT ASTHMA

PLEASE TAKE ACTION WITH MOMS CLEAN AIR FORCE

Posted in: African-American Community, Asthma, Environment, Guest Bloggers, Motherhood, Politics, Pollution, Social Justice|

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For further information, please contact the EPA Call Center at
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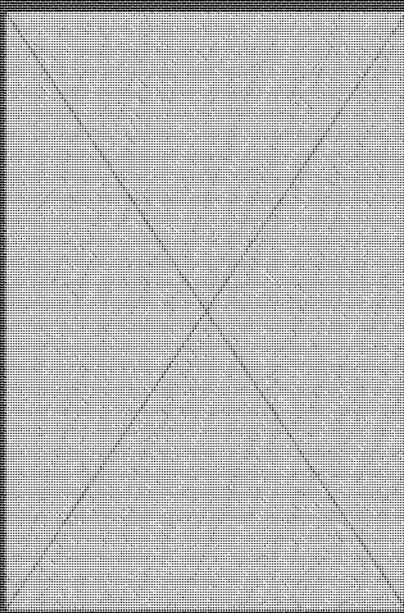Jovante idolized Jerome "The Bus" Bettis for his courage to never let asthma stand in his way on or off the field. With proper treatment, Jovante's doctor was confident that he could continue to pursue his passion for athletics, especially football, which runs deep in our family. Not only do I play on a , but Jovante's father was a fullback for the Cincinnati Bengals. Both Ickey and I had asthma growing up and fully expected Jovante would someday grow out of it just as we thought we had.

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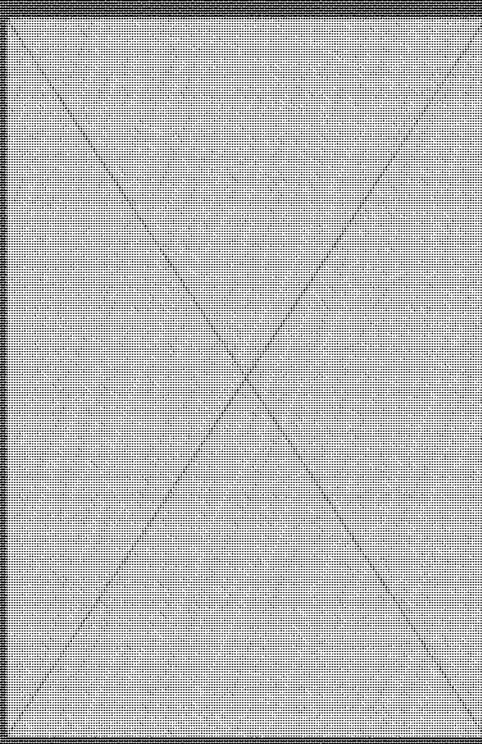

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–Jovante Woods 1994-2010

Words can not express how sad we are for your loss, Chandra. Thank you for sharing your story with MCAF.

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To: Joseph Goffman/DC/USEPA/US@EPA;Kevin Culligan/DC/USEPA/US@EPA[]; evin Culligan/DC/USEPA/US@EPA[]
Cc: Andrea Drinkard/DC/USEPA/US@EPA;"paulja@rapca.org" [paulja@rapca.org]; paulja@rapca.org" [paulja@rapca.org]; bill.o'sullivan@dep.state.nj.us" [bill.o'sullivan@dep.state.nj.us]; scla461@ecy.wa.gov" [scla461@ecy.wa.gov]; lgreene@airquality.org" [lgreene@airquality.org]; ill Becker [bbecker@4cleanair.org]; isti Duvall [mduvall@4cleanair.org]
From: Amy Royden-Bloom
Sent: Mon 4/2/2012 12:37:14 PM
Subject: Questions for EPA for call today

Here are some questions that have come up regarding the GHG NSPS proposal that we would appreciate your addressing on the call today at 1 p.m. Eastern, if possible:

1. Please further explain why modifications are not covered by the section 111(b) GHG NSPS when in the past NSPS have covered modifications (see.e.g., Oil and gas proposal, p. 52741 "Upon promulgation, an NSPS becomes a national standard to which all new, modified or reconstructed sources must comply.")

a. EPA says pollution control projects are, per EPA NSPS regulations, exempt from the definition of modification. However, the NSR regulations with such an exemption were struck down in NY v. EPA, 413 F.3d 3, 40 (D.C. Cir. 2005). Given this, why is EPA comfortable relying so heavily on this interpretation when it seems particularly legally vulnerable?

b. EPA says the modifications it expects coal-fired EGUs to undertake would be pollution control projects, which are exempt from the regulatory definition of modification, but what about other types of modifications?

c. EPA further claims that sources that perform modifications are not "new" sources because they would only be new sources if there were applicable standards of performance, and since EPA is not proposing standards, then they are not new. Isn't this a circular argument? Wouldn't this mean EPA could always choose not to issue NSPS for modified sources?

2. Why is EPA seeking comment on alternative interpretations of whether under section111 EPA needs to make some additional finding in order to include GHGs (pp.103 et seq.)? Has the EPA interpretation that once a source category has been regulated under section111, EPA can add pollutants without making any other finding, never been subject to comment?

Thanks

Amy Royden-Bloom

Senior Staff Associate

National Association of Clean Air Agencies (NACAA)

444 N. Capitol St. NW Suite 307

Washington, DC 20001

202-624-7864

aroyden-bloom@4cleanair.org

To: Joseph Goffman/DC/USEPA/US@EPA[]
From: "Hawkins, Dave"
Sent: Tue 4/3/2012 3:59:01 PM
Subject: Link to GHG settlement
http://www.epa.gov/airquality/cps/settlement.html

Hi Joe,

Looking forward to our call at 1:30 today. (I just finished one arranged by Hugh Wynne for his investor clients: me, Peter Glaser, Ray Harry, and John McManus as speakers. No surprises.)

The link to the original NSPS EGU settlement doc on the EPA web site is broken (go to http://www.epa.gov/airquality/cps/settlement.html and click on Settlement Agreement under Fossil Fuel-Fired Power Plants). The link to the Modification of the agreement still works (but it is not a complete amended agreement; just includes the changed text). Not sure if this is a Freudian slip but I thought I would mention it to you.

d

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d

To: Vickie Patton [vpatton@edf.org]
From: Vickie Patton
Sent: Thur 4/5/2012 4:10:15 PM
Subject: Legal Newsline: R.I. AG pleased with EPA proposal
http://www.legalnewsline.com/news/235689-r.i.-ag-pleased-with-epa-proposal
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Author: BRYAN COHEN

Date: March 30 2012

Title/Lead: R.I. AG pleased with EPA proposal

Publication:LegalNewsLine

Location: Internet

URL: http://www.legalnewsline.com/news/235689-r.i.-ag-pleased-with-epa-proposal

R.I. AG pleased with EPA proposal

BY

Kilmartin

PROVIDENCE, R.I. (Legal Newsline) - Rhode Island Attorney General Peter Kilmartin commended the Environmental Protection Agency on Monday for proposing regulations to limit the amount of greenhouse gas emissions allowed from new power plants for fossil fuels.

The EPA's action follows a settlement reached by a coalition of states that includes Rhode Island, which required the agency to complete limits on power plant emissions of greenhouse gases such as carbon dioxide. The settlement committed the EPA to proposing limits of greenhouse gas emissions for existing power plants.

The potential climate protection benefits of the proposed regulations would be significant over time. The regulations would reduce the greenhouse gas emissions of new coal-fired power plants by approximately 50 percent during the life of the plants.

"Addressing the threat posed by climate change is one of the most important challenges of our time - one that demands attention, leadership and action at all levels of government and by the private sector," Kilmartin said.

"I commend EPA for issuing these common-sense and cost-effective regulations that will result in substantial reductions in greenhouse gas emissions from new fossil fuel power plants. EPA has a continuing legal obligation to take the next step and require existing fossil fuel power plants to reduce

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"I commend EPA for issuing these common-sense and cost-effective regulations that will result in substantial reductions in greenhouse gas emissions from new fossil fuel power plants. EPA has a continuing legal obligation to take the next step and require existing fossil fuel power plants to reduce their emissions."

In March 2011, Rhode Island and 11 other states agreed to a settlement of the 2006 New York v. EPAlitigation requiring the agency to complete greenhouse gas emission standards for modified and new power plants, in addition to existing power plants. The standards proposed by the EPA on Monday partially fulfill the agency's commitments under the settlement. Greenhouse gas emissions pollute the atmosphere in large quantities by adding gases that trap heat and raise the average temperature of the earth. In turn, the gases are changing the climate in Rhode Island and worldwide.

The 2006 litigation was filed by Rhode Island and a coalition of local and state governments in the U.S. Court of Appeals for the District of Columbia Circuit.

The litigation challenged the EPA's failure to comply with the legal mandate of the federal Clean Air Act to limit emissions of greenhouse gases such as carbon dioxide as air pollutants released by power plants. The case was a portion of an integrated legal strategy by Kilmartin's office and other states resulting in a Supreme Court decision in 2007 in Massachusetts v. EPA that greenhouse gases are pollutants that are subject to regulation under the Clean Air Act.

The largest source of greenhouse gas emissions in the United States is fossil fuel-fired power plants. The plants are responsible for 40 percent of the county's man-made carbon dioxide emissions as well as the emission of other pollutants that contribute to haze, acid rain and smog, in addition to the mercury contamination of streams, lakes and fish.

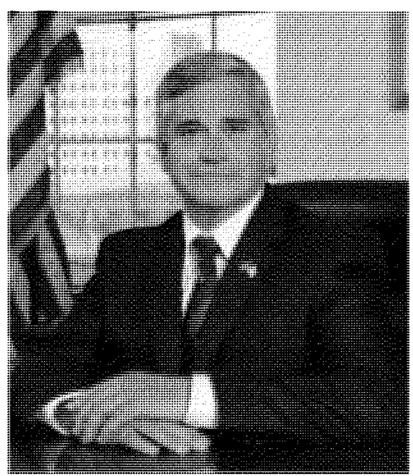
their emissions."

In March 2011, Rhode Island and 11 other states agreed to a settlement of the 2006 New York v. EPAlitigation requiring the agency to complete greenhouse gas emission standards for modified and new power plants, in addition to existing power plants. The standards proposed by the EPA on Monday partially fulfill the agency's commitments under the settlement. Greenhouse gas emissions pollute the atmosphere in large quantities by adding gases that trap heat and raise the average temperature of the earth. In turn, the gases are changing the climate in Rhode Island and worldwide.

The 2006 litigation was filed by Rhode Island and a coalition of local and state governments in the U.S. Court of Appeals for the District of Columbia Circuit.

The litigation challenged the EPA's failure to comply with the legal mandate of the federal Clean Air Act to limit emissions of greenhouse gases such as carbon dioxide as air pollutants released by power plants. The case was a portion of an integrated legal strategy by Kilmartin's office and other states resulting in a Supreme Court decision in 2007 in Massachusetts v. EPA that greenhouse gases are pollutants that are subject to regulation under the Clean Air Act.

The largest source of greenhouse gas emissions in the United States is fossil fuel-fired power plants. The plants are responsible for 40 percent of the county's man-made carbon dioxide emissions as well as the emission of other pollutants that contribute to haze, acid rain and smog, in addition to the mercury contamination of streams, lakes and fish.



To: Joseph Goffman/DC/USEPA/US@EPA[]
From: "Hawkins, Dave"
Sent: Thur 4/5/2012 7:51:32 PM
Subject: quick question

Joe,

We are hoping to get a quick answer to a excerpt from the NSPS preamble that is puzzling us:

“It is important to note that at the same

time that the EPA promulgated the pollution control provision in

the EPA’s regulations under CAA section 111, the EPA promulgated

a similar provision in EPA’s NSR regulations.”

We think the PCP exemption for NSPS was adopted in 1974 and not in 2002 when the NSR exemption was adopted. Do you know who in OGC we could call to clarify?

Thanks

David

To: "Lashof, Dan" [dlashof@nrdc.org]; N=Michael Goo/OU=DC/O=USEPA/C=US@EPA;"Barron, Alex" [Alex.Barron@mail.house.gov]; Barron, Alex" [Alex.Barron@mail.house.gov]; tsirigotis.panagiotis@epa.gov>;CN=Joseph Goffman/OU=DC/O=USEPA/C=US@EPA;CN=Lorie Schmidt/OU=DC/O=USEPA/C=US@EPA;CN=Kevin Culligan/OU=DC/O=USEPA/C=US@EPA[]; N=Joseph Goffman/OU=DC/O=USEPA/C=US@EPA;CN=Lorie Schmidt/OU=DC/O=USEPA/C=US@EPA;CN=Kevin Culligan/OU=DC/O=USEPA/C=US@EPA[]; N=Lorie Schmidt/OU=DC/O=USEPA/C=US@EPA;CN=Kevin Culligan/OU=DC/O=USEPA/C=US@EPA[]; N=Kevin Culligan/OU=DC/O=USEPA/C=US@EPA[]
Cc: "Doniger, David" [ddoniger@nrdc.org]; Hawkins, Dave" [dhawkins@nrdc.org]; Yeh, Starla" [syeh@nrdc.org]
From: CN=Jim Ketcham-Colwill/OU=DC/O=USEPA/C=US
Sent: Mon 4/16/2012 2:14:28 PM
Subject: Item #1
EPA WG June 14 Option 2 7-22-2011 v2.pptx

Jim Ketcham-Colwill
EPA Office of Air and Radiation
Office of Policy Analysis and Review
202-564-1676 (w)

Dear EPA NSPSers-

I'm attaching an updated power point presentation that incorporates into the presentation we made to the Administrator new IPM modeling results for what we have called "Option 2" for the 111(d) standard. We found that this option, which sets state-level emission rate standards for all fossil generating units, produced greater emission reductions at lower cost than our original proposal based on remaining useful life ("option 1").

The new results for Option 2 begin with slide 12. The key new emission results appear on Slide 13 and the new electricity price results appear on slide 14.

Note that for modeling purposes the "option 2" standards were implemented at a regional (rather than state) level and that banking of emission credits was not allowed. Detailed model specs are pasted below.

Let me know if you have any questions and want additional information.

-Dan

Daniel A. Lashof, Ph.D.

Director, NRDC Climate Center

202-289-6868

The NSPS Case includes regional NSPS requirements based on a formula developed by NRDC. It does not include any other treatment of CO_2 emissions performance at the national level. The regional NSPS standards are a function of the historical fossil fuel generation mix in the region and national historical emission rates. The standards are set based on an initial rate for each region and a schedule of reductions in the national emissions rates used in the formula over time, as established by NRDC.

The historical regional emission rates to be used in the calculation of the program standards were developed from the following components:

1. State/regional generation mix – Using historical generation data from EPA and FERC for the years 2008 to 2010, ICF calculated the average share of fossil generation attributable to coal and to combined oil and gas generation. These shares were developed at the state or model region level, consistent with the model regions currently used in IPM©.

2. National coal and oil/gas CO_2 emission rates –Based on national EPA data for the period 2008 to 2010, ICF calculated the average emission rate, in lbs/MWh, for coal-fired generation and for combined oil- and gas-fired generation at 2063 lbs/MWh and 1065 lbs/MWh, respectively.

NRDC specified the initial emission rates for use in the development of the standard for each state/region as the average national emission rate for coal and oil/gas, weighted by the share of generation of each fuel by region over the 2008-2010 period, based the following formula:

Initial Regional Rate = [National coal CO_2 emission rate * coal generation share by region] + [National oil/gas CO_2 emission rate * oil/gas generation share by region]

For each compliance period, the standard for each region will be based on the initial emission rate calculated above adjusted downward by the following factors:

1. For 2015-2019, the annual emission rate used for the coal share declines by 5% relative to the initial emission rate and the rate used for oil and gas declines by 2.5% relative to the initial emission rate. The annual rate standards are flat during this 5-year period.

2. For 2020 and onwards, the emission rate is kept flat and reflects a 15% decline relative to the initial emission rate for coal and a 5% decline relative to the initial emission rate for oil and gas.

All other assumptions in the Option 2 NSPS Case, including other environmental regulations and natural gas prices, are identical to those in the Option 1 NSPS Case. As such, any decrease in natural gas generation and natural gas demand in this case was assumed to not have any material impact on natural gas prices.

NRDC

Options for Achieving Meaningful Carbon Emissions Reductions Through Section 111 of the Clean Air Act

July 22, 2011

Key Goals

NRDC
THE EARTH'S BEST DEFENSE

- Avoid New High Emission Power Plants
- Cut Average Emission Rate of Fossil Fuel Generating Fleet 10-15% by 2020
- Establish Robust Framework That is Technically, Legally, and Politically Defensible

→ Set Standards for Combined Fossil EGU Source Category (i.e., merge Da with KKKK)

Title Page Photo Credit: http://www.sciencenews.org/view/access/id/32053/title/Clear_sky%3F

Legal and Policy Considerations
Selecting the Category: All Fossil-Fueled Power Plants

* "All fossil" category critical to harness all real-world control options, and achieve significant near- and mid-term GHG reductions
* EPA has broad authority under (b)(1)(A) to define source categories to fit the factual circumstances of specific industries
* "All fossil" category – for both (b) and (d) standards – reflects real-world operational and investment decisions
  – Power plants operated as an integrated system – interdependent management decisions on when to operate, build, upgrade, and retire units
  – Walling off coal plants in separate category arbitrarily restricts control options, yields small near-term reductions, and closes off longer-term reduction options
* "All fossil" consistent with *New York* settlement, which does not limit a broader-than-coal approach

New Units -- 111(b)
Key Design Features

NRDC
THE EARTH'S BEST DEFENSE

- Combine Coal (Da) and Gas (KKKK) categories
  - (Subcategory for Peakers)
- Set Standard for Fossil Units at 850 lbs/MWh (except peakers)
- Allow Option to Time-Average Over First 30 Years of Operations
- Technically and Economically Feasible Based On:
  - Natural Gas Combined Cycle

  OR
  - Coal with CCS Installed After 10 years

    (1850 lbs/MWh for 10 years; 350 lbs/MWh for 20 years)

Legal and Policy Considerations – 111(b)
"All Fossil," BDT, and 30-Yr Average Standard Go Together

* 850 lbs/MWh new source standard for "all fossil" category achievable at reasonable cost by combined cycle gas turbines
* Also achievable by new coal with CCS on time average basis over first 30 years
  - E.g., 1850 lbs/MWh for 10 years, 350 lbs/MWh for 20 years
  - Other averaging profiles possible, allowing earlier or later adoption of CCS
* Source commits to an enforceable averaging profile in permit at start-up, with penalties for "excess" emissions in early years held in abeyance as long as source performs "on profile"
  - Penalties enforced for accumulated excess emissions if source fails to perform on profile
* *Portland Cement:* "Section 111 looks toward what may fairly be projected for the regulated future;" "Administrator may make a projection based on existing technology, though that projection is subject to the restraints of reasonableness and cannot be based on 'crystal ball' inquiry"

Existing Units -- 111(d)
Key Design Options

NSPS Option 1 (abbreviated NSPS-1)

- Set Performance Standard at New Source Rate, Phased In at End of Remaining Useful Life

NSPS Option 2 (abbreviated NSPS-2)

- Set State Average Fossil Fuel Emission Rates Based on Fuel-Specific Performance Standards and Fuel Mix in Baseline Period

NSPS Option 3 (abbreviated NSPS-3)

- Set Performance Standard at 15% Below Current Coal Average Rate, Allow Compliance by Averaging with Cleaner Generation that Replaces Part of Generation from Source

Legal and Policy Considerations – 111(d)
"All Fossil," BDT, and Emission-Rate Averaging Go Together

NRDC
The Earth's Best Defense

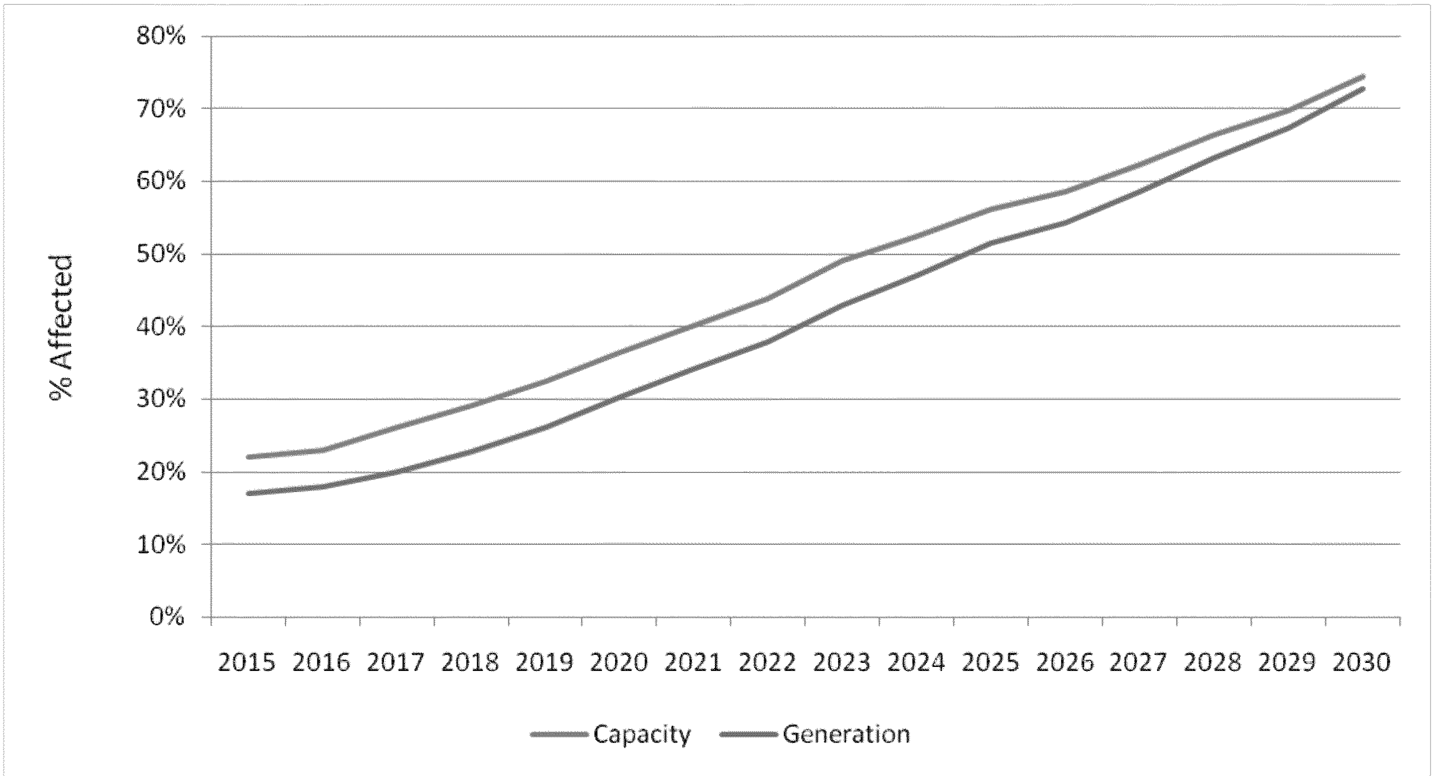
* What's BDT depends on how compliance is defined
  - Unit-by-unit: Each unit has to comply with emission rate on its own
  - Emission-rate averaging: Provides additional compliance option for each unit
  - Emission-rate averaging across "all fossil" category: Provides broadest compliance options for each unit
* Narrower compliance options mean BDT achieves less emission reduction
  - Sources can't adopt lower cost compliance options
  - EPA's ability to "find" all available, reasonable-cost options is limited
* Broader compliance options mean BDT can – and must – achieve more reductions
  - Sources have more options at given cost; easier for EPA to identify and support them

Existing Units -- 111(d)
NSPS Option 1

NRDC
THE EARTH'S BEST DEFENSE

- Required to Meet New Source Standard Within 3 years
- Safe Harbor Until End of Remaining Useful Life
  - Provided No Increase in Emissions Above Baseline
- Allow Emission Averaging Among All Fossil Units
- Credit for Early Retirement
- Optional: Credit for Incremental Renewables & DSM

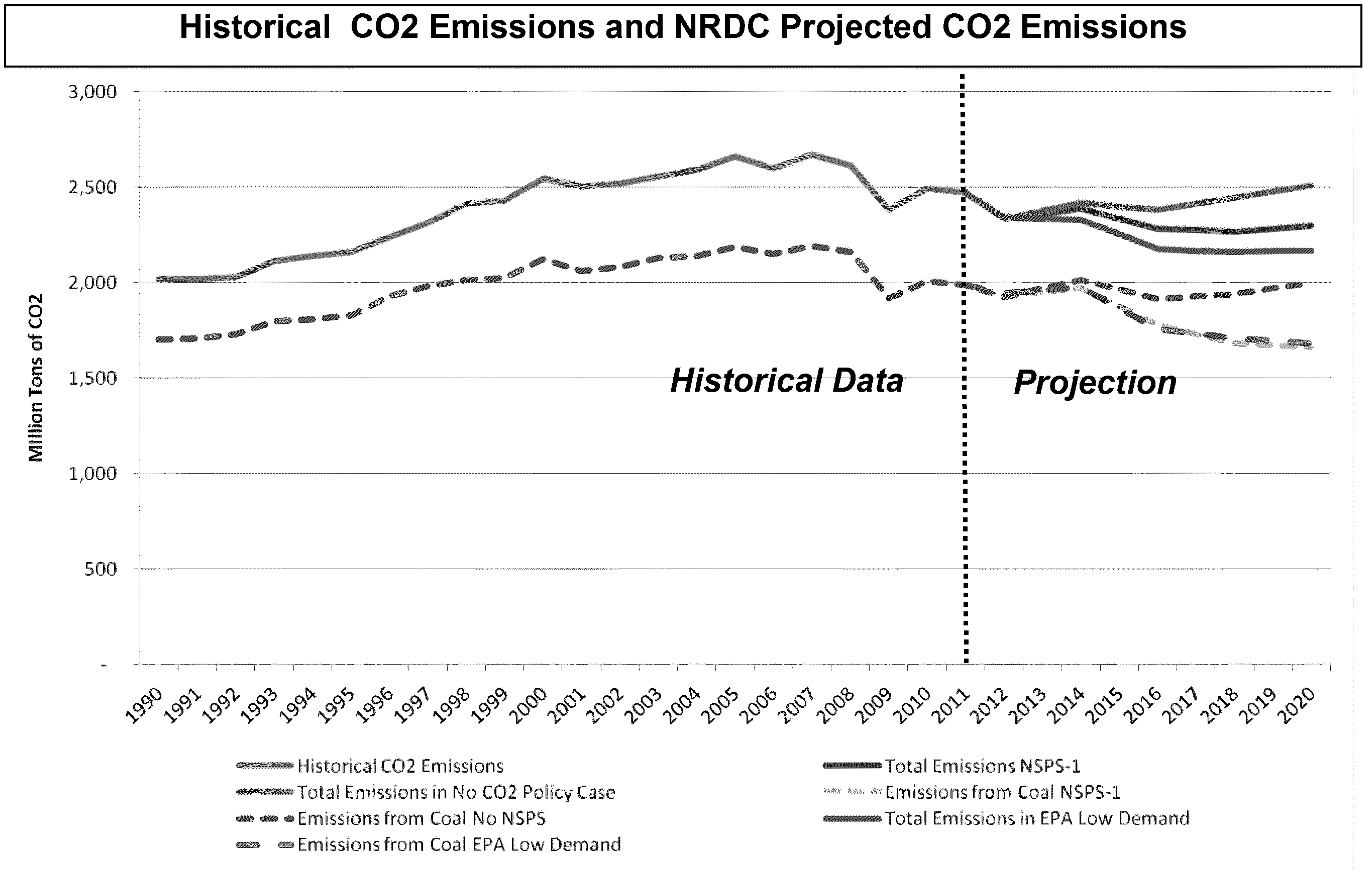
Phase In Based on End of Remaining Useful Life (Age 50)
NSPS-1: Percentage of Coal Fleet Affected Over Time



Source: EPA NEEDS 4.1 data; Calculations based on trigger date of 50 years.

NSPS-1 and No NSPS and EPA Low Demand Cases

U.S. EGU CO2 Emissions (Million Short Tons)



Source for historical CO2 emissions data: EIA. 2011 Figure derived from AEO 2011.

Existing Units -- 111(d)
Key Design Features

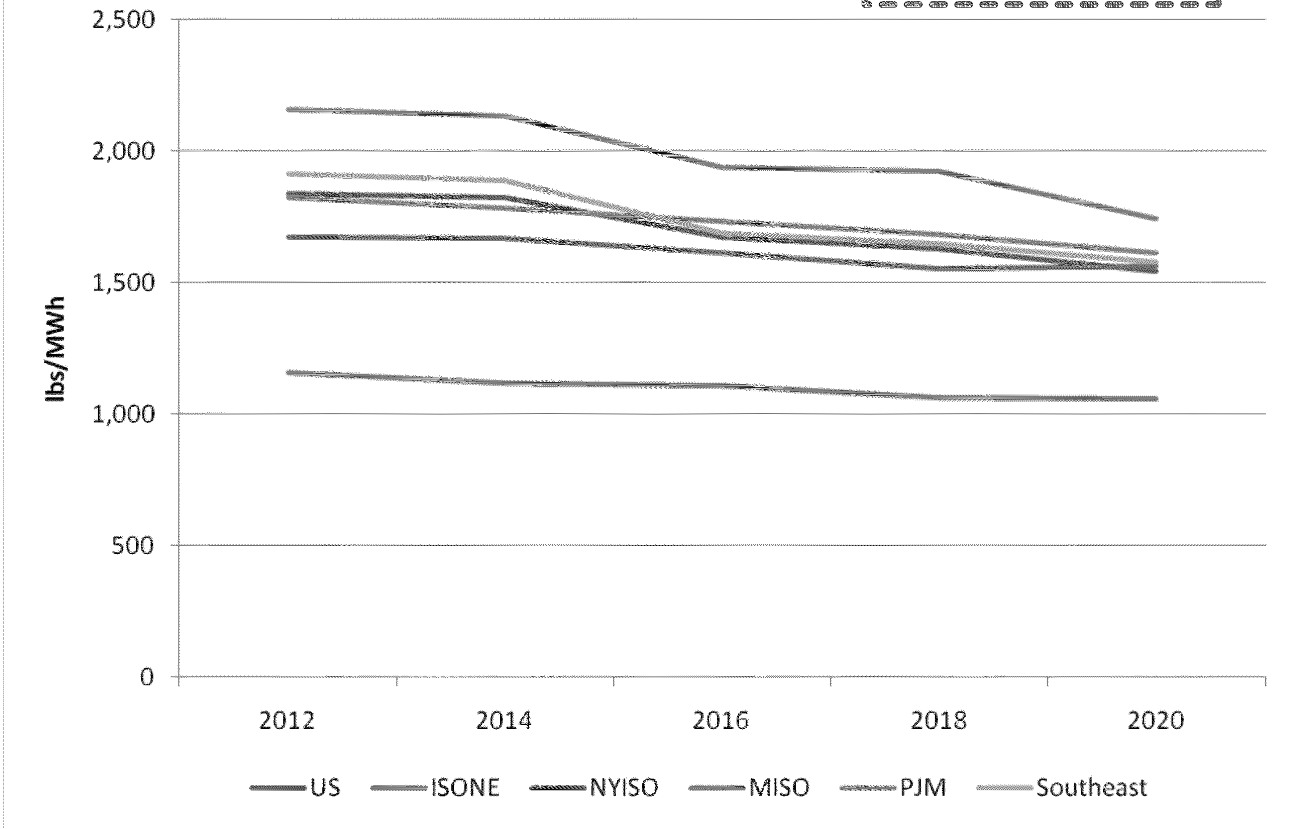
NSPS Option 2

- Phase In Performance Standard for Coal
  - 5% below the current coal average in 2015
  - 15% below the current coal average in 2020
- Phase In Performance Standard for Gas
  - 2.5% below the current gas average in 2015
  - 5% below the current gas average in 2020
- State Standard Based on Fuel Mix in Baseline Period [2008-10]
- Averaging Among All Fossil Units in State
- Optional: Credit for Incremental Renewables & DSM

State Emission Standards Based on Fuel Mix

NSPS-2: Fossil Fuel Emission Rates (US and by Focal Region)

UPDATED



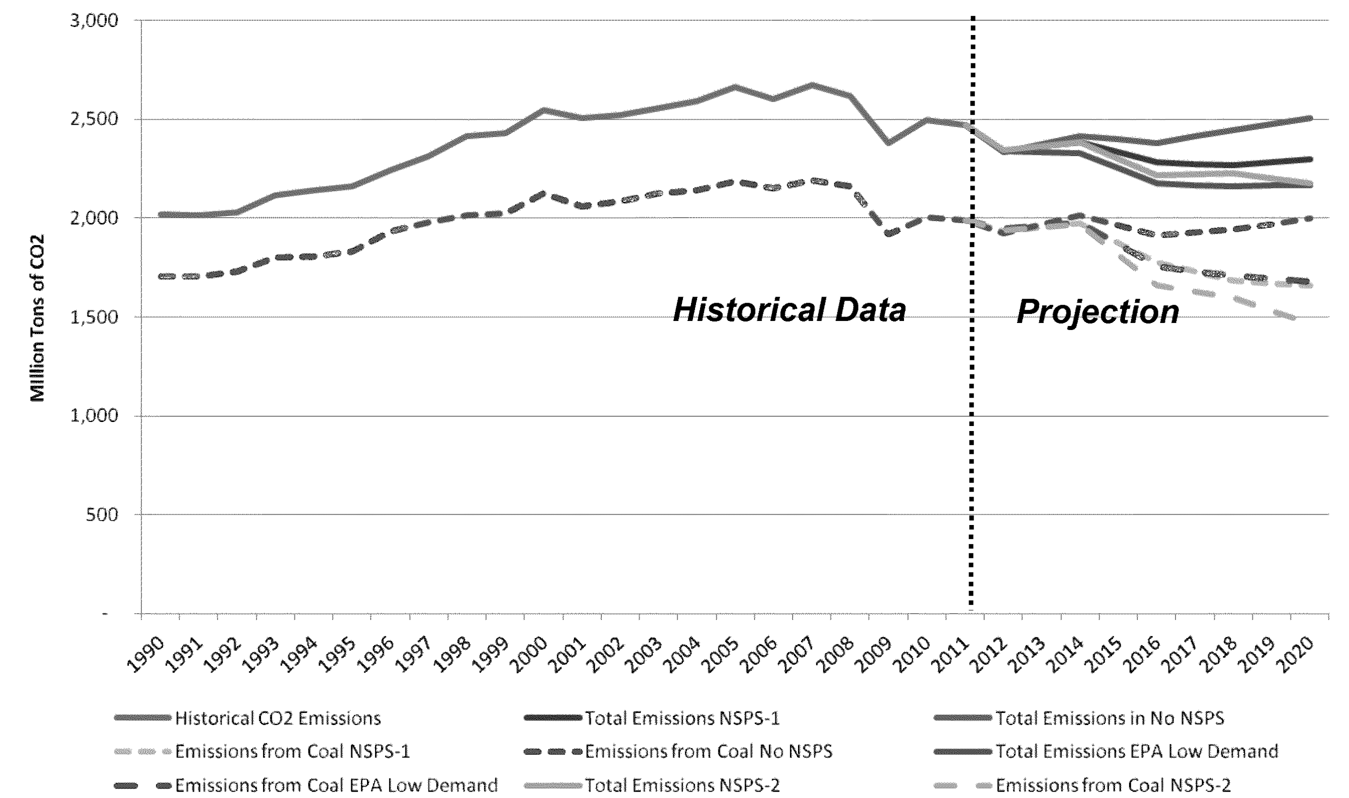
NSPS-2 Emissions Results of NSPS-2 Model Run

U.S. EGU Emissions (Million Short Tons)

UPDATED

NRDC
THE EARTH'S BEST DEFENSE

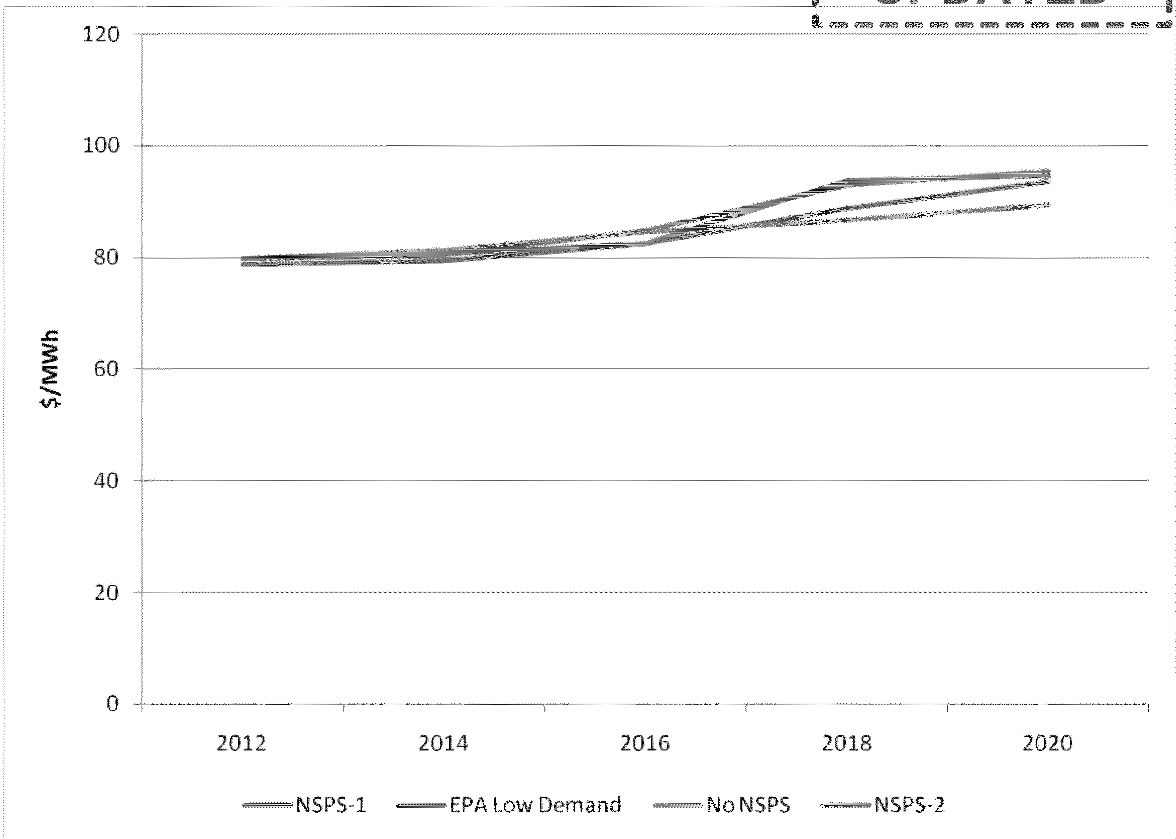
Historical CO2 Emissions and NRDC Projected CO2 Emissions



Source for historical CO2 emissions data: EIA. 2011 Figure derived from AEO 2011.

U.S. Retail Electricity Price Impacts (National Average)

UPDATED



Note: National average based on generation-weighted average of PJM, Southeast, MISO, NYISO, ISONE, accounting for 60% of national generation

Existing Units -- 111(d)
Key Design Features

NSPS Option 3

- Phase In Performance Standard
  - 5% Below Current Coal Average in 2015
  - 15% Below Current Coal Average in 2020
- Safe Harbor If Unit Accepts Obligation to Retire by 2020
  - Binding Obligation Not to Increase Emissions Prior to Shutdown
- Allow Averaging with Incremental Cleaner Generation that Replaces Part of Generation at Unit through Ownership or Contract
  - Leakage Avoided by Requirement to Reduce On Site Emissions
  - Emissions from Replacement Gas Generation Averaged into Rate
  - Optional: Replacement Renewables or DSM Lowers Rate

NSPS Option 3
Compliance Examples

Illustrative On-Site Compliance Path:

* Combustion Controls Reduce Heat Rate by 5%
* Co-fire 10% Sustainable Biomass or 24% Gas

Alternative Compliance Path

* Reduce Coal Unit's Generation by 24%
* Replace Generation with Increased Utilization of NGCC

Alternative Compliance Path Likely Much Cheaper

* No Investment Required at Coal Unit
* NGCC Uses Gas Much More Efficiently, So Lower Fuel Costs

Contact Information

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To: Vickie Patton [vpatton@edf.org]
From: Vickie Patton
Sent: Tue 4/24/2012 7:22:12 AM
Subject: AEP Earnings Call Q1 2012
AEP Q1 2012 Presentation.pdf
AEP Q4 2012.docx

Re "opportunity" from transformation of generation resources in response to market and EPA, re legislation "we continue to be active on coming up with legislation that provides for more of a blanket extension of time" and re fuel switching (see also slide 7)

# # #

The transformation or our generation resources, in response to the market and EPA mandates, is going to be an opportunity for us because we will deploy capital to do that, and we've seen the latest EPA rules, and Mark McCullough and our generation area certainly has worked out a capital path that makes sense for us going forward.

# # #

Our generation transformation activities continue into the market in EPA rules. We now have 4,600 megawatts that'll be retired over a time period, really detailed by the EPA rules end of 2014. But that could change based upon the extension years and also could change because of the markets. So we're staying pretty flexible when the retirements would actually occur based upon a resolution of some of those issues.

But the 4,600 megawatts is a little different than the 6,000 megawatts we had mentioned to you previously at the time of the February 10 deal that we had 6,000 megawatts. If you take out 4 and 5, which we've already retired, and then the Big Sandy activity, that gets you in the 4,600-megawatt number.

So -- but the current view is, is that, from a capital standpoint, there's a capital plan worked out, even with the aggressive EPA schedule. And certainly, we want to be able to mitigate costs to our customers as much as we can during this process. So we continue to be active on coming up with legislation that provides for more of a blanket extension of time to really give customers time to make that adjustment.

And for us, when we retire these plants, the communities involved, the taxes involved, the socio-economic factors involved need to be dealt with in a very positive fashion. And by replacing generation, by coming up with other alternatives, these communities can adjust to that. And I think that's important for us as we deal with an economy that is where it is today.

# # #

Turning to Slide 7, I want to talk a little bit about the coal-to-gas generation switching that has occurred on AEP system and the outlook for the future.

First, it is easy to see that coal-fired net capacity factors had decreased, while gas-fired net capacity factors have increase. This result is more pronounced in the east part of our system, where natural gas capacity is 14% of the total versus the west, where it is 62%.

In the east, net capacity factors for natural gas units increased to 47% in the first quarter of 2012 from 22% in the first quarter of last year. Coal-fired net capacity factors correspondingly had dropped to 47% from 61%. The result is even more pronounced when we focused on our east combined cycle plants, which reached net capacity factors of 78% in the first quarter of this year, up from just 17% from the same period last year.

If you were to exclude the new just [ph] and combined cycle facility, which came online at the end of January of this year, the east combined cycle capacity factor climbs to 85%. East combined cycle generation increased fully 149% quarter-on-quarter.

So what does all this mean? With our east combined cycle fleet operating at such a high capacity factor, we would expect the rate of coal-to-gas switching to remain about the same through the balance of the year. That is, most of our combined cycle gas units are running close to flat out.

With our gas consumption and cash generation up, and with the mild weather that we've experienced, our coal inventories have climbed to 45 days full burn inventory at the end of the quarter from 39 days at the end of last year. We expect inventories to climb over the second quarter. And just as we manage our inventories during the recession, we'll continue to do so now. All of that being said, our coal needs for 2012 are fully hedged and our needs for 2013 are about 80% met.

AEP AMERICAN ELECTRIC POWER®

1Q12 Earnings Release Presentation

April 20, 2012

"Safe Harbor" Statement under the Private Securities Litigation Reform Act of 1995

This presentation contains forward-looking statements within the meaning of Section 21E of the Securities Exchange Act of 1934. Although AEP and each of its Registrant Subsidiaries believe that their expectations are based on reasonable assumptions, any such statements may be influenced by factors that could cause actual outcomes and results to be materially different from those projected. Among the factors that could cause actual results to differ materially from those in the forward-looking statements are: the economic climate and growth in, or contraction within, our service territory and changes in market demand and demographic patterns, inflationary or deflationary interest rate trends, volatility in the financial markets, particularly developments affecting the availability of capital on reasonable terms and developments impairing our ability to finance new capital projects and refinance existing debt at attractive rates, the availability and cost of funds to finance working capital and capital needs, particularly during periods when the time lag between incurring costs and recovery is long and the costs are material, electric load, customer growth and the impact of retail competition, particularly in Ohio due to the February 2012 PUCO rehearing order, weather conditions, including storms, and our ability to recover significant storm restoration costs through applicable rate mechanisms, available sources and costs of, and transportation for, fuels and the creditworthiness and performance of fuel suppliers and transporters, availability of necessary generating capacity and the performance of our generating plants, our ability to resolve I&M's Donald C. Cook Nuclear Plant Unit 1 restoration and outage-related issues through warranty, insurance and the regulatory process, our ability to recover regulatory assets in connection with deregulation, our ability to recover increases in fuel and other energy costs through regulated or competitive electric rates, our ability to build or acquire generating capacity, and transmission line facilities (including our ability to obtain any necessary regulatory approvals and permits) when needed at acceptable prices and terms and to recover those costs (including the costs of projects that are cancelled) through applicable rate cases or competitive rates, new legislation, litigation and government regulation including oversight of nuclear generation, energy commodity trading and new or heightened requirements for reduced emissions of sulfur, nitrogen, mercury, carbon, soot or particulate matter and other substances or additional regulation of fly ash and similar combustion products that could impact the continued operation and cost recovery of our plants, a reduction in the federal statutory tax rate, timing and resolution of pending and future rate cases, negotiations and other regulatory decisions including rate or other recovery of new investments in generation, distribution and transmission service and environmental compliance, resolution of litigation, our ability to constrain operation and maintenance costs, our ability to develop and execute a strategy based on a view regarding prices of electricity, natural gas and other energy-related commodities, changes in the creditworthiness of the counterparties with whom we have contractual arrangements, including participants in the energy trading market, actions of rating agencies, including changes in the ratings of debt, volatility and changes in markets for electricity, natural gas, coal, nuclear fuel and other energy-related commodities, changes in utility regulation, including the implementation of ESPs and the expected legal separation and transition to market for generation in Ohio and the allocation of costs within regional transmission organizations, including PJM and SPP, accounting pronouncements periodically issued by accounting standard-setting bodies, the impact of volatility in the capital markets on the value of the investments held by our pension, other postretirement benefit plans, captive insurance entity and nuclear decommissioning trust and the impact on future funding requirements, prices and demand for power that we generate and sell at wholesale, changes in technology, particularly with respect to new, developing or alternative sources of generation, our ability to recover through rates or prices any remaining unrecovered investment in generating units that may be retired before the end of their previously projected useful lives, our ability to successfully manage negotiations with stakeholders and obtain regulatory approval to terminate or amend the Interconnection Agreement and break up or modify the AEP Power Pool, evolving public perception of the risks associated with fuels used before, during and after the generation of electricity, including nuclear fuel and other risks and unforeseen events, including wars, the effects of terrorism (including increased security costs), embargoes, cyber security threats and other catastrophic events.

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First Quarter 2012 Highlights

- **Financial Performance**
  - Delivered GAAP and on-going earnings of $0.80 per share
  - 2012 Earnings guidance not reaffirmed
  - Remain committed to long-term strategy outlined on February 10th
- **Progress in the 1st Quarter – Moving forward with Repositioning AEP**
  - FINANCE – Issued $800M TCC Securitization bonds (March 14)
  - RETAIL – Acquired BlueStar Energy which establishes a platform for retail growth (March 7)
  - TRANSMISSION – Transco and ETT investments on-track; Transource JV with Great Plains Energy announced (April 4)
- **Ohio Regulatory Update**
  - Capacity filing hearing underway
  - ESP procedural schedule established

Dividend payout and growth rate supported by Regulated Operations

1Q12 Performance

AEP®

First Quarter Reconciliation

	EPS	Ongoing Earnings ($ in millions)
1Q11	$ 0.82	$392
Weather	$ (0.12)	
Customer Switching	$ (0.06)	
Ohio POLR	$ (0.05)	
Transmission Operations	$ 0.01	
Other	$ 0.01	
Rate Changes	$ 0.08	
Operations & Maintenance	$ 0.11	
1Q12	$ 0.80	$389

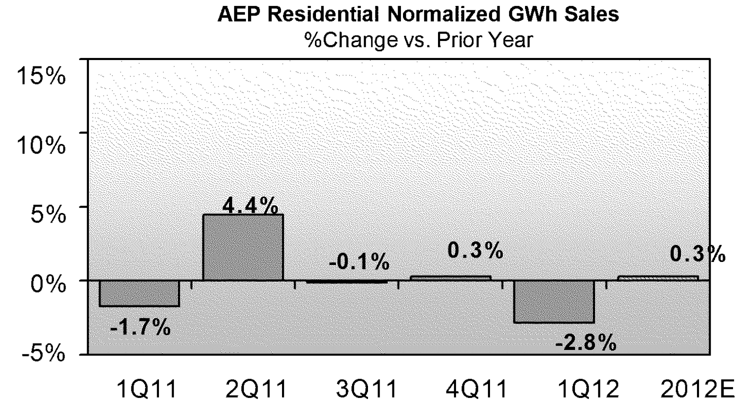
EPS Based on 484MM shares in 1Q12

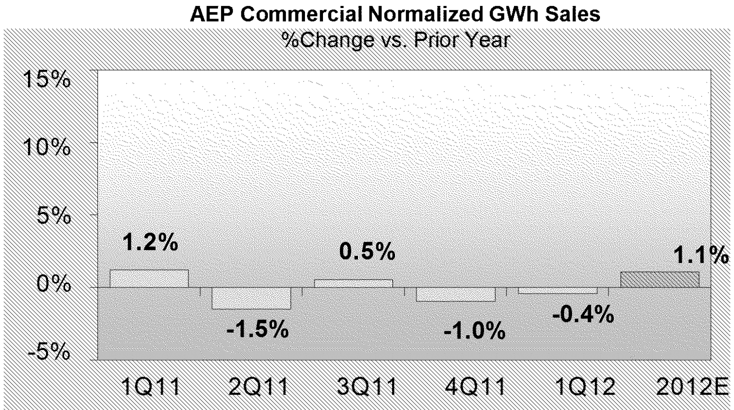
1Q12 Performance Drivers

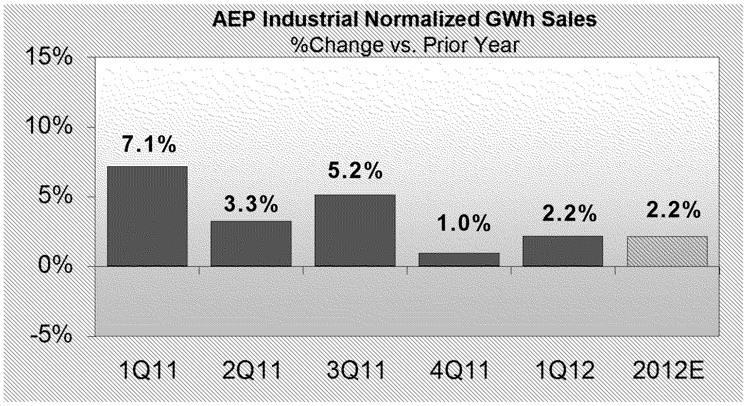
- Weather was unfavorable by $87M vs. prior year, unfavorable $68M vs. normal
- Gross Customer Switching up $42M from prior year. Total 1Q12 retail generation margin lost $57M. As of March 2012, 28% of total AEP Ohio load lost
- Loss of POLR revenues $39M
- Transmission Operations up $5M
- Rate Changes net of offsets of $63M from multiple operating jurisdictions
- O&M expense net of offsets decreased $80M primarily due to spending discipline and reversal of a previously recorded regulatory obligation

1Q12 earnings in-line with 1Q11 earnings

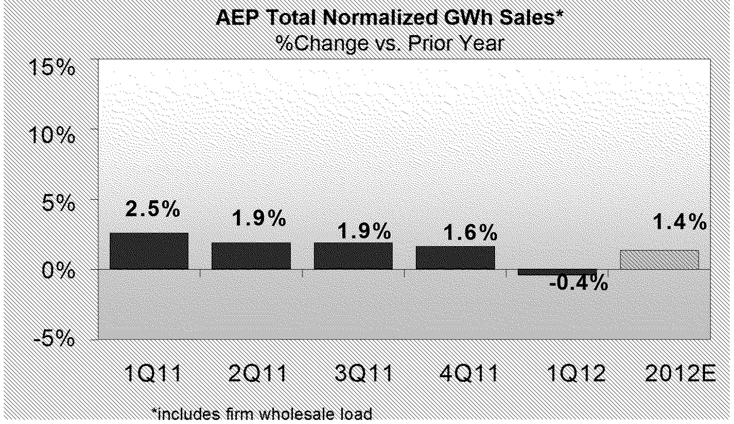
Normalized Load Trends







Note: Chart represents connected load

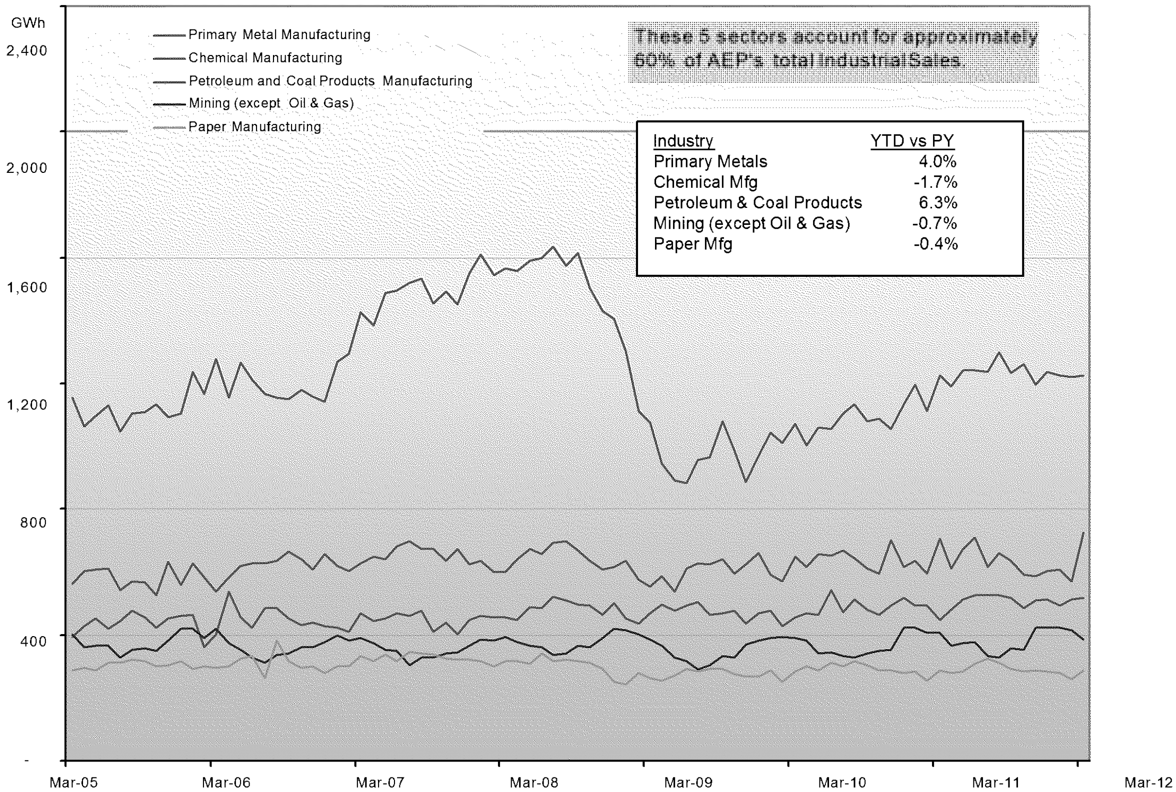


*includes firm wholesale load

Residential/Commercial sales down; Industrial sales up

Industrial Sales Volumes

AEP Industrial GWh by Sector



Industry	YTD vs PY
Primary Metals	4.0%
Chemical Mfg	-1.7%
Petroleum & Coal Products	6.3%
Mining (except Oil & Gas)	-0.7%
Paper Mfg	-0.4%

Industrial sales continue to improve

Coal to Gas Switching

AEP®

	Net Capacity Factor	
	1Q12	1Q11
AEP East		
Coal	47.0%	61.2%
Gas	47.3%	21.7%
AEP SPP		
Coal	75.7%	78.8%
Gas	21.9%	17.2%

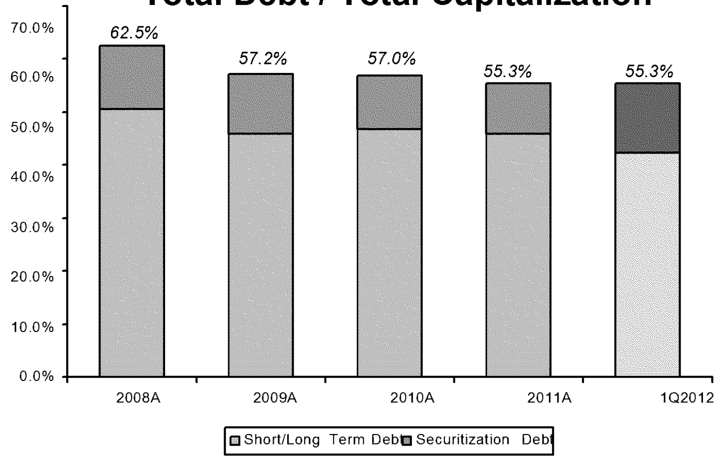
	Net Capacity Factor	
	1Q12	1Q11
AEP East Combined Cycle	77.9%	38.2%

- Natural gas consumption increased 62% 1Q12 compared to 1Q11
- Excluding Dresden, east combined cycle average capacity factor for 1Q12 was approximately 85%
- 45 days system average coal inventory at March 31, 2012
- Coal fully hedged for 2012, approximately 80% hedged for 2013

Gas switching in AEP East complete; managing coal inventories

Capitalization & Liquidity

Total Debt / Total Capitalization



Pension Funding

At the end of the first quarter AEP's pension funded status was 90%

Credit Statistics

	Actual	Target
FFO Interest Coverage	4.7	>3.6x
FFO To Total Debt	20.0%	15%- 20%

Note: Credit statistics represent the trailing 12 months as of 03/31/2012

Liquidity Summary (03/31/2012)

Liquidity Summary (unaudited)		**Actual**	
($ in millions)		Amount	Maturity
Revolving Credit Facility	$	1,750	Jul-16
Revolving Credit Facility		1,500	Jun-15
Total Credit Facilities		**3,250**	
Plus			
Cash & Cash Equivalents		286	
Less			
Commercial Paper Outstanding		(385)	
Letters of credit issued		(189)	
Net available Liquidity	**$**	**2,962**	

Strong balance sheet, solid credit metrics and adequate liquidity

Questions

1Q12 Earnings

	$ millions			Earnings Per Share		
	1st Qtr 2011	1st Qtr 2012	Change	1st Qtr 2011	1st Qtr 2012	Change
Utility Operations	$ 389	$ 383	$ (6)	$ 0.81	$ 0.79	$ (0.02)
Transmission Operations	4	9	5	0.01	0.02	0.01
Non-Utility Operations	8	8	-	0.02	0.02	0.00
Parent & Other	(9)	(11)	(2)	(0.02)	(0.03)	(0.01)
AEP On-Going Earnings	392	389	(3)	0.82	0.80	(0.02)
Cost Reduction Initiative	9	-	(9)	0.02	-	(0.02)
Carbon Capture & Storage	(26)	-	26	(0.06)	-	0.06
Litigation Settlement - Enron Bankruptcy	(22)	-	22	(0.05)	-	0.05
Special Items Total	(39)	-	39	(0.09)	-	0.09
Reported Earnings (GAAP)	$ 353	$ 389	$ 36	$ 0.73	$ 0.80	$ 0.07

Quarterly Performance Comparison

AEP®

American Electric Power
Financial Results for 1st Quarter 2012 Actual vs 1st Quarter 2011 Actual

		2011 Actual			2012 Actual		
		Performance Driver	($ millions)	EPS	Performance Driver	($ millions)	EPS
	UTILITY OPERATIONS:						
	Gross Margin:						
1	East Regulated Integrated Utilities	18,152 GWh @ $ 41.7 /MWhr =	757		17,018 GWh @ $ 44.9 /MWhr =	764	
2	Ohio Companies	13,305 GWh @ $ 53.7 /MWhr =	715		12,863 GWh @ $ 48.0 /MWhr =	618	
3	West Regulated Integrated Utilities	9,903 GWh @ $ 29.6 /MWhr =	293		9,657 GWh @ $ 29.9 /MWhr =	289	
4	Texas Wires	6,314 GWh @ $ 23.5 /MWhr =	149		6,157 GWh @ $ 23.5 /MWhr =	145	
5	Off-System Sales		86			84	
6	Transmission Revenue - 3rd Party		102			115	
7	Other Operating Revenue		125			101	
8	Utility Gross Margin		2,227			2,116	
9	Operations & Maintenance		(835)			(757)	
10	Depreciation & Amortization		(393)			(412)	
11	Taxes Other than Income Taxes		(209)			(211)	
12	Interest Exp & Preferred Dividend		(233)			(217)	
13	Other Income & Deductions		48			43	
14	Income Taxes		(216)			(179)	
15	Utility Operations On-Going Earnings		389	0.81		383	0.79
16	Transmission Operations On-Going Earnings		4	0.01		9	0.02
	NON-UTILITY OPERATIONS:						
17	AEP River Operations		7	0.02		9	0.02
18	Generation & Marketing		1	-		(1)	-
	PARENT & OTHER:						
19	Parent Company On-Going Earnings		(11)			(12)	
20	Other Investments		2			1	
21	Parent & Other On-Going Earnings		(9)	(0.02)		(11)	(0.03)
22	ON-GOING EARNINGS		392	0.82		389	0.80

Retail Rate Performance

	Rate Changes, net of trackers (in millions)
	1Q12 vs. 1Q11
East Regulated Integrated Utilities	$27
Ohio Companies	$37
West Regulated Integrated Utilities	$0
Texas Wires	$0
AEP System Total	$63
Impact on EPS	$0.08

May not foot due to rounding

1Q12 Retail Performance

	Retail Load* (weather normalized)
	1Q12 vs. 1Q11
East Regulated Integrated Utilities	(2.0%)
Ohio Companies	(0.8%)
West Regulated Integrated Utilities	0.3%
Texas Wires	3.6%
Impact on EPS	$0.00

** Excludes firm wholesale load*

	Weather Impact (in millions)
	1Q12 vs. 1Q11
East Regulated Integrated Utilities	($45)
Ohio Companies	($24)
West Regulated Integrated Utilities	($9)
Texas Wires	($9)
Impact on EPS	$0.12

Off System Sales Gross Margin Detail

	1Q11 ($millions)	1Q12 ($millions)
OSS Physical Sales	$ 90	$ 78
Marketing/Trading	$ 32	$ 22
Pre-Sharing Gross Margin	$ 122	$ 100
Margin Shared	$ (36)	$ (16)
Net OSS	$ 86	$ 84

- Physical off-system sales margins decreased from last year by $12M
- AEP/Dayton Hub pricing: 22% decrease in liquidation prices
- Lower Trading & Marketing results by $10M

American Electric Power (AEP) Q1 2012 Earnings Call April 20, 2012 9:00 AM ET

Operator

Ladies and gentlemen, thank you for standing by, and welcome to the First Quarter 2012 Earnings Conference Call. [Operator Instructions] As a reminder, this conference is being recorded. I would now like to turn the conference over to Chuck Zebula. Please go ahead.

Charles E. Zebula

Thank you, Linda. Good morning, and welcome to the First Quarter 2012 Earnings Webcast of American Electric Power. Our earnings release, presentation slides and related financial information are available on our website aep.com. Today, we will be making forward-looking statements during the call. There are many factors that may cause future results to differ materially from these statements. Please refer to our SEC filings for a discussion of these factors.

Joining me this morning for opening remarks are Nick Akins, our President and Chief Executive Officer; and Brian Tierney, our Chief Financial Officer. We will take your questions following their remarks. I will now turn the call over to Nick.

Nicholas K. Akins

Thanks, Chuck, and thank you, everyone, for joining us today on AEP's First Quarter 2012 Earnings Call. It has been a great quarter for us, I think. From an overall viewpoint, AEP has done very well in terms of financial performance.

We delivered GAAP ongoing earnings of $0.80 a share, which is positive, given some significant headwinds of the mild weather, low natural gas prices impacts on all systems sales and the Ohio customer switch. The story demonstrates the value of the diversity of AEP's service footprint and our ability to control costs to respond to these headwinds.

Industrials continue to improve, while commercial and residential still struggle. I think it's an indication of the economy and how much of an issue it is with the recovery of the economy at this point in time. And I think as we progress, though, there's some fundamentals within AEP's service territory, primary metals and oil and gas activity, that are contributing to positive success for our territories.

With that said, we can't reaffirm guidance because of the significant area of risk involving the Ohio situation and the transition to competition, which I'll discuss in more detail a little bit later.

With the Ohio risk, we're still committed to our long-term strategy we've set out for you on February 10 namely: Movement to competitive environment, we will continue to move to that competitive environment in Ohio. We're embracing it. We support it with the corporate separation that goes along with it and the formation of our competitive generation in retail and marketing functions.

Our investment, our regulated businesses, obviously, will continue as well. Our focus on the growth aspects and repositioning of the company around transmission and other growth areas will be significant. The dividend strength is still provided and secured by the regulated businesses. And we have a continued commitment to the 4% to 6% long-term earnings growth rate that we've discussed in February 10.

The transformation or our generation resources, in response to the market and EPA mandates, is going to be an opportunity for us because we will deploy capital to do that, and we've seen the latest EPA rules, and Mark McCullough and our generation area certainly has worked out a capital path that makes sense for us going forward.

So we have made progress in the first quarter on several fronts. On March 7, we issued $800 million of TCC transition funding bonds, an attractive average interest rate of 2.28%, which compared favorably to similar recently priced deals. Proceeds of the bond issue were used to fund the capital program, reduce TCC debt and contribute to the pension, which is now 90% funded.

On March 8, we completed the acquisition of BlueStar Energy, the retail organization based in Chicago that participates in deregulated retail markets and provides energy services such as DSM type activities. Integration of BlueStar with AEP retail is progressing very well and is on schedule, and we now have over 100,000 customers and growing quickly in that area.

I'm pleased with the progress in our reposition of the transmission business. Earnings from transmission continue to improve, and with the recently announced Transource JV with Kansas City Power & Light, Great Plains Energy, and our continued formation with Transco's in our service territory, we continue to deliver more near-term projects to achieve the critical mass for future growth.

Transource is an addition to the capital plan. We believe that it was a great project for us. It shows that critical mass in near-term on the joint venture, although there's not much spend in the first 2 years. It really does pick up in '14, '15, '16. So that graph that we provided for you back in February that had sort of a dampened look toward the later years, as we represented, was really based upon firm, known projects with little risk, and we wanted to show it that way. And now, with the addition of Transource, you're going to see that portion of it sort of kick up in those later years that is shown in that graph.

So that's important for us to start that critical mass and see that transmission investment continue to grow. The reason why we did the Transource deal was to pursue competitive transmission development projects in the advent of Order 1,000 for -- certainly wanted to set the tone for a comparative transmission going forward, and it was important for us to really put together an engine for that future growth.

And we saw, certainly, from the Great Plains perspective, a near-term project that could provide an ability for us to put that critical mass in place and really give us an advantage going forward in the marketplace in the competitive access area. And it also is on the interface of MISO and SPP, so that provides some future prospects for us. And as well, it focuses on other state footprints like Missouri and Kansas.

So overall, it was a very good thing. Great Plains is a great partner for us and one that we're happy to have involved with the transmission business with us.

Our generation transformation activities continue into the market in EPA rules. We now have 4,600 megawatts that'll be retired over a time period, really detailed by the EPA rules end of 2014. But that could change based upon the extension years and also could change because of the markets. So we're staying pretty flexible when the retirements would actually occur based upon a resolution of some of those issues.

But the 4,600 megawatts is a little different than the 6,000 megawatts we had mentioned to you previously at the time of the February 10 deal that we had 6,000 megawatts. If you take out 4 and 5, which we've already retired, and then the Big Sandy activity, that gets you in the 4,600-megawatt number.

So -- but the current view is, is that, from a capital standpoint, there's a capital plan worked out, even with the aggressive EPA schedule. And certainly, we want to be able to mitigate costs to our customers as much as we can during this process. So we continue to be active on coming up with legislation that provides for more of a blanket extension of time to really give customers time to make that adjustment.

And for us, when we retire these plants, the communities involved, the taxes involved, the socio-economic factors involved need to be dealt with in a very positive fashion. And by replacing generation, by coming up with other alternatives, these communities can adjust to that. And I think that's important for us as we deal with an economy that is where it is today.

Turk construction is now 90% complete. We're moving along very well in that prospect, getting Turk done by the end of the year. And rate cases are being prepared to support that investment as well.

So I have to admit, while I've been pleased with the progress of transmission, generation and many of our regulated operating company activities, our time has been spent here in the first quarter and before personally consumed by the ongoing events in Ohio, as we move to a competitive environment.

I'm sure all of you have followed this closely. And I can't talk too much about what's going on because of the ongoing hearings in the capacity case, but without regurgitating the history of the capacity and ESP cases in Ohio, I'll give you my take on the subject.

This is a case where AEP is asking for what other utilities in Ohio have been previously granted, a fair and reasonable transition to competition that maintains the ability for competitors to compete, but maintains the financial integrity of AEP while we unwind some of the commitments that have been made, specifically contracts with PJM for support of FRR-related capacity for our customers and the eastern pool agreement. The agreement that takes the transfer of capacity and energy among the companies in the eastern footprint.

We need time to unwind those type of arrangements. And those commitments have been made previously with the concurrence of the commission, and certainly, we'd like to unwind those in a very rational way.

The ESP plan that we filed on March 30 balances the interest of what we believe are the 3 main interests of the commission. We tried to be responsive to the concerns related to the previous stipulation and provide a clear path to competition with basically a hybrid of the approach of the stipulation, but adjusted with more Duke-like characteristics, such as energy-only options, leading to an earlier, about 6 months, full option and a transition charge to the retail stability rider. So our plan is balanced in these 3 areas, and I'll call it the 3 C's: Customers, competition and the company.

Customer rates have been adjusted to mitigate the concerns of the low-load factor customers with a more moderate application of the rate increases over all classes of customers. And discounted capacity rates have been put in place that allows for competitors to successfully compete. We've shown that customers are indeed switching at the proposed $255 per megawatt day rate. And the company's financial integrity is maintained through the transition period, tied to a utility rate of return that puts us back into position basically at the December stipulation.

So if you visualize a triangle with these 3 areas in each corner, there is a balance. And if you move capacity rates down, you're only lining the pockets of the competitor suppliers at either the customer's expense or the company's expense. And if it's at the customers' expense, the retail stability rider has to increase, causing higher increases in customer rates, and that's probably not a good outcome. And if it's at the company's expense, it's tantamount to taking capacity value that the company is committed for a 3-year period to PJM to run and giving it to competitors to subsidize the acquisition of our customers, which sort of seems a little bit un-American to me. It's really not competition, it's more a confiscation.

So there is a balance that has been struck with this plan that I would hope the PUC will support. I know there has been much discussion about AEP's legal options, but I would much rather see this case resolved through the acceptable order of the commission so that we can all move forward with clarity around the execution that we spoke of on February 10. The capacity case is ongoing as we speak and the procedural schedule for the ESP case has been established that has oral arguments in early July with a decision thereafter.

So it's been a very good quarter considering the headwinds that exists with the economy, and AEP will remain focused on the execution of the areas we've previously mentioned in February 10. Now I'll turn it over to Brian.

Brian X. Tierney

Thank you, Nick, and good morning, everyone. This morning, I'll explain the quarter-on-quarter variances to last year's results, provide some color on load and the economy at AEP service territories, give some insight into coal and gas switching, provide an overview of AEP's capitalization and liquidity, and then get to your questions as quickly as possible.

Turning to slide 4. For the first quarter of this year, as Nick mentioned, AEP earned $389 million, or $0.80 per share in ongoing earnings versus $392 million or $0.82 per share for the first quarter of 2011.

Weather accounted for a negative comparison to last year of $0.12 per share or $87 million. Overall, heating degree days were down 31% versus last year and 29% below normal, as this was the second mildest winter in the last 30 years for the AEP system.

Customer switching in Ohio accounted for a negative comparison the last year of $0.06 per share or $42 million. This reflects a year-on-year decrease of total retail generation margin and is associated with AEP Ohio's total retail load that had shop by the end of the quarter of 28%.

As you remember, in Q1 of last year, we were collecting provider of last resort charges in Ohio end of June. The loss of Ohio pool of revenues versus last year accounted for a negative quarterly comparison of $0.05 per share or $39 million.

On the positive side, Transmission Operations contributed a positive $0.01 per share or $5 million. This reflects increased earnings from Electric Transmission Texas. You will continue to see growth in investment and earnings from ETT and our Transcos, as we put dollars to work to enhance reliability and system efficiency for our customers.

Rate changes reflecting increased investment in our regulated utility operations accounted for a positive comparison to last year's first quarter of $0.08 per share or $63 million.

Finally, operations and maintenance reductions accounted for a positive comparison to the first quarter of last year of $0.11 per share or $80 million. This reflects a combination of spending discipline in the face of weather and other earnings challenges, as well as the reversal of a regulatory obligation that was previously recorded.

Turning to Slide 5, you will see that our weather-normalized residential and commercial sales were lower than prior year, while our industrial sector continues to show improvement, as Nick stated earlier. Overall, weather-normalized sales were down 0.4% for the quarter, reversing a 7-quarter positive trend that was largely driven by the increase in industrial sales. Although our residential and commercial sales were down for the quarter, a number of economic indicators are showing improvement within our service territory.

First, the economy and AP service territory is growing faster than the U.S. economy and faster than it did in 2011. Real GDP growth for AEP service territory in the first quarter of 2012 is estimated at 4.4% compared to estimated U.S. growth of 2.2%. AEP's 4.4% growth compares favorably to that of the first quarter of 2011 of 2.8%.

In addition, the unemployment rate in AEP service territory is lower than it's been since the start of the recession at 7.9%, and lower than the U.S. unemployment rate for the quarter of 8.2%.

We noted that earlier this week, the 4-week moving average for U.S. unemployment claims rose slightly. We hope this is not a new trend for an economy that has been showing signs of improvement.

The employment growth rate for AEP's footprint was better in the first quarter of this year than it was for all of last year, with employment growth in the West part of our seen system at 2.3%, beating the U.S. rate of 2.1%.

Employment growth for the quarter in the East part of our system was only 1.5%, but still exceeded the growth rate for the region for last year. Contrary to this positive economic data, we should note that AEP's combined east territory's residential customer count was down 0.2% for the quarter, but that was more than offset by a combined west residential customer count that increased 0.6%.

We are hopeful that the economic outlook will continue to improve and translate into improved electricity sales in the near term.

Turning to Slide 6, we're looking at the top 5 sectors in our industrial customer class. Primary metals, AEP's largest industrial sector, is up 4% for the quarter-on-quarter period. If you exclude Ormet, our largest customer, which returned to full production in the first quarter of last year, primary metals were up 1.2% quarter-on-quarter.

Chemicals and mining were both down for the quarter, but both sectors have shown quarter-to-quarter volatility throughout the recovery. The paper industry, as a whole, has been slowly declining over the past several years. As more aspects of our daily life become paperless, this trend is likely to continue.

In addition of the sectors depicted on this slide, the transportation equipment manufacturing sector, AEP's seventh largest, is up 5.5% quarter-on-quarter and is being driven by improvements from a number of customers located primarily in the Indiana and Michigan and SWEPCO service territories. This corresponds with the fact that U.S. auto sales in the first quarter were the highest they've been since before the recession.

The oil and gas extraction sector, AEP's ninth largest industrial sector, is up 6.7% quarter-on-quarter and is being driven by developments in the shale gas areas of our service territory, primarily the Eagle Ford development in Texas and the Marcellus development in the east. These increases are coming mostly from gas processing facilities, some of which have come online and others of which are still in development.

Turning to Slide 7, I want to talk a little bit about the coal-to-gas generation switching that has occurred on AEP system and the outlook for the future.

First, it is easy to see that coal-fired net capacity factors had decreased, while gas-fired net capacity factors have increase. This result is more pronounced in the east part of our system, where natural gas capacity is 14% of the total versus the west, where it is 62%.

In the east, net capacity factors for natural gas units increased to 47% in the first quarter of 2012 from 22% in the first quarter of last year. Coal-fired net capacity factors correspondingly had dropped to 47% from 61%. The result is even more pronounced when we focused on our east combined cycle plants, which reached net capacity factors of 78% in the first quarter of this year, up from just 17% from the same period last year.

If you were to exclude the new just [ph] and combined cycle facility, which came online at the end of January of this year, the east combined cycle capacity factor climbs to 85%. East combined cycle generation increased fully 149% quarter-on-quarter.

So what does all this mean? With our east combined cycle fleet operating at such a high capacity factor, we would expect the rate of coal-to-gas switching to remain about the same through the balance of the year. That is, most of our combined cycle gas units are running close to flat out.

With our gas consumption and cash generation up, and with the mild weather that we've experienced, our coal inventories have climbed to 45 days full burn inventory at the end of the quarter from 39 days at the end of last year. We expect inventories to climb over the second quarter. And just as we manage our inventories during the recession, we'll continue to do so now. All of that being said, our coal needs for 2012 are fully hedged and our needs for 2013 are about 80% met.

Slide 8. Let's take a look at the company's capitalization and liquidity measures. First, GAAP total debt to total capitalization remained unchanged from last quarter at 55.3%, but the quality of that metric has improved as we added $800 million of AAA-rated debt to the balance sheet, as we executed our Texas Central securitized debt offering in March.

Securitization financing reduced costs to TCC's customers versus traditional financing and brought a significant cash contribution to AEP. In addition, in February, SWEPCO issued a $275 million 10-year unsecured note at an attractive rate of 3.55%.

Second, at the end of the first quarter, our credit metrics remained solidly BBB. AEP's FFO to interest coverage stands at 4.7x and our FFO to total debt is at 20%. During the quarter, fixed reaffirmed AEP's ratings and Moody's reviewed and left unchanged their ratings for the company and several subsidiaries.

Turning to liquidity. Our sources included our core revolving credit facilities and cash on hand, which, together, totaled approximately $3.5 billion. Our uses of liquidity include a commercial paper and letters of credit, which, together, totaled approximately $500 million. When netted against one another, the company's liquidity at the end of the first quarter was nearly $3 billion.

Lastly, our pension obligation was funded at 90% at the end of the first quarter. This is an improvement from 86% funded at the end of the year in 2011. As our pension funding approaches 100% through improved investment returns and past significant corporate contributions, we are derisking the investment portfolio.

At the 90% funded level, our portfolio asset targets are 40% equities, 10% alternative investments and 50% fixed Income.

As you can see, the platform is strong, as we seek a positive ESP order and transition to retail competition in Ohio. As Nick noted earlier, due to uncertainty in our Ohio regulatory outlook, we are unable to affirm our previous earnings guidance for 2012 at this time.

As a management team, we are committed to an earnings growth rate of 4% to 6% and a dividend level supported by our regulated earnings.

Thank you for listening today. And with that, Linda, I'll turn it back over to you to take questions.

Question-and-Answer Session
Operator

[Operator Instructions] And our first question comes from the line of Greg Gordon from ISI Group.

Greg Gordon - ISI Group Inc., Research Division

I've got a couple of questions. First, can you comment on the staff position that was recently filed in your capacity case, which I know is separate from your ESP filing? I know that they made some opinions on what they felt was sort of a fair capacity rate. And while I know that that's completely independent from the ESP case, I'm wondering if we can take anything from that as it might be -- as the ESP case unfolds?

Robert P. Powers

Yes, well the capacity rate that came out was actually pretty reasonable, it's the adjustments, I guess, that there's some concerns with. And we expect to get their work papers here Friday, and that'll be helpful to us in terms of determining how exactly they came up with those numbers. But since that case is -- the hearings are ongoing now, I'd be hesitant to speculate on it. But certainly, we'll review that and see what the effect will be.

Greg Gordon - ISI Group Inc., Research Division

Right. Because it appears that they come to the conclusion that your sort of Tier 1 capacity rate seems reasonable, but they didn't opine on the level of your sort of Tier 2 -- what a Tier 2 capacity rate might be? Is that fair or unfair?

Brian X. Tierney

Greg, I think the 145 that they netted to is clearly below what we'd view as acceptable. I think the 255, which is -- and they had something close to that on an adjusted basis before they took some adjustments that were probably overstepping is probably closer to what we'd consider to be reasonable.

Greg Gordon - ISI Group Inc., Research Division

Okay, great. And then the second question, where do you stand in your current pending FERC filing? And when is the expectation that we might or might not get a decision on that case?

Nicholas K. Akins

On the FERC capacity case, you mean, Greg?

Greg Gordon - ISI Group Inc., Research Division

Yes, correct.

Nicholas K. Akins

Well, that capacity case is in, and we're waiting on the FERC response to it. And we're obviously unable to tell when FERC would actually render an order, but the case certainly is there and ready for them to render an order.

Operator

And next we'll go to the line of Dan Eggers from Crédit Suisse.

Dan Eggers - Crédit Suisse AG, Research Division

I guess there's so much going on in Ohio in the quarter as far as ESP on and off. Can you just help detail what would've gotten picked up in first quarter results from kind of the ESP plan and what the reversals were kind of around costs and that sort of stuff that affected the first quarter results?

David M. Feinberg

So Dan, obviously, we've detailed what the customer switching is, and that's reflective of current capacity prices that are in play. There was some pickup in Transmission Operations on Slide 11, as we picked up some of the -- they're paying us for generation and transmission. And some of that migrates to line 11 or -- I'm sorry, the transmission line on Slide 11. And then, of course, we noted a, in O&M, a previously recorded regulatory obligation that has to do with about the $35 million partnership with Ohio Component. So it's really those pieces. It's the customer switching and the partnership with Ohio Component.

Dan Eggers - Crédit Suisse AG, Research Division

Okay. And I guess, Nick, you talked about comfort with the environmental CapEx plan, the CapEx plan. With the amount of your coal-to-gas switching you guys are seeing and the lower run rate on the coal plants, are you reevaluating that plan one more time before making any firm decisions, given the lower economic value presumably?

Nicholas K. Akins

Yes, Dan. We continue to look at the options that we have available to us. And obviously, we've committed the capacity in PJM. So it's a matter of how much we have to -- you have to utilize those units. And obviously, they're being utilized less. As Brian said, the capacity factors are much lower. So that gives us some optionality in terms of how the units are operated during the year. And then in terms of retirements, we're looking at the dates associated with those as well. You have the -- and really, it's a question of whether you need the capacity and does it stay online into 2014 or 2015 or even 2016? But if the gas market is lower and capacity becomes available, then we'd have to look at those options as well. So we are looking at that on a regular basis on what those options can be. I was just saying that in the worst case, it appears that we're okay from a capital perspective. And then, if we do get extensions or if we decide to convert to gas in some fashion with gas burners or whatever, we'll have that optionality to do it. So, really, it's a capacity and an energy question.

Dan Eggers - Crédit Suisse AG, Research Division

Okay. And I guess, Brian, just one last question on the cost management. Of the 80, the 35 was the reversal and kind of 45 was your better cost management. Is that something we can continue to expect will happen on a quarterly basis for this year? Or were there some things that kind of pulled up that we'd assume more of a normalization in cost?

Brian X. Tierney

Absolutely, Dan. I think you've always heard from us that if whether in our system sales and regulatory aren't coming in as we had forecast they would for the year, and all 3 of those things are true for this year, that we would manage our O&M accordingly. And so we are currently in the process of, A, having cut some significant components of O&M ,but we're in the process of evaluating how we might do that more aggressively, not just for this year, but really, as Nick has talked about in the past, trying to reposition the cost structure of this company for the competitive environment that we're moving into.

Nicholas K. Akins

Yes, I think that's one basic tentative of the February 10 discussion we had around capital and O&M discipline in response to the environment that we're in. There's no question that where we're at in the economy and as we follow along with that, along with the other issues that we have ongoing, we have to be able to be flexible from that spending standpoint. We're -- and again, it's in the overall context of that repositioning of the company to those growth areas. And we are very focused on, during this year, working on those activities. So we want to reinforce resources for those growth areas. And certainly, at the same time, evaluate the rest of the organization and make sure we're being as responsive as we can to the operating companies, which really goes to the operating company model.

Operator

And next, we'll go to the line of Paul Ridzon from KeyBanc.

Paul T. Ridzon - KeyBanc Capital Markets Inc., Research Division

When you talk about your residential and commercial being down on a weather norm basis, is that being distorted by shopping at all, or is that deliveries versus kind of generations sold?

Brian X. Tierney

Paul, that's total connected load. So it's not being distorted at all by customer switching.

Paul T. Ridzon - KeyBanc Capital Markets Inc., Research Division

And then, you're $0.06 negative on switching. I think you've got $0.21 in the budget that you've laid out in February 10. Are we running to plan?

Brian X. Tierney

Quarter-to-date, Paul, we are. But so much of that depends on what happens with this ESP case, and particularly, the capacity case. And if we get a negative outcome on the capacity case, and we go to something that looks like RPM, that could significantly accelerate shopping. And so the run rate for the year, given the uncertainty that we face after June 1, is something that's certainly in question. And we wouldn't anticipate that you could just extrapolate the year-to-date numbers and come up with a reasonable outcome with what the capacity case gets resolved at.

Paul T. Ridzon - KeyBanc Capital Markets Inc., Research Division

And then lastly, when you say you're 80% hedged on your coal buy for '13, that assumes the same kind of fuel mix as you're kind of laid out in the first quarter?

Nicholas K. Akins

Yes, that's the same kind of fuel mix, I think, and 80% hedged. That -- it's give or take because you're obviously looking during the year at what the actual coal requirements are going to be. So we continually -- and we're becoming more flexible in terms of our coal contracting to ensure that we do have the flexibility if natural gas prices continue to be low, which we expect they will, that we'd be able to respond from a contractual standpoint.

Paul T. Ridzon - KeyBanc Capital Markets Inc., Research Division

Is building your coal piles more a function of weather or fuel mix?

Nicholas K. Akins

I think it's both. Weather and -- it's weather and natural gas prices. Because one of -- I guess, one of the beauties of our system, we bought 5,000 megawatts of gas in the last few years, or built 5,000 megawatts and it gives a lot of flexibility in terms of if you have low gas prices, they're competing on a marginal basis with coal-fired generation then we can make those adjustments. What we're having to change, obviously, is sort of this black swan event of natural gas prices and making us think about what the future coal contracting provisions will be so that we ensure that they're flexible because there was always an assumption that coal is going to be lower than natural gas. Well, that's not the case, so we need to be flexible on both sides.

Operator

And now, we'll go to the line of Jonathan Arnold from Deutsche Bank.

Jonathan P. Arnold - Deutsche Bank AG, Research Division

Can I ask first on the sales numbers in Q1? Obviously, the weather was particularly abnormal and then there's negative nearly 3% number you have normalized in residential. Is that -- how confident are you that that's kind of a good reflection of the real underlying usage or the weather models is sort of thrown off by a very unusual winter?

Brian X. Tierney

Jonathan, it's hard to tell at this point. If you look at that chart on Slide 5, you'll see there's some -- been some pretty extreme volatility in that residential number Q-over-Q. Second quarter of last year was up 4.4%, and then it went to moderately negative in the third quarter. So I think until we see a trend that we can hang our hat on, we really need to watch that data. We don't see anything that is a give up the ghost on the residential customer account or usage for us. But obviously, we're watching that. We'll continue to watch that quarter-to-quarter. We don't like seeing it down 2.8% versus last year. But as you stated, it is an extreme weather year, and making sure that our weather normalization calculations are right when you have such extremes as we're having right now. And to be frank with you, as we have last year, you really need to watch the trend over time.

Jonathan P. Arnold - Deutsche Bank AG, Research Division

So you're kind of leaving the full year forecast where it is until you get a little better sense of the rest of the year?

Brian X. Tierney

Absolutely.

Nicholas K. Akins

That's right. That's right. Because even in today's Dispatch, I think there was a -- Columbus Dispatch, there was an article on housing sales and housing prices moving up. So it's a very sensitive part of the economy right now, and when you look at it, we've had industrials. And as long as we have sustained industrial pickup, you'll see commercials come back in and residential, obviously, come back in as well. And I think that's going to be a positive for AEP.

Jonathan P. Arnold - Deutsche Bank AG, Research Division

Okay. And then if I could on another topic. You talked -- you've obviously talked a lot about Ohio, you talked about positioning for a more competitive future. Can you talk a little bit about competitive activity outside of your territory? How active are you guys able to be, given the amount of focus I'm sure you have at home right now? And obviously, you talked a little bit about the BlueStar integration. But just -- what are you doing strategy-wise in terms of going after margin? And how -- where would you describe yourselves on the trajectory of getting where you business plan needs to be?

Nicholas K. Akins

Jonathan, I'm pleased with the progress of the integration of BlueStar. And they are also participating in Illinois markets, participating in other markets as well. As I've said earlier, though, we want to make sure that we're only participating in markets that we understand. And that would be primarily MISO and PJM-related markets in Texas. We continue to pursue the -- getting a name for a company in Texas. You can't name it AEP, apparently, so we have to name it something else but we're starting that business back up. And I think it's important for us to make sure we take advantage of the back-office systems of BlueStar, which is a major, major positive for us in that transaction. And the people of BlueStar, we have been very, very pleasantly surprised that -- not that there was a surprise, but certainly, the people involved have been very good for our business and have mixed very well with the AEP retail people. So all -- as you said, there's a major emphasis right now on movement in the Ohio market and we're going to make sure that, that happens. But also, we'll continue to progress in these other markets as well. So I'm very happy with the progress there. And remember, it's primarily put in places of hedging activity for the anticipated generation to be separated in Ohio. So we're very much getting prepared for that.

Jonathan P. Arnold - Deutsche Bank AG, Research Division

You've talked about this as a cost-saving opportunity. But isn't there -- you're not going to have to add a load of people and capability and structure?

Nicholas K. Akins

No, we've got a pretty significant number of people with the BlueStar acquisition so it really helped us from a marketing standpoint, but also, from the back-office and system standpoint. And we want to make absolutely sure that as we move forward, that our back-office systems are keeping up with the marketing systems upfront so that we ensure the financial integrity of the business. And we certainly believe that there's margins to be made out there. And when you look at the DSM activity and the other energy support services that can be provided, those services provide margins as well. So I'm happy with the way that's progressing to really develop a platform for us for the future. That's one of the silver linings in all this. I mean, I think Ohio certainly wants to move the competition. And we're moving the competition. We support that. And we support it because there's an opportunity, a real opportunity here, to grow the business in a different way. And we just need to make sure there's a transition that makes sense for us to get there, and that's what we fully support.

Operator

And next we'll go to the line of Jim von Riesemann from UBS.

Jim von Riesemann

I just have a question on clarification. Nick, did you say earlier that you're affirming your 4% to 6% earnings growth? Or were you affirming your strategy to get to that 4% to 6%?

Nicholas K. Akins

No, we're still affirming our 4% to 6% long-term earnings growth.

Jim von Riesemann

How do you get there if you had to withdraw 2012 guidance?

Nicholas K. Akins

Well, withdrawing -- as far as the guidance is concerned, it really is determinative based upon what the Ohio outcome is so it depends on what base you're starting from. And I think you can still have earnings growth focused on the regulated businesses -- the other regulated businesses, including transmission, distribution, all the operating companies, and also, the additional transmission business. And that's really -- that confirms the growth rates. So that's -- and then, from an Ohio standpoint, you really do have to look at the risk involved where the case is not a normal case. It's something that we're very focused on, and that outcome will be determinative of what that guidance range ultimately lines up being.

Operator

And next, we'll go to the line of Anthony Crowdell from Jefferies.

Anthony C. Crowdell - Jefferies & Company, Inc., Research Division

Just hopefully a quick question. We spent some time in Columbus this week and kind of one of the takeaways of it was when you had another filing of an ESP last week. I think there's 2 other filings on this, capacity preceding. It seems that most of the intervening parties, if not all including the commission, are pretty fatigued dealing with all these ESPs and capacity and everything else. I mean, is this an opportunity for AEP to maybe reach a settlement, maybe the parties, there's some tight budgets there, people don't have the staff. Is this an opportunity maybe for AEP to reach a settlement with interveners regarding ESP and the capacity filing?

Nicholas K. Akins

I just think we've been at this for over 1.5 years, and there's a lot of people who are fatigued about this case. And we would very much like to get this thing over with. I think if you had a recognition of the other parties involved that yes, AEP does have a transition. Yes, AEP does have a unique situation with its pool agreement and with the commitments made on behalf of the customers in PJM. Those are contracts that we need to get out of. And if given that time, there's an opportunity for settlement. But based upon the last scenario we went through with the stipulation, it's pretty apparent, unless there's some dramatic shift in the positions taken by some of these parties, it's going to be very difficult, indeed, to get a settlement of the parties in this case. I think this is going to be a case where the commission is just going to have to balance the interest involved and make a credible decision. And I think that's key because if they do that, then we get our cases filed at FERC again, we get moving along with all the precursors to move to a full competitive environment with robust competitors. And that's a tone -- a positive tone, that could be set for the state. So I think it's important for that to happen. I'm just skeptical whether there can be a settlement of all the parties that's delivered to the commission this time around.

Operator

And next we'll go to the line of Steven Byrd from Morgan Stanley.

Stephen Byrd - Morgan Stanley, Research Division

Just building on the last question. You've laid out a potential timetable for a resolution in Ohio. Just given what you're seeing today, could you talk a bit about just the factors that could impact that timetable and just general comfort with that timetable, given the latest that you're seeing in terms of discussions?

Nicholas K. Akins

I think that, certainly, we're committed to trying to get the case over with, and I think the commission has also said publicly that they're focused on getting this case moved along pretty quickly. The procedural schedule is set so that due process could be given to all the parties. But we also know that there is plenty of information that's already been provided throughout the entire case. So I don't think there's anything new. Anybody's going to turn over. There's no new rock uncovered here. So it could give the ability to move along more quickly. I think that -- I'm actually optimistic that the schedule will stay pretty much intact because there's been plenty of time given for the parties based upon the issues that we've already dealt with. I also believe that if you get a reasonable outcome and the capacity case or a FERC orders in the capacity case, it could bring the parties closer together. And I just think that there are some major milestone precursors there, the capacity rate, in particular, that could have a benefit in terms of bringing the parties together. That's also an opportunity for a quicker solution.

Stephen Byrd - Morgan Stanley, Research Division

And then just following up on a different subject on coal hedging. You have mentioned the you're fully hedged for 2012. Given what we're looking at in terms of the gas [indiscernible] fall. Is there some possibility of potentially being over hedged? And how do you think about flexibilities if you were to need to reduce shipment deliveries that are something where you have to deal with penalty payments? Or is there quite a bit of flexibility here? Can you just talk a little bit to that?

Nicholas K. Akins

Yes, Steven, we have very good relationships with the coal suppliers that we have, and we're working through areas of flexibility that could exist. Also, from a contracting standpoint, we typically have a varied mix of coal supplies, long-term, short-term, that can be managed. The issue that we have is that you have coal that's specific to specific units and some inventories are low, some are higher. And we're looking at the possibility of moving coals around to the various areas to mitigate the impacts of coal stockpile increases in the event natural gas prices stay low. So all of those kinds of options are being considered and looked at and actively pursued.

Stephen Byrd - Morgan Stanley, Research Division

Okay, great. And just where you look at today, is there a potential that the hedge level is above the expected usage for the year? Or do you think -- do you see it sort of essentially balanced?

Nicholas K. Akins

Yes, I think we'll be okay because, obviously, it all hinges on a long hot summer, which is what we usually hope for in this business. But if you have that kind of activity, then we should be fine.

Operator

Next, we'll go to the line of Michael Lapides from Goldman Sachs.

Michael J. Lapides - Goldman Sachs Group Inc., Research Division

A handful of questions. One, we've talked a lot about the capacity case and ESP case. Can you talk about the deferred fuel case? It's a big number, $700 million plus of outstanding deferred fuel balances, I don't remember the exact amount. How are you thinking about both the resolution of that case, whether it's separate from or tied into the capacity and ESP cases? And how you get cash recovering? Meaning, is it securitization? Is it over a long period of time? And also, the impact on the customer bill because that's -- like I said at the beginning, it's a big number.

Nicholas K. Akins

Yes, of course, we'd like to get it securitized, and I think we have to get through the process to make sure we can do that portion of it. You have the reg assets sitting out there, and then you have the secure -- the fuel sitting out there, the fuel deferral. The reg assets appears to be a pretty clear of the path of the fuel issue we have to get through. But Brian, you may have some more details on that?

Brian X. Tierney

Yes, Michael, that's just in Ohio. We have a similar situation in APCO West Virginia where we have nearly $400 million of deferred fuel that we are filing to securitize there. And think we're on a faster track to be able to securitize that close to $400 million than we are in Ohio. In Ohio, the securitization law requires that the fuel case be final and unappealable before you'll be able to securitize. So the amounts that we're looking at in Ohio, we'll probably won't meet that threshold of having final orders until 2013. But we believe we could be there as early as this year in APCO, West Virginia, with that $400 million.

Michael J. Lapides - Goldman Sachs Group Inc., Research Division

And what's the total balance last deferred fuel plus, the capitalized interest on it, on the Ohio side?

Brian X. Tierney

It's about $500 million.

Michael J. Lapides - Goldman Sachs Group Inc., Research Division

Okay. One other question and a little bit unrelated to the fuel balance items. Distribution case. Is that also still separate from -- and how are you kind of thinking about how that also gets resolved? Are you kind of looking at there's going to be some kind of global settlement and all 4 cases in Ohio come together?

Nicholas K. Akins

Yes, the distribution case is pretty well done. So yes, so -- and the ESP case really is -- we still have the DRR and those kinds of activities in there. But as far as the distribution case, it's done.

Operator

And next, we'll go to the line of Steve Fleishman from Bank of America.

Steven I. Fleishman - BofA Merrill Lynch, Research Division

Just on the coal to gas switching data, the -- a follow-up on one of the prior question. Do you see any risk of forced bond of coal? Or you think you have enough flexibility? By the way, you mentioned you don't need to do that?

Nicholas K. Akins

No, we don't have any risk of [indiscernible].

Brian X. Tierney

And then we didn't get there during the depths of the recession and we don't see the problem being as acute as it was then, and so we just don't believe that's even in the cards.

Nicholas K. Akins

Yes. And also keep in mind, I mean, a lot of our contracts are relatively good compared to market and rail rates are obviously good as well. So the coal that's actually running sits pretty well in the marketplace. And as you go up higher in the stack and with the designer coals and so forth, that's where you run into those kinds of issues. So we're flexible in that regard.

Steven I. Fleishman - BofA Merrill Lynch, Research Division

Okay. And I'm also just curious, I realize your western region has, I'm sure, much lower coal-to-gas switching price points. Given that gas has continued to come down, is there a possibility that in the west we see these numbers move much more?

Nicholas K. Akins

I don't -- you could see some movement but typically, you're constrained on coal in the western footprint. The delivery cost of coal in our western footprint is very attractive because it's PRB coal with a good contract, a good rail contract. So those -- it'll be hard for natural gas to compete on a basis with coal in our western footprint. And then from a natural gas perspective, you have older -- many of the gas units are single-stage units with higher heat rates, so you won't see them run as much as you would, like a new combined cycle facility, for example.

Steven I. Fleishman - BofA Merrill Lynch, Research Division

Okay. And then one last question on Ohio. It seems like at this point, the capacity case is going to run and be decided before the ESP. Is that correct?

Nicholas K. Akins

Well, we don't know the answer to that. It very well could be. But it could be part of the ESP. We don't know at this point.

Steven I. Fleishman - BofA Merrill Lynch, Research Division

Okay. So the schedule could get moved out so that they're decided more in line?

Nicholas K. Akins

Yes. And then you've got to look at what FERC doing as well. So that could play a part in the picture, too.

Operator

And next, we'll go to the line of Ali Agha from SunTrust.

Ali Agha - SunTrust Robinson Humphrey, Inc., Research Division

Just wanted to clarify the timeline. I know you've talked on that a number of times on this whole Ohio issue. So one thing we do know is that you have temporary relief on the pricing on the capacity that is there until June 1.

Nicholas K. Akins

Right.

Ali Agha - SunTrust Robinson Humphrey, Inc., Research Division

Now you'd asked to expedite the capacity case and the ESP case. Can you say that, that did not play out, or is that still a possibility? They're still looking at things July 3 and beyond. So from your vantage point, can we just lay out a little bit again the chronology of events as you see this play out in Ohio?

Nicholas K. Akins

Yes, I think you do have a gap there between the end of May when the present capacity rate drops off. And I think -- and you really have to go through the process of what the commission intended to begin with when they put that in place. And our view is, is that, that capacity rate was put in to keep the parties neutral there and dependency of all the -- all these other ESP cases going on. And there have to be, in our opinion, some mechanism put in place, whether we request an extension of the stopgap measure that was put in place or some other methods. So we don't know exactly how that would work out at this point. But certainly, as May rolls around, we see the progress of the case, we'll be making decisions on how we approach that with the commission.

Ali Agha - SunTrust Robinson Humphrey, Inc., Research Division

Okay. And also, to be clear on your position on the capacity, Nick, I mean, last time around you guys were okay with the 2 pricing mechanisms where one was the PJM RTO, the other was the fixed 255. I think you, if I'm not mistaken, have little different positions, whether in the ESP or the capacity case. Where now talking about just a non-PJM pricing-related price. So just to be clear, what is your ideal position on how that capacity should be priced during this transition?

Nicholas K. Akins

I think we have filed the 2-step type approach in the case, and the 140-something-rate was applied to those customers that already said that they would switch through the -- to the November timeframe. And those customers did have already switched based upon that premise would be included, including aggregation. And the 255 was placed there as a discounted rate. It's different, obviously, than the capacity rate that we're after. The capacity case would substantiate the 355 actual cost and we're doing the same thing in PJM. But this is -- the capacity rate, in those cases, are discrete components of a larger case in the ESP. So there's a lot of gives and takes within the entire model of the ESP. So that's where we can go to a 255 and 145 type of application on a tiered approach and it would still make sense in the overall sense with the stabilization charge and those types of things. So that's really the context in which we presented those different capacity rates.

Ali Agha - SunTrust Robinson Humphrey, Inc., Research Division

Okay, got it. And I know there's obviously an ongoing process, but any signals or signs that you can share with us to suggest that the commission's views this time around may be any different from what played out last time around?

Nicholas K. Akins

The only thing I can say is I think we've addressed the hot button points that the commission had expressed earlier. I can't say today where the commission is on the filing that we've made. Only they can do that. But when you think about the low load factor issue, we've addressed that. We've opened some portion up to auction and energy auction, then going to a full auction even earlier than what was originally anticipated. And then also, from the capacity standpoint, I think we've fortified the record to show that switching is occurring at that higher tiered 255 level. So I think we've done the things that we were asked to do. And it's really, like I said, is up to the commission to decide now.

Ali Agha - SunTrust Robinson Humphrey, Inc., Research Division

Fair enough. And last question, also just clarifying your previous statement, so if I'm -- on the EPS outlook. So if I'm clear, what you're saying is, once you've concurrently on the commission that the '12 guidance, you'll come out with a new number. But off that, whatever that number is, regardless of what the outcome is, do you still believe '12 through '15, 4% to 6% EPS growth is doable?

Nicholas K. Akins

Yes.

Operator

And now we'll go to the line of Andy Bischof from MorningStar Financial.

Andrew Bischof - Morningstar Inc., Research Division

In regards to BlueStar, you mentioned you had about 100,000 customers. Can you remind me what the pace was when the acquisition was announced?

Nicholas K. Akins

BlueStar had 22,000 customers, as I remember, and then AEP retail...

Brian X. Tierney

About 40,000.

Nicholas K. Akins

Yes, about 40,000 customers. So they continue to make progress there.

Andrew Bischof - Morningstar Inc., Research Division

Okay. And BlueStar has pretty significant capacity in terms of servicing customers before you have to add out into that back-end capability, correct?

Nicholas K. Akins

Oh, absolutely. That's why we acquired BlueStar. And really, they have some of the best information systems relative to retail operations that we've seen, and we obviously looked at several.

Brian X. Tierney

Andy, they were building that business for a much bigger scale than what they had. And the management team over there, before we ever met them, had a very long view of what they wanted to do with that business. And so they've been very thoughtful on how they put their systems together, how they put infrastructure together. And it was that planning and thoughtfulness that we wanted in the management team, and the benefit of their systems and long-range planning that we got with the benefit of the acquisition.

Charles E. Zebula

Thank you for joining us on today's call. As always, our IR team will be available to answer any questions you may have. Linda, will you please give the replay information?

Operator

Certainly, thank you. Ladies and gentlemen, this conference will be available for replay after 11 a.m. Eastern time today through April 27. You may access the AT&T teleconference replay system at any time by dialing 1 (800) 475-6701 and entering the access code of 243109. International participants dial (320) 365-3844. That does conclude our conference for today. Thank you for your participation and for using AT&T executive teleconference. You may now disconnect.

Executives

Charles E. Zebula - Senior Vice President and Treasurer

Nicholas K. Akins - Chief Executive Officer, President and Director

Brian X. Tierney - Chief Financial Officer and Executive Vice President

Robert P. Powers - Chief Operating Officer and Executive Vice President

David M. Feinberg - Senior Vice President, General Counsel, Secretary, General Counsel of American Electric Power Service Corp, Senior Vice President of American Electric Power Service Corp

Analysts

Greg Gordon - ISI Group Inc., Research Division

Dan Eggers - Crédit Suisse AG, Research Division

Paul T. Ridzon - KeyBanc Capital Markets Inc., Research Division

Jonathan P. Arnold - Deutsche Bank AG, Research Division

Jim von Riesemann

Anthony C. Crowdell - Jefferies & Company, Inc., Research Division

Stephen Byrd - Morgan Stanley, Research Division

Michael J. Lapides - Goldman Sachs Group Inc., Research Division

Steven I. Fleishman - BofA Merrill Lynch, Research Division

Ali Agha - SunTrust Robinson Humphrey, Inc., Research Division

Andrew Bischof - Morningstar Inc., Research Division

To: Joseph Goffman/DC/USEPA/US@EPA[]
From: Megan Ceronsky
Sent: Sat 6/30/2012 7:41:40 AM
Subject: Comments
comments new power plants GHG NSPS (non-technical) 6 25 2012.pdf
Environmental Defense Fund, Supplemental Comments on the Proposed Carbon Pollution Standards for New Sources, June 25, 2012.pdf
SC et al Final Comments (6.25.2012).pdf
EDF, Comments on White Stallion & Las Brisas re NSPS (6.25.2012).pdf

Dear Joe:

Attached please find the comments submitted by EDF and colleagues on the proposed GHG NSPS for power plants. We would welcome any questions you might have.

Attached you will find:

Non-technical comments in support of EPA's historic standards signed by more than 30 other health and environmental groups;
Technical comments developed in collaboration with Sierra Club, NRDC, Earthjustice, Environmental Law and Policy Center, Southern Environmental Law Center, NWF, and Clean Air Council;
Supplemental EDF comments addressing, among other topics, the urgent need to make steep cuts in emissions documented by climate science, the need for EPA to swiftly promulgate emission standards for existing power plants, the legal justification for EPA's historic carbon pollution standards for new power plants, and the need to bring EPA's Social Cost of Carbon estimates in line with current state-of-the-art models and methodologies.
Comments addressing, in detail, the inactive status of the Las Brisas and White Stallion power plants in Texas, providing documentation of why these two plants should not be granted transitional source status and exempted from the proposed carbon pollution standards.

I hope you have a lovely weekend!

Megan

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June 25, 2012

President Barack Obama
The White House
1600 Pennsylvania Avenue
Washington, D.C. 20500

The Honorable Lisa Jackson, Administrator
Environmental Protection Agency
Room 3000, Ariel Rios Building
1200 Pennsylvania Avenue
Washington, D.C. 20460

Attn: Docket ID No. EPA–HQ–OAR–2011–0660. Standards of Performance for Greenhouse Gas Emissions for New Stationary Sources: Electric Utility Generating Units

Dear President Obama and Administrator Jackson:

We, the undersigned groups, on behalf of our millions of members and supporters across the nation, write today to express our strong support for the establishment of protective carbon pollution standards for new power plants issued under the nation's clean air laws. We urge you to finalize these standards as soon as possible and to move swiftly to propose and finalize carbon pollution standards for existing power plants. The carbon pollution standards should ensure that new power plants use the most efficient, lowest-emitting technologies and that emissions from existing power plants are reduced by the amounts that science demands. This goal is achievable because of the availability of cost-effective technologies that are produced in America and create American jobs.

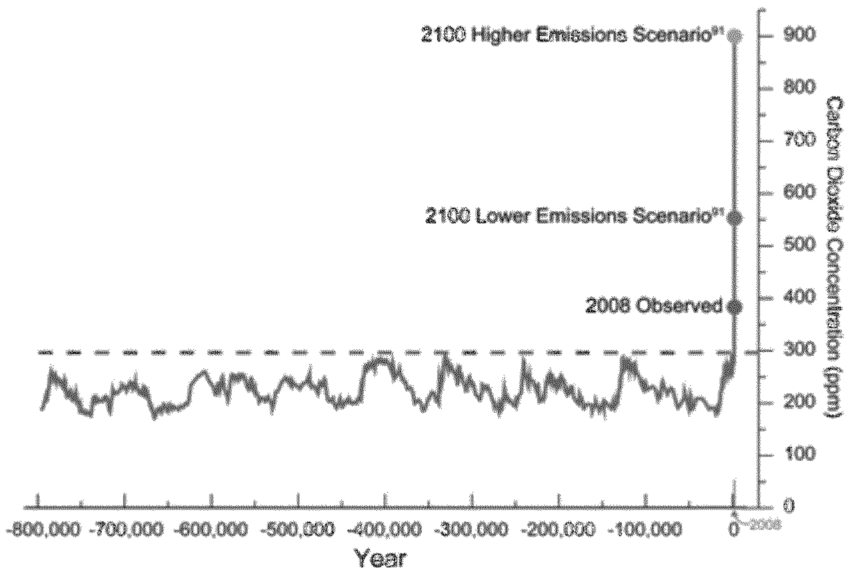
The need to curb climate-destabilizing pollution from power plants is urgent. The new source carbon pollution standards are a vitally important step towards accomplishing this critical task.

In December of 2009 the U.S. Environmental Protection Agency (EPA) concluded—after reviewing a comprehensive and massive body of peer-reviewed scientific research on climate change—that heat-trapping greenhouse gas emissions may reasonably be anticipated to endanger public health and welfare of both current and future generations.[1] Due to human activities—primarily the combustion of fossil fuels and deforestation—the concentration of these gases in the atmosphere is rapidly rising. Atmospheric carbon dioxide (CO_2) levels have increased by approximately 38% since the Industrial Revolution; current atmospheric

[1] *See* Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act, 74 Fed. Reg. 66,496 (Dec. 15, 2009) (to be codified at 40 C.F.R. ch. I).

concentrations of both CO_2 and methane (an even more potent greenhouse gas) are significantly higher than they have been for the last 800,000 years.[2]

800,000 Year Record of Carbon Dioxide Concentration



This chart shows CO_2 concentrations in the atmosphere over the last 800,000 years, based upon analyzing air bubbles trapped in an Antarctic ice core. It also shows that unless we curb greenhouse gas emissions atmospheric CO_2 concentrations will likely double or triple by the end of this century.[3]

The increase in the amount of solar radiation that is trapped in the earth's atmosphere is causing average global temperatures to rise. Global temperature records independently assembled by NOAA, NASA, and the United Kingdom's Hadley Center indicate that global mean surface temperatures have risen by 1.3 ± 0.32°F over the past 100 years (1906-2005), with the greatest warming occurring during the past 30 years.[4]

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[2] *See* U.S. ENVTL. PROT. AGENCY, TECHNICAL SUPPORT DOCUMENT FOR ENDANGERMENT AND CAUSE OR CONTRIBUTE FINDINGS FOR GREENHOUSE GASES UNDER SECTION 202(a) OF THE CLEAN AIR ACT ES-1 to -2 (2009); Kenneth L. Denman et al., *Couplings Between Changes in the Climate System and Biogeochemistry*, *in* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS, at 512 (S. Solomon et al. eds., 2007); Piers Forster et al., *Changes in Atmospheric Constituents and in Radiative Forcing*, *in* CLIMATE CHANGE 2007, *supra*; Eystein Jansen et al., *Paleoclimate*, *in* CLIMATE CHANGE 2007, *supra*; THOMAS R. KARL ET AL., U.S. GLOBAL CHANGE RESEARCH PROGRAM, GLOBAL CLIMATE CHANGE IMPACTS IN THE UNITED STATES (2009).

[3] U.S. GLOBAL CHANGE RESEARCH PROGRAM, *supra* note 2, at 13.

[4] *See* Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act, 74 Fed. Reg. at 66,522; U.S. ENVTL. PROT. AGENCY, *supra* note 2, at ES-2, -28 to -29; Gabriele C. Hegerl, *Understanding and Attributing Climate Change*, *in* CLIMATE CHANGE 2007, *supra* note 2, at 683.

Climate change presents severe risks to the health and well-being of Americans. If carbon pollution is unchecked, the economic and welfare costs of intensifying climate impacts will be profound.

The United States Global Change Research Program has determined that if carbon pollution emissions are **not** reduced it is likely that American communities will experience increasingly severe and costly climate impacts, including:

- Rising levels of dangerous smog in cities—which will lead to an increased risk of respiratory infections, more asthma attacks, and more premature deaths;
- Increased risk of illness and death due to extreme heat;
- More intense hurricanes and storm surges;
- Increased frequency and severity of flooding;
- Increases in insect pests and in the prevalence of diseases transmitted by food, water, and insects;
- Reduced precipitation and runoff in the arid West;
- Reduced crop yields and livestock productivity; and
- More wildfires and increasingly frequent and severe droughts in some regions.[5]

Climate science indicates that it is necessary to make deep cuts in the amount of carbon pollution emitted—which will require major reductions in power sector emissions.

The National Research Council's 2011 report on climate stabilization concurs that steep emission reductions, on the order of 80% globally, are necessary to stop CO_2 concentrations in the atmosphere from reaching dangerous levels.[6] Cutting emissions from the power sector will be a necessary component of these emissions cuts, as the U.S. power sector is responsible for approximately 40% of U.S. carbon emissions[7] and 7% of global greenhouse gas emissions.[8]

America has the resources and the technologies needed to sharply reduce power sector carbon pollution.

The standards should ensure that new power plants use the most efficient, lowest-emitting technology available, and reflect the emission rates achievable by state-of-the-art combined cycle natural gas plants. Standards issued for existing power plants should achieve the pace and scope of emission reductions that science demands and that proven, cost-effective technologies readily enable.

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5 U.S. GLOBAL CHANGE RESEARCH PROGRAM, *supra* note 2, at 8-109.

6 NAT'L RESEARCH COUNCIL, CLIMATE STABILIZATION TARGETS 10 (2011) (excerpt attached as Ex. A). For full report please see: http://www.nap.edu/catalog.php?record_id=12877.

7 U.S. ENVTL. PROT. AGENCY, INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990-2010, at ES-4 tbl.ES-2 (2012).

8 *Environmental Indicators—GHGs*, U.N. STATISTICS DIV., http://unstats.un.org/unsd/environment/air_greenhouse_emissions.htm (last updated July 2010).

Carbon pollution standards for new and existing power plants will further the progress we are making towards a cleaner, more secure, and more independent future for energy in America. These standards can ensure that we will use our nation's electricity resources more efficiently to cut energy costs for American families and businesses, mobilize American innovation, technologies, and fuels for cleaner energy generation, and ensure that America is at the cutting edge of the clean energy economy of the future.

Sincerely,

Citizens for Pennsylvania's Future (PennFuture)
Clean Air Task Force
Clean Water Action
Climate Solutions
Conservation Law Foundation
Earthjustice
Environment America
Environment Northeast
Environmental Defense Fund
Greenpeace USA
Health Care Without Harm
Interfaith Power and Light, The Regeneration Project
League of Conservation Voters
Moms Clean Air Force
National Wildlife Federation
Natural Resources Defense Council
New Jersey Audubon
NW Energy Coalition
Oregon Environmental Council
Physicians for Social Responsibility
Powder River Basin Resource Council
Renewable Northwest Project
Safe Climate Campaign
Sierra Club
Southern Alliance for Clean Energy
The Center for the Celebration of Creation
The Climate Reality Project
US Climate Action Network
Washington Environmental Council
Western Environmental Law Center
Western Resource Advocates
WildEarth Guardians

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June 25, 2011

Via Website and Email
http://www.epa.gov/oar/docket.html
a-and-r-docket@epa.gov, Attn: Docket ID No. EPA-HQ-OAR-2011-0660
EPA Docket Center
U.S. EPA, Mail Code 2822T
1200 Pennsylvania Ave. NW.
Washington, DC 20460

Re: Environmental Protection Agency, Standards of Performance for Greenhouse Gas Emissions for New Stationary Sources: Electric Utility Generating Units
Docket ID No. EPA-HQ-OAR-2011-0660

Environmental Defense Fund, Inc. ("EDF") respectfully offers the following comments on the U.S. Environmental Protection Agency's ("EPA") proposed Standards of Performance for Greenhouse Gas Emissions for New Stationary Sources ("GHG NSPS").[1] EDF submits these comments on behalf of our hundreds of thousands of members nationwide. EDF has participated in this rulemaking proceeding for some time and these comments and all other comments submitted by EDF and its members, alone or jointly with other commenters, should be considered to reflect the comments and views of EDF as part of this proceeding. All documents referred to herein and all Attachments should be incorporated as part of the administrative record of this rulemaking proceeding.

The comments provided below address the following topics:

(I) The Need to Curb Climate-Destabilizing Emissions from Power Plants Is Urgent. The New Source Carbon Pollution Standards Are a Vitally Important Step Towards Accomplishing this Critical Task.

(II) EPA Has Failed to Carry Out Its Legal Responsibilities to Address Greenhouse Gas Emissions from Power Plants Under § 111 of the Clean Air Act.

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[1] 77 Fed. Reg. 22,392 (April 13, 2012).

(III) Both Climate Science and the Clean Air Act Require EPA To Act To Control Carbon Pollution from Existing Power Plants, and Solutions Are Readily Available to Reduce Emissions From These Sources.

(IV) The Determination that Natural Gas Combined Cycle Technology is the Best System of Emission Reduction Was a Proper Exercise of EPA's Authority Under § 111(b).

(V) The Alternate Pathway Provided for Coal Plants Is Consistent with Both the NSPS Program's Technology-Forcing Purpose and Agency Regulatory Practice.

(VI) EPA Is Not Obligated to Make A New Endangerment Finding Once Sources Have Been Listed Under § 111.

(VII) The Social Cost of Carbon Estimate Used in Federal Benefits Analyses Must Be Updated to Reflect Current Science.

(VIII) EPA Should Ensure Future Accessibility of Emission Records.

I. The Need to Curb Climate-Destabilizing Emissions from Power Plants Is Urgent. The New Source Carbon Pollution Standards Are a Vitally Important Step Towards Accomplishing this Critical Task.

In December of 2009 the U.S. Environmental Protection Agency ("EPA") concluded—after reviewing a comprehensive and massive body of peer-reviewed scientific research on climate change—that heat-trapping greenhouse gas emissions may reasonably be anticipated to endanger public health and welfare of both current and future generations.[2] Due to human activities—primarily the combustion of fossil fuels and deforestation—the concentration of these gases in the atmosphere is rapidly rising. Atmospheric carbon dioxide (CO_2) levels have increased by approximately 38% since the Industrial Revolution (see Figure 1); current atmospheric concentrations of both CO_2 and methane (an even more potent greenhouse gas) are significantly higher than they have been for the last 800,000 years.[3]

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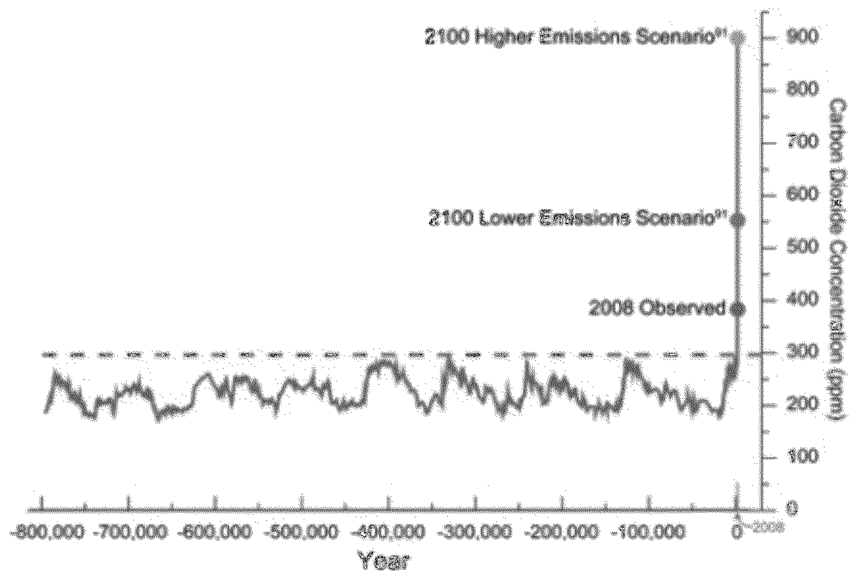
[2] See Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act, 74 Fed. Reg. 66,496 (Dec. 15, 2009) (to be codified at 40 C.F.R. ch. I).

[3] See U.S. Envtl. Prot. Agency, Technical Support Document for Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act ES-1 to -2 (2009) (hereinafter TSD); Intergovernmental Panel on Climate Change, Climate Change 2007: The Physical Science Basis, at 512 (S. Solomon et al. eds., 2007) (hereinafter IPCC 2007); U.S. Global Change Research Program, Global Climate Change Impacts in the United States (2009) (hereinafter USGCRP 2009).

Figure 1. 800,000-Year Record of Carbon Dioxide Concentration



This chart shows CO_2 concentrations in the atmosphere over the last 800,000 years, based upon analyzing air bubbles trapped in an Antarctic ice core. It also shows that unless we curb greenhouse gas emissions, atmospheric CO_2 concentrations will likely double or triple by the end of this century from pre-industrial levels.[4]

The increase in the amount of solar radiation that is trapped in the earth's atmosphere is causing average global temperatures to rise. Global temperature records independently assembled by National Oceanic and Atmospheric Administration, National Aeronautics and Space Administration, and the United Kingdom's Hadley Center indicate that global mean surface temperatures have risen by 1.3 ± 0.32°F over the past 100 years (1906-2005), with the greatest warming occurring during the past 30 years.[5] Climate models can successfully replicate historic climates, but they cannot replicate the observed temperature rise over the past 50 years without incorporating the rising quantities of anthropogenic greenhouse gas emissions.[6] See Figure 2. Further, only models including anthropogenic greenhouse gas emissions can replicate the observed pattern of warming observed in different regions and in different parts of the atmosphere.[7]

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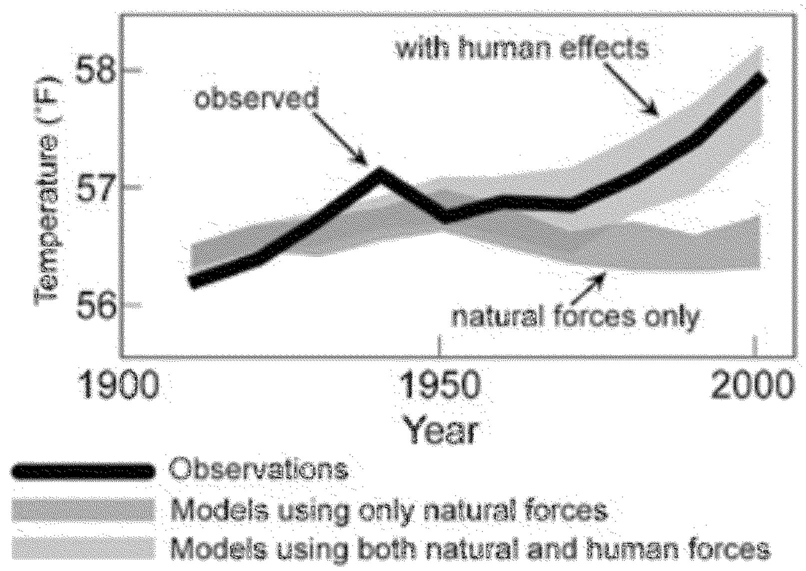
[4] USGCRP 2009 at 2.

[5] See Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act, 74 Fed. Reg. at 66,522; TSD at ES-2, -28 to -29; IPCC 2007 at 683.

[6] USGCRP 2009 at 19, 74 Fed. Reg. at 66518.

[7] IPCC 2007 at 74; Fed. Reg. at 66518.

Figure 2. Separating Human and Natural Influences on Climate



This figure shows that models using only natural forces cannot replicate observed warming – in fact, they would predict a slight cooling. Only models accounting for greenhouse gases can duplicate the observed warming trend.[8]

Rising temperatures are causing thermal expansion of the oceans and accelerated melting of snow and ice, driving the rise in global sea levels observed during the 20th century.[9] In addition, approximately half of anthropogenic greenhouse gas emissions have been absorbed by plants and the oceans.[10] Because carbonic acid forms when CO2 dissolves in water, global average sea surface pH has dropped by approximately .1 pH units since the Industrial Revolution (equivalent to a 30% increase in acidity).[11]

Climate change presents severe risks to the health and well-being of Americans.

Most areas of the United States are likely to warm by 1.8-5.4°F between 2010 and 2039 and by 7-11°F by the end of the century under a high emissions scenario (one assuming business-as-usual emissions) and by 4-6.5°F under a lower emissions scenario (assuming reductions in emission rates).[12] This increase in average temperatures is expected to have wide-ranging impacts. Rising temperatures will increase emissions of volatile organic compounds from plants

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[8] USGCRP 2009 at 20.
[9] 74 Fed. Reg. at 66518.
[10] TSD at 17.
[11] IPCC 2007 at 750; 74 Fed. Reg. at 66518.
[12] Intergovernmental Panel on Climate Change, Climate Change 2007: Impacts, Adaptation and Vulnerability at 626 (M. L. Parry et al. eds., 2007); USGCRP 2009 at 29; TSD at 69.

and soils (precursors of smog), accelerate ozone (and smog) formation, and increase the frequency and duration of stagnant air masses that allow pollution to accumulate. (TSD at 89-93, USGCRP 2009 at 93-94) Higher ozone levels exacerbate respiratory illnesses, increasing asthma attacks and hospitalizations and increasing the risk of premature death.[13]

Rising temperatures will also result in heat waves that are hotter, longer, and more frequent.[14] Under high emission scenarios, extreme heat waves that currently occur once every twenty years are expected to occur at least every other year in much of the country by the end of the century, with the hottest days approximately 10°F hotter than they are today.[15] The sick and elderly are particularly vulnerable to such impacts. In Los Angeles, annual heat-related deaths are projected to double or triple under a low emissions scenario and to increase by five to seven times under a higher emissions scenario, assuming acclimatization to higher temperatures.[16]

Rising temperatures will reduce snowpack and accelerate snow melt, threatening water supplies in late summer in the West.[17] In addition, significant reductions in winter and spring precipitation are projected for the South, especially in the Southwest, further imperiling water supplies.[18] Rising temperatures will likely increase the length and severity of droughts, especially in the American West.[19] Precipitation events in general and some types of storms, particularly hurricanes, are expected to become more intense, increasing the likelihood of severe flooding.[20]

Droughts are expected to be more frequent, and the extent of drought-limited ecosystems is projected to increase by 11% for every degree C of warming in the United States.[21] This is expected to exacerbate the water scarcity already affecting regions of the United States.[22]

Water shortages and heavy precipitation events are likely to further stress flood control, drinking water, and wastewater infrastructure.[23]

Global sea levels are likely to rise between seven inches and four feet during the 21st century, both because of ice sheet melting and because seawater expands as it warms.[24] This amount of sea level rise, in combination with more powerful hurricanes, will increase the risks of erosion,

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[13] Environmental Protection Agency, Regulatory Impact Analysis for the Proposed Standards of Performance for Greenhouse Gas Emissions for New Stationary Sources: Electric Generating Units (March 2012) at 3-2 -3-3, 5-24 (hereinafter RIA).
[14] IPCC 2007 at 750; 74 Fed. Reg. at 66524-25)
[15] USGCRP 2009 at 33-34.
[16] USGCRP 2009 at 90-92.
[17] USGCRP 2009 at 10, 45-46.
[18] USGCRP 2009 at 30; 74 Fed. Reg. at 66,532.
[19] USGCRP 2009 at 30, 41-46; IPCC 2007 at 262-263, 783; 74 Fed. Reg. at 66,532-34.
[20] USGCRP 2009 at 34-36, 44, 64; TSD at ES-4, 115; AR4, IPCC 2007 at 783; 74 Fed. Reg. at 66,525.
[21] RIA at 3-5, 3-8.
[22] RIA at 3-5.
[23] USGCRP 2009 at 47-51, 132-36; 74 Fed. Reg. at 66,532-33.
[24] USGCRP 2009 at 37, 150; AR4, IPCC 2007 at 750.

storm surge damage, and flooding for coastal communities, especially along the Atlantic and Gulf coasts, Pacific Islands, and parts of Alaska.[25] Under a higher emission scenario, what is currently a once-a-century flood in New York City is projected to be twice as common by mid-century and 10 times as frequent by the end of the century.[26] With accelerated sea level rise, portions of major coastal cities, including New York and Boston, would be subject to inundation during storm surges or even during regular high tides.[27] In the Gulf Coast area, an estimated 2,400 miles of major roadways are at risk of permanent flooding within 50 to 100 years due to anticipated sea level rise in the range of 4 feet.[28]

The RIA reports, based on findings of the National Research Council, that ocean acidity has increased "25 percent since pre-industrial times, and is projected to continue increasing."[29] If atmospheric carbon dioxide doubles, oceanic acidity will also increase, leaving almost nowhere in the ocean where coral reefs can survive and threatening the ocean's food webs, which rely upon coral reefs as fish nurseries and planktonic animals that may be unable to survive a more acidic sea.[30] The loss of healthy ocean ecosystems would have devastating effects on the global food supply.

In addition, the more temperatures rise, the greater the risk that non-linear climate thresholds could be reached, generating abrupt changes with potentially catastrophic impacts for natural systems and human societies.[31] Such thresholds include rapid ice sheet disintegration with related acceleration of sea level rise, abrupt shifts in drought frequency and duration, severe acidification-related impacts on marine ecosystems, and runaway warming due to the release of methane from thawing permafrost and methane hydrates in oceanic sediments.[32]

The need to act to mitigate these harms is truly urgent.

II. EPA Has Failed to Carry Out Its Legal Responsibilities to Address Greenhouse Gas Emissions from Power Plants Under § 111 of the Clean Air Act.

In 2005, Environmental Defense Fund asked EPA to carry out its responsibilities under the Clean Air Act to address the climate destabilizing greenhouse gas emissions associated with electric generating units. See April 2005 Comments of Environmental Defense Fund et al re

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[25] USGCRP 2009 at 12, 36, 109-10, 142-43, 149-50.
[26] USGCRP 2009 at 109-10.
[27] USGCRP 2009 at 150.
[28] USGCRP 2009 at 62.
[29] RIA at 3-9.
[30] RIA at 3-7, 3-9 – 3-10; National Research Council, Advancing the Science of Climate Change at 55-56, 59-60 (2010), available at http://www.nap.edu/openbook.php?record_id=12782.
[31] USGCRP 2009 at 26; National Research Council, Abrupt Climate Change, Inevitable Surprises at v, 16, 154 (2002); US Climate Change Science Program, Abrupt Climate Change at 10 (2008); TSD at 66.
[32] USGCRP 2009 at 26, 155 (JA 5349, 5478); TSD 75-78, 134, 137-38 (JA 3423-26, 3482, 3485-86).

"Standards of Performance for Electric Utility Steam Generating Units for Which Construction Is Commenced After September 18, 1978; Standards of Performance for Industrial-Commercial-Institutional Steam Generating Units; and Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units." 70 Fed. Reg. 9706 (Feb. 28, 2005).

Since that time, the power sector has discharged over 10 billion tons of climate-disruptive greenhouse gases. And since 2005, over seven years ago, EPA has neither finalized a standard for new EGUs nor taken any action to address the vast volume of emissions from existing plants. EPA's failure to act is manifestly contrary to law.

EPA is required to establish standards of performance addressing the GHGs from new and existing EGUs under section 111(b), (d) of the Clean Air Act. EDF filed a petition for judicial review in the U.S. Court of Appeals for the D.C. Circuit when EPA refused to establish such emission standards in response to our 2005 comments. The court held the briefing on this claim in abeyance when the U.S. Supreme Court granted review in Massachusetts v. EPA.

On April 2, 2007 the Supreme Court held that greenhouse gases were air pollutants within the capacious definition of that term under the Clean Air Act and directed EPA to carry out its responsibility under section 202 of the Clean Air Act to determine whether greenhouse gases endanger human health and welfare on the basis of science. In September 2007, the D.C. Circuit remanded the case challenging EPA's flawed NSPS for EGUs in light of the Supreme Court's ruling in Massachusetts v. EPA, 549 U.S. 497 (2007). See New York v. EPA (D.C. Cir. 06-1322) (order of Sept. 24, 2007).

EPA has a clear and plain responsibility to take action under the law. As a threshold matter, the Clean Air Act commands EPA to publish a list of each category of stationary source that "causes, or contributes significantly to, air pollution which may reasonably be anticipated to endanger public health or welfare." 111(b)(1)(A); see also id. § 111(a)(3) (defining "stationary source"). All of the predicates for EPA to carry out its long overdue rulemaking responsibilities under section 111 are complete. EPA has issued its finding that six greenhouse gases endanger human health and the environment. See 74 Fed. Reg. 66,496 (Dec. 15, 2009); see also 75 Fed. Reg. 49,556 (Aug. 13, 2010) (denying reconsideration petitions). Demonstrated technologies can significantly reduce greenhouse gas emissions from power plants. Indeed, the legal and policy framework for EPA action has long been explicated. See, e.g., CRS, Climate Change: Potential Regulation of Stationary Source Greenhouse Gas Sources Under the Clean Air Act (May 14, 2009).

But EPA has failed to carry out its responsibilities leaving public health and the environment imperiled. Once EPA has listed a source category, the Agency must promulgate federal standards of performance to regulate emissions from new, modified and reconstructed sources in that category. Section 111(b)(1)(B); see also 111(a)(2) (defining "new source"); 111(a)(4) (defining "modification"); 40 C.F.R. § 60.15(b) (defining "reconstruction"). Such standards are commonly referred to as "new source performance standards" or "NSPS."

By definition, an NSPS is

> a standard for emissions of air pollutants which reflects the degree of emission limitation achievable through the application of the best system of emission reduction which (taking into account the cost of achieving such reduction and any nonair quality health and environmental impact and energy requirements) the Administrator determines has been adequately demonstrated.

Section 111(a)(1).

Section 111(b)(1)(B) explicitly requires that EPA complete a timely review and revision of the NSPS, mandating that "[t]he Administrator shall, at least every 8 years, review and, if appropriate, revise such standards following the procedure required by this subsection for promulgation of such standards." 111(b)(1)(B). This provision further mandates that the 8-year review is required unless "the Administrator determines that such review is not appropriate in light of readily available information on the efficacy of such standard." Id. Similarly, the Administrator must revise the standard "at least every 8 years" unless she promulgates a determination that such a revision is not "appropriate" under the Clean Air Act. Id.

For existing sources, section 111(d) of the Clean Air Act, 42 U.S.C. § 7411(d), requires that the Administrator ensure the promulgation of standards that are based on the new source performance standards. Id. § 7411(d)(1). The procedure that EPA has promulgated for this purpose starts with the required promulgation of federal "emission guidelines" ("EG") for existing sources. See 40 C.F.R. §§ 60.21(e), 60.22; see also 40 C.F.R. §§ 60.20-60.29 (describing overall procedure for existing sources). Specifically, the section 111(d) procedure mandates that:

> Concurrently upon or after proposal of standards of performance for the control of a designated pollutant from affected facilities, the Administrator will publish a draft guideline document containing information pertinent to control of the designated pollutant form [sic] designated facilities. . . . After consideration of public comments and upon or after promulgation of standards of performance for control of a designated pollutant from affected facilities, a final guideline document will be published and notice of its availability will be published in the Federal Register.

Id. § 60.22(a) (emphasis added).

These required emission guidelines for existing sources, like NSPS, must reflect the best demonstrated technology. See id. § 60.22(b)(5); id. § 60.21(e). After EPA establishes these required emission guidelines for existing sources under 40 C.F.R. § 60.22, each State must implement and enforce EPA's guidelines, by submitting a plan that includes standards to control emissions from these sources that are "no less stringent" than the federal emission guidelines. Id. §§ 60.23(a), 60.24(c); see also id. § 60.27.

While EPA has failed to complete its delegated rulemaking responsibilities, the U.S. has represented to the U.S. Supreme Court that EPA is taking action to address greenhouse gases from the power sector. In nuisance claims maintained by a coalition of states against the nation's largest power companies under the federal common law, the U.S. Government expressly pointed to its Settlement Agreement over its failure to address power plant greenhouse gases and represented to the U.S. Supreme Court that EPA was carrying out the Clean Air Act in a way that "speak[s] directly" to the particular claims in question – the regulation of greenhouse gases from power plants – and the common law nuisance claims were thereby displaced:

> In another significant step indicating EPA's active engagement in the process of determining how and when greenhouse-gas emissions will be regulated, EPA announced on December 23, 2010 that it had entered into a proposed settlement agreement in an earlier case about whether the new source perform ance standards (NSPS) for utility boilers (i.e., power plants like defendants') should include st andards for greenhouse-gas emissions.24 That proposed settlement (which was subject to a 30-day public-comment period that expired on January 31, 2011, see 75 Fed. Reg. at 82,392) would commit EPA to complete a NSPS rulemaking under Section 111 of the CAA (42 U.S.C. 7411). If the settlement is adopted by EPA, the purpose of the ensuing rulemaking would be to consider standards applicable to new and modified facilities; it would simultaneously consider standards under which States would be required (under 42 U.S.C. 7411(d)) to impose regulatory limitations on emissions from existing facilities. See p. 4, supra. Under the settlement, EPA would issue a proposed rule by July 26, 2011 and promulgate final regulations by May 26, 2012. 25. Thus, if the settlement is formally adopted, EPA will have established a precise time line for deciding whether and to what extent emissions standards under the CAA will apply to the very carbon-dioxide emissions at issue in this case.
>
> 3. As the foregoing discussion demonstrates, EPA now regulates greenhouse-gas emissions under the currently existing statutory scheme of the CAA, and it may soon be specifically committed to completing a rulemaking to address greenhouse-gas-emissions standards applicable to defendants' already-existing power plants, even if they are not modified. Thus, it is abundantly clear that the CAA, as it is now being implemented by EPA, "speak[s] directly" (Milwaukee II, 451 U.S. at 315 (quoting Mobil Oil, 436 U.S. at 625)) to the particular issue presented by plaintiffs' federal common-law nuisance claims about climate change: regulation of greenhouse-gas emissions, and in particular emissions from stationary sources (like defendants' power plants). The conclusion that EPA's actions have displaced any common-law emissions standards is unaffected by EPA's decision to adopt an incremental approach that will not necessarily lead to standards specifically governing greenhouse-gas emissions from defendants' already existing power plants (unless they are modified and thus require a PSD permit under the new regulations), at least until some time after May 26, 2012. In Middlesex County Sewerage Authority, the Court held that the Marine Protection, Research, and Sanctuaries Act of 1972 displaced federal common law immediately and entirely, even though "Congress allowed some continued dumping of sludge" for nine years after the statute was enacted based on its "considered judgment that it made sense to allow entities like petitioners to adjust to the coming change." 453 U.S. at 22 n.32; see also Massachusetts v. EPA, 549 U.S. at 533 (recognizing that EPA possesses "significant

latitude as to the manner, timing, content, and coordination of its regulations"); id. at 524 ("Agencies, like legislatures, do not generally resolve massive problems in one fell regulatory swoop. They instead whittle away at them over time, refining their preferred approach as circumstances change and as they develop a more nuanced understanding of how best to proceed.").

Although EPA has not yet done precisely what plaintiffs demand here (i.e., cap defendants' carbon-dioxide emissions and require them to be reduced annually for at least a decade, J.A. 110, 153), that is not the relevant test. As this Court has stated: "Demanding specific regulations of general applicability before concluding that Congress has addressed the problem to the exclusion of federal common law asks the wrong question. The question is whether the field has been occupied, not whether it has been occupied in a particular manner." Milwaukee II, 451 U.S. at 324; see also id. at 323 ("Although a federal court may disagree with the regulatory approach taken by the agency with responsibility forissuing permits under the Act, such disagreement alone is no basis for the creation of federal common law."); Illinois v. Outboard Marine Corp., 680 F.2d 473, 478 (7th Cir. 1982) (refusing "to find that Congress has not 'addressed the question' because it has not enacted a remedy against polluters," because that "would be no different from holding that the solution Congress chose is not adequate," and "Milwaukee II * * * precludes the courts from scrutinizing the sufficiency of the congressional solution").

Because EPA's regulatory activities speak directly to the issue of greenhouse-gas emissions, any common-law claims seeking to reduce such emissions have been displaced.

Brief of U.S. Government Brief in AEP v. Connecticut (No. 10-174) at ps. 50-53.

While EPA's mandatory responsibilities to act in addressing new and existing sources under section 111 are manifest and the U.S. Government has pointed to its commitment to act in addressing emissions from the power sector, including existing power plants, as the basis for the U.S. Supreme Court to displace federal common law of nuisance claims, no final standards have been adopted. Moreover, EPA has failed to take any regulatory action at all to address the massive emissions from existing sources. EPA's failure to act contravenes its manifest responsibilities under the law. See, e.g., 42 U.S.C. §7604; 40 CFR part 54; see also Telecomms. Research & Action Center v. FCC, 750 F.2d 70 (D.C. Cir. 1984).

III. Both Climate Science and the Clean Air Act R equire EPA to Act to Control Carbon Pollution from Existing Power Plants, and Solutions Are Readily Available to Reduce Emissions From These Sources.

If promptly finalized the proposed carbon pollution standards for new power plants will help ensure that new American power generation infrastructure is cleaner, more efficient, and less damaging to human health and well-being. Such standards are, however, insufficient to satisfy EPA's legal obligation under the Clean Air Act to control dangerous pollution from existing sources, and incapable of cutting power sector emissions by the amounts demanded by the rigorous science documenting the severe risks posed by climate change to Americans and American communities.

CO_2 emissions from existing power plants are the single largest source of U.S. emissions and are a significant component of global emissions. The EPA's Inventory of Greenhouse Gas Emissions and Sinks reports that electrical generation was responsible for 2,258 million metric tons of CO_2 in 2010 (the most recent year of the inventory), which is 39% of annual U.S. CO_2 emissions.[33] Globally, U.S. power sector emissions constitute approximately 5% of emissions from all anthropogenic sources.[34] It is urgent that we act to reduce greenhouse gas emissions and prevent atmospheric concentrations of these heat-trapping gases from reaching levels that could destabilize our climate with catastrophic impacts for humans and our environment.[35] Dramatically reducing emissions from dominant pollution sources such as the power sector is therefore a necessary component of climate mitigation.

Section 111(d) is well suited to achieving GHG emission reductions from existing sources. Section 111(d) establishes a collaborative, iterative process through which EPA and the States can identify emission reduction opportunities at existing fossil fuel fired power plants and design tailored programs to achieve the required level of reductions. Under § 111(d), EPA will issue Emission Guidelines that identify the best system or systems of emission reduction that have been adequately demonstrated, and establish minimum levels of emission reductions that must be achieved by State plans. The States, however, have considerable flexibility in determining how to achieve the emission reductions identified in the Emission Guidelines. EPA will approve State plans that achieve emission reductions that are equivalent to the emission reductions required in the Emission Guidelines.

There is a wealth of opportunities available to cost-effectively reduce climate-destabilizing emissions from existing power plants. We urge EPA to look broadly across the electric sector in identifying opportunities for emission reductions. Individual plants can reduce their emissions by improving their efficiency, which will allow them to generate more power with less fuel and lower fuel costs. Mobilizing the nation's vast resources of energy efficiency offers the potential to cut not only carbon pollution but also harmful co-pollutant emissions while lowering utility bills for American families and businesses, creating jobs, stimulating local economies via re-channeled energy bill savings, improving energy security, and enhancing grid reliability. Deploying renewable energy and supply-side energy efficiency solutions such as combined heat and power to meet energy demand both have tremendous potential to reduce emissions from fossil fuel fired plants. We can also shift our utilization of fossil-fuel-fired plants to use our cleaner plants more and our dirtier plants less.

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[33] U.S. EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2010 (2012) at Table ES-2.
[34] According to the EDGAR database, global emissions in 2008 were 46,917 million metric tons CO_2e.
[35] National Research Council, Climate Stabilization Targets (2011) at 10.

Marshalling demand-side energy efficiency to secure emission reductions offers a win-win-win solution. A McKinsey analysis of the national economic potential for demand side energy efficiency, for example, indicates that energy efficiency improvements could reduce energy demand by more than 2% each year.[36] Achieving just 70% of the economic energy efficiency potential identified by the McKinsey 2009 analysis would reduce power sector emissions to 10% below 2011 levels by 2020—without considering the emission reduction potential of adding renewables, shifting utilization, or onsite efficiency improvements at power plants. Vermont is already achieving a 2% annual reduction in energy demand through its energy efficiency program.[37] Four states (including Vermont) have binding annual energy savings targets of 2% or above in existing policies: Massachusetts (2.4%), Vermont (2.25%), Arizona (2.2%), and Rhode Island (2.0%). An additional four states have binding annual energy savings targets of 1% or above: New York (1.9%), Minnesota (1.5%), Hawaii (1.5%), and California (1.0%).[38] Demonstrating the potential for reducing emissions via demand side energy efficiency alone will go far towards demonstrating the eminent achievability of significant power section emission reductions in the near term.

Reducing electricity demand via energy efficiency and demand side management – with available technologies – has been demonstrated to be one of the most cost-effective means of reducing GHG emissions from the power sector.[39] The McKinsey 2009 study found that after

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[36] McKinsey, Unlocking Energy Efficiency in the U.S. Economy (2009), available at: http://www.mckinsey.com/Client_Service/Electric_Power_and_Natural_Gas/Latest_thinking/Unlocking_energy_efficiency_in_the_US_economy.aspx. EPRI's 2009 analysis of the economic potential for demand-side energy efficiency, though more limited in scope than McKinsey's, found that the interventions to capture the economic energy efficiency potential could generate a .9% reduction in energy demand per annum—eliminating projected demand growth. EPRI, Assessment of Achievable Potential from Energy Efficiency and Demand Response Programs in the U.S. (2010-2030) (2009), available at: http://www.edisonfoundation.net/iee/reports/EPRI_AssessmentAchievableEEPotential0109.pdf.

[37] Efficiency Vermont, Year 2010 Savings Claim (April 1, 2011) at 3, available at: www.efficiencyvermont.com. Energy efficiency programs in Nevada, Hawaii, Rhode Island, Minnesota, and Vermont all achieved energy demand reductions equivalent to 1% or more of electricity sales in 2009. American Council for an Energy-Efficiency Economy, 2011 State Scorecard (2011) at 17, available at: http://www.aceee.org/research-report/e115.

[38] American Council for an Energy-Efficiency Economy, 2011 State Scorecard (2011) at 21-22, available at: http://www.aceee.org/research-report/e115.

[39] "RGGI investment in energy efficiency depresses regional electrical demand, power prices, and consumer payments for electricity. This benefits all consumers through downward pressure on wholesale prices, yet it particularly benefits those consumers who actually take advantage of such programs, implement energy efficiency measures, and lower both their overall energy use and monthly energy bills. These savings stay in the pocket of electricity users. But positive macroeconomic impacts exist as well: the lower energy costs flow through the economy as collateral reductions in natural gas and oil consumption in buildings and increased consumer disposable income (from fewer dollars spent on energy bills), lower payments to out-of-state energy suppliers, and increased local spending or savings. Consequently, there are multiple ways that investments in energy efficiency lead to positive economic impacts; this reinvestment thus stands out as the most

taking into account the upfront costs of installing efficiency improvements, the efficiency measures they identified would save American families and businesses $500 billion over ten years.[40] In addition, the study estimated that it would require 600,000-900,000 workers during the duration of the 10-year period to develop, produce, and implement the efficiency improvements, administer the programs, and verify the results.[41]

EPA can and must act to curb climate-destabilizing emissions from existing power plants, and can do so in a way that will stimulate the economy, reduce harmful air pollution, and lower utility bills for American families and businesses.

IV. The Determination that Natural Gas Combined Cyc le Technology is the Best System of Emission Reduction Was a Proper Exercise of EPA's Authority Under § 111(b).

A. The NSPS Program Is Intended to Be Technology Forcing to Reduce Emissions from High-Emitting Sectors.

1. Congress Established and the Courts Have Affirmed the NSPS as a Program Intended to Drive Innovation to Reduce Emissions.

Congress created the NSPS program in order to drive down emissions of dangerous air pollutants from major sources of pollution, and designed it to be technology-forcing in systems of emission reduction. The Senate Committee Report issued prior to passage of the Clean Air Act in 1970 stated that "[s]tandards of performance should provide an incentive for industries to work toward constant improvement in techniques for preventing and controlling emissions from stationary sources."[42] The Senate Report also clarified that an emerging control technology used as the basis for standards of performance need not "be in actual routine use somewhere."[43]

Long-established case law confirms that NSPS is intended to be a technology-forcing regulatory mechanism to drive reductions in emissions from major pollution-generating sectors. See Sierra Club v. Costle, 657 F.2d 298, 364 (D.C. Cir. 1981) ("[W]e believe EPA does have authority to hold the industry to a standard of improved design and operational advances, so long as there is substantial evidence that such improvements are feasible."); Portland Cement Association v. Ruckelshaus, 486 F.2d 375, 391 (D.C. Cir. 1973) (The court "reject[ed] the suggestion of the cement manufacturers that the [Clean Air] Act's requirement that emission limitations be 'adequately demonstrated' necessarily implies that any cement plant now in existence be able to

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economically beneficial use of RGGI dollars." The Analysis Group, The Economic Impacts of the Regional Greenhouse Gas Initiative on Ten Northeast and Mid-Atlantic States (Nov. 15, 2011) at 7, available at: http://www.analysisgroup.com/uploadedFiles/Publishing/Articles/Economic_Impact_RGGI_Report.pdf.

[40] McKinsey, Unlocking Energy Efficiency in the U.S. Economy at 14.

[41] Id. at 99.

[42] S. Rep. No. 91-1196, at 17 (1970).

[43] Id. at 16.

meet the proposed standards."). The D.C. Circuit has explained that as EPA fulfills its innovation-forcing mandate, the Agency should be forward-looking when determining what systems of emission reduction are available: "Section 111 looks toward what may fairly be projected for the regulated future, rather than the state of the art at present."[44]

2. New Source Performance Standards Have Played Key Technology-Forcing Roles in the Past.

The Congressional Research Service (CRS) documented the technology-forcing function that NSPS have played in its report on the potential regulation of GHG sources under the Clean Air Act. The report notes that the flexibility inherent in the Administrator's authority to determine which technologies have been adequately demonstrated "has been used to authorize control regimes that extended beyond the merely commercially available to those technologies that have only been demonstrated, and thus are considered by many to have been 'technology-forcing.'"[45]

The CRS report focuses on the 1971 and the 1978 NSPS for sulfur dioxide (SO_2) emitted by coal-fired electric generating units as a prime example of the Agency incentivizing technology development and thereby facilitating ambitious emission reductions through NSPS. The 1971 NSPS required a 70% reduction in new power plant SO_2 emissions, on average, and could be met initially only by burning low-sulfur coal or by using an emergent technology known as flue gas desulfurization (FGD). When the 1971 utility SO_2 NSPS was promulgated, there was only one FGD vendor and only three FGD units in operation. The 1979 NSPS retained the 1971 emission standard but also required a 70-90% reduction in combustion emissions, depending upon the sulfur content of the coal. This requirement could then be met only by using an FGD device.

A history of the development of FGD devices (cited in the CRS report) further illustrates how much the SO_2 NSPS motivated the development of this technology:

> The Standards of Performance for New Sources are technology-forcing, and for the utility industry they forced the development of a technology that had never been installed on facilities the size of utility plants. That technology had to be developed, and a number of installations completed in a short period of time. The US EPA continued to force technology through the promulgation of successive regulations. The development of this equipment was not an easy process.
>
> . . .
>
> Chemical and mechanical engineers had never dealt with the challenges they faced in developing FGD systems for utility plants during this period. Chemical engineers had never designed process equipment as large as was required, nor had they dealt with the complex chemistry that occurred in the early FGD

[44] Id.

[45] Larry Parker & James E. McCarthy, Cong. Research Serv., R40585, Climate Change: Potential Regulation of Stationary Greenhouse Gas Sources Under the Clean Air Act 12 (2009).

> systems. Mechanical engineers were faced with similar challenges. While they had designed equipment for either acid service or slurry service, they typically had not designed for a combination of the two. Generally, equipment was larger than what they normally dealt with in chemical plants and refineries.
>
> It is an understatement to say that the new source performance standards promulgated by the EPA were technology-forcing. Electric utilities went from having no scrubbers on their generating units to incorporating very complex chemical processes. Chemical plants and refineries had scrubbing systems that were a few feet in diameter, but not the 30- to 40-foot diameters required by the utility industry. Utilities had dealt with hot flue gases but not with saturated flue gases that contained all sorts of contaminants. Industry, and the US EPA, has always looked upon new source performance standards as technology-forcing, because they force the development of new technologies in order to satisfy emission requirements.[46]

As can be seen in Figure 3, analysis of patenting activity further demonstrates the dramatic rise in control technology innovation in the U.S. that followed the 1971 SO_2 NSPS promulgation.[47]

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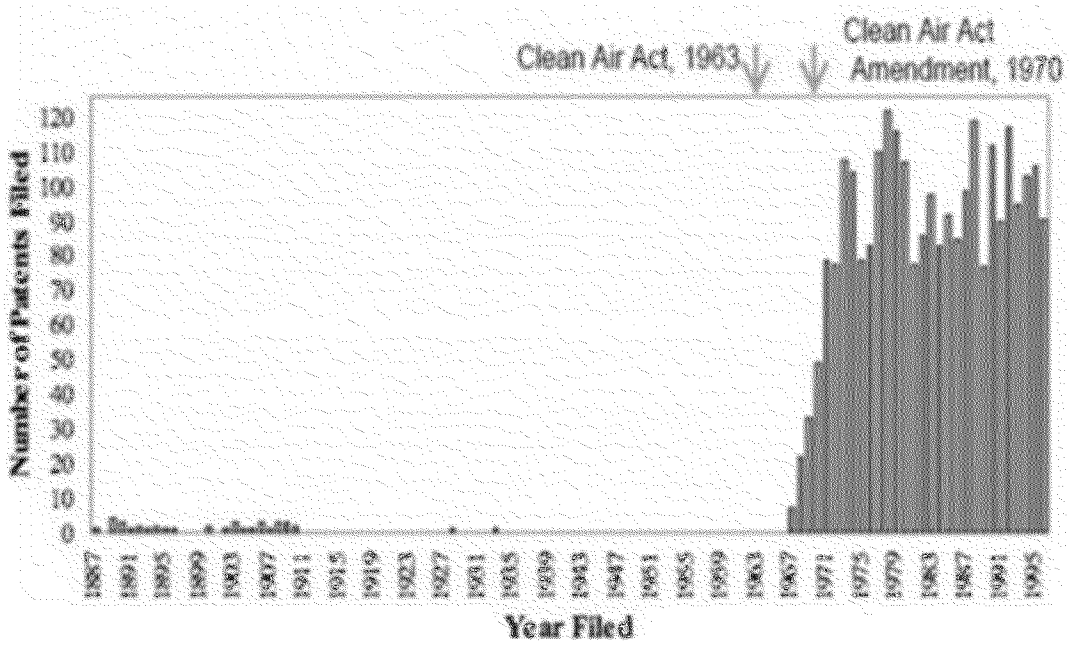
[46] Donald Shattuck et al., A History of Flue Gas Desulfurization (FGD) – The Early Years at 15, 3.
[47] M. Taylor, The Influence of Government Actions on Innovative Activities in the Development of Environmental Technologies to Control Sulfur Dioxide Emissions from Stationary Sources 211-12 (Jan. 2001) (unpublished Ph.D. thesis, Carnegie Mellow University) [hereinafter Taylor Ph.D.] (on file with author); see also ICF Consulting, The Clean Air Act Amendments: Spurring Innovation and Growth While Cleaning the Air 106-08, 118-20, 211-12 (2005).

Figure 3: U.S. Patents Relevant to SO_2 Control Technology as Identified with the Patent Subclass Method[48]



Thanks to these technology advances, when Germany subsequently implemented a program to control acid rain, 33% of the FGD systems installed were licensed from U.S. companies.[49] Researchers of this and similar regulatory initiatives have observed that stringent regulation is required to stimulate significant innovation in control technologies; neither weak regulation nor legislation supporting control technology research have this effect.[50]

The 1979 NSPS is a compelling example of both the flexibility of the Agency's authority under Section 111 and the efficacy of innovation-focused standards in incentivizing technology development.

B. Congress Expanded EPA's Consideration of Solutions, Including Consideration of Cleaner Fuels and Combustion Methods, to Achieve the Protective Emission Standard Reflected in the "Best System of Emission Reduction"

1. Congressional Changes to the NSPS Statutory Provisions Have Authorized Expansive Flexibility to Achieve Rigorous Performance Standards.

In 1990, Congress redefined "standard of performance" to provide expansive flexibility in designing and meeting rigorous performance standards. The 1990 amendments eliminated two requirements from the NSPS provisions (both added via the 1977 amendments): (1) that the

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[48] Id. at 107.
[49] Id. at 56, 131.
[50] See id. at 220; M. Taylor et al., Control of SO2 Emissions from Power Plants: A Case of Induced Technological Innovation in the U.S., 72 Technological Forecasting & Soc. Change 697 (2005).

NSPS be based on a "technological" system of emission reduction and (2) that combustion emissions from "fossil fuel fired stationary sources" be reduced by a set percentage. The 1977 amendments had precluded satisfying the NSPS by simply burning a relatively cleaner fuel (low-sulfur coal).

Throughout the existence of the NSPS program, Congress's statutory mandate has required the Agency to establish strong, protective emission standards based on the best system of emission reduction that could be utilized. The 1990 amendments, however, made statutory adjustments conferring expansive discretion on EPA in considering the solutions that could be deployed to achieve emission reductions – allowing that solution set to go beyond technologies, and to include use of cleaner fuels.[51] The House Committee Report articulated "the effect of the new standard" as "giv[ing] units the flexibility to meet the emission rates established under the new standards through whatever combination of fuels and emission controls the units choose."[52] EPA's proposed establishment of a fuel-neutral "standard of performance" based on the best available clean burning fossil fuels and more efficient combustion methods, such as efficient combined cycle natural gas turbines, together with an alternative compliance pathway for coal-fired EGUs, is thoroughly consonant with these statutory adjustments to EPA's delegated rulemaking authority.[53]

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[51] EPA has previously relied on a particular type of fuel as a means by which a source (gas turbines in Subpart GG of 40 C.F.R. Part 60) can meet the NSPS for sulfur dioxide emissions. See Standards of Performance for New Stationary Sources: Gas Turbines, 44 Fed. Reg. 52,792, 52,800 (Sept. 10, 1979) (codified at 40 C.F.R. § 60.333 (2011)) (providing options for compliance including not burning "fuel which contains sulfur in excess of 0.8% by weight"). The current version of the standard also presents fuel selection as one possible means of compliance. See What emission limits must I meet for sulfur dioxide (SO2)?, 40 C.F.R. § 60.4330 (2011) (providing options for compliance including not burning "fuel which contains total sulfur with potential sulfur emissions in excess of 180 ng SO_2/J (0.42 lb SO2/MMBtu) heat input"). The Sierra Club v. Costle decision specifically approves EPA's practice of setting emission standards based on fuel characteristics (the sulfur content of coal), even though it was decided under the 1977 version of the Clean Air Act. In addition to finding that "the text of the statute nowhere forbids a distinction based on [a fuel's] sulfur content," the D.C. Circuit stated that "reading section 111 to permit a variable standard based on the sulfur content of coal comports with common sense" because "the amount of sulfur in coal is the most relevant factor in designing standards to reduce emissions of sulfur." Sierra Club v. Costle, 657 F.2d 298, 319 (D.C. Cir. 1981). Both of the court's findings are directly analogous to the present rulemaking. EPA's historic consideration of sulfur content parallels its current consideration of GHG emission potential, and it comports with common sense to consider carbon content—the most relevant factor to GHG emissions—when designing GHG emission standards.

[52] H.R. Rep. No. 101-490, pt. 1 (1990) (emphasis added).

[53] Numerous states have likewise adopted or are in the process of adopting fuel-neutral greenhouse gas performance standards for baseload electricity generation based on the emission rates achievable by natural gas fuel combusted in an efficient combined cycle turbine. See, e.g., Wash. Rev. Code § 80.80.040 (2011); Cal. Pub. Util. Code § 8341(d)(1) (West 2012); Or. Rev. Stat. Ann. §§ 757.524, 757.528 (West 2012); N.Y. Comp. Codes R. & Regs. tit. 6, § 251.3 (New

2. The "Best System of Emission Reduction" Language Is Broad and Easily Encompasses a Combined Cycle Turbine Design Burning Natural Gas.

EPA emphasized as early as 1976 that BSER could encompass low-emission production methods.[54] In setting the smelter NSPS, the agency rejected the notion that BSER determinations must rely exclusively on emission control hardware:

> For some classes of sources, the different processes used in the production activity significantly affect the emission levels of the source and/or the technology that can be applied to control the source. For this reason, the Agency believes the 'best system of emission reduction' includes the processes utilized and does not refer only to emission control hardware. It is clear that adherence to existing process utilization could serve to undermine the purpose of section 111 to require maximum feasible control of new sources.[55]

The 1970 "best system of emission reduction" language that the agency interpreted is nearly identical to the current language, adopted in 1990.[56]

In today's electricity sector, coal- and combined-cycle gas-burning power plants—two systems of electricity generation—are largely functionally interchangeable in providing baseload and load-following generation.[57] Indeed, as EPA's proposal notes, the only new generation projected to be built to serve baseload and intermediate demand is from combined cycle natural gas plants.[58] In

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York Department of Environmental Conservation, Proposed Part 251 CO_2 Performance Standards for Major Electric Generating Facilities (proposed 6 NYCRR Part 251, available at http://www.dec.ny.gov/regulations/79520.html).

[54] See Standards of Performance for New Stationary Sources, Primary Copper, Zinc, and Lead Smelters, 41 Fed. Reg. 2332, 2333 (Jan. 15, 1976).

[55] Id.

[56] Compare CAA Amendments of 1970, PL 91-604, § 111(a)(1), 84 Stat. 1676, 1683 (1970) ("The term 'standard of performance' means a standard for emissions of air pollutants which reflects the degree of emission limitation achievable through the application of the best system of emission reduction which (taking into account the cost of achieving such reduction) the Administrator determines has been adequately demonstrated.") with CAA § 111(a)(1), 42 U.S.C. § 7411(a)(1) (2006) ("The term 'standard of performance' means a standard for emissions of air pollutants which reflects the degree of emission limitation achievable through the application of the best system of emission reduction which (taking into account the cost of achieving such reduction and any nonair quality health and environmental impact and energy requirements) the Administrator determines has been adequately demonstrated.").

[57] 77 Fed Reg. at 22411.

[58] Courts have explicitly approved EPA's practice of taking into account industry trends when setting standards. See National Lime Ass'n v. EPA, 627 F.2d 416, 426 n.28 (D.C. Cir. 1980) ("It is expected that as supplies of natural gas and oil become more expensive or unavailable, all new kilns would be rotary lime kilns designed to burn coal."); Standards of Performance for New Stationary Sources: Lime Manufacturing Plants, 42 Fed. Reg. 22,506, 22,507 (May 3, 1977)

identifying BSER, EPA has an obligation to consider the substantial emission advantages of combined-cycle plants burning natural gas as compared to coal-fired plants and to set the performance standard accordingly. The substantial cost advantages of NGCC further reinforce the reasonableness of NGCC as BSER. When considering two functionally interchangeable processes, not to set BSER based on the lower-emitting process, especially when that process is also less expensive, would fail to fulfill the statutory directives of CAA § 111(b) to maximize emission reductions considering cost and other relevant impacts.[59]

V. The Alternate Pathway Provided for Coal Plants is Consistent with Both the NSPS Program's Technology-Forcing Purpose and Agency Regulatory Practice.

A. Designing an NSPS to Incentivize the Development of Low-Emitting Technologies Is Consistent with § 111.

Through the alternative compliance pathway EPA has signaled that carbon capture and sequestration technology will play a role in controlling CO_2 emissions from fossil-fuel-fired power plants—making investments in developing and deploying this technology secure. This regulatory certainty is what power sector participants have identified as the missing link in the development of CCS. In discussing the decision to stop moving forward with a broader deployment of CCS at its West Virginia Mountaineer plant, American Electric Power Chairman and CEO Mike Morris said: "Going forward without a carbon legislation or without an appropriate approach to carbon and its impact it was simply not able for us to go forward and continue that project. . . . We are encouraged by what we saw, we're clearly impressed with what we learned and we feel that we have demonstrated to a certainty that the carbon capture and storage is in fact viable technology for the United States and quite honestly for the rest of the world going forward."[60]

As noted above, the NSPS is intended to drive innovation in methods of reducing emissions. The Sierra Club court determined that legislative history reinforced its interpretation of the statute that one of the purposes of NSPS is to "create incentives for new technology."[61] The court cited several examples from the legislative history about the CAA Amendments of 1977 in which legislators address technology-forcing portions of CAA § 111.[62] The House Committee Report, for instance, noted that "it is prudent public policy to require achievement of the

("[V]irtually all the new kilns that have been built in the last few years have been of the rotary type. . . . [T]he present trend is to build and operate rotary kilns whenever possible.").

59 While there is a cost advantage of natural gas, section 111 calls for the "best system of emission reduction" to be determined "taking into account the cost of achieving such reduction" and other pertinent statutory factors. 42 U.S.C. §7411(a)(1). The costs of a fuel neutral standard based on this best system, therefore, do not require a cost advantage but must not be unreasonable.

60 American Electric Power Q2 2011 Earnings Call (July 29, 2011), CallStreet Raw Transcript.

61 See Sierra Club v. Costle, 657 F.2d 298, 346-47 (D.C. Cir. 1981).

62 See id. at 346 n.174.

maximum degree of emission reduction from new sources, while encouraging the development of innovative technological means of achieving equal or better degrees of control."[63]

The Senate Committee Report on the CAA Amendments of 1970 also clarified that "[s]tandards of performance should provide an incentive for industries to work toward constant improvement in techniques for preventing and controlling emissions from stationary sources."[64] An emerging control technology used as the basis for standards of performance need not "be in actual routine use somewhere."[65] The D.C. Circuit, analyzing the Senate's intent, found that "[t]he essential question was [] whether the technology would be available for installation in new plants."[66]

The D.C. Circuit sanctioned the tailoring of an NSPS to incentivize the development of specific innovative, low-emitting technologies in Sierra Club v. Costle.[67] There, EPA declined to adopt a uniform requirement that all entities in the regulated category reduce SO_2 emissions by 90% because that requirement would have prevented some low-sulfur-coal facilities from using the new technology known as dry scrubbing.[68] EPA thought that it was important to "provid[e] an opportunity for full development of dry SO_2 technology."[69] The court found that, provided that EPA balanced the factors listed in the NSPS provision, designing the NSPS to incentivize new technologies was consistent with the text of the CAA.[70]

EPA's alternative pathway for coal plants serves this well-established technology-forcing purpose by providing regulatory certainty and thus regulatory "pull" for CCS as an emerging control technology. As discussed above, the SO_2 NSPS served this purpose for scrubbers in the 1970s. The CRS report noted that the NSPS could play a similar role for deployment of carbon capture and sequestration: "The [SO_2 scrubber] example indicates that technology-forcing regulations can be effective in pulling technology into the market—even when there remain some operational difficulties for that technology. . . . As an entry point to carbon capture deployment, a regulatory approach such as NSPS may represent a first step."[71]

EPA's alternative compliance pathway for coal plants is thus providing an innovation-driving mechanism for CCS that power sector participants deploying CCS have called for, consistent with the court-affirmed Congressional intent that NSPS serve a technology-forcing role in order to drive down emission reductions.

<u>B. EPA's Analysis of BSER Availability Should Be Forward-Looking and Is Owed Deference.</u>

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[63] Id.
[64] S. Rep. No. 91-1196, at 17 (1970).
[65] Id. at 16.
[66] Portland Cement Ass'n v. Ruckelshaus, 486 F.2d 375, 391 (D.C. Cir. 1973).
[67] See Sierra Club v. Costle, 657 F.2d 298 (D.C. Cir. 1981).
[68] See id. at 343.
[69] Id. at 327-28.
[70] See id. at 346.
[71] Larry Parker & James E. McCarthy, supra note 4, at 19-20.

The thirty-year compliance framework for coal plants using CCS that EPA has proposed involves a forward-looking availability analysis. The courts have affirmed EPA's authority to make such projections. In Portland Cement Association v. Ruckelshaus, the court found that "[t]he Administrator may make a projection based on existing technology, though that projection is subject to the restraints of reasonableness and cannot be based on 'crystal ball' inquiry. . . . [T]he question of availability is partially dependent on 'lead time', the time in which a technology will have to be available."[72] Further, the court noted that "[i]t would have been entirely appropriate if the Administrator had justified the standards, not on the basis of tests on existing sources or old test data in the literature, but on extrapolations from this data, and on testimony from experts and vendors made part of the record."[73]

As discussed above, courts have properly deferred to EPA's analysis of the best systems of emission reduction available.[74] In Sierra Club, the court "on close questions [gave] the agency the benefit of the doubt out of deference for the terrible complexity of its job."[75]

C. NSPS May Alter Business as Usual.

By its very nature, technology forcing may prevent some actors from proceeding with business as usual, if business as usual would entail a lagging process that is more polluting, or would need greater investment to meet a standard, than a lower-emission technology. In setting NSPS for copper smelters, EPA explained that it could set a "single standard [that] would effectively preclude using a process which is much less expensive than the permitted process" so long as the total cost of the standard was reasonable.[76] This precedent demonstrates that "effectively preclud[ing]" a production method can be entirely consistent with reasonableness and economic achievability. Given the entirely reasonable cost of the standard proposed here and the enormous harm to Americans' health, safety, and environment caused by the pollution generated by uncontrolled coal-fired power plants, EPA was entirely justified – indeed, required – to set a standard that will require any new coal plant to be designed and operated in a manner that will make deeps cuts in the amount of harmful pollution generated.

D. The Alternative Compliance Option in the Proposed Rule Closely Resembles Flexibility Mechanisms in Other Rules that EPA Has Promulgated and Courts Have Approved.

1. EPA Has Adopted Other Flexibility Mechanisms.

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[72] Portland Cement Ass'n v. Ruckelshaus, 486 F.2d 375, 391 (D.C. Cir. 1973).
[73] Id. at 401-02. The standards challenged in Portland Cement were finalized after the Agency conducted testing at seven plants, which the D.C. Circuit found to be sufficient. See Portland Cement Ass'n. v. Train, 513 F.2d 506, 509 (D.C. Cir. 1975).
[74] See Sierra Club v. Costle, 657 F.2d at 343, 364 (incentivizing and forcing technology); Portland Cement Ass'n v. Ruckelshaus, 486 F.2d at 391 (relying on cutting-edge technology).
[75] Sierra Club v. Costle, 657 F.2d at 410.
[76] See Standards of Performance for New Stationary Sources: Primary Copper, Zinc, and Lead Smelters, 41 Fed. Reg. 2332, 2333 (Jan. 15, 1976) (emphasis added).

The provision of alternate compliance pathways is a familiar approach under § 111. As noted above, in Subpart GG of 40 C.F.R. Part 60, EPA established burning a particular type of fuel as one option for meeting the SO_2 emissions standard. The agency described that option as "an alternative SO_2 emissions limit."[77] The main limit set a numeric emission standard to be met at the stack, regardless of the fuel burned.[78] In essence, EPA provided an alternative compliance option that remains valid.

The 1981 Sierra Club decision provides another clear example of an alternative compliance option. At issue were the NSPS for EGUs finalized by EPA in June 1979.[79] The main standard required a maximum of 1.20 lbs SO_2/MMBtu and a 90% reduction from uncontrolled levels.[80] EPA, however, also allowed for an optional method of compliance – what the Sierra Club court called an "optional standard" – similar to the "alternative compliance option" in the proposed GHG NSPS.[81] The option provided that, if a fuel's potential SO_2 emissions were less than 0.60 lbs/MMBtu, the emission-reduction requirement decreased from 90% to 70%.[82] As a practical matter, the optional standard allowed low-sulfur-coal facilities to use dry scrubbing rather than wet scrubbing.

Under the Municipal Waste Combustors NSPS for existing sources (also promulgated under a "best system of emission reduction" analysis), EPA authorized states to permit municipal waste combustors to average nitrogen oxides emissions from different units at the same facility or to trade emission reduction credits with other facilities.[83]

EPA's alternative compliance pathway for coal fits within this regulatory tradition.

2. These Types of Flexibility Mechanisms Have Been Judicially Approved.

In Sierra Club v. Costle, environmental petitioners argued that an NSPS's optional standard violated CAA § 111.[84] The court disagreed, relying on § 111(b)(2), which authorizes EPA to "distinguish among classes, types, and sizes within categories of new sources for the purpose of establishing . . . standards."[85]

Also of note, the Sierra Club court was more deferential to EPA when reviewing the optional standard than the main standard. The court did not ask if dry scrubbing could have served as an

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[77] Standards of Performance for New Stationary Sources: Gas Turbines, 44 Fed. Reg. 52,792, 52,792 (Sept. 10, 1979) (emphasis added).
[78] See id.
[79] New Stationary Source Performance Standards: Electric Utility Steam Generating Units, 44 Fed. Reg. 33,580 (June 11, 1979).
[80] See id. at 33,580.
[81] Sierra Club v. Costle, 657 F.2d 298, 316 (D.C. Cir. 1981).
[82] See 44 Fed. Reg. at 33,580.
[83] See Standards of Performance for Municipal Waste Combustors, 60 Fed. Reg. 65,387, 65,402 (Dec. 19, 1995).
[84] See 657 F.2d at 316-17.
[85] CAA § 111(b)(2), 42 U.S.C. § 7411(b)(2) (2006); see also Sierra Club v. Costle, 657 F.2d at 319-20.

independent basis for the standard because it had already found that wet scrubbing was the BSER.

Instead, the court limited its analysis to whether EPA had a reasonable basis for its technical analysis of dry scrubbing. The court determined that "the support in the record for selecting 70% as the magic percentage for encouragement of dry scrubbing [was] less than overwhelming" but recognized that EPA was trying to encourage the development of dry scrubbing technology.[86] Because "it was reasonable for EPA to seek to encourage dry scrubbing and to be concerned with the effect of the NSPS on the future of the new technology," the court upheld the optional standard.[87]

As with the SO_2 NSPS's optional standard in Sierra Club, the alternative compliance option in the proposed GHG NSPS merits respect because it reasonably balances the relevant statutory factors required to be considered in establishing a standard of performance under the law.

VI. EPA Is Not Obligated to Make a New Endangerment Finding Once Sources Have Been Listed Under § 111.

Section 111(b)(1)(A) states that the Administrator "shall include" a category of sources in the list for which performance standards are required "if in [her] judgment it causes, or contributes significantly to, air pollution which may reasonably be anticipated to endanger public health or welfare." Section 111(b)(1)(B) then directs the Administrator to "establish[] Federal standards of performance for new sources within" a listed category. Section 111(a)(1) defines a "standard of performance" as "a standard for emissions of air pollutants which reflects the degree of emission limitation achievable through the application of the best system of emission reduction" which the Administrator determines to have been adequately demonstrated. The statutory language separates the "endangerment" and "contribution" findings, both components of the process of listing a category of sources, from the mandate to promulgate standards of performance for particular air pollutants emitted by those sources. Long Agency practice confirms that EPA's legal obligation to make an endangerment finding under § 111 is satisfied once the initial endangerment finding is made when a group of sources is added to the list of regulated sectors for which NSPS are promulgated. The statutory command directing EPA to promulgate standards of performance for the air pollutants emitted by those sources is separate, and does not include a requirement for an endangerment determination.

In accordance with the statutory language, EPA has never issued a new or revised endangerment finding when revising an NSPS under CAA § 111. See Commercial and Industrial Solid Waste Incineration Units: Reconsideration and Proposed Amendments, Non-Hazardous Secondary Materials that are Solid Waste, 76 Fed. Reg. 80,452 (Dec. 23, 2011) (amending 65 Fed. Reg. 75,338 (Dec. 1, 2000)); Standards of Performance for Stationary Compression Ignition and Spark Internal Combustion Engines, 76 Fed. Reg. 37,954 (June 28, 2011) (amending 71 Fed. Reg. 39,153 (July 11, 2006)); Standards of Performance for New Stationary Sources and

[86] 657 F.2d at 351.
[87] Id.

Emission Guidelines for Existing Sources: Commercial and Industrial Solid Waste Incineration Units, 76 Fed. Reg. 15,704 (Mar. 21, 2011) (amending 65 Fed. Reg. 75,338 (Dec. 1, 2000)); Standards of Performance for New Stationary Sources and Emissions Guidelines for Existing Sources: Hospital/Medical/Infectious Waste Incinerators, 74 Fed. Reg. 51,368 (Oct. 6, 2009) (amending 62 Fed. Reg. 48,348 (Sept. 15, 1997)); Standards of Performance for Fossil-Fuel-Fired Steam Generators for Which Construction Is Commenced After August 17, 1971, Electric Utility Steam Generating Units for Which Construction Is Commenced After September 18, 1978, Industrial-Commercial-Institutional Steam Generating Units, and Small Industrial-Commercial-Institutional Steam Generating Units, 74 Fed. Reg. 5072 (Jan. 28, 2009) (amending 36 Fed. Reg. 24,876 (Dec. 23, 1971)); Standards of Performance for Equipment Leaks of VOC in the Synthetic Organic Chemicals Manufacturing Industry: Standards of Performance for Equipment Leaks of VOC in Petroleum Refineries, 72 Fed. Reg. 64,860-01 (Nov. 16, 2007) (amending 49 Fed. Reg. 22,598-01 (May 30, 1984), 48 Fed. Reg. 48,328-01 (Oct. 18, 1983)); Standards of Performance for Fossil-Fuel-Fired Steam Generators for Which Construction Is Commenced After August 17, 1971, Electric Utility Steam Generating Units for Which Construction Is Commenced After September 18, 1978, Industrial-Commercial-Institutional Steam Generating Units, and Small Industrial-Commercial-Institutional Steam Generating Units, 72 Fed. Reg. 32,710 (June 13, 2007) (amending 36 Fed. Reg. 24876 (Dec. 23, 1971)); Standards of Performance, Emission Guidelines, and Federal Plan for Municipal Solid Waste Landfills and National Emission Standards for Hazardous Air Pollutants: Municipal Solid Waste Landfills, 71 Fed. Reg. 53,272 (Sept. 8, 2006) (amending 61 Fed. Reg. 9905 (Mar. 12, 1996)); Standards of Performance for New Stationary Sources and Emission Guidelines for Existing Sources: Large Municipal Waste Combustors, 71 Fed. Reg. 27,324 (May 10, 2006) (amending 60 Fed. Reg. 65,387 (December 19, 1995)); Standards of Performance for Electric Utility Steam Generating Units for Which Construction Is Commenced After September 18, 1978, Industrial-Commercial-Institutional Steam Generating Units, and Small Industrial-Commercial-Institutional Steam Generating Units, 71 Fed. Reg. 9866 (Feb. 27, 2006) (amending 44 Fed. Reg. 33,580 (June 11, 1979)); Standards of Performance for Municipal Solid Waste Landfills, 67 Fed. Reg. 36,476 (May 23, 2002) (amending 61 Fed. Reg. 9905 (Mar. 12, 1996)); New Source Performance Standards for New Small Municipal Waste Combustion Units, 65 Fed. Reg. 76,378 (Dec. 6, 2000) (amending 60 Fed. Reg. 65,382 (Dec. 19, 1995)); New Source Performance Standards for New Small Municipal Waste Combustion Units, 65 Fed. Reg. 76,350 (Dec. 6, 2000) (amending 60 Fed. Reg. 65,382 (Dec. 19, 1995)); Amendments for Testing and Monitoring Provisions, 65 Fed. Reg. 61,744 (Oct. 17, 2000) (amending testing and monitoring procedures throughout 40 C.F.R. pt. 60); Revision of Standards of Performance for Nitrogen Oxide Emissions From New Fossil-Fuel Fired Steam Generating Units: Revisions to Reporting Requirements for Standards of Performance for New Fossil-Fuel Fired Steam Generating Units, 63 Fed. Reg. 49,442 (Sept. 16, 1998) (amending 51 Fed. Red. 42,768 (Nov. 25, 1986)); Revision of New Source Performance Standards for the Phosphate Fertilizer Industry: Granular Triple Superphosphate Storage Facilities, 62 Fed. Reg. 18,277 (Apr. 15, 1997); Amendment to Standards of Performance for New Stationary Sources: Small Industrial-Commercial-Institutional Steam Generating Units, 61 Fed. Reg. 20,734 (May 8, 1996) (amending 55 Fed. Reg. 37,674 (Sept. 12, 1990)); Standards of Performance for New Stationary Sources and Emission Guidelines for Existing Sources: Municipal Waste Conductors, 60 Fed. Reg. 65,387 (Dec. 19, 1995) (amending 54 Fed. Reg. 52,251 (Dec. 20, 1989), 54 Fed. Reg. 52,209 (Dec. 20, 1989)); Standards of Performance for New Stationary Sources: Automobile and Light-Duty Truck Surface Coating Operations, 59 Fed. Reg. 51,383 (Oct. 11, 1994) (amending 45 Fed. Reg. 85,410 (Dec. 24, 1980)); Standards of Performance for New Stationary Sources: Fossil-Fuel-Fired Steam Generators, 52 Fed. Reg. 28,946 (Aug. 4, 1987) (amending 50 Fed. Reg. 3688 (Jan. 25, 1985)); Standards of Performance for New Stationary Sources: Volatile Organic Liquid Storage Vessels, 52 Fed. Reg. 11,420 (Apr. 8, 1987) (amending 38 Fed. Reg. 15,406 (June 11, 1973), 45 Fed. Reg. 23,374 (Apr. 4, 1980)); Review and Amendment of Standards of Performance for New Stationary Sources; Kraft Pulp Mills, 51 Fed. Reg. 18,538, 18,544 (May 20, 1986); Review and Amendment of Standards of Performance for New Stationary Sources Hot Mix Asphalt Facilities, 51 Fed. Reg. 3298 (Jan. 24, 1986) (amending 39 Fed. Reg. 9308 (Mar. 8, 1974)); Standards of Performance for New Stationary Sources Glass Manufacturing Plants, 49 Fed. Reg. 41,030 (Oct. 19, 1984); Standards of Performance for New Stationary Sources: Stationary Gas Turbines, 47 Fed. Reg. 3767 (Jan. 27, 1982) (amending 44 Fed. Reg. 52,798); Emission Monitoring Requirements and Revisions to Performance Testing Methods, 40 Fed. Reg. 46,250 (Oct. 6, 1975).

The Agency has not issued an endangerment finding even when the revised NSPS adds a new pollutant to those already regulated for a category. See Standards of Performance for Coal Preparation and Processing Plants, 74 Fed. Reg. 51,950, 51,957 (Oct. 8, 2009) ("The plain language of section 111(b)(1)(A) provides that such findings are to be made for source categories, not for specific pollutants emitted by the source category. . . . Determinations regarding the specific pollutants to be regulated are made, not in the initial endangerment finding, but at the time the performance standards are promulgated.") (amending subpart Y, which had set PM standards since 1976); Primary Aluminum Industry, 41 Fed. Reg. 3826 (Jan. 26, 1975) (relying on an endangerment finding for one pollutant when setting standards for two pollutants); National Emission Standards for Hazardous Air Pollutants From Coal- and Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units, 77 Fed. Reg. 9304 (Feb. 16, 2012) (amending 71 Fed. Reg. 9866 (Feb. 27, 2006)); National Emission Standards for Hazardous Air Pollutants From the Portland Cement Manufacturing Industry and Standards of Performance for Portland Cement Plants, 75 Fed. Reg. 54,970 (Sept. 9, 2010) (amending 36 Fed. Reg. 24,876 (Dec. 23, 1971)); Standards of Performance for Petroleum Refineries, 73 Fed. Reg. 35,838 (June 24, 2008) (amending 39 Fed. Reg. 9308 (Mar. 8, 1974)); Standards of Performance for New and Existing Stationary Sources: Electric Utility Steam Generating Units, 70 Fed. Reg. 28,606 (May 18, 2005) (amending 36 Fed. Reg. 24,876 (Dec. 23, 1971)); Standards of Performance for New Stationary Sources; Fluid Catalytic Cracking Unit Regenerators, 54 Fed. Reg. 34,008 (Aug. 17, 1989) (amending 39 Fed. Reg. 9308 (Mar. 8, 1974)); Standards of Performance for New Stationary Sources; Industrial-Commercial-Institutional Steam Generating Units, 52 Fed. Reg. 47,826 (Dec. 16, 1987) (amending 51 Fed. Reg. 42,768 (Nov. 25, 1986)).

The Agency has maintained its practice of not issuing a new or revised endangerment finding even when adding a new source to a category. See Oil and Natural Gas Sector: New Source Performance Standards and National Emission Standards for Hazardous Air Pollutants Reviews, 76 Fed. Reg. 52,738, 52,745 (proposed Aug. 23, 2011) (proposing to regulate VOC emissions from several new source categories of natural gas operations based on existing endangerment finding for SO_2 emissions from natural gas processing plants) (amending 50 Fed. Reg. 40,158 (Oct. 1, 1985)); Standards of Performance for Large Municipal Waste Combustors for Which Construction Is Commenced After September 20, 1994, or for Which Modification or Reconstruction Is Commenced After June 19, 1996 and Emission Guidelines and Compliance Times for Large Municipal Waste Combustors That Are Constructed on or Before September 20, 1994, 66 Fed. Reg. 36,473 (July 12, 2001) (amending 60 Fed. Reg. 65,387 (Dec. 19, 1995)).

VII. The Social Cost of Carbon Estimate Used in Federal Benefits Analyses Must Be Updated To Reflect Current Science.

It is critical that EPA collaborate with other federal agencies and carry out its responsibilities to accurately account for the Social Cost of Carbon ("SCC").

The Social Cost of Carbon is a monetary measure of the incremental damage resulting from greenhouse gas emissions. The SCC assigns a net present value to the marginal impact of one additional ton of carbon dioxide-equivalent emissions released at a specific point in time. EDF commented extensively on the consideration of the SCC in the first light-duty vehicle greenhouse gas rulemaking, the heavy-duty vehicle greenhouse gas rulemaking, and the Notice of Intent for Draft EIS. Those comments are hereby incorporated.

It is imperative that EPA rigorously and transparently account for the SCC in analyzing the impact of the GHG NSPS. In the proposal, EPA used the SCC as estimated by the Interagency Working Group on Social Cost of Carbon (February 2010). While we support the collaboration and work of the Group, the SCC used should always be based on models reflecting the latest science, as the Agency has itself committed to do. All three modeling teams, whose work led to the report by the Interagency Working Group, have since updated their models to reflect the latest research and methodological developments. At the very least, the SCC used should be updated using the current versions of the models.

We make additional suggestions below as to how current modeling approaches can and should be improved in order to meet the Agency's commitment to update the social cost of carbon as the underlying models and methodologies are improved:[88]

- Declining discount rate over time: In assigning a dollar value to reductions in CO_2 emissions, the Agency uses the social cost of carbon and the discount rates included in the Interagency Working Group on Social Cost of Carbon. This includes the use of 5 percent, 3 percent and 2.5 percent discount rates. Recent advances in economic theory indicate that it is not appropriate to use such high and constant discount rates in the context of the social cost of carbon analysis, with a constant 5 percent discount rate being particularly inappropriate. A certainty-equivalent approach, for example, would yield much lower constant discount rates than those currently used. At the very least, we

[88] Interagency Working Group on the Social Cost of Carbon, United States Government, Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis – Under Executive Order 12866 (February 2010).

encourage the Agency to use a range of discount rates of 3 percent and below in its SCC analysis. We strongly recommend, however, that the Agency move as soon as possible to the use of a declining social discount rate. Appropriately accounting for uncertainty around the discount rate over long time horizons generates a discount rate that declines over time. As demonstrated at an academic workshop convened by Resources for the Future on Intergenerational Discounting, September 22-23, 2011, there is broad support for the use of declining discount rates within the relevant community of experts.[89] These declining rates reflect the scientific, economic, and ethical complexities and uncertainties inherent in inter-generational discounting.

- Evaluating catastrophic risks: The SCC numbers currently used seriously undervalue low-probability/high-consequence climate impacts. Functional form assumptions in the models used in the Interagency Report misrepresent these risks and lead to inaccurately low SCC numbers. In particular, they cut off the tails of distribution functions too quickly, ignoring potentially catastrophic climate risks.[90] The SCC numbers used should reflect the uncertainty range around different functional forms and standard assumptions around risk aversion in order to more accurately value potentially catastrophic climate impacts.[91]

- Evaluating non-monetized benefits: GHG reduction policies can significantly undervalue benefits simply because some of these benefits are not easily quantifiable. The White House Office of Management and Budget recognizes that some costs and benefits will be difficult to monetize, but directs agencies to consider other means of quantification.[92] We request that the social cost calculations be updated to include the latest results on newly monetized benefits. All additional climate impacts omitted from the models should at the very least be identified explicitly. A table should be provided that lists, for each economic model, what impacts were not included in the model's estimate of monetized damages. Accompanying text should serve to explain and complement the table entries but not be a substitute for them. Below, we have provided an example table listing impacts typically omitted from SCC models.

List of Impacts Typically Omitted from SCC Models[93]

Agriculture	Reduction in growing season (e.g., in Sahel/southern Africa)
	Increase in growing season in moderate climates
	Impact of precipitation changes on agriculture

[89] See "Workshop on Intergenerational Discounting," 22-23 September 2011, Resources for the Future. http://www.rff.org/Events/Pages/Intergenerational-Discounting-Workshop.aspx
[90] See Martin Weitzman, "Fat-Tailed Uncertainty in the Economics of Climate Change," Review of Environmental Economic Policy, 5(2), 275-292 (Summer 2011).
[91] See Robert E. Kopp, Alexander Golub, Nathaniel O. Keohane, and Chikara Onda, The Influence of the Specification of Climate Change Damages on the Social Cost of Carbon, 6 Economics: The Open-Access, Open-Assessment E-Journal 2012-13 (2012), url http://dx.doi.org/10.5018/economics-ejournal.ja.2012-13.
[92] See OFFICE OF MGMT. & BUDGET, CIRCULAR A-4, 26 (2003).
[93] Information and format for table based on EPA, TECHNICAL SUPPORT DOCUMENT ON BENEFITS OF REDUCING GHG EMISSIONS 16-17 (2008), and EPA, 420-D-09-001, DRAFT REGULATORY IMPACT ANALYSIS: CHANGES TO RENEWABLE FUEL STANDARD PROGRAM 691 tbl. 5.3-4 (2009).

	Impact of weather variability on crop production
Biomes/ Ecosystems	Reverse of carbon uptake, amplification of climate change
	Thresholds or "tipping points" associated with species loss, ecosystem collapse, and long-term catastrophic risk (e.g., Antarctic ice sheet collapse)
	Species existence value and the value of having the option for future use
	Earlier timing of spring events; longer growing season
	Poleward and upward shift in habitats; species migration
	Shifts in ranges of ocean life
	Increases in algae and zooplankton
	Range changes/earlier migration of fish in rivers
	Impacts on coral reefs
	Ecosystem service disruption (e.g., loss of cold water fish habitat in the U.S.)
	Coral bleaching due to ocean warming
Energy	Energy production/infrastructure
	Water temperature/supply impacts on energy production
Foreign Affairs	Social and political unrest abroad that affects U.S. national security (e.g., violent conflict or humanitarian crisis)
	Damage to foreign economies that affects the U.S. economy
	Domestic valuation of international impacts
Forest	Longer fire seasons, longer burning fires, and increased burn area
	Disappearance of alpine habitat in the United States
	Tropical forest dieback in the Amazon
GDP/ Economy	Insurance costs with changes in extreme weather, flooding, sea level rise
	Global transportation and trade impacts from Arctic sea ice melt
	Distributional effects within regions
	Vulnerability of societies highly dependent on climate-sensitive resources
	Infrastructure costs (roads, bridges)
	Extreme weather events (droughts, floods, fires, and heavy winds)
Health	Increased deaths, injuries, infectious diseases, stress-related disorders with more frequent extreme weather (droughts, floods, fires, and heavy winds)
	Increases in malnutrition, food-borne illnesses
	Air quality interactions (e.g., ozone effects, including premature mortality)
Snow/ Glacier	Changes in Arctic/Antarctic ecosystems
	Enlargement and increased numbers of glacial lakes; increased flooding
	Snow pack in southeastern United States

Tourism	Changes in tourism revenues due to changes in ecosystems and weather events
	Arctic hunting/travel/mountain sports
Water	River flooding
	Infrastructure; water supply
	Precipitation changes on water supply; increased runoff in snow-fed rivers
	Increasing ground instability and avalanches

VIII. EPA Should Ensure Future Accessibility of Emission Records.

EPA should take specific and transparent action to ensure forward-compatibility of and continued access to all records submitted from sources that make use of the 30-year compliance pathway under 60.5520(b). Because computer and records technology changes rapidly, it is very likely that data formats used in 2012 will not be the same as those in effect in 2042 or beyond. EPA should take specific actions, including consulting with appropriate experts, to ensure that data are stored and maintained in a format that continues to be accessible for future enforcement, review, and policy-making actions. In addition, and for the same reasons, EPA should modify 60.5565(b) to require sources to prepare and annually update plans for maintaining access to all data required to be maintained under the 60.5520(b) pathway.

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Thank you for your consideration of our views. If you have any questions about the content of these comments, please contact:

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

	)	
Standards of Performance for	)	**Docket No. EPA-HQ-OAR-2011-0660**
Greenhouse Gas Emissions for	)	
New Stationary Sources: Electric	)	*Via regulations.gov*
Utility Generating Units	)	*June 25, 2012*
	)	

Thank you for accepting these comments on EPA's proposed Standards of Performance for Greenhouse Gas Emissions for Stationary Sources; Electricity Utility Generating Units ("EGU NSPS"), 72 Fed. Reg. 22,392 (Apr. 13, 2012).

We submit these comments on behalf of Sierra Club, Environmental Defense Fund, Natural Resources Defense Council, Earthjustice, National Wildlife Federation, Environmental Law and Policy Center, Southern Environmental Law Center, and Clean Air Council ("Joint Environmental Commenters").

I. Introduction

As EPA has properly concluded, the scientific record demonstrating that "elevated concentrations of greenhouse gases in the atmosphere may reasonably be anticipated to endanger the public health and welfare of current and future U.S. generations is robust, voluminous, and compelling."[1] Electric generating units (EGUs) are the single largest source of domestic greenhouse gas emissions. Accordingly, as we discuss at length below, EPA must control greenhouse gas pollution from this source category under section 111 of the Clean Air Act, 42 U.S.C. § 7411. Indeed, unless emissions from new and existing power plants are reduced, the United States will be unable to prevent or mitigate serious harm from climate change.

In this introductory section, we briefly describe some of the harms associated with greenhouse gas emissions and show why the emissions profile of the EGU sector demands expeditious regulation under section 111.

A. Climate Change and Ocean Acidification Caused by EGU Emissions Threaten Public Health and Welfare

[1] 75 Fed. Reg. 49,556, 49,557 (Aug. 13, 2010) (Endangerment Reconsideration Denial), attached as **Ex. 1;** *see also* 74 Fed. Reg. 66,496, 66,523 (Dec. 15, 2009) (Endangerment Finding), attached as **Ex. 2**.

EPA's Regulatory Impact Analysis (RIA)'s overview of the pressing threats associated with greenhouse gas emissions ably canvasses the dangers which the NSPS must combat. The RIA is based largely on the EPA's 2009 Endangerment Finding, along with a 2010 report by the National Research Council.[2] The climate science that forms the basis of the 2009 Endangerment Finding provides a legally sufficient and scientifically compelling justification for curbing greenhouse gas emissions from power plants. Global greenhouse gas emissions and atmospheric concentrations, and hence the risk of catastrophic damage, have increased since they were issued, underlining the importance of emissions controls. Climate science published since 2009 further underlines the urgency of mitigating greenhouse gas emissions.[3]

1. **Harms Associated with Climate Change**

Climate change will comprehensively alter our world. As the RIA recognizes, these changes will cause a wide variety of harms.

a. Direct Threats to Public Health and Welfare from Climate Change

Climate change is threatening, and can be expected to continue to threaten, public health in many regards. It is expected, for instance, to increase the incidence and severity of heat waves which are particularly dangerous to the elderly, very young, and infirm.[4] Warmer days lead to enhanced ozone, or smog, formation, which can exacerbate respiratory illnesses, contributing to asthma attacks and hospitalizations and an increased risk of premature death.[5] Because a warmer atmosphere will hold more moisture, climate change will also be associated with heavier precipitation events, stronger tropical cyclones, and associated flooding, which can damage infrastructure and injure or kill people.[6] Pathogens and pests are expected to spread among susceptible populations due to changes in those species' survival, persistence, habitat

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[2] *See* RIA at 3-1, 3-8. Many of the fundamental assessment reports upon which the Endangerment Finding and the RIA rely are attached and incorporated by reference. The Fourth Synthesis Report by the Intergovernmental Panel on Climate Change is attached as **Ex. 3**, the National Research Council's Report on *Advancing the Science of Climate Change* is attached as **Ex. 4**, and the U.S. Global Change Research Program's Report on *Global Climate Change Impacts in the United States* is attached as **Ex. 5.**

[3] *See, e.g.* Natural Research Council, Climate Stabilization Targets: Emissions, Concentrations, and Impacts over Decades to Millennia (2010), attached as **Ex. 6**; RIA 3-9; Natural Research Council, Advancing the Science of Climate Change, **Ex. 4**, *supra*; RIA, 3-8.

[4] RIA at 3-1 – 3-2.

[5] *Id.* at 3-2 -3-3, 5-24.

[6] *Id.* at 3-3.

range and transmission under changing climate conditions, further endangering the public.[7]

As EPA has documented at length, climate change threatens public welfare. Sea level rise is well-documented and very likely to accelerate.[8] Rising seas, amplified by storm surges and stronger tropical cyclones, will threaten homes, cities, and infrastructure all along our coast, forcing expensive efforts to protect or relocate critical resources.[9] Millions of U.S. citizens will be affected and many will be displaced. Inland, shrinking snowpacks and early spring melts will increase flood risk early in the melt season and will cause water shortages throughout much of the West, which now depends on snowpacks as a reliable water source.[10] Droughts, especially in the western and southern United States, are expected to occur more frequently, and the extent of drought-limited ecosystems is projected to increase by 11% for every degree C of warming in the United States.[11] This is expected to exacerbate the water scarcity already affecting regions of the United States.[12] Further, the combination of changing atmospheric chemistry and shifting, more violent, weather patterns is likely to lead to damage to crops and even to crop failures, with corresponding increases in food prices and declines in availability.[13] On forested lands, the same changes will be associated with more severe fires, pest outbreaks, and higher tree mortality which are likely to disrupt timber production.[14]

b. Climate-Linked Threats to Ecosystems Upon Which Society Depends

These shifts also have major implications for wildlife, biodiversity, and the basic ecosystems services upon which we depend. Observed changes in our climate are already shifting habitat ranges, altering migration patterns, and impacting reproductive behavior.[15] At anticipated levels of increased global average temperature changes, many terrestrial, freshwater and marine species at far greater risk of extinction than in the past.[16] In the Arctic, wildlife faces even greater challenges as climate change leads to significant loss of sea ice and dramatic reduction in marine habitat for polar bears, ice-inhabiting seals, and other animals.[17] And the resilience of many ecosystems is likely to

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[7] *Id.*
[8] *Id.* at 3-6 – 3-7.
[9] *Id.* at 3-3, 3-6 – 3-7.
[10] *Id.* at 3-5.
[11] *Id.* at 3-5, 3-8; U.S. Global Change Research Program's Report on *Global Climate Change Impacts in the United States*, **Ex. 5** *supra*, at 33, 44.
[12] *Id.* at 3-5.
[13] *Id.* at 3-4.
[14] *Id.* at 3-4 -3-5.
[15] *Id.* at 3-7.
[16] *Id.* at 3-7.
[17] *Id.* at 3-7.

be exceeded this century by an unprecedented combination of climate change, associated disturbances (e.g. flooding, drought, wildfire, insects, ocean acidification) and other global change drivers (e.g. land use change, pollution, fragmentation of natural systems, overexploitation of resources).[18]

The footprint of humans on the planet has already stressed ecosystems more than at any time in human history. Terrestrial, freshwater, and marine environments have already undergone extensive transformation and deterioration.[19] More than 75% of Earth's ice-free land has been altered,[20] while about 43% of the native ecosystems in the United States have been converted for agriculture, urban growth, and other economic activities.[21] More than 40% of the world's oceans, and more than 65% of oceans within the United States Exclusive Economic Zone, are designated as having an anthropogenic impact rating of at least "medium high."[22]

Together with these numerous other stressors, climate change is having a significant effect on ecosystems. For example, climate change and other anthropogenic stressors are causing the sixth mass extinction of global biodiversity, with current extinction rates 100 to 1,000 times greater than historical rates.[23] Species with a narrow tolerance for changes in climate conditions and those that cannot easily shift their distribution are at increased risk of extinction.[24] In 2007, the IPCC concluded that 20 to 30% of species

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[18] *See* **Ex. 3,** *supra,* at 48.

[19] Millennium Ecosystem Assessment, *Ecosystems and Human Well-being: Biodiversity Synthesis* (2005), attached as **Ex. 7**; Brook *et al. Synergies among extinction drivers under global change* 23 Trends in Ecology and Evolution 453-46 (2008), attached as **Ex. 8**; Butchart *et al.* Global biodiversity: indicators of recent declines. 328 Science 1164 (2010) , attached as **Ex. 9**.

[20] Ellis EC and Ramankutty N, *Putting people in the map: anthropogenic biomes of the world*, 6 Frontiers in Ecology and the Environment 439 (2008), attached as **Ex. 10**.

[21] Lubowski *et al., Major uses of land in the United States, 2002* (2006), attached as **Ex. 11**.

[22] Halpern *et al., A global map of human impact on marine ecosystems*. 319 Science 948 (2008), attached as **Ex. 12**; Kappel *et al., In the zone comprehensive ocean protection*. 25 Issues in Science and Technology 33–44 (2009), attached as **Ex. 13**.

[23] Pimm, *et al., The future of biodiversity*, 269 Science 347 (1995), attached as **Ex. 14**; Dirzo *et al., Global state of biodiversity and loss*, 28 Annual Review of Environment and Resources 137 (2003), attached as **Ex. 15**; Pimm, *Biodiversity: Climate Change or Habitat Loss — Which Will Kill More Species*, 18 Current Biology R117 (2008), attached as **Ex. 16**; Pereira *et al., Scenarios for Global Biodiversity in the 21st Century*, 330 Science 1496 (2010), attached as **Ex. 17**; Barnosky *et al., Has the Earth's sixth mass extinction already arrived?*, 471 Nature 51 (2011), attached as **Ex. 18**.

[24] Altermatt, *Tell me what you eat and I'll tell you when you fly: diet can predict phenological changes in response to climate change*, 13 Ecology Letters 1475(2010), attached as **Ex. 19**; Clavel, *et al.*, 2011. *Worldwide decline of specialist species: toward a*

worldwide would be committed to extinction if temperatures increase 2.2-4.0° F above late 20th century levels.[25]

Even species that do not go extinct will have to contend with ecological conditions they have not faced before. Many terrestrial species are shifting their geographical ranges in response to changing climate conditions. Plants and animals have moved to higher elevations at a median rate of 0.011 kilometers per decade, and to higher latitudes at a median rate of 16.9 kilometers per decade, 2 to 3 times faster than previously reported.[26] For example, of the 305 bird species tracked in annual Christmas bird counts during the last four decades, 177 species (58%) had significant northward range shifts, with more than 60 species moving 100 miles or farther.[27] It is expected that these range shifts will create unprecedented interactions among species.

Shifts in seasons, especially in the duration and intensity of winter, are also having significant impacts on ecosystems. One consequence of shifting seasons is the increased likelihood of mismatches between interdependent species (e.g., predator and prey, insects and flowers).[28] A striking example is found in the western forests, where warmer winters and longer growing seasons have promoted mountain pine beetle outbreaks and more intense and extensive fires.[29] In turn, the decreased availability of whitebark

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global functional homogenization?, 9 Frontiers in Ecology and the Environment 222 (2011), attached as **Ex. 20**.

[25] IPCC, *Climate change 2007: Impacts, Adaptation, and Vulnerability* (2007), available at http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_wg2_report_impacts_adaptation_and_vulnerability.htm.

[26] Chen *et al.*, Rapid range shifts of species associated with high levels of climate warming. 333 *Science* 1024 (2011), attached as **Ex. 21**.

[27] National Audubon Society, *Birds and Climate Change: Ecological Disruption in Motion* (2009), attached as **Ex. 22**.

[28] Miller-Rushing, A *et al.*, *The effects of phenological mismatches on demography*, 365 Philosophical Transactions of the Royal Society B-Biological Sciences 3177 (2010), attached as **Ex. 23**; Thackeray, *et al.*, *Trophic level asynchrony in rates of phenological change for marine, freshwater and terrestrial environments*, Global Change Biology 16:3304-3313 (2010), attached as **Ex. 24**; Yang *et al.*, *Phenology, ontogeny and the effects of climate change on the timing of species interactions*, 13 Ecology Letters 13:1-10 (2010), attached as **Ex. 25**.

[29] Westerling *et al.*, *Continued warming could transform Greater Yellowstone fire regimes by mid-21st century*, 108 Proceedings of the National Academies of Science, U.S.A., 13165-13170 (2011), attached as **Ex. 26**; Westerling *et al.*, *Warming and earlier spring increases western U.S. Forest wildfire activity*, 313 Science 940 (2006) , attached as **Ex. 27**.

pine nuts as a food source for grizzly bears has been tied to lower cub birth rates, lower over-winter survival rates, and increased conflicts between bears and humans.[30]

These shifts, including changing precipitation regimes and extremes in weather and climate, will, in short, have significant impacts on ecosystems in the coming decades, in some cases causing ecosystem transitions to significantly different community types.[31] For example, more arid ecosystems and river habitat areas are likely to be especially sensitive to changes in precipitation.[32] Reduced river flow and longer droughts in such regions is projected to induce native cottonwood-willow forests to convert to exotic tamarisk or other non-native species with higher drought tolerance.[33] Such changes in ecosystem composition and function will pose significant adaptation challenges for affected human communities.

The upshot is that greenhouse gas emissions are fundamentally destabilizing global ecosystems. Because human society depends upon the goods and services which these ecosystems provide, this ecological crisis is a pressing threat to public welfare.

c. Harms Associated With Ocean Acidification

Some of the carbon dioxide emitted via fossil fuel combustion is absorbed by the oceans. Because carbonic acid forms when carbon dioxide dissolves in water, rising carbon dioxide emissions are causing the seas to become more acidic. As the RIA notes, ocean acidification alone, independent of climate change, demonstrates that greenhouse gases endanger public welfare.[34] The RIA reports, based on findings of the National Research Council, that ocean acidity has increased "25 percent since pre-industrial times, and is projected to continue increasing."[35] If atmospheric carbon dioxide doubles, oceanic acidity will also increase, substantially reducing the area in the ocean where coral reefs can survive and threatening the ocean's food webs, which rely

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[30] Gunther*, et al.*, *Grizzly bear-human conflicts in the Greater Yellowstone Ecosystem* (2010), attached as **Ex. 28**; Gunther *et al.*, *Grizzly bear–human conflicts in the Greater Yellowstone ecosystem, 1992–2000*. 15 Ursus 10 (2004).
[31] Peters, *et al.*, *Long-term trends in climate and climate-related drivers* (2011).
[32] Peters, *et al.*, *Directional climate change and potential reversal of desertification in arid and semiarid ecosystems*, 18 Global Change Biology 151 (2012), attached as **Ex. 29**.
[33] Rood, *et al.*, *Declining summer flows of Rocky Mountain rivers: Changing seasonal hydrology and probable impacts on floodplain forests*, 439 Journal of Hydrology 397 (2008), attached as Ex. **30**.
Stromberg, *et al.*, *Effects of stream flow patterns on riparian vegetation of a semiarid river: implications for a changing climate*, 26 River Research and Applications 712 (2010), attached as **Ex. 31**.
[34] *Id.* at 3-9- 3-10.
[35] *Id.* at 3-9.

upon coral reefs as fish nurseries and planktonic animals that may be unable to survive a more acidic sea.[36]

Ocean acidification is also taking place with extraordinary rapidity. According to a recent paper published in the journal *Science*, which canvassed ocean chemistry for hundreds of millions of years, the current rate of CO_2 release to the oceans, and hence, the rate of acidification, "stands out as capable of driving a combination and magnitude of ocean geochemical changes potentially unparalleled in at least the last ~ 300 [million years] of Earth history."[37] Even if emissions were increasing less quickly than they now are, ocean acidity will increase by 100-150% by the end of this century.[38] Troublingly, this increase in acidity will be accompanied by increasing surface stratification of the ocean, which is a consequence of warmer surface waters. As a result, phytoplankton will experience both increased acidity and more intense light—which in combination has been shown in recent research to dramatically reduce the photosynthesis and growth of diatoms, currently responsible for approximately 40% of total primary production in the oceans."[39] The result of acidification in combination with ocean stratification may be a "widespread decline in marine primary production," doing great damage to the base of the oceanic food chain, with potentially devastating effects on the food supply for many regions.[40]

2. **Increasing Severity of Harm**

Greenhouse gas emissions and atmospheric concentrations have continued to rise in the years since EPA made its Endangerment Finding. As EPA finalizes the NSPS, this evidence of an intensifying threat demonstrates the importance of selecting the most protective standards possible in this rule, along with continued efforts to control emissions from other sectors.

Global greenhouse gas emissions are now rising faster than the IPCC's highest emissions scenario from 2007, as shown in the figure below, compiled by the European Environment Agency.[41]

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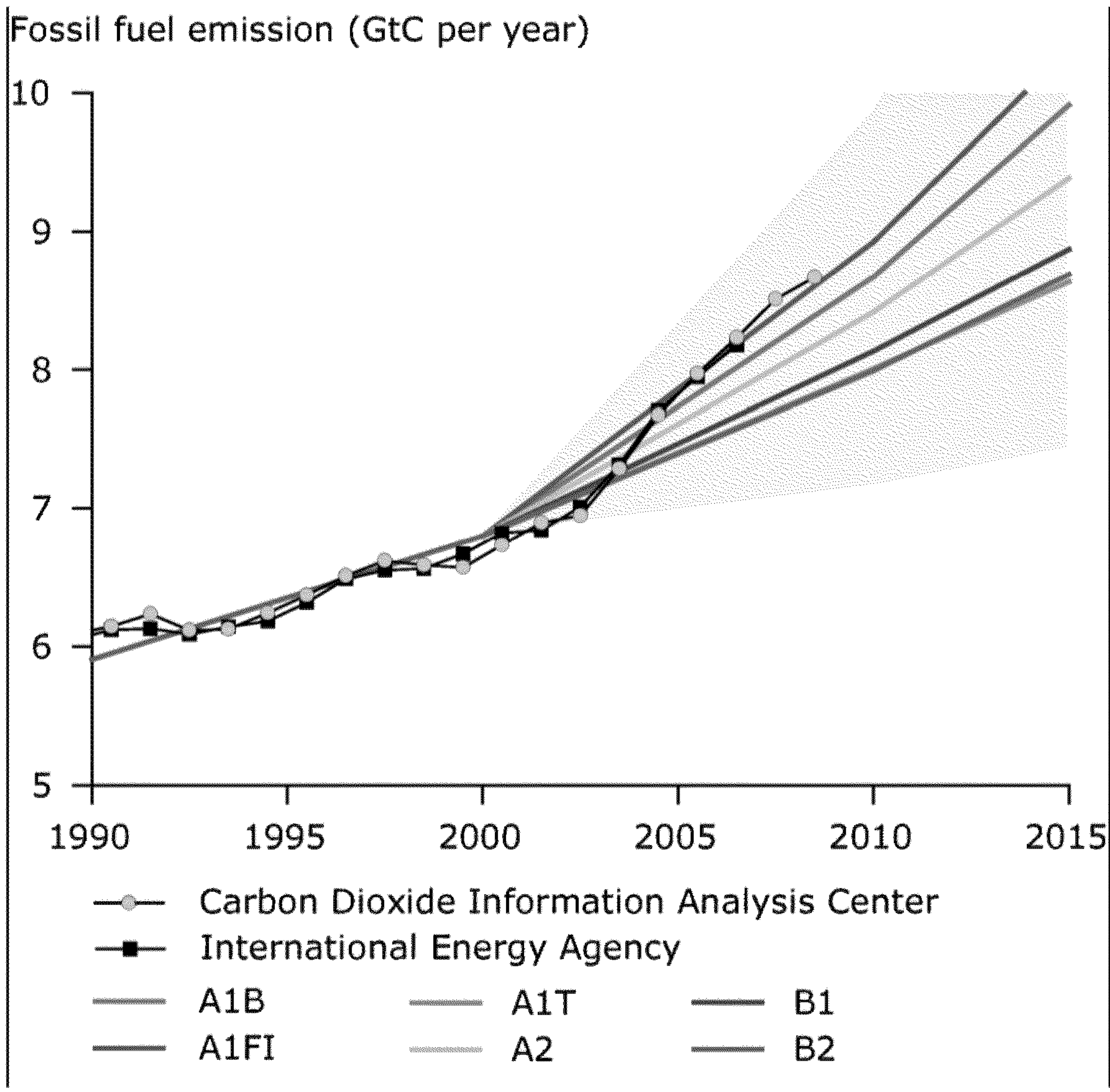
[36] *Id.* at 3-7, 3-9 – 3-10; NRC (2011) at 209-210; NRC (2010) at 55-56, 59-60.
[37] Barbel Honsich *et al.*, *The Geological Record of Ocean Acidification*, 335 Science 1058, doi: 10.1126/science/1208277 (Mar. 16, 2012), attached as **Ex. 32.**
[38] Kunshan Gao *et al.*, *Rising CO_2 and increased light exposure synergistically reduce marine primary productivity, Nature Climate Change*, doi 101038/nclimate1507 (May 6, 2012), attached as **Ex. 33**.
[39] *Id.* at 3.
[40] *Id.* at 1.
[41] Available at http://www.eea.europa.eu/data-and-maps/figures/observed-global-fossil-fuel-co2/ccs102_fig2-3.eps.



The graph shows six IPCC emissions scenarios (labeled A1B to B2), compared with atmospheric carbon measurements from two sources. The highest scenario, A1F1, which is based on a "world of very rapid economic growth" with "fossil-intensive" energy systems,[42] is the most aggressive scenario generally modeled. As the graph demonstrates, global emissions have rapidly increased to match, or even slightly outpace, the A1F1 scenario. Thus, in the absence of swift emissions reductions, we can expect to experience harms even greater than those projected under the IPCC's highest emissions scenarios.

Indeed, recent reports from the IPCC and leading scientific journals confirm that threats to public health and welfare from greenhouse gases are even more pressing than

[42] *See* IPCC, Fourth Synthesis Report at 44 (2007), **Ex. 3**, *supra*.

anticipated just a few years ago. Evidence continues to accumulate that the IPCC's sea level rise projections in its Fourth Assessment Report were quite conservative. A recent IPCC report, for instance,[43] notes that "satellite-measured sea levels continue to rise at a rate closer to that of the upper range of [earlier] projections" and that "the contribution to sea level due to [ice] mass loss from Greenland and Antarctica is accelerating.".[44] Thus, sea level rise – and associated infrastructure damage to American communities – is likely rise at a rate closer to the upper bound, or higher than, the IPCC's projections.[45]

Recent modeling results project that by mid-century warming may by significantly greater than scientists had previously forecast. According to these researchers, average global temperatures could warm by 1.4-3°C (2.5 – 5.4°F), relative to the 1961-1990 period, by 2050, even under mid-range emissions scenarios (which global emissions presently significantly exceed).[46]

This research—in combination with the recent comprehensive analyses by the National Research Council of the National Academy of Sciences of the risks posed by climate change to American communities—indicates that the urgency of acting to curb greenhouse gas emissions has, if anything, grown since the 2009 Endangerment Finding. Emission trajectories are already at or beyond what was anticipated in the foundational 2007 IPCC reports, and are causing severe effects on an accelerated timeline. In the absence of substantial emissions reductions, these threats to public health and welfare may well be catastrophic.

B. Climate Stabilization Requires Immediate, Deep, Reductions in Emissions in the EGU Sector.

1. Emissions from the U.S. Power Sector Must be Controlled to Prevent Serious Harm to Public Health and Welfare

Emissions from the United States power sector are among the single largest contributors to greenhouse gas pollution. Without emissions controls for this sector, it will be very difficult, if not impossible, to stabilize atmospheric greenhouse gas emissions at a safe level.

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[43] IPCC, *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation* (2012), attached as **Ex. 34.**

[44] *Id.* at 178-79.

[45] For a discussion of those impacts, see U.S. Global Change Research Program, Global Climate Change Impacts in the United States (2009) at 111, 139, 145, 149.

[46] *See* Daniel J. Rowlands *et al.*, *Broad range of 2050 warming from an observationally constrained large climate model ensemble*, 5 Nature Geoscience 256 (2012), doi: 10.1038/nego1430 (Mar. 25, 2012), attached as **Ex. 35.**

CO_2 emissions from power plants are the single largest source of U.S. emissions and are a significant component of global emissions. The EPA's Inventory of Greenhouse Gas Emissions and Sinks reports that electrical generation was responsible for 2,258 million metric tons of CO_2 in 2010 (the most recent year of the inventory), which is 39% of annual U.S. CO_2 emissions. [47] Power plant emissions are larger than those of the next largest stationary source category, oil and gas production,[48] and are larger than emissions from the entire U.S. transportation sector. If we are to reduce the United States' contribution to global warming, we must address this major emissions source.

Importantly, doing so will require controlling emissions from plants fueled by *all* fossil fuels, not just coal plants. This is because natural gas plants, in particular, have significant emissions and because, as EPA recognizes in its proposed NSPS, the majority (if not all) of new fossil-fired plants are likely to use natural gas. *See, e.g.*, 77 Fed. Reg. at 22,399. Further efforts to cut carbon emissions must, accordingly, include reductions from these plants.

Specifically, in 2010, combustion at coal-fired power plants was responsible for 1,827.3 million metric tons of CO_2 emissions, while combustion at natural-gas-fired plants was responsible for 399.4 million metric tons of CO_2 emissions.[49] The dominance of coal combustion emissions demonstrates why controls on all coal-fired power plants are necessary to reduce sector emissions, but natural gas-fired plant emissions are also highly significant.

These emissions are particularly important to constrain because natural-gas-fired power plants are the primary source of growth in the category. As the Energy Information Administration (EIA) records, from 2007 to 2011, as the boom in shale gas production lowered gas prices, net coal generation fell from over 2 billion MWh to 1.73 billion MWh, and is set to decline further.[50] During the same period, net natural gas generation climbed from 869 million MWh to over 1 billion MWh, as a result of both increased capacity factors at existing plants and new facility construction, and, as EPA predicts, is likely to continue to increase.[51]

The combustion emissions from new natural gas plants are significantly lower than conventional coal-fired generation. However, achieving greenhouse gas pollution reduction benefits relative to conventional coal-fired plants depends on using the most efficient and lowest-emitting natural gas plants with state-of-the-art combined cycle

[47] U.S. EPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2010* (2012), attached as **Ex. 36**, at Table ES-2.
[48] *See id.*
[49] *Inventory of U.S. Greenhouse Gas Emissions and Sinks* at Table 3-6.
[50] EIA, *Electric Power Monthly* (May 2012) at Table 1.1., attached as **Ex. 37**.
[51] *Id.*

turbines, and also ensuring that potent methane emissions from the production, transportation, and distribution of natural gas are minimized.[52]

Doing so is important if we are to curb dangerous climate-destabilizing emissions, and to responsibly manage the nation's natural gas resources. Further, it is essential that the nation's clean air and clean energy policies stimulate innovation in and deployment of low-carbon and renewable energy resources so that the nation can transition to low-carbon energy generation and expansive use of energy efficiency.

2. Deep Cuts in U.S. Power Sector Emissions Are Consistent with the Global Need for Emissions Reductions

Domestic action will have global benefits. As of 2008, the United States was responsible for approximately 14% of anthropogenic global greenhouse gas emissions.[53] Globally, U.S. power sector emissions constitute approximately 5% of emissions of all greenhouse gases (in CO2e terms) from all anthropogenic sources and about 10% of CO2 emissions.[54] Reducing these emissions will help to substantially reduce the U.S. contribution to climate change.

Significant reductions from large sources like the U.S. power sector are important because steep global cuts are necessary to prevent truly disastrous climate disruption. The National Research Council's 2011 report on climate stabilization reports that steep emission reductions, on the order of 80% globally, are necessary to stop CO_2 concentrations in the atmosphere from reaching dangerous levels and temperatures from exceeding 2°C above pre-industrial levels.[55] To do so, as shown by the below table

[52] We note that emissions from the natural gas production required to support these power plants are also significant; gas production is the second largest stationary source of greenhouse gas pollution according to EPA. *See Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2010*) at Table ES-2. EPA's recent emissions standards for that sector contain partial collateral mitigation of methane emissions from production, and so are critically important to maintain and strengthen as production expands. These standards, however, include important gaps; most notably, they do not directly control methane and do not set standards for existing infrastructure which produces the bulk of emissions. If natural gas generation continues to play an important role in the EGU sector, EPA must set appropriate production standards to ensure that increases in natural gas generation are not coupled with increases in greenhouse gas pollution due to methane leakage during gas extraction and transmission.
[53] European Union Emission Database for Global Atmospheric Research (EDGAR), *Total GHG Emissions Table*, available at http://edgar.jrc.ec.europa.eu/overview.php.
[54] According to the EDGAR database, global emissions in 2008 were 46,917 million metric tons CO_2e.
[55] National Research Council, *Climate Stabilization Targets* (2011) at 10, **Ex. 6,** *supra***.**

drawn from the IPCC's Fourth Assessment Report, global CO_2 emissions must fall by between 50-85% by 2050.[56]

Category	Radiative forcing (W/m²)	CO_2 concentration[c] (ppm)	CO_2-eq concentration[c] (ppm)	Global mean temperature increase above pre-industrial at equilibrium, using "best estimate" climate sensitivity[b, c] (°C)	Peaking year for CO_2 emissions[d]	Change in global CO_2 emissions in 2050 (% of 2000 emissions)[d]	No. of assessed scenarios
I	2.5-3.0	350-400	445-490	2.0-2.4	2000-2015	-85 to -50	6
II	3.0-3.5	400-440	490-535	2.4-2.8	2000-2020	-60 to -30	18
III	3.5-4.0	440-485	535-590	2.8-3.2	2010-2030	-30 to +5	21
IV	4.0-5.0	485-570	590-710	3.2-4.0	2020-2060	+10 to +60	118
V	5.0-6.0	570-660	710-855	4.0-4.9	2050-2080	+25 to +85	9
VI	6.0-7.5	660-790	855-1130	4.9-6.1	2060-2090	+90 to +140	5
						Total	177

a) The understanding of the climate system response to radiative forcing as well as feedbacks is assessed in detail in the AR4 WGI Report. Feedbacks between the carbon cycle and climate change affect the required mitigation for a particular stabilization level of atmospheric carbon dioxide concentration. These feedbacks are expected to increase the fraction of anthropogenic emissions that remains in the atmosphere as the climate system warms. Therefore, the emission reductions to meet a particular stabilization level reported in the mitigation studies assessed here might be underestimated.

b) The best estimate of climate sensitivity is 3°C [WG 1 SPM].

c) Note that global mean temperature at equilibrium is different from expected global mean temperature at the time of stabilization of GHG concentrations due to the inertia of the climate system. For the majority of scenarios assessed, stabilisation of GHG concentrations occurs between 2100 and 2150.

d) Ranges correspond to the 15th to 85th percentile of the post-TAR scenario distribution. CO_2 emissions are shown so multi-gas scenarios can be compared with CO_2-only scenarios.

It will be difficult to meet these reductions without emissions controls for the U.S. power sector.

In the remainder of these comments, we explain what EPA must do in order to meet its Clean Air Act mandate to ensure that all sources in this sector comply with Section 111 standards. A strong NSPS for the power sector is critical to achieving the emissions reductions necessary to prevent dangerous climate change.

II. Delineation of the Source Category

A. EPA Has Reasonably Grouped Coal- and Natural Gas-Fired Power Plants in Category TTTT

EPA proposes to create a new category, TTTT, encompassing "electric utility steam generating units (boilers and IGCC units, which are currently included in the Da category) and combined cycle units that generate electricity for sale and meet certain size criteria (which are currently included in the KKKK category)" for the purposes of regulating GHG emissions. 77 Fed. Reg. at 22,394/2.

This proposal falls squarely within EPA's broad discretion under section 111 to group sources that perform the same function into a single category, combining sources that

[56] IPCC, *Summary for Policymakers, Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (2007) at 15, **Ex. 3** *supra*.

use diverse production methods and fuels to create the same end product. EPA's proposal comports with recent trends in the electricity market, reinforcing the move toward less expensive, lower carbon generation sources. Indeed, Joint Environmental Commenters suggest that EPA should go further and include in the same category all fossil fuel-fired electric generating sources that provide power to the grid, including simple cycle units, since they serve the same broad function. If EPA determines that units that that provide only peaking power should not be subject to the performance standard applicable to intermediate load and baseload units, EPA should adopt a separate standard for those units promptly, but EPA should not exempt any fossil fuel-fired generating units or differentiate among them based on technology or fuel type.

1. **The Combined TTTT Category Matches the Current Structure of the Power Sector**

EPA's inclusion of all fossil fuel-fired plants providing baseload and intermediate-load generation in a single NSPS category is appropriately responsive to new power sector market realities and will improve the environmental efficacy, economic efficiency, and regulatory coherence of the performance standards promulgated for sources in Subpart TTTT.

The first § 111 performance standards promulgated for power plants (in 1971) applied to steam-generating power plants that burned any type of fossil fuel (Subpart D) and governed emissions of SO_2, particulate matter, and NO_x.[57] These standards were revised in 1979, creating Subpart Da.[58] Also in 1979, EPA established performance standards for natural gas turbines to limit emissions of NO_x and SO_2 (Subpart GG).[59] These standards were revised in 2006, creating Subpart KKKK.[60] Also in 2006, EPA moved one type of baseload and intermediate load generating source (Integrated Gasification Combined Cycle Units (IGCC), previously covered under Subpart GG) into the Da category.[61] Following the pattern of consolidation of baseload generation that began in 2006 with the transfer of IGCC plants to Da, proposed category TTTT would encompass all fossil fuel-fired plants providing baseload and intermediate load generation – gas-fired combined cycle (CCNG) units (currently regulated under KKKK) and steam-generating

[57] Standards of Performance for New Stationary Sources, 36 Fed. Reg. 24876, 24879 (Dec. 23, 1971).

[58] New Stationary Sources Performance Standards; Electric Utility Steam Generating Units, 44 Fed. Reg. 33580 (June 1, 1979).

[59] Standards of Performance for New Stationary Sources; Gas Turbines, 44 Fed. Reg. 52792 (Sept. 10, 1979).

[60] Standards of Performance for Stationary Combustion Turbines, 71 Fed. Reg. 38482 (July 6, 2006).

[61] 77 Fed. Reg. at 22,411 (discussing 40 CFR part 60, subpart Da and 70 Fed. Reg. 9706 (Feb. 28, 2005)).

electric generating units and integrated gasification combined cycle units (currently regulated under Da) for the purposes of CO_2 regulation.[62]

Unlike when the NSPS categories were created, coal- and natural gas-fired power plants are now operating interchangeably to provide baseload and intermediate-load generation. An electricity supplier meeting new demand has the option of building a coal-fired plant or a natural gas-fired plant, investing in energy efficiency, or installing renewable generation. As between a coal-fired plant and a natural gas-fired plant, the economics strongly favor CCNG plants.[63]

It is difficult to overstate the transformation in energy markets that has occurred in the United States since the first power plant NSPS categories were listed. For many decades coal- and oil-fired generation provided the majority of baseload fossil fuel-fired generation in the United States,[64] while natural gas plants generally operated in intermediate-load and peaking modes. [65] In 1978, motivated by perceived scarcity of fossil fuel resources, [66] Congress passed and President Carter signed into law a *prohibition* on the use of natural gas in baseload power generation – preserving supplies for use in other applications.[67] In 1987, however, the prohibition was reversed.[68] Between 1988 and 2002 natural gas consumption for electric generation more than doubled,[69] and between 1998 and 2008 more than 90% of new electric capacity built in the United States was natural gas-fired generation.[70]

The shift towards natural gas generation in the power markets has accelerated since 2006 due to the increase in natural gas resources driven by the development of

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[62] 77 Fed. Reg. at 22410 – 22411.

[63] *See* EIA, Updated Capital Cost Estimates for Electricity Generation Plants (November, 2010) at 7. *Available at:* http://205.254.135.7/oiaf/beck_plantcosts/pdf/updatedplantcosts.pdf

[64] EIA, Annual Energy Review 1995 (July 1996) at 235. http://205.254.135.7/totalenergy/data/annual/archive/038495.pdf.

[65] See 44 Fed. Reg. at 52796.

[66] *See, e.g.,* Jimmy Carter, National Energy Bills Remarks on Signing H.R. 4018, H.R. 5263, H.R. 5037, H.R. 5146, and H.R. 5289 Into Law, November 9 1978. "[W]e must shift toward more abundant supplies of energy than those that we are presently using at such a great rate, to coal[.]" *Available at*: http://www.presidency.ucsb.edu/ws/index.php?pid=30136&st=Industrial+Fuel+Use+Act&st1=#ixzz1yRwPuLkN

[67] Sec. 201. New Electric Powerplants, PL 95–620, November 9, 1978, 92 Stat 3289

[68] Sec. 201. Coal Capability of New Electric Powerplants; Certification of Compliance, PL 100-42, May 21, 1987, 101 STAT. 311

[69] EIA, Repeal of the Powerplant and Industrial Fuel Use Act, http://www.eia.gov/oil_gas/natural_gas/analysis_publications/ngmajorleg/repeal.html

[70] Natural Gas Supply Association, Natural Gas Is Vital for Electric Power Generation (2008). *Available at*: http://www.ngsa.org/assets/Docs/Issues/NaturalGasIsVitalForElectricPowerGeneration.pdf

technology to access shale gas. Shale gas accounted for only two percent of total U.S. natural gas production in 2001, and 30 percent by 2011.[71] The U.S. Energy Information Administration projects that this growth will continue, and that shale gas will account for 47 percent of domestic natural gas production by 2035.[72] These developments have led to a sharp reduction in the cost of natural gas for electric power generation, with prices dropping by 60% from 2005 to 2012.[73] As noted elsewhere, Energy Information Administration data indicate that from 2007 to 2011 net coal generation fell from over 2 billion MWh to 1.73 billion MWh, and is set to decline further.[74] During the same period, net natural gas generation climbed from 869 million MWh to over 1 billion MWh, as a result of both increased capacity factors at existing plants and new facility construction. EPA predicts that it is likely to continue to increase.[75]

Today, natural gas plants are commonly operating as baseload plants, providing 25% of U.S. net power generation in 2011,[76] compared to only 10% in 1994.[77] As discussed elsewhere, market analyses project that only new natural gas units (as well as renewables and energy efficiency investments) will be built to serve any growth in energy demand.[78]

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[71] SEC'Y OF ENERGY ADVISORY BD, SHALE GAS PRODUCTION SUBCOMMITTEE 90-DAY REPORT 6 (Aug. 18, 2011), *available at* http://www.shalegas.energy.gov/resources/081811_90_day_report_final.pdf [hereinafter 90-DAY REPORT].

[72] U.S. Energy Information Administration, Annual Energy Outlook 2011 (2011) at 79, *available at* http://205.254. 135.7/forecasts/aeo/pdf/0383(2011).pdf

[73] EIA, Natural Gas Monthly May 2012 at 7, http://205.254.135.7/naturalgas/monthly/pdf/ngm_all.pdf; EIA, Natural Gas Monthly December 2007 at 7, http://205.254.135.7/naturalgas/monthly/archive/2007/2007_12/pdf/ngm_all.pdf

[74] EIA, *Electric Power Monthly* (Apr. 2012) at Table 1.1., attached as Ex. **X**

[75] *Id.*

[76] EIA, Electric Power Monthly May 2012 at 11. http://205.254.135.7/electricity/monthly/pdf/chap1.pdf

[77] EIA, Electric Power Monthly July 1996 at 10. http://205.254.135.7/electricity/monthly/archive/pdf/02269607.pdf; In March 2012, natural gas provided 30% of U.S. net power generation, while coal provided 34%. *See* EIA, U.S. coal's share of total net generation continues to decline (June 5, 2012), *Available at: http://www.eia.gov/todayinenergy/detail.cfm?id=6550.*

[78] *See, e.g.,* EIA, Annual Energy Outlook 2011 (2012) at Table A-9: Electric Generating Capacity. http://www.eia.gov/forecasts/aeo/er/pdf/tbla9.pdf; *See also* EIA, Annual Energy Outlook 2010 (2011) at 67. http://www.eia.gov/oiaf/archive/aeo10/pdf/0383(2010).pdf; Utilities' actions reflect this shift. PSEG plans to increase natural gas from 15 to 35 percent of its generation and shrinking coal's share from 35 to 15 percent. (Steven Mufson "Cheap natural gas jumbles energy markets, stirs fears it could inhibit renewable," The Washington Post (February 1, 2012)); and Southern Company CEO Thomas Fanning observed, "4 years ago...we were about 70% of our energy from coal, and ... about 12% from gas ... In the fourth quarter [of 2011] ... our energy production was 40% coal, 39% gas...Now moving forward, given where gas prices are, we will

Where multiple processes are functionally interchangeable, they should be categorized together to allow for a more rational and comprehensive analysis of opportunities for emission reduction, in order that the most efficient and effective emission reduction opportunities can be identified while being responsive to market realities. As discussed below, EPA has often organized NSPS categories by function in recognition of this principle of regulatory and environmental efficacy.

Selecting a rational definition of source categories that properly reflects industry realities is especially critical given the enormous significance of the power generation sector in contributing to the urgent public health and welfare threats posed by greenhouse gas emissions. As noted elsewhere, the United States power sector is responsible for 40% of U.S. CO_2 emissions[79] and 11% of global CO_2 emissions.[80] Mitigating the risk of catastrophic climate change by curbing greenhouse gas emissions will require major emission reductions from fossil fuel fired power plants. Achieving those reductions as efficiently and cost-effectively as possible is of paramount importance. Grouping together CO_2-emitting sources that provide baseload generation allows EPA to identify the most cost-effective and efficient means of reducing emissions from these sources.

Finally, the categorization used for 111(b) standards also informs the 111(d) performance standards for existing sources. Including all major fossil fuel-fired power plant types in a single performance standard for existing plants will be of equal or even greater importance as EPA develops a 111(d) framework. Encompassing all fossil-fuel fired generation that provides power to the integrated electricity grid may well be essential for ensuring that emissions from existing power plants can be sharply but efficiently and cost-effectively reduced consonant with the statutory language.

2. **Source Categories May Encompass Multiple Production Methods and Fuels**

The statutory text plainly grants EPA discretion to create category TTTT. Section 111(b)(1)(A) directs EPA to designate "categor[ies] of sources . . . [that] cause[] or

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continue to see much more gas production, so it'll become more important." Southern Company, Q4 Earnings Call Q&A, 1/25/2012.

[79] EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 – 2010 (April 15, 2012) at ES-4. http://www.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2012-Main-Text.pdf

[80] *Id.*, showing US power plant CO2 emissions data; United Nations Framework Convention on Climate Change (UNFCCC), National greenhouse gas inventory data for the period 1990–2009 (2011) at 11, showing CO2 emissions data for annex I countries. http://unfccc.int/resource/docs/2011/sbi/eng/09.pdf.; UNFCCC, Sixth compilation and synthesis of initial national communications from Parties not included in Annex I to the Convention (2005) at 6, showing CO2 emissions data from non-annex I countries.

contribute[] significantly to air pollution which may reasonably be anticipated to endanger public welfare." EPA must revise its source category designations "from time to time." *Id.* EPA "*may* distinguish among classes, types, and sizes *within* categories of new sources." § 111(b)(2) (emphases added). Thus, the statute plainly contemplates source categories encompassing different "classes, types, and sizes" of sources, and grants EPA discretion to *not* create subcategories that distinguish among these.

EPA's Section 111(b)(1)(A) authority to revise the source category list includes authority to merge all or part of two existing categories. (We address the question of endangerment separately, below.) EPA undoubtedly has authority to revise the list to add categories covering sources that previously were wholly unregulated, and nothing in the statutory language precludes EPA from changing or combining categories that have already been listed as long as EPA has a rational basis for its categorization decisions.

Categorizing sources by end product, as EPA proposes here, is consistent with the legislative history of the Clean Air Act. In 1970, Congress emphasized that standards would apply to industrial categories, broadly defined, which would suggest focusing on product and pollution, not process:

> [the Agency] could establish uniform pollution control standards for the chemical, oil refining, foundries, food processing, and cement-making industry, and other industries. In each case the pollution control regulation would be directed to the specific pollution of a specific industry. Every plant within the same group could be required to maintain the same high standards. There would be no variation in pollution control procedure by a given industry by region or area of operation.

116 Cong. Rec. 19,218 (1970) (statement of Rep. Vanik).
Categorizing sources by end product is a reasonable and established approach to categorization. As EPA explains, "with the combination, all new fossil fuel-fired electricity generating units that meet specified minimum criteria will be subject to the same requirements, and therefore will be treated alike because they serve the same function, that is to serve baseload or intermediate demand." 77 Fed. Reg. at 22410. EPA has designated product-based categories as early as 1976, when EPA designated a single NSPS encompassing multiple copper smelting production methods. There, EPA set a single standard for new sources despite the use of four different smelting furnace technologies in the US at the time. *Standards of Performance for New Stationary Sources, Primary Copper, Zinc, and Lead Smelters,* 41 Fed. Reg. 2332-2333 (Jan. 15, 1976). EPA explicitly determined that a production method that inherently produced fewer emissions could be BSER, rejecting the argument that BSER only encompasses emission control hardware. *Id.* at 2333.

Since then, numerous other NSPS have categorized sources by function even though the sources may use different technologies, fuels, or processes. As noted in EPA's proposal here, EPA previously combined into one category units that generate electricity for baseload or intermediate demand, moving IGCC units from Category GG to Category Da. 77 Fed. Reg. at 22,411 (discussing 40 CFR part 60, subpart Da and 70 Fed. Reg. 9706 (Feb. 28, 2005)).

Before that, EPA published a "uniform [NSPS] for all utility boilers" for nitrogen oxide emissions, in which EPA set a single standard of 1.6 pounds of NOx per megawatt hour of electricity produced for all new plants, refusing requests to set separate relaxed standards (*i.e.*, to create separate categories or subcategories) for high-sulfur coal-fired boilers and fluidized bed combustion boilers. *Revisions of Standards of Performance for Nitrogen Oxide Emissions for New Fossil-Fuel Fired Steam Generating Units*, 63 Fed. Reg. 49,442, 49,445 (Sept. 16, 1998). EPA's decision to promulgate a single NOx standard, rather than to set "a range of standards by boiler and fuel type," was affirmed by the D.C. Circuit. *Lignite Energy Council v. EPA*, 198 F.3d 930, 933 (D.C. Cir. 1999).

Similarly, EPA adopted a standard applicable to all rotary lime kilns, regardless of whether they were fueled by coal, natural gas, or oil. 47 FR 38832, 38843, see also 40 C.F.R. §§ 60.340(a), 60.342. Most recently, EPA promulgated a single standard for all Portland cement plants, rejecting calls for separate standards for different kiln types (*e.g.* "long wet," "long dry," "preheater," and "preheater with precalciner") or fuels. 75 Fed Reg. 54970, 55,010 – 55,012, 55,015 (Sept. 9, 2010). Promulgation of this single performance standard for different types of sources in the cement kiln category was upheld by the DC Circuit. *Portland Cement Ass'n* v. *EPA,* 665 F.3d 177, 190-93 (D.C. Cir. 2011). *see also* 40 C.F.R. § 60.62(a).[81]

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[81] EPA has also created product-based, rather than fuel- or method-based, categories under the section 112 NESHAP program. Section 112(c)(1) uses language similar to Section 111 in directing EPA to list "categories and subcategories" of sources. The Section 112 categories are to be "consistent with" the Section 111 categorizations "[t]o the extent practicable." *Id.* Section 112(d)(1) likewise provides that EPA "*may* distinguish among classes, types and sizes of sources within a category or subcategory." As EPA has observed, this statutory language is "almost identical" to the language used in Section 111, such that categorization under the two sections should be interpreted similarly. *National Emission Standards for Hazardous Air Pollutants From Coal- and Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units*, 77 FR 9304, 9378 (Feb. 16, 2012).

EPA's Section 112 decisions further demonstrate the appropriateness of the combined category here. EPA's recent NESHAP for Portland cement kilns, promulgated in conjunction with the NSPS discussed above, explicitly refused to subcategorize on the basis of "type of kiln, presence of an inline raw mill, practice of wasting cement kiln dust, total mercury inputs [from different fuel types or from differing limestone inputs], or geographic location." 75 Fed. Reg. at 54,978 (citing

As these examples demonstrate, EPA may – and frequently has – put sources that use different processes in the same category even when one process can meet a stronger standard than the other, or can meet the same standard at lower costs than the other. As early as the copper smelter NSPS, EPA explained that it could set a "single standard [that] would effectively preclude using a process which is much less expensive than the permitted process" so long as the total cost of standard was reasonable.[82] 41 Fed. Reg. at 2333-2334. Thus, EPA adopted a copper smelting standard that EPA acknowledged "favored construction of new flash and electric furnaces over new reverberatory smelting furnaces," the latter of which would face greater expense in meeting the standard. 41 FR 2332-2333. The Portland cement kiln NSPS similarly adopted a uniform NOx standard despite concluding that older kiln designs would face greater costs in meeting this standard. *Portland Cement Ass'n*, 665 F.3d at 190. The statute does not entitle a lagging process – one that is inherently more polluting than another, or one that can meet a given emission level only at higher cost than another – to its own category or subcategory with a weakened standard.

As EPA has correctly stated here, Section 111(a)(1) defines a standard of performance as "*a* standard" reflecting "*the* degree" of emission limitation achievable through application of "the *best* system of emission reduction" that, taking into account costs and other factors, "the Administrator determines has been adequately demonstrated" (emphasis added). The use of the singular and the superlative belie any requirement to water the standard down to accommodate lagging technologies.

To be sure, Section 111(b)(2) states that the Administrator "*may* distinguish among classes, types, and sizes within categories for the purpose of establishing such standards" (emphasis added), but the statute does not require such

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the earlier proposal, 74 Fed. Reg. at 21,144-21,145). The Cement Kiln NSPS, like the NESHAP, did not subcategorize on any of these divisions either. In promulgating a NESHAP for "hardboard" composite wood product processing, EPA adopted a single standard for multiple production methods and refused to promulgate a variance procedure for an uncommon process that would face higher costs in achieving the standard. *Natural Res. Def. Council v. E.P.A.*, 489 F.3d 1364, 1375 (D.C. Cir. 2007) (citing National Emission Standards for Hazardous Air Pollutants: Plywood and Composite Wood Products, 69 Fed. Reg. 45,944 (July 30, 2004)). This decision was upheld by the DC Circuit. *Id.* In the rulemaking, EPA determined that equipment should be classified "according to its function," including the end product and the market in which that product competes. *Id.* (citing 69 Fed. Reg. at 45,948, Summary of Public Comments and Responses at 2-49 (Feb. 2004)). Available at http://www.epa.gov/ttn/atw/plypart/pcwp_final_bid_feb2004.pdf.

[82] Put differently, EPA concluded that the fact that a standard would "effectively preclude" a certain production method was not itself a demonstration that the standard was unreasonable or not economically achievable.

subcategorizations.[83] If, as here, EPA has a reasonable basis, considering the factors in Section 111(a)(1), to hold an entire category of sources to the same emission standard, there is no requirement to set a separate standard for one subgroup. In this case, as EPA has explained, the fact that prospective plant builders have the alternative of building an NGCC plant that can meet the proposed standard at reasonable cost is a sufficient basis for requiring that standard for all fossil fueled EGUs performing the same function. The alternative pathway for coal-fired power plants that install carbon capture and sequestration technology provides additional flexibility for processes other than NGCC to comply, making EPA's action even more reasonable.

3. **Industry Trends Support A Fuel-Neutral Standard**

EPA has strong support for its forecast that only gas-fired power plants will be built to serve baseload and intermediate load growth from other governmental forecasts, and from the electric power industry and financial world. Market analyses project that only new natural gas units (as well as renewables and energy efficiency investments) will be built to serve any growth in energy demand. As Brookings senior economist Peter Wilcoxen explained in April:

> To put it simply: the life-cycle costs of coal-fired power are considerably higher than gas-fired power. This is not a theoretical matter: over the last decade, the electric power sector has responded by adding more than about 200 gigawatts of gas-fired capacity and about 2 gigawatts of coal. The US now has considerably more gas-fired capacity than coal-fired capacity and low gas prices will accelerate that trend even without the EPA decision.[84]

Wilcoxen continued: "Finally, because it only rules out an expensive option that wouldn't have been used anyway, the EPA rule will have no significant effect on electricity prices."

Power companies simply aren't planning to build new coal plants, due to the availability of low-cost natural gas, strong growth in wind and solar power, big opportunities to improve energy efficiency, and even the potential for nuclear power. For example, the country's largest current CO2 emitter, American Electric Power, told the National Journal in March that the proposed rule "doesn't cause immediate concern" for the company. "We don't have any plans to build new coal plants," said AEP spokesperson Melissa McHenry. She continued, "Any additional generational plants we'd build for the next generation will be natural gas." Similarly, PSEG plans to increase natural gas from

[83] *See Lignite Energy Council v. EPA*, 198 F.3d 930, 933 (D.C. Cir. 1999) ("EPA is not required by law to subcategorize – section 111 merely states that 'the Administrator *may* distinguish…within categories.'" (emphasis in the original)).
[84] http://mediamatters.org/research/201204020012.

15 to 35 percent of its generation and shrink coal's share from 35 to 15 percent. And Southern Company CEO Thomas Fanning observed, "4 years ago...we were about 70% of our energy from coal, and ... about 12% from gas ... In the fourth quarter [of 2011] ... our energy production was 40% coal, 39% gas. . . .Now moving forward, given where gas prices are, we will continue to see much more gas production, so it'll become more important."

EPA's proposed action would be fully justified even if it would tip prospective plant builders away from building a new coal-fired EGU they otherwise would have built, and thus even if it would result in changing the forecast of what types of EGUs would be built in the absence of the standard. Standards of performance under Section 111 are intended to shift industry towards lower-emitting source designs and technologies. The standard would be fully justified even if it in fact raised the cost of new electric power generation above the no-standard forecast. While the courts have opined that Section 111(b) may rule out standards that impose "exorbitant" costs, Lignite Energy Council, 198 F.3d at 933 (citing National Asphalt Pavement Ass'n v. Train, 539 F.2d 775, 786 (D.C. Cir. 1976)), the statutory language provides no guarantee that compliance with standards must be achievable at the same cost for all technologies. The statute is "technology forcing"– forcing regulated entities to reach for potentially more expensive, but more protective, technologies even if the unregulated market would not lead to those choices.

This situation presents an even easier case, however, because EPA is following, rather than steering, industry trends. EPA has correctly assessed that no new conventional coal-fired EGUs are expected to be built in the baseline forecast: "[E]conomic models forecast no new construction of coal-fired generation without CCS through the analysis period, which extends until 2020 (when the standard will be revisited)." (Actually, EPA's Regulatory Impact Analysis and other forecasts support this conclusion through 2030, as discussed below.) As EPA concluded: "Because of those economic conditions, there is a strong independent movement of power plants serving baseload generation toward NGCC. In light of that movement, it is appropriate for the EPA to focus on this technology in developing the standard, rather than subcategorizing and providing a separate standard for new coal units."

In short, EPA has correctly assessed that due to baseline market realities – market realities absent this proposed standard – the nation is reasonably expected to meet its electricity needs over the next two decades without constructing new coal-fired plants. As a result, the proposed new source standard actually will impose no additional costs on the industry or on electricity rate-payers and will have no adverse impact on jobs. These market forecasts are robust. As discussed further, below, sensitivity analyses in EPA's Regulatory Impact Analysis show that power companies will not choose to construct any new conventional coal-fired plants before 2030 even if natural gas becomes 4-5 times more costly than it is today and power demand increases faster than expected.

The strength of these forecasts gives the lie to claims that the proposed standard is a "de facto" ban on new coal plants. If power companies simply are not going to build new coal plants for fundamental market reasons in the absence of the proposed carbon pollution standard, then that standard obviously can't be blamed for blocking new coal plants. The problem for new coal plants is that there is no market demand for them. The charge of a "de facto" ban is scapegoating, pure and simple.

These major changes in the fossil generation component of the electric generation industry have significant implications for EPA in carrying out its delegated rulemaking authority to establish standards of performance for greenhouse gas emissions from the power sector. EPA was not only authorized, but required, to take these new fundamental industry realities into account when establishing emissions standards to achieve the "best system of emission reduction" for an important newly regulated pollutant that is emitted in substantial volumes by all fossil fuel-fired power plants.

As EPA has pointed out, courts have specifically approved EPA's setting a standard based on one technology path when that is the path the industry is expected to follow in the underlying baseline market forecast. Id. at 22,411/1, citing Portland Cement Ass'n v. EPA, 665 F.3d 177, 190 (D.C. Cir. 2011) for "affirming the EPA's decision not to subcategorize in part because of 'the universal movement in the portland cement industry towards adoption of preheater/precalciner technology'."

Companies in practice compare natural gas and coal when investing in new baseload power generation, and market fundamentals have dramatically shifted to expansive reliance on gas-powered electricity generation. By including these functionally equivalent sources in the same category, EPA can more effectively assess the "best system of emission reduction" available. It is eminently sensible, indeed compelled by the strong normative term "best," for EPA to provide a fuel-neutral analysis of the best system of emission reduction. Cleaner fuels are often an important component of an effective system of emission reduction. Conversely, not to group these plants together and analyze the best system of emission reduction available for them, when they perform the same function and emit the same pollutant, would fall short of § 111's mandate to secure the maximum emission reductions available, taking cost and other relevant impacts into consideration.

As the Agency has noted previously, the NSPS does not protect high-polluting processes:

> For some classes of sources, the different processes used in the production activity significantly affect the emission levels of the source and/or the technology that can be applied to control the source. For this reason, the Agency believes that the 'best system of emission reduction' includes the processes utilized and does not refer only to emission control hardware. It is clear that adherence to existing process utilization could serve to undermine the

> purpose of section 111 to require maximum feasible control of new sources. In general, therefore, the Agency believes that section 111 authorizes the promulgation of one standard applicable to all processes used by a class of sources, in order that the standard may reflect the maximum feasible control for that class.

Standards of Performance for New Stationary Sources, Primary Copper, Zinc, and Lead Smelters, 41 Fed. Reg. 2332, 2333-2334 (Jan. 15, 1976).

4. **Treatment of Peaking Units and Simple-Cycle Gas-Fired Units**

EPA has asked for comment on the treatment of simple cycle natural gas-fired units that are currently within Category KKKK, and which EPA has proposed not to include in Category TTTT. EPA specifically requested comment on the option of excluding from Category TTTT facilities with permit restrictions limiting operation to less than 1/3 of their potential electric output, or approximately 2,900 hours of full load operation annually.

a. **Distinctions Among Fossil Fuel-Fired Power Plants Should Be Based on Function Rather than Purpose or Technology.**

Joint Environmental Commenters strongly support EPA's decision to combine fossil fuel-fired sources into one category, but we do not support EPA's blanket exclusion of all new simple cycle natural gas-fired units from the category. EPA has failed to justify excluding simple cycle units from any performance standard for GHG emissions. Indeed, there are compelling reasons for including all fossil fuel power plants that provide electricity to the grid in the same category. These units share the same broad function and they are operated as an integrated system.

If a distinction is needed between a peak-load unit and an intermediate-load or baseload unit, that distinction should be made on a functional, objective criterion – e.g., a legally-enforceable limit on how a unit is used – not on the basis of technology type or statements of the owner's or operator's purpose in constructing it. Insofar as EPA proposes to distinguish peaking units from baseload and intermediate- load units, true peakers can be effectively distinguished by an enforceable hours-of-operation limit, and a standard of performance can be rationally tailored to their limited utilization, rather than by categorically excluding all simple-cycle turbines or referring to the "purpose" for which units are constructed. As we discuss below, any such new units used for more than 2000 hours per year[85] should be considered to be serving baseload or intermediate load demand, and should be subject to the same emission limit as other new plants serving such load. To the extent that EPA concludes that peaking units should not be subject to the same standard, EPA should promptly set a separate appropriately tailored standard of performance in a supplementary rulemaking, but should not delay finalizing this rule.

This approach would preserve the option of prospective owners and operators to select designs that fit their expected patterns of use. If the builder of a new combustion turbine wants the option to use the unit for more than peaking purposes, it can add a heat recovery steam generator, for example, to increase the unit's efficiency and reduce its emission rate below the standard (turning the unit into an NGCC). This approach is a cost-effective emission control strategy for units designed to operate more than 2,000 hours per year.

There are several additional advantages to relying on a functional definition of intermediate-load and baseload EGUs, rather than including a categorical exclusion based on a particular technology. First, while market conditions make it unlikely that any new simple cycle combustion turbines would be built for use more than 2,000 hours per year, if such units were so operated there would be significant public health and environmental benefits to requiring them to comply with the proposed standard. Second, a functional approach is more robust in the face of unanticipated technological developments, which, for example, could make simple cycle turbines an economical option for intermediate-load operations – in which case they should be subject to the best system of emission reduction identified for sources serving that purpose. Finally, including an unnecessary categorical exemption from the proposed standard only serves to create the possibility that generators would seek ways to evade the standard by finding ways to qualify for that exemption.

b. The Definition of Electric Generating Unit Does Not Serve to Distinguish Peaking Units from Intermediate-Load and Baseload Units.

EPA has proposed the following definition of electric generating unit:

> *Electric utility generating unit* or *EGU* means any steam electric generating unit or stationary combustion turbine that is constructed for the purpose of supplying more than one-third of its potential electric output capacity and more than 25 MW net-electrical output to any utility power distribution system for sale.

[85] Our proposal below, includes a limit on daily hours or operation. Here we employ a short hand "2000 hours per year" to facilitate discussion of this recommendation.

This definition raises several concerns with regard to the possibility of using it to address peaking units. As an initial matter, any definition that relies solely on the "purpose" of a unit will be difficult, if not impossible, to enforce, especially if market conditions lead an operator to "repurpose" a unit after construction. EPA should revise this definition to provide for more objective criteria for defining an EGU. Further, EPA has not provided any rationale for its proposed use of the "**potential**" electric output of a unit or the reason why "one-third of the potential electric output" should differentiate between EGUs and non-EGU units. While this definition may not have been problematic in the past, the adoption of the proposed CO_2 emission limits may create significant new incentives for coal or gas units to circumvent the rules.

We note that peaking units and even intermediate-load units are built with the purpose of supplying less than one third of their potential electric output to the grid. Peaking units ordinarily have capacity factors of less than 15 percent and intermediate load NGCC units may operate for relatively few days per year so that their electric output is less than the proposed 33 percent of potential output. Further, such units may, and often do, operate at less than full load – an intermediate load unit could operate at 60 percent load factor for half of the year and still not generate 33 percent of its potential electric output capacity. Joint Environmental Commenters therefore strongly urge EPA to change the EGU definition to eliminate this significant loophole.[86] By limiting the sources included in the category to only those that supply more than one-third of their *potential electric output capacity* to the grid, EPA would exclude units that operate at a significant capacity for a significant portion of the year (e.g. 60 percent capacity for half the year). Such units are intermediate load rather than peaking units and should be subject to this standard. We believe this problem may be remedied if the definition is clarified so that a source is an EGU **if at any time** it provides more than one-third of its rated name plate energy capacity to the grid.

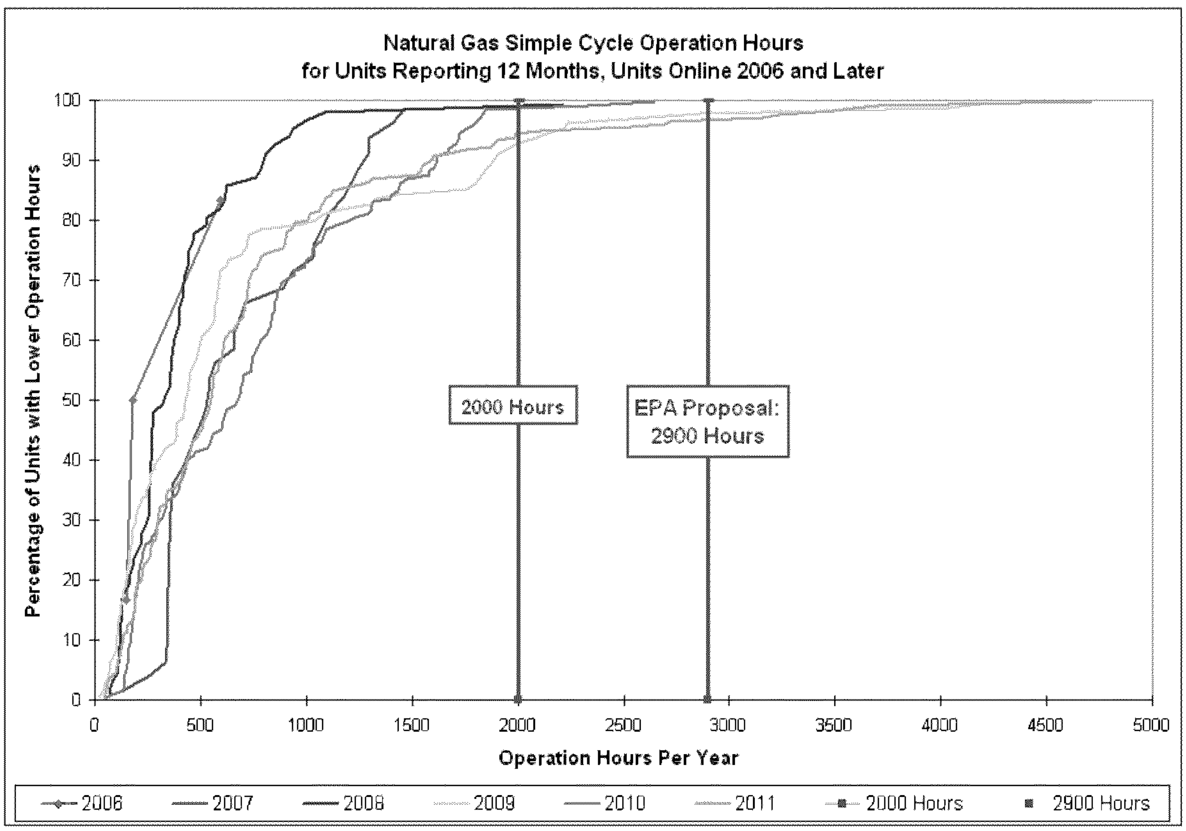
c. The Data Suggest that Simple Cycle Units Are Not Only Used to Serve Peak Power and that Peaking Units Are Those that Operate No More than 2000 Hours per Year.

The available data show that almost all simple cycle combustion turbine ("CT") units have low operating hours – but they also appear to show that there are a number of large CT units with high capacity factors. As discussed above, EPA should not use the definition of electric generating unit to define peaking units because this suggestion leaves open the possibility of intermediate-load units operating at less than rated

[86] We further suggest that EPA could accomplish its goal of providing separate treatment of peakers by defining EGUs without any reference to peakers, so that peakers remain in category TTTT, but by amending proposed section 60.5520(d) to provide a separate standard for peakers, defined using the approach we advocate above.

capacity for long periods of time being classified as peaking units. EPA has suggested that an alternate approach might be to establish a limit on the annual hours of operation of peaking units. We agree that an enforceable hour of operation limit is part of an appropriate alternative approach, but the histogram in Figure 1 shows that EPA's suggested 2900 hours is too high. The "knee in the curve" for these data appears to be below 2000 hours for 2011 (the most favorable[87] year for industry), thus showing that operation greater than 2000 hours is not consistent with the normal operation of CTs.

Figure 1. Hours of Operation for Combustion Turbines, by Year

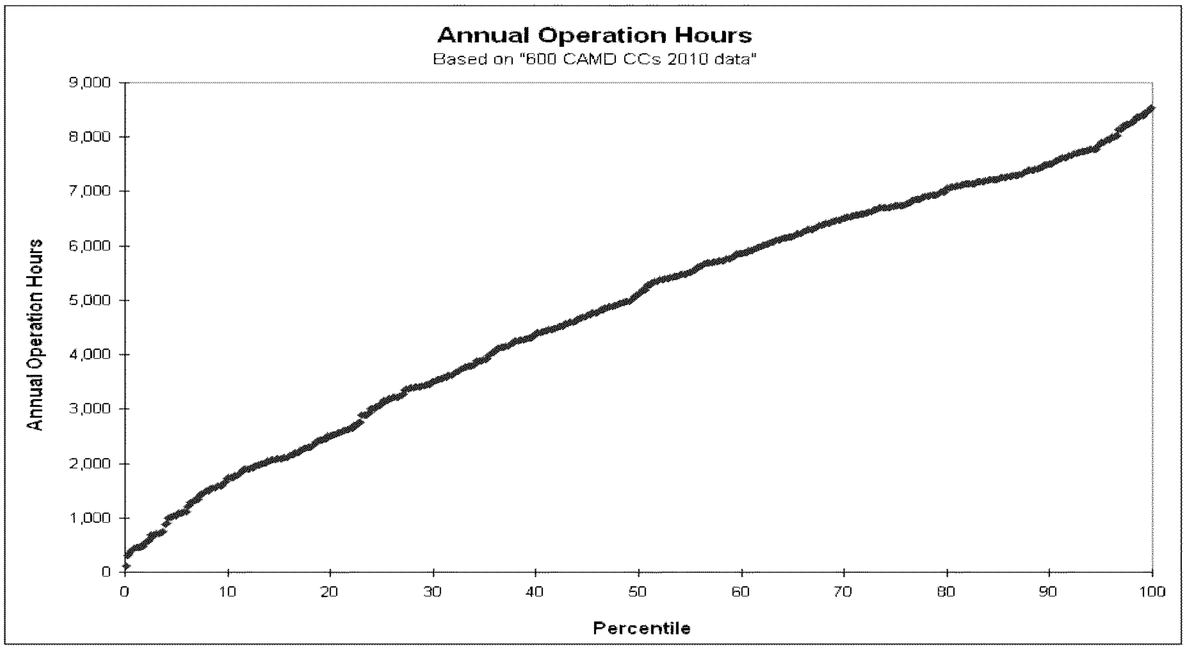


We note that even 2000 hours of operation may represent CTs that are in intermediate load rather than peaking operation, especially if such use is seasonal. We also note that there are a substantial number of combined cycle units that are designed for intermediate load applications but that may have limited hours of operation because of market conditions. Eighty-two of the 592 recently constructed[88] combined cycle units in

[87] For 2008, it is closer to 1100 hours.
[88] First year of operation 2006 or later.

the EPA CAMD data set, Figure 2, operate less than 2000 hours per year; 143 of those units operated less than 2900 hours per year.

Figure 2. Hours of Operation for Combined Cycle Units



These data suggest that an hour of operation test is needed, but that such a test, standing alone, does not sufficiently differentiate peaking from intermediate-load units that may operate seasonally, but for many hours at a time once started up. Such units are seasonal or load following, properly classified as intermediate load units. These units are not true peaking units and are within the functional category defined by EPA. Here, industry practice provides what appears to be the most useful definition of a peaking unit. General Electric defines "peaking" units in terms of an average hour of operation per startup. GE Performance defines base load as operation at 8,000 hours per year with 800 hours per start. It then defines peak load as operation at 1250 hours per year with five hours per start.[89] We urge EPA to include an hour per operating day limit as well as an annual hours of operation limit in its definition of peaking units to (1) properly define peaking units and (2) ensure that, if simple cycle CTs are used as base load or intermediate load units, the emission limits associated with those functions apply. To provide operators with a measure of flexibility, while still distinguishing between seasonally operated intermediate-load units and peaking units, we recommend that the GE norm of 1250

[89] Brooks, F., GE Power Systems, *GE Gas Turbine Performance Characteristics, GER-3567H*, p.14, accessed at http://www.muellerenvironmental.com/documents/GER3567H.pdf

hours per year be relaxed to 2000 hours per year and that the 5 hours per start definition be modified to an 8 hour per operating day limitation, established on a 30-day rolling average basis. EPA should establish the annual hour of operation limit on a rolling annual basis, with the calculation rolled daily.

5. **Treatment of CHP Units**

Under EPA's proposal a unit is not an EGU unless more than one-third of its potential generating capacity is intended to be sold to the grid. Thus, many combined heat and power units (whether coal, oil or natural gas-fired) would be exempt from EPA's proposed rules. However, based on the perceived environmental benefits of CHP, EPA has requested comment on allowing such units to be exempt even if they sell up to 80 percent of their useful output as electricity to the grid. This would seem to be a dangerous incentive for EGUs to avoid the strictures of the rule by partnering with smaller industrial operations. The likely result of the exemption EPA is considering would be substantially increased GHG emissions with no countervailing environmental benefit. Joint Environmental Commenters therefore strongly oppose exempting CHP units if more than one-third third of their potential generating capacity is intended to be sold to the grid.

EPA has also solicited opinion about how to account for CHP emissions. The EPA proposal would allow CHP units to count 75 percent of their thermal output as part of their gross output used to calculate their emission rate in demonstrating compliance. However, the more appropriate way to recognize the potential environmental benefits of CHP is to appropriately account for the emissions associated with useful thermal output. We believe that it makes more sense to deduct the CO_2 emissions from CHP units that is associated with their other uses of a portion of the energy created, rather than adding a "theoretical" electric generation (representing the amount of electricity that would have been generated by steam used onsite) to their output. Both approaches have a similar result—the effective emission rate for CHP units is reduced for compliance purposes. However, it is more appropriate to assign the emissions associated with producing used thermal output to the sector where that thermal energy is used (which is outside the scope of this standard) than it is to assign theoretical additional electric output to CHP units based on their thermal output. The emissions to be deducted should be calculated by determining the emissions that would have been generated had the useful thermal output been produced in a separate thermal-only facility. This approach obviates the need to determine how to convert thermal output to electricity output for compliance purposes (e.g. crediting 75 percent versus 100 percent of a CHP unit's thermal output for the purpose of calculating its electricity generation emissions rate).

B. EPA Has Reasonably Determined that EGUs in Category TTTT May Reasonably Be Anticipated to Endanger Public Health or Welfare and That Their CO_2 Emissions Contribute Significantly to Endangerment

As noted above, Section 111(b)(1)(A) states that the Administrator "shall include" a category of sources in the list for which standards are required "if in [her] judgment it causes, or contributes significantly to, air pollution which may reasonably be anticipated to endanger public health or welfare." Reading the statutory language, "it" refers to the category, not to specific pollutants from the category. Section 111(b)(1)(B) then directs the Administrator to "establish[] Federal standards of performance for new sources within" a listed category. Section 111(a)(1) defines a "standard of performance" as "a standard for emissions of air pollutants which reflects the degree of emission limitation achievable through the application of the best system of emission reduction" which the Administrator determines to have been adequately demonstrated. The endangerment and contribution findings are components of the process of listing a category of sources, and not a part of the process of promulgating standards of performance for particular air pollutants emitted by those sources. As a result, EPA has a strong plain language argument for interpreting Section 111(b)(1) as not requiring a specific endangerment or contribution determination for greenhouse gas emissions from sources in Category TTTT – namely, that EPA made the required endangerment and contribution determinations when the agency first listed the new category's two components, Categories Da and KKKK. The proposal correctly states:

> [S]ection 111 does not by its terms require that the EPA make any endangerment finding with respect to those particular pollutants [greenhouse gases], or any cause-or-contribute significantly finding with respect to the source category, at the time the EPA promulgates the standards of performance for those pollutants.

77 Fed. Reg. at 22,412/2.

The proposal nonetheless notes that it may be argued that endangerment and contribution determinations are needed when issuing performance standards for a pollutant not previously covered. EPA asks for comment on whether those determinations must be specifically made under Section 111 or whether relevant determinations made under other proceedings can be considered.

Joint Environmental Commenters submit that the endangerment determination made for greenhouse gases, including CO_2, in December 2009 fully satisfies any requirement under Section 111, not only for category TTTT, but for any other category for which EPA may set greenhouse gas standards going forward. EPA made very clear in the 2009 final rule that the endangerment component of that rule was generic – it applied with equal force to anthropogenic greenhouse gas "air pollution," irrespective of the sources from which greenhouse gas "air pollutants" were emitted.

Section 202(a)(1) provides:

> The Administrator shall by regulation prescribe (and from time to time revise) in accordance with the provisions of this section, standards applicable to the emission of any *air pollutant* from any class or classes of new motor vehicles or new motor vehicle engines, which in his judgment cause, or contribute to, *air pollution* which may reasonably be anticipated to endanger public health or welfare.

(emphasis added.) Thus, the statutory provision applied in the 2009 endangerment finding required EPA to consider whether the "pollution" may reasonably be anticipated to endanger (not the "pollutant"). EPA explained:

> As discussed in the Proposed Findings, to help appreciate the distinction between air pollution and air pollutant, the *air pollution* can be thought of as the total, cumulative stock in the atmosphere, while the *air pollutant,* can be thought of as the flow that changes the size of the total stock.

74 Fed. Reg. 66536 (emphasis in original). Thus, in finding endangerment, the 2009 finding determined that the "total, cumulative stock" of GHGs—not just mobile source emissions—could reasonably be anticipated to endanger. And as the 2009 finding makes clear, the total, cumulative stock of GHGs includes EGU emissions. 74 Fed. Reg. 66539-40. Indeed, EGUs are "the largest emitting sector," *id.* 66539, larger than §202(a) sources, *id.* 66540 (§202(a) sources' emissions are "behind the electricity generating sector").

The endangerment determination was made after an extraordinarily thorough scientific review and after full consideration of public comments. It was reaffirmed after full consideration of petitions for reconsideration.

There is no basis in the statutory text for requiring EPA to re-do this endangerment determination in a Section 111 rulemaking. This would be true even if more time had passed since the 2009 determination. Nothing in the statute requires EPA to re-make or refresh the 2009 endangerment determination for greenhouse gas air pollution when subsequently taking action regarding the greenhouse gas emissions of a specific category of mobile or stationary sources or other emission sources under Section 202, Section 111, or any other regulatory provision of the Act.

Indeed, EPA has made many previous decisions under Section 111 to cover a pollutant emitted by a category when an endangerment finding for that pollutant had been previously made. While EPA examined the category's emissions of air pollutants and the availability of control measures, in no case did EPA consider or reconsider whether the pollutant endangered public health or welfare. For example, in 1973 EPA included limits for particulate matter emissions in the standards of performance for asphalt concrete plants.[90] EPA had previously determined that particulate matter endangers public health and welfare. EPA issued the particulate matter emission limits for asphalt concrete in reliance on that earlier determination, without any review of endangerment in the Section 111 rulemaking.[91] More recently, in 2010, as part of the (overdue) eight-year review of the standards for cement kilns under Section 111(b)(1)(B), EPA added limitations for cement kilns' emissions of oxides of nitrogen (NO_x). Here again, EPA did so without reviewing whether NO_x endangers public health or welfare, either directly or as a precursor to ozone or fine particles.

Thus, both the statutory text and EPA's long-established practice confirm that an endangerment determination has no expiration date. If someone believes there is a new and significant scientific basis for revising or rescinding an endangerment determination, that party has the option of petitioning EPA for a new rulemaking.[92]

While the 2009 endangerment determination was generically applicable to all anthropogenic greenhouse gas air pollution, the contribution determination formally made in that rulemaking related solely to motor vehicle emissions. The 2009 finding did note, however, that power plants' carbon dioxide emissions are double those of cars and light-duty trucks. If Section 111(a)(1)(A) is interpreted to require a determination that the emissions of sources in Category TTTT "cause or contribute significantly" to greenhouse gas air pollution, then such a requirement is easily met for this category. As EPA states: "Fossil fuel-fired electric utility generating units are by far the largest emitters of GHGs, primarily in the form of CO_2, among stationary sources in the U.S." In fact, EGUs are responsible for approximately 40 percent of total U.S. energy-related CO_2 emissions,[93] and almost one third of total U.S. greenhouse gas emissions. 77 Fed. Reg. at 22,403-04 (Tables 2 and 3). U.S. EGUs are responsible for nearly 10 percent of all global anthropogenic CO_2 emissions. As the proposal states:

> [U]nder this alternative interpretation, in today's rulemaking, the EPA proposes to find that CO_2 emissions from fossil fuel-fired EGUs cause or contribute significantly to the GHG air pollution. The EPA's basis for this proposed finding is, in part, that the large amounts of CO_2 emitted by fossil fuel-fired EGUs clearly exceed the low hurdle necessary for the cause-or-contribute-significantly finding. As noted above in Tables 2 and 3, fossil fuel-fired EGUs emit almost one-third of

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[90] 38 Fed. Reg. 15,380 (June 11, 1973).
[91] The PM standard was upheld in *Nat'l Asphalt Pavement Ass'n v. Train*, 539 F.2d 775 (D.C. Cir. 1976).
[92] *Oljato Chapter of Navajo Tribe v. Train,* 515 F.2d 654 (D.C. Cir. 1975).
[93] 77 Fed. Reg. at 22,403/1-2 ("In 2009, the electric power sector—consisting of those entities whose primary business is the generation of electricity—accounted for 40 percent of all energy-related CO_2 emissions.")

> all U.S. GHG emissions, and constitute by far the largest single stationary source category of GHG emissions.

Id. at 22,413/1.

Joint Environmental Commenters agree with EPA that "so great is the contribution of CO_2 air pollutants from EGUs to GHG air pollution, that it is simply not necessary in this rulemaking to determine thresholds for when a contribution may be considered to be a "significant[]" contribution." *Id.* We also agree that "[i]f it were necessary, the EPA proposes that a limited amount of contribution would meet that standard in light of the fact that GHG air pollution is caused by a large number of types of sources and that no one source category dominates the entire inventory." *Id.* These plainly are reasonable conclusions and the only conclusions with respect to carbon pollution that are consistent with the Clean Air Act's overarching purpose to protect public health and welfare.

As a practical matter, Joint Environmental Commenters see little distinction between what the agency calls its first and second alternative interpretations. Under either of these interpretations, reliance upon the 2009 endangerment determination together with the 2010 disposition of the reconsideration petitions readily satisfies any requirement in § 111 for a determination that anthropogenic CO_2 emissions may reasonably be anticipated to endanger public health or welfare. Although not necessary, EPA could supplement that determination in this rulemaking with reference to the 2010 and 2011 assessments of the National Academy of Sciences, or other subsequent scientific assessments. Likewise, under either alternative interpretation, the facts EPA has cited regarding CO_2 emissions from EGUs in the TTTT Category – "The fact that affected EGUs emit almost one-third of all U.S. GHGs and comprise by far the largest stationary source category of GHG emissions," *id.* at 22,413/2 – more than amply demonstrate that these emissions contribute significantly to that dangerous air pollution.

Finally, we agree with EPA that it is not necessary in this rulemaking to determine a lower limit for "significant" contribution. Petitioners in the challenge to the 2009 endangerment finding are arguing that the finding is invalid because EPA did not define a threshold distinguishing non-endangerment from endangerment. EPA rejoined it does not need such a threshold:

> In sum, EPA does not need to quantify the myriad possible combinations of risk of harm and severity of harm, covering the very wide range of relevant climate and environmental circumstances, that would *not* constitute endangerment before it may make a fully rational judgment that the specific facts and circumstances here *do* in fact amount to endangerment.

EPA Endangerment Br. (D.C. Cir. 11-14-2011), at 87. Similarly here, EPA doesn't have to define what categories might not contribute significantly, given that the category at issue clearly does contribute significantly. In the 2009 finding, EPA has already found §202(a) emissions contribute to endangerment. In doing so, the agency noted inter alia:

> For example, the emissions of well-mixed greenhouse gases from CAA section 202(a) sources are larger in magnitude than the total well-mixed greenhouse gas emissions from every other individual nation with the exception of China, Russia, and India, and are the second largest emitter within the United States behind the electricity generating sector. As the Supreme Court noted, ''[j]udged by any standard, U.S. motor-vehicle emissions make a meaningful contribution to greenhouse gas concentrations and hence, * * * to global warming.'' *Massachusetts* v. *EPA,* 549 U.S. 497, 525 (2007).

74 Fed Reg. 66499. If U.S. §202(a) emissions exceed those of most countries, then the even larger emissions from U.S. EGUs do so as well. If U.S. §202(a) emissions (in the words of the Supreme Court in *Mass. v. EPA*), "[j]udged by any standard," make a "meaningful" contribution to GHG concentrations and global warming, then so do the even larger emissions from U.S. EGUs. 5. While neither the 2009 finding nor *Massachusetts v. EPA* addressed the word "significantly" as it appears in §111, it seems at least reasonable – indeed, inevitable – for EPA to conclude that a source category contribution that exceeds the emissions of most countries and is "meaningful" is also "significant[]."

III. Determination of BSER

A. EPA Has a Duty to Adopt Emission Standards for Greenhouse Gas Emissions From EGUs

The proposed rules stem from litigation regarding EPA's mandatory duty to review NSPS standards under § 111(b)(1)(B). Every eight years, EPA must: (1) review its standards, (2) determine whether it is "appropriate" to revise them, including whether it is appropriate to add additional pollutants to the standards, and (3) if so, revise them accordingly. Here, EPA has concluded that it is appropriate to add an additional pollutant, carbon dioxide, and is therefore proposing standards. This is a proper (if delayed) effectuation of the mandatory eight-year review.

EPA has long interpreted this "appropriateness" determination to turn on two factors: (1) the amount of emissions of a given pollutant from that source category and (2) the availability of demonstrated control measures. [94] This two part test was appropriate in

[94] As EPA stated in reviewing the standards governing portland cement plants: "We have historically declined to propose standards for a pollutant where it is emitt[ed] in low

previous rulemakings because there was no dispute about whether the source category in question was properly listed under § 111(b)(1)(A) or whether the air pollutant was one that could be regulated in a standard of performance, as defined in § 111(a)(1). In this instance, the source category was properly listed (as discussed above) and carbon dioxide is properly an air pollutant (as discussed above). Thus, EPA was correct in determining that it is appropriate to regulate carbon dioxide under the NSPS.

In fact, Joint Environmental Commenters believe that any other conclusion would be beyond EPA's discretion. Given the fact that all of the sources in question are regulated within a source category already and that carbon dioxide is an air pollutant, *Massachusetts v. EPA*, 549 U.S. 497 (2007), for which an endangerment finding has been made, EPA could come to no other rational conclusion during its eight year review. EGUs unquestionably emit large amounts of carbon dioxide, and there is an adequately demonstrated system of emission reductions: natural gas combined cycle technology. Since EPA has a mandatory duty to review its NSPS every eight years, to decide against setting emission limits for carbon dioxide the agency would have to deny one of the foregoing facts. We submit that so concluding would be arbitrary and capricious, and that therefore NSPS regulation is compelled by the Clean Air Act.

B. The NSPS Program Is Intended to Be Technology Forcing to Reduce Emissions from High-Emitting Sectors.

1. Congress Established and the Courts Have Affirmed the NSPS as a Program Intended to Drive Innovation to Reduce Emissions.

Congress created the NSPS program in order to drive down emissions of dangerous air pollutants from major sources of pollution, and designed it to be technology-forcing in systems of emission reduction. The Senate Committee Report issued prior to passage of the Clean Air Act in 1970 stated that "[s]tandards of performance should provide an incentive for industries to work toward constant improvement in techniques for preventing and controlling emissions from stationary sources."[95] The Senate Report also clarified that an emerging control technology used as the basis for standards of performance need not "be in actual routine use somewhere."[96]

Long-established case law confirms that NSPS is intended to be a technology-forcing regulatory mechanism to drive reductions in emissions from major pollution-generating sectors. *See Sierra Club v. Costle*, 657 F.2d 298, 364 (D.C. Cir. 1981) ("[W]e believe EPA

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amounts or where we determined that a [best demonstrated technology] analysis would result in no control." 75 Fed. Reg. 54,996-97 (Sep. 9, 2010).

[95] S. Rep. No. 91-1196, at 17 (1970).

[96] *Id. at* 16.

does have authority to hold the industry to a standard of improved design and operational advances, so long as there is substantial evidence that such improvements are feasible."); *Portland Cement Association v. Ruckelshaus*, 486 F.2d 375, 391 (D.C. Cir. 1973) (The court "reject[ed] the suggestion of the cement manufacturers that the [Clean Air] Act's requirement that emission limitations be 'adequately demonstrated' necessarily implies that any cement plant now in existence be able to meet the proposed standards.") The D.C. Circuit has explained that as EPA fulfills its innovation-forcing mandate, the Agency should be forward-looking when determining what systems of emission reduction are available: "Section 111 looks toward what may fairly be projected for the regulated future, rather than the state of the art at present."[97]

2. **New Source Performance Standards Have Played Key Technology-Forcing Roles in the Past.**

The Congressional Research Service (CRS) documented the technology-forcing function that NSPS have played in its report on the potential regulation of GHG sources under the Clean Air Act. The report notes that the flexibility inherent in the Administrator's authority to determine which technologies have been adequately demonstrated "has been used to authorize control regimes that extended beyond the merely commercially available to those technologies that have only been demonstrated, and thus are considered by many to have been 'technology-forcing.'"[98]

The CRS report focuses on the 1971 and the 1978 NSPS for sulfur dioxide (SO_2) emitted by coal-fired electric generating units as a prime example of the Agency incentivizing technology development and thereby facilitating ambitious emission reductions through NSPS. The 1971 NSPS required a 70% reduction in new power plant SO_2 emissions, on average, and could be met initially only by burning low-sulfur coal or by using an emergent technology known as flue gas desulfurization (FGD). When the 1971 utility SO_2 NSPS was promulgated, there was only one FGD vendor and only three FGD units in operation. The 1979 NSPS retained the 1971 emission standard but also required a 70-90% reduction in combustion emissions, depending upon the sulfur content of the coal. This requirement could then be met only by using an FGD device.

A history of the development of FGD devices (cited in the CRS report) further illustrates how much the SO_2 NSPS motivated the development of this technology:

> The Standards of Performance for New Sources are technology-forcing, and for the utility industry they forced the development of a technology

[97] *Id.*

[98] Larry Parker & James E. McCarthy, Cong. Research Serv., R40585, Climate Change: Potential Regulation of Stationary Greenhouse Gas Sources Under the Clean Air Act 12 (2009).

> that had never been installed on facilities the size of utility plants. That technology had to be developed, and a number of installations completed in a short period of time. The US EPA continued to force technology through the promulgation of successive regulations. The development of this equipment was not an easy process.
>
> . . .
>
> Chemical and mechanical engineers had never dealt with the challenges they faced in developing FGD systems for utility plants during this period. Chemical engineers had never designed process equipment as large as was required, nor had they dealt with the complex chemistry that occurred in the early FGD systems. Mechanical engineers were faced with similar challenges. While they had designed equipment for either acid service or slurry service, they typically had not designed for a combination of the two. Generally, equipment was larger than what they normally dealt with in chemical plants and refineries.
>
> It is an understatement to say that the new source performance standards promulgated by the EPA were technology-forcing. Electric utilities went from having no scrubbers on their generating units to incorporating very complex chemical processes. Chemical plants and refineries had scrubbing systems that were a few feet in diameter, but not the 30- to 40-foot diameters required by the utility industry. Utilities had dealt with hot flue gases but not with saturated flue gases that contained all sorts of contaminants. Industry, and the US EPA, has always looked upon new source performance standards as technology-forcing, because they force the development of new technologies in order to satisfy emission requirements.[99]

As can be seen in Figure 3, analysis of patenting activity further demonstrates the dramatic rise in control technology innovation in the U.S. that followed the 1971 SO_2 NSPS promulgation.[100]

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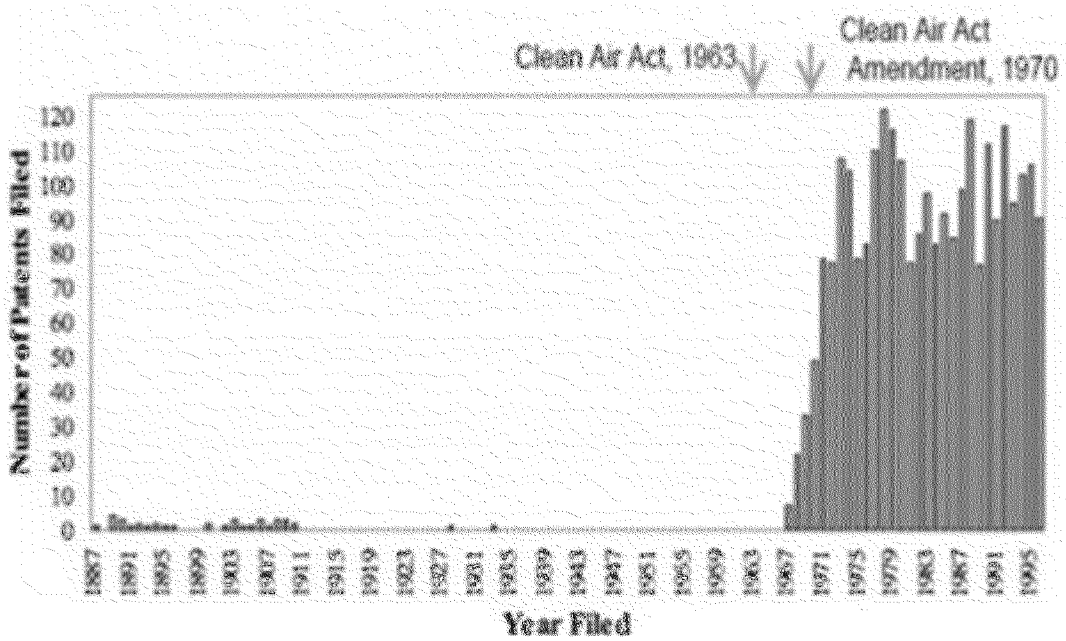
[99] Donald Shattuck et al., A History of Flue Gas Desulfurization (FGD) – The Early Years at 15, 3.

[100] M. Taylor, The Influence of Government Actions on Innovative Activities in the Development of Environmental Technologies to Control Sulfur Dioxide Emissions from Stationary Sources 211-12 (Jan. 2001) (unpublished Ph.D. thesis, Carnegie Mellow University) [hereinafter Taylor Ph.D.] (on file with author); *see also* ICF Consulting, The Clean Air Act Amendments: Spurring Innovation and Growth While Cleaning the Air 106-08, 118-20, 211-12 (2005).

Figure 3: U.S. Patents Relevant to SO_2 Control Technology as Identified with the Patent Subclass Method[101]



Thanks to these technology advances, when Germany subsequently implemented a program to control acid rain, 33% of the FGD systems installed were licensed from U.S. companies.[102] Researchers of this and similar regulatory initiatives have observed that stringent regulation is required to stimulate significant innovation in control technologies; neither weak regulation nor legislation supporting control technology research have this effect.[103]

The 1979 NSPS is a compelling example of both the flexibility of the Agency's authority under Section 111 and the efficacy of innovation-focused standards in incentivizing technology development.

3. **The "Best System of Emission Reduction" Language Is Broad and Easily Encompasses a Combined Cycle Turbine Design Burning Natural Gas.**

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[101] *Id.* at 107.
[102] *Id.* at 56, 131.
[103] *See id.* at 220; M. Taylor et al., *Control of SO2 Emissions from Power Plants: A Case of Induced Technological Innovation in the U.S.*, 72 Technological Forecasting & Soc. Change 697 (2005).

EPA emphasized as early as 1976 that BSER could encompass low-emission production methods.[104] In setting the smelter NSPS, the agency rejected the notion that BSER determinations must rely exclusively on emission control hardware:

> For some classes of sources, the different processes used in the production activity significantly affect the emission levels of the source and/or the technology that can be applied to control the source. For this reason, the Agency believes the 'best system of emission reduction' includes the processes utilized and does not refer only to emission control hardware. It is clear that adherence to existing process utilization could serve to undermine the purpose of section 111 to require maximum feasible control of new sources.[105]

The 1970 "best system of emission reduction" language that the agency interpreted is nearly identical to the current language, adopted in 1990.[106]

In today's electricity sector, coal- and combined-cycle gas-burning power plants—two systems of electricity generation—are largely functionally interchangeable in providing baseload and load-following generation.[107] Indeed, as EPA's proposal notes, the only new generation projected to be built to serve baseload and intermediate demand is from combined cycle natural gas plants.[108] In identifying BSER, EPA has an obligation to

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[104] *See* Standards of Performance for New Stationary Sources, Primary Copper, Zinc, and Lead Smelters, 41 Fed. Reg. 2332, 2333 (Jan. 15, 1976).
[105] *Id.*
[106] *Compare* CAA Amendments of 1970, PL 91-604, § 111(a)(1), 84 Stat. 1676, 1683 (1970) ("The term 'standard of performance' means a standard for emissions of air pollutants which reflects the degree of emission limitation achievable through the application of the best system of emission reduction which (taking into account the cost of achieving such reduction) the Administrator determines has been adequately demonstrated.") *with* CAA § 111(a)(1), 42 U.S.C. § 7411(a)(1) (2006) ("The term 'standard of performance' means a standard for emissions of air pollutants which reflects the degree of emission limitation achievable through the application of the best system of emission reduction which (taking into account the cost of achieving such reduction and any nonair quality health and environmental impact and energy requirements) the Administrator determines has been adequately demonstrated.").
[107] 77 Fed Reg. at 22411.
[108] Courts have explicitly approved EPA's practice of taking into account industry trends when setting standards. *See National Lime Ass'n v. EPA*, 627 F.2d 416, 426 n.28 (D.C. Cir. 1980) ("It is expected that as supplies of natural gas and oil become more expensive or unavailable, all new kilns would be rotary lime kilns designed to burn coal."); Standards of Performance for New Stationary Sources: Lime Manufacturing Plants, 42 Fed. Reg. 22,506, 22,507 (May 3, 1977) ("[V]irtually all the new kilns that have been built

consider the substantial combustion emission advantages of combined-cycle natural gas as compared to coal-fired plants and to set the performance standard accordingly. The substantial cost advantages of NGCC further reinforce the reasonableness of NGCC as BSER. When considering two functionally interchangeable processes, not to set BSER based on the lower-emitting process, especially when that process is also less expensive, would fail to fulfill the statutory directives of CAA § 111(b) to maximize emission reductions considering cost and other relevant impacts.[109]

C. Legality and Appropriateness of the Alternative Compliance Option

The alternate pathway provided for coal plants is consistent with the NSPS program's technology-forcing purpose.

1. Designing an NSPS to Incentivize the Development of Low-Emitting Technologies Is Consistent with § 111.

Through the alternative compliance pathway EPA has allowed a path for carbon capture and sequestration technology to play a role in controlling CO_2 emissions from fossil-fuel-fired power plants—helping make investments in developing and deploying this technology secure. This regulatory certainty is what power sector participants have identified as the missing link in the development of CCS. In discussing the decision to stop moving forward with a broader deployment of CCS at its West Virginia Mountaineer plant, American Electric Power Chairman and CEO Mike Morris said: "Going forward without a carbon legislation or without an appropriate approach to carbon and its impact it was simply not able for us to go forward and continue that project. . . . We are encouraged by what we saw, we're clearly impressed with what we learned and we feel that we have demonstrated to a certainty that the carbon capture and storage is in fact viable technology for the United States and quite honestly for the rest of the world going forward."[110]

As noted above, the NSPS is intended to drive innovation in methods of reducing emissions. The *Sierra Club* court determined that legislative history reinforced its

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in the last few years have been of the rotary type. . . . [T]he present trend is to build and operate rotary kilns whenever possible.").

[109] While there is a cost advantage of natural gas, section 111 calls for the "best system of emission reduction" to be determined "taking into account the cost of achieving such reduction" and other pertinent statutory factors. 42 U.S.C. §7411(a)(1). The costs of a fuel neutral standard based on this best system, therefore, do not require a cost advantage but must not be unreasonable.

[110] American Electric Power Q2 2011 Earnings Call (July 29, 2011), CallStreet Raw Transcript.

interpretation of the statute that one of the purposes of NSPS is to "create incentives for new technology."[111] The court cited several examples from the legislative history about the CAA Amendments of 1977 in which legislators address technology-forcing portions of CAA § 111.[112] The House Committee Report, for instance, noted that "it is prudent public policy to require achievement of the maximum degree of emission reduction from new sources, while encouraging the development of innovative technological means of achieving equal or better degrees of control."[113]

The Senate Committee Report on the CAA Amendments of 1970 also clarified that "[s]tandards of performance should provide an incentive for industries to work toward constant improvement in techniques for preventing and controlling emissions from stationary sources."[114] An emerging control technology used as the basis for standards of performance need not "be in actual routine use somewhere."[115] The D.C. Circuit, analyzing the Senate's intent, found that "[t]he essential question was [] whether the technology would be available for installation in new plants."[116]

The D.C. Circuit sanctioned the tailoring of an NSPS to incentivize the development of specific innovative, low-emitting technologies in *Sierra Club v. Costle*.[117] There, EPA declined to adopt a uniform requirement that all entities in the regulated category reduce SO_2 emissions by 90% because that requirement would have prevented some low-sulfur-coal facilities from using the new technology known as dry scrubbing.[118] EPA thought that it was important to "provid[e] an opportunity for full development of dry SO_2 technology."[119] The court found that, provided that EPA balanced the factors listed in the NSPS provision, designing the NSPS to incentivize new technologies was consistent with the text of the CAA.[120]

EPA's alternative pathway for coal plants serves this well-established technology-forcing purpose by providing regulatory certainty for CCS as an emerging control technology. As discussed above, the SO_2 NSPS served this purpose for scrubbers in the 1970s. The CRS report noted that the NSPS could play a similar role for deployment of carbon capture and sequestration: "The [SO_2 scrubber] example indicates that technology-forcing regulations can be effective in pulling technology into the market—even when there remain some operational difficulties for that technology. . . . As an entry point to

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[111] See *Sierra Club v. Costle*, 657 F.2d 298, 346-47 (D.C. Cir. 1981).
[112] *See id.* at 346 n.174.
[113] *Id.*
[114] S. Rep. No. 91-1196, at 17 (1970).
[115] *Id.* at 16.
[116] *Portland Cement Ass'n v. Ruckelshaus*, 486 F.2d 375, 391 (D.C. Cir. 1973).
[117] *See Sierra Club v. Costle*, 657 F.2d 298 (D.C. Cir. 1981).
[118] *See id.* at 343.
[119] *Id.* at 327-28.
[120] *See id.* at 346.

carbon capture deployment, a regulatory approach such as NSPS may represent a first step."[121]

EPA's alternative compliance pathway for coal plants is thus providing the very mechanism for CCS that power sector participants deploying CCS have called for, consistent with the court-affirmed Congressional intent that NSPS serve a technology-forcing role in order to drive down emission reductions.

2. **EPA's Analysis of BSER Availability Should Be Forward-Looking and Is Owed Deference.**

The thirty-year compliance framework for coal plants using CCS that EPA has proposed involves a forward-looking availability analysis. The courts have affirmed EPA's authority to make such projections. In *Portland Cement Association v. Ruckelshaus*, the court found that "[t]he Administrator may make a projection based on existing technology, though that projection is subject to the restraints of reasonableness and cannot be based on 'crystal ball' inquiry. . . . [T]he question of availability is partially dependent on 'lead time', the time in which a technology will have to be available."[122] Further, the court noted that "[i]t would have been entirely appropriate if the Administrator had justified the standards, not on the basis of tests on existing sources or old test data in the literature, but on extrapolations from this data, and on testimony from experts and vendors made part of the record."[123]

As discussed above, courts have properly deferred to EPA's analysis of the best systems of emission reduction available.[124] In *Sierra Club*, the court "on close questions [gave] the agency the benefit of the doubt out of deference for the terrible complexity of its job."[125].

3. **NSPS May Alter Business As Usual.**

By its very nature, technology forcing may prevent some actors from proceeding with business as usual, if business as usual would entail a lagging process that is more

[121] Larry Parker & James E. McCarthy, *supra* note 4, at 19-20.
[122] *Portland Cement Ass'n v. Ruckelshaus, 486 F.2d 375, 391 (D.C. Cir. 1973).*
[123] *Id.* at 401-02. The standards challenged in *Portland Cement* were finalized after the Agency conducted testing at seven plants, which the D.C. Circuit found to be sufficient. *See Portland Cement Ass'n. v. Train*, 513 F.2d 506, 509 (D.C. Cir. 1975).
[124] *See Sierra Club v. Costle*, 657 F.2d at 343, 364 (incentivizing and forcing technology); *Portland Cement Ass'n v. Ruckelshaus*, 486 F.2d at 391 (relying on cutting-edge technology).
[125] *Sierra Club v. Costle*, 657 F.2d at 410.

polluting, or would need greater investment to meet a standard, than a lower-emission technology. In setting NSPS for copper smelters, EPA explained that it could set a "single standard [that] would *effectively preclude* using a process which is much less expensive than the permitted process" so long as the total cost of the standard was reasonable.[126] This precedent demonstrates that "effectively preclud[ing]" a production method can be entirely consistent with reasonableness and economic achievability. Given the entirely reasonable cost of the standard proposed here and the enormous harm to Americans' health, safety, and environment caused by the pollution generated by uncontrolled coal-fired power plants, EPA was entirely justified – indeed, required – to set a standard that will require any new coal plant to be designed and operated in a manner that will make deeps cuts in the amount of harmful pollution generated.

4. **EPA Has Authority to Adopt Alternative Compliance Mechanisms.**

a. EPA Has Adopted Other Flexibility Mechanisms.

The provision of alternate compliance pathways is a familiar approach under § 111. As noted above, in Subpart GG of 40 C.F.R. Part 60, EPA established burning a particular type of fuel as one option for meeting the SO_2 emissions standard. The agency described that option as "an *alternative* SO_2 emissions limit."[127] The main limit set a numeric emission standard to be met at the stack, regardless of the fuel burned.[128] In essence, EPA provided an alternative compliance option that remains valid.

The 1981 *Sierra Club* decision provides another clear example of an alternative compliance option. At issue were the NSPS for EGUs finalized by EPA in June 1979.[129] The main standard required a maximum of 1.20 lbs SO_2/MMBtu and a 90% reduction from uncontrolled levels.[130] EPA, however, also allowed for an optional method of compliance—what the *Sierra Club* court called an "optional standard"—similar to the "alternative compliance option" in the proposed GHG NSPS.[131] The option provided that, if a fuel's potential SO_2 emissions were less than 0.60 lbs/MMBtu, the emission-reduction requirement decreased from 90% to 70%.[132] As a practical matter, the

[126] *See* Standards of Performance for New Stationary Sources: Primary Copper, Zinc, and Lead Smelters, 41 Fed. Reg. 2332, 2333 (Jan. 15, 1976) (emphasis added).
[127] Standards of Performance for New Stationary Sources: Gas Turbines, 44 Fed. Reg. 52,792, 52,792 (Sept. 10, 1979) (emphasis added).
[128] *See id.*
[129] New Stationary Source Performance Standards: Electric Utility Steam Generating Units, 44 Fed. Reg. 33,580 (June 11, 1979).
[130] *See id.* at 33,580.
[131] *Sierra Club v. Costle*, 657 F.2d 298, 316 (D.C. Cir. 1981).
[132] *See* 44 Fed. Reg. at 33,580

optional standard allowed low-sulfur-coal facilities to use dry scrubbing rather than wet scrubbing.

EPA's alternative compliance pathway for coal fits within this regulatory tradition.

b. Flexibility Mechanisms Have Been Judicially Approved.

In *Sierra Club v. Costle*, environmental petitioners argued that an NSPS's optional standard violated CAA § 111.[133] The court disagreed, relying § 111(b)(2), which authorizes EPA to "distinguish among classes, types, and sizes within categories of new sources for the purpose of establishing . . . standards."[134]

Also of note, the *Sierra Club* court was more deferential to EPA when reviewing the optional standard than the main standard. The court did not ask if dry scrubbing could have served as an independent basis for the standard because it had already found that wet scrubbing was the BSER.

Instead, the court limited its analysis to whether EPA had a reasonable basis for its technical analysis of dry scrubbing. The court determined that "the support in the record for selecting 70% as the magic percentage for encouragement of dry scrubbing [was] less than overwhelming" but recognized that EPA was trying to encourage the development of dry scrubbing technology.[135] Because "it was reasonable for EPA to seek to encourage dry scrubbing and to be concerned with the effect of the NSPS on the future of the new technology," the court upheld the optional standard.[136]

As with the SO_2 NSPS's optional standard in *Sierra Club*, the alternative compliance option in the proposed GHG NSPS merits respect because it reasonably balances the relevant statutory factors required to be considered in establishing a standard of performance under the law as well as technical factors that are unique to the development of CCS technology.

D. CO_2 Emission Limits for Intermediate and Base-load EGUS

1. EPA's Proposed CO_2 Emission Limits Are Too Lenient

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[133] *See* 657 F.2d at 316-17.
[134] CAA § 111(b)(2), 42 U.S.C. § 7411(b)(2) (2006); *see also Sierra Club v. Costle*, 657 F.2d at 319-20.
[135] 657 F.2d at 351.
[136] *Id.*

Joint Environmental Commenters agree with EPA's proposal to adopt a fuel-neutral standard for CO_2 emissions from base load and intermediate load electric generating units. We also agree that the final standard should be based on the best system of emission reduction achievable for natural gas combined cycle generation. Generation of electricity by use of natural gas combined cycle (NGCC) technology has been common for decades and, indeed, represents the most likely choice for new fossil fuel-fired generation over the next several decades. However, there is a substantial variation in performance of this type of technology that EPA's proposal fails to reflect. The "best system of emission reduction" (BSER) may not reflect the emissions performance of the worst performing unit that employs NGCC technology, but must be set at a level that reflects the best existing performers *and* improvements in performance that may be reasonably anticipated in the time frame over which sources subject to the standard are constructed. In other words, just as standards for new vehicles may be more demanding for later model years with more lead time, so too standards for power plants under Section 111(b) may require better performance of plants built in later years if supported by reasonable projections of technological improvements during this lead time.

In setting performance standards under section 111, EPA has made a consistent practice of examining existing sources to identify the best systems of emission reduction in use. In this case, the record does not indicate that EPA has performed a comparable analysis to support the proposed standard. Joint Environmental Commenters have undertaken an analysis of the available data and literature and conclude that a more stringent standard is technically and economically achievable. Based on our analysis, we recommend that EPA adopt a standard in the range of 825-850 lbs/MWh (net), rather than the 1000 lbs/MWh (gross) the Agency has proposed.

Joint Environmental Commenters urge that a more stringent standard than the one proposed is necessary to ensure that, in a time of historically low natural gas prices, developers of new EGUs choose the most efficient units available. The data on existing units demonstrates that developers do not always choose such units, even with higher natural gas prices. Given the urgent need to reduce carbon emissions from the entire electricity sector, a stringent standard is needed to minimize carbon emissions from NGCC units.

Within EPA's proposed category of intermediate load and base load fossil-fuel fired EGUs, NGCC units generally exhibit lower CO_2 emission rates than coal or oil-fired units or natural gas simple cycle units; but within the group of NGCC units there are clear distinctions in the emission reductions associated with differences in designs. Similar units, even similar units produced by the same manufacturer, show substantially different rates of CO_2 emissions.

The emission rates of some existing NGCC units are twice as high as the best performers. These differences are not serendipitous, but the consequence of deliberate decisions of the designers to incorporate features and systems that enhance combustion and generating efficiency. For example, the performance of NGCC units is improved when the manufacturer designs the turbines to operate at higher temperatures. For every 30 Celsius degree ("°C") rise in gas turbine firing temperature, the combined cycle efficiency increases by about one percent; an efficiency of 60 percent can be reached if the design operating temperature approaches 1500 °C.[137] Improved gas turbine efficiencies can also be achieved through the use of improved thermal coatings, closed circuit steam or water cooling of turbine blades, and use of nitrogen instead of steam as the diluent for reducing NO formation. The efficiency of the NGCC unit can be also substantially increased by using fully-fired heat recovery steam generator (HRSG) units, which have higher, but nonetheless reasonable, construction costs than partially fired or unfired HRSGs.[138] These techniques and the relative efficiency improvements that result from their use are well known, and are routinely offered by vendors as optional cost-effective upgrades to standard units.[139]

In addition to considering the demonstrated performance of the existing units with the best system of emission reductions, EPA is obliged to incorporate those performance improvements that can be reasonably anticipated. Over the past few years there has been an across the board effort by turbine manufacturers to significantly increase the efficiency of gas turbine design under full and part-load conditions in both simple and combined cycle mode.[140] New, more efficient models, not reflected in the performance data relied on by EPA, have recently been introduced or announced by vendors for entry into the market in the near future.

EPA assembled original equipment manufacturer (OEM) combined cycle performance specifications from Gas Turbine World.[141] This data set includes 89 combined cycle gas turbines that EPA concluded would be subject to the proposed standard if they were new. This data is included in the docket in a spreadsheet called "Gas Turbine Workbook" in a tab called "Combined Cycle." We agree these data are a reasonable starting point but note that they have been updated in the 2012 GTW Handbook.[142] This new edition represents the most up-to-date information available at

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[137] P. Chiesa and E. Macchi, Trans. ASME, Journal of Engineering for Gas Turbine and Power, v. 126, no. 4, pp. 770-85, 2004.

[138] See, Chase, D.L and Kehoe, P.T. GE Power Systems, *GE Combined-Cycle Product Line and Performance, p.3* http://physics.oregonstate.edu/~hetheriw/energy/topics/doc/elec/natgas/cc/combined%20cycle%20product%20line%20and%20performance%20GER3574g.pdf

[139] Id. at Table 14.

[140] See discussion in Gas Turbine World, 2012 GTW Handbook, pp. 6 -24.

[141] 2011 Performance Specifications, Gas Turbine World, 27th Ed., Available at: http://www.gtwbooks.com/GTW-Archive.html for $55.

[142] Gas Turbine World, 2012 GTW Handbook, v. 29 ("2012 GTW Handbook")

this time, and EPA should consider it in making its final decision. Accordingly, EPA must update its analysis to incorporate this newly available information.

These Gas Turbine World Handbook performance specifications are based on "new and clean" gas turbine ratings for net plant output and base load operation of a standardized reference plant, including losses and auxiliary loads, on natural gas fuel, at 59°F, sea level, and reasonably realistic steam cycle conditions.[143] Thus, they do not reflect the range of operating conditions that will be experienced by future NGCC facilities. However, it should be noted that manufacturers also employ conservative factors in establishing performance specifications, since they are subject to damages if the units do not perform as specified. EPA adjusted the Gas Turbine World performance specifications to account for various factors it assumed were not included in the specifications.

EPA's adjustments included:

- 5 percent increase in design heat rate to account for part-load conditions;
- 1 percent increase in design heat rate to account for operation at non-design ambient temperatures;
- 5 percent increase in design heat rate to account for degradation in performance over the life of the facility;
- 125 Btu/kWh increase in heat rate to account for increased pressure drop from post-combustion controls, e.g., SCR.

These adjustments amount to an increase in the net heat rate of nearly 13 percent.[144]

Joint Environmental Commenters agree that some correction to design data is needed to address certain operational variables. However, in some instances EPA's proposed corrections are not supported by information in the record and are either overly large or entirely unwarranted. Finally, the Gas Turbine World Handbook points out that the performance specifications are conservative and that better performance is possible – as much as a 1.5 percent gain in overall plant efficiency – for higher, but none the less reasonable, costs.[145] Thus, in our opinion, the "best system of emission reduction" emission rate reflected in the proposed standard is significantly higher than is warranted.

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[143] 2012 GTW Handbook, p. 64.

[144] 125 Btu/kW is slightly less than two percent of the heat rate of the better performing units.

[145] 2012 GTW Handbook, p. 64.

2. **The EPA Temperature Adjustment Is Not Warranted**

EPA increased the ISO heat rate by 1 percent to account for operation at non-design ambient temperatures. The OEM design specifications are based on 59° F. We agree that an increase in ambient air temperature reduces gas turbine power with a proportionate increase in heat rate and CO_2 emissions. However, this adjustment proposed by EPA is inconsistent with BSER, since inlet cooling is available and routinely used to increase power output of gas turbines. Inlet cooling improves efficiency during high ambient temperature operation of 5 percent to 25 percent of gas turbine nameplate rating, reducing fuel consumption and hence reducing CO_2 emissions.[146] A number of inlet cooling technologies are commercially available, including wetted media, fogging, wet compression, and chilling. In fact, inlet cooling is used to reduce inlet temperatures below 59 °F, thus increasing efficiency to better than ISO conditions. EPA should ascertain the extent to which any adjustment is warranted where inlet cooling technology is employed. Based on the information in the open literature reviewed by Joint Environmental Commenters, the need for an adjustment for ambient temperature has not been demonstrated. This conclusion is supported by EPA's in-use CAMD data discussed below.

3. **The EPA Performance Adjustment Is Overestimated**

Degradation is an important factor to be considered, as the heat rate of the facility will gradually deteriorate between overhauls. EPA has asserted that "although generally estimated at less than 3 percent over the life of the facility", it would "conservatively" apply a 5 percent increase in heat rate due to degradation to account for adverse conditions and different turbine designs. Since EPA acknowledges that this figure is substantially larger than supported in the record, it may not be used to set the standard for new units. Our review of the literature indicates that 5 percent is a significant overestimate given maintenance practices that are widely used and known to improve output (and revenue) and indeed, that 3 percent is likely to be too high for newly designed and constructed units that employ efficient designs.[147] Published

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[146] Gas Turbine Inlet Cooling. Scope, Cost and Performance for New and Retrofit Power Plant Projects, 2010 Gas Turbine World Handbook, pp. 32 - 39. This article reports CO2 emissions from a combined cycle plant using turbine inlet cooling of 700 lb/MWh (Fig. 6). See also: D.V. Punwani, Turbine Inlet Cooling: Increased Energy Efficiency & Reduced Carbon Footprint Aspects for District Energy Systems, June 13-16, 2010, http://www.turbineinletcooling.org/News/Avalon_IDEA2010June.pdf.

[147] See, e.g., I.S. Diakunchak, Performance Deterioration in Industrial Gas Turbines, Journal of Engineering for Gas Turbines and Power, v. 114, April 1992, pp. 161-168 (1%); S. Can Gulen and Sal Paolucci, Real-time On-line Performance Diagnostics of Heavy-duty Industrial-gas Turbines, Transactions of the ASME (2%), Available at: http://www.thermoflow.com/WALK_GTEYE/ASME_2000-GT-

industry information asserts that good maintenance practices, including frequent off-line water washing, reduce both the amount of performance degradation and the rate of performance degradation.[148] In determining the appropriate factor for performance degradation, EPA needs to consider far more detailed information than it has to date and ascertain the extent to which top-performing units – including units with better initial designs and units that employ appropriate maintenance practices –experience the assigned degradation factor. We note that the Gas Turbine World Handbook relied on by EPA for much of its proposal asserts that the performance degradation between overhauls ranges between 2 and 6 percent. In the absence of specific credible information that documents the use of a higher figure, BSER requires the use of the lower end of this range.

4. **The Pollution Control Device Performance Impact Is Overestimated**

EPA has assumed a decrease of 125 Btu/kWh in the adjusted heat rate to account for increased pressure drop from post-combustion controls, such as SCR. However, no support is provided for this estimate – EPA simply states that it has applied this correction factor. Further, this estimate is demonstrably too high.

The emissions of NO_x are commonly controlled in NGCC plants by installing SCR catalyst in a spool piece in the HRSG. This typically results in an increase in backpressure of about 2 inches water gauge. In some states, CO and VOCs are additionally controlled by installing oxidation catalyst in the spool piece, especially in areas that are nonattainment for ozone. The addition of catalyst in the flue gas path for these post-combustion controls increases the backpressure by about 3 inches of water gauge total. This increase results in a loss in power output, increasing the heat rate. We agree with EPA that an adjustment is warranted as the OEM performance specifications assume no pollution controls. However, we believe that EPA's proposed pollution control heat rate penalty of 125 Btu/Kwh is unsupported and can be shown to be too high.

Joint Environmental Commenters estimated the impact of a 3 inch increase in HRSG backpressure for 17 of the most common NGCC plants using Thermoflow's power plant modeling software, GT Pro and GT Pro Macro. Our analyses assumed a base HRSG backpressure of 19 inches water, corresponding to maximum backpressure during duct burner power augmentation; ambient pressure of 14.7 psia (sea level); 59°F, and 60 percent relative humidity. These analyses, included in Appendix Bindicate that an increase in HRSG backpressure of 3 inches water gauge due to SCR plus oxidation catalyst in the HRSG gas path would increase the gross LHV heat rate by 24 to 44

312_ThermoflowGTEYE.pdf; J. Petek and P. Hamilton, Performance Monitoring for Gas Turbines, Orbit, v. 25, no. 1, 2005; Emerson Process Management, Gas Turbine Engine Performance, January 2005.

Btu/kWh and the net LHV heat rate by 26 to 47 Btu/kWh. This is nearly a factor of three lower than assumed by EPA and should be employed in the absence of model specific testing.

In sum, where EPA has proposed to correct the manufacturer's documented plant performance at ISO conditions by a factor of 11 percent plus 125 Btu/Kwh, Joint Environmental Commenters believe that this correction factor has not been shown to be larger than 7-8 percent plus 50 Btu/kWh.

5. **The Partial-Load Adjustment Should be Reexamined**

The EPA increased the ISO design heat rate for all design configurations by 5 percent to account for part-load conditions but provides no specific support for its choice.[149] This figure appears to be based on worst-case conditions and does not consider improved performance achieved with the best partial-load controls and most efficient turbine models that would satisfy BSER. Gas turbines with higher design performances, for example, exhibit superior part load performance.[150] BSER should be established based on gas turbines with higher design performances and the best available part-load control. We further note that the global growth in wind power and solar generation has spurred the introduction of more flexible gas and steam turbine designs for combined cycles capable of fast startup and ramping, operational flexibility, and better part-load efficiencies.[151] Thus, we believe a 5% increase in heat rate for part-load operation for new units has not been substantiated and that EPA should consider, based on an examination of the available data and literature, including the Kim paper cited herein, whether a lower percentage increase is appropriate under the best system of emission reduction analysis. It may be possible to develop a more reasonable estimate of part-load performance degradation that can be calculated with simple algorithms (that can be set up in an Excel spreadsheet) and urge EPA to consider this approach.[152]

6. **Existing Unit Emission Rates Are Commonly Lower Than EPA' Proposed Standard**

[149] 4/12 EPA Memo ("We selected a 5 percent heat rate increase relative to the design rate to account for part-load conditions.").
[150] Kim 2004, p. 71.
[151] 2012 GTW Handbook, p. 46.
[152] S. Can Gülen and Joseph John, Combined Cycle Off-Design Performance Estimation: A Second-Law Perspective, Proceedings of ASME Turbo Expo 2011, June 6-10, 2011.

Figure 1 shows the emission rates from the units in EPA's data set, the EPA proposed limit and Joint Environmental Commenters recommended alternative of 825-850 lbs/MWh, all expressed as net emissions. Note that approximately one-half of the existing units have already met the recommended alternative limit. The recommended alternative limit would require more efficient designs than, reflected in the performance data in EPA's data set, while EPA's proposed limit would only have affected 15 percent of the theoretical "existing units" in that data.

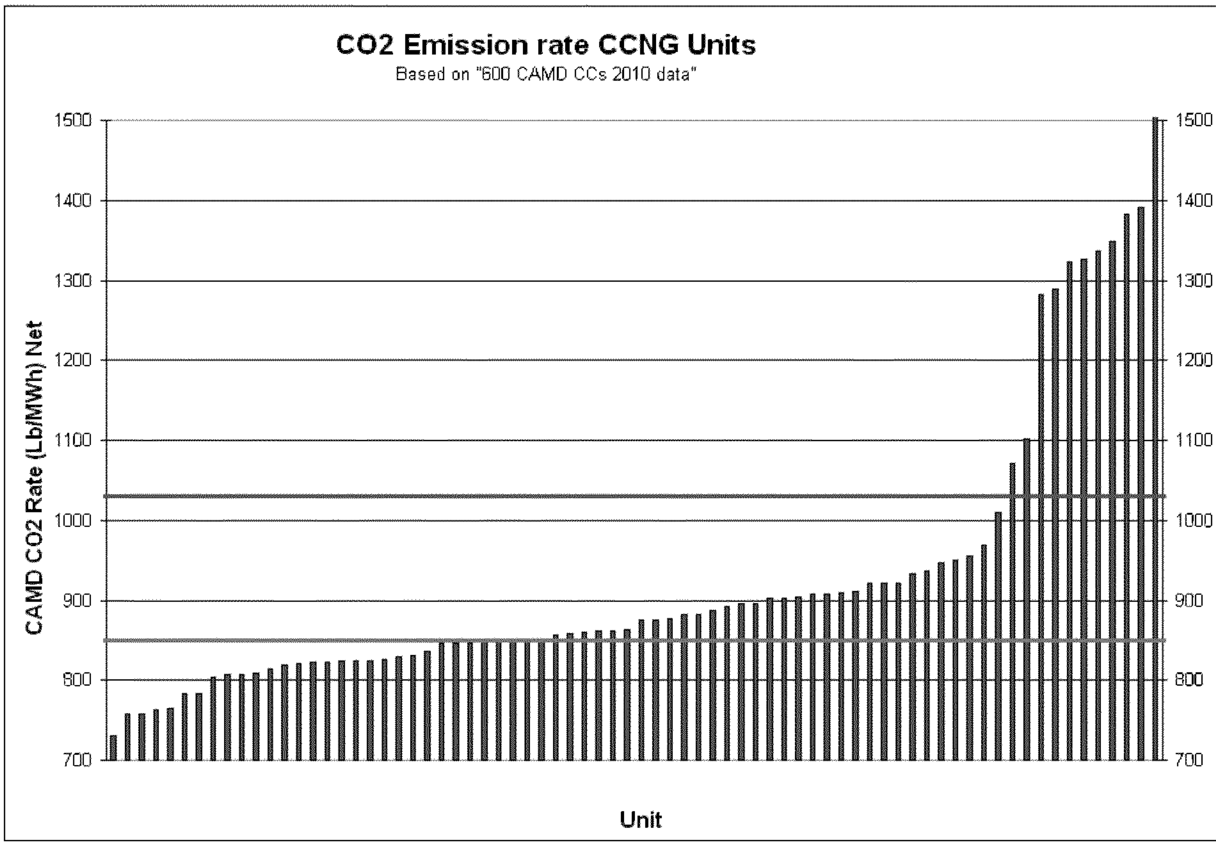
While Joint Environmental Commenters agree that EPA should consider the design information provided by the Gas Turbine World Handbook, the agency should also recognize that vendor performance guarantees are necessarily conservative, as the vendor may be liable for damages if the promised performance is not achieved. EPA has at its disposal a wealth of CO2 emissions data that sources have been reporting pursuant to the CAA's Acid Rain Program. These data provide an additional source of information that reflects the actual, rather than theoretical, emissions of the leading systems of emission reduction. Moreover, EPA has traditionally relied on in-use testing to assist it in identifying BSER limits. However, we note that in this case, data for existing units does not necessarily establish BSER because it is based on outdated turbine models that will be replaced by more efficient models in the near-term. This anticipated improvement in efficiency and attendant reduction in CO_2 emissions should be addressed in establishing BSER. The CAMD data for existing units represent a ceiling which the emission rate standard for new units should not exceed.

While we recognize that the lack of unit capacity data in the CAMD data file[153] makes use of that information difficult for purposes of determining the size of the unit, the CAMD CO_2 emission data have been collected in much the same way that EPA's proposed standard will be enforced. It therefore should be no less accurate than the information that will be used to enforce the standard. It should also be noted that these units have experienced in-use variation in temperature, altitude and performance degradation with time, and so incorporate the factors that EPA assigns to manufacturers' performance specifications. Figure 1 sets out the Performance data reported by EPA[154] for the 73 units ("EPA Data Set") converted from gross to net emissions by application of a 3 percent correction factor. We have also added lines that represent EPA's proposed 1000 lb/MWh limit (gross) on a net basis and a more reasonable limit of 825 - 850 lbs/MWh based on the best performers in this data set.

Figure 1. Unit Emission Rates for Combined Cycle Units – EPA Data Set

[153] The capacity data are from information collected and maintained by the Energy Information Administration (EIA).

[154] Memorandum from OQAPS to EGU NSPS Docket, *Design Data for New Combined Cycle Facilities*, Attachment Entitled "Gas Turbine World Performance Specifications (Apr. 12, 2012), Document ID No. EPA-HQ-OAR-2011-0660-0068



7. In Service Emissions Data Show That EPA's Proposed Limits Are Too Lenient

Table 1, below, lists all identified units that commenced operation since 2005[155], where the highest annual average CO_2 emission rate during the period from 2006 to 2011, on a net basis, is less than 850 lb/MWh.[156] As identified in Appendix A, certain data were excluded as outliers. The gross emission rates were converted to net by applying a 3 percent conversion factor, but no adjustment is made for load,

[155] We anticipate submitting a supplemental comment including emissions from such units that commenced operations at an earlier date.

[156] These data generally reflect operations in the first year where the HRSG may not yet have been operating. If the "outlier" data are included, the average of the top 10 units increases slightly to 807 lb/MWh (net) and the number of existing units that have demonstrated an ability to comply with a standard of 850 lb/MWh is reduced to 20. We have also excluded the Kleen Energy Center and Jack County units, where substantial variability in the data prevented us from ascertaining the representative high emission rate, and the Sand Hill Energy Center, where questions concerning the reported emission rate (603-655 lb) are as yet unresolved. Where less than a full year's data is reported, all available data was used.

temperature, NOx controls or decay in performance over time as these are reflected in the data itself. These units include units with different in-service dates, some with NOx controls, some in warm climates (many are in MS and FL, some at low altitudes (Astoria, 3 feet), some at high altitudes (Lakeville, 4500 feet) and with varying loads (as shown in the underlying data on gross CO2 emissions). As Table 1 shows, there were 30 units in the data base whose highest reported annual emissions were below 850 lb/MWh (net). The average of the highest reported annual emissions of this group is 817 lb/MWh (net). The average of the highest reported annual emissions of the top 10 performers is 791 lb/MWh (net).

Table 1 – Highest Reported Annual Average CO_2 Emission Rate – 2006 -2012 (Units < 850 lb/MWh(net)

FacilityID_ORISPL	**Facility Name**	**State**	**UnitID**	**CO2 Emission rate (gross)**	**CO2 Emission Rate (net)**
55375	Astoria Energy	NY	CT2	741	763
7845	Lagoon Creek	TN	LCC1	743	765
56237	Lake Side Power Plant	UT	CT01	766	789
56237	Lake Side Power Plant	UT	CT02	767	790
56031	Fox Energy Company LLC	WI	CTG-1	768	791
7845	Lagoon Creek	TN	LCC2	775	798
55375	Astoria Energy	NY	CT1	778	801
56407	West County Energy Center	FL	WCCT3C	778	801
55853	Inland Empire Energy Center	CA	1	780	803
56407	West County Energy Center	FL	WCCT3A	781	804
56407	West County Energy Center	FL	WCCT3B	781	804
55230	Jack County Generation Facility	TX	CT-4	783	806
55694	Quantum Choctaw Power, LLC	MS	AA-002	790	814
710	Jack McDonough	GA	4A	802	826
7082	Harry Allen	NV	**6	803	827
7082	Harry Allen	NV	**5	804	828
56407	West County Energy Center	FL	WCCT1A	806	830
564	Curtis H. Stanton Energy Center	FL	CCB	807	831
55694	Quantum Choctaw Power, LLC	MS	AA-001	810	834
56407	West County Energy Center	FL	WCCT1C	811	835
55853	Inland Empire Energy Center	CA	2	811	835
56407	West County Energy Center	FL	WCCT2B	811	835
56234	Caithness Long Island Energy Center	NY	0001	812	836

56407	West County Energy Center	FL	WCCT2C	815	839
56407	West County Energy Center	FL	WCCT2 A	816	840
2720	Buck	NC	12C	816	840
2720	Buck	NC	11C	816	840
56407	West County Energy Center	FL	WCCT1B	817	842
621	Turkey Point	FL	TPCT5B	824	849

These data incorporate substantial allowances for variability in performance as they are based on the highest annual average reported for each of these units from 2006-2011. No further allowance is called for. We anticipate that industry commenters may make broad arguments based on anecdotal information that further allowances are needed, for example, because of increased emissions from supplemental firing (duct burners). Those emissions are included in the data, but in the event that EPA is persuaded by such arguments, we offer below a means of addressing duct burners to accommodate such variability in annual CO_2 emission rate as might be occasioned by the use of these devices. These data, along with the performance specification data discussed earlier, clearly establish that the emission rate standard for new units should be no greater than a range of 825 -850 lb/MWh

8. **Small combined cycle unit emission rates**

EPA proposes a single CO2 standard for all affected units, regardless of the size of the facility or year of introduction of the turbine model. As a result, the performance data reflecting the very smallest of the **existing** NGCC designs, the 25 MW unit models, appear to have driven the selection of the proposed standard. There are two major problems with this approach: (1) BSER is not for existing models but rather new sources, and (2) it fails to recognize that the biggest plants that emit most of the CO2 currently employ the most efficient techniques and designs. The efficiency of combined cycle units is largely a function of gas turbine operating temperature; the use of enhancement techniques, such as inlet air cooling; and the use of fully fired HRSGs. There is nothing in the laws of physics that prevents smaller NGCC units from achieving the efficiencies of larger units. However, the Gas Turbine World Handbook data reveals that small units generally had efficiencies less than 55 percent while the better performing larger units had efficiencies of 59 to 60 percent.

As demonstrated earlier, NSPS standard setting is intended by Congress to drive technology transfer. Joint Environmental Commenters believe EPA should set a standard that drives this segment of the sector to develop smaller units with the same efficiencies as the larger units available today. At a minimum, EPA may not allow the theoretical existence of a potential market for a few small units to serve as a basis for setting a standard that is overly lax when applied to the larger units that are more likely to be responsible for most of the emissions from the category. To the extent that EPA is concerned that smaller units may not be able to meet the same limits as larger units, EPA should establish a size-based subcategory, as it has in other rules, and set a separate limit for smaller units.

We note that EIA data cannot be used to identify these small units as the EIA data report only the capacity of the combustion turbine for some of the smaller units and identifies several large (275 MW) units as less than 100 MW. Figure 2 lists all units that we have identified within the CAMD database for which the combined cycle unit capacity is 130 MW or less.

The Roseville Energy Center units are listed in CAMD as 42 MW units. The Roseville units appear to be the lowest emitting small combined cycle units in the CAMD data base. The reported annual emission rate for these units for the years 2006-2012 ranges from 877-926 lb/MWh on a gross emissions basis. If we assume that this unit is the benchmark for a small NGCC emission standard and apply a 3 percent conversion factor to the highest years' emissions the resulting limit for small NGCCs would be 954 lb/MWh (net). This difference in performance is consistent with the 2010 Gas Turbine World data on efficiencies, where small units generally had efficiencies less than 55 percent while the better performing larger units had efficiencies of 59-60 percent.

Table 2 displays the highest reported annual average emission rate (gross) and the highest reported emission(net) for each of the small units that we have been able to identify. Thirteen of these 15 units would have complied with EPA's proposed 1000 lb (gross) emission limit but none of these units would have met the 825-850 lb (net) range recommended above.

Table 2. Small combined cycle emission rates

Column1	Column2	Column3	Column4	Column5
Name	Unit ID	High CO2 Rate (Gross) From Period of Observation	Highest Reported CO2 emission rate (net)	Combined Cycle Block Capacity
Sacramento Power Authority	1	863	889	172
Frederickson	F1CT	911	938	137
Roseville	CT001	922	950	160
Roseville	CT002	926	954	160
Raesfeld	PCT2	937	965	154

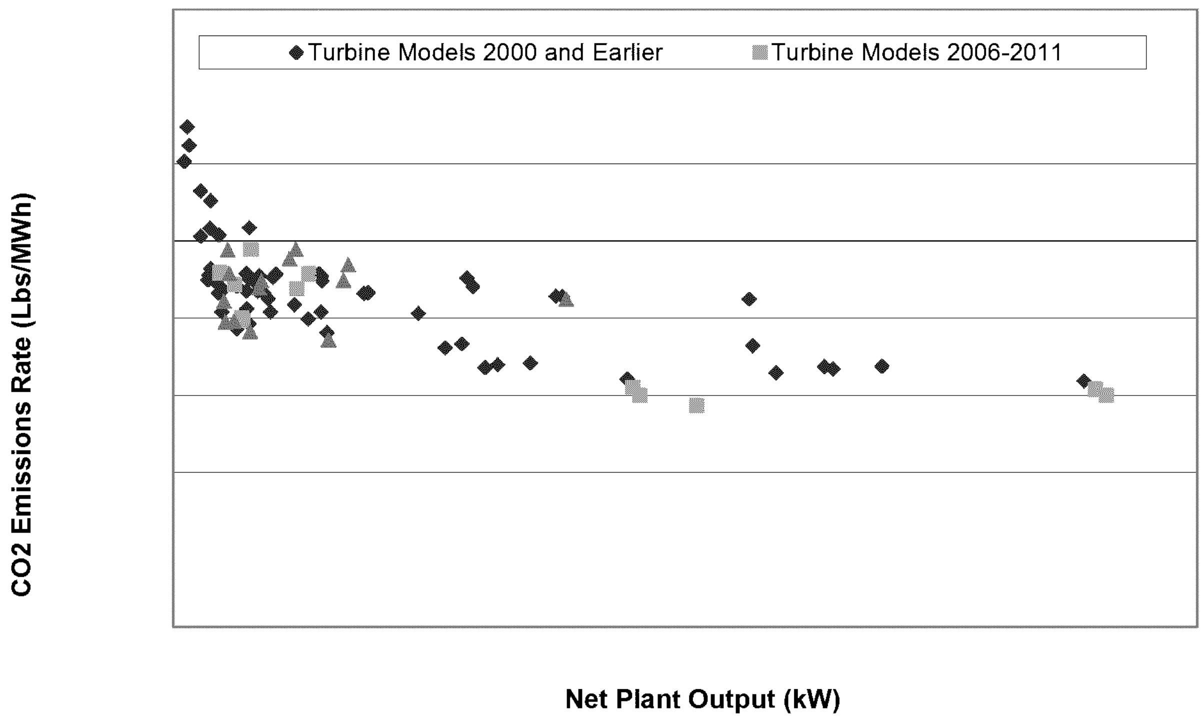
Raesfeld	PCT1	941	969	154
Carson Cogen	D1	959	988	55
Indeck Corinth	1	963	992	128
Pinelawn	00001	974	1,003	80
L'Energia	2	977	1,007	82
Dighton	1	984	1,014	169
Bluffview	CTG-1	986	1,015	60
Arapahoe	CT6	994	1,024	150
Arapahoe	CT5	1,016	1,046	150
Indeck Olean	1	1,043	1,074	79

The Gas Turbine World unit performance specifications show a substantial number of potential small combined cycle designs where the demonstrated emission rate at ISO conditions is at or below 900 lb/MWh. See Figures 2 and 3.[157] With the application of reasonable factors to account for operation at non-ISO conditions, an emission limitation of 1000 lb/MWh (net) appears to be attainable by these units. If EPA determines that subcategories by size are justified, the data demonstrate that the "cut point" in capacity between large and small units should be somewhere between 150 MW and 200 MW. Further analysis would be required to identify where, within this range, the subcategories should be divided.

Figure 2

[157] See also Appendix C.

Revised Gas Turbine Workbook, CO2 Emission Rate (Lbs/MWh) vs. Net Plant Output (kW)



9. **EPA Should Adopt a Net Electrical Output Standard**

EPA states that its proposed standard is in pounds of CO_2 per MWh of electricity produced on a gross basis. 77 FR 22394, 22398, 22436. However, our review of EPA's calculations that arrived at the 1000 lb/MWh standard indicates they were made and are reported on a net basis and mischaracterized in the rulemaking preamble. These calculations are reported in the spreadsheet, “Gas Turbine Workbook" in a tab called "Combined Cycle."

We note that the ISO performance specifications relied on by EPA are routinely reported on a net electrical output basis and that EPA has proposed that the CO_2 emission limit be based on a gross electrical output basis. Joint Environmental Commenters recommend that the final standard be established on a net electrical basis and thus would not make further adjustments to the design-based calculations. However, should EPA decide to promulgate a standard based on gross electrical output using the net heat rates used to develop the draft standard, EPA must then convert the net electric output-based calculations to a gross electrical output basis. We recommend the generally accepted conversion factor of 3 percent. That is, heat rates on a gross electric output basis should be assumed to be 3 percent lower than the heat rates reported by Gas Turbine World on a net electric output basis.

Joint Environmental Commenters strongly recommend that the standard be based on emissions per net generation. A net emission standard (1) more accurately reflects what is to be regulated; (2) can be implemented in a simple and straight forward fashion (especially for new units); (3) provides an appropriate incentive for minimizing parasitic loads, and (4) is needed to accomplish the fuel- neutral goal of the standard and ensure that actual emissions from CCS coal-fired units do not exceed the level of emissions from BSER NGCC units. The net v. gross correction is relatively small for natural gas units (3 percent) but large and presently uncertain for CCS coal units. Enforcement of a standard based on net generation is relatively straightforward. The CO_2 measurement procedure is unchanged; but the measurement of the amount of electricity occurs at the bus bar or "delivery point" at the plant where ownership of the energy changes hands rather than at the generator itself.

The difference between of a gross and net generation standard is the treatment of emissions associated with the operation of auxiliary equipment, such as a scrubber, or in this instance the CCS process equipment. With a net generation standard, 100 percent of the real world emissions associated with generating the electricity that serves the public are measured and subject to the standard. Under a gross generation standard, that portion of the real world emissions that is associated with operating the CCS process equipment would be ignored. While the difference between net and gross generating capacity is quite small (3 percent) for a CCNG unit, it may be far larger (perhaps on the order of 30 percent) for coal-fired CCS units. If a CCS plant emits at the rate of EPA's proposed standard of 1000 lbs/MWh on a gross basis, but 30 percent of its power is used to run the CCS system, then its net output is only 0.7 MWh and so its emission rate per MWh would be 1000 lb/0.7 MWh or 1428 lb/MWh. In such a case, 428 lb/MWh of real world emissions would be ignored. In the case of a NGCC plant operating at a 1000 lb/MWh (gross) emission rate, 3 percent of its power is used to meet the needs of the balance of the plant and so the net output to the grid would be 0.97 MWh and its emission rate per MWh would be 1000 lb/0.97 MWh or 1031 lb/MWh. Joint Environmental Commenters submit that it is inappropriate to consciously ignore any real world emissions for no stated reason and submit that the extremely large difference in impact on units using different fuels is inconsistent with the stated fuel neutrality of the proposal.

While EPA has determined that NGCC and not CCS technology is BSER, we note that CCS equipped coal-fired units can meet both the EPA proposed limit on a net basis and the more protective net limit suggested by the Joint Environmental Commenters. In order to comply with a net emission limit of 1000 lb a coal-fired power plant with uncontrolled emissions of 2000 lb/MWh would have to employ a CCS that was 65 percent effective. A 70 percent effective CCS unit would be needed to meet our recommended alternate limit while a 79 percent effective CCS unit would be required to achieve the 600 lb/MWh limit proposed by EPA in its 30 year compliance option. Each of these capture rates have been shown to be achievable.[158] EPA should also ensure that the energy consumed by pre-combustion techniques, such as coal gasification, for CCS is properly accounted for.

10. **Duct Burners**

EPA has corrected for the reduction in efficiency associated with less than full load operation, but has not addressed the issue of the increased rate of emissions associated with the use of duct burners to serve peak power needs. We believe that the use of duct burners is embedded in the data and is not significant in terms of affecting the annual CO_2 emission rate. However, the specific emissions associated with the use of duct burners in the publicly available data are difficult to disaggregate. Joint Environmental Commenters anticipate that industry commenters may argue that the use of duct burners justifies a higher emission standard than is suggested by the performance specifications relied on by EPA or by CAMD data. EPA should not accept broadly based or anecdotal arguments to support such assertions, but should require credible, comprehensive data. The EPA should also investigate high efficiency duct burners. While we doubt that such data will be forthcoming, if sufficient factual information is presented to support such arguments, we suggest that, rather than raising emission limits for all units, EPA treat emissions from duct burners as peaking emissions, subject to the hourly limitations recommended in this comment for other peaking units, and not included for purposes of determining compliance with the emission limits for intermediate and base-load units. We believe that this could be accomplished by measuring the amount of natural gas consumed by the duct burners and applying the CO_2 emission factor of 117 lb CO_2/MMBtu and by measuring the increased generation that results from the use of the duct burners. Both the increased generation and the increased CO_2 would be subtracted from the annual emission calculation.

11. **Summary of Comments Regarding CO_2 Emission Limits**

1. We support a fuel-neutral, single category for all fossil fueled EGUs, with subcategories based on the function of the unit either as base load /intermediate-load unit or as a peaking unit.
2. EPA should identify the best system of emission reduction for this category. As a matter of engineering, this will require identifying the BSER for natural gas units, since they are generally lower emitting than coal or oil-fired units.

[158] Some would maintain that the energy penalty for CCS is "only" 20 percent which changes the emission rates but not the underlying issue.

3. BSER is to be established on what is achievable, not necessarily what has been done in the past. An emission limit that virtually all units constructed in the past six years can meet does not represent BSER.
4. At the very least, BSER should be no higher than the emission rate achieved by the average of the best performing existing combined cycle natural gas units.
5. Both (1) the design specification information (after applying reasonable factors for load, age, temperature and altitude) and (2) the in-service emissions data for the best performing units demonstrate that the emissions limitation for new intermediate and base load units should not be greater than 825-850 lb/MWh (net).
6. We strongly recommend the use of net generation rather than gross. A net emission standard (1) more accurately reflects what is to be regulated; (2) can be implemented in a simple and straight forward fashion (especially for new units); (3) provides the appropriate incentive to minimize parasitic loads; and (4) is needed to accomplish the fuel- neutral goal of the standard and ensure that actual emissions of CCS coal-fired units do not exceed the level of emissions from BSER NGCC units.
7. We anticipate that industry commenters may argue that small combined cycle units cannot meet either the limits proposed by EPA or the more stringent limits recommended by environmental commenters. At present the record does not support such an argument given that the same technologies that reduce the emission rates of larger units could be incorporated into smaller units. However, to the extent that EPA agrees with comments concerning small units, we recommend that EPA establish a separate BSER limit for units 150-200 MW or less, rather than relaxing the standard for the more common and more efficient larger units which emit the majority of the CO_2. Based on the several sets of information available to EPA, we do not believe that a limit greater than 950 – 1000 lb/MWh (net) is warranted for these smaller units.
8. While we agree that peaking units serve a different functional purpose, they can contribute significant greenhouse gas emissions. We recommend that EPA expeditiously commence a rulemaking establishing a standard for these units.
9. We anticipate that industry commenters may argue that units that employ duct burners to a large extent cannot comply with either the limit proposed by EPA or the more stringent limits recommended by environmental commenters. We note that the emissions from these devices are included in the reported emissions data and so should already be accounted for. Should submissions from industry to the record in this rulemaking demonstrate otherwise, we recommend treating both the generation and the emissions associated with the use of these devices as peaking unit emissions, which, as a matter of function and engineering design, they are.

E. 30 Year Compliance Option

Besides the basic 1000 lbs CO2/MWh standard, EPA proposed a separate 30 year averaging compliance option for coal- and petroleum coke-fired EGUs adopting CCS. 77 Fed. Reg. 22,406. This option includes two phases of emissions limitations that, over 30 years, would yield a 1000 lbs CO2/MWh cumulative average. EPA proposed to allow a

10 year first-phase, with the emissions limit set at 1800 lbs CO_2/MWh. For the remaining 20 years, the source would have to meet a limit of 600 lbs CO_2/MWh. The higher limit may be reached by a number of currently available coal technologies, and the lower limit may be reached by those technologies with the addition of CCS. EPA also proposed to allow sources to seek approval for alternative 30 year timelines with shorter (but not longer) periods of operation without CCS, and with other corresponding two-phase emission limits averaging to 1000 lbs/MWh over 30 years (so long as the first-phase limit does not exceed 1800 lbs/MWh).

These numbers should be revised downward to comport with the lower standard we recommend. For example, if EPA sets an annual standard at 825 lbs CO_2/MWh, then plants using the 30 year compliance option should be required to achieve emissions of 1625 lbs/CO_2 MWh during their first ten years of operation and emissions of 425 lbs CO_2/MWh for the next 20 years.

F. A More Stringent Standard Is Economically Achievable

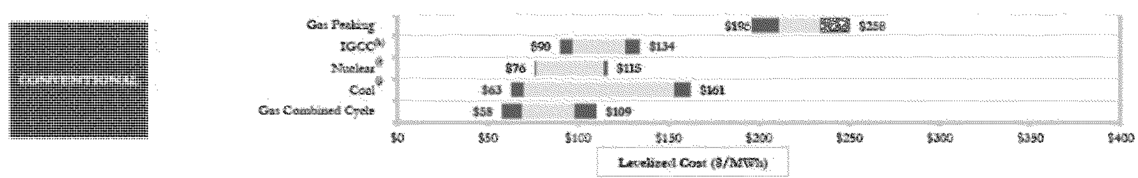
EPA correctly concludes that setting an NGCC-based BSER will not impose unreasonable (or even significant) costs upon the industry. *See* RIA at 5-15. The D.C. Circuit holds that considerations of economic achievability may weaken an NSPS only in highly exceptional circumstances. *See Portland Cement Ass'n v. Train*, 513 F.2d 506, 508 (D.C. Cir. 1975) ("Portland Cement II") (NSPS may be made less stringent in response to economic considerations only "where the costs of meeting standards would be greater than the industry could bear and survive…"); *Lignite Energy Council*, 198 F.3d at 933 (EPA's standards will be upheld unless environmental or economic costs of using a technology are "exorbitant"). Here, the EPA's proposed standards are squarely within the bounds of these principles on economic achievability. The Agency's decision to set an emission limit based on NGCC plants is backed up by a thorough and reasonable analysis of the fossil fuel-generation industry's near-term future.

As EPA correctly concludes, "all indications suggest that very few new coal-fired power plants will be constructed in the foreseeable future." 77 Fed. Reg. at 22,413. It is simply not economic to proceed with these plants in a time of low electricity demand and low natural gas prices. *See id.* EPA observes correctly in the RIA that, consistent with these trends, the Energy Information Administration (EIA)'s Annual Energy Outlook for 2012 forecasts no new unplanned coal capacity through 2020. RIA at 5-5. EIA's most recent Electric Power Monthly report confirms that this trend continues. As of April 2012, *none* of the 4844 MW of the new units to come online are coal-fired; instead, new capacity additions are largely in renewable power or natural gas. EIA, *Electric Power Monthly May 2012* at Table ES3.[159] Conversely, retirements to date have been predominantly coal-fired units. *See id.* at Table ES4. Because the industry is already

[159] Attached as **Ex. 37** *supra,* at 6.

constructing NGCC plants, rather than coal plants, solidifying this economic trend with the NSPS will impose few, if any, additional costs.

Industry-wide levelized cost figures compiled by independent analysts also support EPA's analysis. The most recent (2011) edition of Lazard's Levelized Cost of Energy Analysis,[160] a widely-used reference, shows that even high-end values for the levelized cost of NGCC, which assume very high fuel prices, still fall at or below the mid-range levelized cost of coal generation. With lower fuel prices, the levelized cost of NGCC falls below the bottom end of coal unit costs.



Further, as we discuss in detail above, new large NGCC plants are being constructed at carbon emissions efficiencies substantially greater than 1000 lbs/Mwh of CO_2. The fact that these highly-efficient plants are being constructed by many different operators even in the absence of the NSPS firmly demonstrates that they are economic. Far from imposing "exorbitant" costs on industry, efficient plants save fuel costs per unit of electricity produced, and so lower costs.

Under these circumstances, there is no credible argument that the proposed standard, or even a significantly more rigorous standard for gas-fired plants, would impose significant costs upon industry. As these economic analyses demonstrate, EPA's conclusion that the standard is economically achievable is justified both for individual plants and for the industry nationally. Courts have made it clear that EPA may examine the economic achievability of a standard at the "*broadest sense at the national and regional levels and over time* as opposed to simply at the plant level in the immediate present." In *Sierra Club v. Costle*, 657 F.2d 298, 330 (D.C. Cir. 1981) (emphasis added). Viewed over the next eight years, the industry plainly will continue its shift away from expensive coal-fired electricity, further supporting EPA's conclusion that the NSPS is manifestly achievable and cost-effective.

IV. Monitoring, Compliance, and Enforcement Issues

Compliance with the GHG performance standard is, of course, essential to ensure the benefits of that standard. EPA proposes a monitoring and compliance scheme that allows facilities to report their emissions on the basis of either fuel consumed or direct monitoring of actual emissions, that incorporates a monthly reporting period, and that

[160] Attached as **Ex. 40.**

provides an affirmative defense for exceedances attributable to malfunctions. Proposed 60 C.F.R. §§ 60.5530, 60.5535, 60.5540. In general, the proposal provides a workable system when applied to intermediate- and baseload gas-fired power plants, although EPA should clarify the calculation of penalties for noncompliance and we object to the proposed affirmative defense. For coal-fired power plants, EPA should require direct monitoring of emissions, removing the option for emission estimates based on fuel inputs.

A. EPA Should Clarify Penalties and the Duration of Violations

EPA proposes to average emissions over a 12 month period for purposes of determining compliance with the standard. Proposed 40 C.F.R. § 60.5520(a). We acknowledge the appropriateness of a long averaging time to account for daily and seasonal fluctuations in electricity demand, together with source's differing efficiencies at various loads. This long averaging period raises issues regarding penalties and enforcement. EPA should answer these questions now, rather than awaiting individual enforcement actions, and ensure that penalties are sufficient to incentivize compliance.

EPA proposes to require facilities to "measure or calculate a 12 month rolling average CO2 emission rate, calculated per calendar month, in terms of tons/MWh." 77 Fed. Reg. at 22437-38 (Proposed 40 CFR §§ 60.5525(c), 60.5540(a)-(b)). Each month, the facility must calculate average emissions per output for the month, then calculate the average of monthly averages for the prior year. Proposed 40 C.F.R. § 60.5540. The facility "is determined to have excess emissions" if this "12-operating month rolling average value" exceeds the applicable emissions limit. *Id.*

A facility that violates this limit will be subject to penalties, but EPA has not addressed how those penalties will be calculated. The Clean Air Act provides for imposition of penalties of up to $37,500 "per day of violation" of NSPS standards. CAA § 113(d)(1)(B), 42 U.S.C. § 7413(d)(1)(B); 40 C.F.R. Part 19 (adjusting $25,000 maximum daily penalty for inflation). EPA should explicitly state that when a facility's twelve-month average CO2 emissions exceed the applicable limit, the facility has been in violation of the limit for every day of the preceding year[161]. The "violations" the CAA is concerned with are excess emissions themselves, not merely the days on which calculation occur. Further, irrespective of whether the emissions on a given day are above or below the standard, each day's emissions contribute to the violation of the annual average.

Relatedly, EPA should require daily, rather than monthly, calculation of the rolling annual average emissions. Under this approach, once a facility calculates an initial violation, each subsequent day on which the rolling average exceeds the limit is another

[161] Under EPA's standard practice with respect to rolling averages, days that have already contributed to the initial violation are not counted again if the violation continues on subsequent days.

day of violation for purposes of penalty calculation. Because this average is likely to be calculated automatically, and because sources must know each day's emissions in order to manage their compliance obligations, this change should impose no additional burden on facility operators. This approach is required because the intent of the CAA penalty provisions is to deter violations by ensuring the availability of penalties that are greater than the economic benefit of the violation. If the average is calculated on a monthly basis, a facility could argue that violations only occur on the days in which the calculation is required. Under this argument, a facility could perpetually violate the standard but be liable for at most $450,000 per year.[162] Given the very large potential economic benefits that may accrue from unlawful operation of highly profitable plants[163], this potential liability falls far short of the level necessary to induce compliance. Such aninterpretation by a company that fails to comply would be inconsistent with the statutory scheme. Rather than invite this dispute, however, EPA should preempt it by switching to daily, rather than monthly, calculation of the rolling average and explicitly affirming how it intends to enforce these averages.

B. EPA's Should Not Adopt the Proposed Affirmative Defense

Joint Environmental Commenters applaud EPA's recognition that the proposed NSPS emission standard must apply at all times, including during periods of startup, shutdown, and malfunction ("SSM"). 77 Fed. Reg. at 22,407. In *Sierra Club v. EPA*, 551 F.3d 1019, 1027-28 (D.C. Cir. 2008), the D.C. Circuit made clear that, under the Act, emissions standards require "continuous" control of pollution. Although in that case the Court was evaluating the legality of SSM exemptions to emissions standards promulgated pursuant to Section 112 of the Act, its holding is not limited to Section 112 emission standards; rather, because the Court was interpreting 42 U.S.C. § 7602(k), the Act's definition of "emission standard" that applies throughout the Act, its holding is equally applicable to NSPS such as those proposed here. EPA thus properly proposes an NSPS that would apply at all times, including malfunction periods.

Nonetheless, EPA also proposes an "affirmative defense" to penalties when the standard is violated due to a malfunction. *See* 77 Fed. Reg. at 22,437 (proposing 40 C.F.R. § 60.5530). The proposed affirmative defense is inconsistent with the text of the Act and is unnecessary in light of the long averaging times EPA has proposed for the standard. Moreover, it would create significant barriers to enforcement that have not been identified in the proposal. As a result, the affirmative defense risks increasing actual emissions and thus blunting the efficacy of the proposed rule.

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[162] 12 monthly reports x $37,500 per report in violation.

[163] Assuming a wholesale price of $40/MWh, a 400 MW unit operating at an 85 percent capacity factor would generate $120 million per year in revenues.

EPA's promulgation of an affirmative defense under the NSPS provisions does not comport with the statutory language. The proposed affirmative defense is inconsistent with the Act's requirement, codified at 42 U.S.C. § 7602(k), that emission limits be continuous. *See Sierra Club v. EPA*, 551 F.3d at at 1027-28. By allowing operators to escape liability during malfunctions, the affirmative defense effectively lifts emission limits during such periods. Whether an operator's authority to emit pollutants in an uncontrolled manner stems from an exemption to emission limits or an affirmative defense to such limits, the effect is the same: intermittent controls allowing unabated emissions. Intermittent pollution control is precisely what Congress intended to avoid by requiring that limits be continuous. *Id.* at 1027 (citing *Kamp v. Hernandez*, 752 F.2d 1444, 1452 (9th Cir. 1985)).

By removing civil penalties for periods of malfunction, the proposed affirmative defense also precludes effective citizen participation in enforcement. The statute lays out how the courts are to assess civil penalties, whether a case is brought by EPA or a citizen. 42 U.S.C. § 7413(e). Congress intended citizens to be able to enforce the NSPS using the full range of civil enforcement mechanisms available to the government and subject only to the limitation that the government not be "diligently prosecuting" its own civil enforcement action. CAA §§ 304(a)(2), (b)(1)(B). EPA's rule proposal undermines the judiciary's assigned role in assessing penalties and discourages citizen participation in (and the efficacy of) CAA enforcement actions.

The statute instructs judges how to determine the size of civil penalties whenever they are sought. The scheme Congress established does not contemplate that EPA can limit when civil penalties can be assessed. 42 U.S.C. § 7413(e), *see also Chevron, U.S.A., Inc. v. Natural Res. Def. Council, Inc.*, 467 U.S. 837, 842-43 (1984). Civil penalties are a remedy available in citizen enforcement actions when the agency has not acted, and the statute gives judges a list of factors to consider in assessing penalties. CAA § 113(e). Imposing additional agency-created limits exceeds EPA's delegated authority.[164] A court in a citizen enforcement action must consider these factors and make its own determination of what civil penalties are "appropriate" under CAA § 304(a).[165] An owner of a covered facility must not be able to evade civil penalties that apply when the congressionally-mandated factors in the statute are met.[166] *See* 42 U.S.C. § 7413(e)

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164 *See Chevron*, 467 U.S. at 842-43; *see also Barnhart v. Sigmon Coal Co.*, 534 U.S. 438, 462 (2002) ("We will not alter the text in order to satisfy the policy preferences of the Commissioner."); *North Carolina v. EPA*, 531 F.3d 896, 910 (D.C. Cir. 2008) ("All the policy reasons in the world cannot justify an agency reading a substantive provision out of a statute.").

165 The Ninth Circuit recently explained that under an analogous provision of the Clean Water Act, 33 U.S.C. § 1319(d), "the civil penalties provision is committed to judicial, not agency, discretion." *Sackett v. EPA*, 622 F.3d 1139, 1146-47 (9th Cir. 2010) *cert. granted in part*, 131 S. Ct. 3092 (2011), *rev'd on other grounds by* 132 S. Ct. 1367 (2012).

166 Even if the statute were ambiguous in this regard, the proposed affirmative defense would nonetheless be invalid under *Chevron* step two and arbitrary and capricious since it is unreasonable to construe the statute as

(listing factors). Notably, courts interpreting the analogous provision of the Clean Water Act have held that the statutorily enumerated factors cannot warrant elimination of a penalty. *See United States v. Lexington-Fayette Urban County Gov't*, 591 F.3d 484, 488 (6th Cir. 2010) (collecting cases from the Fourth, Sixth, Ninth, and Eleventh Circuits)

Although section 113(d) grants EPA some discretion regarding administrative penalties, this grant of authority does not extend to penalties courts may impose under sections 113(e) or 304. Under section 113(d), EPA may "compromise, modify, or remit, with or without conditions, *any administrative penalty* which may be imposed under [subsection 113(d)]." 42 U.S.C. § 7413(d)(2)(B) (emphasis added). Sections 113(e) and 304 contain no similar grant of authority. Instead, Section 304(a) grants courts the sole authority "to apply any appropriate civil penalties" in citizen suits. The explicit reference to EPA's ability to modify penalties in one subsection and its absence in the other subsection of the same provision indicates that Congress made an intentional decision that EPA may not alter by rule.[167]

The proposed affirmative defense would also hinder citizen participation in CAA enforcement, contrary to the congressional intent of conferring on citizens the right to protect themselves from pollution. The affirmative defense would likely be used on a routine basis by polluting sources seeking to avoid penalties, just as the malfunction exemption was. As a result, citizens who seek the assessment of civil penalties against polluters in order to protect themselves and achieve the Act's goals would be forced to engage in fact-intensive disputes over the cause of emission violations and adequacy of responsive measures – an outcome Congress intended to prevent with the simple straightforward enforcement and penalty provisions in the Clean Air Act. *NRDC v. Train*, 510 F.2d 692, 724 (D.C. Cir. 1974) (Congress intended for citizen suit enforcement to avoid re-delving into "technological or other considerations."). This burden on citizens would make it less likely that they would enforce the Act. Decreased citizen enforcement would result in fewer civil penalties, which in turn would reduce overall compliance with the Act, since civil penalties provide a powerful deterrent to violators.

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allowing EPA to prevent courts from considering specifically listed factors. *See Chevron*, 467 U.S. at 843 (explaining that if the statute does not answer the question at issue, "the question for the court is whether the agency's answer is based on a permissible construction of the statute"); *see also Gen. Instrument Corp. v. F.C.C.*, 213 F.3d 724, 732 (D.C. Cir. 2000) (explaining that "an arbitrary and capricious claim and a *Chevron* step two argument overlap"); *Motor Vehicle Mfrs. Ass'n of U.S., Inc. v. State Farm Mut. Auto. Ins. Co.*, 463 U.S. 29, 43 (1983) (explaining that agency acts in arbitrary and capricious manner if it fails to consider "relevant factors" or "entirely fail[s] to consider an important aspect of the problem"). By "upset[ting] the statutory balance struck by Congress," as discussed above, the affirmative defense is unreasonable under *Chevron* step two. *Int'l Alliance of Theatrical & Stage Employees v. N.L.R.B*, 334 F.3d 27, 35 (D.C. Cir. 2003).

167 Even if EPA, rather than courts, bore responsibility for applying the section 113(e) factors, EPA would be required to consider all the section 113(e)(1) factors in setting the penalty. CAA § 113(e)(1), 42 U.S.C. § 7413(e)(1); *see also N.Y. Cross Harbor R.R. v. Surface Transp. Bd.*, 374 F.3d 1177, 1184 (D.C. Cir. 2004) (holding that "Board's failure to balance the competing interests . . . requires" vacatur of agency action).

See, e.g., *Pennsylvania v. Del. Valley Citizens' Council for Clean Air*, 478 U.S. 546, 560 (1986). As the Supreme Court explained: "To the extent that [civil penalties] encourage defendants to discontinue current violations and deter them from committing future ones, they afford redress to citizen plaintiffs who are injured or threatened with injury as a consequence of ongoing unlawful conduct." *Friends of the Earth, Inc. v. Laidlaw Envtl. Servs.*, 528 U.S. 167, 186 (2000).[168]

The proposed affirmative defense is unnecessary. As EPA suggests, long averaging periods obviate any possible need for an affirmative defense. 77 Fed. Reg. at 22409 (requesting comment on this issue). This is true for both the twelve-month and 30-year averaging period. Any period of malfunction or other higher emissions is likely to be brief, especially any event satisfying the terms of the proposed affirmative defense, which requires "repairs [to be] made as expeditiously as possible" and for the "frequency, amount, and the excess emissions (including bypass) [to be] minimized to the maximum extent practicable." Proposed 40 C.F.R. §60.5530(a)(2), (a)(3) (77 Fed. Reg. at 22437). The impact of such a brief period of malfunction will be diluted across an entire year when the average emissions are computed. Thus, by running only slightly more efficiently than EPA requires, a prudent facility owner will be able to provide an adequate margin of safety to insulate against any possible violation of the standard. Indeed, as EPA's own data shows,[169] new NGCC plants – the type of fossil fuel-fired power plant EPA reasonably expects to be built in the coming years[170] – should easily be able to meet, and in most cases exceed, a substantially lower standard than the standards we advocate here and that EPA has proposed the proposed standard during normal operation. Thus, owners of future TTTT plants can build in a margin of safety to account for malfunctions over the course of the year, and still meet the standard. These arguments apply with even greater force to potential coal-fired units on the 30-year compliance option. In summary, because the standard provides a long averaging time, a prudent operator -- the only type of operator to whom the affirmative defense would apply[171] -- will never need the affirmative defense. Codifying this affirmative defense would invite complexity and prolonged dispute while providing no discernible benefit.

EPA's prosecutorial discretion similarly defeats any argument for the affirmative defense. EPA has discretion to decide what cases to prosecute, to consider settlements,

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168 S. Rep. 101-228, at 373 (1989), *as reprinted in* 1990 U.S.C.C.A.N. 3385, 3756.

169 *See* "New Combined Cycle Units," EPA-HQ-OAR-2011-0660-0029, *available at* http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OAR-2011-0660-0029 (last visited June 1, 2012).

170 *See, e.g.,* 77 Fed. Reg. at 22,418 ("[I]t seems unlikely that utilities would choose a natural gas-fired boiler as the generation technology of choice when NGCC is a much more efficient, less expensive, and more widely-used technology").

171 The affirmative defense would only apply to operators who have taken reasonable care to avoid malfunctions: i.e., prudent operators. *See* 77 Fed. Reg. 22,437.

and to request civil penalties in a case-by-case manner, as long as it acts consistently with the Clean Air Act to protect clean air as its top priority. *See* 42 U.S.C. § 7401. Promulgating this affirmative defense is equivalent to giving polluters "get out of jail free" cards for serious emission exceedances and violations. Polluters are likely to claim that any violation of the standard is due to a malfunction in order to evade the requirements. Allowing polluting sources to evade financial penalties – which are the real teeth of the standards – through this type of measure may lead to sources no longer even trying to prevent process upsets. It will also increase the complexity and expense of enforcement actions. EPA has provided no evidence that an affirmative defense for malfunctions would serve the purpose of section 111, to protect people from air pollution.

The precedent on which EPA relies does not support the affirmative defense. EPA primarily cites old cases that have been superseded by subsequent legislative and judicial developments, as EPA acknowledges. *See* 77 Fed. Reg. at 22,409 ("...[I]ntervening case law such as *Sierra Club v. EPA* and the CAA 1977 amendments undermine the relevance of these cases today. . . ."). The only recent case EPA relies on, *Montana Sulphur & Chemical Co. v EPA*, 666 F.3d 1174 (9th Cir. 2011), did not consider the lawfulness of an affirmative defense. Rather, that court considered an industry challenge to EPA's imposition of numerical emission limitations on flaring in a Federal Implementation Plan (FIP). *Id.* at 1191. The court rejected this challenge because it determined that continuous emission limitations are required under the Act and because EPA had offered sufficient "leeway" for "truly unavoidable emissions." *Id.* The court cited an analogous affirmative defense incorporated into the FIP as an aspect of this leeway, as well as the laxity of the proposed emissions limitations, the latter allowing some short periods of flaring with emissions in excess of what is generally permitted. 666 F.3d 1191.[172] In this brief discussion the court did not consider the legality of the affirmative defense, including, in particular, the conflict between the affirmative defense and Section 113(e) discussed above.

Even assuming *arguendo* that EPA does have authority to promulgate any type of affirmative defense to penalties for malfunctions, EPA should also promulgate the following provisions:

1. A specific amount of compensatory penalties should apply to each reported malfunction (consistent with the Act). These funds should be dedicated to enforcement and inspections of the specific facility, to create greater assurance that malfunctions will not happen again.

2. EPA should modify the regulations so that the affirmative defense cannot be used by a specific facility or company more than once within a set period of time, such as 10 years. The affirmative defense should become automatically unavailable to a facility that has previously had a malfunction within the last 10 years, to ensure that this defense does not swallow the value of the standards.

[172] Here, the long compliance period accomplishes the same effect.

3. EPA should promulgate specific public reporting and notification requirements for malfunctions and emission exceedances. Specifically, EPA should require that when a facility provides EPA with a notification of a malfunction or emission standard exceedance under the regulations, this notice will be made publicly available on EPA's website within 14 days. Commenters support EPA's proposal to require reporting of malfunctions, as proposed at 40 C.F.R. § 60.5530(b), but it is important that this information be electronically reported, and made publicly available as soon as possible.

Commenters urge EPA not to adopt an affirmative defense that undermines citizen rights and remedies under the Act. Given the serious nature of climate change, EPA should not retract or weaken citizen rights and remedies, as this proposal does, by making it more difficult to obtain meaningful relief when facilities are releasing unacceptably high levels of carbon dioxide into the atmosphere.

C. EPA Should Require Direct Monitoring of CO2 Emissions, Especially for Coal Plants

EPA proposes to allow facilities to determine compliance with the standard by either monitoring emissions directly or by estimating emissions based on fuel consumption. Proposed 40 C.F.R. §§ 60.5535, 60.5540.[173] Direct monitoring of emissions, especially using continuous emission monitoring systems ("CEMS"), is generally more accurate than estimation of emissions using fuel consumption, as EPA has previously acknowledged.[174] Accordingly, EPA should require CEMS for emissions from all units.[175]

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[173] It appears that EPA inadvertently omitted a third provision relating to using fuel consumption to estimate emissions. Proposed 40 C.F.R. § 60.5535(c) refers the option of "determin[ing] . . . C02 mass emissions are by monitoring fuel combusted in the affected EGU and periodic fuel sampling *as allowed under § 60.5525(c)(2)*," but the proposal does not contain a section 60.5525(c)(2).

[174] *See, e.g.*, U.S. EPA, Regulatory Impact Analysis for the Mandatory Reporting of Greenhouse Gas Emissions Proposed Rule ('RIA') at 5-15 – 5-21 (Mar. 2009), attached as **Ex. 41**, John Schakenbach, Robert Vollaro, & Reynaldo Forte, U.S. Office of Atmospheric Programs, *Fundamentals of Successful Monitoring, Reporting, and Verification under a Cap-andTrade Program* ('*Fundamentals*'), 56 J. of the Air & Waste Mgmt. Ass'n 1576, 1581 (Nov. 2006), attached as **Ex. 42**.

[175] EPA should also clarify that all plants must undergo an initial performance test pursuant to 40 C.F.R. § 60.8. In the preamble to the proposed rule, EPA explicitly "propose[s] that owners/operators of a new unit, conduct an initial performance test to demonstrate compliance with the CO2emissions limits beginning in the calendar month following initial certification of the CO2 and flow rate monitoring CEMS," "[c]onsistent with the performance testing requirements in the CAA section 111 regulatory general provisions (40 CFR part 60.8) and CEMS certification requirements (40 CFR part 75.4(b))." 77 Fed. Reg. at 22409. Despite this statement, Proposed Table 1 to Subpart TTTT of Part 60, "Applicability of Subpart A General Provisions to Subpart TTTT,"

For coal plants in particular, using fuel input to estimate emissions understates emissions compared to direct monitoring. Thus, even if EPA concludes that fuel-based emission estimates are sufficient for gas-fired plants, EPA nonetheless should require CEMS monitoring of emissions for coal plants. We note that it appears that all existing coal-fired plants already use CEMS, to comply with existing reporting requirements under the Acid Rain Program and Greenhouse Gas Reporting Rules.[176] Accordingly, requiring coal plants to use CEMS will improve reporting accuracy while imposing little if any additional burden on industry.

The value of CEMS data is illustrated by analysis of plants for which EPA has both CEMS and fuel-based emission estimates. Power plants within the Clean Air Act's Acid Rain Program report CO2 emissions to the EPA; essentially all, if not all, coal-fired plants do so using CEMS, while most oil- and gas-fired plants use site-specific emissions calculations.[177] The Energy Information Administration ('EIA') also calculates emissions for these plants, but uses fuel consumption data rather than the CEMS information.[178] These parallel data sets allowed US Geological Survey scientists to compare measured and estimated emissions for 2900 plants, including the 828 plants which report using CEMS measurements (which are, almost entirely, coal plants).[179] They documented significant divergences between the two data sets. Overall, the fuel consumption data provided an average 4.6% lower emissions estimate.[180] This average divergence masks even greater divergence in estimates regarding individual plants.[181] This discrepancy is

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indicates that § 60.8 does not apply. Because EPA's preamble explicitly states that section 60.8 will apply, and because EPA includes no discussion to the contrary, we assume proposed Table 1 is in error.

176 Katherine V. Ackerman & Eric T. Sundquist, *Comparison of Two U.S. Power-Plant Carbon Dioxide Emissions Data Sets*, 42 Environmental Science & Technology 5,688, 5,690 (June 2008), attached as **Ex. 43** ("Currently, all coal-fired units use CEM systems").

177 See 40 C.F.R. §§ 75.10(a)(3) (CO2 monitoring options); 75.13 (CEMS requirements).

178 Katherine V. Ackerman & Eric T. Sundquist, *Comparison of Two U.S. Power-Plant Carbon Dioxide Emissions Data Sets*, 42 Environmental Science & Technology 5,688, 5,688 (June 2008), attached as **Ex. 43,** *supra.*

179 See id. at 5,689.

180 *Id.*

181 The study authors expressed this overall variability by calculating the absolute relative difference. The systemic 4.6% underestimate included above is the "signed relative difference", which is generated by adding up all the paired differences, positive or negative (e.g., -5+5+1=1) and dividing by the number of data pairs – and the average absolute difference, which is calculated by adding the absolute value of those differences (e.g. 5+5+1=11), and so measures the total variation between the pairs because oppositely-signed differences do not cancel each other out. Using these methods, while the signed relative difference between matched pairs was 4.6%, the corresponding absolute relative difference was 17.1%.

likely due to the inherent inaccuracy of fuel sampling for coal plants. Samples are typically taken from different parts of the fuel pile and the calculations do not take into account environmental conditions at the time of fuel use, such as wet or frozen coal. Accordingly, EPA should require coal-fired plants to use CEMS to calculate CO2 emissions, using the procedures provided in proposed 40 C.F.R. § 60.5540(a).

D. Enforcement of the 30 Year Compliance Option

Joint Environmental Commenters submit that if included in the final standards, the 30 year compliance option must be structured with additional features necessary to ensure compliance through a plant's lifetime. Requirements and expectations must be explicit, clear, and binding before construction on a project can begin. EPA's regulations must require that an EPA- or state-issued permit under the 30-year option include milestones for assuring that all necessary steps are taken to prepare for, and operate under, the lower second-phase emission limitation. Such milestones should include specific deadlines and required filings with the permitting agency for the following steps: (1) completing detailed construction plans for all CCS-related components including not only carbon capture equipment but also all necessary infrastructure and sequestration arrangements, along with any other components needed for compliance with the second-phase emission limitation, (2) signing construction contracts, with reportable milestones, (3) obtaining all required state and local regulatory approvals, and (4) securing all necessary financing. All such milestones requirements should be incorporated into Title V permits as conditions on operation. This will ensure that they are binding and enforceable, especially to the extent that they require any ongoing obligations through Phase I.

Additionally, EPA should ensure that an EGU will not commence construction or first-phase operation without effective assurances of financial capability and responsibility to meet second-phase obligations. To do so, EPA's regulations should require the owner or operator to provide an escrow payment system, insurance policy, surety bond, or other similar instrument. Such an instrument would have enough value to pay for CCS installation, including meeting all the permit milestones, and the funds would be available to pay for installation. That value will be forfeited for any failure to comply with emissions limitations. EPA should require financial assurances to be sufficient to make a failure to install or operate CCS more expensive than installing and operating it, which will ensure that every source choosing the 30 year compliance option will fulfill its obligations.

Joint Environmental Commenters urge these requirements recalling the experience of the South Coast Air Quality Management District (AQMD) with the Regional Clean Air Incentives Market (RECLAIM). When the RECLAIM limitations on NOx emissions tightened, regulated sources claimed compliance would be too expensive. They succeeded in undermining AQMD and basically ended RECLAIM. It is widely acknowledged that the RECLAIM program did not have sufficient guarantees that the necessary investments would take place during the first phase to ensure success of the second phase. EPA should consider that failure and design a set of requirements that avoids the same problems.

Joint Environmental Commenters further note the research conducted by Resources for the Future (RFF) on the need for financial securitization for deferred compliance obligations like the proposed 30-year averaging period. We encourage EPA to consider a discussion paper from RFF: Dalia Patino Echeverri, et al., Resources for the Future, *Flexible Mandates for Investment in New Technology* (2012), *available at*http://www.rff.org/RFF/Documents/RFF-DP-12-14.pdf. Their research shows that the significant risk of backsliding inherent in the thirty-year option can be mitigated by requiring payments into an escrow fund or other financial assurances.

1. **Failure to Comply**

Two provisions of the Clean Air Act provide penalties for NSPS violations. Section 113(d)(1) authorizes civil penalties for NSPS violations of up to $37,500 per day. 74 Fed. Reg. 628.[1] This equates to a maximum penalty of $13,687,500 per year. Separately, Section 120 authorizes noncompliance penalties that are set at the amount of economic benefit gained from noncompliance. § 120(d)(2). These noncompliance penalties are in addition to, and not in lieu of, the civil penalties. § 120(f).

A source that fails to comply with its 30 year compliance option limits is therefore subject civil penalties of as much as $13.6 million per year, plus a noncompliance penalty as necessary to recovery of whatever additional profit it gained from its failure to comply. Joint Environmental Commenters note that a failure to install CCS would incur an economic benefit not just from first-phase operations, but also from avoided installation costs. EPA should make clear in the regulations that it retains the authority to recover all economic benefit from failing to comply. With vigorous enforcement, then, it will be in no source's economic interest to fail to comply with second-phase emissions limitations. These penalties provide an essential backstop to the surety bond or equivalent instrument discussed above.

Joint Environmental Commenters further note that a failure to operate installed pollution control equipment is a "modification" that subjects a source to New Source Performance Standards. *See, e.g., National-Southwire Aluminum Co. v. U.S. E.P.A.*, 838 F.2d 835 (6th Cir. 1988) (turning off pollution control equipment constitutes a modification). While EPA has failed to propose standards for modifications (as discussed elsewhere in these comments), the regulations should provide that if a source decides not to operate existing CCS equipment, it will become subject to the New Source Performance Standards and New Source Review.

2. Alternative Timelines

Joint Environmental Commenters have no objection to allowing sources to propose different 30-year timelines that achieve greater near-term reductions. Accordingly, if EPA elects to allow a source greater flexibility in choosing the 30-year timeline applicable to it, such alternative timelines must be subject to three restrictions. First, no source should be allowed to exceed 1800 lbs CO_2/MWh in any year. Second, no source should be allowed to defer the first-phase emission limitation by more than ten years from the start of operations. Third, the 30-year averaging must be based on permitted emissions in each year, rather than on actual emissions. A source permitted for 1800 lbs CO_2/MWh that runs at 1600 lbs CO2/MWh would not earn credit for use in another year. Instead, the timeline sets out ceilings that may not be exceeded.

These conditions are reasonable and necessary to ensure reliable compliance with a 30-year compliance path that, as EPA recognizes, creates unique enforcement concerns. There is no justification for imposing interim emission limits less stringent than what supercritical boilers, IGCC units, and pressurized CFB boilers can meet from the commencement of operations. Further, establishing a minimum interim standard of 1800 lbs CO2/MWh will help to provide certainty both to regulators and regulated sources and avoid situations where sources find themselves ultimately unable to achieve sufficient emission reductions to make up for excess emissions during the first phase of operations.

Finally, we support EPA's suggestion to automatically terminate the 30-year averaging compliance option for new plants commencing construction after 2020. We agree that "flexibility is likely to be most important for the first several CCS projects (i.e., "first movers")" and that it should not be necessary to include this type of compliance option when the NSPS is next reviewed. 77 Fed. Reg. at 22,407. Automatic termination of the provision will avoid creating expectations that could as a practical matter constrain EPA's options at the next review, and it will not prevent EPA from renewing the provision if it is still determined to be appropriate in 2020.

V. Transitional, Modified, and Reconstructed Sources

A. Transitional Sources

EPA proposes to exempt from the NSPS certain new sources that EPA believes are "poised to commence construction in the very near future." 77 Fed. Reg. at 22,421. EPA appears to be concerned that applying the NSPS to these sources would have adverse economic effects by stymieing projects that otherwise would be moving forward promptly. EPA's concerns are unfounded. In fact, exempting these sources is the action that would be detrimental to the public. Many of the projects on EPA's list of potential transitional sources would saddle ratepayers with huge costs if built as planned. Others are massively subsidized by the public fisc. Some are not needed to meet electricity demand. Almost all of these projects are far from commencing construction, and most lack financing. Several of these projects, if they go forward at all, are fully capable of meeting the proposed standard.

Instead of exempting failing, risky, and expensive projects, EPA should follow the rule defining "new sources" that Congress set forth in Section 111(a)(2) of the Clean Air Act, and require the sources on the "Potential Transitional Source" list to comply with the same performance standard that applies to all other new sources in this category.

1. **EPA's List of "Potential Transitional Sources" Consists Only of Projects That Are Failing, Unnecessary, or Able to Meet the Proposed Standard.**

EPA proposes to exempt up to 15 proposed coal-fired power plants that – to EPA's understanding – already have preconstruction permits that meet PSD requirements but have yet to begin construction. 77 Fed. Reg. at 22,421. EPA labels this group "potential transitional sources," and indicates that only those sources on the list that "commence construction" by April 13, 2013 may ultimately qualify for the exemption. *Id.* The sources included on this list are not the sort of projects that merit special treatment. Building a coal-fired power plant under current economic conditions is a risky and ill-advised investment that nearly all power companies have moved away from.[182] Dozens of similarly ill-conceived projects have already been canceled.[183]

Public information about these projects demonstrates that they are either (a) able to meet the NSPS for new sources; or (b) highly unlikely to ever complete construction (whether or not they convince state authorities that they have "commenced" construction by April 2013).[184] EPA's concern that applying the new source standard to this group would undermine otherwise successful projects is therefore unfounded.

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[182] See discussion in Section ___ supra [EPA Has Reasonably Grouped Coal- and Natural Gas-Fired Power Plants in Category TTTT]; *See also, e.g.*, Union of Concerned Scientists, *A Risky Proposition: The Financial Hazards of New Investments in Coal Plants* (2011) and *Burning Coal, Burning Cash* (2010), attached as **Exs. 44 & 45**.
[183] 77 Fed. Reg. at 22,422, n. 66; *Plans for 150 New Coal Plants Scrapped, Transition to Clean Energy Picks Up Steam, at* http://action.sierraclub.org/site/MessageViewer?em_id=195922.0; Sierra Club Coal Tracker, *at* http://www.sierraclub.org/environmentallaw/coal/plantlist.aspx.
[184] We discuss the issue of "commencing construction" further in Section C below.

a. Limestone 3 (Texas)

Limestone 3, a proposed addition to NRG Energy's existing Limestone power plant, received its PSD permit in December 2009. NRG has neither applied for a wastewater permit, nor identified any plans to proceed with the project. This project is not moving forward, nor is there any indication that NRG has expended a significant amount of resources on developing the plant, or that it could not change its design plans at this time.

b. White Stallion (Texas)

By EPA's own standards, White Stallion does not meet the first prong of the test for "potential transitional sources." EPA defines these sources as those that "have received approval for their PSD preconstruction permits *that meet CAA PSD requirements*." 77 Fed. Reg. at 22,421. EPA gave notice to the Texas Commission on Environmental Quality ("TCEQ") multiple times that the White Stallion PSD permit does not comply with the Clean Air Act. In September 2010, following a series of letters throughout the permitting process, EPA informed TCEQ that "[b]ecause of the deficiencies identified in our written correspondence and the lack of required NAAQS demonstrations, if TCEQ were to issue the permits as they are proposed *they would not be consistent with federal requirements*..."[185] TCEQ nevertheless issued the permits without correcting these deficiencies. Accordingly, by EPA's own determination, the PSD permit does not meet CAA requirements and should not qualify White Stallion as a "transitional source."

The plant is also facing a number of hurdles unrelated to carbon regulation. Perhaps most significant, the plant has been unable to acquire sufficient water rights to satisfy the plant's needs. The local surface water authority, the Lower Colorado River Authority, rejected White Stallion's proposal to contract for surface water in 2011, and White Stallion has not come close to obtaining sufficient groundwater rights.[186] Nor does it have a plan for conveying available groundwater to its site.[187]

In addition, a state judge remanded the plant's air permit to TCEQ for consideration of whether the information in the application is consistent with the company's submittal to the Army Corps of Engineers for a wetlands permit.[188] Although the remand process

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[185] Letter from L. Starfield, Deputy Regional Administrator, to M. Vickery, Executive Director of TCEQ(Sept. 29, 2010) (emphasis added), attached as **Ex. 46**.

[186] Declaration of C. Roberts ¶¶5, 10, 12 (and corresponding attachments),*White Stallion Energy Center, LLC et al. v. EPA*, No. 12-1100 (and consolidated cases) (D.C. Cir., filed May 17, 2012), attached as **Ex. 47**.

[187] *Id.* ¶11.

[188] Order, *Envt'l Defense Fund, Inc. v. Texas Comm'n on Envt'l Quality*, No. D-1-GN-11-000011, Dist. Ct. of Travis County, Tex., 201st Judicial Dist. (June 20, 2011), attached as **Ex. 48**.

on that particular issue recently concluded, the same judge will hear additional claims that the air permit is unlawful, several of which were underscored by EPA in its comments on the permit.[189]

White Stallion's plant design also remains in flux. For example, the company has announced a switch from wet-cooling to dry-cooling, which will require substantial additional space.[190] White Stallion has not indicated how it will reconcile this larger footprint with its commitment not to construct upon the site's wetlands. In short, the plant has many hurdles and likely design changes before it; it is not close to fruition.

c. Coleto Creek (Texas)

Coleto Creek, originally proposed in 2008, appears unlikely to gain financing whether or not it can nominally "commence construction" by the April 2013 deadline. According to a project official, "the project is now on hold."[191] Moreover, the developers have expressed the willingness and capability to incorporate CCS technology if the plant does move forward: "A still-active website outlining the proposal says the plant owners are 'looking ahead in anticipation of future carbon-capture regulations,'" so the new unit "has been designed to be retrofitted with carbon-capture technology." *Id.*

d. Holcomb 2 (Kansas)

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[189]A state court judge has stated his intent to remand the permit for the proposed Las Brisas Energy Center, which faced similar criticism from EPA as White Stallion. Letter from Hon. S. Yelenosky to Counsel of Record, Re: Cause No. D-1-GN-11-001364, *Envt'l Defense Fund, Inc. et al vs. Tex. Comm'n on Envt'l Quality*, 261st Judicial District Court, Travis County, Tex. (May 14, 2012), attached as **Ex. 49**. The Las Brisas remand suggests that White Stallion also faces an uphill battle in state court.

[190] On October 6, White Stallion officials announced that due to "setbacks" in acquiring surface water rights from the LCRA, "the project would now implement a dry cooling technology." Heather Menzies, *White Stallion Clears Two Major Hurdles*, Bay City Tribune (Oct. 6, 2011), attached as **Ex. 50**; *See also* United States Environmental Protection Agency, *Cooling Water Intakes: Section 316(b): Phase I—New Facilities, Technical Development Document for the Final Regulations Addressing Cooling Water Intake Structures for New Facilities*, EPA-821-R-01-036, Nov. 2001, *at* http://water.epa.gov/lawsregs/lawsguidance/cwa/316b/phase1/technical_index.cfm, Chapter 3, p. 3-34 (noting that "[d]ry cooling towers generally require approximately 3 to 4 times the area of a wet tower for a comparable cooling capacity.").

[191] Bill Dawson, *Texas and carbon capture: A status report on power plants, policy and research*, Texas Climate News (May 15, 2012), at http://texasclimatenews.org/wp/?p=4972.

The Holcomb 2 (aka Sunflower) project does not qualify as a "potential transitional source" for numerous reasons. EPA has repeatedly advised the Kansas Department of Health and Environment in writing that the PSD permit for Holcomb 2 does not comply with the Clean Air Act because it does not include required emission limits to ensure that the plant will not exceed the one-hour NAAQS for NO_2 and SO_2.[192] Because EPA has repeatedly acknowledged that the permit does not "meet CAA PSD requirements," 77 Fed. Reg. at 22,421, Holcomb 2 cannot qualify as a "potential transitional source." Moreover, the preconstruction permit is currently being challenged in the Kansas Supreme Court on these and other grounds.

Contrary to EPA's suggestion that the potential transitional sources it has identified are already fully planned and designed, the air pollution control equipment for Holcomb 2 is still in the early design stages and will likely require "substantial redesign."[193]

In addition, the United States District Court for the District of Columbia has ruled that the Rural Utility Service ("RUS") violated the National Environmental Policy Act ("NEPA") by failing to produce an environmental impact statement in connection with its involvement in approving past financial arrangements related to the project. *See Sierra Club v. U.S. Dep't of Agriculture*, No. Civ. A 07-1860, 2012 WL 263506 (D.D.C. Jan. 30, 2012), appeal docketed, No. 12-5097 (D.C. Cir. Apr. 9, 2012). Pursuant to the court's order, RUS cannot consent to the current project proposal until an EIS has been completed. *Id.* at * 10-11. Sunflower has not yet requested approval from RUS for the current project proposal, nor identified an alternative that would not require RUS approval.

Finally, the majority owner of the proposed Holcomb 2 project, Tri-State Generation and Transmission, Inc., has published and filed with the Colorado Public Utilities Commission a final Electric Resource Plan showing the plant is unnecessary to meet demand. Of the 24 resource planning scenarios modeled by Tri-State, none showed any real need for coal-fired power from Holcomb 2 to meet future energy demand. Rather, Tri-State's modeling demonstrated that future demand could be met with a combination of cleaner alternatives, such as demand side management and renewable generation resources.[194]

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[192] *See* Letter from K. Brooks, Regional Administrator, U.S. EPA to R. Moser, Secretary, Kansas Department of Health and the Environment, dated Feb. 3, 2011, attached as **Ex.51**; Letter from K. Brooks, Regional Administrator, U.S. EPA to R. Moser, Secretary, Kansas Department of Health and the Environment, dated Oct. 31, 2011, attached as **Ex. 52**.

[193] Declaration of Ranajit Sahu in Support of Sierra Club's Opposition to Intervenor's Motion to Dismiss One Issue of Four on Grounds of Mootness, *Sierra Club v. Moser*, Case No. 11-105,493-AS (Kan. Mar. 16, 2012), attached as **Ex. 53**.

[194] Integrated Resource Plan / Electric Resource Plan for Tri-State Generation and Transmission Associate, Inc., Submitted to Western Area Power Authority, Colorado Public Utilities Commission, Nov. 2010, attached as **Ex. 54**. *See also* Tri-State Generation

When questioned, Tri-State advised the press that it planned to delay construction of Holcomb 2.[195] Because the owners of the proposed project intend to delay construction independent of the NSPS, Holcomb 2 should be required to meet the NSPS.

e. De Young (Michigan)

The expansion of the James De Young coal-fired power plant in Holland, Michigan is a failing and unnecessary project. It has been criticized by the Michigan Public Service Commission as unnecessary and more costly than available alternatives for meeting energy demand. The Commission determined in a 2010 report that the Holland Board of Public Works had failed to demonstrate the need for the facility as the sole source to meet projected capacity requirements, and that Holland had underestimated the role of energy efficiency and renewable generation resources in future years.[196] The estimated cost of construction continues to rise.[197] A consultant for the City of Holland also analyzed the City's energy demands and available options and found that the City could meet its needs without a new coal or gas-fired power plant. Instead, the consultant recommended a combination of efficiency, 37MW of wind, and 24 MW of solar power.[198] Despite these recommendations, Holland continues to pursue this unneeded project. A challenge to its PSD permit is pending before the Michigan Court of Appeals.

f. Wolverine (Michigan)

The Wolverine plant was originally proposed in 2007 by the Wolverine Power Cooperative and it has not garnered sufficient support to move forward. As with the De Young plant, the Michigan Public Service Commission has determined that the plant is not needed. The Commission concluded in a 2009 report that Wolverine had not presented compelling evidence that the proposed coal-fired power plant was the best means of meeting future energy demand, and that Wolverine did not adequately

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and Transmission Associate, Inc.'s Resource Planning Presentation, June 10, 2010, attached as **Ex. 55**.

[195] Tim Carpenter, *KDHE seeks input on coal plant*, Topeka-Capital Journal (July 4, 2010), *at* http://cjonline.com/news/state/2010-07-04/kdhe_seeks_input_on_coal_plant.

[196] Staff Report to Michigan Department of Natural Resources & Environment on Holland Board of Public Works' Electric Generation Alternatives Analysis For Proposed Permit to Install (PTI) No. 25-07 For Circulating Fluidized Bed Coal Boiler in Holland, Michigan, July 7, 2010, Docket Number: U-16077, attached as **Ex. 56**.

[197] *Holland BPW awaiting studies on power plant decision — deadlines, rising costs loom*, The Holland Sentinel (May 5, 2012) http://www.hollandsentinel.com/news/x43405729/Holland-BPW-awaiting-studies-on-power-plant-decision-deadlines-rising-costs-loom.

[198] Garforth International Report (September 9, 2011), attached as **Ex. 57**.

explore demand-side management options such as energy efficiency.[199] Wolverine Power itself seems to recognize that its original proposal for a coal-fired power plant may not be the best way forward: In early 2010, it announced that energy demand in 2009 was down 14.6% from 2008 numbers and that it had purchased a 340-MW natural gas plant. A challenge to Wolverine's PSD permit is currently pending before the Michigan Court of Appeals.

g. Plant Washington (Georgia)

Plant Washington does not qualify for the "transitional source" exemption as defined by EPA. As of the NSPS proposal, it had not obtained the complete, final, and legally effective construction and operation air permit that is required before the plant can commence construction.[200] Nor is it anywhere close to beginning meaningful construction. Its developer, Power 4 Georgians, has not completed critical design elements for the plant, including the design of the boiler or major pollution controls. *Id.* In recent permit applications, many of the major pieces of equipment, including the main boiler and major pollution controls are listed as "TBD,"or "To Be Determined." *Id.*

h. Bonanza (Utah)

The Bonanza plant proposal has been dormant for years and does not meet the first criteria that EPA has set forth for "potential transitional sources": a final PSD permit. The EPA's Environmental Appeals Board ("EAB") remanded the permit to EPA Region 8 in 2008 for failure to properly justify its decision not to establish a BACT limit for carbon dioxide.[201] The permit was never finalized and the Region has not reissued a PSD permit for the plant. Even if the remanded permit could be treated as a final PSD permit, it has expired automatically because the project has not moved forward since the remand and the proponent has not sought a permit extension. *See* 40 C.F.R. § 52.21(r)(2); 40 C.F.R. § 124.5(g)(2); *Sierra Club v. Franklin County Power*, 546 F.3d 918, 929-30 (7th Cir. 2008).

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[199] Staff Report to Michigan Department of Environmental Quality on Wolverine Power Supply Cooperative's Electric Generation Alternatives Analysis For Proposed Permit to Install (PTI) No. 317-07 For Circulating Fluidized Bed Coal Boilers at Rogers City, Michigan, Sept. 8, 2009, Docket Number: U-16000, attached as **Ex. 58**.

[200] Declaration of K. Ebersbach, *White Stallion Energy Center, LLC et al v. EPA*, No. 12-1100 and consolidated cases (filed May 17, 2012), attached as **Ex. 59**.

[201] Order Denying Review in Part and Remanding in Part, *In re Deseret Power Electric Cooperative,* PSD Appeal No. 07-03 (Evntl. App. Bd. Nov. 13, 2008), *available at* http://yosemite.epa.gov/oa/EAB_Web_Docket.nsf/Filings%20By%20Appeal%20Number/C8C5985967D8096E85257500006811A7/$File/Remand...39.pdf.

i. Two Elk (Wyoming)

Two Elk is a proposed pulverized coal plant designed in the early 1990s. It originally applied for an air permit in 1996. Over the last 16 years, it has not been able to muster financing for its plant or more than two or three employees. The construction site currently consists of a stack foundation, a road, and an administrative and storage building.[202] There are no plans to drill water wells (the next step for construction) and the company has halted its agreement with PacifiCorp for interconnection to the grid.[203] After witnessing the company's inaction for decades, local residents have ceased to take the project seriously.[204]

Nor does Two Elk have a final PSD permit, as its PSD permit is still under consideration by the state of Wyoming. In a 2007 settlement agreement with the state resolving a dispute about whether its permit had expired for lack of construction, Two Elk agreed that if its construction schedule were to lapse again, it would apply for a permit modification that would include a new BACT analysis, along with all the other requirements that would apply to a new PSD permit.[205] The Wyoming Department of Environmental Quality ("WDEQ") informed Two Elk in 2010 that this settlement term had been triggered. Two Elk subsequently told WDEQ that it would provide all the necessary information to satisfy the settlement agreement, including a new BACT analysis and air dispersion modeling.[206] Two Elk never completed this application.

Rather, Two Elk's communications with WDEQ reveal that the company is still in the process of designing the basics of the plant. In March 2010, Two Elk sought permission to burn biomass in addition to coal, and submitted a new analysis of potential boiler technology.[207] Thus, the plant certainly does not meet EPA's criterion of being a fully designed and planned project. Moreover, Two Elk has repeatedly stated its intent to

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[202] Wyoming Department of Environmental Quality Memorandum re: Two Elk Power Plant Site Visit (May 16, 2011), attached as **Ex. 60**.
[203] *See* Two Elk Quarterly Progress Report, First Quarter 2012 (April 13, 2012), attached as **Ex. 61**.
[204] Rone Tempest, *"Stimulus" for Two Elk: Big Checks, But No New Jobs*, WyoFile (Sept. 27, 2011), attached as **Ex. 62**.
[205] Joint Stipulated Settlement Agreement at ¶3.G, Wyoming Environmental Quality Council, Docket No. 07-2601, attached as **Ex. 63**.
[206] Letters from B. Enzi, Vice President, Two Elk Power Company, to C. Schlictemeir and J. Corra, Wyoming Department of Envt'l Quality ("WDEQ") (May 11, 2010), attached as **Exs. 64 & 65** [2 letters].
[207] Letter from B. Enzi to J. Corra, WDEQ, re: adding biomass as an additional fuel (March 29, 2010), attached as **Ex. 66**; Correspondence between WDEQ and Two Elk re: July 2010 Boiler Technology Analysis, attached as **Ex. 67**.

study and implement CCS capture at the site.[208] Two Elk should be able to make plans to meet the NSPS (in the unlikely event that it moves forward with its project).

For all of the reasons above, Two Elk is a wholly unworthy candidate for EPA's proposed transitional source exemption. It is clear that this project is not bringing jobs or economic development to Wyoming. A recent investigative report pointed out that despite gaining hundreds of millions of dollars in federal grants, which were used to pay the CEO a salary of over $1 million in a two-year period, the company only employs one other person – its lobbyist.[209] Providing special treatment for this project, which has not materialized despite 16 years of support from the state and federal government, will not help the public.

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Several of the "potential transitional sources" EPA has identified are already planning to implement CCS or will otherwise meet the NSPS. For these sources, EPA's statement that "it would be challenging" for the transitional sources "to proceed with construction without substantial re-design of the project in order to install CCS and thereby be in compliance with the 1,000 lb CO 2/MwH standard", 77 Fed. Reg. at 22,424, does not hold true, particularly in light of the flexibility provided by EPA's 30-year compliance path. EPA claims without basis that "[i]mposition of an unexpected emission rate requirement at such a late date could upset carefully crafted financial plans, causing delay or even cancellation of the project." *Id.* at 22,425. Rather than attempting to set a separate standard for these sources, EPA claims that it lacks the information to do so and can therefore exempt them. *See* 77 Fed. Reg. at 22,425 ("[W]e do not have information as to key components of their proposed project and business plan, including, among other things, the amount of capture from the planned CCS system or possible revenue streams associated with CCS."). Lack of information is not a sufficient reason to exempt these plants from the standard, nor is it a credible reason with respect to plants that have or are receiving federal funding. EPA could seek the necessary information from the plants' developers during this rulemaking proceeding, and much of the relevant information is available publicly if it does not already reside with other federal agencies administering financial assistance programs.

Like the projects described above, some of the CCS projects are unlikely to proceed. The others can readily meet the proposed standard.

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[208] Two Elk Grant Application Package for Recovery Act: Clean Coal Initiative, Round 3 (Excerpt), at 3, attached as **Ex. 68** ("Two Elk Energy Park's Carbon Project links coal-fired power production, 90% flue gas CO2 removal and EOR in WY; demonstrates CCS, boosts domestic oil production and raises federal oil and coal revenues.")
[209] Rone Tempest, *Two Elk "Stimulus": Big Checks, But No New Jobs*, Wyofile (Sept. 27, 2011), attached as **Ex. 62,** *supra*.

j. Summit (Texas)

Summit is an integrated gasification combined cycle ("IGCC") plant that plans to emit less CO_2 than a natural gas plant. The company president, Eric Redman, stated in May of this year that "CO_2 emissions would amount to about 200 pounds per MWh, making the Texas plant far more climate-friendly than even the best combined-cycle natural-gas plants, which emit about 850 to 1,000 pounds per MWh."[210] Accordingly, there is no apparent risk that treating Summit as a new source, as defined by statute, would derail the project.

k. Tenaska (Texas)[211]

The Tenaska proposal in Texas remains speculative. Like other Texas plants, Tenaska has had difficulty acquiring sufficient water rights to satisfy the plant's needs.[212] In addition, challenges to the plant's PSD permit are pending in state court.[213] Tenaska's vice president of environmental affairs, Gregory Kunkel, stated recently that it is unclear whether the project will continue. If the plant does succeed in moving forward, the NSPS should not be a barrier. Mr. Kunkel has stated that "Trailblazer is designed to perform much better than the proposed standard".[214] Comments filed in this docket by Tenaska, Inc. confirm that, as currently designed, the plant can meet the proposed NSPS.[215]

l. Taylorville (Illinois)

The Taylorville facility has recently put its plans for coal gasification on hold and is discussing constructing a natural gas facility instead. In addition, even if the plant does move forward with coal gasification, the facility is designed to be carbon capture ready, is planned for one of the most promising geologic locations in the country for CCS, and

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[210] Summit Power, Latest News, *at* http://www.summitpower.com/in-the-news/can-environmentalists-learn-to-love-a-texas-coal-plant/, citing *Can Environmentalists Learn To Love a Texas Coal Plant?*, Yale Environment 360 (May 31, 2012).
[211] EDF does not join in these comments.
[212] *Stamford to Sell Water to Tenaska*, Sweetwater Reporter (July 13, 2011), *at* http://www.sweetwaterreporter.com/content/stamford-sell-water-tenaska ("The company still needs to find hundreds of millions of gallons more water and needs to go through an appeal process on its air permit before construction can begin.").
[213] *Sierra Club v. Texas Comm'n on Envt'l Quality*, No. 11-12-00040 (11th App. Ct., Tex.); *Multi-County Coalition v. Texas Comm'n on Envt'l Quality*, No. 11-12-00108 (11th App. Ct., Tex.).
[214] Bill Dawson, *Texas and carbon capture: A status report on power plants, policy and research,* Texas Climate News (May 15, 2012) at http://texasclimatenews.org/wp/?p=4972.
[215] Tenaska's proposal for 30-year averaging is in fact more stringent than what EPA proposes.

has applied for an injection permit to sequester carbon from the facility. Comments filed in this docket by Tenaska, Inc. confirm that, as currently designed, the plant can meet the proposed NSPS.

State utility regulators have determined that if the project moves forward as a coal gasification plant, it will place a heavy and unnecessary burden on ratepayers. In a 2010 facility cost report, the Illinois Commerce Commission determined that electricity generated by Taylorville would cost substantially more than that generated by other types of facilities ($212.73 per MWh versus $88.80 to $121.97 for wind versus $154.05 to $160.78 for combined cycle combustion turbines).[216] The Commission also concluded that the rate impacts on residential and small business customers would likely exceed the maximum allowable amount, and additional project costs would be borne by commercial and industrial customers. *Id.* For this reason, the project continues to face significant opposition from large industrial users who are concerned about the higher cost of electricity.

m. Goodspring (Pennsylvania)

The Goodspring plant developers recently announced plans to construct a natural gas combined cycle facility instead of a coal facility.[217] Accordingly, the plant will meet the NSPS.

n. Power County (Idaho)

Southeast Idaho Energy's Power County project received its air permit in 2009. That permit includes an enforceable CO_2 emission limit that would require the plant to achieve a 58 percent reduction in its CO_2 emissions. The company has five years to reduce its onsite carbon emissions to the levels required in the permit; until then, it will be allowed to purchase carbon offsets. Southeast Idaho Energy has not proceeded with construction or other permitting. In March 2011, the *Idaho State Journal* reported that plans for the plant were "indefinitely stalled due to lack of funding."[218] Soon after, city officials of American Falls, Idaho confirmed that the company had closed its local office

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216 Illinois Commerce Commission, Report to the General Assembly, Analysis of the Taylorville Energy Center, Facility Cost Report, at 2, Sept. 1, 2010, attached as **Ex. 69**.

217 Mark Gilger, Jr., *Coal Cleared from Plans*, Republican Herald (May 19, 2012), *at* http://republicanherald.com/news/coal-cleared-from-plans-1.1317514 (last visited June 18, 2012).

218 John O'Connell, *Plans for fertilizer plant stalled due to funding woes,* Idaho State Journal, (March 31, 2011) *at* http://www.idahostatejournal.com/news/online/article_eb21e9f0-5c1b-11e0-9e32-001cc4c03286.html (last visited June 13, 2012).

there.[219] Thus, plans to proceed with the plant were likely abandoned long prior to EPA's proposed rule. In any event, it is not clear that the project would be covered by this rule. Its owner does not intend to sell power to the grid; rather, the purpose indicated in the plant's permit is only to produce fertilizer, ammonia, and related products.

o. Cash Creek (Kentucky)

Cash Creek is a proposed IGCC plant that originally received its PSD permit in 2006. It has not moved forward with plans to construct. EPA has just granted a petition to object to the plant's Title V permit.[220] Among other issues, EPA determined that the state permitting authority had not conducted a proper BACT analysis, and that certain permit terms were too vague to be enforceable. Kentucky issues combined Title V and PSD permits. Thus, Cash Creek is not in possession of a valid PSD permit that meets Clean Air Act requirements; it no longer meets EPA's first criteria for transitional sources.

p. Las Brisas (Texas)

Las Brisas is a petroleum coke-fired power plant proposed for Corpus Christi, Texas, which EPA correctly excluded from its list of potential transitional sources. First, it does not have a final PSD permit. In Texas, EPA Region 6 handles PSD permits for greenhouse gases because the state refused to do so. EPA has determined that Las Brisas must obtain a PSD permit for greenhouse gases, but has not yet issued the permit. In addition, a Texas judge recently indicated his intent to remand the plant's PSD permit for criteria pollutants because it does not comply with CAA requirements.[221] The Texas Commission on Environmental Quality had approved the company's permit over EPA's objections and against the recommendation of two administrative law judges. The state judge's ruling was consistent with EPA's determination that the permit did not meet regulatory requirements.[222] Thus, there is no plausible argument that this plant is in possession of a final PSD permit that meets CAA requirements. As it lacks these key

[219] *Southeast Idaho Energy closes office at American Falls*, Idaho State Journal, May 27, 2011, *at* http://www.idahostatejournal.com/news/online/article_6e13933a-884b-11e0-bc3c-001cc4c002e0.html.

[220] Order Granting in Part and Denying in Part Petition to Object, *In the Matter of Cash Creek Generation, LLC*, Petition IV-2010-04 (June 22, 2012), attached as **Ex. 70**.

[221] Letter from Hon. S. Yelenosky to Counsel of Record, Re: Cause No. D-1-GN-11-001364, *Envt'l Defense Fund, Inc. et al vs. Tex. Comm'n on Envt'l Quality*, 261st Judicial District Court, Travis County, Tex. (May 14, 2012), attached as **Ex. 49**, *supra*.

[222] *See* Letter from L. Starfield, Deputy Regional Administrator, EPA Region 6, to M. Vickery, Executive Director, Texas Commission on Environmental Quality (TCEQ), January 24, 2011 urging TCEQ not to issue Las Brisas PSD permit until certain issues were resolved.

permits, as well as a final wastewater permit, Las Brisas is not "poised to begin construction in the very near future."

Nor are there any other proposed coal-fired power plants that might meet the criteria EPA sets forth for the "transitional source" classification. Sierra Club tracks PSD permits for coal-fired power plants nationwide and has identified no other source that has a final PSD permit, has completed design and planning, and is poised to commence construction.

In sum, the potential transitional sources fall into two general groups. The first consists of various types of conventional coal-fired power plants, which have no special features in common to distinguish them from other fossil fuel generators and, in any event, are not likely to progress. These plants have failed or are on course to fail for reasons that have nothing to do with EPA's proposed carbon regulation. The other group consists of plants proposing to use CCS, or convert to natural gas, which could meet the proposed standard if they succeed in moving forward. As a result, EPA would not impose a substantial economic cost or otherwise scuttle viable projects by simply including these sources in the new source standard.

2. **EPA Should Not Exclude "Transitional Sources" from the New Source Performance Standard Set for Other Fossil Fuel Fired EGUs.**

Section 111(a)(2) of the Clean Air Act defines a "new source" as any stationary source that commences construction or modification after publication of proposed new standards of performance under section 111 that will be applicable to the source. 42 U.S.C. § 7411(a)(2).[223] Under this definition, any new fossil fuel-fired EGU greater than 25 megawatt electric (MWe) that commences construction after April 13, 2012, is a "new source" and will be subject to the CO_2 standard that EPA ultimately promulgates when the source begins operating. *United States v. City of Painesville*, 644 F.2d 1186, 1191 (6^{th} Cir. 1981) (CAA §111(a)(2) "plainly provides that new sources are those whose construction is commenced after the publication of the particular standards of performance in question."). Because the statute uses the date a standard is proposed to define which sources are subject to the standard, the transitional source exemption cannot be harmonized with the statutory protections contemplated by Congress when it enacted section 111.

EPA offers a number of justifications for grandfathering this group of sources, most of which revolve around the assumption that a "substantial redesign" would be

[223] "The term 'new source' means any stationary source, the construction or modification of which is commenced after the publication of regulations (or, if earlier, proposed regulations) prescribing a standard of performance under this section which will be applicable to such source." 42 U.S.C. § 7411(a)(2).

required for these sources to meet the proposed standard, which would "disrupt the plans" and "schedule" of the sources, resulting in a loss of "sunk costs." 77 Fed. Reg. at 22,400, 22,424. However, EPA points to no authority that allows it to exempt certain sources on this basis. EPA must establish performance standards for new sources within a listed category. 42 U.S.C. § 7411(b). Those standards apply to *any* source in that category that commences construction after EPA publishes such proposed standards. 42 U.S.C. § 7411(a)(2). While EPA "may distinguish among classes, types, and sizes within categories of new sources *for the purpose of establishing* such standards," 41 U.S.C. § 7411(b)(2)(emphasis added), Section 111 does not contemplate that EPA may exclude some subset of new sources in the category from the established standard.[224]

EPA further argues that, "[t]here is nothing in CAA section 111 that suggests that Congress expected that the EPA may determine the BSER in a way that would significantly disrupt the plans of the regulated sources that are implicated here." *Id.* But in its definition of "new sources" in Section 111(a)(2), Congress anticipated that sources in the midst of development might be affected by new standards.[225] Nor is it necessary for Congress to have foreseen the specific application of a statute for it to be applied in accord with its terms.

EPA's approach allows it to pick and choose favored sources within a category that do not have to meet the chosen standard, setting a dangerous precedent for future rulemakings. By EPA's logic, any individual source within a category covered by an NSPS could seek an exemption from a proposed new source performance standard based on "disruption" of its plans. This result is both unfair and inconsistent with EPA's obligations.

The exemption for certain sources also departs from EPA's past practice. None of the previous NSPS rulemakings cited by EPA exempts certain hand-picked sources based on the timing of their projects or "sunk costs" in planning a particular design. *See Lime Manufacturing Plants NSPS* (setting standards for rotary kilns, but not other types of kilns, because the vast majority of the industry uses that particular technology);[226]

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[224] *See Asarco, Inc. v. EPA*, 578 F.2d 319, 330-31 (D.C. Cir. 1978) (J. Levanthal, concurring) ("[T]he flexibility to distinguish between classes of new sources may serve to authorize a differential in the standards applicable to new and modified equipment in those cases where warranted by cost differences and cost-benefit analysis. This approach would not permit the Administrator to immunize a modified facility (one type of new source) from regulation under a performance standard, but would permit an alternative course that promotes the underlying statutory concept of progressively bringing all pollution sources within the constraint of performance standards.")).
[225] *See City of Painesville,* 644 F.2d at 1191-92 (noting that "legislative history weighs heavily against the [source's] position" where source that had not commenced construction at the time of the proposed standard argued it was not a "new source").
[226] 42 Fed. Reg. 22,506, 22,507 (May 3, 1977).

Standards of Performance for Coal Preparation and Processing Plants: Supplemental Proposal (setting more lenient standard for modified sources based on "physical layout," while recognizing that reconstructed sources, as well as new sources, can "take design options into account" and therefore could meet a stricter standard);[227] *Standards of Performance for Coal Preparation and Processing Plants: Final Rule* (same);[228] *Standards of Performance for Petroleum Refineries: Final Rule* (setting more lenient fine particulate standards for modified or reconstructed fluid catalytic cracking units based on detailed analysis of existing refineries and cost of compliance).[229] When EPA has distinguished a class of sources based on cost, it has done so based on detailed information on *additional* costs to a facility, not costs previously spent on a particular design. Moreover, EPA did not exempt some new sources entirely.[230] Finally, unlike here, EPA undertook a detailed investigation of costs.

In this rulemaking, EPA does not purport to analyze the expenditures of the potential transitional sources, how far along they are in the design process, or whether it would be more costly for these projects to meet the standard compared with other yet-to-be constructed plants. EPA explicitly admits that it does not know whether the proposed standard would be "so costly and disruptive as not to be BSER" for any particular source. 77 Fed. Reg. at 22,423. EPA must base its decisions on fact rather than conjecture. As detailed above, the record demonstrates that sources on EPA's proposed list do not meet EPA's own standards for distinguishing them – i.e., plants that have a permit meeting PSD requirements, are committed to a particular design, and "nearly ready to commence construction." Thus, EPA lacks a factual basis for distinguishing these sources from other new sources. Nor could EPA possibly develop such facts, given the true status of the plants described above.

EPA also relies on a series of "practical problems" to justify its failure to develop a separate standard for what it calls transitional sources. 77 Fed. Reg. at 22,426. These practical difficulties, as well as EPA's point that there are only a small group of sources

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[227] 74 Fed. Reg. 25,304, 25,306-09 (May 27, 2009).
[228] 74 Fed. Reg. 51950, 51953 (Oct. 8, 2009).
[229] 73 Fed. Reg. 35,838, 35,845-47 (June 24, 2008).
[230] In the Lime Kilns standard, it is not clear EPA claimed to be excluding any new lime plants, since EPA projected that all new kilns would be rotary. *See National Lime Ass'n v EPA*, 627 F.2d 416, 426 n.28 (D.C. Cir. 1980) ("It is expected that as supplies of natural gas and oil become more expensive or unavailable, all new kilns would be rotary lime kilns designed to burn coal"); 42 Fed. Reg. 22,506, 22,507 ("virtually all the new kilns that have been built in the last few years have been of the rotary type.... [T]he present trend is to build and operate rotary kilns whenever possible."). Moreover, the exclusion of non-rotary kilns from the lime standards was not part of the challenge to the standards. The D.C. Circuit's approval of EPA's action in that rulemaking therefore is not confirmation that EPA has free reign to exclude certain new sources from the new source standards.

at issue, many of which may never begin construction, only serve to underscore why the sources should simply be included with the rest of the new sources under Congress's bright line standard. By carving out a group of fossil fuel-fired EGUs based solely on the timing of their project development, EPA creates unnecessary complications and uncertainty.

EPA's final rational for exempting transitional sources is that, if constructed, they eventually will be covered by standards for existing plants to be issued under Section 111(d), "eliminating any prospect of a regulatory gap of any material concern." 77 Fed. Reg. at 22,427. This rationale ignores both the Act's bright line definition of "new source" and the policy reasons for including any plant that has not "commenced construction" at the time of the proposal in that definition. The sources EPA has identified as "transitional" are, by definition, pre-construction and are therefore still able to make major design choices at a lower cost than plants that are already built and operating. EPA has recognized that "[i]t is much easier, both in technical and practical terms, to consider the air quality impacts and pollution control requirements of a major new source of air pollution before it has been constructed and has begun operation rather than after."[231] Likewise, Courts have recognized that requiring control technology *at the time of construction* is fundamental to the NSPS program. *See Sierra Club v. Costle*, 657 F.2d 298, 325 (D.C. Cir. 1981) ("The standards must to the extent practical force the installation of all the control technology that will ever be necessary on new plants at the time of construction when it is cheaper to install. . .").

In addition, EPA cannot rely on regulations implementing Section 111(d) to cover these sources because EPA has not taken action to issue those regulations, in spite of its legal obligation to do so. Implementing the existing source regulations could take years even after EPA issues them, and any standard that eventually applies to existing sources will be limited by the opportunities available to reduce emissions from existing plants. For sources that emit millions of tons of CO2 annually, the delay in imposing emission standards coupled with the more limited scope of the existing source standard creates a regulatory gap of substantial concern to the protection of human health and the environment.

3. **Potential Enforcement Difficulties Would Compound the Problems With the "Transitional Source" Proposal.**

EPA's "Transitional Source" proposal is unwise because, in addition to the concerns discussed above, it suffers from a number of additional practical problems. EPA sets a deadline of April 13, 2013 for the "potential transitional sources" to

[231] *Requirements for the Preparation, Adoption, and Submittal of Implementation Plans; Approval and Promulgation of Implementation Plans*, 54 Fed. Reg. 27,274-01, 27,281(June 28, 1989).

"commence construction," as that term is defined by NSPS rules, in order to be classified as a "transitional source". EPA reasons that this "12-month period, serv[es] as a surrogate for the missing information," i.e., "which of these sources have incurred costs and material commitments to the extent that a 1,000 lb CO 2/MWh standard would be so costly and disruptive as not to be BSER." 77 Fed. Reg. at 22,422-23.

In fact, due to ineffective enforcement of the definition of "commence construction," a plant's ability to meet this standard may have no bearing on whether meeting the standard would be costly and disruptive. Past experience shows that states may consider even an isolated incident of pouring concrete, digging a hole, or corresponding with contractors, to be "commencing construction" even though the activity does not meet the regulatory definition. Although this problem is not unique to the so-called transitional sources, the exemption provides extra incentive for sources to try to game the definition, and demonstrates that commencement of construction is not a reasonable "surrogate" for sunk costs.. 77 Fed. Reg. at 22,422. As defined in the NSPS regulations,

> Commenced means, with respect to the definition of 'new source' in section 111(a)(2) of the Act, that an owner or operator has undertaken a continuous program of construction or modification or that an owner or operator has entered into a contractual obligation to undertake and complete, within a reasonable time, a continuous program of construction or modification.

40 C.F.R. § 60.2. "Construction means fabrication, erection, or installation of an affected facility." *Id.* "Affected facility means, with reference to a stationary source, any apparatus to which a standard is applicable." *Id.*

The NSPS rules contain no mechanism enabling EPA to ensure that this definition is correctly applied. EPA does not explain in the proposal how applicability determinations would be made or enforced for the transitional sources. By all appearances, sources would determine for themselves whether or not they have "commenced construction." If the source concludes otherwise, it would not report on its compliance with the NSPS.[232] The first time EPA, or the public, would be able to review whether a source has correctly self-identified as "transitional" and therefore

[232] Any "affected facility", i.e., a facility "to which a standard is applicable" must notify EPA of commencement of construction within 30 days of such date. 40 §§ CFR 60.1, 60.2, 60.7(a)(1). EPA's proposed regulatory language, 40 § C.F.R. 60.5510(b)(3), states that transitional sources commencing construction within one year are not affected facilities. *See also* 40 CFR § 60.8(b) ("Within 60 days of achieving maximum production rate, but not later than 180 days after start-up, the owner or operator must conduct a performance test to demonstrate compliance *with the applicable standard.*").

exempt from the NSPS, would be during the Title V permitting process. In many states, this occurs only after a plant completes construction.[233]

This lack of oversight is extremely troubling given past experience in both the NSPS and the PSD contexts. The examples below demonstrate that facilities will attempt to interpret "commence construction" exceedingly broadly to access the exemption, and that some states may condone interpretations that violate regulatory language and EPA guidance. Furthermore, in states where EPA has delegated its Clean Air Act authority, EPA does not have a ready mechanism to enforce the legally correct interpretation.

- **Preparatory, Planning and Procurement Activities.** Companies seeking to take advantage of the exemption of new sources from other NSPS programs have interpreted the terms "program of construction" and "contractual obligation to undertake ... a continuous program of construction" very broadly, spawning litigation over EPA applicability determinations. For example, Sierra Pacific Power argued that its expenditures on planning and procurement, without associated physical construction activity, were sufficient to "commence construction" because it constituted a "program" of construction. *Sierra Pacific Power Co. v. EPA*, 647 F.2d 60 (9th Cir. 1981).

  Another example – from the PSD context – is the Beech Hollow plant in Pennsylvania, which counted a long list of preparatory and planning activities such as site grading work, preparation of a project site layout, and fuel and water feasibility studies as "construction" under the PSD regulations.[234]

  Also in Pennsylvania, the Wellington plant, which originally received approval of its PSD permit in 2005, has kept its permit "alive" for the last seven years with nothing

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[233] Because it would certainly be more costly for a plant to discover that it must meet the NSPS for greenhouse gases at that time, EPA may not permit such an approach. See Sierra Club v. Costle, 657 F.2d 298, 325 (D.C. Cir. 1981) ("The standards must to the extent practical force the installation of all the control technology that will ever be necessary on new plants at the time of construction when it is cheaper to install").

[234] Letter from J. Katz, Director, Air Protection Division, U.S. EPA Region 3, to G. Jugovic, Director, Southwest Regional Office, Pennsylvania Dep't of Envt'l Protection (Nov. 9, 2009), attached as **Ex. 71**; Letter from R. Bologna, Principal, Robinson Power Company, LLC to B. Hatch, Air Quality Program, Southwest Regional Office, Pennsylvania Dep't of Envt'l Protection, (Sep. 23, 2009), attached as **Ex. 72** (detailing purported "construction" activities).

more than earthmoving activities, an underground piping system, engineered fill and drainage system, and steel pilings to support a coal hopper.[235]

- **Contractual Obligation.** Companies have likewise attempted to interpret the "contractual obligation" method of commencing construction very broadly. In *Potomac Electric Power Co (Pepco). v. EPA*, 650 F.2d 509 (4th Cir. 1981), Pepco claimed that its mere communications with suppliers had created a binding obligation under traditional contract law principles, and thus exempted the company from new NSPS regulations.

- **Isolated Bursts of Minimal Construction.** The Two Elk plant was originally proposed 16 years ago, in 1996. After several extensions on the construction deadline in its 1998 permit, the plant obtained a PSD permit in 2003 on condition that it finally commence construction by May 2005. Shortly before the deadline, Two Elk hired a contractor to pour a concrete slab for its stack foundation, and executed a contract for a boiler.[236] Just two months later, in July 2005, it ordered construction to stop for lack of funding and it slowed design and engineering activities to a minimal pace.[237] The state found, nonetheless, that Two Elk's activities in 2005 were sufficient to commence construction as defined in PSD regulations[238] Seven years later, the project proponents have made no further progress on the plant itself.[239] (This

[235] *See, .e.g*, Penn. Dept. Envtl. Protection, Plan Approval Extension (June 27, 2008), attached as **Ex. 73**.

[236] Order Granting Motion to Dismiss, Wyoming Environmental Quality Council, Docket No. 02-2601, ¶4 (July 18, 2005), attached as **Ex. 74**; Wyoming Department of Environmental Quality Memorandum re: Two Elk Site Inspection (May 31, 2005), attached as **Ex. 75**.

[237] See E-mail from C. Cool (Bechtel) to Foster Wheeler, Re: Reduction in Workload & Staffing (July 28, 2005), attached as **Ex. 76** (ordering boiler contractor to "immediately reduce workload and staffing levels"); Two Elk Generating Facility, Interim NTP Progress Report No. 3 (August 2005), attached as **Ex. 77** (noting that "all engineering efforts have slowed to a minimal pace," and "all construction efforts are on hold").

[238] Joint Stipulated Settlement Agreement, Wyoming Environmental Quality Council, Docket No. 07-2601, at 2, attached as **Ex. 63**, *supra*; Order Granting Motion to Dismiss, Wyoming Environmental Quality Council, Docket No. 02-2601, ¶4 (July 18, 2005), attached as **Ex. 74**, *supra*.

[239] Two Elk Quarterly Progress Report, First Quarter 2012 (April 13, 2012), attached as **Ex. 61**, *supra,* at 2 ("Pacificorp acknowledges receipt, on March 27, 2012, of Two Elk Generation Parnters, LP's ['Interconnection Customer'] written notice of suspension of all work by PacifiCorp associated with the construction and installation of facilities and/or upgrades for Interconnection Customer's proposed 250/285 MW Large Generating Facility . . .The current suspension directly affects the milestone dates . . ."),

example demonstrates that EPA's proposed one-year deadline for "commencing" construction may bear no relation whatsoever to the reality of whether a plant is on its way to being constructed and completed.)

Similarly, Franklin County Power of Illinois tried to maintain the validity of a PSD permit essentially by digging a 15-foot deep hole at its construction site, which was later filled in, and by entering into a memorandum agreement with Black & Veatch outlining their "intent" to develop an engineering, procurement, and construction ("EPC") contract. *Sierra Club v. Franklin County Power of Illinois, LLC,* 546 F.3d 918, 924 (7th Cir. 2008).

None of these interpretations are consistent with existing EPA regulations and guidance, yet state regulatory agencies did not enforce the correct interpretation. Although citizen groups or EPA ultimately did so in some of these examples, that opportunity may not be available for the proposed transitional sources until the issuance of a Title V permit, likely after completion of construction. In any case, such litigation is costly for both citizens and the sources at issue, particularly if a court were to determine a plant is subject to the NSPS after it has been fully constructed. EPA has not pointed to any mechanism to enforce the correct definition of "commence construction" at a meaningful point in the process.

The test proposed by EPA also runs counter to Congress's judgment that proposed NSPS should not provide a perverse incentive for sources to rush to construct to avoid meeting the standard. The construction window does just that; sources would have an incentive to push half-baked projects to commence construction by the deadline. This would inevitably lead to bad decisions, ill-advised capital investments, and costly litigation, all of which ultimately places a burden on ratepayers, shareholders, or members in the case of cooperatives. Extending that deadline for any reason would do nothing to ameliorate these problems, but would rather increase the number of sources rushing their projects through. These are the very consequences Congress sought to avoid in enacting the definition of "new source" in Section 111(a)(2).[240] By enacting a bright-line standard, Congress avoided this uncertainty and the wasteful

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and 3 ("no final agreements for drilling water supply wells and/or exploratory boring have been finalized"); Wyoming Department of Environmental Quality Memorandum re: Two Elk Power Plant Site Visit (May 16, 2011), attached as **Ex. 60**, *supra* ("No definite time frames for the power line relocation or the water well drilling were discussed.").

[240] Senate Report, S. Rep. No. 91-1196 (1970) ("The overriding purpose of [Section 111] would be to prevent new air pollution problems, and toward that end, maximum feasible control of new sources at the time of their construction is seen by the committee as the most effective and, in the long run, the least expensive approach.") (emphasis added).

costs associated with it, and removed the perverse incentive to rush – and then interrupt – construction activities.

B. Modified Sources

Section 111 directs EPA to set standards of performance for "new sources," § 111(b)(1)(B), which are defined to include modified sources, § 111(a)(2). *See also* 40 C.F.R. § 60.1. Nonetheless, in the current proposal, "EPA is not proposing standards of performance for NSPS modifications for GHGs." 77 Fed. Reg. at 22421. EPA's explanation for this decision is that most foreseeable modifications will be pollution control and efficiency projects, and that EPA has questions about the effect of these activities. *Id.* at 22400. EPA has provided no reason to assume that pollution control projects would lead to an increase in the maximum hourly emissions rate for GHS under the as-yet unproposed NSPS for modified sources. EPA's remaining reasons for not proposing a standard for modified units are equally insufficient, because efficiency projects will likely be undertaken in compliance with the very rule in question and because EPA already has information sufficient to support promulgation of a standard for modified sources. Finally, EPA's proffered legal justification for excluding modified sources rests on a strained interpretation of the statute. Accordingly, EPA should promptly set an appropriate standard for modified sources.

1. **EPA Provides No Basis For Assuming that Pollution Control Projects Will Necessarily Entail "Modifications"**

Existing regulations define "modification" to mean an increase in the mass of pollutant emitted per hour of operation. 40 C.F.R. § 60.14(a)-(b), (h). EPA states that "Based on current information, most of the projects that we believe EGUs are most likely to undertake in the foreseeable future that could increase the maximum achievable hourly rate of CO_2 emissions would constitute pollution control projects." 77 Fed. Reg. at 22400. EPA has not substantiated this assertion, or explored whether pollution control options are readily available that would enable compliance with CAA rules without resulting in an increase in the amount of CO_2 emitted per hour of operation. Although some options for pollution control technology would increase hourly emissions over what they otherwise would be, other options are available that would not increase emissions. Accordingly, EPA cannot assume without substantiation that facilities that undertake pollution control projects—whether voluntarily or pursuant to other CAA rules—will undergo a "modification" as currently defined by section 111.[241] Nor can EPA

[241] Of course, even if pollution control projects *do* increase hourly CO_2 emissions, existing NSPS regulations provide that these projects are not "modifications" for purposes of the NSPS program. 40 C.F.R. § 60.14(e). As EPA notes, the DC Circuit has held that a similar regulation in the PSD program violated the text of the statute, and the DC Circuit's reasoning calls the NSPS pollution control project exemption into

use such an unsupported assumption as a justification for failing to propose a standard for modified sources.

The specific pollution control projects existing sources are most likely undertake are those needed to comply with the CSAPR and MATS rules. Admittedly, some specific options for pollution control technology would increase hourly emissions over what they otherwise would be by introducing an additional CO_2 emission stream, typically from a reagent used in the pollution control. Other technologies exist, however, that do not involve added CO_2 emissions. Sulfur dioxide can be removed without increasing CO_2 emissions by choosing the proper reagent—for example, calcium hydroxide $Ca(OH)_2$ in dry scrubbers or lime in wet scrubbers. Mercury can be removed with activated carbon injection without increasing CO_2 emissions, because the injected carbon is generally not combusted and does not form CO_2 —instead, this carbon is largely captured by the facility's particulate control devices, with the remainder emitted as particulate carbon. Absent an investigation of these and other technologies, EPA cannot assume that compliance with CSAPR, MATS, and other CAA programs inevitably entails an increase in hourly CO_2 emissions.

Even if a pollution control project does increase hourly CO_2 emissions when considered in isolation, a facility has other options to offset this increase at the facility-wide level and thereby avoid a modification. For example, a facility may install offsetting efficiency improvements. EPA rested on a similar offsetting option in setting the NSPS for cement kilns. There, EPA adopted a single NOx standard for new and modified sources. EPA did not discuss whether existing sources that undertook a modification could in fact achieve the NOx standard; instead, EPA merely noted available pollution control technology would allow existing sources to zero out any net emission increases that they would otherwise have, thereby avoiding becoming "modified" sources and triggering the standard. *Portland Cement Ass'n*, 665 F.3d at 190 (citing *ASARCO, Inc. v. EPA*, 578 F.2d 319, 328–29 (D.C. Cir. 1978)). Here, we do not suggest that the standard for modified sources should be the same as the standard for new sources. Instead, we merely note that EPA has previously recognized that existing sources have this option to avoid undergoing "modifications," and we urge EPA to acknowledge and investigate this option here.[242]

Even where pollution control projects introduce a parasitic load and reduce a facility's net electrical output, this need not lead to an increase in hourly emissions since the regulations specify that the maximum hourly emission rate is to be determined as kg/hr

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question. 77 Fed. Reg. 22421 (discussing *New York v. EPA*, 413 F.3d 3, 40 (D.C. Cir. 2005). Environmental commenters contend that even without relying on this exemption, options exist to allow pollution control projects to be undertaken without undergoing a "modification" for purposes of section 111.

[242] Furthermore, because EPA has not provided any discussion of what the standard for modified sources could or will be, EPA has provided no reason to believe that a source that does undergo a modification will face an unreasonable or onerous burden.

not lb/MWh. Thus, while installation of pollution control equipment may reduce the net electrical output of the facility and decrease the efficiency of the facility as expressed in pounds of CO_2 emitted per net megawatt hour produced, this change does not in itself cause an increase in hourly CO_2 emissions.

Accordingly, EPA cannot assume without substantiation that pollution control projects will constitute modifications under existing 40 C.F.R. § 60.14. *See also Environmental Defense v. Duke Energy*, 549 U.S. 561, 575-76 (2007) (discussing EPA's authority to define "modification" for purposes of section 111). Although environmental commenters do not necessarily support the current regulatory definition of "modification," EPA has not announced any intention of amending this regulation.

1. EPA's Concern Regarding Projects to Increase Efficiency Is Unwarranted

EPA expresses a separate concern that facilities will undertake "equipment changes *to meet the requirements of this rulemaking* and that may have the effect of increasing the sources' maximum hourly achievable emission rate, even while decreasing actual emission rate." 77 Fed. Reg. at 22421 (emphasis added). The meaning of this passage is unclear. EPA has not proposed any obligations on existing sources, so it is unclear how *this rulemaking* could require any existing facility to make equipment changes. Even if EPA were to impose efficiency standards on existing sources, EPA has not explained how the possibility of changes taken to comply with a CO_2 specific-rule could problematically trigger obligations under that same rule.[243] It may be that EPA is concerned that existing sources will be required to take actions pursuant to as-yet unproposed 111(d) guidelines for CO_2 emissions, and that these actions will result in an increase in hourly emissions. In any event, because EPA has not proposed a 111(d) guideline, any such concern would be premature.

2. EPA Has Not Identified An Information Deficit That Precludes Setting A Standard for Modified Sources

EPA's remaining explanation for why it is not proposing a standard for modified sources is a purported lack of information. 77 Fed. Reg. 22421. EPA states that it lacks information regarding "types of physical or operational changes sources may undertake," "the amount of increase in CO_2 emissions from those changes," "types of control actions sources could take to reduce emissions" (including availability and cost

[243] Although there may be situations where controlling one pollutant results in an increase in emission of another pollutant, where this rule regulates CO_2, as measured by a single standard, and nothing else, there is no apparent possibility of conflicting obligations.

thereof), and "the types of sources and types of changes at issue that could provide the basis for a proposal for efficiency measures." *Id.*

But EPA already has information regarding measures that existing EGUs may take to increase efficiency and the costs of these measures. This data, together with EPA's authority to "compensate for a shortage of data through the use of other qualitative methods, including the reasonable extrapolation of a technology's performance in other industries," *Lignite Energy Council v. U.S. E.P.A.*, 198 F.3d 930, 934 (D.C. Cir. 1999), provide information sufficient for setting a standard for modified sources.
Although EPA broadly contends that it lacks "an adequate base of information to propose standards of performance for modifications," 77 Fed. Reg. at 22421, EPA does not assert that there is no "adequately demonstrated" BSER for modified sources.

3. **The Phrase "Which Will Be Applicable To Such Source" in § 111(a)(2) Is Not A Grant of Agency Discretion**

EPA offers a circular reading of the statutory text to argue that it has legal authority to decline to set a standard for modified sources. In enacting section 111(a)(4), Congress stated its intent to regulate emissions from modified sources. *See also Wisconsin Elec. Power Co. v. Reilly*, 893 F.2d 901, 909 (7th Cir. 1990) (reviewing legislative history and summarizing the role of modifications as a trigger for obligations under the NSPS and PSD programs). EPA states that a source is not a modified source unless EPA has proposed to regulate it as such. Specifically, EPA states that a source is not a "modified source" unless, at the time the modification occurs, "there is a proposed or final 'standard of performance under this section *which will be applicable to such source*.'" 77 Fed. Reg. 22421 (quoting CAA § 111(a)(2)) (emphasis added). EPA concludes that if it chooses not to propose a standard of performance that would be applicable to the source, the source cannot be a modified source, and that EPA therefore has no obligation to regulate it. For the reasons we explain in discussing transitional sources above, this strained interpretation of section 111(a)(2) is at odds with the mandatory language regarding EPA's obligation to promulgate standards for categories of sources. EPA has authority to set a standard or standards for modified sources that differs from the standard for new sources,[244] but EPA cannot simply choose to exempt modified sources from the standard-setting process. Notably, EPA recently acknowledged that the text of these provisions and the policy concerns underlying the statute require EPA to

[244] *See Asarco, Inc. v. EPA*, 578 F.2d 319, 330-31 (D.C. Cir. 1978) (concurring option, J. Levanthal) ("[T]he flexibility to distinguish between classes of new sources may serve to authorize a differential in the standards applicable to new and modified equipment in those cases where warranted by cost differences and cost-benefit analysis. This approach would not immunize a modified facility (one type of new source) from regulation under a performance standard, but would permit an alternative course that promotes the underlying statutory concept of progressively bringing all pollution sources within the constraint of performance standards.")

set standards for modified sources in conjunction with standards for new sources. *National Emission Standards for Hazardous Air Pollutants From the Portland Cement Manufacturing Industry and Standards of Performance for Portland Cement Plant*, 75 Fed. Reg. 54970, 54996 (Sept. 9, 2010) (rejecting industry's request to exempt modified kilns from the new standard).

4. **EPA Can Not Rely on Section 111(d) Guidelines that EPA Has Yet to Propose**

EPA states that excluding modified sources from the proposed standard is acceptable because any excluded sources will become "existing" sources subject to as-yet unproposed 111(d) guidelines. If EPA had proposed 111(d) guidelines in conjunction with the proposed 111(b) rule, then EPA's rationale might have had a stronger justification. EPA's current proposal, however, together with the suggestion that it will promulgate 111(d) guidelines at an unspecified future time, does not comport with the obligation to regulate emissions from modified sources.

5. **Conclusion**

Joint Environmental Commenters believe that EPA should have proposed a standard for modified sources in conjunction with its standard for new sources. We recognize, however, the EPA also has an obligation to promulgate a final rule promptly. The most reasonable course for EPA therefore is to adopt a standard for "new" sources, and to propose and finalize a standard that applies to modified sources as soon as possible.

C. Reconstructed Sources

Although the text of section 111 refers only to new and modified sources, EPA's implementing regulations define "reconstruction" as a subcategory of modification. 40 C.F.R. § 60.15. Reconstruction is "the replacement of components of an existing facility to such an extent that . . . the fixed capital cost of the new components exceeds 50 percent of the fixed capital cost that would be required to construct a comparable entirely new facility." *Id.* § 60.15(b). EPA does not propose to set a standard of performance for reconstructed sources. As with modified sources, EPA asserts that it lacks information that would inform such a standard, and that if EPA proposes a standard that does not apply to reconstructed sources, then under section 111(a)(2), EPA is not required to regulate these sources. Our comments above regarding EPA's rationale for excluding modified sources apply with equal force to reconstructed sources.

Indeed, failing to set a standard for reconstructed risks drastically weakening the effectiveness of the rule. If reconstructed sources are excluded from the standard, a person wishing to construct a new plant could take an existing facility, demolish everything but a few parts, and then construct a new plant reusing these existing facilities—including a plant substantially larger than the old facility. Under the existing regulations this would be a "reconstruction," and under EPA's proposal, this effectively new facility would be wholly exempt from the new standard. By exempting such reconstructed units from compliance with the standard, the proposal leaves these sources "free to increase emissions without application of [BSER]," in derogation of EPA's section 111 responsibilities. Cement NSPS, 75 Fed. Reg. at 54996.

VI. Relationship with Other CAA Programs

Joint Environmental Commenters understand and share EPA's intention that the promulgation of performance standards for CO_2 under § 111 not affect the emission thresholds established in the Tailoring Rule[245] that determine applicability of the Prevention of Significant Deterioration permitting program. Joint Environmental Commenters are confident that EPA has the tools to easily address any concerns regarding the impact of this rule on PSD applicability. We encourage the Agency to include regulatory language in the final NSPS providing that the applicability of the Tailoring Rule thresholds is unaffected by the promulgation of any NSPS for greenhouse gas emissions. One helpful clarification, for example, would be to add a clear statement to these final regulations stating that the NSPS applicability trigger in the PSD regulations governing "[r]egulated NSR pollutant" at 40 C.F.R. §§ 51.166(b)(49)(ii); 52.21(b)(50)(ii) incorporates the tailoring thresholds.

A. EPA Must Act Without Delay To Curb CO_2 Emissions From Existing Power plants Under Section 111(d)

We conclude these comments by reminding EPA that the new source standard, important as it is, does not complete the agency's job of protecting the American people from dangerous power plant pollution. EPA also has the obligation under Section 111(d) of the Clean Air Act and the agency's own regulations, 40 C.F.R. §§ 60.20-29, to cut the 2.3 billion tons of dangerous carbon pollution from the existing fleet of power plants.

For greenhouse gases, Section 111(d) also requires standards for existing sources. Specifically, Section 111(d) applies when the existing sources in a category emit a pollutant that is not covered under Sections 108 (criteria air pollutants for which national ambient air quality standards (NAAQS) are established) or Section 112 (hazardous air pollutant standards). That is the case for the CO_2 emitted from the nation's existing power plants. According to EPA's Database on 2010 Greenhouse Gas

[245] 75 Fed. Reg. 31,514 (June 3, 2010).

Emissions from Large Facilities,[246] 1,562 power plants reported emitting a total of 2.326 billion metric tons CO_2-equivalent of greenhouse gases, nearly all of which was CO_2.

Section 111(d) addresses the authority to set standards for these existing plants. EPA's regulations implementing § 111(d) require that the agency issue an "emissions guideline" setting forth what the agency considers BSER for existing sources that "reflects the application of the best system of emission reduction (considering the cost of such reduction) that has been adequately demonstrated for designated facilities, and the time within which compliance with emission standards of equivalent stringency can be achieved."[247]

The states then have time limits for adopting state plans that apply the emission guideline by implementing performance standards for existing sources.[248] As under Section 110, EPA has the responsibility to establish federal plans containing acceptable performance standards if state plans are not submitted on time or if they fail to meet the requirements set out in the emission guidelines.[249]

States and environmental organizations brought suit against EPA in 2006 when the agency formally refused to set standards for CO_2 emissions when it reviewed and revised the NSPS for EGUs. In 2007, after the Supreme Court rejected EPA's position in *Massachusetts v.* EPA, the Court of Appeals for the District of Columbia Circuit remanded the power plant rulemaking to EPA for action consistent with the Supreme Court's decision that the Clean Air Act does cover the greenhouse gas pollution that drives climate change. After a long delay, and response to notice from the state and environmental litigants that they would return to court to compel action unreasonably delayed, EPA entered a settlement agreement with the litigants providing a schedule for proposing and taking final action on standards under both §§ 111(b) and (d).[250]

In 2011, the Supreme Court specifically referred to EPA's commitments to acting under the § 111, its regulations, and the settlement agreement to establish standards for CO_2 emissions from both new and existing power plants. *American Electric Power Co. v. Connecticut*, 131 S.Ct. 2527, 2537-38 (2011) (footnote omitted):

> Section 111 of the Act directs the EPA Administrator to list "categories of stationary sources" that "in [her] judgment ... caus[e], or contribut[e]

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246 http://ghgdata.epa.gov/ghgp/main.do.

247 40 C.F.R. § 60.22(b)(5).

248 40 C.F.R. § 60.23.

249 Section 111(d)(2) states that EPA: "shall have the same authority ... to prescribe a plan for a State in cases where the State fails to submit a satisfactory plan as he would have under section 110(c) of this title in the case of failure to submit an implementation plan."

250 http://epa.gov/carbonpollutionstandard/settlement.html

> significantly to, air pollution which may reasonably be anticipated to endanger public health or welfare." § 7411(b)(1)(A). Once EPA lists a category, the agency must establish standards of performance for emission of pollutants from new or modified sources within that category. § 7411(b)(1)(B); see also § 7411(a)(2). And, most relevant here, § 7411(d) then requires regulation of existing sources within the same category. For existing sources, EPA issues emissions guidelines, see 40 C.F.R. § 60.22, .23 (2009); in compliance with those guidelines and subject to federal oversight, the States then issue performance standards for stationary sources within their jurisdiction, § 7411(d)(1).
> ***
> EPA is currently engaged in a § 7411 rulemaking to set standards for greenhouse gas emissions from fossil-fuel fired power plants. To settle litigation brought under § 7607(b) by a group that included the majority of the plaintiffs in this very case, the agency agreed to complete that rulemaking by May 2012. 75 Fed.Reg. 82392.

Although the litigants agreed to several extensions of that schedule, EPA has not acted in conformity with that schedule. While EPA has proposed standards for new sources under § 111(b) – the standard on which we comment today – the agency has not yet taken action under § 111(d) for existing sources.

It is urgent that EPA not only complete this rulemaking by promulgating the § 111(b) standards for new power plants, but that the agency act without further delay to meet its commitments under § 111(d) and the settlement agreement, by proposing, taking comment on, and promulgating the required emission guideline for existing sources, which triggers the state plan requirements summarized above. Significant and affordable reductions can and must be made in the 2.3 billion tons of heat-trapping CO_2 pollution from existing power plants, and EPA must get on with that job without further delay.

Respectfully submitted,

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June 25, 2012

Via Website and Email (without attachments)
http://www.epa.gov/oar/docket.html
a-and-r-docket@epa.gov, Attn: Docket ID No. EPA-HQ-OAR-2011-0660
EPA Docket Center
U.S. EPA, Mail Code 2822T
1200 Pennsylvania Ave. NW.
Washington, DC 20460

Re: Environmental Protection Agency, Standards of Performance for Greenhouse Gas Emissions for New Stationary Sources: Electric Utility Generating Units
Docket ID No. EPA-HQ-OAR-2011-0660

On behalf of Environmental Defense Fund, Inc. ("EDF"), we respectfully offer the following comments with regard to the U.S. Environmental Protection Agency's ("EPA") proposed Standards of Performance for Greenhouse Gas Emissions for New Stationary Sources ("GHG NSPS") and its applicability to certain "transitional" or potentially "transitional" sources. See 77 Fed. Reg. 22,392 (April 13, 2012). EDF submits these comments on behalf of its hundreds of thousands of members nationwide and its tens of thousands of members in Texas and surrounding states. EDF has participated in this rulemaking proceeding for some time and these comments and all other comments submitted by EDF and its members, alone or jointly with other commenters, should be considered to reflect the comments and views of EDF as part of this proceeding. All documents referred to herein and all Attachments should be incorporated as part of the administrative record of this rulemaking proceeding.

In the proposed GHG NSPS, EPA states that it is not proposing a standard of performance for transitional sources. EPA proposes the following regulatory text to delineate "transitional" sources as part of § 60.5510 as follows:

"(3) Transitional Sources.
(i) You are not subject to this subpart if you own or operate a transitional source that commences construction within 12 months after April 13, 2012.
(ii) For purposes of paragraph (b)(3)(ii) a 'transitional source' is defined as an EGU with a base load rating of more than 73 megawatts (MW) (250 million British thermal units per hour (MMBtu/h)) heat input of fossil fuel, except as provided for in § 60.5510(b)(1) and (2), and that received a complete permit that meets the requirements of the Prevention of Significant Deterioration Program under part C of Title I of the Clean Air Act prior to April 13, 2012 (*or that had an approved PSD permit that has expired and is in the process of being extended, if the source is participating in a Department of Energy CCS funding program).*

In the GHG NSPS proposal, EPA has identified 15 proposed sources for potential treatment as "transitional" sources. EDF together with several additional environmental groups submitted joint comments in response to the GHG NSPS proposal. Those comments explained that EPA's "transitional" source proposal is contrary to the plain language and fundamental purposes of the NSPS program, unnecessary as the various sources in question either can meet the 1000 lb CO_2/MWhr standard of performance proposed or are highly unlikely to ever complete construction, and practically unenforceable.

One of those 15 proposed sources is the White Stallion Energy Center ("WSEC") in Texas. Although not included on the list of transitional sources, another source that may seek status as a transitional source is the Las Brisas Energy Center ("LBEC") in Texas. EDF participated in the contested case proceedings for both sources. These additional comments supplement the Joint Environmental Commenters comments, joined by EDF, on the transitional source proposal by adducing further evidence that even if the "transitional" proposal is viable – and we believe it is fundamentally flawed for the reasons stated – that neither WSEC nor LBEC are entitled to transitional source status. As explained in the more detailed comments below, WSEC and LBEC fail to meet EPA's own core criteria for transitional sources as they have *not* "received a complete permit that meets the requirements of the Prevention of Significant Deterioration Program under part C of Title I of the Clean Air Act prior to April 13, 2012."

WSEC

WSEC received a PSD preconstruction permit in December of 2010 based on an October 19, 2010 Final Order issued by the Texas Commission on Environmental Quality ("TCEQ") overturning an earlier decision made by two independent Administrative Law Judges ("ALJs") to deny WSEC's application for a PSD permit and against the recommendations of EPA's Region 6 Office. The ALJs stated that they "cannot recommend that WSEC's application be granted at this time." EPA Region 6 stated in one of its comment letters to TCEQ that "[b]ecause of the deficiencies identified in our written correspondence and the lack of required NAAQS demonstrations, if TCEQ were to issue the permits as they are proposed they would not be consistent with federal requirements." Attachment A. Ignoring EPA's comments and the recommendations of the ALJs, TCEQ issued the permits. Consequently, WSEC's PSD preconstruction permit fails to address the health-based 1-hour SO_2 and NO_2 NAAQS, fails to address the ozone NAAQS at all and is otherwise not in compliance with the federal Clean Air Act and the Texas Clean Air Act. Additionally, as discussed below, WSEC's PSD preconstruction permit is based on an out-dated site plan. Since WSEC's PSD preconstruction permit is incomplete and based on an out-dated site plan, it should not qualify as a transitional source.

As background, in September 2008, WSEC filed an application with TCEQ for federal and state air quality permits for a 1,320 megawatt petroleum coke and coal-fired power plant which included a site plan showing the location of various facilities and equipment that will be sources of air pollutant emissions. Randy Bird, WSEC's Chief Operating Officer, signed the application and certified that the "facts included in the application" including the Air Permit Site Plan were "true and correct." Attachment B, Exhibit A, Tab 2. In December 2008 and again in February 2009, WSEC supplemented its application with an "Air Quality Modeling Analysis" which analyzed air quality impacts as required under 40 CFR §52.21(k), an EPA rule incorporated into TCEQ's air quality rules.[1] Attachment B, Exhibit A, Tab 3. WSEC's air quality impacts analysis and supporting modeling were based only on the now outdated Air Permit Site Plan. Attachment B, Exhibit A, Tab 3 at White Stallion Exhibit 103, p. 15 of 515.

In February 2010, two ALJs from the State Office of Administrative Hearings ("SOAH") conducted an evidentiary hearing on WSEC's air permit application. At the outset of the hearing, evidence was introduced showing that WSEC's sworn and certified application for a wastewater discharge permit, filed with the TCEQ's Water Quality Division in February 2009, and its sworn application for a § 404 wetlands permit, filed with the US Army Corps of Engineers (the "Corps") in September 2009, included site plans that were different from WSEC's September 2008 Air Permit Site Plan, even though all three plans were for the same power plant. Attachment B, Exhibit B, pp. 11-12. When the site plans submitted to the Water Quality Division and the Corps were compared to the Air Permit Site Plan, the evidence showed that more than 20 emissions points were at different locations. Attachment B, Exhibit C, pp. 148-154. Despite the fact that these subsequently filed site plans were different than and conflicted with the Air Permit Site Plan, WSEC's CEO Frank Rotondi testified on cross examination:

> It is my testimony that we have submitted a site plan in the air application for this project to which we are fully and completely prepared to build this project in every respect.

Attachment B, Exhibit B, p. 12; Exhibit C, p. 77. Mr. Rotondi further testified that the only site plan that had been approved by WSEC's so-called "development committee" was the Air Permit Site Plan.[2] Attachment B, Exhibit B, p. 12; Exhibit C, p. 88-90.

Emails were introduced (dated 2009) among WSEC's consultants and management that discussed further revisions to the site plan to minimize impacts to wetlands. Attachment B, Exhibit A, Tab 4. These e-mails, exchanged more than a year before the contested case held on the air permit application, acknowledged that these changes "may affect the wastewater permit and the air dispersion modeling."[3] *Id.*

Based on this evidence, a motion to dismiss or alternatively remand WSEC's application to TCEQ pursuant to § 382.0291(d) of the Texas Health & Safety Code was made. Attachment B, Exhibit C, pp. 6-9. Section 382.0291(d) provides:

> (d) An applicant for a license, permit, registration, or similar form of permission required by law to be obtained from the commission **may not amend the application after the 31st day before the date on which a public hearing on the**

[1] See 30 Tex. Admin. Code § 116.160(c)(2)(B).

[2] Both Mr. Rotondi and Mr. Bird (who signed both of the sworn and certified applications filed with TCEQ's Water Quality and Air Permit Divisions respectively) are on WSEC's so-called "development committee."

[3] The following persons were included in this email chain: WSEC CEO Frank Rotondi who testified at the air permit hearing in support of the application; Larry Shell, Vice President & Sr. Project Manager for Stanley Consultants, Inc. (the firm that designed and engineered the proposed plant) who testified as an expert in support of the Application; Joe Kupper, air dispersion modeler with the RPS Group who testified as an expert at the hearing in support of the Application; Shanon DiSorbo, consultant with RPS Group who testified as an expert at hearing in support of the Application; and Scott Jecker, wetlands consultant who prepared WSEC's wetlands application filed with the Corps. Attachment B, Exhibit A, Tab 4.

> **application is scheduled to begin. If an amendment of an application would be necessary within that period, the applicant shall resubmit the application to the commission and must again comply with notice requirements and any other requirements of law** or commission rule as though the application were originally submitted to the commission on that date.

Tex. Health & Safety Code Ann. § 382.0291(d). It was argued that WSEC's subsequent site plans, filed under sworn certification and subject to criminal penalty, constituted an amendment to the Air Permit Site Plan or showed at least that an "amendment to the application would be necessary." It was further argued that EDF and the public were entitled to notice, comment, and an opportunity for hearing on the power plant that WSEC actually intended to build, which was unclear at that time.

The ALJs denied the motion. In doing so, the ALJs expressed concern with WSEC's changing site plans but expressly relied on WSEC's CEO's sworn testimony that WSEC was "fully willing to comply in every respect with construction of this project according to [the air permit] site layout." Attachment B, Exhibit C, pp. 77-78. As the ALJs state in their Proposal for Decision (PFD):

> Mr. Rotondi testified that WSEC intended to build the facility as stated in this [the air] application. Although we were concerned about WSEC's actions in filing other site plans, we concluded that those actions did not change the facts that led the Commission to refer this case to SOAH. **If WSEC intended to build the proposed facility as shown in the site plan in this application, then Protestants' concerns did not rise to the level of a legal basis for continuing the hearing**.

Attachment B, Exhibit B, p. 13-14 (emphasis added).

Following a six-day evidentiary hearing, the ALJs recommended that TCEQ deny WSEC's application on grounds other than the multiple-site-plan issue. However, on October 19, 2010, TCEQ issued the Final Order granting WSEC's air permit application. Attachment B, Exhibit A, Tab 1. On November 10, 2010, a motion for rehearing was filed.

On December 2, 2010, EDF received documents in response to a FOIA request filed with the Corps. Attachment B, Exhibit A, Tab 6. These documents showed that, on or about October 25, 2010, within ***six days*** of TCEQ issuing the Final Order, WSEC had revised its wetlands permit site plan. *Id.* WSEC then filed this revised site plan (i.e. the October 25th Site Plan) with the Corps in November 2010. As an expert air dispersion modeler, Roberto Gasparini, Ph.D., attested in support of the Motion for Remand, the October 25th Site Plan is materially different from the Air Permit Site Plan and moves 73 of the 84 emissions points modeled by WSEC in the air permit proceeding. Attachment B, Exhibit D, ¶ 7.[4] Sixty-four (64) of the 73 relocated emissions points moved 100 meters or more and at least two moved more than 750 meters. *Id.* Dr. Gasparini further testified that: "In order to determine whether the plant as depicted in the October 2010 Site Plan complies with applicable air quality standards, it is necessary to verify the location of the emissions sources

[4] Non-substantive changes were made to Exhibits D and D-1 in May of 2011 to correct typographical errors in the affidavit and a copying error with Exhibit D-1. These new exhibits are behind the "Revised Exhibits D" tab of Attachment B to this letter.

and perform new air dispersion modeling." Attachment B, Exhibit D, ¶ 9. In the Reply to WSEC's response to the Motion for Remand, Dr. Gasparini explained that one of the 73 emission source that moved is the Railcar Unloading Building (EPN DCRAILUL). Attachment B, Exhibit E, ¶ 5. This emission source represents the third largest emitter of particulate matter at the proposed WSEC power plant and it was moved approximately 788 meters from the middle of the property to a location very close to the property line. *Id.* Another of the 73 emission sources that moved is Conveyor 3 (EPN CONV3). *Id.* This emission source is a conveyor used for transporting materials. *Id.* By moving the Railcar Unloading Building farther from the material storage piles, the length of this conveyor must be increased. *Id.* Therefore, the emission rate from this conveyor must be increased since conveyor emission rates are based in part on conveyor length. *Id.* Dr. Gasparini concluded that [without] remodeling the emissions from the sources as they would be located on White Stallion's new site plan, it is not possible to determine whether the net effect would be a violation of one or more of the federal or state clean air standards." *Id.* ¶ 6. TCEQ and WSEC presented no evidence in the District Court challenging Dr. Gasparini's affidavits or controverting those conclusions.

On December 6, 2010, a motion was filed with TCEQ to reopen the record, extend the time for filing a supplemental motion for review, and extend the time for motions for rehearing. By letter dated December 17th, TCEQ stated that the motions for rehearing had been overruled by operation of law on December 8th but TCEQ did not rule on, or even mention, the motion to reopen the record based on this newly discovered evidence.

An administrative appeal with the Travis County District Court was filed and the previously mentioned Motion for Remand was filed, which included Dr. Gasparini's affidavits. After oral argument on the motion, the District Court granted the motion and ordered a remand for the taking of additional evidence stating that: the additional evidence was material; there were good reasons why it was not presented before SOAH and TCEQ in the air permit proceedings; and absent granting the motion, the "public would not be afforded meaningful participation in the [air] permit application review process." Attachment C, Remand Order. Specifically, that Court stated that additional evidence should be taken on: (1) the October 25th site plan submitted by White Stallion to the Corps; and (2) on the site plan's "impacts on WSEC's TCEQ air permit application under applicable law."

TCEQ and WSEC then challenged the Court's Remand Order and filed petitions for writs of mandamus with the Texas Third Court of Appeals, which denied the petitions. Both WSEC and TCEQ then filed petitions with the Texas Supreme Court seeking writs of mandamus. Like the Third Court of Appeals, the Supreme Court denied the petitions.

On or about October 4th, 2011, the Corps granted WSEC its § 404 wetlands permit based on what appears to be the October 25th Site Plan.[5]

More recently on June 13, 2012, the TCEQ admitted into the record the evidence offered as requested by the District Court, subject to objections, and informed the District Court that it was not changing its decision. This evidence, which remains the only evidence in the record on this issue, establishes that the new site plan violates the short-term PM_{10} PSD increment standard and the short-

[5] http://www.swg.usace.army.mil/whitestallion/whitestallion.asp

term SO_2 NAAQS. Attachment D, Exhibits 200 – 207. WSEC and TCEQ did not offer any evidence to the contrary. As a result, WSEC has not and cannot meet its burden under 40 CFR § 52.21(k) and TCEQ's own rules which require WSEC to demonstrate that emissions from the plant it actually intends to build will not cause or contribute to a violation of any NAAQS or PSD increment standard.

WSEC should not be granted transitional source status based on a preconstruction air permit for site plan that WSEC does not intend to build. We know that WSEC does not intend to build the plant according to the Air Permit Site Plan because WSEC has subsequently represented to the Corps, subject to criminal penalty, that it intends to build an entirely different plant. The Corps has now issued WSEC a wetlands permit based on this new site plan. Neither EPA nor the public has had an opportunity to review and comment on this site plan in the context of air permitting. Granting WSEC transitional source status based on what may amount to be a "***bait-and-switch***" would be rewarding WSEC for its actions at the expense of the public and is exactly what EPA Region 6 warned TCEQ about in its May 13, 2011 comment letter. Attachment A.

Even if WSEC takes the position that its new site plan is not an amendment of its air permit application and that it plans to construct the plant according to the Air Permit Site Plan then WSEC must amend their wetlands permit because it is based on a different site plan – one that moves 73 of 84 emissions points. Alternatively, if WSEC plans to construct the proposed plant according to the wetlands permit site plan then WSEC must amend its air permit. Either way WSEC cannot construct without amending one or the other.

However, WSEC's PSD preconstruction permit is not incomplete merely due to its reliance on an out-dated site plan that the public has never had the opportunity to review. The PSD preconstruction permit is also incomplete because it wholly fails to address several legally applicable NAAQS, including the NAAQS for ozone, and the new NAAQS for NO_2 and SO_2. Instead of modeling ozone impacts or otherwise estimating those impacts, WSEC relied on a simple mathematical ratio of its estimated NOx emissions to VOC emissions to conclude that its 1,320 megawatt coal and petroleum coke fired power plant located within 20 miles of the adjoining Houston-Galveston-Brazoria Severe Non-Attainment Area will be ozone neutral. Attachment E. Consistent with TCEQ's rules and Appendix W, EPA Region 6 specifically requested in two comment letters to TCEQ that WSEC/TCEQ consult with it on the use of a modeling protocol that would estimate potential ozone impacts from WSEC. Attachment A. Neither WSEC nor TCEQ elected to consult with EPA or conduct photochemical modeling. In a third comment letter to the TCEQ, EPA Region 6 again reiterated its request for consultation and expressed its serious concern about the "ozone analysis" (or lack thereof) conducted by WSEC. *Id.* TCEQ ultimately issued WSEC its PSD preconstruction permit based on that limited ratio without actually considering the ozone impacts caused by WSEC.

WSEC has also not demonstrated compliance with the health-based 1-hour NAAQS for NO_2 and SO_2. WSEC received its air permit in December of 2011 based on a Final Order dated October 19, 2011, well after the effective dates of the health-based 1-hour NAAQS for NO_2 and SO_2. But WSEC did not conduct any modeling to demonstrate compliance with 40 CFR § 52.21(k) and TCEQ rules for the NAAQSs. But others did. The resulting dispersion modeling predicts that emissions from WSEC will result in multiple exceedances of the 1-hour NAAQS for SO_2 with the Highest 4th High being 240 $\mu g/m^3$. Attachment D, Exhibits 200 and 207. This evidence was recently admitted into the administrative record by TCEQ. There is no evidence to the contrary.

The bottom-line is that (1) WSEC does not have a complete PSD preconstruction permit because it fails to address the ozone NAAQS and the health-based 1-hour NAAQS for SO_2 and NO_2 and (2) WSEC does not have a permit that authorizes construction immediately because of the inconsistent site plans. EPA Region 6 itself continues to have serious concerns about this permit as evidenced by its numerous comment letters. Attachment A. Thus WSEC should not be rewarded for its actions and granted transitional source status when it obtained a permit based on a site plan it has no intention of building and an application that is wholly deficient.

EPA also requested information about sunk costs and legal challenges associated with WSEC. EDF offers the following additional comments that may factor into EPA's consideration of those issues. Based on hearing testimony and administrative records we know the following:

- WSEC has no employees. Attachment F, p. 71.
- WSEC is a limited liability corporation that is owned in part by Sky Energy, which itself has just four employees. *Id.*
- Neither Sky Energy nor WSEC own or operate any power plants. *Id.*
- WSEC has an option to purchase the real property where the proposed plant is to be located, but there is no evidence in the record indicating whether WSEC has exercised that option.
- WSEC was not required to conduct an Environmental Impact Statement, although one was requested by EPA Region 6, Texas Parks & Wildlife and the City of Houston, among others. Attachment G (Comment Letters).
- In response to EPA's concern that certain transitional sources may lack space for CO_2 removal equipment, attached are copies of WSEC's Air Permit Site Plan and TPDES site plan both of which identify specific areas reserved for future CO_2 removal equipment. Attachment B, Exhibit A, Tab 4; Attachment H.
- At the time of the hearing WSEC had not secured a fuel contract for petroleum coke. Attachment F, p. 107.
- At the time of the hearing WSEC had not secured a contract with a retail provider of electricity or contract operator of the proposed plant. Attachment F, pp. 94, 104-105.
- In late 2011, the Lower Colorado River Authority declined to enter into a water supply contract with WSEC.[6]

Regarding legal challenges, at present WSEC is facing a number of legal challenges. Currently WSEC's air permit application is under challenge in District Court by a number of parties. There will be additional challenges to the recent action taken by the TCEQ during the remand period. WSEC's TPDES permit application is still pending at TCEQ and will likely be referred by the TCEQ to the State Office of Administrative Hearings for a contested case hearing sometime this year. Over 90 hearing requests were filed on WSEC's TPDES permit application according to TCEQ Commissioners' Integrated Database.[7] WSEC is also facing legal challenges in its

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[6] http://lcra.org/newsstory/2011/boardmeetingcanceledWStallion.html; http://www.statesman.com/blogs/content/shared-gen/blogs/austin/green/entries/2011/11/16/lcra_rejects_white_stallion_co.html

[7] http://www12.tceq.state.tx.us/crpub/index.cfm?fuseaction=iwr.itemdetail&addn_id=858429022009061.

groundwater proceeding before the local groundwater conservation district.

EDF believes that these factors coupled with WSEC's incomplete PSD preconstruction permit compel exclusion of WSEC from consideration as a transitional source.

LBEC

Las Brisas Energy Center, LLC ("Las Brisas") has applied for preconstruction permits to build the Las Brisas Energy Center ("LBEC"), a proposed petroleum coke-fired power plant in Corpus Christi, Texas. Las Brisas received a *partial* PSD preconstruction permit by virtue of a TCEQ Final Order dated February 22, 2011. Because Las Brisas did not receive its permit until after the effective date of EPA's PSD permitting requirements for greenhouse gases, Las Brisas additionally filed a GHG PSD permit application with EPA on or about October 28, 2011. It is EDF's understanding that this application remains pending. Accordingly, Las Brisas has not received a complete PSD preconstruction permit by the date of the GHG NSPS proposal, and as such, has not been listed by EPA among the 15 potential transitional sources.

To the extent that Las Brisas may assert that it should be treated as a transitional source, EDF believes it is important for EPA to consider the procedural history of Las Brisas's PSD permit application. This history demonstrates that Las Brisas's failure to receive a complete PSD permit prior to the effective date of the GHG PSD requirements is attributable to its own repeated refusals to comply with applicable requirements under the CAA.

Las Brisas filed its application with the TCEQ on May 19, 2008, seeking various air quality permits including a PSD permit authorizing the construction of the proposed LBEC facility. The proposed LBEC plant is located near downtown Corpus Christi, Texas and would be a major new source of air pollution consisting of four (4) petroleum coke-fired circulating fluidized bed ("CFB") boilers and associated facilities with an output of 1,200 megawatts. Las Brisas also sought a permit to emit hazardous air pollutants. During 2008, Las Brisas submitted multiple subsequent revisions to its application, including air dispersion modeling for purposes of demonstrating compliance with applicable NAAQS and PSD Increments.

On January 7, 2009, TCEQ issued a Draft Permit Nos. 85013, PSD-TX-1138 and HAP-48 (collectively "the Draft Permit") and a Preliminary Determination Summary describing TCEQ's review to date. Numerous persons and organizations protested Las Brisas's application, including EDF, the Texas Clean Air Cities Coalition ("TCACC"), the Sierra Club, the Clean Economy Coalition ("CEC"), the League of Latin American Citizens ("LULAC") and a number of individual protestants.

Pursuant to TCEQ regulations and Las Brisas's own request, the application was referred to SOAH for a contested case hearing on whether the requested permits should be issued. On November 2 through 12, 2009, SOAH Administrative Law Judges Tommy Broyles and Craig Bennett conducted a nine-day hearing on the merits on Las Brisas's application (the "Initial Hearing").

Las Brisas's evidence indicated that the proposed LBEC plant would utilize approximately 7.2 million tons per year of petroleum coke and limestone. The application states that material handling facilities for this petroleum coke and limestone are "required" for LBEC to operate. However, in its application Las Brisas failed to include the emissions from these required facilities in its inventory of emissions, nor did Las Brisas include such emissions in its air dispersion modeling for purposes of demonstrating compliance with applicable NAAQS and PSD Increments. In a motion filed months before the November 2009 hearing, Las Brisas was notified that its application was deficient due to failure to address the material handling facilities, yet Las Brisas failed to make any amendment to its application.

Las Brisas also failed to perform a case-by-case Maximum Achievable Control Technology ("MACT") analysis for the LBEC boilers. A December 2000 EPA decision (the "2000 Listing Decision") subjected coal-fired and oil-fired electric utility generating units ("EGUs") to case-by-case MACT analysis. See 65 FR 79825 (December 20, 2000). Las Brisas contended that the petroleum coke-fired LBEC EGUs were neither "coal-fired" nor "petroleum-fired" (even though petroleum coke is a by-product of oil and has been included in multiple definitions of "coal" utilized by EPA) and as such no MACT analysis was necessary. However, it was undisputed at hearing that the LBEC boilers will emit large quantities of the exact same HAPs – including arsenic, mercury, lead, chromium, cadmium, beryllium and nickel – which were cited in EPA's 2000 Listing Decision as the reason for requiring a MACT analysis for "coal-fired" and "oil-fired" boilers. TCEQ's own permit engineer Randy Hamilton testified that there was no technical reason why petroleum coke-fired boilers should be treated differently from coal-fired and oil-fired boilers and exempted from the MACT analysis requirements. Furthermore, EPA specifically notified TCEQ that MACT applies to the proposed LBEC pet-coke fired boilers, setting forth in a February 2009 comment letter to TCEQ a list of detailed considerations "for [TCEQ] to consider as you develop the case-by-case section 112(g) MACT standard for the LBEC." See Attachment I at p. 1.

After the Initial Hearing, the SOAH judges issued a Proposal for Decision ("Initial PFD") dated March 29, 2010, recommending that TCEQ not grant the application on multiple grounds. Among these grounds, SOAH concluded that MACT applied to the LBEC boilers and that as a result the application must either be denied or remanded to the TCEQ for further technical review. In addition, the SOAH judges concluded that Las Brisas failed to demonstrate that it complied with applicable air quality standards in light of its failure to disclose the actual material handling facilities required for LBEC to operate, and to model emissions impacts from those facilities.

TCEQ considered SOAH's Initial PFD and issued an Interim Order on July 1, 2010 (the "Interim Order"). In the Interim Order, TCEQ ruled, contrary to both SOAH's and EPA's position, that the LBEC boilers were not subject to case-by-case MACT requirements. However, TCEQ remanded the case to SOAH to take additional evidence on various other issues cited by SOAH, including the material handling facilities for LBEC.

Thus, as a direct result of Las Brisas's failure to disclose and address its material handling plans, an additional hearing before SOAH was required, significantly delaying the issuance of any permit. This hearing was originally scheduled for September 7-10, 2010, but was postponed for six weeks until October 18, 2010 after Dr. Roberto Gasparini, Ph.D, one of the expert witnesses on air dispersion modeling, was seriously injured in an auto accident. Las Brisas complained of this postponement, arguing that it would be harmed by the continuance because of the potential for the EPA to implement its GHG Tailoring Rule (Tailoring Rule) before a final order can be issued in this case, thus potentially requiring consideration of GHG emissions. In response, SOAH stated as follows:

> [T]he [Judges] note that [Las Brisas] finds itself in this predicament of its own making. As noted in the [Initial PFD] , [Las Brisas] failed to meet its burden of proof when given a two-week hearing to present its application-even though it had been made aware of many of the issues by the protestants months before the hearing (on, for example, secondary emissions and materials handling concerns). [Las Brisas] never addressed some of those deficiencies . . . Thus, [Las Brisas] finds itself in the present predicament because it failed to prove its application met all applicable rules and regulations during the first hearing.

See Attachment J at pp. 3-4. SOAH thus denied Las Brisas's request for reconsideration of the six week continuance.

Prior to the October, 2010 hearing, Las Brisas presented two new "hypothetical" material handling scenarios, neither of which was included in its application. Although Las Brisas quantified emissions from each of the two hypothetical scenarios and included those emissions in its air dispersion modeling, Las Brisas refused to commit to either scenario, and ultimately stated that the "hypothetical" scenarios were "strictly for demonstrative purposes." In addition, Las Brisas treated the material handling facilities as "secondary emissions" rather than emissions from the LBEC stationary source, even though its application stated the material handling facilities were "required" for LBEC to operate. Las Brisas submitted its additional air dispersion modeling to TCEQ prior to July 2010, and that modeling was subjected to technical review by the TCEQ's Air Dispersion Modeling Team ("ADMT") prior to the October 2010 hearing.

SOAH conducted a four-day evidentiary hearing on remand from October 18-21, 2010. Undisputed evidence was presented through expert witness Dr. Gasparini showing that, if the required material handling facilities are included as part of LBEC "stationary source" for purposes of performing air dispersion modeling, LBEC greatly exceeds the maximum 24-hour PSD increment for PM_{10} of 30 $\mu g/m^3$. Thus, it was contended that by excluding the required material handling facilities from LBEC and dividing the stationary source in two, Las Brisas seeks to permit a new source of air pollutants that, as a matter of law cannot be permitted as a single stationary source.

On December 1, 2010, SOAH issued a Proposal for Decision on Remand ("Remand PFD"). In the Remand PFD, SOAH once again concluded that Las Brisas failed to meet its burden of proof by failing to demonstrate compliance with the 24-hour PSD increment for PM_{10}, finding that, the TCEQ improperly assisted Las Brisas in carrying its burden of proof in violation of a Texas statute (Texas Water Code § 5.228(e)) by performing its own air dispersion modeling correcting deficiencies in the Las Brisas's modeling. In the Remand PFD, the ALJs also found that the Las Brisas's reliance on "hypothetical" material handling scenarios did not demonstrate compliance with applicable PSD increments absent a binding requirement to utilize such scenarios, stating "[t]o make the necessary showing, an applicant has to be bound to the operations it has modeled . . . [o]therwise, any showing is merely illusory."

By letter dated January 24, 2011, EPA notified TCEQ that it still harbored significant concerns about Las Brisas's compliance with federal requirements. Attachment K. In this letter, EPA noted that it had promulgated a health-based 1-hour nitrogen dioxide (NO_2) and sulfur dioxide (SO_2) NAAQS and that EPA interpreted CAA and PSD regulations to require a showing of compliance with these NAAQS. EPA noted that it had not been provided any records demonstrating compliance with these standards. In fact, it is undisputed that no demonstration of compliance has been made by Las Brisas as to the new 1-hour NO_2 and SO_2 NAAQS. In the February 24, 2011 letter, EPA also notified TCEQ that Las Brisas would need to work with EPA to determine whether it is subject to new GHG permitting requirements which became effective January 2, 2011.

Notably, the health-based 1-hour NO_2 and SO_2 NAAQS were enacted effective April 12, 2010 and August 23, 2010, respectively. Thus, the application of SO_2 NAAQS and GHG permitting requirements – which each became effective after TCEQ's remand on July 1, 2010 – to Las Brisas resulted directly from its complete failure to disclose its material handling plans in the initial SOAH hearing and resulting failure to meet its burden of proof. In short, Las Brisas and Las Brisas alone is to blame for the applicability of NAAQS and GHG requirements to its project.

Despite SOAH's and EPA's concerns, TCEQ nevertheless issued a Final Order on February 22, 2011 granting the permits. In addition to erroneously granting the permits, TCEQ failed to include in the Final Order any requirement (as recommended by the SOAH) that Las Brisas actually utilize one of the two "hypothetical" material handling scenarios that Las Brisas relied upon for its "demonstration" of compliance with the NAAQS and PSD Increments.

Thus, in granting the requested permits, TCEQ ignored EPA's position: (1) that a MACT analysis was required for the LBEC boilers; (2) that LBEC is subject to the health-based NO_2 and SO_2 NAAQS, and (3) that LBEC is subject to GHG permitting requirements. In addition, TCEQ ignored SOAH's conclusions on at least three legal issues: (1) SOAH's conclusion in the Initial PFD that a case-by-case MACT analysis was required; (2) SOAH's conclusion in the Remand PFD that the permits could not be issued without violating Texas Water Code § 5.228(e); and (3) SOAH's conclusion in the Remand PFD that Las Brisas could not demonstrate compliance with applicable PSD Increments for PM_{10} absent a binding commitment to utilize the "hypothetical" material handling facilities that Las Brisas made the basis of its application.

TCEQ's decision granting the permits was appealed to the 345th Judicial District Court of Travis County, Texas. The appeal was briefed by all parties and oral argument was held May 7, 2012. By letter dated May 14, 2012, 345th District Court Judge Hon. Stephen Yelenosky announced that he intends to reverse TCEQ's Final Order granting the Las Brisas permits on at least four grounds, concluding TCEQ erred: (1) by failing to require a MACT demonstration for the LBEC CFB boilers; (2) by allowing to Las Brisas to rely on non-binding material handling scenarios for purposes of "demonstrating compliance" with applicable CAA requirements; (3) by failing to require Las Brisas to demonstrate compliance with the new NO_2 and SO_2 NAAQS, which "became effective while Las Brisas application was still under review and months prior to the second hearing before SOAH, on remand from the [TCEQ]"; and (4) by assisting Las Brisas in meeting its burden of proof in violation of Texas Water Code § 5.228(e). Attachment L at pp. 2-6. As of the date of these comments, plaintiffs have submitted a proposed order, but no formal order has been entered yet.

In conclusion, the history of this case reveals:

- Las Brisas filed its application in 2008, and had a full evidentiary hearing on that permit application before SOAH in 2009;

- Prior to the 2009 hearing, concerns were raised with Las Brisas's failure to address emissions from its required material handling, yet Las Brisas failed to amend its application to address this failure;

- As a direct result of Las Brisas's failure to address emissions from the required material handling facilities, TCEQ remanded its application to SOAH in mid-2010 for further review, resulting in significant delay in permit issuance;

- As a result, Las Brisas became subject to the health-based 1-hour NO_2 and SO_2 NAAQS which took effect in 2010;

- SOAH held an additional evidentiary hearing in October 2010, prior to which TCEQ performed additional technical review of Las Brisas's air dispersion modeling;

- During this hearing, Las Brisas could have, but elected not to, submit evidence regarding compliance with the health-based 1-hour NO_2 and SO_2 NAAQS;

- As a result of Las Brisas's failure to address material handling in its application and other errors, no permit was issued until after January 2, 2011, when EPA's new GHG PSD requirements took effect;

- As of the current date, Las Brisas has an incomplete PSD permit because its application for a GHG PSD permit is still pending; moreover, it has failed to meet multiple other applicable pre-construction requirements under the CAA including (i) any MACT demonstration for the LBEC boilers; (ii) any attempt to demonstrate compliance with the new 1-hour NO_2 and SO_2 NAAQS; and (iii) any demonstration of compliance with the 24-hour PM_{10} PSD increment; and

- As an additional result of Las Brisas's and TCEQ's failures to comply with multiple CAA requirements, a Texas District Court Judge has announced he intends to reverse TCEQ's February, 2011 order granting Las Brisas's permit.

The history of Las Brisas's application demonstrates a repeated refusal to comply with multiple core requirements of the CAA, despite the admonishments of both EPA and SOAH. Had it complied with applicable CAA requirements, Las Brisas could have received a permit shortly after the November 2009 SOAH hearing. However, it did not do so, despite ample notice of the deficiencies in its application. Las Brisas has only itself to blame for its current predicament.

Finally, it has comes to EDF's attention that Las Brisas has claimed in a Petition for Review of EPA's GHG New Source Performance Standards filed with the United States Court of Appeals for the District of Columbia Circuit that it "has invested approximately $40 million in the development of LBEC." Attachment M at p. 3. Las Brisas does not itemize or otherwise describe the nature of the expenses that comprise this alleged $40 million sum. It appears possible that a large portion of this sum may consist of a lease covering the LBEC property which contains a 30 to 35 year term and annual rents of up to $948,520.00. Attachment N at pp. 1, 3 (copy of Lease Agreement between Las Brisas Energy Center, LLC and Port of Corpus Christi Authority of Nueces County, Texas, filed with Water Quality Division of TCEQ). To the extent Las Brisas contends that this lease is included in its claimed $40 million investment, EPA should be aware that the copy of the LBEC lease agreement filed with TCEQ indicates that the rental obligation is not absolute, as Las Brisas has the right to terminate this Lease Agreement if its financing for improvements is not closed by January 31, 2013. Attachment N at p.2, last paragraph of Section 1.01. And in any event, even if Las Brisas has in fact expended substantial sums in connection with its project, such an expenditure does not excuse its own willful failure to comply with applicable requirements under the CAA.

In light of the history of its application, absolutely no equitable or extenuating circumstances exist justifying inclusion of Las Brisas among the transitional sources. To the exact contrary, EDF submits that making any exception would be particularly unjustified and inappropriate, and would simply reward Las Brisas for its own refusal to comply with core CAA requirements.

# # #

Thank you for your consideration of these comments.

To: Joseph Goffman/DC/USEPA/US@EPA[]
From: "Jared Snyder"
Sent: Mon 9/20/2010 4:16:01 PM
Subject: NSPS

Joe, Would you and Gina be available to discuss 111(d) with Brian Turner of California and me on September 28 (or maybe Sept 29 if 9/28 is unavailable)? I'll call you to discuss.

Thanks, Jared

To:
Vickie_Patton@environmentaldefense.org;ddoniger@nrdc.org;joanne.spalding@sierraclub.org;Michael.Myers@ag.ny.gov[];
doniger@nrdc.org;joanne.spalding@sierraclub.org;Michael.Myers@ag.ny.gov[];
oanne.spalding@sierraclub.org;Michael.Myers@ag.ny.gov[]; ichael.Myers@ag.ny.gov[]
Cc: DGunter@ENRD.USDOJ.GOV;CN=Avi Garbow/OU=DC/O=USEPA/C=US@EPA;CN=Elliott Zenick/OU=DC/O=USEPA/C=US@EPA;CN=Eric Ginsburg/OU=RTP/O=USEPA/C=US@EPA;CN=Joseph Goffman/OU=DC/O=USEPA/C=US@EPA;CN=Peter Tsirigotis/OU=RTP/O=USEPA/C=US@EPA[]; N=Avi Garbow/OU=DC/O=USEPA/C=US@EPA;CN=Elliott Zenick/OU=DC/O=USEPA/C=US@EPA;CN=Eric Ginsburg/OU=RTP/O=USEPA/C=US@EPA;CN=Joseph Goffman/OU=DC/O=USEPA/C=US@EPA;CN=Peter Tsirigotis/OU=RTP/O=USEPA/C=US@EPA[]; N=Elliott Zenick/OU=DC/O=USEPA/C=US@EPA;CN=Eric Ginsburg/OU=RTP/O=USEPA/C=US@EPA;CN=Joseph Goffman/OU=DC/O=USEPA/C=US@EPA;CN=Peter Tsirigotis/OU=RTP/O=USEPA/C=US@EPA[]; N=Eric Ginsburg/OU=RTP/O=USEPA/C=US@EPA;CN=Joseph Goffman/OU=DC/O=USEPA/C=US@EPA;CN=Peter Tsirigotis/OU=RTP/O=USEPA/C=US@EPA[]; N=Joseph Goffman/OU=DC/O=USEPA/C=US@EPA;CN=Peter Tsirigotis/OU=RTP/O=USEPA/C=US@EPA[]; N=Peter Tsirigotis/OU=RTP/O=USEPA/C=US@EPA[]
From: CN=Patricia Embrey/OU=DC/O=USEPA/C=US
Sent: Tue 9/21/2010 9:07:06 PM
Subject: In preparation for our September 22, 2010
Draft EGU settlement Sept 21.DOC

This is to confirm that we are holding a second, settlement confidential, meeting/call tomorrow at 3 p.m. Eastern Time.

Same call in number: [redacted] code: [redacted]

For anyone attending in person, we will use the same room as last week -- 7500 Ariel Rios North. Please let us know if any of you will be here in person so that we can arrange to sign you in.

In preparation for the meeting we have put together a confidential draft settlement agreement for your review. We hope that you will have the opportunity to read it through before call, so that we can have a productive discussion.

SETTLEMENT AGREEMENT

This Settlement Agreement is made by and between the following groups of Petitioners: (1) Natural Resources Defense Council (NRDC), Sierra Club, and Environmental Defense Fund (EDF) (collectively "Environmental Petitioners"); and (2) the States of New York, **[California, Connecticut, Maine, New Mexico, Oregon, Rhode Island, Vermont, and Wisconsin, the Commonwealth of Massachusetts, the District of Columbia, and the City of New York]** (collectively "State Petitioners"), and Respondent, the U.S. Environmental Protection Agency ("EPA") (collectively "the Parties").

WHEREAS, EPA published a final action entitled "Standards of Performance for Electric Utility Steam Generating Units, Industrial-Commercial-Institutional Steam Generating Units, and Small Industrial-Commercial-Institutional Steam Generating Units," 71 Fed. Reg. 9,866 (Feb. 27, 2006) (the "Final Rule");

WHEREAS, the Final Rule included amendments to the standards of performance for steam generating units subject to 40 C.F.R. part 60, subpart Da;

WHEREAS, in connection with this Final Rule, EPA declined to establish standards of performance for greenhouse gas ("GHG") emissions;

WHEREAS, Environmental and State Petitioners filed petitions for judicial review of the Final Rule under the Clean Air Act ("CAA") Section 111, 42 U.S.C. § 7411, contending, *inter alia*, that the Final Rule was required to include standards of performance for GHG emissions from electric utility steam generating units ("EGUs");

WHEREAS, the portion of Environmental and State Petitioners' petitions for review of the Final Rule that related to GHG emissions were severed from other petitions for review of the Final Rule, and were formerly pending before the United States Court of Appeals for the District of Columbia Circuit (the "Court") under the caption *State of New York, et al. v. EPA*, No. 06-1322;

WHEREAS, EPA requested remand of the Final Rule to EPA for further consideration of the issues related to GHG emissions in light of the Supreme Court's decision in *Massachusetts v. EPA*, 549 U.S. 497 (2007);

WHEREAS, the Court remanded the Final Rule to EPA for further proceedings in light of *Massachusetts v. EPA*, without vacating the Final Rule, by its Order of September 24, 2007 (the "Remand Order");

WHEREAS, as of the date of this Settlement Agreement, EPA had not taken any publicly noticed action to respond to the Remand Order;

WHEREAS, Environmental Petitioners submitted a letter to EPA on August 20, 2010, requesting that EPA agree to consider GHG emissions in conjunction with other utility standards to be proposed in March 2011, and threatening the possibility of further litigation in the absence of such an agreement;

WHEREAS, EGUs are, collectively, the largest source category of GHG emissions in the United States, according to a recent EPA analysis. *See* 74 Fed. Reg. 56,260, 56,363 (Oct. 30, 2009);

WHEREAS, based on EPA's initial evaluation of available GHG control strategies, it appears that there are cost-effective control strategies for reducing GHGs from EGUs;

WHEREAS, EPA believes that if it sets standards of performance for GHGs, it would be appropriate for it to concurrently issue emissions guidelines for GHGs from existing affected EGUs pursuant to CAA section 111(d), 42 U.S.C. § 7411(d), and 40 C.F.R. § 60.22;

WHEREAS, the Parties wish to enter into this Settlement Agreement to resolve the Environmental and State Petitioners' request for consideration of GHGs in NSPS for EGUs and to avoid further litigation on this issue, without any admission or adjudications of fact or law;

NOW THEREFORE, the Parties, intending to be bound by this Settlement Agreement, hereby stipulate and agree as follows:

1. EPA agrees that it will sign and promptly transmit to the Office of the Federal Register a proposed rule by May 31, 2011, that addresses standards of performance for GHGs for new and modified EGUs that are subject to 40 C.F.R. part 60, subpart Da. EPA shall provide the Environmental and State Petitioners a copy of the proposed rule within five business days of signature.
2. EPA agrees that if it proposes standards of performance pursuant to Paragraph 1 it will also sign and promptly transmit to the Office of the Federal Register a proposed rule by May 31, 2011, that addresses emissions guidelines for GHGs from existing EGUs that would have been subject to 40 C.F.R. part 60, subpart Da if they were new sources. EPA shall provide the Environmental and State Petitioners a copy of the proposed rule within five business days of signature.
3. After considering any public comments received concerning the proposed rule described in Paragraph 1, EPA will sign and promptly submit to the Office of the Federal Register a final rule no later than May 31, 2012**,** that takes final action with respect to the proposed rule described in Paragraph 1. EPA shall provide the Environmental and State Petitioners with a copy of its final action within five business days of signature.
4. If EPA finalizes standards of performance for GHGs pursuant to Paragraph 3 then based on consideration of the public comments received concerning the proposed rule described

in Paragraph 2, EPA will sign and promptly submit to the Office of the Federal Register a final rule no later than May 31, 2012, that takes final action with respect to the proposed rule describe in Paragraph 2. EPA shall provide the Environmental and State Petitioners with a copy of its final action within five business days of signature

5. Upon EPA's fulfillment of each of the obligations stated in Paragraphs 1 through 4 above, this Settlement Agreement shall constitute a full and final release of any claims that Environmental and State Petitioners may have under any provision of law to compel EPA to respond to the Court's Remand Order, or for any attorneys' fees and costs in such an action.

6. Environmental and State Petitioners shall not file any motion or petition for review seeking to compel EPA action in response to the Remand Order unless EPA has first failed to meet an obligation stated in Paragraphs 1 through 4 above. If EPA fails to meet such an obligation, Environmental and State Petitioners' sole remedy shall be to file an appropriate motion or petition with the Court seeking to compel EPA to take action responding to the Remand Order. In that event, all Parties reserve any claims or defenses they may have in such an action, and the terms of this Settlement Agreement shall not be included in the record or other filings presented to the Court nor referenced in any such filing.

7. This Settlement Agreement constitutes the sole and entire understanding of EPA and the Environmental and State Petitioners and no statement, promise or inducement made by any Party to this Settlement Agreement, or any agent of such Parties, that is not set forth in this Settlement Agreement shall be valid or binding.

8. Except as expressly provided in this Settlement Agreement, none of the Parties waives or relinquishes any legal rights, claims or defenses it may have.

9. The provisions of this Settlement Agreement can be modified at any time by written mutual consent of the Parties.

10. Except as expressly provided herein, nothing in the terms of this Settlement Agreement shall be construed to limit or modify the discretion accorded EPA by the CAA or by general principles of administrative law.

11. The commitments by EPA in this Settlement Agreement are subject to the availability of appropriated funds. No provision of this Settlement Agreement shall be interpreted as or constitute a commitment or requirement that EPA obligate, expend or pay funds in contravention of the Anti-Deficiency Act, 31 U.S.C. 1341, or any other applicable appropriations law or regulation, or otherwise take any action in contravention of those laws or regulations.

12. Nothing in the terms of this Settlement Agreement shall be construed to limit EPA's authority to alter, amend or revise any final rule EPA may issue pursuant to Paragraph 3 or 4, or to promulgate superseding regulations.

13. The Parties agree and acknowledge that before this Settlement Agreement is final, EPA must provide notice in the Federal Register and an opportunity for public comment pursuant to CAA Section 113(g), 42 U.S.C. 7413(g). After this Settlement Agreement has undergone an opportunity for notice and comment, the Administrator and/or the Attorney General, as appropriate, shall promptly consider any such written comments in determining whether to withdraw or withhold her/his consent to the Settlement Agreement, in accordance with section 113(g) of the CAA. This Settlement Agreement

shall become final on the date that EPA provides written notice of such finality to the Environmental and State Petitioners.

14. The undersigned representatives of each Party certify that they are fully authorized by the Party that they represent to bind that respective Party to the terms of this Settlement Agreement. This Settlement Agreement will be deemed to be executed when it has been signed by the representatives of the Parties set forth below, subject to final approvals pursuant to Paragraph 13.

DATE:______________ ______________________________________

DAVID GUNTER
U.S. Department of Justice
Environment and Natural Resources Division
Environmental Defense Section
P.O. Box 23986
Washington, D.C. 20026-3986
(202) 514-3785
David.Gunter2@usdoj.gov

Counsel for EPA

DATE:______________ ______________________________________

Counsel for **[environmental petitioners]**

Counsel for [**state petitioners**]

To: goffman.joseph@epamail.epa.gov[goffman.joseph@epamail.epa.gov]; Johnson.Addie@epamail.epa.gov>[]
Cc: brian.turner@wdc.ca.gov[brian.turner@wdc.ca.gov]
From: "Jared Snyder"
Sent: Wed 9/22/2010 9:05:58 PM
Subject: Re: NSPS

Thanks Joe.

Addie, I'd like to do this on the 28th if possible. Would you like me to propose some times? Thanks, Jared
-----Original Message-----
From: <Goffman.Joseph@epamail.epa.gov>
Cc: Snyder, Jared <jjsnyder@gw.dec.state.ny.us>
To: <Johnson.Addie@epamail.epa.gov>

Sent: 9/21/2010 6:23:08 PM
Subject: Re: NSPS

Addie can set something up for the three of us. Gina will join us if her schedule permits (she might be traveling or getting ready to on the 28th/29th).. Thanks.

Joseph Goffman
Senior Counsel to the Assistant Administrator
Office of Air and Radiation
US Environmental Protection Agency
202 564 3201

From: Joseph Goffman/DC/USEPA/US

To: "Jared Snyder" <jjsnyder@gw.dec.state.ny.us>

Date: 09/21/2010 11:27 AM

Subject: Re: NSPS

Thanks for this and for your vmail. Let me touch base with Gina.
Thanks.

Joseph Goffman
Senior Counsel to the Assistant Administrator
Office of Air and Radiation
US Environmental Protection Agency
202 564 3201

From: "Jared Snyder" <jjsnyder@gw.dec.state.ny.us>

To: Joseph Goffman/DC/USEPA/US@EPA

Date: 09/20/2010 12:18 PM

Subject: NSPS

Joe, Would you and Gina be available to discuss 111(d) with Brian Turner of California and me on September 28 (or maybe Sept 29 if 9/28 is unavailable)? I'll call you to discuss.

Thanks, Jared

To: Joseph Goffman/DC/USEPA/US@EPA[]
From: "Jared Snyder"
Sent: Wed 9/22/2010 9:25:38 PM
Subject: Re: NSPS

Yes, of course. You might think about letting Brian know the schedule you have in mind when we meet, but I leave that to you. Cal is a litigant, I believe. J
-----Original Message-----
From: <Goffman.Joseph@epamail.epa.gov>
To: Snyder, Jared <jjsnyder@gw.dec.state.ny.us>

Sent: 9/22/2010 5:12:12 PM
Subject: Re: NSPS

just sent you a scheduler. I assume that the settlement discussions now ongoing with New York State via Mike Meyers and you continue to be kept absolutely confidential. thanks.

Joseph Goffman
Senior Counsel to the Assistant Administrator
Office of Air and Radiation
US Environmental Protection Agency
202 564 3201

From: "Jared Snyder" <jjsnyder@gw.dec.state.ny.us>

To: <goffman.joseph@epamail.epa.gov>, <Johnson.Addie@epamail.epa.gov>

Cc: <brian.turner@wdc.ca.gov>

Date: 09/22/2010 05:06 PM

Subject: Re: NSPS

Thanks Joe.

Addie, I'd like to do this on the 28th if possible. Would you like me to propose some times? Thanks, Jared
-----Original Message-----
From: <Goffman.Joseph@epamail.epa.gov>
Cc: Snyder, Jared <jjsnyder@gw.dec.state.ny.us>
To: <Johnson.Addie@epamail.epa.gov>

Sent: 9/21/2010 6:23:08 PM
Subject: Re: NSPS

Addie can set something up for the three of us. Gina will join us if her schedule permits (she might be traveling or getting ready to on the 28th/29th).. Thanks.

Joseph Goffman
Senior Counsel to the Assistant Administrator
Office of Air and Radiation
US Environmental Protection Agency
202 564 3201

From: Joseph Goffman/DC/USEPA/US

To: "Jared Snyder" <jjsnyder@gw.dec.state.ny.us>

Date: 09/21/2010 11:27 AM

Subject: Re: NSPS

Thanks for this and for your vmail. Let me touch base with Gina.
Thanks.

Joseph Goffman
Senior Counsel to the Assistant Administrator
Office of Air and Radiation
US Environmental Protection Agency
202 564 3201

From: "Jared Snyder" <jjsnyder@gw.dec.state.ny.us>

To: Joseph Goffman/DC/USEPA/US@EPA

Date: 09/20/2010 12:18 PM

Subject: NSPS

Joe, Would you and Gina be available to discuss 111(d) with Brian Turner of California and me on September 28 (or maybe Sept 29 if 9/28 is unavailable)? I'll call you to discuss.

Thanks, Jared

To: CN=Joseph Goffman/OU=DC/O=USEPA/C=US@EPA[]
Cc: "Jared Snyder" [jjsnyder@gw.dec.state.ny.us]
From: CN=Joseph Goffman/OU=DC/O=USEPA/C=US
Sent: Wed 9/22/2010 9:41:57 PM
Subject: Re: NSPS

just got a vmail form Mike which, as it happens, answered my question......

Joseph Goffman
Senior Counsel to the Assistant Administrator
Office of Air and Radiation
US Environmental Protection Agency
202 564 3201

From: Joseph Goffman/DC/USEPA/US
To: "Jared Snyder" <jjsnyder@gw.dec.state.ny.us>
Date: 09/22/2010 05:31 PM
Subject: Re: NSPS

Yep. I think you're right. Is NY/Mike representing them in the discussions we're having?

Joseph Goffman
Senior Counsel to the Assistant Administrator
Office of Air and Radiation
US Environmental Protection Agency
202 564 3201

From: "Jared Snyder" <jjsnyder@gw.dec.state.ny.us>
To: Joseph Goffman/DC/USEPA/US@EPA
Date: 09/22/2010 05:26 PM
Subject: Re: NSPS

Yes, of course. You might think about letting Brian know the schedule you have in mind when we meet, but I leave that to you. Cal is a litigant, I believe. J
-----Original Message-----
From: <Goffman.Joseph@epamail.epa.gov>
To: Snyder, Jared <jjsnyder@gw.dec.state.ny.us>

Sent: 9/22/2010 5:12:12 PM
Subject: Re: NSPS

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Office of Air and Radiation
US Environmental Protection Agency
202 564 3201

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To: <goffman.joseph@epamail.epa.gov>, <Johnson.Addie@epamail.epa.gov>

Cc: <brian.turner@wdc.ca.gov>

Date: 09/22/2010 05:06 PM

Subject: Re: NSPS

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Cc: Snyder, Jared <jjsnyder@gw.dec.state.ny.us>
To: <Johnson.Addie@epamail.epa.gov>

Sent: 9/21/2010 6:23:08 PM
Subject: Re: NSPS

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Joseph Goffman
Senior Counsel to the Assistant Administrator
Office of Air and Radiation
US Environmental Protection Agency
202 564 3201

From: Joseph Goffman/DC/USEPA/US

To: "Jared Snyder" <jjsnyder@gw.dec.state.ny.us>

Date: 09/21/2010 11:27 AM

Subject: Re: NSPS

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Thanks.

Joseph Goffman
Senior Counsel to the Assistant Administrator
Office of Air and Radiation
US Environmental Protection Agency
202 564 3201

From: "Jared Snyder" <jjsnyder@gw.dec.state.ny.us>

To: Joseph Goffman/DC/USEPA/US@EPA

Date: 09/20/2010 12:18 PM

Subject: NSPS

Joe, Would you and Gina be available to discuss 111(d) with Brian Turner of California and me on September 28 (or maybe Sept 29 if 9/28 is unavailable)? I'll call you to discuss.

Thanks, Jared

To: Joseph Goffman/DC/USEPA/US@EPA[]
From: "Doniger, David"
Sent: Wed 10/13/2010 8:24:11 PM
Subject: FW: E&E on new Duke study promoting CAA Section 111
ddoniger@nrdc.org
www.nrdc.org
http://switchboard.nrdc.org/blogs/ddoniger/
paper
Greenwire
Click here
ddoniger@nrdc.org
www.nrdc.org
http://switchboard.nrdc.org/blogs/ddoniger/

Note Holmstead comments.

David D. Doniger

Policy Director, Climate Center

Natural Resources Defense Council

1200 New York Ave., NW

Washington, DC 20005

Phone: (202) 289-2403

Cell: (202) 321-3435

Fax: (202) 789-0859

ddoniger@nrdc.org

on the web at www.nrdc.org

read my blog: http://switchboard.nrdc.org/blogs/ddoniger/

From: Doniger, David
Sent: Wednesday, October 13, 2010 4:23 PM
To: Climate EPA GHG/CAA fight
Subject: E&E on new Duke study promoting CAA Section 111

CLIMATE: Scholars suggest new Clean Air Act approach to curbing GHGs (10/13/2010)

Gabriel Nelson, E&E reporter

Though the Obama administration will be challenged no matter how it chooses to regulate greenhouse gases under the Clean Air Act, the statute's New Source Performance Standards (NSPS) would be a more practical way to reduce emissions under existing law, three Duke University experts argue in a new paper.

So far, U.S. EPA has used only the New Source Review (NSR) provisions of the Clean Air Act to regulate greenhouse gases from factories, power plants and other large facilities. Starting on Jan. 2, 2011, the agency will require permits for new and modified facilities that would exceed certain emissions levels.

Critics contend that existing laws are ill-suited to address climate change, but as long as the Obama administration is intent on regulating greenhouse gases under the Clean Air Act, the NSPS provisions are the best option, say Jonas Monast, Tim Profeta and David Cooley of Duke's Nicholas Institute for Environmental Policy Solutions.

Supplementing existing NSR rules with the performance standards would allow EPA to build a "cost-effective program that delivers meaningful emissions reductions, is consistent with both the statutory language of the act and legal precedent, and is politically viable," the scholars wrote in a paper released yesterday.

EPA argues that it is required to regulate greenhouse gases because of its scientific finding that carbon dioxide emissions are a threat to human health and welfare. That finding was prompted by the Supreme Court's 2007 decision in Massachusetts v. EPA, which told the agency to decide whether to regulate carbon dioxide as a pollutant.

The new paper, which emerged from a gathering of Clean Air Act scholars earlier this year, aims to balance EPA's legal obligations and political realities as the agency moves forward with its regulations, Profeta said in an interview. So far, the agency has taken a "careful" approach by limiting its greenhouse gas rules to the largest emissions sources, he said.

"That was a legal decision, but what they really need to do now is figure out the best way to use the act to tackle greenhouse gases comprehensively," Profeta said. "The only way that changes is with intervention from legislators."

The performance standards, which could also be used to set emissions limits for existing facilities as well as new sources, have gotten broad support from environmental groups and are seen by industry as preferable to the rules finalized by EPA this year.

The NSPS approach would provide more certainty than the litigation-plagued NSR program, said Jeff Holmstead, an industry attorney at Bracewell & Giuliani LLP who was EPA's air chief under President George W. Bush.

Unlike NSR rules, the NSPS provisions could include emissions trading, allowing EPA to borrow some of the ideas that were put forward in Congress during negotiations on a climate bill. That would help the administration strike deals with industry groups and avoid some legal challenges, the new paper says.

The standards could be based on energy efficiency and other available technologies. According to a recent study by the think tank Resources for the Future, standards for efficiency and biomass use at coal-fired power plants could reduce the sector's greenhouse gas emissions by 5 to 10 percent.

Including existing facilities would allow for greater reductions, and it could also prevent some of the legal wrangling over NSR permits, which must be done for each individual facility. Compared to the NSR rules, which he described as the "worst of all worlds," performance standards "could be better environmentally and more acceptable to industry, depending on how they do it," Holmstead said.

"It depends a lot on how aggressive they try to be," he added. "There are sensible ways to get meaningful reductions in CO_2, but nowhere near the types of reductions that many in the environmental community are talking about being necessary."

'Not the end of the matter'

In its proposed budget for fiscal 2011, the Obama administration requested $7.5 million for EPA to assess the option of setting greenhouse gas limits for several major industry sectors through the NSPS program. Though EPA did not include greenhouse gas limits in its recently finalized standards for cement kilns, the agency hinted that those types of requirements might be on the way.

"This is not the end of the matter," EPA says in the rule. "To the contrary, based on our current knowledge we believe that it may be appropriate for the agency to set a standard of performance for GHGs" (Greenwire, Sept. 9).

In a recent letter to EPA Administrator Lisa Jackson, three major environmental groups threatened to take legal action if the agency did not agree to set performance standards for power plants. The letter, which was signed by attorneys from the Sierra Club, Natural Resources Defense Council and Environmental Defense Fund, asked the agency to make a decision by Sept. 15.

That deadline came and went without a public announcement from EPA. There is "nothing new to report," said David Doniger, policy director at the NRDC's climate center, in an interview yesterday.

In the absence of climate legislation, the environmental groups feel the performance standards are "the best tool we have," Doniger said.

Though the Obama administration's climate rules have prompted several lawmakers to introduce measures that would strip EPA of its authority to regulate greenhouse gases, Doniger said he was not worried about the potential backlash from the stationary source rules.

"We think that when the dust settles on this, and the NSR regulations go into effect, people will see that there's been a whole lot of crying wolf and Chicken Little," Doniger said. "The requirements are the same as those that have applied to other pollutants for decades -- the factories get built, the economy keeps growing, and the air gets cleaner."

Click here to read the paper.

David D. Doniger

Policy Director, Climate Center

Natural Resources Defense Council

1200 New York Ave., NW

Washington, DC 20005

Phone: (202) 289-2403

Cell: (202) 321-3435

Fax: (202) 789-0859

ddoniger@nrdc.org

on the web at www.nrdc.org

read my blog: http://switchboard.nrdc.org/blogs/ddoniger/

To: "David Farnsworth" [DFarnsworth@raponline.org]; Binz, Ron" [Ron.Binz@dora.state.co.us]; Morgan, Rick (PSC)" [RMorgan@psc.dc.gov]; Fox, Jeanne" [Jeanne.Fox@bpu.state.nj.us]; oseph Goffman/DC/USEPA/US@EPA;[dowens@eei.org]; dowens@eei.org>;[efisher@eei.org]; efisher@eei.org>;"Stipnieks, Elizabeth" [EStipnieks@eei.org]; Stipnieks, Elizabeth" [EStipnieks@eei.org]; Emerson, Jennifer" [jemerson@nrdc.org]
From: "Robert J. Thormeyer"
Sent: Thur 10/14/2010 6:28:08 PM
Subject: FW: NARUC Webinar Announcement-- EPA's Plans to Regulate Carbon Dioxide: Implications for Utility Regulators
power plant pollution and the Clean Air Act - NARUC 10-15-10.pptx
rthormeyer@naruc.org
mkeogh@naruc.org
http://www.raponline.org
http://twitter.com/naruc

FYI, attached is Mr. Doniger's presentation.

Rob

From: Emerson, Jennifer [mailto:jemerson@nrdc.org]
Sent: Thursday, October 14, 2010 2:17 PM
To: Robert J. Thormeyer
Subject: FW: NARUC Webinar Announcement-- EPA's Plans to Regulate Carbon Dioxide: Implications for Utility Regulators
Importance: High

Hi Robert – Attached is David Doniger's presentation. If you would please, forward it to your list.

Thanks

Jen

Jennifer Emerson

NRDC Climate Center

p:202-289-2401

f: 202-789-0859

jemerson@nrdc.org

From: Stipnieks, Elizabeth [mailto:EStipnieks@eei.org]
Sent: Thursday, October 14, 2010 12:35 PM
To: David Farnsworth; Binz, Ron; Morgan, Rick; Fox, Jeanne; Emerson, Jennifer; Goffman.Joseph@epa.gov; Owens, David; Fisher, Emily
Cc: Robert J. Thormeyer; Miles Keogh
Subject: RE: NARUC Webinar Announcement-- EPA's Plans to Regulate Carbon Dioxide: Implications for Utility Regulators

Dear David,

Attached is the EEI presentation for the upcoming NARUC Webinar on EPA's Plans to Regulate Carbon Dioxide. Emily, David and I will join you at the NARUC offices tomorrow at 1:30 p.m. to conduct the session.

Thank you for the opportunity to present and look forward to seeing you tomorrow.

Liz

202-508-5566

From: David Farnsworth [mailto:DFarnsworth@raponline.org]
Sent: Wednesday, October 13, 2010 9:45 AM
To: Stipnieks, Elizabeth; Binz, Ron; Morgan, Rick; Fox, Jeanne; Emerson, Jennifer; Goffman.Joseph@epa.gov; Owens, David; Fisher, Emily
Cc: Robert J. Thormeyer; Miles Keogh
Subject: RE: NARUC Webinar Announcement-- EPA's Plans to Regulate Carbon Dioxide: Implications for Utility Regulators

Hello Ms. Sanford-Fisher and Mr. Doniger,

NARUC's Task Force on Climate Policy is looking forward to your participation in its Webinar this Friday. (Please see announcement below).

NARUC plans to follow the same format that it used in its earlier Webinar this fall; participants are presenting from the NARUC offices at 1101 Vermont Avenue, NW Suite 200 in Washington DC for this event.

Rob Thormeyer at NARUC is your point of contact there. (202)-898-9382 rthormeyer@naruc.org

If you have questions and are unable to get in touch with him, then please contact Miles Keough. (202) 898-2217 mkeogh@naruc.org

If you have any other questions please feel free to call me.

Thank you again for agreeing to participate. We look forward to this.

df

David Farnsworth,

Senior Associate

The Regulatory Assistance Project

50 State Street, Suite 3
Montpelier, Vermont
Tel: 802-498-0708/802-223-8199

Mob: 802-595-5227
Fax: 802-223-8172
Website: http://www.raponline.org

NARUC Webinar Announcement

The EPA Rulemakings Series, Part 2:

The EPA's Plans to Regulate Carbon Dioxide: Implications for Utility Regulators Co-sponsored by the Task Force on Climate Policy, the Energy Resources and the Environment Committee, the Subcommittee on Clean Coal and Carbon Sequestration

Join your NARUC colleagues on Friday, October 15, for the second in a series of Webinars focusing on upcoming rulemakings from the U.S. Environmental Protection Agency. This webinar will focus on EPA's plans to regulate CO2. How will these rules impact State utility regulation? What do State commissioners and staff need to know? How will commissions make regulatory decisions given the development of EPA's program? Hear from experts at the EPA as they detail their proposal, and from a panel of respondents. A question and answer session will follow. The EPA is the administration's lead agency for reducing greenhouse gas emissions. Hear for yourself how this effort will work.

NARUC staff will send out information during the week of October 12 about how members can participate. The webinar is for NARUC members only. It will be recorded and posted on the Association's Website.

Participants:

Joe Goffman, Senior Counsel, Office of Assistant Administrator, Air and Radiation, EPA Additional speakers from EPA may participate

Respondents:

David Owens, Edison Electric Institute

David Doniger, Natural Resources Defense Council

Date: October 15, 2010

Time: 1:30 p.m.- 3:30 p.m. ET

Where: Your Office

*Subsequent webinars will address:

- A case study into how States are preparing for these initiatives
- How States are coordinating coal-fleet retirements and resource planning.

Follow NARUC on Twitter! http://twitter.com/naruc Rob Thormeyer Director of Communications National Association of Regulatory Utility Commissioners

1101 Vermont Ave. NW #200

Washington, DC, 20005

(w) 202-898-9382

(c) 703-336-2332

Power Plant Pollution and the Clean Air Act

David Doniger
Policy Director, NRDC Climate Center

NARUC Webinar
Washington, October 15, 2010

NATURAL RESOURCES DEFENSE COUNCIL
THE EARTH'S BEST DEFENSE

The Clean Air Act and Greenhouse Gases

Massachusetts v. EPA (2007), Supreme Court rules GHGs are "air pollutants" under Clean Air Act; EPA ordered to act if they endanger public health & welfare

EPA finds GHGs endanger public health & welfare

December 17, 2009

Mobile Sources (202)

Contribution to air pollution that endangers

Emission standards for new vehicles, reflecting technology, cost, lead-time

Standards for cars and light trucks issued April 1; more standards in development

Vehicle standards trigger "New Source Review"

Stationary Sources (111)

Significant contribution to air pollution that endangers

Emission standards for new & existing sources, reflecting technology, cost, remaining useful life, energy & other environmental factors

Possible flexibility approaches

Decisions on power plants & other industries pending

National Ambient Air Quality Standards (108-110)

Triggers state-by-state *implementation*

NGO petition pending

New Source Review

New and modified major emitting facilities must have preconstruction permit reflecting best available control technology considering cost, etc., for each pollutant subject to regulation (165, 169)

- When will new source review start?
  - January 2, 2011.
- What is the threshold for major emitting facility?
  - 100,000 tons carbon dioxide equivalent, phasing down to 50,000 tons.
- BACT means technology that is available and affordable.
- No permits required —
  - for continuing operations (even increasing output),
  - for capital changes that don't increase pollution.

Section 111 and GHGs

- Power plants on remand, *New York v. EPA.*
  - Petitioners (including NRDC) have waited three years and are now pressing for action.
- Endangerment determination already made.
- Significant contribution – power plants contribute 40% of U.S. CO_2.
- EPA needs to set:
  - Section 111(b) performance standards for new and modified plants – federal standards.
  - Section 111(d) performance standards for existing plants – state and federal action.

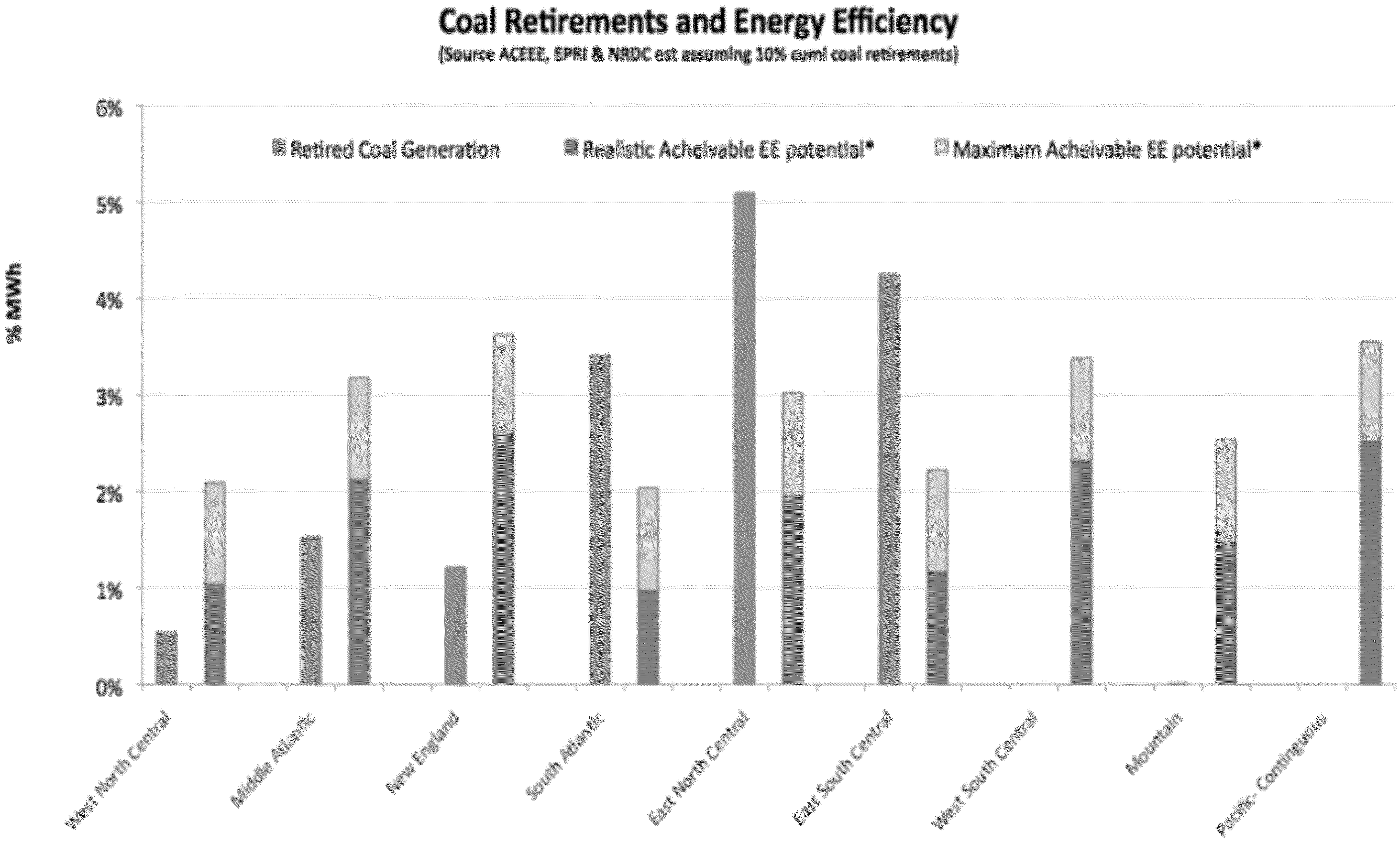
Basis of Performance Standards

- Standards must reflect:
  - "the degree of emission limitation achievable through the application of the best system of emission reduction which (taking into account the cost of achieving such reduction and any nonair quality health and environmental impact and energy requirements) the Administrator determines has been adequately demonstrated"

Basis of Performance Standards

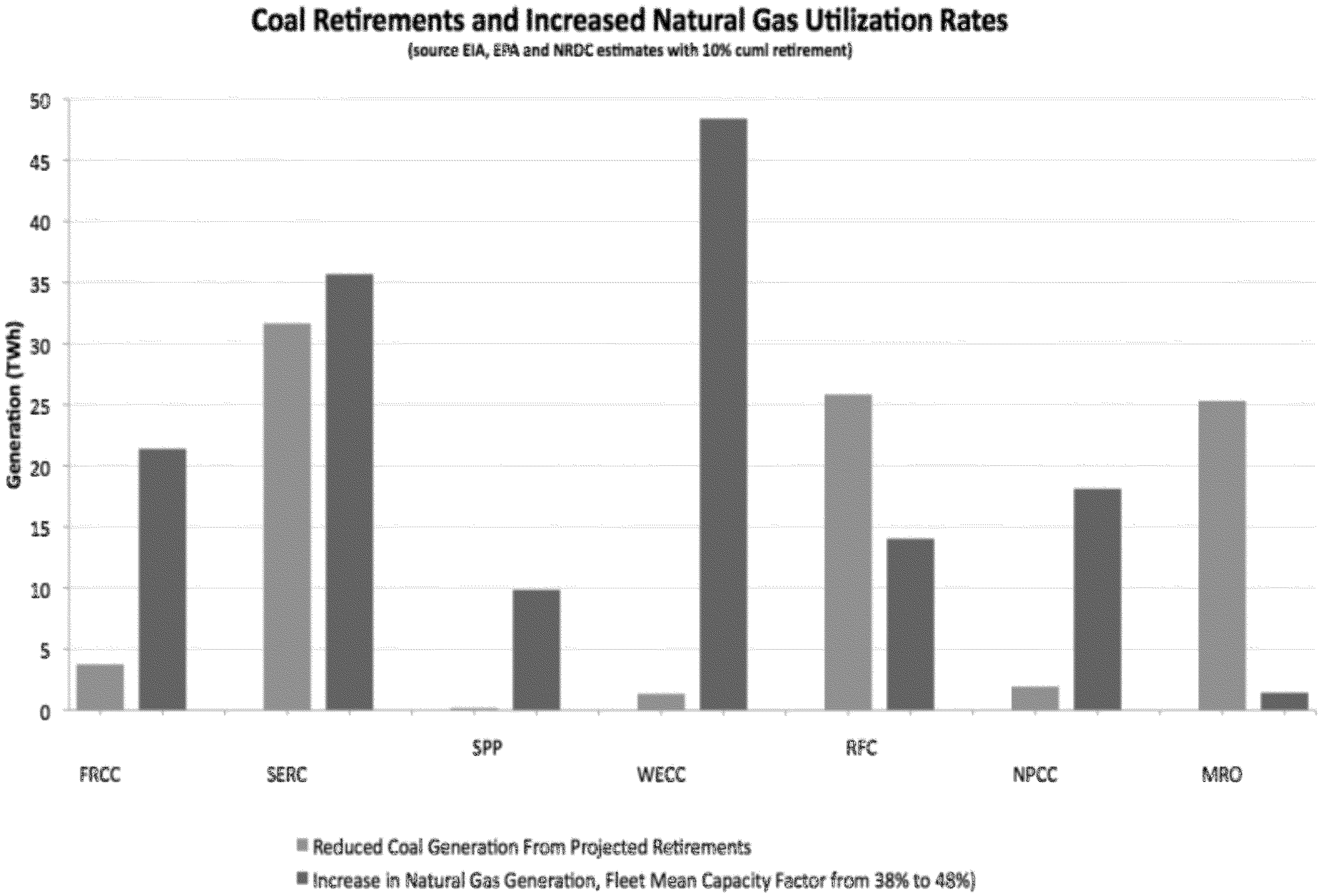
- EPA can consider:
  - For new plants, standards based on performance of gas, achievable by gas or by coal with CCS.
  - For existing plants, different standards for different cohorts of plants, based on remaining useful life.
  - Possible role for emissions averaging or trading

Interim 3 FOIA 2015-003711

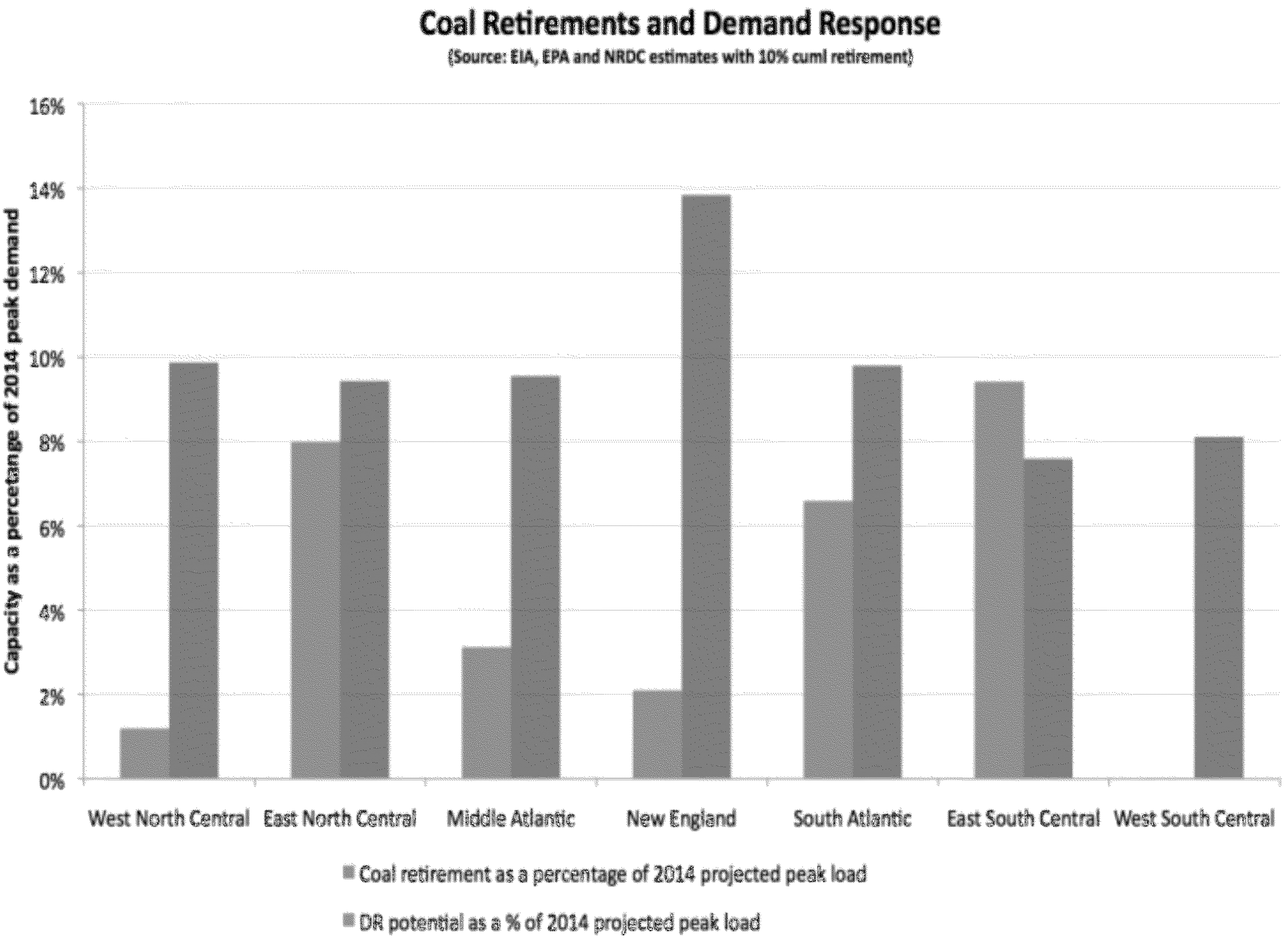


* EPRI's annual average load growth reduction of 0.234% MWh/yr realistic achievable and 0.389% MWh/yr maximum achievable (relative to 1.2% AEO load growth projection) was tempered with ACEEE's state-by-state efficiency data to reflect regional variance within a bounded load growth projection.

Source: switchboard.nrdc.org/blogs/ssuccar/3_reasons_why_we_dont_have_to_1.html

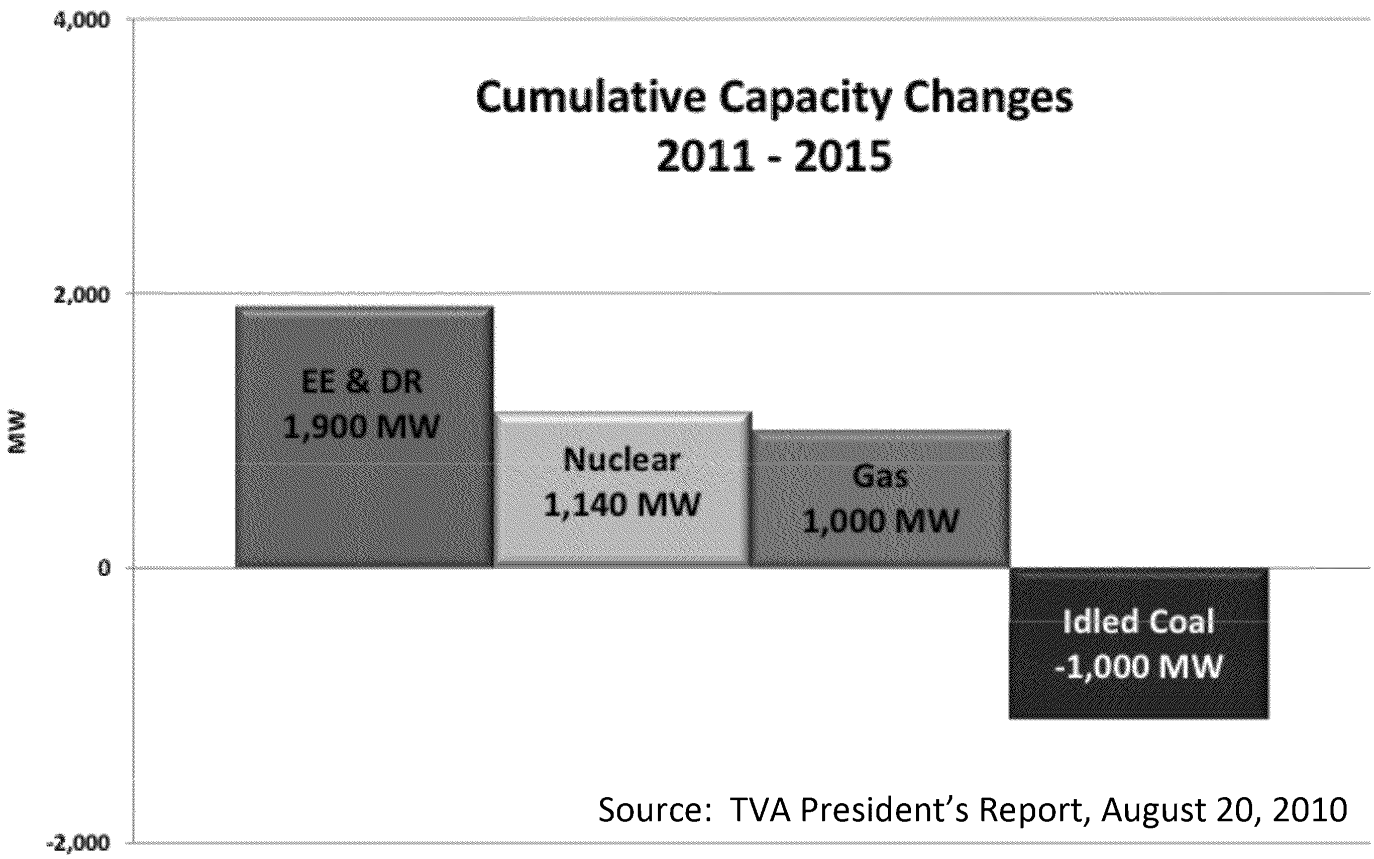


Source: switchboard.nrdc.org/blogs/ssuccar/3_reasons_why_we_dont_have_to_1.html

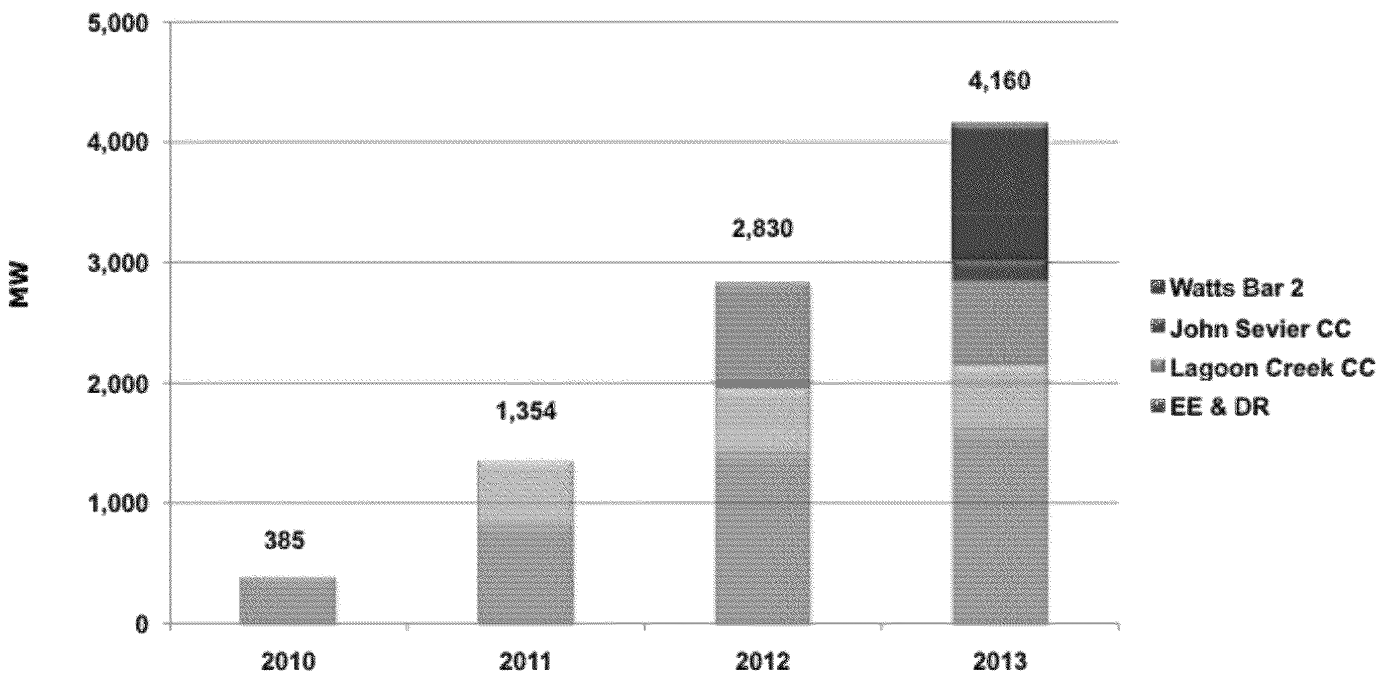


Source: switchboard.nrdc.org/blogs/ssuccar/3_reasons_why_we_dont_have_to_1.html

Capacity Additions



Capacity Additions (Cumulative)



Source: TVA President's Report, August 20, 2010

For more information:

- Samir Succar, 3 Reasons Why We Don't Have to Choose Between our Health and a Reliable Power Grid: Facilitating a Transition Away From Dirty Coal, http://switchboard.nrdc.org/blogs/ssuccar/3_reasons_why_we_dont_have_to_1.html
- John Walke, EPA Proposes Rule to Cut Smog and Soot Pollution From Power Plants in the Eastern & Midwestern U.S., switchboard.nrdc.org/blogs/jwalke/epa_proposes_rule_to_cut_smog.html
- David Doniger, Making Climate Progress with the Tools We Already Have, http://switchboard.nrdc.org/blogs/ddoniger/making_climate_progress_with_t.html
- NRDC policy analysis on global warming, www.nrdc.org/globalwarming/

NRDC NATURAL RESOURCES DEFENSE COUNCIL
THE EARTH'S BEST DEFENSE

To: Joseph Goffman/DC/USEPA/US@EPA;Lorie Schmidt/DC/USEPA/US@EPA;Howard Hoffman/DC/USEPA/US@EPA;Joel Beauvais/DC/USEPA/US@EPA;Kevin Culligan/DC/USEPA/US@EPA[]; orie Schmidt/DC/USEPA/US@EPA;Howard Hoffman/DC/USEPA/US@EPA;Joel Beauvais/DC/USEPA/US@EPA;Kevin Culligan/DC/USEPA/US@EPA[]; oward Hoffman/DC/USEPA/US@EPA;Joel Beauvais/DC/USEPA/US@EPA;Kevin Culligan/DC/USEPA/US@EPA[]; oel Beauvais/DC/USEPA/US@EPA;Kevin Culligan/DC/USEPA/US@EPA[]; evin Culligan/DC/USEPA/US@EPA[]
Cc: Vickie Patton [vpatton@edf.org]; egan Ceronsky [mceronsky@edf.org]
From: Mark MacLeod
Sent: Fri 4/22/2011 6:51:26 PM
Subject: WRI facilitated 111(d) Principles
WRI Dialogue Comments Final 4 18 2011.pdf

All,

Thanks again for your valuable time today. Here is the WRI facilitated document we discussed. The membership is listed in #2. We will follow up with some of the other references cited in today's call.

Have a great weekend.

Mark

DIALOGUE ON PERFORMANCE STANDARDS FOR EXISTING POWER PLANTS

PARTICIPANT COMMENTS TO EPA

April 18, 2011

1. Introduction

EPA has announced that it will proceed with the design and proposal of performance standards for the electric power sector this year, with promulgation anticipated in May 2012. In response to that announcement, a number of leadership states, clean energy companies, environmental advocates and advisory non-profit organizations began a dialogue on how best to design and implement greenhouse gas standards of performance for existing electric generating units. While many of the participants have long supported Congressional action on climate change, the participants are committed to engaging with EPA to ensure the development of reasonable greenhouse gas regulations. Participants in the dialogue have sought to identify areas of agreement, including principles for the design of performance standards and flexibility to allow for cost-effective compliance. The comments highlight a number of issues on which participants have not settled on a single approach but on which participants suggest EPA take comment on a range of options during the rulemaking process. This document contains the participants' input to EPA on the implementation of section 111(d) of the Clean Air Act.

2. Dialogue Participants

The World Resources Institute convened the Dialogue with the following participants:

2.1. State Participants: California Air Resources Board, Minnesota Pollution Control Agency, and the New York Department of Environmental Conservation.

2.2. Companies: Calpine Corporation, Consolidated Edison, Inc., Constellation Energy, Entergy Corporation, Exelon Corporation, National Grid, NextEra Energy, New York Power Authority, PG&E Corporation, Public Service Enterprise Group, Inc., Seattle City Light and Sempra Energy.

2.3. National environmental organizations: Environmental Defense Fund (EDF) and Natural Resources Defense Council (NRDC).

2.4. Advisory organizations and think tanks: Center for Clean Air Policy (CCAP), Georgetown Climate Center, and M.J. Bradley & Associates.

3. Principles for Development of Standards of Performance

3.1. Standards of performance under section 111 of the Clean Air Act have the potential to drive reductions of greenhouse gas emissions from the electric sector while maintaining system reliability.

3.2. In establishing standards of performance under section 111, EPA should use a forward-looking assessment with the goal of providing long-term investment signals and define a pathway to assure meaningful, cost-effective limits on greenhouse gas emissions from the electric sector over time.

3.3. In devising the federal guidelines states must follow in their plans to cover existing power plants under section 111(d), EPA should provide states substantial flexibility, as is contemplated by the Clean Air Act, in how any required reductions are achieved.

3.4. To maximize the cost effectiveness of the greenhouse gas regulations, states should be able to utilize market-based programs that reduce these emissions from electricity generating units by at least as much as would otherwise be achieved by application of EPA's guidelines.

3.5. EPA rules and guidelines to states and state programs should be as cost-effective and legally durable as possible within the requirements of the Clean Air Act.

3.6. EPA rules and guidelines should support, and not create barriers to, harmonization across state boundaries while permitting individual states to exceed federal requirements.

3.7. EPA rules and guidelines should promote regulatory certainty.

3.8. The standards should avoid creating unintended incentives to continue the operation of inefficient and higher emitting electric generating units beyond when they might otherwise repower or retire.

3.9. EPA guidelines should be designed to encourage energy efficiency and the transition to cleaner energy sources.

3.10. EPA guidelines should not penalize early greenhouse gas emissions reduction actions undertaken by states and affected sources.

4. Defining the Affected Source Category

The category of affected sources should cover all fossil-fuel-fired electric generating units that exceed a specific threshold. EPA should seek comment on at least the following alternatives:

4.1. A nameplate capacity threshold (in megawatts of thermal equivalent output), such as 25 MW. The Regional Greenhouse Gas Initiative (RGGI) uses a 25 MW nameplate capacity threshold, which has the advantage of being a threshold that is not dependent on how much the affected units operate.

4.2. An annual emissions threshold in tons, such as 25,000 tons per year. California's emissions trading program has a 25,000-ton annual threshold, which has the advantage of only covering sources that actually operate to emit significant amounts of greenhouse gases.

4.3. A state should have flexibility to apply its requirements to a wider scope of existing electric generating units.

5. Considerations for Form and Stringency

EPA should establish the minimum stringency states must meet but allow states the flexibility to achieve greater reductions.

5.1. If EPA sets a rate-based standard, that standard should be based on electricity output.

5.2. EPA should consider whether to set a single standard for the entire category, for subcategories, or for individual units. In proposing the level of the standard, EPA should consider the availability of averaging and/or crediting programs that may enable greater reductions including the reasonable assumption that states will adopt plans containing one or more flexibility mechanisms to lower costs.

5.3. EPA should assess what emission reductions are achievable based on a number of factors, including but not limited to: technology type, fuel, plant in-service date, historic emission rates, utilization or annual capacity factor, the impact of new and forthcoming non-GHG environmental regulations and their effect on utilization, and availability of GHG pollution control technologies.

5.4. EPA should take comment on a phased approach under which standards predictably become more stringent over time.

5.4.1. Such a phased approach could be based on expected technology availability, including improving efficiency, increased use of lower emitting fuels, and post-combustion measures (e.g., carbon capture and sequestration). Additionally, as stated in section 111(d), EPA could consider other factors, including "remaining useful life" of affected sources.

5.4.2. EPA should also consider whether to include different approaches for initial standards, intermediate standards, and longer-term standards. For example, EPA could set initial standards based on units or subcategories and transition to a single standard or fewer sub-categories, in anticipation of availability of additional pollution control options and increased participation by states using flexibility mechanisms that may be harmonized across state boundaries.

6. State Plans under Section 111(d)

6.1. EPA should propose a clear methodology by which states may demonstrate that their programs achieve emission reductions equal to or greater than any reductions required by the EPA guideline. The methodology should be flexible enough to accommodate state plans that differ in manner of regulation from those described by EPA in its emissions guidelines or those EPA might impose under section 111(d)(2) of the Act. EPA should take comment on whether to provide the states with one or more templates that states may implement.

6.2. Any state program that expressly limits emissions should be allowed to serve as the basis for a state's 111(d) plan if it can demonstrate reductions equal or greater than any emission reductions required by the EPA guideline. EPA should take comment on whether and under what circumstances other programs (such as renewable energy standards) may serve as the basis for all or part of a state's 111(d) plan.

6.3. EPA should take comment on various flexibility mechanisms that states could utilize in their section 111(d) plans, including but not limited to: (a) averaging (e.g., facility, fleet, or across a sector); (b) credits generated by, among other things, emissions performance that is better than the required emissions rate and better than the unit's historical performance, non-emitting electric output or end-use efficiency, plant retirements before the end of a plant's "remaining useful life," and reductions from other sectors covered by section 111(d) plans; (c) banking and use of multiyear compliance periods; (d) use of emission allowances; (e) auctions; and (f) new entrant measures.

6.4. EPA should explain the bases on which a state can demonstrate that its plan will achieve equivalent or greater emission reductions. EPA should:

6.4.1. Explain how to translate a rate-based standard into a mass-based standard and *vice versa.* For example, if the standards designated by EPA are rate-based standards, EPA should identify a methodology for determining equivalent mass-based standards, using modeling and other tools.

6.4.2. Consider increasing the stringency required for plans that include flexibility elements beyond those used by EPA in setting the minimum standards in the guidelines. Increased stringency could offset potential uncertainties in emissions reductions within a given compliance period or reflect the additional emission reductions achievable under a program with flexibility. EPA took a similar approach in the Large Municipal Waste Combustor guidelines.[1]

6.4.3. Explain how a state implementing a multi-sector program or participating in a multistate program can establish equivalency. EPA should explain under what circumstances states may rely on a multi-sector/multistate equivalency analysis, or may submit multi-sector/multistate plans.

6.4.4. EPA should take comment on whether to set state emission budgets for use in determining equivalence with the standard, using modeling analyses (such as the Integrated Planning Model (IPM), for example) that incorporate a phased reduction pathway and consider recently proposed and upcoming rulemakings.

6.4.5. A state should be required to demonstrate that its plan will achieve emission reductions equal to or greater than would be achieved by the application of EPA's standards. Some participants believe that if a state's program includes sources from uncovered sectors or uncovered jurisdictions, the state should be required to demonstrate that its plan will achieve the required emission reductions from the affected categories of sources. Other participants believe EPA should consider whether reductions from outside the affected categories of sources should be taken into account in the equivalency determination.

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[1] *See* 40 C.F.R. 60.33b, subpart Cb tables 1 and 2 (compare emissions standards in table 1 with more stringent standards in table 2 for facilities using an averaging approach); 60 Fed. Reg. 65387, 65402.

6.5. EPA should propose a process for determining state equivalency:

6.5.1. EPA should evaluate under what circumstances states take into account the projected impact of flexibility measures such as banking. EPA should take comment on whether states should conservatively value such impacts relative to any accompanying uncertainties.

6.5.2. A state should subsequently be required to periodically demonstrate (e.g., every three to five years) that its plan is achieving actual emission reductions equal to or greater than EPA standards, similar to the State Implementation Plan process. EPA should also propose a process for remedying any shortfall. *See, e.g.,* the assurance mechanism in the Clean Air Transport Rule, 75 Fed. Reg. 45210, 45133.

6.5.3. In developing a state equivalency methodology, EPA should consider factors that would change a state's equivalency requirements over time. EPA should consider a process for periodically adjusting each state's emissions reduction obligation based on technological improvements, changes in fuel mix and changes made in the fleet of covered sources in each state. EPA should also take comment on whether to provide states with guidance on the interpretation and implementation of "remaining useful life" provision.

6.6. EPA should consider the availability of emissions averaging and other flexible approaches when deciding, in its guidelines, whether to allow states to apply less stringent standards to particular facilities under 40 CFR 60.24(f), which allows for potential unit exemptions.

To: Joseph Goffman/DC/USEPA/US@EPA;Lorie Schmidt/DC/USEPA/US@EPA;Howard Hoffman/DC/USEPA/US@EPA;Joel Beauvais/DC/USEPA/US@EPA;Kevin Culligan/DC/USEPA/US@EPA[]; orie Schmidt/DC/USEPA/US@EPA;Howard Hoffman/DC/USEPA/US@EPA;Joel Beauvais/DC/USEPA/US@EPA;Kevin Culligan/DC/USEPA/US@EPA[]; oward Hoffman/DC/USEPA/US@EPA;Joel Beauvais/DC/USEPA/US@EPA;Kevin Culligan/DC/USEPA/US@EPA[]; oel Beauvais/DC/USEPA/US@EPA;Kevin Culligan/DC/USEPA/US@EPA[]; evin Culligan/DC/USEPA/US@EPA[]
Cc: Megan Ceronsky [mceronsky@edf.org]; ark MacLeod [mmacleod@edf.org]
From: Vickie Patton
Sent: Mon 4/25/2011 4:51:22 AM
Subject: CRS Report, NSPS Case Study, Adequately Demonstrated
CRS - Potential Regulation of Stationary Greenhouse Gas Sources Under the CAA - May 14 - 2009 (parker, mccarthy).pdf
Margaret Taylor - Government Actions, Technology Innovation, SO2 Controls - Carnegie Mellon Dissertation - Jan 2001.pdf
Portland Cement Assn v. EPA 486 F.2d 375 (DC Cir 1973).pdf
Portland Cement Assn v. Train 513 F2d 506 (DC Cir 75) (aff'd on remand).pdf

Here are some additional materials for your consideration.

The CRS report on the regulation of stationary source greenhouse gases that includes an examination of NSPS issues.

The CRS report draws from the attached Carnegie Mellon PhD dissertation by Margaret Taylor (The Influence of Government Actions on Innovative Activities in the Development of Environmental Technologies to Control Sulfur Dioxide Emissions from Stationary Sources). Taylor examines in detail the convergence of policy and technological innovation associated with Agency's 1971 SO2 NSPS, 1978 SO2 NSPS and 1990 CAAA Title IV program for SO2 including the policy genesis of the SO2 controls, the nascent stages of FGD technology, and the acceleration of technological progress resulting from EPA's policies. One note is her explanation that the German acid rain protection requirements adopted in 1983 resulted in the installation of 35,000 MW of FGD in four years -- 33 percent of which were licensed from US companies (see ps. 56 & 223, n. 108).

We have also attached Judge Leventhal's 1973 opinion in Portland Cement re the contours of "adequately demonstrated" under the NSPS (as well as the DC Circuit decision affirming the standards on remand).

Thank you again for your precious time.

Sincerely yours,
Vickie

From: Mark MacLeod
Sent: Friday, April 22, 2011 12:51 PM
To: Joseph Goffman/DC/USEPA/US; Lorie Schmidt/DC/USEPA/US; Howard Hoffman/DC/USEPA/US; beauvais.joel@epa.gov; culligan.kevin@epa.gov
Cc: Vickie Patton; Megan Ceronsky

Subject: WRI facilitated 111(d) Principles

All,

Thanks again for your valuable time today. Here is the WRI facilitated document we discussed. The membership is listed in #2. We will follow up with some of the other references cited in today's call.

Have a great weekend.

Mark

<< File: WRI DIalogue Comments Final 4 18 2011.pdf >>

Congressional Research Service

Climate Change: Potential Regulation of Stationary Greenhouse Gas Sources Under the Clean Air Act

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Specialist in Energy and Environmental Policy

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Specialist in Environmental Policy

May 14, 2009

Congressional Research Service
7-5700
www.crs.gov
R40585

CRS Report for Congress
Prepared for Members and Committees of Congress

Summary

In the 111th Congress, both the House and Senate committees of jurisdiction are expected to give climate change legislation high priority. The House Energy and Commerce Committee has already held hearings on draft legislation, and expects to hold markup before Memorial Day. The schedule for Senate action is less certain, but presumably it will follow House consideration. With the inauguration of President Obama, there is a proponent of greenhouse gas (GHG) legislation in the White House, as well, markedly improving the prospects for enacting some sort of legislation to reduce GHG emissions.

Although new legislation to address greenhouse gases is a leading priority of the President and many members of Congress, the ability to limit these emissions already exists under various Clean Air Act authorities that Congress has enacted, a point underlined by the Supreme Court in an April 2007 decision, *Massachusetts v. EPA.* Indeed, the EPA has already began the process that could lead to greenhouse gas regulations for motor vehicles in response to that court decision.

Thus, controlling GHGs could follow a two-track approach, with Congress and the Administration pursuing new legal authority (for cap-and-trade, carbon tax, or other mechanisms) at the same time that the Administration, through the Environmental Protection Agency (EPA), exercises existing authority under the Clean Air Act to begin regulation of greenhouse gas emissions.

The key to using the Clean Air Act's authority is for the EPA Administrator to find that GHG emissions are air pollutants that endanger public health or welfare. The Administrator proposed such an endangerment finding April 17, 2009, beginning a public comment period that is expected to run through June. It should be noted, despite EPA's apparent commitment to move forward with an endangerment finding, that EPA Administrator Jackson and others in the Administration have made clear their preference that Congress address the climate issue through new legislation.

If an endangerment finding is finalized, the agency could proceed to set GHG emission standards for motor vehicles. (A separate report, CRS Report R40506, *Cars and Climate: What Can EPA Do to Control Greenhouse Gases from Mobile Sources?*, discusses the endangerment finding and possible controls on mobile source GHGs.) The finding might also lead the agency and state permitting authorities to establish controls for stationary sources, including electric power plants and other industrial sources that account for the largest share of GHG emissions.

This report discusses EPA's authority to control GHG emissions from stationary sources under the Act, and the various options that EPA could exercise. Of these, perhaps the strongest basis for establishing a traditional regulatory approach would be Section 111 of the CAA, which provides authority to set New Source Performance Standards and, under Section 111(d), requires the states to control emissions from existing sources of the same pollutants. Other sections of the Act, not previously used, might provide authority to establish a cap-and-trade system for GHG emissions.

The report is not a legal analysis. Our intention is to describe legal issues and arguments that have been raised and to discuss potential EPA approaches to their resolution, without drawing legal conclusions.

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Introduction

In the 111th Congress, both the House and Senate committees of jurisdiction are expected to give climate change legislation high priority. The House Energy and Commerce Committee has already held hearings on draft legislation, and expects to hold markup before Memorial Day. The schedule for Senate action is less certain, but presumably it will follow House consideration. With the inauguration of President Obama, there is a proponent of greenhouse gas (GHG) legislation in the White House, as well, markedly increasing the probability for enacting some sort of legislation to reduce GHG emissions. The President has said that a new energy, environment, and climate policy will be "a leading priority of my presidency, and a defining test of our time."

Although new legislation to address greenhouse gases is a leading priority of the President and many members of Congress, the ability to limit these emissions already exists under various Clean Air Act (CAA) authorities that Congress has enacted, a point underlined by the Supreme Court in an April 2007 decision (discussed below). Indeed, the U.S. Environmental Protection Agency (EPA) has already begun the process that could lead to greenhouse gas regulations for mobile sources in response to court decisions.

If EPA moves to regulate greenhouse gases from mobile sources, legal and policy drivers would be activated that could lead to regulation of stationary sources as well. The legal drivers are beyond the scope of this report, which is focused on the policy options and control alternatives available to EPA if it were to use existing authorities to regulate greenhouse gases from stationary sources.

Indeed, stationary sources are the major sources of the country's greenhouse gas emissions. Overall, 72% of U.S. emissions of greenhouse gas come from stationary sources (the remainder come from mobile sources). As indicated in Table 1, relatively large sources of fossil-fuel combustion and other sources are responsible for about one-half the country's total emissions. If EPA were to embark on a serious effort to reduce greenhouse gas emissions, stationary sources, and in particular large stationary sources, would have to be included. This concentration of greenhouse gas emissions is even more important from a policy standpoint: reductions in greenhouse gas emissions from these sectors are likely to be more timely and cost-effective than attempts to reduce emissions from the transport sector.

This report discusses three major paths and two alternate paths of statutory authorities that have been identified by EPA and others as possible avenues the agency might take in addressing greenhouse gas emissions under existing CAA provisions. After discussing the approaches, we identify categories of control options EPA could consider, including an EPA-coordinated cap-and-trade program. Then we discuss the administrative difficulties in using the Clean Air Act for greenhouse gas control, particularly New Source Review and Title V permitting requirements. Finally, we conclude by putting the issue into the context of previous environmental challenges the CAA has faced.

Table 1. Selected U.S. Stationary Sources of Greenhouse Gases

Source	2007 Emissions	% of Total GHGs
Electricity Generation (CO_2, CH_4, N_2O)		
Coal-fired	1977.7	27.8%
Natural gas-fired	374.1	5.3%
Fuel Oil-fired	55.4	0.8%
Industrial fossil-fuel combustion (CO_2, CH_4, N_2O) Mostly Petroleum refineries, chemicals, primary metals, paper, food, and nonmetallic mineral products		
Coal-fired	108.1	1.5%
Natural gas-fired	385.6	5.4%
Fuel Oil-fired	353.3	5.0%
Industrial Processes		
Iron and Steel Production (CO_2, CH_4)	74.3	1.0%
Cement Production (CO_2)	44.5	0.6%
Nitric Acid Production (N_2O)	21.7	0.3%
Substitution of Ozone Depleting Substances (HFCs)	108.3	1.5%
Other		
Natural Gas Systems (CO_2, CH_4)	133.4	1.9%
Waste Incineration (CO_2, N_2O)	21.2	0.3%
TOTAL	3657.6	51.3%

Source: EPA inventory, April 2009.

The Entry Point: *Massachusetts vs. EPA*

A regulatory approach using existing Clean Air Act authorities has been under consideration at EPA for more than a decade. In 1998, EPA'sGeneral Counsel, Jonathan Cannon, concluded in a memorandum to the EPA Administrator that greenhouse gases were air pollutants within the Clean Air Act's definition of the term, and therefore could be regulated under the Act.[1] Relying on the Cannon memorandum as well as the statute itself, on October 20, 1999, a group of 19

[1] Memorandum from Jonathan Z. Cannon, EPA General Counsel, to Carol M. Browner, EPA Administrator, EPA's Authority to Regulate Pollutants Emitted by Electric Power Generation Sources (April 10, 1998).

organizations petitioned EPA to regulate greenhouse gas emissions from new motor vehicles under Section 202 of the Act.[2] Section 202 gives the EPA Administrator broad authority to set "standards applicable to the emission of any air pollutant from any class or classes of new motor vehicles" if in her judgment they contribute to air pollution which "may reasonably be anticipated to endanger public health or welfare."

EPA denied the petition in 2003[3] on the basis of a new General Counsel memorandum issued the same day in which the General Counsel concluded that the CAA does not grant EPA authority to regulate CO_2 and other GHG emissions based on their climate change impacts.[4] The denial was challenged by Massachusetts, eleven other states, and various other petitioners in a case that ultimately reached the Supreme Court. In an April 2, 2007 decision (*Massachusetts v. EPA*), the Court found by 5-4 that EPA *does* have authority to regulate greenhouse gas emissions, since the emissions are clearly "air pollutants" under the Clean Air Act's definition of that term.[5] The Court's majority concluded that EPA must, therefore, decide whether emissions of these pollutants from new motor vehicles contribute to air pollution that may reasonably be anticipated to endanger public health or welfare. If it makes this finding of endangerment, the Act requires the agency to establish standards for emissions of the pollutants.[6]

The Advance Notice of Proposed Rulemaking (ANPR)

For nearly two years following the Court's decision, the Bush Administration's EPA did not respond to the original petition nor make a finding regarding endangerment. Its only formal action following the Court decision was to issue a detailed information request, called an Advance Notice of Proposed Rulemaking (ANPR), on July 30, 2008.[7]

The ANPR occupied 167 pages of the *Federal Register*. Besides requesting information, it took the unusual approach of presenting statements from the Office of Management and Budget, four Cabinet Departments (Agriculture, Commerce, Transportation, and Energy), the Chairman of the Council on Environmental Quality, the Director of the President's Office of Science and Technology Policy, the Chairman of the Council of Economic Advisers, and the Chief Counsel for Advocacy at the Small Business Administration, each of whom expressed their objections to

[2] The lead petitioner was the International Center for Technology Assessment (ICTA). The petition may be found on their website at http://www.icta.org/doc/ghgpet2.pdf.

[3] The agency argued that it lacked statutory authority to regulate greenhouse gases: Congress "was well aware of the global climate change issue" when it last comprehensively amended the Clean Air Act in 1990, according to the agency, but "it declined to adopt a proposed amendment establishing binding emissions limitations." Massachusetts v. EPA, 549 U.S. 497 (2007).

[4] Memorandum from Robert E. Fabricant, EPA General Counsel, to Marianne L. Horinko, EPA Acting Administrator, EPA's Authority to Impose Mandatory Controls to Address Global Climate Change Under the Clean Air Act (August 28, 2003).

[5] Massachusetts v. EPA, 549 U.S. 497 (2007). The majority held: "The Clean Air Act's sweeping definition of 'air pollutant' includes '*any* air pollution agent or combination of such agents, including *any* physical, chemical ... substance or matter which is emitted into or otherwise enters the ambient air.... ' ... Carbon dioxide, methane, nitrous oxide, and hydrofluorocarbons are without a doubt 'physical [and] chemical ... substances[s] which [are] emitted into ... the ambient air.' The statute is unambiguous."

[6] For further discussion of the Court's decision, see CRS Report RS22665, *The Supreme Court's Climate Change Decision: Massachusetts v. EPA*, by Robert Meltz.

[7] U.S. EPA, "Regulating Greenhouse Gas Emissions Under the Clean Air Act," 73 *Federal Register* 44354, July 30, 2008.

regulating greenhouse gas emissions under the Clean Air Act. The OMB statement began by noting that, "The issues raised during interagency review are so significant that we have been unable to reach interagency consensus in a timely way, and as a result, this staff draft cannot be considered Administration policy or representative of the views of the Administration."[8] It went on to state that "... the Clean Air Act is a deeply flawed and unsuitable vehicle for reducing greenhouse gas emissions."[9] The other letters concurred. The ANPR, therefore, was of limited use in reaching a conclusion on the endangerment issue and, in any event, it presents the views of an Administration no longer in office.

The current Administration made review of the endangerment issue a high priority. On April 17, 2009, EPA proposed a finding that GHGs do endanger both public health and welfare and that GHGs from new motor vehicles contribute to that endangerment.[10] Publication of the proposal in the *Federal Register* on April 24 began a 60-day public comment period. In addition, public hearings will be held May 18 in Arlington, VA, and May 21 in Seattle, WA.

Potential Implications for Stationary Sources

While there has been considerable speculation in the literature about the meaning of *Massachusetts v. EPA* for stationary sources, there have also been several attempts to invoke the various authorities of the Clean Air Act to begin controlling greenhouse gas emissions from stationary sources.[11] Among the legal initiatives currently underway are the following:

- In 2006, the EPA revised the New Source Performance Standard (NSPS) for electric utilities and other steam generating units without including any CO_2 standard, or other requirement. Led by New York, several states filed a petition for review of the new NSPS, challenging the omission of any CO_2 requirement. In September 2007 the D.C. Circuit Court of Appeals remanded the case back to EPA for further proceedings "in light of *Massachusetts v. EPA*."[12]
- In 2007, EPA Region 8 granted a Prevention of Significant Deterioration (PSD) permit authorizing construction of a waste-coal-fired electric generating plant near Bonanza, Utah. Appealing the decision, the Sierra Club argued to the Agency's Environmental Appeals Board (EAB) that because the Court had found in *Massachusetts v. EPA* that CO_2 was an air pollutant under the Act, and that EPA has imposed CO_2 monitoring and reporting requirements, the Bonanza plant was required to install Best Available Control Technology (BACT) for CO_2 emissions. The EAB rejected the Sierra Club's interpretation of the PSD-NSR language, but remanded it back to Region 8 for reconsideration of a CO_2 BACT requirement.[13] In another PSD-NSR (New Source Review) case, EPA Region 9

[8] "Regulating Greenhouse Gas Emissions Under the Clean Air Act," 73 *Federal Register* 44356, July 30, 2008.

[9] Ibid.

[10] Environmental Protection Agency, "Proposed Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act," PrePublication Copy, April 17, 2009, at http://epa.gov/climatechange/endangerment/downloads/GHGEndangermentProposal.pdf.

[11] For a legal discussion of these initiatives, see CRS Report RL32764, *Climate Change Litigation: A Survey*, by Robert Meltz.

[12] New York v. EPA,, No 06-1322 (D.C. Cir., September 24, 2007)

[13] The Board rejected the Region's argument that it was limited by an historical agency interpretation to read "subject to regulation" as meaning "subject to a statutory or regulatory provision that requires actual control of emissions of that (continued...)

filed a motion with the EAB in April 2009 for a voluntary remand of the PSD permit for the Desert Rock coal-fired power plant in New Mexico to allow for a reconsideration of its permit to include a CO_2 limitation. Region 9 wants to reconsider its decision not to require Desert Rock to install "carbon-ready" integrated gasification combined-cycle technology instead of allowing current pulverized-coal technology.[14]

- In 2009, the Environmental Integrity Project, an environmental group, filed a complaint with the D.C. Circuit Court to force the EPA to review nitrous oxide (N_2O) emissions from nitric acid plants.[15] The group argues that EPA has not reviewed the NSPS for such plants since 1984, despite the statutory requirements for periodic reviews.

It should be noted that amidst this legal activity and EPA'sapparent commitment to move forward with an endangerment finding, EPA Administrator Jackson and others in the Administration have made clear that their preference would be for Congress to address the climate issue through new legislation. In the press release announcing the proposed endangerment finding, the agency stated, "Notwithstanding this required regulatory process, both President Obama and Administrator Jackson have repeatedly indicated their preference for comprehensive legislation to address this issue and create the framework for a clean energy economy."

Potential Paths for GHG Stationary Source Control

When looking at the CAA from the point of view of reducing GHGs from stationary sources, three existing paths are available. As indicated in Table 2, the three paths are (1) to regulate GHGs as criteria air pollutants, (2) to regulate GHGs as hazardous air pollutants, or (3) to regulate GHGs as designated air pollutants. Each of these paths are discussed below, along with two lesser explored trails: Section 115 and Title VI.

(...continued)

pollutant." Since EPA has yet to issue a CAA regulation requiring actual control of CO_2 emissions, Region 8 argued, BACT for CO_2 is not required. Hence, the Board remanded the permit to the Region for it to reconsider whether to impose a CO_2 BACT limit. Deseret Power Electric Cooperative, PSD Appeal No. 07-03 (E.A.B. November 13, 2008).

[14] For more information on Desert Rock's PSD-NSR permit, see http://www.epa.gov/region09/air/per mit/desert-rock/.

[15] Complaint at 2, *Environmental Integrity Project v. EPA*, No. 1:09-cv-00218 (D.C. Circuit, filled February 4, 2009).

Table 2. Simplified Requirements under Title I for Most Stationary Sources

	Section 109 **(NAAQS)**	Section 112 **(Air Toxics)**	Sections 111(d)/129 **(Designated Pollutants)**
Minimum Controls	**New/Modified Source:** EPA-determined NSPS under Sec. 111	**New Source:** EPA-determined MACT under Sec. 112	**New/Modified Source:** EPA-determined NSPS under Sec. 111
	Existing Source: Depends on area's attainment status/ visibility provisions	**Existing Source:** Less stringent EPA-determined MACT	**Existing Source:** State determination under EPA standards issued under Sec. 111(d)
Implementing Provisions	State Implementation Plans under Sec. 110 New Source Review (NSPS, PSD, nonattainment) Sec. 126 Petitions	Statutory list under Sec. 112(b)(1) EPA determination under Sec.112(b)(2) or (b)(3)	Designated Pollutant Plans under Sec. 111(d)/129 New Source Review (PSD)

Notes: NAAQS stands for National Ambient Air Quality Standard and is discussed below. MACT stands for Maximum Achievable Control Technology and is discussed after the discussion of NAAQS.

Path 1: Regulating GHG through National Ambient Air Quality Standards (NAAQS)

Importance of NAAQS

The backbone of the Clean Air Act is the creation of National Ambient Air Quality Standards (NAAQS). The need to attain NAAQS, which are set at levels designed to protect public health without consideration of costs or economic impact, is the driving force behind much of clean air regulation.

The authority for NAAQS is found in Sections 108 and 109 of the Act. Under Section 108, EPA is to identify air pollutants that, in the Administrator's judgment, endanger public health or welfare, and whose presence in ambient air results from numerous or diverse sources. Under Section 109, EPA is required to set NAAQS for the identified pollutants.

Section 109 requires the EPA Administrator to set both primary and secondary NAAQS. Primary NAAQS must be set at a level that will protect public health with an adequate margin of safety. Secondary NAAQS are required to protect public welfare from "any known or anticipated adverse effects associated with the presence of such air pollutant in the ambient air." Public welfare covers damage to crops, vegetation, soils, wildlife, water, property, building materials, etc., and such broader variables as visibility, climate, economic values, and personal comfort and well-being.

Over the years, EPA has identified six air pollutants or categories of air pollutants for NAAQS: sulfur dioxide (SO_2), particulate matter ($PM_{2.5}$ and PM_{10}), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone, and lead. These six are referred to as "criteria" pollutants. Each of the criteria pollutants was identified for NAAQS regulation in the 1970s. Since that time, although the specific standards (the allowed concentrations) have been reviewed and modified, no new criteria pollutants have been identified.

NAAQS and Controlling GHGs

If carbon dioxide (CO_2) or other greenhouse gases were identified as criteria pollutants, NAAQS would then have to be set. CO_2, the most important greenhouse gas, is arguably an air pollutant that endangers public health or welfare,[16] and its presence in ambient air results from numerous or diverse sources. Thus, it meets the basic criteria of Section 108. But setting a NAAQS for CO_2 raises a number of potential issues, four of which are discussed in the following sections.

Setting a Standard

An initial difficulty would arise in choosing a level at which to set a NAAQS. Primary and secondary NAAQS are expressed as concentrations of the pollutant in ambient air that endanger public health or welfare. For the six current criteria pollutants, the focus has been on setting *primary* (health-based) standards—i.e., identifying a concentration in ambient air above which ambient concentrations of the pollutant contribute to illness or death. These standards are based on both concentration-response studies undertaken in laboratory conditions (often animal studies, but some involving humans), and on epidemiology that demonstrates a correlation between greater exposure to the pollutant and higher rates of morbidity and mortality.

For CO_2 at current and projected levels, there are not the same direct linkages between higher concentrations and health as there are for each of the current NAAQS. A person exposed to current ambient levels of CO_2 will not be sickened. Nor is it likely that one could demonstrate a connection between CO_2 and morbidity or mortality through epidemiology, in part because CO_2 concentrations are relatively uniform across the globe and change very slowly. The argument that can be made is more indirect: that higher levels of CO_2 are likely over time to cause higher temperatures, and higher temperatures and associated changes in climate-related processes are likely to have health consequences.

If EPA concluded that this connection between CO_2, higher temperatures, and human health were sufficient to justify establishing a primary NAAQS, it would still be difficult to pick out a specific CO_2 concentration for a standard. Among scientists concerned about greenhouse gas concentrations, some argue for a level of 350 parts per million (ppm) as the concentration that must be attained,[17] others argue for 450 ppm, and some for levels of 550-600 ppm. Current

[16] We say "arguably" because EPA has not yet made this endangerment finding (although it has proposed doing so), and there are climate skeptics who would dispute whether such a finding is justified. On the other hand, the vast majority of the climate science community, as represented by the Intergovernmental Panel on Climate Change, have concluded that "[w]arming of the climate system is unequivocal ... ," and "[m]ost of the observed increase in globally-averaged temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic GHG concentrations." Further, "Most impacts are expected to be adverse (e.g., lower agricultural productivity in many regions, drought, rising sea levels, spread of disease vectors, greater needs for cooling)." See CRS Report RL34266, *Climate Change: Science Highlights*, by Jane A. Leggett. Within EPA, it would appear that the relevant staff concluded that an endangerment finding was justified in 2007, but the agency took no action as the result of the involvement of other agencies and the White House. See Testimony of Jason Burnett, Former Associate Deputy Administrator, EPA, at Senate Environment and Public Works Committee, "Regulation of Greenhouse Gases under the Clean Air Act," Hearing, September 23, 2008.

[17] The argument for 350 ppm is based largely on concern over melting glaciers, polar ice caps, and sea level, not direct (continued...)

concentrations in the Earth's atmosphere are about 385 ppm, increasing by 1 or 2 ppm per year. The mechanics of implementing a standard will be discussed in greater detail below, but it is important to note here that unless one chose a standard at or below the current ambient level, establishing a primary NAAQS would have no consequence. It is only if ambient concentrations of the pollutant exceed the standard that action must be taken.

A further point regarding the setting of a NAAQS is the importance of distinguishing primary from secondary standards. If one were to set a NAAQS for CO_2 or other GHGs, it is perhaps the secondary NAAQS that is most relevant to the discussion. As noted above, secondary NAAQS are designed to prevent damage to crops, vegetation, soils, wildlife, water, property, building materials, etc. and such broader variables as visibility, climate, economic values, personal comfort and well-being.

EPA—under both Democratic and Republican Presidents—has generally given short shrift to the setting of secondary NAAQS: most have been set at a level identical to the primary standard, with little discussion of the agency's reasoning. In part, this is because secondary NAAQS have no deadlines attached to their attainment and there is no enforcement mechanism or penalty for failure to attain them.

Thus, it would hardly be worth the effort to establish a NAAQS for GHGs unless one could establish a defensible case for a specific primary standard that was below ambient levels. Primary NAAQS, unlike their secondary kin, do have deadlines: there are consequences for a failure to attain them in a timely manner.

Identifying Nonattainment Areas

If a CO_2 or GHG NAAQS were set by EPA, the next step would be to identify nonattainment areas (i.e., areas where ambient concentrations of CO_2 and/or other GHGs exceed the NAAQS). The procedure for doing so is specified under Section 107 of the Act. For the six current criteria pollutants, there are distinct local and regional concentrations of each pollutant that can generally be linked to stationary or mobile sources in the area. In some cases, the sources may be relatively distant, with pollutants (or precursors) emitted hundreds of miles away. But with all of the current criteria pollutants, there are significant variations in local and regional concentrations, and only those areas with pollutant readings higher than the NAAQS are designated "nonattainment."

For CO_2, this would not be the case. Concentrations are relatively homogeneous across the entire country—indeed, across the world. Thus, the entire United States would need to be designated nonattainment if concentrations exceeded the standard.

Developing State Implementation Plans

A third element of NAAQS that appears ill-suited to the regulation of GHGs is the mechanism used to bring about compliance with NAAQS, the State Implementation Plan (SIP) provisions in Section 110 and Sections 171-179B. SIPs describe the sources of pollution in a nonattainment area and the methods that will be used by the area to reduce emissions sufficiently to attain the

(...continued)

public health considerations.

standard. They are required to be developed and submitted to EPA for each nonattainment area within three years of its designation.

SIPs build on some national standards (for new motor vehicles and new or modified power plants, for example), but they assume that most sources of the pollution to be controlled are local, and therefore, that the measures needed to reach attainment are measures tailored to local conditions. To the extent that significant emission sources are located in other states, downwind states are authorized under Section 126 to petition EPA for controls on such upwind sources.

If pollution is uniform throughout the country, there is no reason why the measures taken to reduce it should vary from locality to locality. Nor will a nonattainment area be able to demonstrate that its pollution control measures will have any measurable impact on the ambient concentration of most greenhouse gases. Thus, State Implementation Plans tailored to each nonattainment area would be ill-suited to the nature of the problem.

Attaining the Standard

It is also unlikely that any state or nonattainment area on its own could demonstrate reasonable further progress toward attainment of the standard (as is required by Section 172), particularly within the 5- to10-year period specified in Section 172 for attainment of a NAAQS. Greenhouse gases accumulate in the atmosphere, and some can take hundreds of years to diminish, even if current global emissions decline. Global emissions are increasing. Individual states and nonattainment areas would have little chance of reversing this trend through any set of actions they might undertake on their own.

Path 2: Regulating GHGs through Section 112 as Hazardous Air Pollutants

Importance of Section 112

As revised by the 1990 CAA amendments, Section 112 contains four major provisions: Maximum Achievable Control Technology (MACT) requirements for major sources; health-based standards to be imposed for the residual risks remaining after imposition of MACT standards; standards for stationary "area sources" (small, but numerous sources, such as gas stations or dry cleaners, that collectively emit significant quantities of hazardous pollutants); and requirements for the prevention of catastrophic releases. The MACT and area source provisions would appear to be the most relevant, if GHGs were to be controlled under this section.

The MACT provisions require EPA to set standards for sources of the listed pollutants that achieve "the maximum degree of reduction in emissions" taking into account cost and other non-air-quality factors. MACT standards for new sources "shall not be less stringent than the most stringent emissions level that is achieved in practice by the best controlled similar source." The standards for existing sources may be less stringent than those for new sources, but generally must be no less stringent than the average emission limitations achieved by the best performing 12% of existing sources. Existing sources are given three years following promulgation of standards to achieve compliance, with a possible one-year extension; additional extensions may be available for special circumstances or for certain categories of sources.

In addition to the technology-based standards for major sources of hazardous air pollution, Section 112 requires EPA to establish standards for stationary "area sources" (small, but numerous, sources such as gas stations or dry cleaners, that collectively emit significant quantities of hazardous air pollutants). In setting these standards, EPA can impose less stringent "generally available" control technologies, rather than MACT.

Section 112 and Controlling GHGs

Could EPA regulate GHG emissions as hazardous air pollutants under Section 112? In its comments on the ANPR, the Bush Administration's Department of Energy stated that "... it is widely acknowledged that a positive endangerment finding could lead to ... the listing of one or more greenhouse gases as hazardous air pollutants (HAP) under section 112."[18] EPA, on the other hand, was more circumspect in its analysis, stating:

> The effects and findings described in section 112 are different from other sections of the CAA addressing endangerment of public health discussed in previous sections of today's notice. Given the nature of the effects identified in section 112(b)(2), we request comment on whether the health and environmental effects attributable to GHG fall within the scope of this section.[19]

The language of Section 112 refers to pollutants that may present a threat of adverse human health effects or adverse environmental effects. This language might be broad enough that GHGs could be categorized as hazardous air pollutants and subjected to the regulatory tools provided by the section, but because the section was written to apply to carcinogenic and other toxic air pollutants present in emissions in small quantities, there would be questions as to whether Congress intended the use of the section's authority for pollutants such as GHGs. The legislative history of the Act makes clear that it was designed primarily to regulate pollutants commonly referred to as "air toxics." Hazardous air pollutants are defined as "any pollutant listed pursuant to subsection [112](b)." Congress provided an initial list of 189 hazardous air pollutants in that subsection, and it established criteria and procedures for revising the list in Section 112(b)(2). In the 18 years since the criteria were established, EPA has not added any substances to the list.

The procedures for revising the list provide that the Administrator may do so "by rule," adding pollutants that may present, through inhalation or other routes of exposure, a threat of adverse human health effects, or, through a variety of routes of exposure, adverse environmental effects. The human health effects language is qualified with wording that suggests the type of pollutants Congress had in mind when it drafted this section: substances that include, but are not limited to, ones known or reasonably anticipated to be carcinogenic, mutagenic, teratogenic, neurotoxic, acutely or chronically toxic, or which cause reproductive dysfunction.

The section is also not well-suited to the most common GHGs, such as CO_2, that are emitted in very large quantities. For example, it defines a major source as one that emits 10 tons per year or more of any hazardous air pollutant. Annual CO_2 emissions in the United States are about 6 billion metric tons, and hundreds of thousands, perhaps millions of sources (including large residential structures) might qualify as major sources if CO_2 were listed as a hazardous air pollutant under this section.

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[18] 73 *Federal Register* 44367, July 30, 2008.

[19] Ibid., p. 44493.

Section 112 might be useful, if at all, for regulating small volume chemicals that are very potent greenhouse gases: sulfur hexafluoride (SF_6), for example. SF_6 has a global warming potential 22,800 times as great as CO_2 and accounted for about one-quarter of one percent of total U.S. GHG emissions in 2007, when measured by its global warming potential. SF_6 emissions were 16.5 million metric tons of CO_2-equivalent in that year. Actual emissions expressed as SF_6, however, were only 690 metric tons. Nitrogen trifluoride (NF_3), another chemical with low emission levels but high global warming potential, might be another candidate, if EPA chose this regulatory route. Section 112 generally considers a major source of emissions to be one that emits more than 10 tons per year of a hazardous air pollutant, and it allows the Administrator to establish a lesser quantity as the major source threshold, based on the potency of the air pollutant or other relevant factors.

Once the source categories for hazardous air pollutants are identified, Section 112 establishes a presumption in favor of regulation of the designated pollutants; it requires regulation unless EPA or a petitioner is able to show "that there is adequate data on the health and environmental effects of the substance to determine that emissions, ambient concentrations, bioaccumulation or deposition of the substance may not reasonably be anticipated to cause any adverse effects to human health or adverse environmental effects."

Path 3: Regulating GHGs through Sections 111 as Designated Air Pollutants

Given the difficulties in following the first two paths, much of the attention, including EPA's,has been on the third path. The term "designated pollutant" is a catch-all phrase for any air pollutant that isn't either a criteria air pollutant under Section 108 or a toxic air pollutant under Section 112. Examples of these include fluorides from phosphate fertilizer manufacturing or primary aluminum reduction, or sulfuric acid mist from sulfuric acid plants.

Importance of Section 111

The authority to regulate such pollutants is Section 111.[20] Section 111 establishes New Source Performance Standards (NSPS), which are emission limitations imposed on designated categories

[20] In addition to using Section 111, in its July 2008 Advance Notice of Proposed Rulemaking EPA discussed at some length the possibility of using Section 129 of the act to regulate GHG emissions from solid waste combustion units. This would seem to be among the more unlikely routes to regulation of GHGs.

Section 129 is structured differently from most of the other CAA authorities discussed here: there is no provision for an endangerment finding, and there is no blanket authority for the Administrator to regulate pollutants that endanger public health or welfare; there is, instead, a specific list of 10 types of pollution for which the Administrator shall establish standards, with no provision for adding pollutants to the list.

Furthermore, waste incineration is a relatively small source of GHG emissions. According to the latest EPA *Inventory of Greenhouse Gas Emissions and Sinks*, incineration of waste emitted 20.8 million metric tonnes of CO_2 in 2007, less than 0.3% of total U.S. GHG emissions.

To the extent that Section 129 provides broader authority to the Administrator, it does so by referencing Section 111: "The Administrator shall establish performance standards and other requirements pursuant to Section 111 and this section for each category of solid waste incineration units." Thus, the authority the Administrator has over waste combustion units is addressed in our discussion of EPA's authority over stationary sources in general under Section 111.

of major new (or substantially modified) stationary sources of air pollution. A new source is subject to NSPS regardless of its location or ambient air conditions.[21]

Section 111 provides authority for EPA to impose performance standards on stationary sources—directly in the case of new (or modified) sources, and through the states in the case of existing sources (Section 111(d)). The authority to impose performance standards on new and modified sources refers to any category of sources that the Administrator judges "causes, or contributes significantly to, air pollution which may reasonably be anticipated to endanger public health or welfare" (Sec. 111(b)(1)(A)). In establishing these standards, the Administrator has the flexibility to "distinguish among classes, types, and sizes within categories of new sources" (Sec. 111(b)(2)).

The performance standards themselves are to reflect "the degree of emission limitation achievable through the application of the best system of emission reduction which (taking into account the cost of achieving such reduction and any nonair quality health and environmental impact and energy requirements) the Administrator determines has been adequately demonstrated" (Sec. 111(a)(1)). Both the Administrator and the individual states have the authority to enforce the NSPS.

Controlling GHG through Section 111

Section 111 appears to provide a strong basis for EPA to establish a traditional regulatory approach to controlling greenhouse gas emissions from large stationary sources. As noted, the section gives EPA considerable flexibility with respect to the source categories regulated, the size of the sources regulated, the particular greenhouse gases regulated, along with the timing and phasing in of regulations. This flexibility extends to the stringency of the regulations with respect to costs, and secondary effects, such as nonair quality, heath and environmental impacts, along with energy requirements. This flexibility is encompassed within the Administrator's authority to determine what control systems she determines have been "adequately demonstrated." As discussed later, this determination has been used to authorize control regimes that extended beyond the merely commercially available to those technologies that have only been demonstrated, and thus are considered by many to have been "technology-forcing."

In sum, Section 111 has several advantages in considering greenhouse gas controls including that it (1) has flexibility with respect to the size of the source controlled (Section 111(b)(2)), (2) can prioritize its schedule of performance standards (Section 111(f)(2)), (3) can consider costs and other factors in making determinations, and (4) has discretion with respect to determining technology that has been adequately demonstrated. Essentially, using Section 111, EPA can determine who gets controlled, when they get controlled, how much they get controlled, and at what price.

[21] The federal focus on new facilities arose from several factors. First, it is generally less expensive to design in to new construction necessary control features than to retrofit those features on existing facilities not designed to incorporate them. Second, uniform standards for new construction ensures that individual states will not be tempted to slacken environmental control requirements to compete for new industry. NSPS was also seen as enhancing the potential for long-term growth, ensuring competitiveness between low and high sulfur coals, and creating incentives for new control technologies. See Senator Edmund Muskie, Senate Consideration of the Report of the conference Committee (August 4, 1977), in U.S. Senate, Committee on Environment and Public Works, *A Legislative History of the Clean Air Act Amendments of 1977* (95th Congress., 2d session; Serial No. 95-15) (1979), vol. 3, p. 353.

Going Off the Beaten Path: Regulating under Section 115 or Title VI

Section 115: International Pollution

On the face of it, Section 115 would appear the ideal provision to address the global issue of climate change. It is focused on international problems and has unique international triggers. Specifically, Section 115 could be invoked by EPA on one of two bases.

First, EPA could act if it receives reports, surveys, or studies from "any duly constituted international agency" that gives EPA:

> reason to believe that any air pollutant or pollutants emitted in the United States cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare in a foreign country.... [22]

Unlike the endangerment triggers under other sections of the Act, the endangerment finding under Section 115 refers to international effects based on data from internationally recognized sources. Many would argue that reports by the Intergovernmental Panel on Climate Change (IPCC) would fit this requirement. A United Nations body, created by the World Meteorological Organization and United Nations Environment Programme, the group and its results are referenced by EPA in its ANPR and its proposed endangerment finding.

Second, in addition to a unique international endangerment trigger, Section 115 can be invoked without any EPA endangerment finding at all. Specifically, EPA is directed to act "whenever the Secretary of State requests him to do so with respect to such pollution [that endangers public health or welfare in a foreign country] which the Secretary of State alleges is of such a nature...." (Section 115(a)). Thus, an allegation by the Secretary of State is sufficient cause for EPA to act.

The action called for under Section 115 is implemented through Section 110(a)(2)(H)(ii) that requires states to revise their SIPs to prevent or eliminate the endangerment identified. Apparently, based on this reference to SIPs, EPA states in its ANPR that Section 115 could only be exercised if EPA were to promulgate a NAAQS for greenhouse gases.[23] However, this is arguable. Section 110(a)(2)(H)(ii) states that SIPs must be crafted to provide for revisions:

> ...whenever the Administrator finds on the basis of information available to the Administrator that the plan is substantially inadequate to attain the national ambient air quality standard which it implements *or to otherwise comply with any additional requirements established under this Act. [emphasis added]*

In their article arguing in favor of using Section 115 to address climate change, Martella and Paulson state their opposition to EPA's blanket assertion that a greenhouse gas NAAQS would be necessary to invoke Section 115:

> ... based on the plain language of the statute, however, this is unlikely to have been what Congress intended. Section 115 is not in any way limited to criteria pollutants. In fact, the

[22] Section 115(a)

[23] 73 *Federal Register* 44483, July 30, 2008.

> opposite is true. It applies specifically to "any air pollution." Clean Air Act Section 110(a)(2)(H)(ii) makes it clear that SIP must provide for the revision of the plan not only when the plan is inadequate to attain a NAAQS, but also to otherwise comply with any additional requirements, such as a revision required by Section 115.[24] [footnotes omitted]

The above actions are prefaced on a condition of reciprocity; Section 115 applies "only to a foreign country which the Administrator determines has given the United States essentially the same rights with respect to the prevention or control of air pollution occurring in that country as is given that country by this section." (Section 115(c)) EPA notes in its ANPR that reciprocity with one or more affected countries may be sufficient to trigger Section 115.[25] Many countries currently attempting to comply with the Kyoto Protocol, such as the European Union, could argue that their efforts to reduce greenhouse gases are being hindered by absent or inadequate U.S. controls. Such countries could argue they meet the criteria under Section 115(c) with respect to reciprocity and point to international studies supporting their position. Secondly, countries at substantial risk from climate change, such as low-lying island countries, could argue endangerment from the lack of U.S. action. Thirdly, countries that only contribute a *de minimis* level of emissions, such as virtually all of Africa, could argue that their low emissions meet the criterion for U.S. action.

Subject to the limitations of the SIP process, EPA notes that Section 115 would provide it with some flexibility in program design. Martella and Paulson take a much more expansive view of the flexibility available, arguing:

> While designating SIPs as the implementation vehicle, Section 115 otherwise does not impose strictures on the contours and requirements of any prospective program(s) to reduce greenhouse gas emissions.... A Section 115-based program could therefore include model thresholds and source categories set by EPA, similar to the Northeast Ozone Transport.
>
> Additionally, EPA could develop a holistic model plan to be implemented by the states. Multiple model approaches also could be presented to the states allowing each state to pick the most appropriate solution for its particular mix of greenhouse gas sources....
>
> Additionally, Section 115 provides a mechanism to limit the scope of the program in terms of the sources....[26]

Because EPA asserts that invoking Section 115 would require a greenhouse gas NAAQS, the action would also invoke NSR under Part C and Title V permitting requirements. One of Martella and Paulson's primary arguments in favor of Section 115 is their belief that Section 115's unique endangerment requirements (or no endangerment requirement if the Secretary of State alleges endangerment) should not trigger PSD-NSR or Title V permitting requirements.[27]

Finally, it should be noted that Section 115 has never been implemented, and many countries would prefer a negotiated settlement on climate change, rather than this approach.

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[24] Roger Martella and Matthew Paulson, "Regulation of Greenhouse Gases Under Section 115 of The Clean Air Act," *Daily Environment Report*, March 9, 2009, pp. 12-17.

[25] 73 *Federal Register* 44483, July 30, 2008.

[26] Martella and Paulson, previously cited, pp. 15-16.

[27] Ibid., p. 11.

Title VI: Stratospheric Ozone Protection

Added to the Clean Air Act in 1990, Title VI is the country's implementing legislation for the Montreal Protocol and succeeding agreements to address ozone depletion by human-made substances. Some of the substances that deplete the ozone layer also contribute to climate change (e.g., CFCs, HCFCs). In addition, some substances chosen as substitutes for ozone depleting chemicals are themselves greenhouse gases (e.g., HFC-134a, PFCs). Finally, the process of making acceptable substitutes for more powerful ozone-depleting chemicals (e.g., HCFC-22) produces greenhouse gases as a byproduct of production (e.g., HFC-23).

Beyond these chemical relationships, there is continuing research on the atmospheric relationship between the stratosphere (and the ozone layer) and climate change.

There are two provisions of Title VI that could be used to address greenhouse gas emission under certain conditions. They are discussed below.

Section 612: Safe Alternatives Policy

As noted above, some substitutes for ozone-depleting substances are greenhouse gases, such as HFCs and PFCs. Section 612 authorizes EPA to the maximum extent practicable, to identify substitutes for ozone-depleting chemicals that reduce overall risks to human health and the environment. Specifically, Section 612(c) requires the EPA to make it unlawful to replace an ozone-depleting substance with any substitute substance which EPA determines "may present adverse effects to human health or the environment" where EPA has identified an available, less harmful substitute. The resulting program is called the Significant New Alternatives Policy (SNAP). With appropriate substitutes identified, SNAP could be used to reduce emissions of HFCs and PFCs without invoking any other provisions of the CAA.

Section 615: Authority of Administrator

Like Section 115, Section 615 is potentially a powerful mechanism to control greenhouse gas emissions under certain circumstances. Like Section 115, it has a unique endangerment finding requirement and even broader discretionary authority for EPA to respond. Section 615 states:

> If, in the Administrator's judgment, any substance, practice, process, or activity may reasonably be anticipated to affect the stratosphere, especially ozone in the stratosphere, and such effect may reasonably be anticipated to endanger public health or welfare, the Administrator shall promptly promulgate regulations respecting the control of such substance, practice, process or activity, and small submit notice of the proposal and promulgation of such regulation to the Congress.

Invoking Section 615 in the case of greenhouse gases would involve a two-part judgment by the EPA: First, that greenhouse gases may reasonably be anticipated to affect the stratosphere (particularly the ozone layer) and, second, that the effect on the stratosphere may reasonably be anticipated to endanger public health or welfare. In its ANPR, EPA determined that it was beyond the scope of its ANPR to assess and analyze the available scientific information on the effects of greenhouse gases on the stratosphere.

If EPA were to judge the scientific data adequate to meet the two-part test, the authority available would be broad and deep. As stated by EPA in its ANPR: "... depending on the nature of any finding made, section 615 authority may be broad enough to establish a cap-and-trade program for the substance, practice, process or activity covered by the finding.... "[28]

Potential Control Approaches for Stationary Sources

In its Technical Support Document for its ANPR, EPA takes a narrow view of the alternatives available to it in imposing greenhouse gas performance standards.[29] For existing electric generating sources, the EPA focuses on incremental improvements in the heat rates of existing units through options that "are well known in the industry" with an overall improvement in efficiency likely to be less than 5%. For new electric generating sources, EPA noted the availability of more efficient supercritical coal units, the future availability of ultra-supercritical units, and the possibility of limited biomass co-firing.

Continuing along this line of reasoning, EPA also suggested that it could develop regulations that anticipate future technology. For example, a phase-in approach to applying CO_2 standards to powerplants would be to mandate that "carbon-ready" generating technology be required for new construction. The objective would be to anticipate the widespread need for some form of carbon capture technology in the future by preparing for it with compatible fossil-fuel combustion technology now. The technology most discussed is integrated-gasification, combined-cycle (IGCC). As noted earlier, EPA is considering this option with respect to the *Desert Rock* PSD-NSR permit reconsideration. With respect to some of the carbon capture technology under development, IGCC has certain advantages over pulverized coal technology. However, just how much IGCC is "carbon ready" is subject to debate. EPA states in its ANPR that it believes such a staged approach is available to it under section 111:

> EPA believes that section 111 may be used to set both single-phase performance standards based upon current technology and to set two-phased or multi-phased standards with more stringent limits in future years. Future-year limits may permissibly be based on technologies that, at the time of the rulemaking, we find adequately demonstrated to be available for use at some specified future date.[30]

The technical support document does not mention some more aggressive options. These include a fuel-neutral standard or a technology-based standard. For example, for carbon dioxide emissions from a newly-constructed powerplant, a fuel-neutral standard could follow the example set by the 1997 and 2005 NOx NSPS and the 2005 NOx NSPS for modified existing sources. Under those regulations, the NOx emissions standard is the same, regardless of the fuel burned—solid, liquid, or gaseous.[31] This standard is much more expensive for coal-fired facilities to comply with than for natural-gas fired facilities, thus encouraging the lower-carbon gas-fired technologies. Likewise, EPA could choose to set a newly-constructed powerplant standard based on the performance of natural gas burnt in a combined-cycle configuration – the fuel and technology of

[28] 73 *Federal Register* 44519, July 30, 2008.

[29] *U.S. Environmental Protection Agency, Technical Support Document for the Advanced Notice of Proposed Rulemaking for Greenhouse Gases; Stationary Sources, Section VII* (June 5, 2008), final draft.

[30] 73 *Federal Register* 44490, July 30, 2008.

[31] Under Sec. 60.44Da(d)(1), the 1997-2005 NSPS is set at 1.6 lb per megawatt-hour gross energy output, based on a 20-day rolling average; it is lowered to 1.0 lb per megawatthour gross energy output for powerplants commencing construction after February 28, 2005 (Sec. 60.44Da(e)(1). Under Section 60.44Da(e)(3), the 2005 NSPS for modified sources is at either 1.4 lb. A fuel-neutral standard is also set for reconstructed powerplants.

choice for construction of new powerplants for the last two decades. If EPA wanted to encourage the rollover of the existing coal-fired powerplant fleet to natural gas, nuclear, or renewable sources, it could apply a fuel-neutral standard to modified sources as well. For example, a CO_2 emission standard of 0.8 lb. per kilowatt-hour output could be met by a new natural gas-fired, combined-cycle facility, as well as any non-emitting generating technology, such as nuclear power or renewables. In contrast, the standard would require a 60% reduction in emissions from a new coal-fired facility – forcing the development of a carbon control technology, such as carbon capture and storage (CCS), in order for a new coal-fired facility to be built or modified.

The viability of these options, or even more aggressive technology-forcing standards, would depend on how EPA determined whether a technology had been "adequately-demonstrated" and the seriousness of its costs and energy requirements. As discussed below, EPA has used the NSPS to encourage the installation of pollution control equipment on powerplants, even while the equipment's development status was still being debated.

Forcing Commercialization of Technology Through a Regulatory Requirement: An Example from the SO_2 New Source Performance Standards

> It is an understatement to say that the new source performance standards promulgated by the EPA were technology-forcing. Electric utilities went from having no scrubbers on their generating units to incorporating very complex chemical processes. Chemical plants and refineries had scrubbing systems that were a few feet in diameter, but not the 30- to 40-foot diameters required by the utility industry. Utilities had dealt with hot flue gases, but not with saturated flue gases that contained all sorts of contaminants. Industry, and the US EPA, has always looked upon new source performance standards as technology-forcing, because they force the development of new technologies in order to satisfy emissions requirements.[32]

The most direct method to encourage adoption of carbon capture technology would be to mandate it. Mandating a performance standard on stationary sources is not a new idea: The process of forcing the development of emission controls on coal-fired powerplants is illustrated by the 1971 and 1978 SO_2 NSPS for coal-fired electric generating plants. As noted earlier, the Clean Air Act states that NSPS should reflect "the degree of emission limitation achievable through the application of the best system of emission reduction which (taking into account the cost of achieving such reductions and any non-air quality health and environmental impact and energy requirements) the Administrator determines has been adequately demonstrated."[33] In promulgating its first utility SO_2 NSPS in 1971, EPA determined that a 1.2 pound of SO_2 per million Btu of heat input performance standard met the criteria of Sec. 111—a standard that required, on average, a 70% reduction in new powerplant emissions, and could be met by low-sulfur coal that was available in both the eastern and western parts of the United States, or by the use of emerging flue gas desulfurization (FGD) devices.[34]

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[32] Donald Shattuck, et al., *A History of Flue Gas Desulfurization (FGD)—The Early Years*, UE Technical Paper (June 2007), p. 3.

[33] 42 U.S.C. 7411, Clean Air Act, Sec. 111(a)(1).

[34] 40 CFR 60.40-46, Subpart D—Standards of Performance for Fossil-Fuel-Fired Steam Generator for Which Construction is Commenced After August 17, 1971.

At the time the 1971 Utility SO_2 NSPS was promulgated, there was only one FGD vendor (Combustion Engineering) and only three commercial FGD units in operation—one of which would be retired by the end of the year.[35] The number of units and vendors would increase rapidly, not only because of the NSPS, but also because of the promulgation of the SO_2 NAAQS, the 1973 Supreme Court decision preventing significant deterioration of pristine areas,[36] and state requirements for stringent SO_2 controls, which opened up a market for retrofits of existing coal-fired facilities in addition to the NSPS focus on new facilities. Indeed, most of the growth in FGD installations during the early and mid-1970s was in retrofits. Taylor estimates that between 1973 and 1976, 72% of the FGD market was in retrofits.[37] By 1977, there were 14 vendors offering full-scale commercial FGD installation.[38]

However, despite this growth, only 10% of the new coal-fired facilities constructed between 1973 and 1976 had FGD installations. In addition, the early performance of these devices was not brilliant.[39] In 1974, American Electric Power (AEP) spearheaded an ad campaign to have EPA reject FGD devices as "too unreliable, too impractical for electric utility use" in favor of tall stacks, supplementary controls, and low-sulfur western coal.[40] This effort was ultimately unsuccessful as the Congress chose to modify the NSPS requirements for coal-fired electric generators in 1977 by adding a "percentage reduction" requirement. As promulgated in 1979, the revised SO_2 NSPS retained the 1971 performance standard but added a requirement for a 70%-90% reduction in emissions, depending on the sulfur content of the coal.[41] At the time, this requirement could be met only through use of an FGD device. The effect of the "scrubber requirement" is clear from the data provided in **Figure 1**. Based on their analysis of FGD development, Taylor, Rubin, and Hounshell state the importance of demand-pull instruments:

> Results indicate that: regulation and the anticipation of regulation stimulate invention; technology-push instruments appear to be less effective at prompting invention than demand-pull instruments; and regulatory stringency focuses inventive activity along certain technology pathways.[42]

[35] Margaret R. Taylor, *The Influence of Government Actions on Innovative Activities in the Development of Environmental Technologies to Control Sulfur Dioxide Emissions from Stationary Sources,* Thesis, Carnegie Institute of Technology (January 2001), pp. 37, 40.

[36] Fri v. Sierra Club, 412 US 541 (1973). This decision resulted in EPA issuing "prevention of significant deterioration" regulations in 1974; regulations what were mostly codified in the 1977 Clean Air Amendment (Part C).

[37] Taylor, ibid., p. 37.

[38] Taylor, ibid., p. 39.

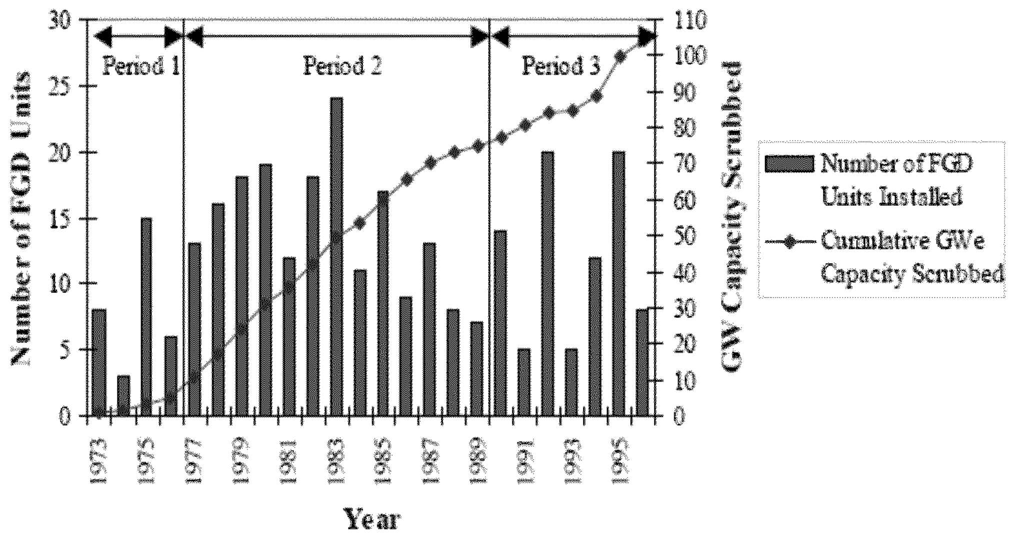
[39] For a discussion of challenges arising from the early development of FGD, see Donald Shattuck, et al., *A History of Flue Gas Desulfurization (FGD)—The Early Years,* UE Technical Paper (June 2007).

[40] Examples include full-page ads in the Washington Post entitled "Requiem for Scrubbers," "Scrubbers, Described, Examined and Rejected," and "Amen." For an example, see *Washington Post,* p. A32 (October 25, 1974).

[41] 40 CFR 60.40Da-52Da, Subpart Da—Standards of Performance for Electric Utility Steam Generating Units for Which Construction is Commenced After September 18, 1978.

[42] Margaret R. Taylor, Edward S. Rubin, and David A. Hounshell, "Control of SO_2 Emissions from Power Plants: A Case of Induced Technological Innovation in the U.S.," *Technological Forecasting & Social Change* (July 2005), p. 697.

Figure 1. Number of FGD Units and Cumulative Gigawatt (GW) Capacity of FGD Units: 1973-1996



Source: Adapted by Taylor from Soud (1994). See Margaret R. Taylor, op. cit., 74.

Note: Numbers are archival through June 1994, then projected for 1994-96.

That government policy could force the development of a technology through creating a market should not suggest that the government was limited to that role, or that the process was smooth or seamless. On the latter point, Shattuck, et al., summarize the early years of FGD development as follows:

> The Standards of Performance for New Sources are technology-forcing, and for the utility industry they forced the development of a technology that had never been installed on facilities the size of utility plants. That technology had to be developed, and a number of installations completed in a short period of time. The US EPA continued to force technology through the promulgation of successive regulations. The development of the equipment was not an easy process. What may have appeared to be the simple application of an equipment item from one industry to another often turned out to be fraught with unforeseen challenges.[43]

The example indicates that technology-forcing regulations can be effective in pulling technology into the market—even when there remain some operational difficulties for that technology. The difference for carbon capture technology is that for long-term widespread development, a new infrastructure of pipelines and storage sites may be necessary in addition to effective carbon capture technology.[44] In the short-term, suitable alternatives, such as enhanced oil recovery needs and in-situ geologic storage, may be available to support early commercialization projects without the need for an integrated transport and storage system. Likewise, with economics more favorable for new facilities than for retrofits, concentrating on using new construction to introduce carbon capture technology might be one path to widespread commercialization. As an

[43] Shattuck, et. al., p. 15.

[44] See CRS Report RL33971, *Carbon Dioxide (CO2) Pipelines for Carbon Sequestration: Emerging Policy Issues*, by Paul W. Parfomak and Peter Folger.

entry point to carbon capture deployment, a regulatory approach such as NSPS may represent a first step, as suggested by the SO_2 NSPS example above.

Potential for Cap-and-Trade

Whether EPA can set up a cap-and-trade program under the Clean Air Act is the subject of considerable debate in the literature.[45] Much of the debate surrounds the provisions of Section 111(d). However, there are other authorities in the Act that might serve as a basis for a EPA-coordinated cap-and-trade program.

Potential Under Section 111

EPA, along with other commenters, has linked the potential effectiveness of Section 111(d) to whether it can be interpreted to allow a cap-and-trade program for CO_2 . As stated by EPA: "EPA also believes that because of the potential cost savings, it might be possible for the Agency to consider deeper reductions through a cap-and-trade program that allowed trading among sources in various source categories relative to other systems of emissions reduction."[46] As noted, Section 111 explicitly allows EPA to take cost into consideration in developing performance standards. Whether that consideration could justify a trading program across different greenhouse gases, and across different source categories with different best available systems of emissions reduction is not known. A lead author of the winning brief in *Massachusetts v. EPA* makes a case against such authority:

> Numerous parties have argued that section 111 does not authorize the creation of a cap-and-trade program. Among other things, section 111(h) provides a contingency plan in the event performance standards are "not feasible" to implement. In that case, section 111(h) gives EPA the authority to "promulgate a design, equipment, work practice, or operational standard, or combination thereof, which reflects the best technological system of continuous emissions reduction which … the Administrator determines has been adequately demonstrated." 42 U.S.C. Section 7411(h)(1). One of the ways a performance standard might prove "not feasible" is if "a pollutant or pollutants cannot be emitted through a conveyance designed and constructed to emit or capture such pollutants." 42 U.S.C. 7411(h)(2)(A). Clearly, Congress thought the most likely scenario under section 111 was for pollutants to be "emitted through a conveyance designed and constructed to emit or capture such pollutant[s]"– an assumption at odds with the operation of a trading program. Other aspects of section 111 also point away from the creation of a trading program under this provision [reference omitted].[47]

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[45] See EPA, ANPR, pp. 44514-44516; Lisa Heinzerling, *Testimony Before the Subcommittee on Energy and Air Quality of the Committee on Energy and Commerce*, Hearing (April 10, 2008); Robert R. Nordhaus, "New Wine into Old Bottles: The Feasibility of Greenhouse Gas Regulation Under the Clean Air Act*," N.Y.U. Environmental Law Journ*al (2007), pp. 53-72; Inimai M. Chettiar and Jason A. Schwartz, *The Road Ahead: EPA's Options and Obligations For Regulating Greenhouse Gases* (April 2009); and Alaine Ginocchio, et al*., The Boundaries of Executive Authority: Using Executive Orders to Implement Federal Climate Change Policy* (February 2008).

[46] U.S. Environmental Protection Agency, "Regulating Greenhouse Gas Emissions Under the Clean Air Act; Proposed Rule," 73 Federal Register 44490, July 30, 2008.

[47] Lisa Heinzerling, Testimony Before the Subcommittee on Energy and Air Quality of the Committee on Energy and Commerce, House of Representatives (April 10, 2008), pp. 12-13.

In sum, whether this authority can be expanded to creating a comprehensive cap-and-trade program is under debate. Focused on existing sources, EPA used Sec. 111(d) to justify its promulgated rule (now vacated) to reduce mercury emissions from powerplants. Although some have argued that the court decision in this case repudiated EPA's reasoning, the case was actually not decided on the basis of Section 111(d).[48]

Potential Under Other Sections

Three other sections of the Act, (Sections 110, 115, and 615) might also be considered as possible authority for establishing an economy-wide cap-and-trade program for GHG emissions, although each has its own weaknesses. Section 110 of the Act establishes requirements for State Implementation Plans (SIPs). While primarily designed to demonstrate how a state with nonattainment areas will bring those areas into attainment with NAAQS, the section also contains language that might serve as the basis for the use of broader GHG regulatory tools once emission standards were issued under any section of the Act. Specifically, Section 110(a)(2)(A) says that each SIP shall

> ... include enforceable emission limitations and other control measures, means, or techniques (including economic incentives such as fees, marketable permits, and auctions of emissions rights), as well as schedules and timetables for compliance, as may be necessary or appropriate to meet the applicable requirements of this Act ....

The predicate is that there must first be an applicable requirement under the Act. Thus, Section 110 would not be an authority that EPA could use to *initiate* regulation of GHGs. Also, although the section mentions economic incentives, marketable permits, and auctions, it is not clear that such authority could be used for economy-wide control measures. The precedents for the authority's use that EPA cited in the ANPR, for example, included such regulations as the NOx SIP call, which established a cap-and-trade program for powerplant emissions of NOx, and the Clean Air Interstate Rule, which also allowed trading of emission allowances by powerplants.

As stated in the ANPR:

> EPA has often incorporated market-oriented emissions trading elements into the more traditional performance standard approach for mobile and stationary sources. Coupling market-oriented provisions with performance standards provides some of the cost advantages and market flexibility of market-oriented solutions while also directly incentivizing technology innovation within the particular sector, as discussed below. For example, performance standards for mobile sources under Title II have for many years been coupled with averaging, banking and trading provisions within a subsector. In general, averaging allows covered parties to meet their emissions obligation on a fleet- or unit-wide basis rather than requiring each vehicle or unit to directly comply. Banking provides direct incentives for additional reductions by giving credit for overcompliance; these credits can be used toward future compliance obligations and, as such, allow manufacturers to put technology improvements in place when they are ready for market, rather than being forced to adhere to a strict regulatory schedule that may or may not conform to industry or company

[48] New Jersey v. EPA, 517 F.3d 574 (D.C. Cir. 2008). The case was decided on whether EPA could delist electric generating units as a source of hazardous air pollutants without following the criteria laid out in Section 112(c). For a discussion see CRS Report RS22817, *The D.C. Circuit Rejects EPA's Mercury Rules: New Jersey v. EPA*, by Robert Meltz and James E. McCarthy.

developments. Allowing trading of excess emission reductions with other covered parties provides an incentive for reducing emissions beyond what is required.[49]

The two other possible authorities for a cap-and-trade program, Sections 115 and Section 615, have never been used to control any pollutant, much less to establish a cap-and-trade program. Assuming Section 115 could be invoked without a supporting NAAQS, there might be sufficient flexibility to institute a cap-and-trade program. The program would have to be created by each state under Section 110 to comply with EPA-determined state GHG emission caps in response to Section 115. Because it would function through Section 110, EPA could not impose a cap-and-trade system on the states; rather, the states would have to voluntarily agree to cooperate in a EPA-coordinated cap-and-trade scheme.

As noted earlier, if Section 615 could be successfully triggered by the science, EPA'sdiscretion in setting up a regulatory scheme would be substantial. As stated by EPA in its ANPR: "... depending on the nature of any finding made, section 615 authority may be broad enough to establish a cap-and-trade program for the substance, practice, process or activity covered by the finding...."[50]

Implementation Issues

New Source Review

Any new or modified facility emitting (or potentially emitting) over 250 tons of any regulated pollutant must undergo preconstruction review and permitting, including the installation of Best Available Control Technology (BACT), except those pollutants regulated under Sections 112 and 211(o). New sources under the Prevention of Significant Deterioration provisions of Part C (PSD-NSR) must undergo preconstruction review and must install BACT as the minimum level of control.[51] State permitting agencies determine BACT on a case-by-case basis, taking into account energy, environmental, and economic impacts. BACT cannot be less stringent than the federal NSPS, but it can be more so. More stringent controls can be required if modeling indicates that BACT is insufficient to avoid violating PSD emission limitations, or the NAAQS itself.

PSD-NSR is required for any pollutant "subject to regulation" under the Clean Air Act, but there are varying interpretations of what the phrase "subject to regulation" means. Environmental groups have argued that CO_2 is already subject to regulation because utilities are required under Section 821 of the Clean Air Act Amendments of 1990 to monitor and report CO_2 emissions to EPA. Others argue that an endangerment finding would make GHGs subject to regulation, and,

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[49] ANPR, p. 44412.

[50] 73 *Federal Register* 44519, July 30, 2008.

[51] The 1977 CAA broadened the air quality control regimen with the addition of the Prevention of Significant Deterioration (PSD) and visibility impairment provisions. The PSD program (Part C of Title I of the CAA) focuses on ambient concentrations of SO_2, NOx, and PM in "clean" air areas of the country (i.e., areas where air quality is better than the NAAQS). The provision allows some increase in clean areas' pollution concentrations depending on their classification. In general, historic or recreation areas (e.g., national parks) are classified Class I with very little degradation allowed, while most other areas are classified Class II with moderate degradation allowed. States are allowed to reclassify Class II areas to Class III areas, which would be permitted to degrade up to the NAAQS, but none have ever been reclassified to Class III.

therefore, trigger PSD-NSR requirements for new sources. In its proposed endangerment finding, EPA noted its current interpretation of the law is that a final positive endangerment finding for motor vehicles under Section 202 would not *per se* make greenhouse gas emissions subject to PSD-NSR.[52] However, the interpretive memorandum on which this conclusion is based,[53] issued in December 2008, is currently under review by the new Administration.

Issue of Case-by-Case BACT Determinations

Two aspects of the New Source Review provision create potential difficulties in using the CAA to control greenhouse gases. First, as noted earlier, PSD-NSR has specified thresholds for triggering its provisions: a "major emitting facility is generally defined as emitting or having the potential to emit 250 tons annually of a regulated pollutant (Sec. 169(1)).[54] With respect to greenhouse gases, this is a fairly low threshold. By comparison, several bills introduced in the 110th Congress set thresholds for inclusion in the reduction program at 10,000 metric tons annually.

The second administrative issue for PSD-NSR is the requirement that BACT be determined on a case-by-case basis. Combined with a 250 ton threshold, this could mean a massive increase in state-determinations of BACT. If the threshold was 250 tons annually, the resulting increased permit activity would be at least an order of magnitude, according to EPA (discussed below).

On this second issue, it should be noted that several commenters believe this would not be a major problem (unless a cap-and-trade program is implemented). As stated by the Institute for Policy Integrity:

> Since including GHGs in the PSD program may greatly expand the number of permits issued, making case-by-case determinations for each individual source may stretch the resources of EPA and state permitting authorities. Moreover, traditional technological controls may not exist for every GHG emitted by every regulated facility. However, there is flexibility in the statute to resolve these problems.

[52] See Proposed Endangerment Finding, footnote 29 (p. 106).

[53] Memorandum from EPA Administrator Stephen L. Johnson to Regional Administrators, "EPA's Interpretation of Regulations that Determine Pollutants Covered by Federal Prevention of Significant Deterioration (PSD) Permit Program," December 18, 2008, 19 pages, at http://www.epa.gov/nsr/documents/psd_interpretive_memo _12.18.08.pdf.

[54] It should be noted that, unlike the definition of major source, the definition of a major modification is defined by regulation, not statute. As defined under the 1970 CAA, a modification is "any physical change in, or change in the method of operation of, a stationary source which increases the amount of any air pollutant emitted by such source or which results in the emission of any air pollutant not previously emitted"(Section 111(a)(4)). In subsequent regulations issued in 1975 with respect to NSPS, EPA defined modification as any physical or operational change that resulted in any increase in the maximum hourly emission rate of any controlled air pollutant.[54] EPA regulations also stated that any replacement of existing components that exceeded 50% of the fixed capital costs of building a new facility placed the plant under NSPS, regardless of any change in emissions. With the advent of National Ambient Air Quality Standards non-attainment provisions (Part D), PSD provisions (Part C), and NSR in 1977, a different approach to defining modification was appropriate as the focus was shifted from enforcing NSPS emission rates to achieving attainment and compliance with PSD. In promulgating regulations for the PSD and non-attainment programs, EPA defined "significant" increase in emissions in terms of tons per year emitted by a major source. For sulfur dioxide and nitrogen oxides, the threshold is 40 tons per year. Facilities exceeding that threshold are subject to NSR.

Given this history of setting *de minimis* emission increases for triggering NSR review for modifications, it is possible EPA could set a substantially higher level for at least carbon dioxide emissions, and perhaps other greenhouse gases, if it determined such thresholds were appropriate

> Though BACT determinations are generally to be made on a case-by-case basis, the D.C. Circuit recognized in *Alabama Power* that exceptions can be made if "case-by-case determinations would, as a practical matter, prevent the agency from carrying out the mission assigned to it by Congress." The development of "presumptive BACT" determinations should be permissible and may help streamline the permitting process [footnote omitted]."[55]

In addition, assuming PSD is triggered by regulation under Section 111, the BACT requirements may be identical to the NSPS determinations under Section 111. It is also likely that most small sources would not have an NSPS as EPA applied its discretion under Section 111 in determining the most cost-effective emissions reductions. With no NSPS floor for a BACT determination, it is possible that NSR requirements for sources not covered under Section 111 could be quite lax.

Title V and the Size Threshold

In the ANPR, EPA discussed the possibility that an endangerment finding and subsequent regulation of GHGs as air pollutants under any section of the Act could trigger Title V permit requirements, and that all facilities that have the potential to emit a GHG pollutant in amounts of 100 tons per year or more would be required to obtain permits. Under this reasoning, the regulation of CO_2 from motor vehicles under Section 202, for example, could lead to Title V permit requirements for CO_2 from powerplants and other sources. In the ANPR, the agency stated:

> Using available data, which we acknowledge are limited, and engineering judgment in a manner similar to what was done for PSD, EPA estimates that more than 550,000 additional sources would require Title V permits, as compared to the current universe of about 15,000–16,000 Title V sources. If actually implemented, this would be more than a tenfold increase, and many of the newly subject sources would be in categories not traditionally regulated by Title V, such as large residential and commercial buildings.[56]

Thus, like PSD-NSR, a major complication that Title V introduces is the potential for very small sources of greenhouse gases to need permits in order to operate. Furthermore, Title V requires that covered entities pay fees established by the permitting authority, and that the total fees be sufficient to cover the costs of running the permit program.

The potential for increased permitting activity has led to speculation on its potential extent. For example, some agricultural interests have spun the possibility that Title V could be invoked for emissions from agricultural activities and the requirement for permit fees into something they refer to as the "cow tax." On November 18, 2008, for example, Cattle Network stated "EPA Proposes 'Cow Tax.'" The article even generated specific amounts for the "tax": $175 per dairy cow and $87.50 per beef cow.[57] EPA says that it has no plans to regulate agricultural activities' GHG emissions. Indeed, the agency currently exempts most major agricultural sources from any Clean Air Act controls on conventional air pollutants under an arrangement known as the Air

[55] Inimai M. Chettiar and Jason A. Schwartz, *The Road Ahead: EPA's Options and Obligations for Regulating Greenhouse Gases*, April 2009, p. 105.

[56] 73 *Federal Register* 44511, July 30, 2008.

[57] Cattle Network, November 18, 2008, at http://www.cattlenetwork.com/Content.asp?ContentID=269579.

Compliance Agreement.[58] Thus, it would seem unlikely that the agency would now make a priority of subjecting small agricultural sources to GHG requirements.

However, the need to deal with the size issue has been noted by EPA and other commenters. Alternatives to lessen the extent and cost of these provisions fall into three categories: (1) legal or regulatory interpretations that increase EPA's flexibility to determine what sources would need permits and when; (2) the expanded use of general permits; (3) interpretation of different endangerment findings to exclude Title V and/or PSD-NSR.

Legal or Regulatory Interpretations that Increase Flexibility

EPA noted two possible legal theories under which it could avoid imposing PSD-NSR or Title V permitting requirements on small sources. Under "the judicial doctrine of administrative necessity," the agency stated that it might be able "to craft relief in the form of narrowed source coverage, exemptions, streamlined approaches or procedures, or a delay of deadlines."[59] The agency also stated that in rare cases, the courts will apply statutory provisions in a manner other than that indicated by the plain meaning, if "absurd, futile, strange, or indeterminate results" would be produced by literal application.

If EPA has the authority, such as under Section 111, it will almost certainly focus on the large sources first. As noted in the introduction, when it comes to stationary sources, size matters. Twenty-eight percent of the country's GHGs comes from an Energy Information Administration (EIA) estimated 670 coal-fired electric powerplants. Farms, by contrast, number more than 2 million, and emit less than 4% of total GHGs. EPA could argue that either administrative necessity or "strange," perhaps "absurd" results (to use EPA's terms) justified priorities and resources being focused on the former with the latter being either substantially delayed or possibly ignored. Methane (CH_4) provides another interesting contrast in potential priorities. For example, about 1.8% of GHG emissions, in the form of methane, are generated by 1,800 landfills; a slightly larger amount (2.4%) is emitted by roughly a million cattle and swine operations. As stated by the Institute for Policy Integrity:

> Courts grant agencies much more leeway in deferring full implementation of a statute than in creating permanent exemptions. Invoking the doctrine of administrative necessity, EPA should be able to justify expanding NSR permit applicability to the largest sources first, and then gradually including smaller sources. The timeline set for phasing in smaller sources could not take longer than reasonably necessary given EPA's administrative burdens, but EPA will have a good deal of discretion to determine its own resources and capability [footnotes omitted].[60]

A second means of reducing the administrative burden is to increase the effective size of an affected source by defining "potential to emit" in terms of potential actual emissions. In particular, EPA suggested in its ANPR that determining the potential to emit in terms of actual usage instead of maximum potential could have some benefit in some cases. For example, if a small boiler's potential to emit was based on actual usage of 1000 hours a year, instead of

[58] See CRS Report RL32947, *Air Quality Issues and Animal Agriculture: EPA's Air Compliance Agreement*.

[59] 73 *Federal Register* 44512, July 30, 2008. Also see ensuing discussion through page 44514.

[60] Inimai M. Chettiar and Jason A. Schwartz, *The Road Ahead: EPA's Options and Obligations for Regulating Greenhouse Gases*, (April 2009), p. 104.

continuous potential usage (8760 hours), the effective size of the boiler under NSR would increase 8.76 times.[61]

General Permits

Perhaps the most straightforward method of reducing administrative burden is for EPA to adopt a general permit scheme for PSD-NSR and Title V. For categories with numerous similar sources of emissions, the Clean Air Act provides in Section 504(d) that the permitting authority—be it EPA or a delegated state agency—may issue a "general permit" covering all sources in the category. This provision substantially reduces the administrative burden of issuing permits, allowing notice and opportunity for public hearing on the category as a whole and the provisions of the general permit, rather than requiring the same for each individual source. General permits have been widely used by the agency under the Clean Water Act, and are used by about half the states for control of various air pollution sources. Thus, there is precedent for their use in a Clean Air Act greenhouse gas control program for multiple, relatively minor sources of emissions.

A general permit does not relieve the permittee from filing a permit application or from complying with permit conditions, which would include some sort of monitoring and reporting requirements. But a permit application for a general permit can be relatively simple, and since there are few costs to issuing the permit, permit fees, which are required by Section 502(b) to cover the reasonable costs of the permit program, but are to be utilized only to cover such costs, would be relatively low. A sampling of states using general permit fees for other types of air pollutants found fees ranging from $100 to $350 per permittee.

Such an approach may also be available to small sources potentially caught under PSD-NSR. Both EPA in the ANPR and the Institute for Policy Integrity provide arguments for PSD-NSR general permits for small sources to avoid absurd results or respond to administrative necessity.[62]

Section 304: Citizen Suits

If an endangerment finding triggered emissions standards or limitations under the CAA (e.g., Section 111, Part C), it would also bring into play Section 304, Citizen Suits. Section 304 allows any person to commence a civil action against any other person (including government entities and instrumentalities) for violation of an emissions standard or limitation under the Act. It also provides for suits against EPA for failing to perform a nondiscretionary act or duty. Most specifically, Section 304 provides for suits

> ... against any person who proposes to construct or constructs any new or modified major emitting facility without a permit required under part C of title I (relating to significant deterioration of air quality) or part D of title I (relating to non-attainment) or who is alleged to have violated (if there is evidence that the alleged violation has been repeated) or to be in violation of condition of such permit.[63]

[61] 73 *Federal Register* 44503, July 30, 2008..

[62] 73 *Federal Register 44507*-44511, July 30, 2008; Inimai M. Chettiar and Jason A. Schwartz, *The Road Ahead: EPA's Options and Obligations for Regulating Greenhouse Gases*, (April 2009), pp. 103-106.

[63] Section 304(a)(3).

Citizen suits have been widely used by environmental groups to force the Administrator to undertake nondiscretionary duties and to enforce the Act's requirements against emitting facilities. Should the agency fail to move forward with GHG standards following an endangerment finding, suits seeking to force action would almost certainly be filed.

Conclusion

The current debate on the appropriateness of using the Clean Air Act to regulate greenhouse gas emissions is not the first such debate that has occurred when a new environmental challenge has been directed at the Act. During the 1980s, suggestions were made that acid rain and/or stratospheric ozone depletion could be addressed via then-existing provisions, rather than by new Amendments. For example, in 1985, the CRS stated the following with respect to addressing acid rain through the existing Clean Air Act:

> *Various Clean Air Act provisions could be used to address acid precipitation*, including issuing more stringent secondary ambient air quality standards, setting a sulfatestandard,and enforcing SO2 reductions more vigorously. (a) Typically, however, such actions require a demonstration of cause-effect relationship that has not been obtained, at least in the view of many policymakers;and/or they require actions under peripherally related provisions such as visibility protection—which are already subject to controversy on their own right. (b) Any such actions would likely be expensive, both in resources and in political/administrative capital. (c*) Program administrators have therefore said they will not use the Clean Air Act aggressively and innovatively to combat acid precipitation without an explicit Congressional mandate and/or compelling new evidence linking specific damages to specific pollutants* [emphasis in original].[64]

In both cases, the Congress moved to add new Titles to the Act (Title IV to address acid rain, and Title VI to address stratospheric ozone depletion). In the case of Title IV, a new market-based approach to reducing pollutants was introduced to implement a statutory reduction requirement (i.e., the SO_2 emissions cap) in hope that the cost would be optimized. The result was so successful that it was used by states and EPA to begin addressing interstate transport of smog (i.e., the NOx SIP Call) and has been suggested by some as the optimal approach to controlling greenhouse gases.

However, controlling greenhouse gases is a substantially more complex environmental, technical, economic, and social issue than either acid rain or stratospheric ozone depletion are. It is possible that one size does not fit all in this debate. Some sources may not respond significantly to a market-based approach because they are not particularly price-sensitive. Others may be too small or dispersed to include. For example, the European Union's market-based approach covers only about 40% of the EU's emissions. Other instruments are used to address difficult sectors, such as transportation.

Thus, initiatives to use the current Clean Air Act could be designed as a substitute for what is perceived by some as a protracted congressional debate, or as a complementary effort to address sources or gases that a future market-based system may choose to exclude from its provisions. As

[64] *The Clean Air Act and Proposed Acid Rain Legislation: Can We Get There from Here?* CRS Report 85-50 ENR, by Larry B Parker, John E. Blodgett, Alvin Kaufman, and Donald Dulchinos, p. 9.

summarized in 2008 by Lisa Heinzerling in testimony to the Subcommittee on Energy and Air Quality of the House Energy and Commerce Committee:

> ... the Clean Air Act contains numerous provisions that might be used to regulate greenhouse gases. The advantages of using these provisions include: they can be deployed now; they use regulatory strategies that are familiar to, indeed are the bread and butter work of, the Environmental Protection Agency; they call for regulation of numerous and diverse sources and thus, taken as a group, they have an inherent fairness to them; they do not pose unusual enforcement difficulties or untoward administrative burdens.
>
> There are also disadvantages to using existing Clean Air Act provisions to address climate change. Most of the provisions do not have statutory deadlines.... To the extent one favors cap-and-trade as a regulatory mechanism for addressing climate change, one might worry about the lack of clear authority for such a scheme under the existing statute. The NAAQS program is an ungainly framework for regulating globally harmful pollutants. PSD requirements are triggered for sources that are "large" when it comes to conventional pollution but "small" from the perspective of global pollutants.[65]

A final endangerment finding would present EPA with many options. However, the ultimate decision on what the Nation's greenhouse gas policy should be rests with the Congress. If it disagrees with any approach undertaken by EPA, it can override the agency's decision, or respond as it did with acid rain and stratospheric ozone depletion—with new statutory authorities.

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[65] Testimony of Lisa Heinzerling, U.S. Congress, House Committee on Energy and Commerce, Subcommittee on Energy and Air Quality, *Strengths and Weaknesses of Regulating Greenhouse Gas Emissions Under Existing Clean Air Act Authorities*, 110th Cong., 2nd sess., April 10, 2008, pp. 14-15.

CARNEGIE MELLON UNIVERSITY

CARNEGIE INSTITUTE OF TECHNOLOGY

THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

TITLE: The Influence of Government Actions on Innovative Activities in the Development of Environmental Technologies to Control Sulfur Dioxide Emissions from Stationary Sources

PRESENTED BY: Margaret R. Taylor

ACCEPTED BY THE DEPARTMENT OF: Engineering and Public Policy

MAJOR PROFESSOR	DATE
MAJOR PROFESSOR	DATE
DEPARTMENT HEAD	DATE

APPROVED BY THE COLLEGE COUNCIL:

DEAN	DATE

Carnegie Mellon University

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By

Margaret R. Taylor

Pittsburgh, Pennsylvania

January 2001

Acknowledgments

This dissertation would not have been possible without the hard work and support of many wonderful people. Two men of great patience and intelligence were particularly important to its success. David Hounshell and Ed Rubin made an excellent team and devoted many hours to the approach and details of this dissertation. They have a number of great qualities, but I particularly want to thank David for his quiet guidance and broad knowledge and Ed for his detailed management and expertise. Both of these advisors were very important to my intellectual development and I will always be grateful to them.

David and Ed were involved throughout the dissertation process, but other people were particularly influential in specific sections of this dissertation. Although they were later additions to my committee, I want to thank Linda Argote and Scott Farrow for their important contributions to this dissertation. Linda was tremendously helpful in guiding the treatment of organizational learning in this dissertation, while Scott raised key issues regarding environmental economics. I also want to thank Kathleen Carley, who was extremely helpful in guiding the network analysis work done for this dissertation.

The combination of interdisciplinary research methods used in this dissertation posed a number of logistical challenges. Although there are too many people to mention comprehensively here, I want to thank everyone who helped me throughout the laborious processes of: identifying data of different types and sources; usefully organizing these data; selecting, learning and applying various quantitative and qualitative methodologies; and synthesizing the process and findings into this document.

There are several people I would like to thank in particular for their help with the various methodologies used in this research. First, I would like to thank several people involved in the expert interview methodology. Primary among them are the many experts in SO_2 control technologies who volunteered their time to assist me with this dissertation. Although I cannot name them individually for reasons of confidentiality, I would particularly like to thank the individuals who sat with me for structured interviews that enriched the entire work. In addition, I want to thank EPRI for providing me with a small conference room to conduct interviews in at the Mega Symposium in Atlanta, Georgia in 1999, and Clifford and Cynthia Hale for putting me up (or putting up with me) during that time. I also want to thank Granger Morgan and Baruch Fischoff for their assistance in commenting on iterations of the interview protocol, as well as Irene Brychcin for her expert transcription services. Eleanor Lewis and Felicia Wu provided useful advice on analyzing these transcriptions.

Second, I would like to thank three people for their help in analyzing both performance improvements in SO_2 control technologies over time and the existence of learning by doing in these technologies. Two of these people were particularly helpful in the conversion of EIA 767 form data from machine language to a format that is manipulable by relational database and spreadsheet software packages. Neil Gerrans helped me develop an approach for this conversion, and Arthur Taylor provided expert programming assistance in order to accomplish the conversion. In addition to this data assistance, I want to thank Jean Abraham for her help in statistical analysis, particularly in the investigation of learning curves.

Third, I want to thank a number of individuals for their assistance with the patent work contained in this dissertation. Patent examiner Gary P. Straub provided professional advice about patent classifications that was very useful for the development of the class-based dataset. CHI Research experts Francis Narin and Michael Albert provided authoritative assistance that led to the development of the abstract-based dataset. They also provided a computerized dataset that included patents found through the abstract-based search filter. John Warwick, a graduate of Carnegie Mellon University, was invaluable in developing and tailoring a very important computer tool to efficiently use publicly accessible patent websites for many purposes. I am very grateful to him for his long-standing cooperation and assistance. In addition, I would like to thank Grant Bromhal, Tamara Bedic, Kelly Baldrate, Tamar Rosenfeld, Asish Arora, and Laura Dugan for their help with various parts of the patent analysis.

Fourth, I would like to thank three people for their assistance with the content and network analyses of the SO_2 Symposium. Jennifer White did an excellent job in coding the many conference proceedings. Arthur Taylor again provided skilled computer assistance, particularly in the development of co-author matrices. Jusung Lee was also very important to the success of the final network graph construction process due to his expert programming skills and knowledge about network analysis and Krackplot 3.0.

Besides these individuals who were so important to specific sections of this dissertation, I want to thank the many friends I have made at Carnegie Mellon University and elsewhere for their enriching conversations on research as well as their emotional support. Engineering and Public Policy staff, past and present graduate students, and some faculty members have been especially helpful. A partial list of supportive friends includes Indira Nair, Alan McDonald, Nigel Clarke, Tiziana Casciaro, Ned Welch, Kristina Dahlin, Tom Astebrook, Rahul Tongia, and Jim Corbett.

No acknowledgements section would be complete without acknowledging the intellectual and emotional support of my family. Al, Betsy, and Arthur Taylor have been there for me from my beginnings right to the day I defended and hopefully for many years to come.

Finally, but most importantly, I want to thank my wonderful husband, Angelo Del Priore, for his years of friendship and love. I will always be grateful to him for his sacrifice in moving to Pittsburgh to be with me while I finished my PhD. He is my teammate and my partner, and I don't know what I would have done without the love and support he provided me (not to mention the occasional kick in the pants when I needed one). This dissertation is dedicated to him.

Financial support for much of this work was provided by the Center for Integrated Study of the Human Dimensions of Global Change, a joint creation of the National Science Foundation (SBR-9521914) and Carnegie Mellon University.

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Chapter 1 Introduction

Motivation and Definitions

In the management field of strategy, it is understood that the structural conditions of many industries are strongly determined by government policies. Michael Porter's seminal book, *Competitive Strategy*, lays out several ways in which government affects the forces driving industry competition. Government actions, including regulation and subsidies, can form a barrier to entry or even exit in an industry. Similar actions can strongly affect the relative positions of an industry's suppliers and buyers (government can also *be* a supplier or a buyer itself). Finally, government actions can affect the positions of substitutes vis-à-vis existing firms, as well as rivalry among existing competitors (Porter, 1980).

Less well-developed in the management and economics literatures, however, is the concept that a diverse set of government actions is similarly influential in the decisions of organizations both to engage in and to manage innovative activities. One reason for this is that it is difficult to parse out the role of government from among the numerous factors driving innovation. By studying innovation in an area in which government clearly plays a strong role, however, it should be possible to gain insights into the relationship between government actions, private innovative activities, and ultimately, the technologies that result from innovation. These insights could lead to a better understanding of the inducement mechanisms for innovation inherent in government actions, ranging from regulations to taxes to subsidies to public innovative activities, in a number of industries in which government plays a more subtle role. With this enhanced understanding, it should be possible for better policies to be designed to promote innovation for social and economic goals ranging from industrial competitiveness to environmentally sustainable growth.

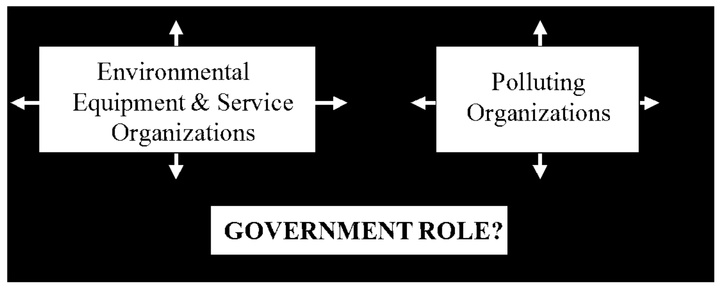
In light of these eventual policy goals, this dissertation studies the interaction between government actions and innovative activities in a technology area in which government is well known to play an important role: environmental control technology. As referred to in this dissertation, environmental control technology is equivalent to end-of-pipe technology, or the subset of environmental technology that reduces emissions of pollutants after they have been formed (see U.S. Environmental Protection Agency, 1997). There are two main reasons why government has a strong role in promoting innovation in environmental control technology. First, environmental technological innovation has been considered by academics to be central to meeting environmental goals since at least the mid-1970s (see Kneese and Schultze, 1975; Magat, 1978; Orr, 1976). In recent years, the appeal of promoting environmental technological innovation has increased as concerns about global climate change mitigation and the maintenance of economic growth have grown. Examples of environmental policy instruments with technological goals incorporated into their design include: "best available control technology" standards in command and control regulation that provide first mover advantages and lock-in possibilities to innovators; market-based instruments that encourage the development of lower cost environmental technology options; and subsidies that attempt to support an appropriate level of expenditure on environmental control technology research, development, and demonstration. The second reason for a strong government presence in fostering innovation in environmental control technology stems from the fact that a clean environment is a public good that typically provides weak market incentives for private investment and development.

There are, of course, very important private actors involved in innovation in an environmental control technology, and two are particularly central: polluting organizations and organizations that manufacture, sell, and service environmental control equipment. Although polluting organizations conduct a broad range of innovative activities to meet environmental control obligations and occasionally produce environmental control equipment for their own use, the more typical situation is that these organizations purchase environmental control technology from outside suppliers (see Kemp 1997, p. 40). These outside suppliers conduct important innovative activities both to maintain their in-service technologies and to develop new generations of their technologies. There are two important parallels between the innovative activities conducted by both polluting organizations and environmental equipment suppliers. First, both organizations, to a greater and lesser extent, often have more important lines of business than environmental control; innovative activities in these technologies are therefore not always the highest research and development (R&D) budget priority for these organizations. Second, neither organization typically conducts innovative activities in a vacuum; both learn from each other, as well as from other sources of innovation in environmental control technology such as government, universities, and non-profit research and development organizations.

Because of this interconnectedness of sources of innovation in environmental control technology, innovation in this area must be depicted and investigated as revolving around a complex of organizations. Figure 1.1 represents the "black box" of an "industrial-environmental innovation complex," defined by the relationships among organizations involved with innovation in an environmental control technology. The arrows surrounding the two central private actors in this figure represent organizational connections, primarily to the other sources of innovation discussed above.

FIGURE 1.1

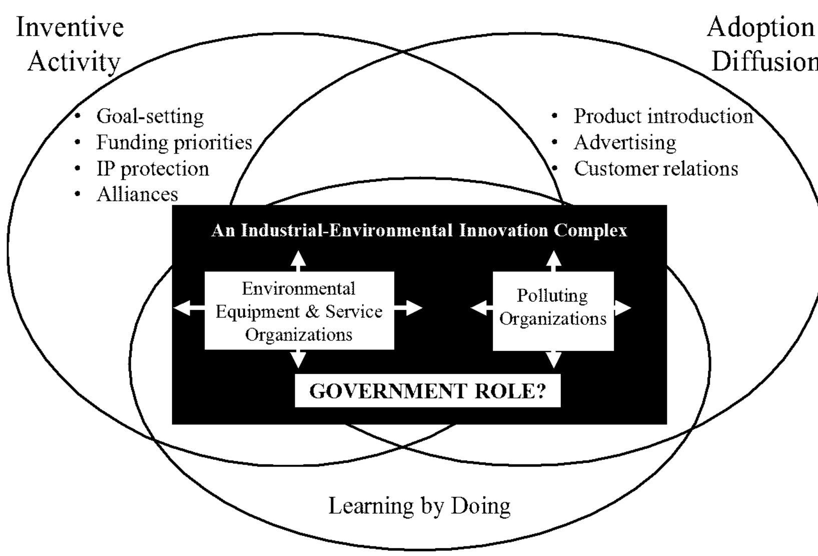
An Industrial-Environmental Innovation Complex



Inside this black box, overlapping innovative activities occur, while outside this black box, innovative outcomes can be observed in the technologies that result from these activities. Figure 1.2 illustrates the combined innovative activities of invention, adoption and diffusion, and learning by doing that take place within an industrial-environmental innovation complex, and provides sample business choices that are related to these activities.

FIGURE 1.2

Sample Innovative Activities within an Industrial-Environmental Innovation Complex



The depiction of innovative activities in this figure is partially based on definitions in Rogers (1995), Rosenberg (1994), and Schumpeter (1942). In keeping with definitions begun in

Schumpeter (1942), "invention" or "inventive activity" here refers to the development of a new technical idea. As stated in Clarke and Riba (1998), "an invention is an idea, sketch, or model for a new device, process or system. It might be patented or not, it might lead to innovation or not." "Innovation," or "adoption" here, in Schumpeter's rubric refers to the first commercial implementation of a new invention into the marketplace. "Diffusion" refers to the widespread use of a commercial innovation and is often studied by researchers as a communication process through which future users become persuaded to adopt new technologies, in part due to information from previous users (Rogers, 1995). Finally, post-adoption innovative activities that result from knowledge gained from operating experience, such as "learning by using," "learning by doing," and "reinvention," are referred to here as "learning by doing." Learning by doing refers to technological improvements that occur as a result of a user's modifications of the operations of an adopted innovation in order to correct difficulties or take advantage of opportunities observed during operation. Studies have shown that a considerable amount of innovative activity can be traced to operating personnel or to the contact of other researchers with operating personnel (for a discussion, see Cohen and Levin, 1989).

Previous Research

Previous research on the effects of government actions on innovative activities in environmental technology can be found in two literatures.[1] The first, the mainstream innovation literature, is rather large and generally traces its origins to Schumpeter (1942). It is this literature, which often consists of aggregate, multi-industry empirical economic studies (although sociological studies and some focused case studies are also included) that is the basis for the

[1] In both literatures, the broader set of technologies encompassed by "environmental technology" is generally addressed, rather than the more limited "environmental control technologies."

definitions of innovative activities used in this dissertation (for a review, see Stoneman, 1995). This literature is generally centered on technologies for which market forces have been the primary drivers. Environmental technology, however, was considered in this literature at least as early as a 1969 article by Rosenberg that sought historical examples of the "forces which provide inducements to technical change ... what Hirschman has called 'inducement mechanisms' [reference to Hirschman (1958) in Rosenberg (1969, pg. 1)]." One of the inducement mechanisms Rosenberg found was a constraint-imposing environmental legislation that a 1948 article showed improved the competitive advantage of the Swedish sulphate producers that were able to meet it.

Although influential economists and others have dealt with environmental technological innovation in more recent years, their work is typically considered part of a second literature, the environmental technology literature. This literature, while considerably smaller than the mainstream innovation literature, is diverse, encompassing theoretical economic studies, a few large empirical economic studies, and a number of case studies scattered among various disciplines [for a useful review and critique of much of this literature, see Kemp (1997)]. In this literature, the observation made by Rosenberg, among others, that competitive advantage sometimes accrues to firms able to meet environmental constraints has been popularized in the last ten years by debate on the "Porter Hypothesis." This hypothesis emerged from an influential page-long essay by the strategy expert Michael E. Porter in 1991 in which he argues that tough environmental standards that stress pollution prevention, do not constrain technology choice, and are sensitive to costs can spur innovation and thereby enhance industrial competitive advantage (Porter, 1991).

Underlying this idea is the concern that environmental standards only spur innovation if the details of these standards are properly specified; this concern has been a long-standing theme in the environmental technology literature. Since at least the early 1970s, a major thrust of the theoretical economic studies in this literature has been for economists to consider the possibility that "market-based" environmental approaches such as taxes, subsidies, and permits would induce technical innovation more effectively than traditional "command-and-control" regulation. In a review of these theoretical economic studies by Jaffe and Stavins (1995, S-45), the authors found that while most supported the idea that market-based approaches *should* be most effective in inducing innovation, they had inconsistent and inconclusive results about specific approaches. In addition, the authors state that other theoretical research has found that "which policy instruments are most effective in encouraging innovation and diffusion depends upon specific elements of instrument design and/or characteristics of affected firms." (Jaffe and Stavins, 1995, S-45)

The idea that specifics matter to the understanding of the influence of environmental government actions on innovation is especially well articulated in Kemp (1997). He effectively argues that many environmental technology studies ignore four central features of environmental technology innovation.[2] These features are: the innovative role of outside suppliers; the control efficiencies of specific technologies; the implementation issues that affect firm behavior (such as the amount of advance notice given about pending regulation and the speed with which the policy instrument requires firms to act to meet a stated environmental goal); and the complicated relationship between regulators and industry. Two studies that empirically consider the effects of regulatory stringency as a driver of environmental technological innovation, to contradictory

[2] In addition, he argues that many environmental technology studies are seriously limited by tendencies to ignore the political economy effects of policy instruments

results, provide useful examples of the importance of being sensitive to these features. Jaffe and Palmer (1997), for example, found that there is no statistical correlation between pollution abatement expenditures and patenting activity.[3] These authors conduct their analysis as if regulated firms perform all of the R&D measured by patents, although the important innovative role of other organizations has been demonstrated repeatedly (Ashford, Ayers, and Stone, 1985; Dupuy, 1997; Heaton, 1990; Kemp, 1997; Lanjouw and Mody, 1996). Lanjouw and Mody (1996), in contrast, found that pollution abatement expenditures and patent activity parallel each other across environmental media with roughly a two-year lag. These authors assume for measurement purposes that "all environmentally responsive innovation in a field responds to events in a broadly similar fashion." (Lanjouw and Mody, 1996, p. 557) This is despite the fact that specific technologies in an environmental problem area, which often exhibit a variety of control efficiencies, may react differently to different environmental standards. The results of both studies are therefore somewhat in doubt because of their reliance on aggregate data sources that mask the complexities of environmental technological innovation.

Case studies of environmental technological innovation necessarily pay more attention to the specifics of government actions and environmental technologies than do theoretical and some empirical economic studies. What they gain in accuracy, however, they are typically considered to lose in generalizability. One instance in which case studies can have a generalizable impact is when a relatively large number of such studies show similar findings. Such a grouping of case studies has been analyzed and synthesized in an article by Ashford, Ayers, and Stone (1985) that Kemp (1997) states is the most "comprehensive review" of the technology effects of specific environmental policies. In this article, the authors review (although not in complete detail) ten cases of regulation between 1970 and 1985 and their effects on the innovation and diffusion of

[3] Pollution abatement expenditures are the authors' somewhat questionable proxy for regulatory severity.

technologies by private firms. For each case, basic information is provided about the regulated substance and technology, the regulating authority, regulatory characteristics, and the industrial response, including the authors' categorizations of the type and degree of technological innovation. Appendix A contains a table summarizing these cases that was adapted from Ashford, Ayers, and Stone (1985) and Kemp (1997).

Three particularly interesting findings emerge from these cases. First, Ashford et. al. find that "a relatively high degree of [regulatory] stringency appears to be a necessary condition" for inducing higher degrees of innovative activities (Ashford, Ayers, and Stone, 1985, note 36 at 429).[4] Second, Ashford et. al. find that while "excessive regulatory uncertainty may cause industry inaction, too much certainty will stimulate only minimum compliance technology" (Ashford, Ayers, and Stone, 1985 pg. 426).[5] Third, Ashford et. al. find that in some of the cases they studied in which government scrutiny was clear well before regulations were imposed, "anticipation of regulation stimulates innovation" (Ashford, Ayers, and Stone, 1985 pg. 426).[6] Other studies of environmental technological innovation, such as the innovation survey of firms in the United Kingdom by Green, McMeekin, and Irwin (1994) and the diffusion study of the Ontario organic chemical industry by Dupuy (1997), support these findings.

This discussion has focused on findings in the environmental technology literature about innovative responses to characteristics of environmental regulation as well as to "market-based" mechanisms such as taxes, subsidies, and permits. Other government actions that influence

[4] The authors define a regulation as stringent for at least one of three reasons: it requires significant reduction in exposure, it requires costly compliance using existing technology, or it requires significant technological change (Ashford, Ayers, and Stone, 1985).

[5] Examples of some of these regulatory uncertainties can be found in Organization for Economic Cooperation and Development, Environment Committee (1985).

[6] Although the Ashford et. al. examples focused on innovation by polluting organizations, it is likely that anticipation of regulation is a driver of innovation by environmental equipment and service organizations as well. This is because regulation can guarantee a demand for these organizations' products; demand has been shown in the mainstream innovation literature to be an important spur for innovation (see Mowery and Rosenberg, 1982).

environmental technological innovation include innovation waivers, public innovative activities, and efforts by the public to promote technology transfer. The environmental technology literature has basically overlooked the importance of public innovative activities and technology transfer mechanisms in promoting environmental technological innovation, although it has considered past experiences with innovation waivers in the U.S. In theory, innovation waivers – incentive devices built into environmental regulation that generally extend regulatory deadlines and exempt polluting organizations from penalties in return for efforts by firms to develop innovative technologies to meet environmental standards – are very attractive to polluting organizations and regulatory agencies. In practice, innovation waivers proved to be ineffective because of ambiguous requirements, short deadlines, and institutional and administrative difficulties (see discussions in Ashford, Ayers, and Stone, 1985, pp. 443-62, and Kemp, 1997).

Approach and Organization of this Dissertation

This dissertation seeks to contribute to the environmental technology literature by concentrating on an extended case study of innovative responses to multiple government actions centered on the abatement of a single pollutant. This approach has several virtues. First, it learns from the criticisms of aggregate studies by allowing the specifics of policy instruments, environmental technology features, and affected organizations within the industrial-environmental innovation complex to contribute to the resulting insights. Second, it limits the variety of environmental technology features, such as those articulated in Kemp (1997), which could undermine insights into innovative responses since it considers a single set of technologies over time. Third, it allows for the consideration of the effects of many government actions – ranging from command and control regulation, to market-based approaches, to public innovative activities and technology transfer mechanisms – on environmental technological innovation.

This is important because it is the universe of government actions, rather than any single government action, which really affects corporate strategy and resulting innovative activities.

An additional contribution of this dissertation is that it conducts this extended innovation study through the integration of several established and repeatable quantitative as well as qualitative research methods. This is important for two reasons. First, this methodological approach provides a more realistic understanding of innovative processes than any single method would be able to provide (for a useful review of methodological issues in the study of technological innovation, see Cohen and Levin, 1989; Schmoch and Schnoring, 1994). Second, the fact that these methods are well established and repeatable increases the likelihood that the insights of this dissertation will be able to be synthesized with those of similarly conducted future case studies. These insights could then have a more generalized impact on policy discussions related to innovation, particularly in the environmental area.

The case study examined by this dissertation is the set of technologies that control sulfur dioxide (SO_2) emissions from electric power plants. This is a particularly useful case to investigate because the history of both the government actions pertinent to these technologies and innovative activities in these technologies is well documented and long-standing. In addition, the international availability and relevance to other environmental problems of the polluting and controlling technologies involved in this case make the case a useful basis for future comparison with other environmental control technologies.[7] The political, institutional, and industrial history of these technologies is explored in Chapter Two.

The specific methodologies used in this dissertation, which include analyses of U.S. patents, SO_2 control technology conference proceedings, learning curves, and interviews of

[7] Electric power plant emissions are implicated in such environmental problems as global climate change and smog formation, while SO_2 control technologies are seen as the basis of other power plant end-of-pipe solutions.

influential experts, are depicted in Figures 1.3 and 1.4. Figure 1.3 illustrates the methodologies used to delve into the innovative activities of invention, adoption, diffusion, and learning by doing that occur within the black box of the SO_2 industrial-environmental innovation complex. These innovative activities are explored in Chapters Three, Four, and Five. Figure 1.4, on the other hand, illustrates the methodologies used to understand the outcomes of these activities, as observed in technological improvements realized over time. These outcomes are primarily addressed in Chapter Two, although they are contextually important to the entire dissertation. The various insights of Chapters Two through Five are synthesized in Chapter Six.

FIGURE 1.3

Methodologies Used in this Dissertation: Innovative Activities

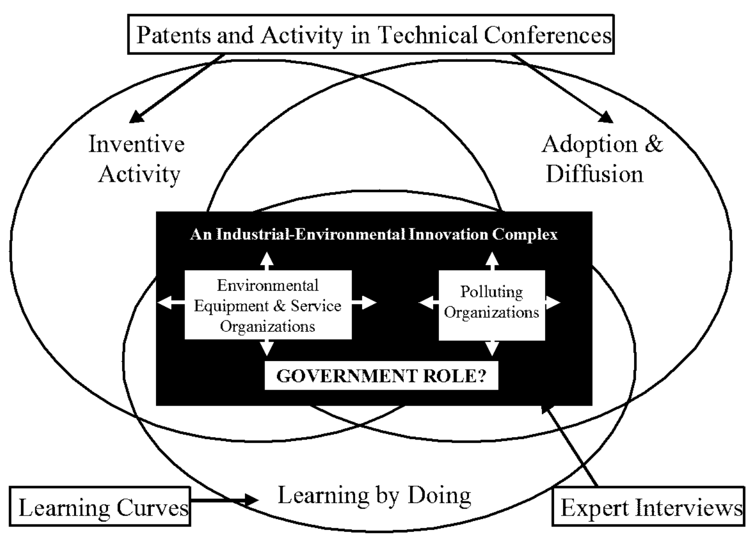
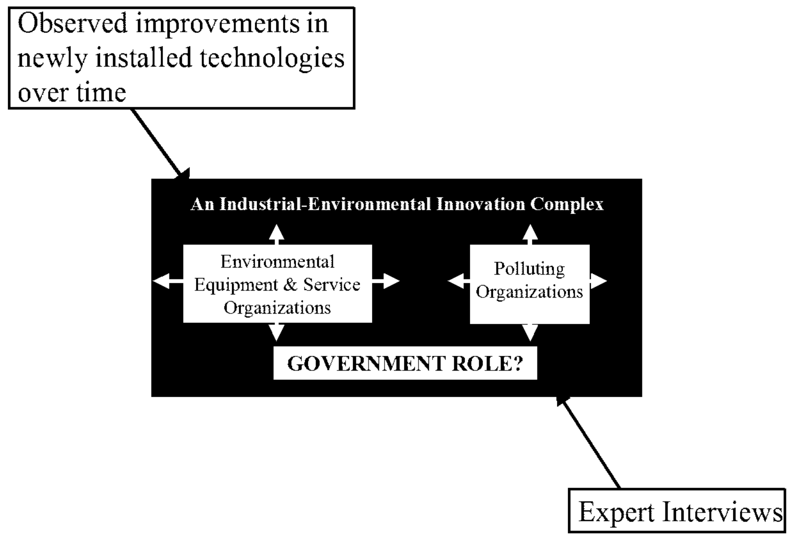


FIGURE 1.4

Research Approach of this Dissertation: Innovative Outcomes



Note on Expert Interview Method

Most of the research methods depicted in these figures lend insight into only one or two overlapping innovative activities or to innovative outcomes, and are thus described in detail in the appropriate sections of Chapters Two through Five. The research method of expert interviews, however, speaks broadly to both innovative activities and outcomes and will briefly be discussed here. Expert interviews were sought for two main reasons. First, they were sought in order to ground the other research methods in the organizational context and constraints of the industrial-environmental innovation complex. Second, they were sought in order to gain insight into the validity of some of the data sources used in the other research methods. For example, they provided insight into the importance of patents to the protection of SO_2 control technologies.

In order to gain the most useful insights out of the interview process, a relatively large, yet logistically reasonable set of experts had to be identified, contacted, and interviewed. There were two main selection factors behind the choice of experts to be interviewed. First, the expert would have to have been significantly active in research in the SO_2 industrial-environmental innovation complex for a long enough period of time to have historical perspective on innovation in these technologies and on government actions that were important to their development. Second, since the SO_2 industrial-environmental innovation complex encompasses multiple sources of innovation, the experts interviewed would have to represent a number of different organizational affiliations. In answer to the first selection criteria, experts were identified primarily through the frequency with which they presented papers at a technical conference held on SO_2 control technologies for over three decades.[8] In answer to the second selection criteria, the experts interviewed represented a variety of organizational affiliations in the SO_2 industrial-environmental innovation complex, including the U.S. government, EPRI, utilities, architect and engineering firms, vendor firms, and universities. Table 1.1 describes the affiliations of the twelve experts interviewed for this dissertation, as well as assigns labels to each of these experts for use in identifying their statements throughout this dissertation.

TABLE 1.1

Characteristics of Experts Interviewed, with Dissertation Identification Labels

Expert Affiliations	Label
Architect and Engineering Firm	A
Utility	B
Environmental Equipment Vendor	C
Utility, Architect & Engineering Firm	D
Consulting Firm, Environmental Equipment Vendor	E
Contract Non-Profit Research & Development Organization	F
Utility	G
University, Government Agency	H
Consulting Firm, Contract Non-Profit Research & Development Organization	I
University	J
Government Agency	K
Consulting Firm	L

[8] For a fuller explanation of the method for interviewee selection, see Appendix B.

The interviews conducted for this dissertation follow the methodological tradition of innovation counts and surveys in the mainstream innovation literature (for reviews, see Archibugi, 1988; Archibugi and Pianta, 1996; Cohen and Levin, 1989; Hansen, 1992; Smith, 1992a; Smith, 1992b). One of the prominent uses of such innovation surveys is to understand what technical experts consider to be significant innovations in a technology area. In this dissertation, experts were asked not only their perceptions of the significant technological and organizational developments in the evolution of SO_2 control technologies, but also their perceptions of significant government actions affecting the SO_2 industrial-environmental innovation complex (the interview protocol is included in Appendix C). In addition, experts were asked targeted questions about some of the data sources analyzed in this dissertation, as well as questions about the role of operating experience in the evolution of SO_2 control technology. The results of these questions are discussed in Chapters Three, Four, and Five, as are expert opinions about the causes of patent trends developed in Chapter Three. More general insights derived from the expert interviews inform the entire dissertation.

Chapter 2 The Innovative Context of SO_2 Control Technologies

Sulfur dioxide (SO_2) is primarily emitted to the atmosphere through the burning of sulfur-containing materials, of which fossil fuels such as coal and oil are the most important examples. SO_2 is, therefore, the byproduct of many long-standing economically productive processes. Table 2.1 demonstrates that, although the importance of selected sources of SO_2 emissions in the United States has changed over time, coal-fired electric power plants have been the primary source of these emissions since 1960.

TABLE 2.1

U.S. Sulfur Dioxide Emissions Estimates, 1940-1998 (Thousand Short Tons)

Year / Activity	1940	1950	1960	1970	1975	1980	1985	1990	1995	1998
Fuel Combustion										
Electric Utilities	2,427	4,515	9,263	17,398	18,268	17,469	16,272	15,909	12,080	13,217
Coal	2,276	4,056	8,883	15,799	16,756	16,073	15,630	15,220	11,603	12,426
Oil	151	459	380	1,598	1,511	1,395	612	639	413	730
Gas	NA	NA	NA	1	1	1	1	1	9	2
Industrial Processes	6,060	5,725	3,864	4,568	3,310	2,951	3,169	3,550	3,357	2,895
Coal	5,188	4,423	2,703	3,129	1,870	1,527	1,818	1,914	1,728	1,485
Oil	554	972	922	1,229	1,139	1,065	862	927	912	773
Gas	145	180	189	140	263	299	397	543	548	558
Other	3,642	3,964	2,319	1,490	1,082	971	579	831	793	609
Industrial Processes										
Chemical & Allied Manufacturing	215	427	447	591	367	280	456	297	286	299
Metals Processing	3,309	3,747	3,986	4,775	2,849	1,842	1,042	726	530	444
Copper	2,292	2,369	2,772	3,507	1,946	1,080	655	323	177	NA
Petroleum & Related Industries	224	340	676	881	727	734	505	430	369	345
Other	334	596	671	846	740	918	425	399	403	370
Transportation										
On-Road Vehicles	3	103	114	411	503	521	522	542	304	326
Non-Road Engines/ Vehicles	3,190	2,392	321	83	99	175	208	934	1,008	1,084
TOTAL ALL SOURCES	19,952	22,357	22,227	31,161	28,011	25,905	23,229	23,678	19,189	19,647

Sources: Adapted from U.S. Environmental Protection Agency, Office of Air Quality Planning & Standards (1997); (1998); and (1999)

Public concern about SO_2 pertains to its negative effects both on human health and on ecosystem well being, although both types of effect have not always been recognized. Its human health effect is as a local eye, nose, and throat irritant, which in the extreme has contributed to such deadly air pollution incidents as the killer smogs that occurred in Donora, Pennsylvania, in 1948 and London, United Kingdom, in 1952 (Snyder, 1994; Cooper and Alley, 1994).[9] In addition, in recent years it has been implicated in increased mortality due to its role as a fine particle. Its ecosystem effect is as a major contributor (with nitrogen oxides) to acid deposition (acid rain), the regional air pollution phenomenon related to the acidification of lakes and streams, plant damage, and reduced forest growth.

Environmental technology strategies pertinent to SO_2 emissions take one of three approaches: (1) alternative power generation technologies such as fluidized bed combustion and synthetic fuels; (2) pre-combustion reduction of sulfur in the burning of lower-sulfur fuels, either naturally as in the case of switching to low-sulfur coal, or technologically through the removal of sulfur from existing coals; and (3) removal of SO_2 from the post-combustion gas stream.[10] Only the latter two of these strategies, pre-combustion and post-combustion removal, involve a technological response relevant to the standard coal-fired power generation processes generally in use over the last thirty years.[11] Pre-combustion control technologies primarily involve physical removal processes such as crushing and grinding to remove inorganic sulfur in the form of pyrite from coal. More advanced chemical and biological pre-combustion technologies exist

[9] These incidents resulted from simultaneous high concentrations of SO_2 and particulates.
[10] Sub-bituminous and lignite coals, found primarily in easily surface-mined deposits in the western U.S., are typically lower in both heat and sulfur content. Bituminous and anthracite coals, found primarily in deposits that are deep-pit mined in the eastern U.S., are typically higher in heat and sulfur content (Laitos and Tomain, 1992, p. 450).
[11] Tall gas stacks that disperse SO_2 from local areas were once promoted by the electric power industry as an effective method of controlling SO_2 emissions from existing generation processes. These are no longer relevant because of regional concerns about SO_2 and acid rain.

that can also remove some of the organic sulfur from coal for a greater overall SO_2 emission reduction, but these processes are costly and exist only in non-commercial stages. None of these pre-combustion technologies, however, removes as much SO_2 as post-combustion control technologies.

These technologies, which are installed on roughly 90 gigawatts (or about one-third) of U.S. electrical capacity, can be grouped under such names as "flue gas desulfurization" (FGD) systems or "scrubbing" technologies. FGD systems involve contacting a post-combustion gas stream with a base reagent in order to remove SO_2. These systems can be categorized as wet, dry, or other, following an article by Jozewicz et. al. in 1999. Wet FGD processes include wet throwaway and gypsum by-product processes involving reagents like limestone, lime, dolomitic lime, sodium carbonate, and seawater. Dry FGD technologies include the throwaway processes of spray drying, sorbent injection into the furnace, boiler, or downstream duct, and circulating fludized bed. Other FGD processes include regenerable processes with reagents such as sodium sulfite (Wellman-Lord) and magnesium oxide, as well as combined sulfur oxide/nitrogen oxide technologies. The two most dominant wet and dry systems will be described here.

The dominant wet FGD systems use limestone as the scrubbing reagent and today achieve reliable, 95%+ SO_2 removal efficiencies.[12] Figure 2.1 shows a simple schematic of a wet limestone FGD system. In the wet scrubber in this figure, limestone slurry is typically contacted with flue gas in a gas absorber where SO_2 is absorbed, neutralized, and partially oxidized to calcium sulfite and calcium sulfate.[13] Equation 2.1 displays the overall stoichiometry of the limestone SO_2 absorption process.

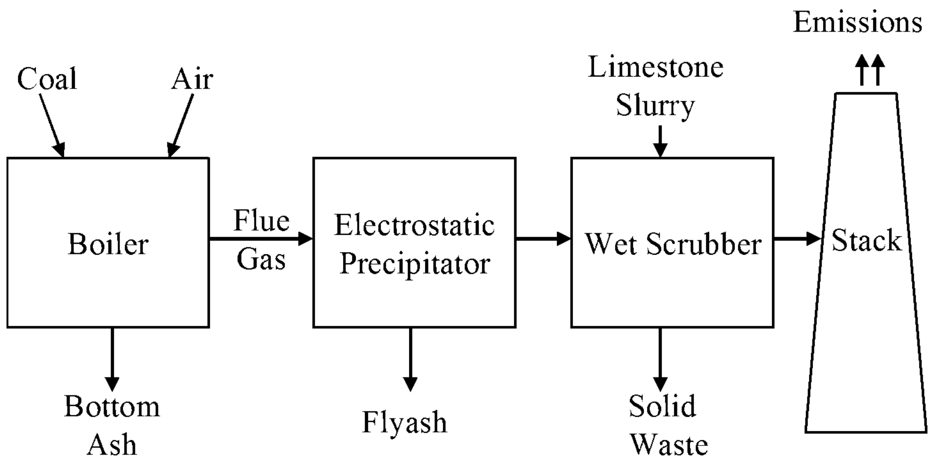
---

[12] Wet limestone scrubbing is dominant in the worldwide utility FGD market in part because limestone is inexpensive and widely available

[13] Absorber devices include packed towers, plate or tray columns, venturi scrubbers, and spray chambers (Barbour et. al. 1995).

FIGURE 2.1

Schematic of a Typical Wet Limestone FGD System



EQUATION 2.1

Stoichiometry of the Limestone SO_2 Absorption Process

$$CaCO_3\,(s) + 2SO_2 + H_2O \rightarrow Ca^{+2} + 2HSO_3^- + CO_2\,(g)$$

$$CaCO_3\,(s) + 2HSO_3^- + Ca^{+2} \rightarrow 2CaSO_3 + CO_2 + H_2O$$

Source: (Cooper and Alley, 1994, p. 454)

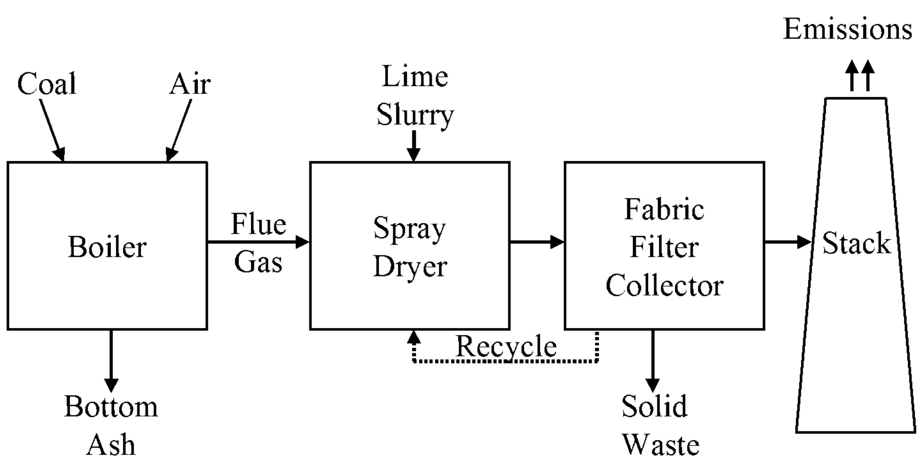
Thorough contact between the gas and the sorbent is essential to the success of the mass transfer operation of absorption. Absorber towers have different flow designs to accomplish this: countercurrent, crosscurrent, and cocurrent. In the most commonly installed countercurrent designs, the waste gas stream enters at the bottom of the column and exits at the top while the sorbent stream does the opposite. One of the main advantages of these designs is that they provide the highest theoretical removal efficiency because gas with the lowest pollutant concentration contacts liquid with the lowest pollutant concentration. In addition, they usually require lower liquid-to-gas ratios than cocurrent designs, in which both the waste gas and the sorbent enter the column at the top of the tower and exit at the bottom (Barbour et. al., 1995). In general, greater liquid-to-gas ratios mean higher SO_2 absorption efficiency, but also higher operating costs because of higher energy needs due to high pressure drops and pumping needs. This is important to consider since the power consumption of a limestone FGD unit is typically large, on the order of 3 to 6% of the power generated by the plant for older FGD systems and 2 to 3% for newer ones (Cooper and Alley, 1994, p. 467). In a crosscurrent tower, the waste gas flows horizontally across the column while the sorbent flows vertically down the column. The advantage of these designs is that they generally have lower pressure drops and require lower liquid-to-gas ratios than the other two designs, while the disadvantage of these designs is that they offer less contact time for absorption (Barbour et. al., 1995).

It is very important to optimize the process chemistry of wet limestone FGD systems; failure to do so can result in scaling and plugging of system internals based on the precipitation of calcium sulfite and sulfate inside the scrubber, as well as corrosion of internals due to the high acidity of the SO_2 removal environment. Since scale typically forms via natural oxidation when the slurry oxidation level ranges between 15 and 95 percent, scaling and plugging issues have largely been resolved in state-of-the-art scrubbers by either increasing the oxygen content of limestone slurry above this range (forced oxidation) or decreasing the oxygen content below this range (inhibited oxidation, accomplished with slurry additives like emulsified sulfur or sodium thiosulfate) (Srivastava, Singer, and Jozewicz, 2000, p. 4). Corrosion has been dealt with through the use of new construction materials such as alloys, clad carbon steel, and fiberglass. An additional concern with wet limestone scrubbing has always been waste disposal, since early vintage scrubber wastes required expensive disposal options such as the construction of large sludge ponds with liners or significant landfilling. Even modern inhibited oxidation processes require landfilling of byproduct calcium sulfite. In limestone forced oxidation processes with nearly complete oxidation of over 99%, however, saleable gypsum byproducts are produced that can be useful in such industries as wallboard manufacture and cement production (Jozewicz et. al. 1999; Cooper and Alley, 1994, p. 454-65). These limestone forced oxidation systems are "the preferred process for wet FGD technology worldwide" (Jozewicz et. al. 1999).

The dominant dry FGD systems are lime spray drying processes, which typically achieve lower removal efficiencies at lower costs and for smaller capacities than wet systems. Figure 2.2 shows a simple schematic of a lime spray dryer FGD system. In lime spray dryers, a lime slurry is sprayed into the tower and SO_2 is absorbed to form calcium sulfite and sulfate. The water evaporates and the dry solids are collected in a fabric filter collector with fly ash. Equation 2.2 displays the overall stoichiometry of scrubbing SO_2 with a lime reagent, which is much more reactive than a limestone reagent (and is similarly more expensive). As in the case of limestone scrubbing, the dilute concentration of SO_2 in flue gas is an issue for dry scrubbing since contact between the gas and the base reagent is essential for SO_2 removal. This is more difficult in dry systems, although ultrafine grinding of reagents has contributed to the resolution of this difficulty (Cooper and Alley, 1994, pp. 457-8).

FIGURE 2.2

Schematic of a Typical Dry FGD System



EQUATION 2.2

Stoichiometry of the Lime SO_2 Absorption Process

$$CaO + H_2O = CaOH_2$$

$$SO_2 + H_2O = H_2SO_3$$

$$H_2SO_3 + Ca(OH)_2 = CaSO_3 * 2H_2O$$

$$CaSO_3 + 2H_2O + 1/2O_2 = CaSO_4 * 2H_2O$$

Source: (Cooper and Alley, 1994, p. 455)

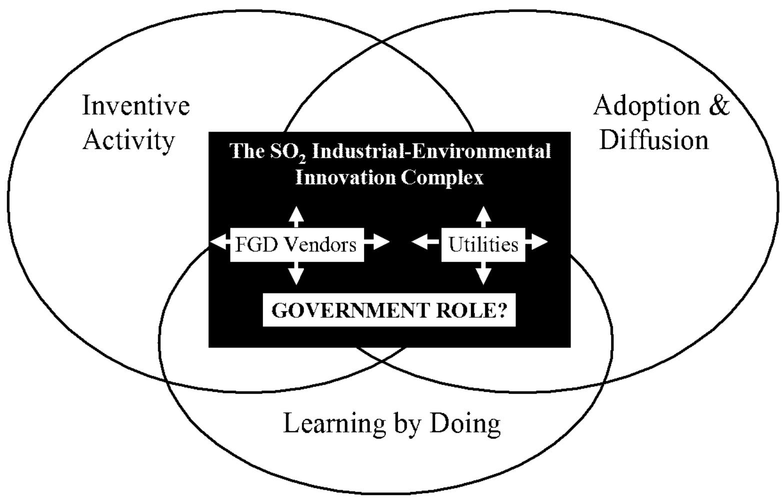
The various post-combustion FGD processes described here provide the central technology set for the SO_2 industrial-environmental innovation complex defined in Chapter One.[14] As a result, the vendors of these systems – wet FGD processes in particular – are the primary environmental equipment and service organizations discussed in this dissertation. The primary polluting organizations discussed are, as previously indicated, the utility companies that

[14] Pre-combustion technologies as well as monitoring and instrumentation technologies help to round out this technology set.

operate coal-fired electric power plants. Figure 2.3 represents the SO_2 industrial-environmental innovation complex as a black box, inside which actors such as FGD vendors, utilities, and government affect the combined innovative activities of invention, adoption and diffusion, and learning by doing.

FIGURE 2.3

Innovative Activities in the SO_2 Industrial-Environmental Innovation Complex



To the first order, government is vital to this complex because it has worked to define, through such actions as legislation, executive orders, and lawsuits, the need to control SO_2 emissions that abatement technologies seek to meet. Some of these government actions, however, have been used not only to define the rationale for and level of SO_2 emissions reductions needed, but have also defined, in various ways, the manner in which emissions reductions should be achieved by polluting organizations. For example, over the past fifty years, SO_2 legislation and its sometimes-accompanying regulation, has: proposed financial incentives for installing abatement equipment; set the stringency of emissions control that technological solutions must meet; defined the flexibility and time constraints that SO_2 polluting organizations have to address abatement requirements; and defined through their scope the market size of equipment suppliers. In addition, government has funded research, training, and technical assistance programs including demonstration projects, grants to vendors, and technology transfer opportunities that directly affected the operation and design of equipment used to control SO_2 emissions.

Government actions, therefore, have had a considerable influence on the SO_2 industrial-environmental innovation complex and its resulting technologies. The remainder of this chapter describes some of the government actions that have influenced the development of SO_2 control technologies since before 1970. It also details some of the actions of other components of the SO_2 industrial-environmental innovation complex over time. In addition, it sketches the chronology of technological changes in SO_2 control throughout the text and in a special section at the end of the chapter that helps to quantify the innovative outcomes observed outside the black box of the SO_2 industrial-environmental innovation complex.

In order to maintain the narrative clarity of over three decades of evolving political, institutional, industrial, and technological developments regarding SO_2 control technologies, the majority of this chapter is broken down into chronological sections. These are oriented around the passage of three major national environmental legislative events involving SO_2 emissions from stationary sources: the Clean Air Act Amendments of 1970, 1977, and 1990. These amendments are landmarks in the evolution of government SO_2 control actions because each establishes a different national regulatory strategy and corresponding technological options for the SO_2 industrial-environmental innovation complex.

Before 1970

Government Actions Before 1970

The role of government in air pollution control evolved from the local level to the federal level during the three decades preceding the passage of the 1970 Clean Air Act Amendments. The first major impetus for the shift in this role is generally considered to be the December 1948 smog incident in Donora, Pennsylvania, during which twenty people died and over 6,000 became ill (see Snyder, 1994; Bailey, 1998, p. 89). In 1949, representatives of the Donora and Pittsburgh areas introduced the first two air pollution control bills in Congress, although no action was taken on them. These two bills called for greater research into the health effects of pollution, and similar bills over the next few years also called for health research as well as possible methods of preventing pollution, including tax relief for the purchase by companies of pollution abatement equipment (see Bailey, 1998).

The similarity of the Donora incident to other incidents in urban areas in America over the preceding fifty years, however, "did little to shake the prevailing belief that air pollution was a periodic, local problem that could be addressed by local governments" (Bailey, 1998, p. 91). More important in changing this perception were the recurrent automobile-driven smog of Los Angeles and the efforts of a number of members of California's congressional delegations to bring air pollution under federal control. As a result of failed legislative efforts and a successful lobbying effort of President Eisenhower led by Senator Thomas H. Kuchel of California, the nation's first major national air pollution legislation was drafted as an amendment to the 1948 Water Pollution Control Act. When it was signed in 1955, the resulting Air Pollution Control Act provided for five million dollar annual authorizations for five years under the rubric that the federal government should protect the right of states and local governments to control air pollution while supporting and aiding research and devising and developing abatement methods (Bailey, 1998, pp. 95-6). The Air Pollution Control Act, which was extended in 1959 and 1962, provided for federal surveys of specific local problems upon request and for the publication of reports by the Surgeon General. The authorized five million dollars was to be spent on demonstration projects, grants-in-aid to state and local government air pollution control agencies, and for research by the Public Health Service (PHS).

Congress followed this initiative by passing the Clean Air Act in 1963. The research of the Air Pollution Control Act had provided evidence to Congress of the extent of the air pollution problem and "the inadequacy of state control arrangements" (Bailey, 1998, p. 104). Beyond research results, public concern about air pollution had been growing for some time. The London smog disaster in 1952, in which almost 700 people died, had received a large amount of publicity. This incident combined with broad public concern about fallout from the atmospheric testing of nuclear weapons to heighten public awareness about air pollution. Then in 1962, the publicity received by the publication of Rachel Carson's book *Silent Spring* appeared to provide a catalyst to transform this concern into civic action. Associations representing local politicians began to lobby for an enhanced federal role in response to growing constituent concern, and the Kennedy and then Johnson administrations supported such an enhanced role. When signed on December 17, 1963, the Clean Air Act authorized $95 million for fiscal years 1964-67 to expand the traditional federal role in conducting research and offering financial assistance to the states. But for the first time it also empowered the federal government, through the Secretary of the Department of Health, Education, and Welfare, to take legal action against interstate polluters.

During the remainder of the 1960s both public and congressional interest in air pollution control grew. For example, the results of periodic public opinion polls by the Opinion Research

Corporation demonstrate that a rapidly increasing percent of respondents agreed that air pollution was a "very or somewhat serious problem." Although only 28% agreed with this statement in 1965, this percentage increased to 48% in 1966, 55% in 1968, and eventually 69% in 1970 (see Bailey, 1998, pp. 125, 140; Erskine, 1972). By 1970, pollution was considered the second most important problem facing the nation (Jones, 1973).[15] Major air legislation passed in 1965 (the Motor Vehicle Air Pollution Control Act) and in 1967 (the Air Quality Act), while minor reauthorizations passed in 1966 (the Clean Air Act) and 1969 (the Air Quality Act). In 1966, the first action to provide tax relief for investments in air pollution control equipment passed after the defeat of forty-four previous tax incentive bills introduced between 1949 and 1965 (Bailey, 1998, p. 126).[16]

The 1967 Air Quality Act was the first national environmental legislation in which lobbying at cross-purposes emerged between the coal industry and the utility industry on the issues of abatement equipment and federal air pollution standards for stationary sources. The coal industry was particularly interested in "federal pre-emption of state authority and greater research into abatement technologies" because of strict air pollution efforts outside of the federal legislative sphere (Bailey, 1998, pp. 128-9). The New York City Council in 1965 had severely restricted the use of high sulfur coal, including an outright ban for domestic heating appliances. Four northeastern states in December 1966 had announced plans to combat air pollution that threatened the coal industry. And in March 1967, the Secretary of the Department of Health, Education, and Welfare published a report that recommended reducing the reliance on high sulfur coal because citizens in virtually all major American cities were exposed to unhealthy

[15] This perception was enhanced by the January 1969 Santa Barbara oil spill and the inflaming of Cleveland's Cuyahoga River in the summer of 1969 (Bailey, 1998, p. 140).
[16] Air pollution control equipment was exempted from the suspension of the tax investment credit in new and used machinery provided in the Revenue Act 1962.

levels of SO_2. The coal lobby's influence helped incorporate into the Air Quality Act, as signed by President Johnson on November 21, 1967, $125 million (down from the Senate's proposed $375 million) for research into methods of reducing the pollution caused by fuel combustion. The 1967 Air Quality Act also directed the states to set ambient air quality standards; if the states did not do so in fifteen months after passage, the act called for federal intervention. But although various drafts of the Air Quality Act incorporated federal emissions standards, the bill as finally passed did not (Bailey, 1998, p. 135).

In the period before 1970, therefore, there were three major government legislative actions on air pollution that were particularly relevant for the control of SO_2 from stationary sources: the 1955 Air Pollution Control Act, the 1963 Clean Air Act, and the 1967 Air Quality Act. In all three of these measures, Congress provided research funding, with provision of a federal role in demonstration programs included as early as 1955. Federal financial assistance to state and local governments for the control of air pollution was also an aspect of all three of these measures. Finally, these three measures evince a growing federal enforcement role in air pollution, from authority over interstate polluters in 1963 to all states without ambient air quality standards by February 1969. Congress and the President would expand the federal role even further in the 1970s.

Other Actions by the Industrial-Environmental Innovation Complex Before 1970

The earliest FGD device used by an electric power plant was installed in 1926 at the Battersea Power Station in London, England. The alkaline water from the Thames River provided most of the reagent for the device as well as the ultimate destination of the scrubber effluent. Other early scrubbers using lime as the reagent were installed in the United Kingdom in 1935 and 1937, but they were shut down early in World War II due to the concern that their "vapor plumes provided possible aerial guidance to enemy aircraft" (see McIlvaine, 1990).

Lime/limestone scrubbing did not reemerge until the 1950s. In the United States, the Tennessee Valley Authority (TVA) conducted small-scale and limited pilot-plant studies. Large-scale FGD operations, however, first occurred abroad. In 1964, a scrubber installation began operating at an iron ore sintering plant in Russia, and in 1966, a lime scrubber began operating at a large sulfuric acid plant in Japan (McIlvaine, 1990).

The first major plant work in the United States appears to have been that of Universal Oil Products (UOP) at a Wisconsin utility installation beginning in 1965. In 1966, Combustion Engineering, in conjunction with National Dust Collector Riley Environeering, tested a system involving boiler injection of limestone, followed by scrubbing, in a pilot unit at a Detroit Edison power plant. The first commercial installations of this process in boilers larger than 100 MW occurred in St. Louis, Missouri, and Lawrence, Kansas, in 1968. The pilot installation of this process demonstrated SO_2 removal of 98 percent at a stoichiometric limestone-to-SO_2 ratio of 1.1 to 1. Unfortunately, the installations demonstrated a number of problems, including pluggage, and the design was then changed so that limestone was no longer introduced directly into the boiler but rather into slurry recycle tanks. This change improved the reliability of the system, although it resulted in lower SO_2 removal efficiencies (McIlvaine, 1990).

The U.S. FGD equipment and services industry, therefore, had its start in the years before 1970, although significant growth did not occur in this industry until after 1970. By the late 1960s, however, there was enough interest in the operating experience problems of FGD technology that the first SO_2 Control Symposium was held in 1969. This conference continued to convene regularly and became a major agent of knowledge transfer in the SO_2 industrial-environmental innovation complex.

1970-1976

Government Actions 1970-76

The debate about what level of government should have jurisdiction over air pollution continued into the 1970s. Many favored the primacy of state and local governments based on the idea that they best understood local air conditions and industry sources. Others favored a strong role for the federal government because of its large resources and ability to set uniform industry standards that would keep the competitive playing field level. The 1970 amendments to the Clean Air Act, in fact, incorporated both of these positions.

The 1970 Clean Air Act Amendments (1970 CAA) were signed on December 31, 1970, almost a year after President Nixon submitted proposals with some of its basic provisions. The 1970 CAA divided the nation's sources of SO_2 emissions into two categories – existing and new – and directed the newly created Environmental Protection Agency (EPA) to set National Ambient Air Quality Standards (NAAQS) for criteria air pollutants, including SO_2.[17] These pollutants, so-called because the NAAQS were established based on health criteria, were to be subject to primary standards, which protected human health, and secondary standards, which addressed such environmental welfare concerns as structures, crops, animals, and fabrics (Cooper and Alley, 1994, p. 3; Findley and Farber, 1992, pp. 100-1). Primary NAAQS were expressly prohibited from taking into consideration economic or technical feasibility.[18] For SO_2,

[17] Presidential Reorganization Order #3 created this agency in July 1970 by combining fifteen existing units of the federal executive branch, particularly from the National Air Pollution Control Administration in the Department of Health, Education, and Welfare (Ackerman and Hassler, 1981 p. 133; Zimmerman et. al., 1980, p. 3-2).
[18] This was affirmed in Union Electric Co. v. EPA (1976) (Laitos and Tomain, 1992, p. 157).

the NAAQS were set at values of 0.14 parts per million (ppm) averaged over one day, and 0.03 ppm averaged over a year.

Within nine months of the promulgation of an NAAQS, each state had to submit to the EPA a State Implementation Plan (SIP) setting out how the state would achieve and maintain the NAAQS for existing sources.[19] According to the 1970 CAA Section 110 (a) (1-2), a SIP was required to provide for the attainment of primary NAAQS within three years of the plan's approval. Secondary standards were to be achieved within "a reasonable time." Once the EPA Administrator approved a SIP, it became enforceable as both state and federal law, with penalties up to $25,000 per day and up to one year in prison for each SIP provision violation (Bryner, 1995, p.101; Findley and Farber, 1992, p. 103). Under the SIPs, SO_2 emissions from existing sources that contributed to violations of primary NAAQSs were to be eliminated by 1975-77. Thus, the SIPs became an important regulatory force for reducing SO_2 emissions from existing power plants and other sources.

The 1970 CAA also spoke to new sources when it directed the EPA to set nationally unified performance standards for major categories of stationary sources including fossil-fuel-fired steam electric generators. Section 111 of the 1970 CAA stated that the EPA Administrator was to set these performance standards in a manner that would take advantage of the "best system of emission reduction which (taking into account the costs of achieving such reduction), the Administrator determines has been adequately demonstrated (Ackerman and Hassler, 1981, p. 11)." In December 1971, the EPA fulfilled this mission by setting New Source Performance Standards (NSPS) for SO_2 emissions from new and modified steam generators with a heat input greater than 250 million British Thermal Units (MBTU) per hour. The NSPS for SO_2 set a

[19] The EPA promulgated NAAQS on the first five criteria air pollutants in April 1971 (Bailey, 1998, p. 167).

maximum allowable emission rate of 1.2 pounds of SO_2 per MBTU of heat input. This standard was based on the EPA Administrator's finding that the ability of scrubbers to eliminate at least 70 percent of a coal burner's SO_2 had been adequately demonstrated. This would allow the NSPS to be met with the use of scrubbers, based on the combustion of the high sulfur eastern coals typically in use at the time (the sulfur content of these coals was about 4 pounds of SO_2 per MBTU heat input, so a 70% reduction would allow the emission of 30% of the SO_2 per MBTU combusted, or 1.2 pounds per MBTU).[20] Alternatively, plants could burn low-sulfur coals (of about 0.7% sulfur or less) and still achieve the NSPS emission level. Such low-sulfur coals were generally available only in the western U.S., however, which was remote from most coal-fired power plants at the time.

In addition to the 1970 CAA and its associated NSPS for SO_2 from stationary sources, two other legislative developments of note occurred in 1970-76 that had implications for SO_2 control.[21] First, in response to the Arab oil embargo of October 1973 and the resulting U.S. energy crisis, President Nixon signed the Energy Supply and Environmental Coordination Act (ESECA) in June 1974 in order to promote the use of domestic coal versus foreign oil.[22] The ESECA emerged from a lengthy legislative process in which the philosophy of the 1970 CAA came under attack. As passed, it reauthorized the 1970 CAA for another year while allowing suspensions of final clean air standards until January 1, 1979, provided that primary NAAQS would not be violated (Bailey, 1998, p. 182). The second important legislative development arose from some of the court challenges to the 1970 CAA and the EPA that were undertaken at

[20] See description of 37 Fed. Reg. 5767-71 (1972), published after Kennecott Copper Co. v. EPA, 462 F. 2d 846 (D.C. Cir. 1972) required more specific explanations of the reasoning underlying the EPA's ambient air regulations (Ackerman and Hassler, 1981, p. 19, 139).
[21] Also of interest was the introduction of a bill in 1971 to tax SO_2 emissions (Bailey, 1998, p. 171).
[22] In the mid-1970s, oil-fired generation represented 16-17 % of U.S. generation (Energy Information Administration, 2000b, p. 215).

cross-purposes by environmentalist and industrial lobbying groups during the 1970-76 period. In one of these cases, Fri v. Sierra Club 412 US 541 (1973), the Supreme Court agreed with environmentalists that the EPA could not approve SIPS that permitted the degradation of areas of air that were cleaner than the 1970 CAA minimum standards. In response to this decision, in 1974 the EPA issued "prevention of significant deterioration" (PSD) regulations that divided all clean air areas of the country into three categories based on their levels of industrial development. Pristine parks and wilderness areas were to be allowed almost no change in existing air quality, while areas in the other two categories would be permitted industrial development ranging from moderate to the maximum possible without violating national air quality standards.

Multiple options were available to utilities to attain compliance with federal SO_2 legislation and regulation in the 1970-76 time period, but EPA officials particularly promoted scrubbing in part due to perceived difficulties with alternative options. One alternative to scrubbing, switching to low-sulfur western coal, was considered unfeasible due to its heat and ash characteristics, high transport costs, and perceived unavailability compared to more abundant higher sulfur coals. This availability concern was especially important since the United States was trying to increase its fossil fuel independence during the energy crisis, and reliance on a limited supply fuel would not advance this goal. Other alternatives to scrubbing, such as chemical coal cleaning, fluidized bed combustion (FBC), solvent refined coal, and low-BTU gasification, were researched during this period but not considered to be even potentially competitive until the early 1980s. In addition, between 1973 and 1976 EPA officials removed their support for tall stacks and other supplemental control systems that primarily dispersed SO_2 for local health concerns as new findings on sulfate transport emerged (Gage, 1976; Quarles Jr.

et. al., 1974; Train, 1976). The only exception to EPA's generally negative stance toward scrubbing alternatives lay in technologies such as physical coal cleaning and the blending of low- and high-sulfur coals, which were considered sufficient control methods for plants facing modest reductions.

In support of its position favoring FGD technology, the EPA engaged in multiple research, development, demonstration, and technology facilitation activities during this time period, six of which are noted here. First, starting in 1967 and lasting throughout the 1970-76 period, the EPA and its predecessors began funding the Tennessee Valley Authority (TVA) Office of Agricultural and Chemical Development to prepare cost estimates of various FGD processes. These estimates required the TVA to be very familiar with the state of technology development over the years (McGlamery et. al., 1976). It is important to note that TVA was a good choice for these estimates. TVA held the unique position among utilities of being not only the nation's largest electric utility system but also a quasi-governmental agency with good working relationships with government (Durant, 1985, pp. 8, 36-7).[23] Eighty percent of TVA's generation came from a number of high-sulfur coal burning steam plants first constructed in the late 1940s, so it had a strong interest in SO_2 control strategies (see McCraw, 1976; Durant, 1985). Finally, TVA had significant expertise in air quality protection (although not to the same extent as water quality). TVA had pioneered electrostatic precipitators for controlling particulate emissions in the 1950s, its expertise in modeling the effects of wind currents on pollution

[23] TVA was established in the 1930s under Franklin Delano Roosevelt's New Deal in order to provide low-cost power that would fuel the economic development of the depressed Tennessee Valley. It was under federal oversight through the congressional appropriations process, yet it had private organizational direction through a three-member board.

transport was world-renowned, it had installed an early, experimental FGD system in the 1960s, and it had also developed a system-wide intermittent SO_2 control strategy in the 1960s.[24]

In addition to this technology evaluation activity with TVA, the EPA supported five other research, development, demonstration, and technology facilitation activities in the 1970-76 period. First, the EPA established the influential Shawnee test facility in April 1972, in cooperation with TVA and the engineering firm Bechtel. Equipped with three 10 MW boilers, this facility provided invaluable operating data on scrubbing, beginning with lime/limestone systems (Quarles Jr. et. al., 1974). Second, in 1973 the EPA began its financial commitment to the SO_2 Control Symposium, a technical conference that continues today. Third, in March 1974 the EPA contracted with PEDCo-Environmental Consultants, Inc. to evaluate the status of FGD technology in the U.S. on a bimonthly basis (Devitt, Isaacs, and Laseke, 1976). These FGD evaluations continued into the late 1980s. Fourth, the EPA engaged in cooperative research and demonstration activities with utility/vendor teams and in 1975 signed a Memorandum of Understanding with the recently formed Electric Power Research Institute (EPRI, founded in 1973) to "facilitate sharing of technical information and cooperation of R&D projects (Gage, 1976)." Finally, the Federal Nonnuclear Energy Research and Development Act, passed in December 1974, provided the legislative authorization for the EPA's energy/environmental control technology program, which was to be particularly important in conducting SO_2 control research in the late 1970s (Zimmerman et. al., 1980).

Government actions in the 1970-76 period centered around the 1970 CAA, which spawned litigation, legislation, and research. Both the 1970 CAA and the 1971 NSPS were flexible regarding the viable technological alternatives for attainment for both existing and new

[24] This plan included increasing stack height to dilute emissions, periodic shutdowns when SO_2 levels were high, and burning low-sulfur or cleaned coal when health hazards existed.

sources of SO_2, and a number of technological strategies were pursued during this time. The stringency of the NSPS and the limited availability of coal emitting less than 1.2 pounds of SO_2 per MBTU, however, provided a particularly strong incentive for the development of FGD technology. The tight deadline for attainment of primary SO_2 emissions standards – May 31, 1975 – also provided a profit incentive for FGD vendors to expand their commercial capabilities.

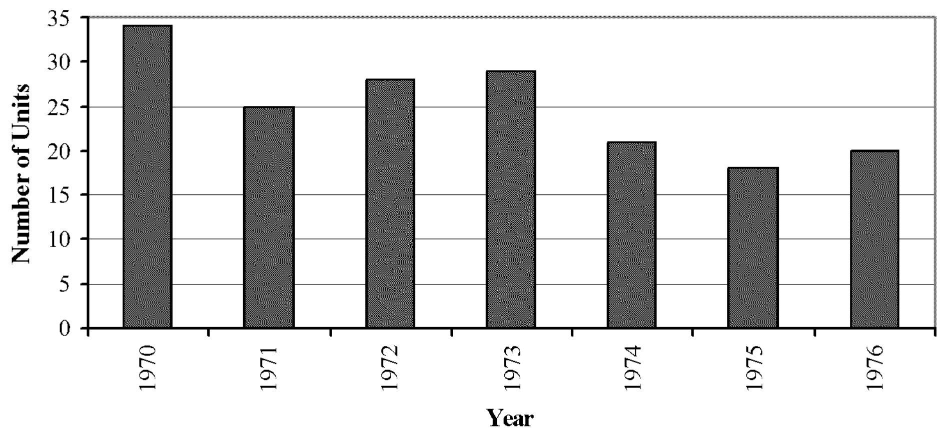
Other Actions by the Industrial-Environmental Innovation Complex 1970-76

By the time of the promulgation of the SO_2 NSPS in 1971, only three commercial scrubber units were operating on power plants in the United States. The oldest of these would be discontinued later that year (Ackerman and Hassler, 1981). The next five years, however, saw the total number of commercial scrubber units grow by a factor of ten.

In order to understand the market forces operating on the SO_2 industrial-environmental innovation complex, it is important to keep in mind the 1970 CAA division of sources into the categories of "existing" and "new and modified." In general, "new" FGD units accompany the construction of new coal-fired utility boilers, while "retrofit" FGD units are constructed on existing boilers. Figure 2.4 shows the number of new utility-operated coal-fired steam turbine units brought online between 1970 and 1976. This is the market background for new FGD units, particularly after the 1971 NSPS. Figure 2.5 shows the total number of commercial FGD units brought online between 1973 and 1976, broken down into the realized categories of new and retrofit construction. By comparing the two datasets underlying these figures, it appears that 10% of the new coal-fired boilers brought online between 1973 and 1976 had new FGD units. Retrofit FGD technology accounted for 72% of total FGD unit installation between 1973 and 1976 and was thus the driver of the utility FGD market. This is despite the construction of significant numbers of new coal-fired boilers after the 1971 NSPS and despite the fact that retrofit technology was generally 25-30% more expensive than new technology during the 1970-76 period (Ackerman and Hassler, 1981, p. 135).

FIGURE 2.4

Number of New Utility-Operated Coal-Fired Steam Turbine Units in 1970-76

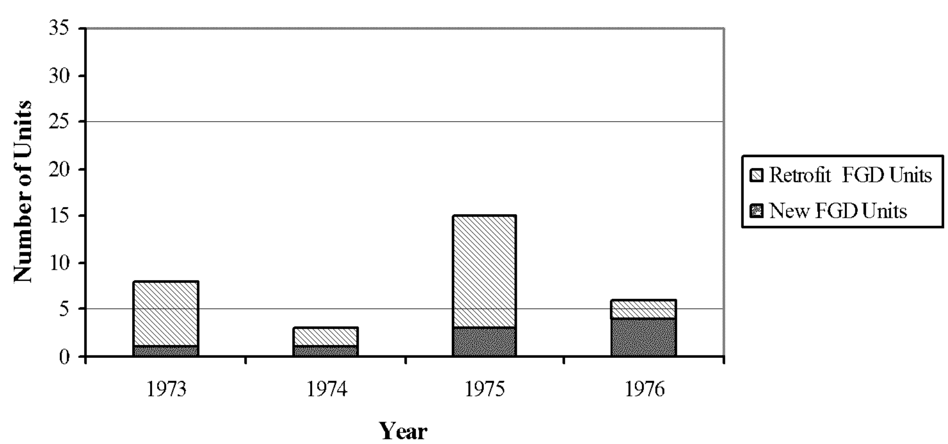


Source: Adapted from Energy Information Administration (1996)

Notes: The year of commercial operation is the year that control of the unit was turned over to the dispatcher. Includes all units active since 1970.

FIGURE 2.5

U.S. Scrubber Market, 1973-76



Source: Adapted from Soud (1994)

The predominant type of FGD technology in 1970-76 was wet lime/limestone, but some utilities during this period had begun to investigate less expensive spray dryers. In addition, a few commercial regenerable processes were installed in the early 1970s (Devitt, Isaacs, and Laseke, 1976; McIlvaine, 1990). According to a 1976 overview of FGD technology by PEDCo-Environmental Consultants, Inc., SO_2 removal efficiencies ranged from 40 to 90% during the 1970 to 1976 period. FGD technology had been installed during this period on units varying both in size – from 30MW to 800MW – and in the sulfur content of coals consumed.[25] The PEDCo-Environmental Consultants, Inc. overview also noted that

> (1) More systems are being installed to meet state standards that are more stringent than NSPS levels. (2) More systems are being installed on low sulfur coal vs. high sulfur coal applications. (Devitt, Isaacs, and Laseke, 1976, p. 18).

The number of scrubber vendors increased greatly during the 1970-76 period and throughout the 1970s. In 1971, only one scrubber vendor was in the utility FGD market. In 1972, two firms were in the market. A year later, seven vendors (Peabody International, Combustion Equipment Associates, Chemico, Research-Cottrell, Combustion Engineers, Davy Powergas, and UOP) "stated that they are now prepared to offer full scale commercial systems (Quarles Jr. et. al., 1974, p. 32)." In 1974, there were ten such vendors, in 1977 there were thirteen such firms, and in 1978 there were fourteen scrubber vendors in the FGD market. By the end of the 1970s, sixteen U.S. firms supplied FGD systems to utilities, as did the U.S. government agencies of TVA and the Department of Interior's Bureau of Mines. The foreign firms Chiyoda International, Davy Powergas, and Mitsubishi International Heavy Industries Ltd., also served the U.S. utility FGD market by the end of the 1970s.

Table 2.2 lists the sixteen U.S. scrubber vendors and shows relevant acquisition information for these firms. They are listed in order of their year of entry into the domestic

[25] Coals with 0.4-1.0% sulfur were considered "low" and 6.0% sulfur were considered "high" in these years. Perceptions of low and high sulfur coals varied over time with overall sulfur percentages dropping for both types of coal. Coals with 2.6% sulfur are now considered high sulfur.

utility FGD market. The major line of business of most of these firms was not air pollution control. In fact, air pollution control activities were major lines of business of only American Air Filter (before its acquisition by Allis-Chalmers), Combustion Equipment Associates, Peabody International, and Research-Cottrell. Only Research-Cottrell realized more than 50% of its total sales revenues from air pollution control equipment (Zimmerman et. al., 1980, pp. 4-10).

TABLE 2.2

U.S. Firms Entering Domestic Utility FGD Market in the 1970s

Firm Name (1980 Parent Corporation in Parentheses)	Year of Entry into Domestic Utility FGD Market	Year of Purchase by Parent Corporation
Combustion Engineering	1971	NA
Buell (Envirotech)	1972	1972
American Air Filter (Allis-Chalmers)	1974	1978
Babcock & Wilcox (J. Ray McDermott)	1974	1978
Combustion Equipment Associates	1974	NA
Peabody International	1974	NA
Research-Cottrell	1974	NA
Riley Stoker (Riley Co.)	1974	1971
UOP (Signal Companies, Inc.)	1974	1969
United Engineers (Raytheon Co.)	1974	1978
Chemico (Envirotech)	1976	1976
FMC Corporation	1977	NA
Pullman Kellogg (Pullman, Inc.)	1977	1944
Wheelabrator - Frye	1977	NA
Western Precipitation (Joy Manufacturing)	1978	NA
Rockwell International	1979	NA

Source: Adapted from Zimmerman et. al. (1980)

As indicated by the acquisition information in Table 2.2, a number of large diversified corporations entered the utility FGD market during the 1970s in what was "perceived to be a booming market (Zimmerman et. al., 1980, pp. 4-8)." Unfortunately, as Table 2.3 indicates, this market exhibits relatively low profitability as compared to the S&P 400, although data show that profitability was gradually increasing in the industry in the 1976-78 period. Gross profitability was highest for Joy Manufacturing and also rather high for Wheelabrator, two early leaders in the dry FGD systems that found quick popularity in low-sulfur coal applications (McIlvaine, 1990; Zimmerman et. al., 1980, pp. 4-22). In addition, the FMC Corporation demonstrated consistently good performance. The volatility of the FGD equipment and services industry, indicated in the large number of acquisitions in this period, ultimately caused Riley, American Air Filter, and Combustion Equipment Associates to drop out of the business (McIlvaine, 1990).

TABLE 2.3

Profitability Ratios of the Utility FGD Industry as Compared to Standard & Poor's 400 Industrials, 1976-78

Firm Name	Gross Profitability[a] (% of Revenues)			Net Profitability[b] (% of Revenues)		
	1976	**1977**	**1978**	**1976**	**1977**	**1978**
Combustion Engineering	7.7	7.9	8.8	3.0	3.3	3.4
Buell, Chemico (Envirotech)[c]	7.1	6.3	3.6	3.8	3.1	1.2
American Air Filter (Allis-Chalmers)[c]	9.9	10.4	11.3	3.5	3.6	4.3
Babcock & Wilcox (J. Ray McDermott)[c]	NA	NA	9.3	NA	NA	3.0
Combustion Equipment Associates	14.4	12.6	Loss	7.0	8.0	Loss
Peabody International	9.3	9.3	10.1	3.9	4.0	4.3
Research-Cottrell	6.6	7.9	7.5	2.7	3.4	3.7
Riley Stoker (Riley Co.)[c]	6.0	4.6	4.9	2.3	2.9	3.1
United Engineers (Raytheon Co.)[c]	7.9	8.6	9.1	3.5	4.0	4.6
UOP (Signal Companies, Inc.)[c]	9.2	9.5	9.4	2.5	3.3	3.3
FMC Corporation	12.4	12.4	10.9	5.3	5.5	4.8
Pullman Kellogg (Pullman, Inc.)[c]	2.2	2.6	4.0	1.5	1.6	2.5
Wheelabrator - Frye	9.1	10.4	10.5	4.6	4.7	5.1
Western Precipitation (Joy Manufacturing)[c]	17.4	16.0	14.3	7.5	7.1	5.5
Rockwell International	6.9	7.1	9.0	2.3	2.5	3.7
S&P 400 Industrials	14.4	14.2	NA	5.3	5.1	NA

Source: Adapted from Zimmerman et. al. (1980, 4-24,5)

a Gross profitability, as percentages of revenues, is defined as revenues less operating costs but before depreciation, interest, and taxes.

b Net profitability, as percentage of revenues, is defined as revenue less operating costs, depreciation, interest, and taxes but before extraordinary items.

c Parent corporation in parentheses.

The large number of subsidiary firms in the FGD market and the small number of firms with air pollution control as the major line of business makes economic analysis difficult, especially for R&D expenditures. Nevertheless, Table 2.4 provides a snapshot of R&D budgets for the four companies whose major line of business was air pollution control in order to indicate the approximate level of R&D being conducted by scrubber vendors in the late 1970s.[26]

TABLE 2.4

1976-79 R&D Expenditures by Utility FGD Suppliers with Major Business Area of Air Pollution Control Equipment

	1976	1977	1978	1979
American Air Filter	2,801	3,547	Acquired	Acquired
Combustion Equipment Associates	800	993	1,002	1,246
Peabody International	1,700	2,100	2,400	2,700
Research-Cottrell	3,772	3,225	4,168	3,638

Source: Adapted from Zimmerman et. al. (1980, p. 4-28)

Notes: Units in thousands of (assumed) 1980 Dollars. For American Air Filter and Research-Cottrell, customer-sponsored research, development, and demonstration projects were undertaken.

Analysts believed at the time that these R&D expenditures were not as large as they would be in a strictly market-driven industry. A National Research Council Study on R&D in the EPA published in 1977 explained this view:

> The current set of legislative mandates to EPA … does not take full advantage of self-interest by instituting incentives for private parties to perform research, especially on pollution control technology…. Some legislation may even have the effect of discouraging private research initiative. As a consequence, the government is forced to conduct research that might be more efficiently performed in the private sector. … The validity of research conducted by EPA to support its decision-making will always be suspect merely because the agency is … in the adversary process of regulation and standard setting (Zimmerman et. al., 1980 3-19, 3-20).

[26] This business line is typically dominated by particulate control equipment.

The R&D being conducted by various actors in the SO_2 industrial-environmental innovation complex in the 1970-76 period focused in large part on the reliability problems experienced by scrubber users. Table 2.5 summarizes the major reliability problems of scrubbers operating during this period, as detailed in an important EPA hearing on power plant compliance with SO_2 air pollution regulations.

TABLE 2.5

Observed Technical Problems in Early Scrubbers

Problem	Comm. Ed. Will County	Mitsui Chemico Plant	EPA Shawnee	K.C. P&L LaCygne	Louisville G&L Paddy's Run
Chemical Scaling	Minor	No	No	Minor	No
Demister Pluggage	Yes	No	No	Yes	No
Wet/Dry Pluggage	No	No	No	No	No
Erosion/ Corrosion	Yes	No	Minor	Yes	No
Reheater Problems	Yes	No	No	Yes	No
Mechanical Problems (Fans, pumps, dryers, etc.)	Yes	No	No	Yes	Minor
Start-up Date	Feb. 1972	Mar. 1972	Apr. 1972	Feb. 1973	Apr. 1973
Process	Limestone	Lime	Limestone & Lime	Limestone	Limestone
Oil or coal	Coal	Coal	Coal	Coal	Coal
Size, MW	156	156	3*10 MW	840	70

Source: Testimony at hearing on power plant compliance with SO_2 regulations conducted between October 18, 1973 and November 2, 1973 by the EPA (Quarles Jr. et. al., 1974, p. 35)

In addition to these problems, sludge disposal was widely recognized by diverse SO_2 industrial-environmental innovation complex actors at this hearing as a significant problem with potential implications for the environment (Quarles Jr. et. al., 1974, p. 51).

According to PEDCo-Environmental Consultants, Inc., by 1976, performance of units had improved to the point that the average operability of scrubber units ranged "from about 80-95% depending upon the system and the averaging period (Devitt, Isaacs, and Laseke, 1976, p.24)."[27] Other technological improvements by 1976 were in increased limestone utilization and sludge oxidation for more effective waste disposal. The TVA reported in 1976 on some of the lime and limestone technological developments that had recently occurred.[28] These changes included sludge fixation; a growing tendency for utilities to increase scrubber redundancy and sparing as insurance for reliability problems; the use of spray towers in place of mobile-bed scrubbing devices; and measures to promote increased operating reliability (McGlamery et. al., 1976, p. 88).

Besides these changes in scrubber design, EPRI, which had started its own R&D program for FGD in 1974, called on the utility industry in 1976 to institute some changes in scrubber operations. To maximize reliability, EPRI stated that "utilities must assume responsibility to make the scrubber system work." According to EPRI, assuming responsibility meant having a qualified staff of "chemists as well as mechanical and chemical engineers," not depending on process guarantees and fixed-cost contracts, and giving "the scrubber operating and maintenance priority equal to all other power station systems (Nannen and Yeager, 1976, p. 112)."

In summary, the 1970-76 period was one of great activity in the SO_2 industrial-environmental innovation complex. As the SO_2 control market grew rapidly, many firms either entered the utility FGD market or acquired existing entrants. Although FGD vendors as well as utilities – particularly through EPRI – initiated R&D efforts during this time period, the EPA's legislative mandate was recognized by contemporaneous observers to have provided only a limited incentive or even a disincentive for private rather than public R&D. The technological successes of both types of R&D helped to improve reliability, limestone utilization, and waste

[27] Operability, or the hours the FGD system was operated divided by boiler operating hours in the period, was the most commonly reported variable representing scrubber reliability due to data availability.
[28] There had not been as many noteworthy developments in regenerable processes.

disposal in the 1970-76 period, although a considerable amount of progress in FGD technology was still to occur.

1977-1989

Government Actions 1977-89

The 1977-89 period was characterized by competing goals and needs that affected government actions relevant to the SO_2 industrial-environmental innovation complex. Competition between national environmental, energy, and economic priorities on the one hand, and competition between regional economic goals and interests on the other, particularly defined the legislative climate and associated implementation regulations and research budgets during this period.

The 1977 Clean Air Act Amendments (1977 CAA), with their associated New Source Performance Standards (1979 NSPS), were products of conflict between the environmental, coal industry, and utility industry lobbies, and uncertainties within the EPA itself. Enacted August 8, 1977 after a two-and-a-half year legislative process, the 1977 CAA benefited both these lobbies in different ways. The 1977 CAA benefited environmentalists interested in SO_2 emissions reduction by (1) codifying Prevention of Significant Deterioration review, (2) requiring continuous emission controls in light of emerging concerns about the long-range transport of sulfates, and (3) extending EPA's regulatory domain to include industrial boilers below 250 MBTU (Bailey, 1998, p. 190; Train, 1976, p. 5). The amendments benefited polluting organizations by (1) extending deadlines for industrial polluters, states, and cities with particularly acute air pollution problems to achieve emissions reductions and (2) granting new source building rights in non-attainment areas for NAAQS as long as "best available control technology" (BACT) was installed.[29]

The 1977 CAA also satisfied an unlikely alliance between environmentalists and the coal industry. In its Section 111 it directed the EPA to implement, within one year, a new NSPS for SO_2 emissions based on a percentage reduction from levels that sources would emit in the absence of control technology (Findley and Farber, 1992, p. 105). This percentage reduction provision was intended to promote the universal use of scrubbing technology (Ackerman and Hassler, 1981, p. 37). Environmentalists were interested in scrubbers to cut new plant emissions below 1.2 pounds per MBTU, while the coal lobby wanted the 1.2 level maintained but the SO_2 reductions to come from control technology so that high sulfur coal could supply the new power plant market. Despite the scrubber promotion of section 111, a subsection (h) kept the legislation from being absolutely "technology-based" since "the subsection denies the administrator the authority to require a particular 'design, equipment, work practice, or operational standard (Ackerman and Hassler, 1981, p. 51).'"

Although section 111 directed the EPA to implement a new NSPS for SO_2 emissions by August 1978, intra- and inter-agency conflict stymied the development of the final NSPS until June 1979. At issue was how stringent the percentage standard would be and what it would mean for FGD technology. In late fall 1977, EPA's Office of Air, Noise, and Radiation (OANR) circulated a recommendation for a "full scrubbing" regulation. Besides requiring all coal burning plants to meet both the old 1.2 pound per MBTU limit, the OANR regulation would require the removal of 90% of the SO_2 released by coal combustion, which was the highest removal efficiency state-of-the-art FGD could achieve at the time (hence the term "full

[29] EPA Administrator Russell Train had announced on May 30, 1975 that thirty-four of the nation's 247 air quality control regions would be unsuccessful in meeting primary NAAQS for SO_2 emissions (Bailey, 1998, p. 184).

scrubbing") (Ackerman and Hassler, 1981, p. 80). At about the same time, the EPA's Office of Air Quality, Planning, and Standards (OAQPS) began working on a computer model to compare the OANR plan versus a "partial scrubbing" alternative in which some scrubbers would be allowed to scrub at percentages lower than 90% in order to reduce operating and maintenance costs (Ackerman and Hassler, 1981, p. 82). The Department of Energy (DOE), which had been established in October 1977 to take responsibility for coordinating a comprehensive national energy plan, strongly supported the OAQPS partial scrubbing option as better for the nation's energy independence.[30]

The EPA was slow to resolve the full versus partial scrubbing options. In July 1978, it became clear that the EPA would not meet the statutory deadline on the SO_2 NSPS. At this time, the Sierra Club obtained a court order to ensure that the EPA decision was made by June 1979. On September 19, 1978 the first EPA proposal on the NSPS – based on the OANR plan, but leaving the full versus partial scrubbing issue unresolved – was published in the Federal Register (Ackerman and Hassler, 1981, pp. 85-7). By January 1979, opinion within the OAQPS centered on reducing the emissions ceiling from 1.2 pounds per MBTU to 0.55 pounds per MBTU. This ceiling is the equivalent of requiring an 86.25% emission reduction for high sulfur coals of 4 pounds per MBTU, since it would allow the emission of 13.75% of the SO_2 per MBTU combusted, or 0.55 pounds per MBTU. The 0.55 ceiling would force the use of some type of control technology, since no coal could achieve this goal alone without technological assistance. This ceiling would force technology at greater advantage to environmental interests and, since partial scrubbing was cheaper than full scrubbing, at lower costs to utilities and other polluters

[30] The Department of Energy Organization Act brought together into a cabinet level department such federal government energy-related organizations the Energy Research and Development Administration, the Federal Energy Administration, and the Federal Power Commission (Zimmerman et. al., 1980, p. 3-23).

than the OANR plan (Ackerman and Hassler, 1981, pp. 89-90). Eastern coal interests, however, objected to the 0.55 ceiling. The National Coal Association presented an estimate that a 0.55 limit, assuming scrubber removal efficiencies of 85%, would preclude the burning of 75-100% of the coal produced in Ohio, Illinois, Indiana, northern West Virginia, and western Kentucky (although the organization had transparently excluded major eastern zones of low sulfur coal) (Ackerman and Hassler, 1981, p. 99). Congressional concern based on this presentation was impossible for the EPA Administrator to ignore in April and May 1979, especially since the Senate Majority Leader was Robert Byrd of coal-producing West Virginia.

The ultimate solution to the NSPS for SO_2 lay in dry scrubber technology. Research indicated that dry scrubbers could operate more cheaply than conventional wet scrubber technology at removal efficiencies of 70% or less. In April 1979, the EPA began modeling runs based on cost estimates of the dry scrubber, and in June 1979, the EPA finally issued the new NSPS for SO_2, which set a "wet-scrubbing/dry-scrubbing sliding scale" of 1.2 pounds per MBTU with a 90% reduction, or 0.6 pounds per MBTU with a 70% reduction (Alm and Curham, 1984, p. 108). Under this sliding scale, models showed costs to be far lower than the full scrubbing option of OANR, with SO_2 emissions almost as low as in the 0.55 ceiling OAQPS plan (Ackerman and Hassler, 1981, p. 101). This regulation was challenged in court on the basis that it did not meet the statutory command to require in all situations "the best technological system of continuous emissions control." But the regulation was upheld, and subsequently made the practice of fuel switching to lower sulfur coals insufficient to obtain compliance with the NSPS.

Concern about fuel switching, from eastern high-sulfur coal to western low-sulfur coal, and from oil and natural gas to coal and synthetic fuels, was at the heart of not only much of the conflict related to the 1977 CAA, but also of competing interests between the EPA and the DOE. Two major energy acts, the National Energy Act of 1978 and the Energy Security Act of 1980, demonstrate the changing perception of optimal fuel choices in support of the national goal of reducing dependence on foreign oil. The five pieces of legislation that composed the earlier bill promoted the use of U.S. coal, as had the earlier Energy Supply and Environmental Coordination Act. The several pieces of legislation that comprised the later bill, however, attempted to turn "energy policy away from conventional resources and toward the development and promotion of synthetic oil and gas derived from coal, oil shale, and tar sands (Laitos and Tomain, 1992, p. 425)." In addition, the Energy Security Act of 1980 also promoted renewable resources and conservation.

Whereas the EPA's involvement in air pollution research, development, and demonstration (RD&D) stemmed primarily from its role in the CAA, the DOE's involvement in air pollution RD&D began to grow in the late 1970s due to its promotion of environmentally acceptable coal use either through direct combustion or in synthetic fuels creation. Although in 1979, the EPA was still the "principal federal participant in the [RD&D] of air pollution control technologies;" by 1985 that role had shifted to the DOE (Zimmerman et. al., 1980, p. 3-3). One of the first indicators of that shift was the transfer in fiscal year 1979 of much of the FGD component of the EPA's Energy/Environmental Control Technology program to the DOE Fossil Energy Research Program (FERP) Advanced Environmental Control Technology program (Zimmerman et. al., 1980, pp. 3-7, 3-33).[31] Table 2.6 and Table 2.7 show the changing RD&D budget situation for the EPA, DOE, and other entities involved in research on SO_2 abatement from stationary sources in 1977 to 1985.

[31] In 1979, the EPA Energy/Environmental Control Technology program was planned, reviewed, and implemented cooperatively between EPA and DOE.

TABLE 2.6

1977-81 Federal Government Budgets and Expenditures for Air Pollution Control RD&D

	1977	1978		1979		1980		1981
	Actual	Bdgtd	Actual	Bdgtd	Actual	Bdgtd	Actual	Est.
EPA Air Pollution Control								
Ind. Processes: Air Quality	6,586	500	5,691	5,000	3,989	4,050		4,099
Energy/Env. Control Tech.								
Fuel Proc., Prep., & Adv. Combustion	18,700	18,150	21,360	11,167	12,598	12,822		18,537
Flue Gas SO_x Control	4,940	3,200	11,604	2,099	3,054	1,889		3,514
NO_x Control	9,740	10,100	21,275	14,850	13,879	13,815		12,484
Flue Gas Particulate Control	3,550	3,900	14,183	9,889	9,392	8,000		8,040
Total	43,516	40,350	74,113	43,005	42,912	40,576		46,674
EPA Energy								
Coal Cleaning	4,500	4,360	8,110	1,469	1,325	1,213		
Fluidized Bed Combustion (FBC)	5,930	6,000	5,040	3,309	4,354	4,925		
Adv. Oil Processing	2,660	1,200	1,950	755	428	-		
Syn. Fuels	5,610	6,590	6,260	5,634	6,491	6,487		
Biomass Conversion	-	-	-	-	-	147		
Total	18,700	18,150	21,360	11,167	12,598	12,822		18,537
DOE Env. Engineering								
Coal	4,100	4,900		4,735		4,743		5,826
Nuclear	4,000	6,500		5,950		3,895		5,055
Oil Shale	200	800		773		819		1,431
Petrol. & Gas	2,400	3,300		3,287		7,897		8,407
Solar, Etc.	800	1,300		1,432		1,406		1,491
Total	11,500	16,800		16,177		18,760		22,210
DOE FERP: Coal Prep.			5,020	2,371			12,650	11,000
DOE FERP: Adv. Env. Cont. Tech.								
Flue Gas Cleanup								
Adv. FGD					600		8,300	9,000
Combined FG Cleanup					1,300		5,700	6,000
Wet Limestone FGD					800		6,050	6,000
Subtotal					2,700		20,050	21,000
Gas Stream Cleanup								
Fuel Cell Cleanup					-		1,400	3,000
Process Mod.					1,000		2,000	2,000
Turbine Cleanup					1,400		7,000	8,000
Subtotal					2,400		10,400	13,000
Tech. Support					1,900		7,000	8,000
Cap. Equip.					-		800	500
Total					7,000		38,250	42,500
DOE FERP: Combst. Sys. Program								
Atmospheric FBC			24,500		23,600		25,900	22,800
Pressurized FBC			15,229		14,234		15,000	21,400
Adv. Combst. Tech.			13,036		7,342		4,950	2,000
Alt. Fuel Utilization			1,915		9,400		2,500	22,000
Combst. Sys. Demo. Plants			11,000		-		2,500	-
Cap. Equip.			465		573		-	300
Total			66,145		52,149		50,850	68,500

Source: Adapted from Zimmerman et. al. (1980, p. 3-9)

Notes: Units are in thousands of (assumed) 1980 dollars. In 1981, only estimated figures are available for this budgetary breakdown due to limitations in the source data.

TABLE 2.7

1981-85 Expenditures for Air Pollution Control R&D, 1981-85

	DOE	EPRI	EPA	TVA	GRI	Assoc-iations	States	Private Cofndg
Fuel & Feedstock Prod. Tech.		229,220						
Coal Prep.	36,739			3,994			3,974	13,798
Coal Mixtures/Alt. Fuels	27,242					730	24	9,742
Liquefaction	302,108						8,899	470,233
Surface Gasification	223,069				40,500	112	2,879	212,972
Underground Gasification	35,633				4,400	768		5,042
Power & Energy Producing Technologies		239,625						
AFBC	21,059			82,610		1,354	4,093	46,312
PFBC	69,260							15,861
Fuel Cells	179,308			178	63,300	652		65,465
Magnetohydrodynamics	177,961							6,913
Heat Engines	67,469					343		8,383
Environmental Pollution Reduction Technologies								
Flue Gas Cleanup	50,477		19,000	24,824		19,737	2,376	21,542
Gas Stream Cleanup	45,832		40,300			303	9,938	913
Advanced Combustors	7,723			200		499	1,187	6,998
Cross-Cutting R&D								
Coal Waste Management	19,134			1,884	1,700		532	14,629
Adv. Research & Tech. Development	213,744				4,900	603	5,115	82,057
Subtotals								
Clean Coal R&D	798,583	239,625	59,300	113,512	42,200	2,078	25,003	358,063
Other Coal	578,175	229,220		178	72,600	2,023	14,014	622,797
Total	1,476,753	468,845	59,300	113,690	114,300	25,101	39,017	980,860

Source: Adapted from U.S. Department of Energy, Office of Fossil Energy (1987, p. 39)

Notes: Units are in thousands of (assumed) 1987 dollars. "Other coal" includes liquefaction, underground gasification, fuel cells, and elements of advanced research and technology development. GRI stands for the Gas Research Institute.

EPA's R&D focus shifted from wet FGD improvements in the mid-1980s to low-cost dry technologies such as the spray dryer, lime/limestone injection with multistage burners, advanced calcium silicate injection, and electrostatic precipitator sulfur oxides removal. The main impetus for this work was the "anticipation of a major U.S. acid rain retrofit program being considered by Congress (U.S. Environmental Protection Agency, 1995, p. 4)." The DOE, in the meantime, continued to sponsor some wet FGD work. In December 1985, the DOE added to its existing coal-based environmental research efforts a major new program called the Clean Coal Technology Demonstration Program (CCT).

This $2.5 billion program was enacted largely through the efforts of Senator Robert Byrd of West Virginia in order to keep coal research alive after the demise of the Synfuels Corporation. The program, which is expected to run until 2004, partnered DOE research with that of various industries to demonstrate advanced "clean" coal technologies at a scale large enough for the market to judge their commercial potential. Industries provided over 50 percent of the cost of the CCT demonstrations and also played a major role in project definition and in ensuring eventual commercialization. The program has been implemented through a series of project selections in response to nationwide competitive solicitations known as Program Opportunity Notices (PON) with different levels of government funding and objectives (U.S. Department of Energy, Assistant Secretary for Fossil Energy, 1996, p. 2-1). Table 2.8 provides a snapshot of the status of the CCT program selection process as of December 31, 1995.[32] As was the case with earlier funding by the DOE of air pollution control R&D, the CCT projects have not been limited in their focus to SO_2 emissions reductions alone.

TABLE 2.8

CCT Project Selection Process Summary

Solicitation	PON Issued	Proposals Submitted	Projects Selected	Projects in CCT Program by 12/31/95
CCT-I	February 17, 1986	51	17	8
CCT-II	February 22, 1988	55	16	11
CCT-III	May 1, 1989	48	13	13
CCT-IV	January 17, 1991	33	9	6
CCT-V	July 6, 1992	24	5	5
	TOTAL:	**211**	**60**	**43**

Source: (U.S. Department of Energy, Assistant Secretary for Fossil Energy, 1996, p. 2-1)

[32] 57% of the projects had completed operations by the end of fiscal year 1998 (U.S. Department of Energy, Assistant Secretary for Fossil Energy, 1999).

One of the reasons for the shift in air pollution R&D preeminence from the EPA to the DOE was the success of President Ronald Reagan's deregulation agenda in cutting EPA's operating budget by more than one-third between 1981 and 1983, with resulting personnel losses of 20% (Vig and Kraft, 1990, p. 38). The EPA budget never returned to the pre-1980 level throughout the 1980s. The DOE, meanwhile, did not suffer as much during this period even though President Reagan had pledged to abolish the DOE and the Solar Energy Research Institute, as well as to dismantle the United States Synthetic Fuels Corporation established under the Energy Security Act of 1980 (Laitos and Tomain, 1992, pp. 426-7).

The conflict between President Reagan's anti-government supporters and pro-environment legislators was also a contributing factor to the dearth of legislation passed in the 1980s to regulate SO_2 emissions, although conflicting environmental, industry, and coal interests were still the greatest barriers to government action. Acid rain had become the prominent concern about SO_2 emissions by 1980, prompting the passage of the Acid Precipitation Act of 1980 which established the U.S. National Acid Precipitation Assessment Program (NAPAP). The NAPAP program ultimately spent $500 million by the time it published in 1990 "the definitive scientific and technical synthesis" on acid precipitation (Irving, 1990). Other than the establishment of NAPAP, however, Congress was unable to pass any legislation on acid rain throughout the 1980s despite high-level lobbying by the Canadian government.

This stalemate did not reflect a lack of effort in Congress, particularly by congressional representatives of northeastern states, which suffered more from acid rain than other parts of the country. In 1982 and 1984 the Senate reported legislation out of committee that would mandate SO_2 emissions reductions to curb acid rain (Bailey, 1998, pp. 218, 220). In 1986 the House reported a bill out of subcommittee that would provide for a "phased reduction in the emissions that caused acid rain and sought to reduce the financial burden on the Midwest by imposing a national tax on electricity (Bailey, 1998, p. 221-2)." And in 1987, the Senate reported out of committee an overhaul of the CAA that would tighten acid rain precursor controls (Bailey, 1998, p. 226). With this bill, as with the others, conflict between U.S. regional economic interests pertaining to the coal and utility industries precluded further legislative action, as attempts to balance these competing interests were unsuccessful. This is evidenced in the case of the 1987 bill, when a proposal was circulated to have the federal government subsidize the capital cost of installing scrubbers. This proposal was included to allay the fears of senators from high-sulfur coal producing and consuming regions about the economic impact of SO_2 controls. Senators from western states opposed this proposal, claiming that utilities in their states burned low-sulfur coal and "had already installed scrubbers at their own expense (Bailey, 1998, p. 226)."

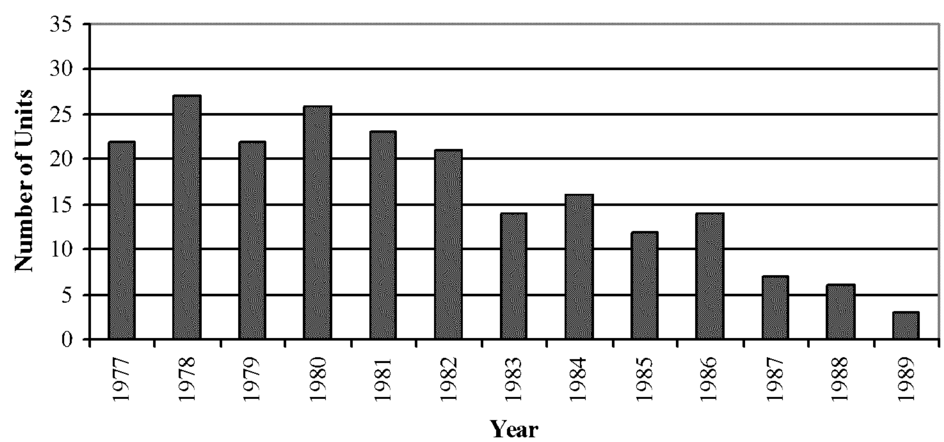
By the end of the 1977-89 period, leadership transitions in the Senate and the Executive branch of government helped to alter the balance between these competing interests. In addition, the long period of study of acid rain and several attempts at producing acid rain legislation set the stage for the passage of the 1990 Clean Air Act Amendments, in which the control of acid rain was finally dealt with legislatively.

Other Actions by the Industrial-Environmental Innovation Complex 1977-89

The U.S. market for FGD grew between 1977 and 1983, then declined between 1983 and 1989. Figure 2.6 shows the general decline in the number of new utility-operated coal-fired steam turbine units brought online between 1977 and 1989. This is the market background for new FGD units, particularly after the 1979 NSPS. Figure 2.7 shows the total number of commercial FGD units brought online between 1977 and 1989, broken down into the realized categories of new and retrofit construction. Note that new FGD units associated generally with new power plant construction dominated the FGD market in the 1977-1989 period, with 69% of all FGD units installed in 1977-89 (in contrast to the 28% of all units in the 1973-76 time period). The market dominance of new FGD units is important to understand in light of the overall decline in new coal-fired unit construction in the utility industry throughout the 1980s. By comparing the two datasets underlying these figures, it appears that 60% of the new coal-fired boilers brought online in these years had new FGD units.[33]

FIGURE 2.6

Number of New Utility-Operated Coal-Fired Steam Turbine Units in 1977-89



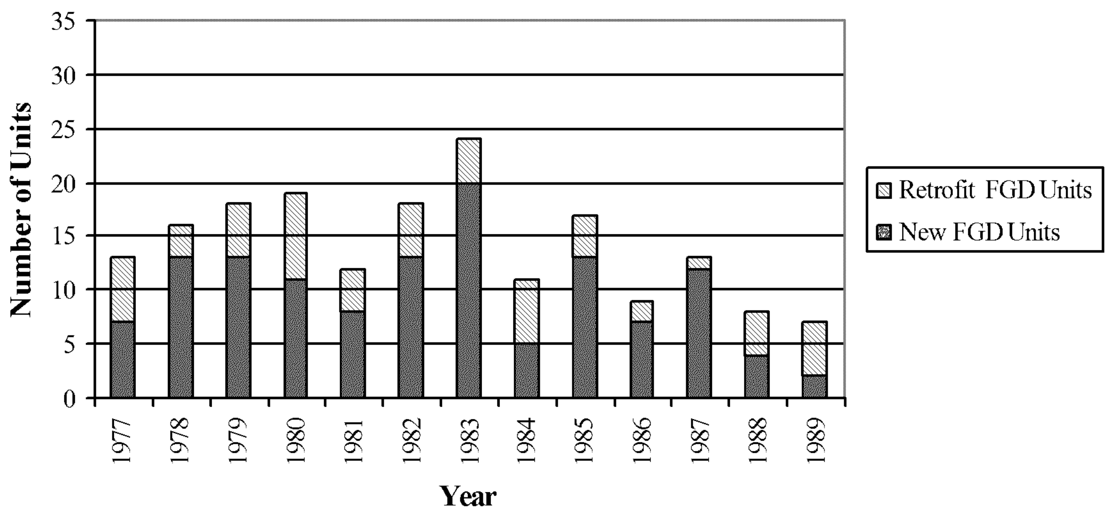
Source: Adapted from Energy Information Administration (1996)

Notes: The year of commercial operation is the year that control of the unit was turned over to the dispatcher. Includes all units active since 1977.

[33] There are three years in this time period in which the number of new FGD units listed exceeds the number of new coal-fired units listed. This may be due to errors in the data or to a definitional issue in which some "new" FGD units actually accompany substantially modified coal-fired utility boilers that are not included in the new utility boiler dataset.

FIGURE 2.7

U.S. Scrubber Market, 1977-89



Source: Adapted from Soud (1994)

For U.S. scrubber vendors, the decline of the total domestic FGD market after 1983 was partially compensated for by a sudden growth in the European FGD market. In 1983 Germany adopted a stringent program to control acid rain that resulted in 35,000 MWe of FGD systems being installed in four years, 33% of which were licensed from U.S. companies. Other European countries started following Germany's lead in the second half of the 1980s (McIlvaine, 1990).

FGD equipment and service organizations experienced some change in the 1977-89 period, as befits a period of changing demand. Table 2.9, however, shows that the top five FGD vendors, in terms of U.S. market share, did not change much during the period. Note that the FGD market remained highly concentrated. A number of acquisitions also happened during this period, as had occurred in the late 1970s. Particularly noteworthy are the acquisition of Combustion Engineering by ABB Environmental Systems (which also purchased the patents of

Rockwell International) and the acquisition of Envirotech by General Electric Environmental Services (GEESI) (McIlvaine, 1990).

TABLE 2.9

Top Five FGD Vendors in the U.S. in 1980 and 1989

Five Leading FGD Vendors (1980)	Market Share of U.S. Operating MW (1980)	Five Leading FGD Vendors (1989)	Market Share of U.S. Operating MW (1989)
Envirotech=GEESI	23.2%	Combustion Engineering=ABB E.S.	25.2%
Combustion Engineering=ABB E.S.	16.3%	Envirotech=GEESI	14.3%
Research-Cottrell	14.3%	Babcock & Wilcox	13.6%
Combustion Equipment Associates	9.7%	Wheelabrator	9.3%
Babcock & Wilcox	9.3%	Research-Cottrell	7.9%
Total Market Share	72.8%	Total Market Share	70.4%

Source: 1980 data from Zimmerman et. al. (1980); 1989 data from Soud (1994)

Recall from Table 2.7 that a number of non-governmental actors engaged in air pollution control R&D in the early 1980s, including the Gas Research Institute (GRI), EPRI, associations, utilities, and scrubber vendors. One of these research activities was of particular importance: the 1987 founding of the EPRI High Sulfur Test Center, located at New York State Electric and Gas's Kintigh Station. This facility was equipped with wet scrubbers at the bench scale, the mini-pilot scale, and the pilot scale, as well as with a spray dryer at the pilot scale and facilities for dry duct injection testing. It has generated considerable data on the operating characteristics of FGD systems treating combustion gases from coal of greater than 2% sulfur (Row, 1994, pp. 301-2). Table 2.10 lists the perceptions of various R&D actors in wet and dry FGD technology of the stimuli, methods, and impediments pertinent to their R&D activities in 1980. It serves as an important reference for the consideration of this dissertation's central topic, the influence of government actions on technological change in SO_2 control technologies.

TABLE 2.10

1980 Perceptions of Stimuli, Methods, and Impediments involved in Technology Development Efforts

	User (Utilities, EPRI)	**Vendor**	**Government (EPA, DOE)**
Wet Limestone FGD			
Stimuli	• CAA (SIP, NSPS) • Compliance cost reductions • Presence of EPRI • Regulatory impact of acid rain problem	• Market opportunity/profit motive • CAA (NSPS, SIP) • Cost-effectiveness of technology	• Necessity of demonstrating technology which could achieve standards • Probability of technical success • Cost-effectiveness of technology
R&D Methods	• In-house R&D • Cooperative participation in pilot and full-scale demonstrations • Litigation to change regulations	• In-house R&D • Government contracts	• Interagency R&D and operation of pilot and full-scale demonstrations • Cooperative participation with users-vendors on pilot and full scale demos
Impediments	• Funding • Lack of corporate support of R&D • Legal constraints • Rate determination • Regulatory uncertainty	• Funding • Legal constraints (antitrust laws, patent policies) • Regulatory uncertainty	• Uncertainty – intra-agency roles • Lack of government-industry cooperation re: best sites for demos
Dry FGD Systems			
Stimuli	• Complexity/unreliability of existing technology • CAA (NSPS) • EPA enforcement intentions • Lack of government R&D	• Market opportunity/ profit motive • Cost-effectiveness of technology • Relative maturity of technology • CAA (NSPS) • Solicitation from utilities • EPA enforcement intentions • Patent policies	• Enhancement of air quality • Acid rain problem
R&D Methods	• In-house R&D • Cooperative participation in pilot and full-scale demos with vendors and government • Litigation to change regulations	• In-house R&D • Cooperative participation in pilot and full-scale demos with utilities and government • Government contracts	• Intra- and inter-governmental R&D on operation of pilot-scale demonstration • Cooperative participation with users/ vendors on pilot-scale demos
Impediments	• Funding • Legal constraints (antitrust laws) • Uncertainty – government-industry roles • Inadequate lead time	• Funding • Utility industry inertia • Nonapplicability of technology to high-sulfur coal • Unresolved technical questions • Legal constraints (antitrust laws) • Uncertainty – governmental R&D	• Funding • Reluctance of vendors to participate in demos • Unresolved technical questions • Uncertainty – inter-governmental roles • Political constraints

Source: (Zimmerman et. al., 1980, pp. 2-2, 2-3)

Notes: Stimuli include those factors that encourage or facilitate R&D. Methods are the means by which the institutional actor is involved in the R&D process. Impediments discourage or present barriers to R&D.

The technological changes that occurred in the 1977-89 period increased state-of-the-art wet FGD removal efficiencies to 95% and dramatically increased scrubber reliability. A study of 111 FGD installations in 1986-88 showed that FGD systems contributed 1% or less to the total unavailability factor in 70% of the installations, regardless of retrofit status or bypass capability (Rittenhouse, 1992, p. 23). Chief among the technological changes behind these improvements was the development of a better understanding of scrubber process chemistry, which led to the development of the limestone forced oxidation and inhibited oxidation processes. Other technical developments in this time period included: the development of chemical additives to increase the performance of the scrubber sorbent; the improvement of scrubber construction materials; and the reduction of limestone particle size to improve gas-liquid contact. The development of chemical additives was of particular importance. The addition of organic acids, such as dibasic and adipic acid, to the scrubber sorbent can improve SO_2 removal efficiencies, reduce the required liquid-to-gas ratio, reduce scaling, improve sorbent utilization, and improve waste-handling characteristics (Irving, 1990, p. 25-138). By the end of the 1977-89 period, organic acids had only been added to existing scrubber facilities in the U.S., although in Germany they had already begun to be used in new scrubber design.

By the end of the 1977-89 period, a considerable amount of experience had been gained in constructing and operating FGD units. A better understanding of process chemistry developed in this time period, which dramatically improved scrubber reliability and increased removal efficiencies to 95%. While the scrubber itself changed in these years, the major firms selling these scrubbers did not change considerably. The main FGD equipment and services firms remained the same between 1977 and 1989, although the U.S. market fluctuated and foreign markets became more important to the industry.

1990-99

Government Actions 1990-99

Government actions on SO_2 emissions control in the 1990-99 period focused almost entirely on the provisions of the 1990 Clean Air Act Amendments (1990 CAA) pertaining to acid rain control. Although the 1990 CAA's establishment of a new permitting system for stationary sources in Title V was of interest to the SO_2 industrial-environmental innovation complex, the Title IV program for Acid Deposition Control was of particular interest because it legislated a national cap on SO_2 emissions. The emissions trading system implemented to meet this cap was instituted in two phases, with several intermediary deadlines and exceptions built into the law. This trading system provided new flexibility for utilities to comply with SO_2 reduction requirements for existing sources, including switching to lower sulfur fuels and trading emission allowances.

The 1990 CAA had precursors in both the 1987 draft bill to reform the CAA (as mentioned previously) and in the presidential campaign of 1988. In August 1988, presidential candidate George Bush promised to "cut millions of tons of SO_2 by 2000 (Bailey, 1998, p. 229)." On June 12, 1989, President Bush's proposals to reform the CAA were released. One of the three main goals of the proposal was to combat acid rain; to do so, Bush called for a system of tradable permits to control SO_2 emissions, which would be reduced by 10 million tons by 2000. These proposals progressed through Congress, with some political compromises and the shortening of deadlines in the administration's proposal by one year, until the 1990 CAA was enacted into law on November 15, 1990.

As passed, the 1990 CAA acid rain provisions in Title IV establish an SO_2 allowance emissions "cap and trade" program for existing and new units (see Environmental Law Institute, 1994). Under this program, U.S. SO_2 emission levels will be capped permanently in 2010 at about half of industry-wide 1980 emission levels, or 8.95 million annual tons (U.S. Environmental Protection Agency, Office of Air and Radiation, Acid Rain Division, 2000). This emissions cap will be accomplished gradually through phases in which first, a subset of existing plants reduce their emissions, and then the industry overall meets a cap that is less stringent than the ultimate cap. In Phase I of the program, which lasted between January 1, 1995 and December 31, 1999, the subset of plants targeted for emissions reductions included 261 utility units specifically required to participate ("Table A Units").[34] These units were to be limited to an aggregate rate of 2.5 lb/MBTU (note the relative laxity of this standard when compared to the NSPS emissions ceiling of 1.2 lb/MBTU). Phase I also included 125 utility units that elected to participate as part of multi-unit compliance plans, as well as ten other units that opted into the program.[35] In 1999, the emissions target established by the program for the 398 participating units was 6.99 million tons (U.S. Environmental Protection Agency, Office of Air and Radiation, Acid Rain Division, 2000). In Phase II of the program, which takes place between 2000 and 2009, the nationwide cap for all utilities with a capacity greater than 25 megawatts (over 2100 total units), will be 9.48 million tons (or an aggregate of 1.2 lb/MBTU). It is currently estimated that an additional 500 new units will be built in the next two years that will be subject to Phase II

[34] The Table A generating units required to participate were from 110 plants in twenty-one eastern and midwestern states, and included all units with a capacity of at least 100 MWe and a 1985 SO_2 emission rate greater than 2.5 lb/MBTU. Table A units represented 17% of U.S. generating capacity in 1990. Two of the Table A generators have two boilers, so the number of Table A units is sometimes listed as 263 rather than 261 (Zipper and Gilroy, 1998, p. 830; Schmalensee et. al., 1998).

[35] Table A units could reassign their emission reduction requirements to "substitute" non-Table A units if both were controlled by the same owner or operator. Table A units that reduced their generation requirements (and therefore emissions) could transfer their generation to a "compensating" non-Table A unit that had not had substantial emissions reductions since 1985 and was either in the Table A unit's dispatch system or in contractual agreement with the Table A unit. In addition, a voluntary opt-in program allowed non-affected industrial and small utility units to participate in Phase I (Schmalensee et. al., 1998; Zipper and Gilroy, 1998).

of the program (U.S. Environmental Protection Agency, Office of Air and Radiation, Acid Rain Division, 2000).

The allowance program that implements these emissions caps involves the distribution and gradual reduction of tradable facility "allowances," where one allowance is worth the right to emit one ton of SO_2. Allowances are given to facility operators by the EPA Administrator, based on several provisions of Title IV, and are then transferable and bankable by these operators.[36] An annual allowance auction and direct sales held by the EPA beginning in 1993 (direct sales were eliminated in 1997) provide formal opportunities for allowance transfers, although transfers can occur outside these events. No matter how many allowances a facility accrues, however, it is not allowed to violate federal or state limits for the protection of human health under Title I of the CAA. At the end of every year, the EPA "reconciles" the annual emissions of each unit (as measured through continuous emission monitors) with the allowances held by the unit. A 30-day grace period at the end of the year provides utilities with an opportunity to purchase additional allowances if necessary in order to avoid fines (Environmental Law Institute, 1994; Zipper and Gilroy, 1998).

Phase I Table A units provide an example of how the allowance system works. These units were allocated allowances by multiplying 2.5 lb/MBTU by the average annual heat input for each unit in 1985-7 (considered the "baseline," and excluding outage periods greater than four months).[37] In any given year, the total allowable emissions level for SO_2 is the number of

[36] Additional allowances were given to: (1) Illinois, Indiana, and Ohio to compensate for additional costs associated with their high SO_2 emissions (Bryner, 1995, p. 166); (2) "compliance" utilities for demand-side management or renewable energy use (Zipper and Gilroy, 1998); (3) utility systems that reduced coal use by at least 20% between 1980-5 and that rely on coal for less than 50% of total electricity; (4) "clean" states to boost economic growth (Bryner, 1995); and (5) "control units," which demonstrated that they had cut emissions by 90% by 1997 using "qualifying technology," and "transfer units" which reassigned their emissions to control units (U.S. Environmental Protection Agency, Office of Air and Radiation, Acid Rain Division, 1999).

[37] Units without an operating history in these years were to have their baselines set by the EPA Administrator (Molburg, 1993).

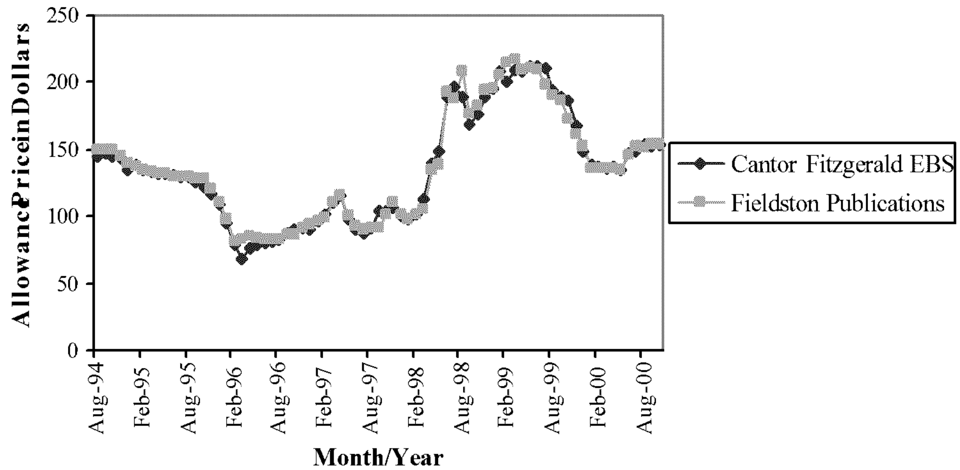
allocated allowances plus any allowances banked from the previous year. Thus, the total allowable emissions level for SO_2 in 1999 was the 6.99 million 1999 allowances granted to the Table A and participating non-Table A units, plus an additional 9.63 million allowances banked from 1998.

On the basis of emissions reductions and compliance costs, the completed Phase I of Title IV has been considered a general success.[38] In 1995, SO_2 emissions reductions were almost 40% below their required level and emissions levels were lower than allocation levels in each of the years of Phase I. Initial estimates for allowance prices ranged between $400 and $1000/ton, but, as Figure 2.8 demonstrates, prices have been considerably lower than estimates (U.S. Environmental Protection Agency, Office of Air and Radiation, Acid Rain Division, 2000). It is not yet clear whether Phase II of Title IV will be equally successful.

[38]There have been challenges to the flexibility of Title IV, however. The ongoing coal industry concern about the competition of low sulfur coal with scrubbed high sulfur coal prompted attempts by at least five states – Kentucky, Illinois, Indiana, Ohio, and Pennsylvania – to protect high sulfur coal interests (Ellerman and Montero, 1998, p. 37). In addition, the concern that national allowance trading would not suitably improve the regional acid rain transport and chemistry patterns that adversely impact New York prompted the state to pass a bill preventing "clean" New York utilities from trading allowances with "dirty" utilities upwind (Hernandez, 2000).

FIGURE 2.8

Monthly Average Price of Sulfur Dioxide Allowances Under Title IV, 1993-2000



Source: Monthly price report of Cantor Fitzgerald Environmental Brokerage and a market survey conducted by Fieldston Publications (U.S. Environmental Protection Agency, 2000)

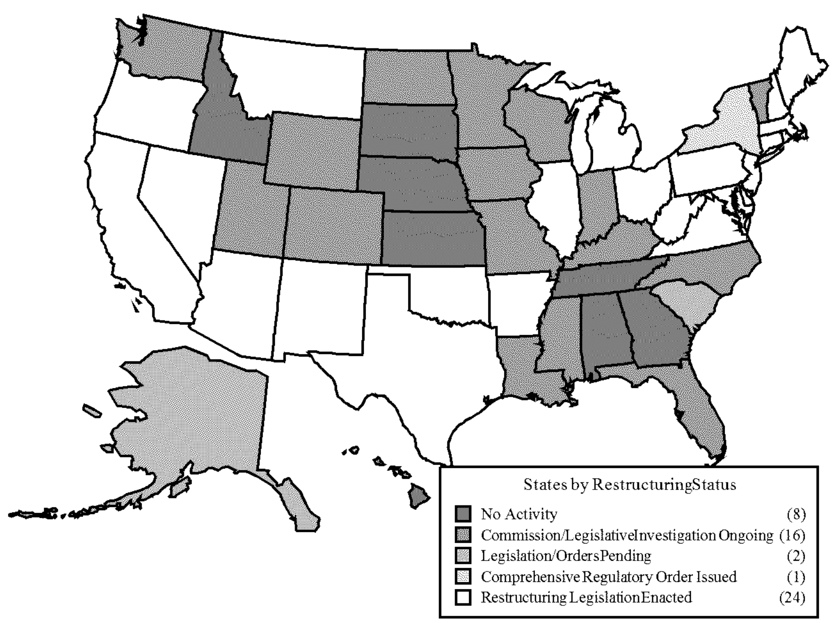
In addition to the 1990 CAA, polluting organizations in the SO_2 industrial-environmental innovation complex were affected profoundly by one other set of government actions in the 1990s: actions related to utility restructuring, or deregulation. The utility industry is currently transitioning from a vertically integrated and regulated monopoly to a competitive market in which retail customers choose electricity suppliers. Although this change originated with the Public Utility Regulatory Policies Act (PURPA) of 1978, when utilities were required to interconnect with and buy power from nonutilities meeting certain criteria at the utilities' avoided cost, most of the government actions behind this change have occurred in the 1990s. In 1992, the Energy Policy Act (EPACT) opened access to transmission networks and exempted certain nonutilities from the Public Utility Holding Company Act of 1935 (PUHCA).[39] In 1996,

[39] PUHCA had required vast interstate holding companies to divest until each became a single utility system serving a bounded geographic area, while limiting their business only to those activities considered appropriate to the operation of an integrated utility.

the Federal Energy Regulatory Commission issued Order 888, which facilitated nonutilities' transmission access, and Order 889, which required utilities to share electronic information about available transmission capacity. With national government actions thus clearing the way for nonutilities to participate in wholesale electric power sales, state legislators were able to put into practice a common belief held by governmental and non-governmental actors: that electricity generation would be more cost-effective in a competitive market. Figure 2.9 shows the current status of state electric industry restructuring activity in the U.S. Note that transmission and distribution will remain regulated and noncompetitive (Energy Information Administration, 2000a).

FIGURE 2.9

Status of State Electric Industry Restructuring Activity as of December 2000



Source: Energy Information Administration (2000c)

Other Actions by the Industrial-Environmental Innovation Complex 1990-99

Several early uncertainties associated with the implementation of Phase I of the 1990 CAA affected the FGD market strongly in the 1990-99 period. Allowance prices were the central uncertainty, as they were at the root of utility compliance choices between fuel switching and FGD installation in order to meet the relatively modest Phase I emissions cap.[40] Program deadlines enhanced this uncertainty, as Phase I utilities had to submit compliance plans to the EPA by February 15, 1993, before EPA's rules were proposed and before the first allowance auction was held in the spring of 1993 (Burtraw, 1996, p. 82). In EPRI workshops held in 1992, 60% of utility respondents called "uncertainties" their greatest concern about the 1990 CAA (Rittenhouse, 1992, p. 21). With these polluting organization abatement uncertainties, environmental equipment and service organizations had a much more difficult time anticipating the future size of the utility FGD market in the U.S. Initial and widespread Phase I predictions, based in part on the unrealistically high Phase I allowance price predictions, had scrubber vendors anticipating "35-40 scrubber contracts between 1995 and 1999," and expressing concern about "the capacity of FGD manufacturers in the United States to meet the demand (Burtraw, 1996, p. 90; Munton, 1998, p. 28)."

The ultimate market for utility FGD, however, was considerably smaller than anticipated. Table 2.11 displays the range of Phase I compliance options chosen by affected units by 1995. FGD unit installations were chosen by only 10% of Table A units, although they were responsible for one-third of 1990-5 emission reductions.[41] A combination of fuel switching and

[40] Utilities weighed both wet and dry FGD options unsuccessfully against the low price of SO_2 allowances in the 1990-99 period [among others, see Torrens and Platt (1994)].
[41]When it became clear that Phase I retrofit installations would fall short of projections, some analysts envisioned a possible market in utilities designating their FGD-equipped units as substitute units and then upgrading those units to state-of-the-art technology in order to gain additional allowances (Feeney, 1995). The low prices of allowances and high upgrade costs in the 1990s, however, did not allow this market to grow rapidly.

blending proved to be the most popular method of compliance due to low prices for both low sulfur coal and allowances.[42, 43] The appeal of this option was slow to register with some Phase I-affected utilities, however. A number of these utilities responded to a 1996 survey that they had actually reversed initial decisions to scrub substantial capacity, with two-thirds pointing to low-sulfur coal costs and one-third to low allowance prices as the reason for their reversal (Schmalensee et. al., 1998, p. 65).

TABLE 2.11

Compliance Strategies of Units Affected in Phase I of Title IV of the 1990 CAA, as of 1995

Compliance Strategy	Number of Units	Emissions Reduction, 1990-95 (Million tons)
Table A Units		
Fuel switching/blending	162	2.550
Obtaining allowances	39	0.100
Installing FGD Equipment	27	1.410
Using Previous Controls	25	0.130
Retiring Facilities	7	0.030
Boiler Repowering	1	0.007
Total Table A	261	4.230
Substituting and Compensating Units	182	0.420
Total Phase I	443	4.650

Source: Zipper and Gilroy (1998, p. 830)

Table 2.12 lists the twenty-seven FGD units that came on-line at sixteen utilities in order to comply with Phase I, in the order in which they came on-line. Three of the dominant scrubber vendors, responsible for 81% of this capacity, remained the same in this period as in the 1970-76 and 1977-89 periods. Acquisitions continued in the 1990-99 period, as they had in earlier periods. Most noteworthy were the acquisition in the fall of 1997 of GEESI by the Canadian-

[42] The popularity of low-sulfur coal in the 1990s continued a trend: coal with less than 1% sulfur comprised more than one-half of the coal market by 1990 (compared to one-quarter of the market in the 1970s) (Munton, 1998).

[43] Fuel switching costs declined in 1990-5 due to "improved operating efficiencies" in the rail and coal industries and the expansion of low-cost, low sulfur western coal production (Zipper and Gilroy, 1998). Utilities paying greater than market value for high-sulfur coal due to "escalator clauses" in long-term contracts especially benefited from switching western coal under short-term contracts (Munton, 1998).

owned Marsulex and the acquisition of Joy Engineering by Babcock & Wilcox in the spring of 1995.

TABLE 2.12

FGD Retrofits for Compliance with Phase I

Online Year	State	Boiler Units	Plant & MWe	Utility	FGD Vendor
1992	Georgia	Y1BR	Yates* (123)	Georgia Power	Chiyoda
	Indiana	7, 8	Bailly* (844)	Northern Indiana Public Service	Pure Air, a partnership of Mitsubishi Heavy Industries and Air Products and Chemicals, Inc.
1994	Kentucky	1, 2	Elmer Smith (530)	City of Owensboro	Wheelabrator
	Ohio	1	General J.M. Gavin (1,300)	Ohio Power	Babcock & Wilcox
	Pennsylvania	2	Conemaugh (936)	Pennsylvania Electric Company	ABB = Combustion Engineering
	West Virginia	1, 2, 3	Harrison (2,052)	Monongahela Power Company	Marsulex = GEESI
1995	Indiana	2,3	F.B. Culley (333)	Southern Indiana Gas & Electric	Riley
	Indiana	4	Gibson (668)	PSI Energy	Babcock & Wilcox
	Kentucky	H1, H2	Henderson MP&L (364)	Big Rivers Electric	Wheelabrator
	Kentucky	1	Ghent (557)	Kentucky Utilities	Babcock & Wilcox
	New Jersey	2	B.L. England (163)	Atlantic City Electric Company	Marsulex = GEESI
	New York	1,2	Milliken* (316)	New York State Gas & Electric	Saarberg-Holter-Umwelttechnik
	Ohio	2	General J.M. Gavin (300)	Ohio Power	Babcock & Wilcox
	Ohio	1	Niles (133)	Ohio Edison	ABB = Combustion Engineering
	Pennsylvania	1	Conemaugh (936)	Pennsylvania Electric Company	ABB = Combustion Engineering
	Tennessee	1,2	Cumberland (2,600)	Tennessee Valley Authority	ABB = Combustion Engineering
	West Virginia	3	Mt. Storm (550)	Virginia Electric & Power Company	Marsulex = GEESI
1996	Indiana	1, 2	Petersburg (724)	Indianapolis Power & Light	Marsulex = GEESI

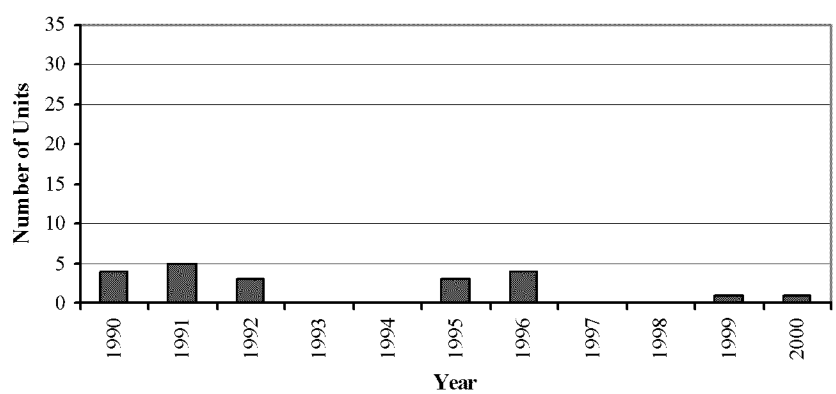
Source: Energy Information Administration (1997, P. 10), Smith and Dalton (1995), DOE (1999), Virginia (1999), Test (1995), SIGECO (1992)

Note: For consistency with previous tables in this chapter, two major scrubber vendors are listed with their post and pre-acquisition names.

The U.S. market for FGD was not completely dominated by Phase I, however. Figure 2.10 shows the extremely low level of new utility-operated coal-fired steam turbine units brought online between 1990 and 1995 and planned as of January 1, 1996. This is the market background for new FGD units that were not affected by Title IV of the 1990 CAA, and probably reflects the uncertainties of utility restructuring. Figure 2.11 shows the total number of commercial FGD units brought online between 1990 and 1993, broken down into the realized categories of new and retrofit construction. Note that new FGD units associated generally with new power plant construction comprised 52% of the FGD market in these four years, which is a more balanced proportion than in either the 1973-76 period (28%) or the 1977-1989 period (69%). Unfortunately for FGD vendors, the dearth of new power plant construction, in combination with the Phase I decisions of affected utilities to favor fuel switching over the installation of FGD, meant a very small U.S. FGD market on the basis of both new and retrofit construction.

FIGURE 2.10

Number of New Utility-Operated Coal-Fired Steam Turbine Units in 1990-2000 by Historical or Planned Year of Commercial Operation

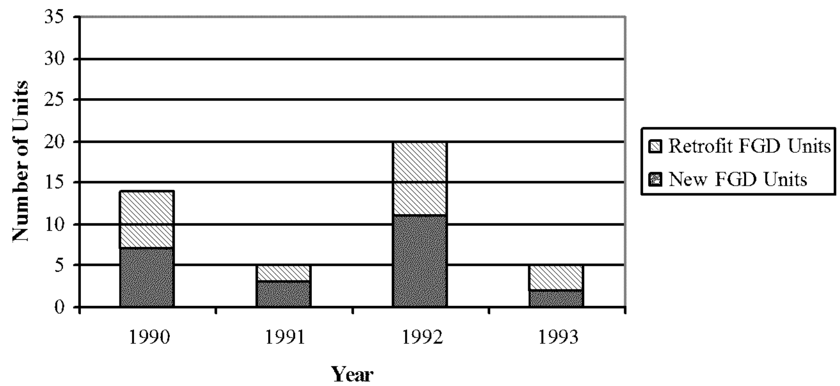


Source: Adapted from Energy Information Administration (1996)

Notes: The year of commercial operation is the year that control of the unit was turned over to the dispatcher. Includes all units active since 1990 and all units planned as of January 1, 1996.

FIGURE 2.11

U.S. Scrubber Market, 1990-93



Source: Adapted from Soud (1994)

Although the FGD market certainly appeared bleak in the early 1990s, there are a number of FGD orders that have been made since 1995 for either Phase II or NSPS compliance purposes. In 1998, orders were placed for Wheelabrator scrubbers to service 890 MWe capacity at two boiler units at Tampa Electric's Big Bend plant, and for one ABB FGD system to service 650 MWe at one boiler at Edison Mission Energy's Homer City plant in Pennsylvania. In 1999, scrubbers were ordered for two boiler units at Springfield Illinois Municipal Electric's 173 MWe Dallman plant, Marsulex scrubbers were ordered for two 550 MWe boiler units at Virginia Electric and Power Company's Mount Storm plant in West Virginia, and ABB scrubbers were ordered for Pacificorp's 1,340 MWe Centralia plant in Washington. Finally, in 2000, Public Service Company of Colorado ordered Babcock & Wilcox scrubbers for two boiler units at its 504 MWe Cherokee facility as well as for one unit at its Valmont facility. It is unclear, however, how large the utility FGD market will become as Phase II progresses while newly deregulated utilities struggle with the need to add new generating capacity.

R&D efforts in the 1990-99 period did not remain at levels as high as in earlier periods. The DOE retained its government R&D prominence in FGD through its CCT program, but EPRI reduced its R&D efforts for FGD significantly, for two reasons. First, efforts in SO_2 control R&D were reduced as "the scope for improving performance of today's reliable FGD systems, which achieve SO_2 reductions around 95% … is lessening (Row, 1994, p. 301)." Second, EPRI's overall R&D funding levels declined substantially in the 1990s in the face of growing competition in the electric utility industry. The R&D funding levels of scrubber vendors were also hurt by the decline in scrubber demand during the mid- and late-1990s.

Several developments occurred in FGD technology during the 1990-99 period that enhanced the cost-effectiveness of the technology, as measured by capital costs, operating costs, and SO_2 removal efficiency. Capital costs for scrubbers fell by almost 50% between 1989 and 1996 (Zipper and Gilroy, 1998). One important reason for this was lessening concern about scrubber reliability. As stated earlier, the FGD technology itself had become highly reliable by 1989, and since allowance sales provided an additional safety net in case of a reliability problem, costly design options such as spare absorber modules were dropped in the 1990-99 period. Additional capital cost savings resulted from several factors, including: a trend toward larger capacity modules that provided economies of scale; increased flue gas velocity in the absorber which lowered the unit cost; elimination of flue gas reheat components; and reduced reagent preparation costs (Energy Information Administration 1997; Burtraw, 1996). The potential revenue-generating allowances obtainable with greater FGD removal efficiencies sped the diffusion of higher removal efficiency scrubbers in the 1990-99 period. SO_2 removal efficiencies in excess of 98 percent were accomplished through such measures as the incorporation of additives (e.g. dibasic acid, formic acid, and magnesium compounds) in scrubber designs, and improved gas-liquid contact throughout the scrubber system via improved hydraulics and ultrafine limestone particle size.

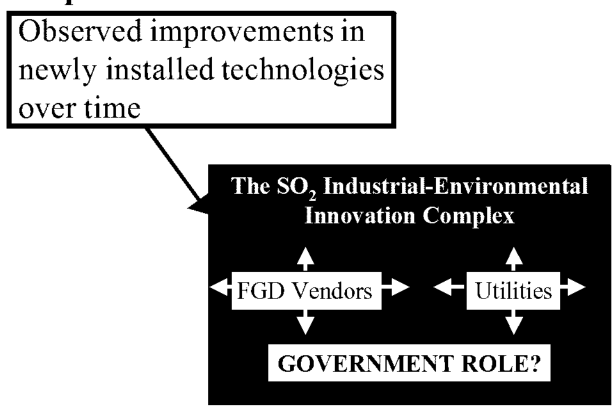
Finally, operating and maintenance costs were reduced due to a number of innovations. New materials of construction such as alloys, clad carbon steel, and fiberglass provided corrosion resistance at reduced cost, with subsequent savings in maintenance costs. Operation without gas reheat, wastewater evaporation systems, and heat exchangers that used waste heat from stack gases to increase power plant efficiency all enhanced energy efficiency. Labor costs were reduced through improvements in instrumentation and controls, while operating costs could be offset by the sale of commercial-grade gypsum from wet limestone forced oxidation processes (U.S. Environmental Protection Agency, Office of Air Quality Planning & Standards, 1997; Jozewicz et. al., 1999; Schmalensee et. al., 1998).

Outside the Black Box: Outcomes of Innovation in SO_2 Control Technologies

As the preceding discussion has shown, government actions have had a considerable influence on the SO_2 industrial-environmental innovation complex and its resulting technologies. In later sections of this dissertation, some of this influence will be quantified with respect to the innovative activities undertaken by the actors in this complex. Expert opinion about innovative outcomes in SO_2 control technologies will also be described throughout the dissertation. The remainder of this chapter, however, will focus on quantifying the innovative outcomes observed outside the black box of the SO_2 industrial-environmental innovation complex. Figure 2.12 represents the method used in this section to quantify, through the use of market and performance data, improvements in the removal efficiencies and capital costs of newly installed FGD systems over time.[44]

FIGURE 2.12

Observed Improvements as a Measure of Innovative Outcomes



The method used in this section to quantify innovative outcomes is similar to the learning curve method employed in Chapter Five, in that it charts performance improvements as the dependent variable related to the independent variable of cumulative output. The method used here differs from the learning curve method, however, in that it considers improvements in state-of-the-art FGD systems over time rather than simply the performance improvements that occur based on organizational learning at a given facility. Thus, it will be called a "generational" analysis, for the new generations of state-of-the-art FGD systems to come online over the years. Whereas the learning curve method relies on one data set for a consistent plant-level analysis that is then aggregated to derive overall trends, the generational method used here employs two data sets and a series of studies in order to assess FGD industry trends.

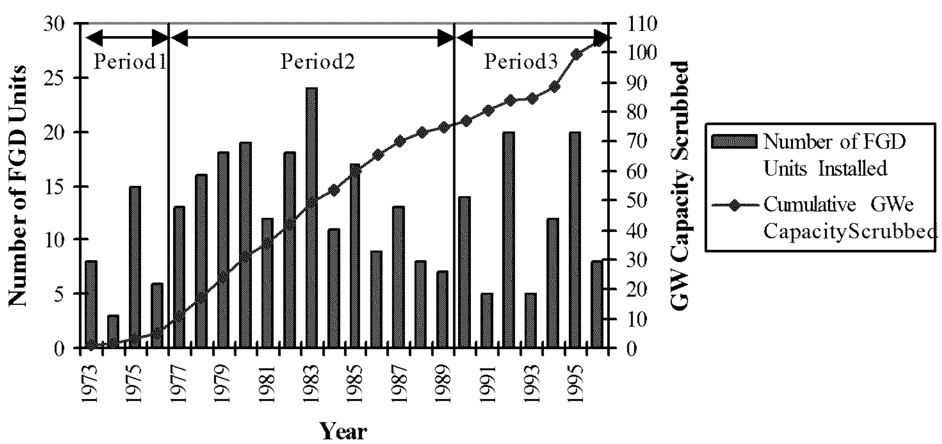
Both the generational analysis of SO_2 removal efficiencies and that of capital costs rely on a predictor variable that represents the cumulative output of FGD systems. The cumulative

[44] Reliability and operating costs are not considered in this section. As stated previously, reliability became a negligible concern by 1989. Changes in capital costs over time incorporate reliability considerations to a large extent. Operating cost trends are examined in Chapter Five, which deals with learning curve analysis.

output of an FGD system can be considered to be the cumulative gigawatts (GWe) of electrical capacity scrubbed by all FGD systems in the U.S. For both generational analyses, the cumulative FGD capacity is taken from an International Energy Agency (IEA) dataset considered reliable on FGD capacity (Soud, 1994).[45] Figure 2.13 shows the cumulative GWe capacity scrubbed by FGD units that came online between 1973 and 1996, as calculated from this dataset (parts of this graph were shown throughout the preceding discussion of government and non-government actions in SO_2 control).

FIGURE 2.13

Number of FGD Units and Cumulative GWe Capacity of FGD Units from 1973 to 1996



Source: Adapted from Soud (1994)

Note: These numbers are archival through June 1994, then projected for 1994-96.

The generational analysis of SO_2 removal efficiencies relies on performance data for U.S. FGD units that came online between 1973 and 1996. These data are provided in a very detailed and complex DOE Energy Information Administration (EIA) form 767 dataset, which covers

[45] There is some question about reliability after the publication date of June 1994, since the 1994 to 1996 data is based on scrubber orders known at the time.

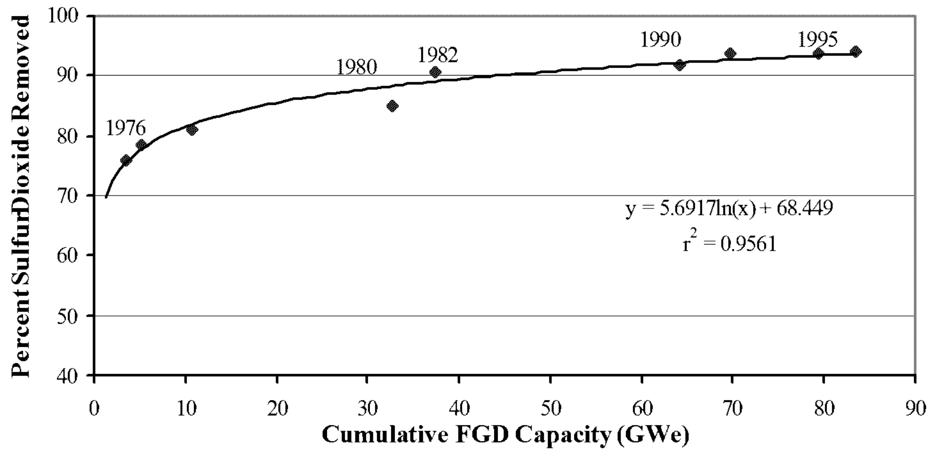
U.S. scrubbers with inservice dates as early as 1969 (see Energy Information Administration (1999) and Appendix D for details on the data and the data translation process).[46] The exact removal efficiency calculated in this analysis for each year is an average of the estimated removal efficiencies (at the annual operating factor) of each year's class of inaugural FGD units. Figure 2.14 displays the improvement in wet limestone FGD system SO_2 removal efficiencies between 1973 and 1996 as a function of cumulative FGD GWe capacity.[47] Overlaid on the average estimated removal efficiency data pointsis a logarithmic curve that explains over 95% of the variance. Note that the rate of SO_2 removal efficiency improvement is particularly high between 1976 and 1980, as efficiencies improved from a 1975 removal level of about 70% to a 1980 level of almost 90% removal. These years correspond with years of high FGD industry profit and entry into the utility FGD market. These years also correspond with the period of promulgation and implementation of the 1977CAA and the FGD-promoting 1979 NSPS. In general, the logarithmic curve in Figure 2.14 indicates the "innovative life-cycle" of FGD technologies, since it shows the technology to be born and improve rapidly in the 1970s and early 1980s, then mature as removal efficiencies flatten out.

[46] This dataset has well-documented inaccuracies (see Weilert and Dyer, 1995).

[47] Because of a concern that low- to moderate-removal dry and other FGD systems might be masked as wet FGD systems due to inaccuracies and missing information in the EIA 767 dataset, data points were excluded from this figure if they showed lower removal efficiencies than the state-of-the-art in previous years.

FIGURE 2.14

Improvements in SO_2 Removal Efficiency of Commercial FGD systems as a Function of Cumulative Installed FGD Capacity in the U.S.



Source: Based on data from Soud (1994), Energy Information Administration (1999)

FGD capital costs are not as simple to analyze as SO_2 removal efficiencies because capital costs entail a great number of site-specific design factors that muddy cost trends. For this reason, the generational analysis of capital costs relied on a dependent variable based not on actual utility data, but rather on a series of capital cost studies conducted over the last three decades. As mentioned previously, TVA performed periodic utility capital cost benchmark studies in the 1970s and early 1980s. EPRI began to perform similar benchmarking studies in the mid-1980s and continued these studies into the 1990s. All of these studies incorporated systematic cost assumptions associated with contemporary technology design applied to standardized coal-fired power plants. Five of these studies, representing wet limestone scrubbing technology as it appeared in 1976, 1980, 1982, 1990, and 1995, were used to examine trends in FGD capital costs for a benchmark 500 MWe plant burning a high sulfur (3.5% sulfur) coal (McGlamery et. al., 1980; Laseke, Jr. et. al., 1982; Keeth, Ireland, and Moser, 1986; Keeth, Ireland, and Radcliffe, 1990; Keeth, Ireland, and Radcliffe, 1991).[48] The reported capital cost in each study was adjusted to a basis of 1997 dollars using the procedure described in Appendix E. Other adjustments were made to account for slight differences in the relevant assumptions of the TVA and EPRI studies. For example, one study used somewhat higher sulfur coal and smaller plant size than the reference plant design. In these cases, reported cost results were adjusted using a power plant computer model that accounts for the influence of each cost factor on total FGD cost (Rubin, Kalagnanam, and Berkenpas, 1995; Rubin et. al., 1997).

Figure 2.15 provides a systematic estimate of FGD capital cost reductions as a function of FGD GWe capacity (based on Soud, 1994; McGlamery et. al., 1980; Laseke, Jr. et. al., 1982; Keeth, Ireland, and Moser, 1986; Keeth, Ireland, and Radcliffe, 1990; and Keeth, Ireland, and Radcliffe, 1991. Overlaid on these estimated costs is a third-order polynomial equation that accounts for over 98% of the variance in these capital costs over time. Note that capital cost reductions were minimal in the 1976 to 1980 time period during which SO_2 removal efficiencies improved rapidly. Indeed, steeper improvements in capital costs occurred only after steep improvements in SO_2 removal efficiencies (capital costs improved greatly between 1980 and 1990, while removal efficiencies improved rapidly between 1976 and 1980). As in the case of SO_2 removal efficiencies, however, capital costs leveled out in the 1990s, although to a lesser extent than removal efficiencies.

[48] Note that these years were also highlighted in Figure 2.14 for purposes of comparison.

FIGURE 2.15

Reductions in Capital Cost of a New Wet Limestone FGD System for a Standardized Coal-fired Power Plant (500 MWe, 3.5% sulfur coal, 90% SO_2 removal)

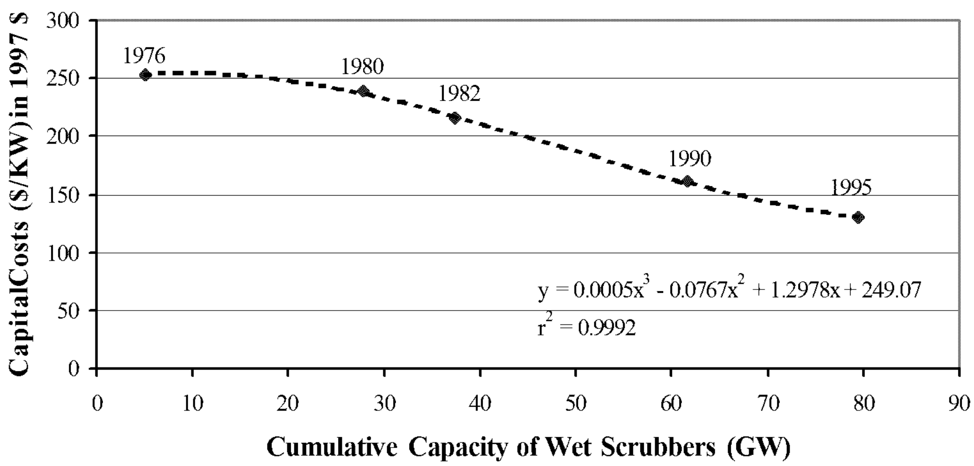


Figure 2.14 and Figure 2.15 quantify the improvements in SO_2 removal efficiencies and capital costs that were a major outcome of innovative processes occurring inside the black box of the SO_2 industrial-environmental innovation complex during the 1970s, 1980s, and 1990s. These two figures do not merely show the existence of important innovations in a heavily government-influenced technology, however. These figures also suggest innovative priorities in the SO_2 industrial-environmental innovation complex and hint at possible predictive implications about environmental technological innovation.

It appears that the priority order for SO_2 control technology development was first, to demonstrate that FGD technology could meet high removal standards, and second, to make this technology cost-competitive. This is probably a typical priority order for the development of an environmental control technology, as long as the most expensive technological solution is still cheaper than the alternative to meeting the environmental standard that created the need for the technology. This sort of calculation is considerably more uncertain in the emission-trading regime of the 1990 CAA than in earlier national environmental regulatory events.

One of the advantages of developing the logarithmic and third-order polynomial equations fitted to the data in Figure 2.14 and Figure 2.15 is that these models characterize improvements in performance and reductions in cost as a simple function of technology diffusion. The simplicity of these functions is likely to make this work accessible to models of future environmental change, which have important uncertainties related to the rate of relevant environmental technological change. Of course, finding similar functions in other case studies of environmental innovation will be important to developing a more general understanding of these rates of change. Some of this work will be done for nitrogen oxide control technologies and carbon sequestration technologies in fulfillment of the USDOE Office of Science Notice 00-08 for the Integrated Assessment of Global Climate Change Research.

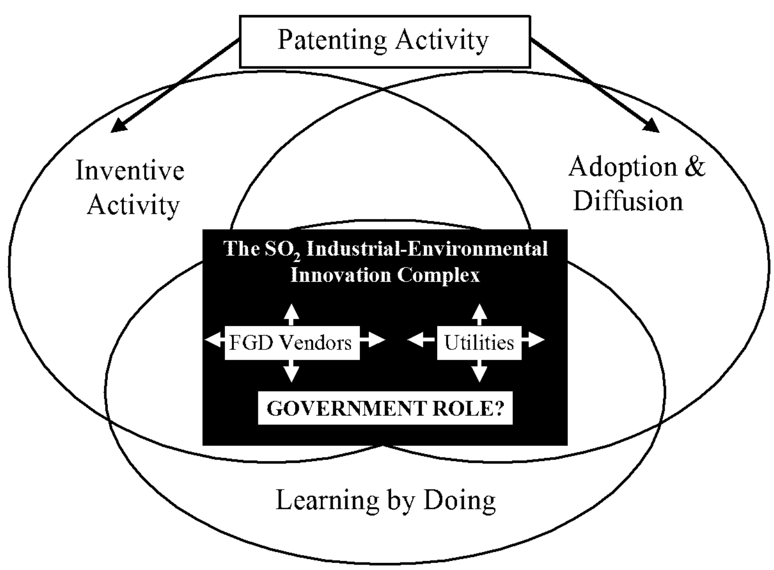
This section provided a quantitative overview of innovative outcomes in SO_2 control technologies, while the historical descriptions that comprised the majority of this chapter provided a qualitative understanding of the context in which these innovations occurred. The next three chapters each focus on ways of measuring the innovative processes of invention, adoption and diffusion, and learning by doing that take place within the SO_2 industrial-environmental innovation complex. The influence of government actions on these processes over the past three decades will be highlighted.

Chapter 3 Patent Analysis

Chapter Two described the outcomes of innovation in SO_2 control technologies between 1970 and 1999 and quantified the improvements that took place in these years with respect to SO_2 removal efficiencies and capital costs. In order to arrive at these outcomes, innovative activities occurred that were influenced by the government actions and business concerns that were also described in Chapter Two. Figure 3.1 portrays the combined innovative activities of invention, adoption and diffusion, and learning by doing that occur within the SO_2 industrial-environmental innovation complex.

FIGURE 3.1

Patents as a Measure of Inventive Activity and Adoption & Diffusion Strategy



No attempt was made in Chapter Two to quantify any of these innovative processes. This chapter focuses on measuring inventive activity in the SO_2 industrial-environmental innovation complex over time in an effort to observe the influence of government action on the innovation process. The measure used in this chapter is patenting activity, which has not only been used by many studies to gauge inventive activity, but also speaks to the marketing strategies of firms that can lead to adoption and diffusion (for published reviews of patent research, see Archibugi and Pianta, 1996; Basberg, 1987; Griliches, 1990; Pakes and Simpson, 1989; Pavitt, 1985; Schankerman, 1989).

The introductory section of this chapter defines patents and discusses the patenting process. It also explores some of the advantages and disadvantages of using patents as an innovation measure. Some of the techniques other researchers have used to compensate for these disadvantages are also discussed in this section, and an overview of how these disadvantages are accounted for in this dissertation is provided. The introductory section of this chapter concludes with expert perceptions of the role of patents in the SO_2 industrial-environmental innovation complex. The second and third sections of this chapter describe two different approaches employed in this dissertation to create patent datasets for use as a stage on which to observe the influence of government action on innovation. The results of these approaches are presented and discussed; expert opinion on these results is also included in some of the interpretations.

Patents and the Patenting Process

A patent is a government grant to an inventor of a legal right to the exclusive manufacture and sale of a useful, non-obvious, novel invention for a set period of time in exchange for making details of the invention public. In theory, a patent rewards an inventor for investing in inventive activity with a temporary monopoly right for the commercialization of the resulting invention. The societal reward for granting this monopoly right is the enhancement of the public good of "knowledge" from which new discoveries and innovations draw. In practice, the patent is not always commercially exploited by the inventor or the organization to which the inventor may assign the patent right.

Instead, the patent may be treated by its owner as an intellectual property that can be bought, sold, traded or licensed to other firms or individuals as part of the patent owner's commercial strategy. An inventor may thus file a patent application not only as the result of a new inventive effort, but also as the result of a new strategic interest in exploiting an existing invention. In general, though, researchers have observed that patenting activity occurs at a fairly early stage in a research project (Hall, Griliches, and Hausman, 1986; Stoneman, 1983).

Patents are not always applied for when a technical advance occurs that meets all the conditions for patenting and is thus "patentable," however, and certain types of technical advances are not patentable. Survey results in Mansfield (1986) show that firms apply for a patent for about 66-87% of patentable inventions. A firm's understanding of competitive conditions and the strength of patent protection in its industry determine the decision whether to file for a patent. Keeping a patentable advance secret can be more beneficial to a firm interested in appropriating the commercial benefits of inventive activity than paying patent fees and publicly revealing details of the technical advance. This is especially, but not exclusively, true in industries in which technologies develop so rapidly that inventions get quickly outdated and in industries in which patents are difficult to enforce. The attractiveness of secrecy to a firm in any industry is enhanced if a firm appreciates that it has a strong position, vis-à-vis competitors, in its firm-specific skills and know-how that will make imitation by competitors costly and time-consuming. Other firm characteristics that can make imitation difficult include the ability to quickly launch and distribute a new product and the ability to maintain especially low prices on a new product. [For more about the firm decision to patent, see Cohen, Nelson, and Walsh (1996); Ferne (1998, p. 14); Mansfield, Schwartz, and Wagner (1981); Pavitt (1985, p. 81); Scherer

(1976); Schmoch and Schnoring (1994, p. 399); Taylor and Silberston (1973); von Hippel (1982)].

Once a firm decides to apply for a patent, it faces a decision about where to file for patent protection. A patent can be filed in an industrialized country like the United States in two main ways: either directly to the national patent office or through the global Patent Cooperation Treaty (PCT) administered by the World Intellectual Property Organization (WIPO). Direct application to individual national patent offices is typically less costly than application to international mechanisms such as the PCT, but applying through the PCT can be less expensive and burdensome if the inventor is interested in filing for patent protection in multiple countries around the world. If patent protection is sought in multiple countries, it is the first application filed anywhere in the world that is considered the "priority" application. The year this application is filed is considered the priority file year, and the priority country is typically assumed to be the country in which the invention is developed. It is this priority application that is considered the basic patent in an international patent "family" consisting of all the patent documents associated with a single invention that are published in different countries (National Science Board, 1999, p. 6-23).

In general, a patent is filed in countries the patent applicant seeks to market in. The size of the U.S. market has helped to make the U.S. patent system the largest in the world and has therefore made it a useful patent system for researchers to explore international issues related to inventive activity. This chapter deals only with patent data from the U.S. system. About 100,000 patents are granted every year by the United States Patent and Trademark Office (USPTO), about half of which are invented in the United States and considered "domestic applications (Narin, 1994a; Narin, 1994b)." Between 1880 and 1989, the number of domestic patent applications in the U.S. increased at a slower rate than real GNP and investment, but the late 1980s and early 1990s demonstrated a sharp increase in U.S. patent applications (Arundel and Kabla, 1998; Griliches, 1990; Kortum and Lerner, 1997).

Once a patent is filed in the United States, it undergoes an examination process that ultimately leads to granting or rejecting the patent. The granting rate has varied over time in the United States (as well as in different countries). Data from domestic applications filed between 1965 and 1980 showed the U.S. granting rate varied from a low of 58 percent in 1965 to a high of 72 percent in 1967 (Griliches, 1990, p. 1663).

If a patent is granted, a publicly accessible document (available electronically for patents granted since 1975) is created with three main parts: the front page, the technical claims that form the legal heart of the patent, and associated diagrams. The front page of the patent is particularly useful for the researcher to gain information not just about the invention (in summary form), but also about the inventor, the organization the inventor may assign the patent right to (the "assignee"), and the intellectual background of the invention as evidenced in references to previous patents and other sources. Figure 3.2 displays the front page of a U.S. patent relevant to SO_2 control. Information contained on this front page includes the following fields of summary information: the patent number, grant date, title, inventor and assignee (including geographic origin), application file date, foreign application priority data, International Patent Classification (IPC), United States Patent Office Classification (USPC), patent and non-patent references, abstract, and number of claims. By convention, all patent front pages, regardless of the granting authority, contain most of the same fields of summary information in the same order as in this sample patent (Clarke and Riba, 1998, p. 2). In addition to these fields, U.S. patents sometimes have a "statement of government interest" if the U.S.

government has helped to develop the invention being patented and would like to retain the right to use (not commercialize) the invention without dealing with infringement issues.

FIGURE 3.2

Sample Patent Front Page

United States Patent **4,279,873**

Felsvang et al. **Jul. 21, 1981**

PROCESS FOR FLUE GAS DESULFURIZATION

Inventors: **Karsten S. Felsvang**, Allerød; **Ove E. Hansen**, Vaerløse; **Elisabeth L. Rasmussen**, Holte, all of Denmark

Assignee: **A/S Niro Atomizer**, Søborg, Denmark

Appl. No.: **39,892**

Filed: **May 17, 1979**

Foreign Application Priority Data

May 19, 1978 [DK] Denmark 2237/78

Int. Cl. **C01B 17/00**
U.S. Cl. **423/242**
Field of Search .... 423/244 A, 244 R, 242 A, 423/242 R, 243

References Cited

U.S. PATENT DOCUMENTS

3,305,307	2/1967	Sporman et al.	23/129
3,531,748	10/1970	Pinter et al.	423/242
3,929,968	12/1975	Taub	423/242
3,932,587	1/1976	Grawthan	423/242
3,966,418	6/1976	Prevel et al.	23/284
3,969,482	7/1976	Teller	423/235
4,001,384	1/1977	Iwakura et al.	423/551
4,002,724	1/1977	McKie	423/242
4,197,278	4/1980	Gehri et al.	423/248

FOREIGN PATENT DOCUMENTS

96138	10/1958	Czechoslovakia
2304496	8/1974	Fed. Rep. of Germany
2419579	11/1974	Fed. Rep. of Germany
2550488	5/1977	Fed. Rep. of Germany
1333635	10/1973	United Kingdom

Primary Examiner—O. H. Vertiz
Assistant Examiner—Gregory A. Heller
Attorney, Agent, or Firm—Schuyler, Banner, Birch, McKie & Beckett

ABSTRACT

SO_2 is absorbed from hot flue gas by spray drying a $Ca(OH)_2$-containing suspension in the flue gas. Fly ash is left in the flue gas which is to be treated in the spray absorption process, and the powder which is produced by the spray absorption process and which consequently contains the fly ash and partly reacted $Ca(OH)_2$ is partially recycled. Operation is controlled to obtain a temperature of the flue gas after the treatment which is 8°–20° C. above the saturation temperature of the flue gas at this stage. The process leads to optimum use of the $Ca(OH)_2$ used as absorbent and of the neutralization power inherent in the fly ash. Problems due to sedimentation of the absorbant before its atomization are avoided.

13 Claims, 4 Drawing Figures

Several of the patent front page fields require additional explanation and notes. First, the title of the patent is often not as clear an indicator of the nature of the invention as might be expected, due to the use of general terms and vague language (Clarke and Riba, 1998, p. 2). In some instances, this vagueness is a deliberate attempt by patent attorneys to "hide" their clients' patents from competitors' search engines. Second, the "assignee" field does not always appear on a granted patent. Inventors who work for private companies, the federal government, or universities often must assign ownership of their patents to their employers. Inventors who do not assign their patent rights to another organization are considered individual inventors, and assignee fields often do not appear on the front pages of their patent applications (National Science Board, 1999, p. 6-18).

Third, a number of classification systems exist that attempt to categorize patents by their technical content according to class and subclass. In many instances, an examiner will assign more than one classification to a patent, although the first is accepted as the "main" classification. Guides are issued to understand, through keywords, which classes consist of which types of technologies. Developed and managed by WIPO, the IPC is revised roughly every five years, and contains about 20,000 terms related to the form or construction of the invention. The USPC is administered by the USPTO and contains about 370 active classes and 128,000 subclasses related to the function or purpose of the invention (Clarke and Riba, 1998, p. 4; National Science Board, 1999, p. 6-21).

Fourth, the references of a patent to previous patents are not simply a matter of the judgment of the inventor as in the case of references in articles or books. Patent references point to the "prior art" of a patent, or earlier inventions whose claims are legally determined by the patent examiner to be closely related to the claims in the citing patent (Narin, 1994b, p. 152). Generally, patent applicants and their attorneys contribute some of a patent's references, and the patent examiner will modify these citations during the examination process, often adding or subtracting citations (Jaffe, Fogarty, and Banks, 1998, p. 199).

Finally, the abstract of a patent is meant to be a brief description of the technical nature of the invention. The abstract, like the patent claims, should demonstrate the usefulness of the invention and may do so by describing a problem the current technological state-of-the-art does not solve that the patented invention claims to solve (Clarke and Riba, 1998, p. 2-3). In practice, abstracts are not always brief and, like titles, may employ non-obvious keywords.

After a patent is granted, it is in force for a set period of time. For many years, U.S. patents were guaranteed for seventeen years after the grant date. Beginning with applications filed on and after December 12, 1980, however, these seventeen years were only guaranteed contingent on the payment of patent renewal fees due 3 ½, 7 ½, and 11 ½ years from the grant date (U.S. Patent and Trademark Office, 2000a). U.S. maintenance fees for the common "utility" type patent as of December 29, 1999, are shown in Table 3.1. The "small entities" described in this table are concerns with less than 500 employees (13 CFR 121.802). Surcharges on late maintenance fee payments range between $130 and $1,640 (U.S. Patent and Trademark Office, 2000b).

TABLE 3.1

Patent Maintenance Fees

	Most Assignees	Small Entities
Maintenance Fee at 3 ½ years	$830	$415
Maintenance Fee at 7 ½ years	$1,900	$950
Maintenance Fee at 11 ½ years	$2,910	$1,455

Source: U.S. Patent and Trademark Office (2000b)

Although patent renewal rates are of interest to researchers, the subset of patents for which maintenance fee data are available is relatively small compared to the total universe of U.S. patents. In his 1990 review of patent research, Griliches (1990, p. 1681) gives some basic information on the payment of maintenance fees for patents filed in 1981-4. Unpublished tabulations from the USPTO's Office of Documentation Information showed that, as of the end of 1988, 84% of these patents were renewed after the first 3 ½ year period (83% of U.S.-owned patents and 85% of foreign-owned patents were renewed). Griliches (1990) also cites an unpublished manuscript by Manchuso, Masuck, and Woodrow (1987) on a smaller sample of the same data in which 87% of U.S.-invented patents were renewed but only 61% of individually-owned patents were renewed. When this study separated patents by technology, "chemical" patents were maintained at the highest rates, and "mechanical" patents were maintained at the lowest rate.

In 1995, the patent term was changed to twenty years from the earliest effective *filing* date claimed by the applicant, contingent on the payment of the same renewal fees as in the earlier revision. As a result of this change, the incentive of patent applicants to prolong the application process and obtain a de facto extension of patent coverage was reduced, while pressure was increased on the patent office to expedite the examination process (U.S. Patent and Trademark Office, 1999, p. 7).

Research Use of Patents

Researchers have long used patents as a measure and descriptive indicator of inventive activity because they provide considerable research advantages (for published reviews of patent research, see Archibugi and Pianta, 1996; Basberg, 1987; Griliches, 1990; Pakes and Simpson, 1989; Pavitt, 1985; Schankerman, 1989). Some of the advantages of using patents as a measure and a descriptive indicator for inventive activity are clear from the discussion of the patenting process above. The nature of the "trade-off" involved in the granting of patents to inventors benefits researchers in two ways. First, the time-consuming and costly nature of the patenting process and the monopoly right to commercialize an invention that results from the granting of a patent are reasons why researchers can expect that the inventive activity measured in patent counts is, on the whole, non-trivial. Further evidence of the non-trivial nature of patents is empirically shown in surveys by Napolitano and Sirilli (1990), Scherer et. al. (1959), and Sirilli (1987), which demonstrate that the eventual use by firms of the inventions detailed in their patent applications ranges from 40% to 60% of total applications (Archibugi and Pianta, 1996, p. 454). Second, the societal benefit of publishing patent information is good not only for enhancing technical knowledge, but also for improving the understanding of the innovation process. The public accessibility of patent information is constantly increasing, as more information is made electronically available for a growing number of countries and application years. The detailed front page summary information about the invention, the inventor, the assignee, and the intellectual background of the patent is clearly of interest to researchers studying the nature, locus, and timing of inventive activity.

Analysis of the relationship between patent data and the inventive input of research and development ("R&D") expenditures has also strengthened patent analysis as a measure of inventive activity. As stated in Griliches (1990, p. 1674), "the evidence is quite strong that when a firm changes its R&D expenditures, parallel changes occur also in its patent numbers." Since patents are an intermediate output of R&D, they are typically used by researchers as a measure of inventive output; but this close relationship between levels of R&D expenditures and levels of patents tie patents strongly to inventive input as well. This is particularly important since R&D expenditure data are not typically available for all inventing entities, especially in a detailed manner [see Cohen and Levin (1989); Griliches (1990); Lanjouw, Pakes, and Putnam (1998); Schmoch and Schnoring (1994)].

Finally, another advantage of the use of patenting activity as an invention measure is that analysis has shown that patenting activity can be linked to events that occur outside the firm. In an analysis of the relationship between patents, R&D, and the stock market rate of return, Pakes (1985) showed that about 5 % of the variance in the stock market rate of return is caused by events that change both R&D expenditures and patent applications. The implication of this is that an observation of a dramatic increase or decrease in a firm's patent activity is an indication "that events have occurred to cause a large change in the market value of its R&D program

(Griliches, 1990, 1683-4)." The Jaffe and Palmer (1997) and Lanjouw and Mody (1996) papers discussed in Chapter One of this dissertation both take advantage of this finding by attempting to relate environmental patenting to pollution abatement expenditures as a measure of severity of regulation.

Problems Encountered with the Use of Patents in Research

However useful patents are as a measure and a descriptive tool for inventive activity, they also present the researcher with difficulties that can be categorized into three problem areas. First, technical difficulties arise in both locating patents of interest and allocating these patents to relevant industrial and product groups. Second, analysis difficulties arise from variations in the strategic decisions of entities to apply for patent protection. Both these problem areas were touched upon in the discussion of patents and the patenting process above. The third problem area involves difficulties with comparing patents against each other because of a number of "qualitative homogeneity" issues related to the question of whether all patents are of equal value simply because they have unique patent numbers.

Most patent research identifies patents of interest based on a classification system such as the IPC or the USPC and then allocates these patents to relevant industry or product groups; care must be taken with both of these research tasks. The subclasses often used by researchers to identify patents can be vague and can cause a researcher to miss relevant patents; at the same time, since a patent can be assigned to multiple subclasses, irrelevant patents can be netted in subclass-based searches. Additional identification problems arise from a researcher's choice of classification system, since the IPC, USPC, and other classification systems vary according to the level and nature of technical detail they use to categorize patents. Patent identification can also be problematic when subclasses are not used as the basis for identification. Non-obvious keywords in a patent's title or abstract can foil careless electronic searches based on these front page fields. Finally, identifying patents by assignee firms and then classifying these patents according to the firm's major business lines, as was first done by Scherer (1984), is an imprecise method because of the number of firms with diverse business and technical interests and/or multiple name changes over time.

Allocation of patents to relevant industrial groupings presents other difficulties. Most patent systems do not require patent examiners to link patents directly to the standard industrial classification (SIC) digit level that would correspond with the patented invention's potential use (the Canadian patent system is an exception). Instead, researchers have to develop their own methods of allocating patents to either the industry that made the patent, the industry likely to produce the patented invention, or the industry that will use the patented invention. In the mid-1970s the USPTO established the Office of Technology Assessment and Forecast (OTAF), which developed a concordance that attempted to link patent subclasses to the three and 2 ½ digit levels of the SIC based on the industry of production. Unfortunately, the vagueness of subclass descriptions resulted in assigning many subclasses to multiple SIC codes, a practice that has limited the concordance's usefulness to researchers (Griliches, 1990, p. 1667-8).

As was mentioned earlier, a number of strategic factors influence an entity's decision to patent (its "patent propensity"). Indeed, strategic concerns can cause inventing entities to engage in such contrary actions as choosing to patent when they do not expect to commercialize an invention or choosing not to patent when they do expect to commercialize an invention. Variations in the patent propensities of firms and individuals can be a particular problem in comparative research, because such variations can occur by nation, by industry, by firm, and even by invention. Innovation survey information has provided the greatest insight into the patent propensities of various industries and has demonstrated its usefulness as an interpretive tool for patent analyses.

Finally, the patent problem area most frequently discussed in the literature involves difficulties in comparing patents without regard to their varying degrees of usefulness either to their owners or to society at large. Not all inventions are economically or technically equal, yet patent counts can give this appearance. Even in the hypothetical situation in which two inventions would be economically and technically equivalent, the claims of the two inventions could be bundled into a different number of patents so that the two inventions appear unequal. The Japanese patent system, for example, is particularly famous for granting patent status to a smaller number of claims than other patent systems. In addition to these problems with the qualitative homogeneity of granted patents, another source of error in the measurement of inventive activity by patents is the number of useful inventions that are not patentable. A technical advance may not be patentable for a variety of reasons related to such things as the type of technology invented or the incremental nature of the advance (Cohen and Levin, 1989).

Archibugi and Pianta (1996) reviews four different methods to weight patent counts that have been developed by researchers to address problems related to the apparent qualitative homogeneity of patents. The first of these methods uses the period of time over which patent maintenance (or "renewal") fees are paid in order to assess the private economic value of a patent to its owner. Research using renewal fee information includes Lanjouw, Pakes, and Putnam (1998), Pakes and Schankerman (1984), Pakes and Simpson (1989). The second method involves counting the patents that cite a given patent in their prior art in order to indicate the social value, or technological importance, of that patent. Research using citation information includes (Albert et. al., 1991; Carpenter, Narin, and Woolf, 1981; Jaffe, Trajtenberg, and

Henderson, 1993; Narin, 1994a; Narin, 1994b; Narin and Olivastro, 1988; Trajtenberg, 1990). The third method involves the use of international patent families in order to make more accurate international comparisons and also assess the private value of patents. Research using patent families includes Grupp (1993), Lanjouw, Pakes, and Putnam (1998), Schmoch and Kirsch (1993). Finally, the fourth method, which is less frequently used than the other methods, uses counts of the number of claims made in each patent in order to provide an informed basis for patent comparison. Research using patent claims includes Tong and Frame (1994).

Use of Patents in this Dissertation

In summary, there are several advantages to the use of patents as a measure of inventive activity. Patents provide publicly accessible and detailed technical and organizational information for what can be assumed to be non-trivial inventions over a long period of time. This is a particular advantage in this dissertation, since patents can help link commercially-relevant technical information with adopted & diffused innovations and the knowledge gained from operating experience with these innovations. Close parallels between levels of R&D expenditures and patenting activity are another advantage of patents as a measure of inventive activity, especially in industries – such as the FGD equipment and services industry – in which detailed R&D information is very difficult to obtain. Finally, the linkages that have been shown in the literature to occur between events external to the firm and patenting activity suggest that patents can provide insights into connections between inventive activity and government actions pertinent to SO_2 R&D, such as new legislation.

The three main research disadvantages of patents, however, need to be considered in order to utilize patents optimally in research. In this dissertation, two approaches are taken to resolve the first research problem, the technical difficulties with patent identification and allocation. In the first approach, patents are identified through a search of patent subclasses and in the second, through an electronic search of patent abstracts and the manual assignation of captured patents into technological and organizational categories. Concerns about the second research problem – the various reasons for patenting in the SO_2 industrial-environmental innovation complex – are addressed in this dissertation through interviews with experts from a range of different organizations. Finally, the third research problem – the appearance of qualitative homogeneity among patents – is addressed in this dissertation through three methods to gauge the private and social value of patents. The private value of patents is gauged using patent renewal data and a direct validation of patents against "commercially important" patents obtained from firms with large market shares inthe FGD equipment and services industry. The social value of patents is gauged using patent citation data.

Perception of Patents

This section discusses one of the three problems encountered in the use of patents in research, namely concerns about the various reasons for patenting in the SO_2 industrial-environmental innovation complex. It does so in the context of expert perceptions of patenting in SO_2 control technologies. The other two problem areas involved in the use of patents in research, the technical problems involved in patent identification and allocation as well as the misleading appearance of qualitative homogeneity among patents, will be addressed in the next two sections of this chapter.

As discussed in Chapter One, twelve experts were interviewed for this dissertation through a structured two-hour interview process designed to elicit opinions about innovative activity in the SO_2 industrial-environmental innovation complex.[49] These experts were asked questions dealing with the historical development of technologies and government actions, as well as with organizational issues related to innovative activity. In addition, each expert was asked questions pertinent to the methods used in this dissertation to quantify innovation. Five questions dealt specifically with patents in the SO_2 industrial-environmental innovation complex. Three of these five questions involved the experts' perceptions of the role of patents in the SO_2 industrial-environmental innovation complex, and will be discussed in this section. These three questions addressed: the importance of patents to various organizations; the approach of organizations to the patenting process; and significant technologies that are covered by patents. The other two (of five) questions involved direct interpretation of the results of patent analysis, and will be discussed in another section of this chapter.

Levels of Patenting Activity

All twelve experts made statements in the interviews that support both the existence of a role for patents in the SO_2 industrial-environmental innovation complex, as well as the perception that this role is not currently vital to innovative activity. There was some disagreement among the experts as to the frequency of patent applications in the SO_2 industrial-environmental innovation complex. Three experts, experts B, E, and L, supported the view that many patents are applied for in FGD technologies. Expert B stated that "a lot of the vendors patent everything they do," while expert E suggested that the role of patents in the FGD equipment and services industry is growing in importance, particularly as the globalization of the industry increases. Alternatively, four other experts supported the view that patent frequency is

[49] The characteristics of these experts appear in Table 1.1, where they are listed in conjunction with their identification labels in the dissertation.

low in FGD technologies. Expert K stated that "surprisingly few patents are really out there." Expert I stated that patents do not cover most of the technology in use today, while experts A and B explained that very few people in their organizations apply for patents. Expert K, however, agreed with the statement that the role of patents is increasingly important, as there has been a "history of patent infringement" and legal "aggravation" that has prompted SO_2 control technology innovators to be much more careful about patent protection in recent years.

The frequency of patenting activity is, of course, related to the perceived advantages of patents. Expert G stated that the advantage ofsome of the early patents was to allow certain organizations to attract business and then maintain market position. Experts C and D mentioned enhanced customer perceptions of patent-holding entities as an advantage of patent ownership. In support of this, expert D stated that "customers do ask what's patented in an offering" and expert C mentioned that suppliers with strong patent portfolios achieve a temporary advantage because of enhanced customer perceptions of the supplier. Experts A and D, however, also stressed the commercial advantage of organizational "know-how." As was mentioned earlier in the discussion of the patenting process, previous research has shown that firms with perceptions that their know-how is particularly strong often find secrecy to be an attractive approach to managing intellectual property. No expert, however, mentioned secrecy as an alternative to patent protection in SO_2 control technologies. It is an interesting feature of the FGD equipment and services industry, however, that product differentiation associated with specific scrubber vendors was considered by experts D and H to be more important to the commercial technological strategy of companies than patents. According to these two experts, this differentiation is generally respected by the other organizations in the SO_2 industrial-environmental innovation complex.

Besides product differentiation, the composition of the SO_2 industrial-environmental innovation complex and the volatility and profitability of the FGD equipment and services industry were also specifically linked by experts to relatively low levels of patenting activity in SO_2 control technologies. Regarding composition, four experts (D, G, H, K) explained that the public nature of some of the most prominent innovating organizations in the SO_2 industrial-environmental innovation complex – specifically EPA, DOE, and EPRI – reduced the importance of patents in SO_2 control technologies.[50] This was because a considerable amount of information pertinent to SO_2 control innovation was shared freely among innovators and the public. Thus, the opportunity for private intellectual property protection did not arise as much as it might have in an area dominated more by private firms. This was particularly true before the Federal Technology Transfer Act of 1986 and Executive Order 12591 of April 1987; until the enactment of these government actions, agencies like EPA and DOE were not subject to considerable pressure to obtain patents. For EPRI, also, the importance of patents has grown over time, as utility deregulation has pressured EPRI to find new ways to demonstrate its importance as a technological innovator in order to sustain EPRI membership levels. In addition to the dampening effect of considerable public sector involvement in SO_2 innovation on patenting activity, one expert (D) explained that the volatility of the FGD equipment and services industry and the length of the patent application process discouraged patent filing. Finally, one expert (E) explained that the low profitability of the industry has helped to keep R&D levels, and subsequent patents, relatively low.

[50] While not technically public, EPRI represents the shared research investments of the public monopolies of utilities (before deregulation).

Reasons for Patenting, Enforcement, and Patentability

Those entities that do patent in SO_2 control technologies do so, according to nine of the experts, for at least one of three main reasons. Six – B, C, F, G, H, L – mentioned the standard incentive of protecting important innovations of technical merit in a way that will give an advantage over competitors in the FGD equipment and services industry. Five experts – D, F, G, I, K – identified prestige as important to a variety of actors in the SO_2 industrial-environmental innovation complex, including individual researchers, sections of government agencies, and entire organizations such as EPRI.[51] Careers, funding levels, public-private partnerships, and membership levels could all be enhanced by the tangible rewards of the prestige accompanying successful patents. Finally, three experts – C, D, H – who suggested either technological importance or prestige as incentives for patenting, also mentioned blocking other innovators as an incentive for filing patent applications in the FGD equipment and services industry.

The incentives for patenting of protecting innovations from competitors and blocking competitors from innovating both depend on the level of patent enforcement in the SO_2 industrial-environmental innovation complex. Eleven of the twelve experts touched on the enforcement of patents. Nine of these experts – B, C, D, E, F, G, H, I, L – generally agreed that patent enforcement has not been extremely effective, as a number of patents have been relatively easily invented around or gotten around in other ways. Experts B and C even recalled customers retrofitting a supplier's patented invention knowing that the vendorwas unlikely to enforce the patent. Experts A, B, H, I, and K, however, were able to mention specific court actions that enforced patent rights. One additional expert, expert F, who also agreed that patents could be gotten around relatively easily, explained that for some less powerful innovators in the FGD

[51] Two of these experts also mentioned the standard incentive for patenting.

equipment and services industry, the threat of patent enforcement hassles, even without the expectation of actual enforcement actions, is enough to protect their rights from more powerful innovators.

Of course, in order to enforce a patent, patent protection must be applied for, and there was a certain amount of disagreement among the experts about what inventions are patentable. For example, expert D considered some of the chemical advances in SO_2 control unpatentable; another expert, expert K, considered these same types of advances "fundamental work" and stated that this type of work is likely to result in patents. Four experts in total – A, D, J, K – addressed the issue of patentability in the SO_2 industrial-environmental innovation complex. Experts A, D, and J saw an important dichotomy between know-how and patentability (two of these three had previously touted the importance of know-how in improving SO_2 control technologies). Expert J explained that patents did not cover the way an FGD system is put together.

Patent Coverage of Specific Technologies

Nine of the experts (A, B, C, D, F, H, I, K, L) were able to mention specific SO_2 control technologies that have been patented. Four of these experts (A, B, H, K) mentioned the Niro Atomizer recycle patent on spray dryers, which was the subject of a particularly notorious court case. Other patents well-known to experts included the Babcock & Wilcox tray patent (experts B, C, D, F, H, K, L mentioned this patent), the Dravo patents on thiosorbic technology for magnesium enhanced lime scrubbing (experts A, D, F, H, L mentioned these patents), and the ABB nozzle arrangement patent (experts A, B, C mentioned this patent). Other patents mentioned included: a number of nozzle patents, a patent on reducing scaling in a two-loop scrubber using forced oxidation, a horizontal spray scrubber, patents on hydroclones, a patent on a lance-type of oxidation and air introduction system, a patent on sludge stabilization, a patent on placing a baghouse downstream from a spray dryer, a patent on buffering with formic acid, a patent on nahcolite injection used in magnesium lime injection, and a patent on a combined SO_2-NOx removal process using zinc-oxide.

Several of the experts were also able to mention a number of important SO_2 control technologies for which they believe no patent coverage exists. Experts C and D selected dibasic acid as such a technology while one of these experts also mentioned inorganic acid. Experts C, D, H, and I believe that there are no patents on forced oxidation, which has been arguably the most important advance in SO_2 control technology overall, although expert G believes that the broad coverage of earlier patents implies coverage for forced oxidation. Expert H was unaware of any patents in the area of high velocity scrubbing, an area that has been a particularly important technological focus in the last few years. Finally, expert I believed that there is no patent on how to effectively wash a mist eliminator.

Although three questions were asked of the experts regarding their perception of the role of patents in the SO_2 industrial-environmental innovation complex, not all three were equally relevant for understanding the context in which variations could occur in the patent propensities of organizations in the SO_2 industrial-environmental innovation complex. For example, that most experts could name specific patented technologies was less relevant to this overall research issue than that experts believe some important technologies have no patent coverage. According to the trend of other expert statements, this is likely to be a result of patentability issues that affect these technologies consistently, rather than a result of variations among innovating entities in SO_2 control. This consistency is important in order to have confidence in patent analysis. It is contributed to by the general agreement of experts that there is an increasingly important role, albeit not necessarily a vital one, for patents in SO_2 control technologies, and that patent ownership bestows financial advantages on both private and public innovators (despite somewhat weak enforcement).

Subclass-Based Dataset

Linkages have been shown in the literature to occur between events external to the firm and patent activity. This suggests that patents, which provide public, detailed, and consistent technical and organizational information for inventions over a long period of time, can be used to develop insights into connections between inventive activity and government actions pertinent to SO_2 R&D, such as new legislation. In order to investigate whether patent activity levels change in a corresponding manner with such government actions, it is necessary to generate a dataset that correctly identifies patents relevant to SO_2-control technologies. This dataset should be crafted with due consideration to the remaining problem areas notable in the use of patents in research, namely the technical difficulties in patent identification and allocation and the appearance of qualitative homogeneity among patents.[52] In light of the patent identification and allocation difficulties, two methods are used in this dissertation to develop such a dataset. In this section, a patent dataset is created based on USPC subclasses that are valid for over one hundred years. In the next section, a patent dataset is created based on an electronic search of patent abstracts (relevant for patents granted in the 1970s through 1990s) that is easier to refine and analyze according to technological and organizational categories. In both sections, some consideration is made for the qualitative homogeneity of patents based on either their private or social value.

[52] The second research problem area – the variety of reasons for patenting in the SO_2 industrial-environmental innovation complex – was considered in the previous section.

As discussed in the "Patents and the Patenting Process" section above, the majority of patent studies identify relevant patents through the use of a patent classification system's subclasses. This holds true in research into environmentally responsive innovation, although environmental control technology poses additional challenges in patent identification beyond those faced in most patent research.

The two most prominent (and contradictory) previous studies to use patent data to understand the relationship between environmental regulation and innovation employ class-based patent location techniques. In the first of these studies, Lanjouw and Mody (1996), the authors develop a patent dataset using IPC classes. These IPC classes are determined by first, searching IPC class descriptions, and second, using a USPC keyword index in order to determine relevant patents and backtrack these patents to their IPC classes. Lanjouw and Mody note that if too few IPC classes are used to create the inventive activity dataset, relevant patents will be left out. Yet they assume that this will not diminish the relative validity of the dataset as long as all "environmentally responsive innovation in a field responds to events in a broadly similar fashion." An obvious counterexample to this assumption is the 1979 New Source Performance Standards (NSPS) accompanying the 1977 Clean Air Act (CAA), in which the new percentage reduction requirements favored technologies with greater removal efficiencies over other technologies and approaches.

In the second of these studies, Jaffe and Palmer (1997), the authors identify patents through the use of industry patent totals based on the USPTO's OTAF concordance of USPC subclasses to 2 ½ digit levels of the SIC (based on the industry of production). As mentioned in the "Patents and the Patenting Process" section above, this concordance has had limited usefulness in patent identification because the vagueness of subclass descriptions has resulted in the inaccurate assignment of many subclasses to multiple SIC codes. Jaffe and Palmer (1997, p. 614) note that these problems are likely to be particularly harmful in developing datasets indicative of inventive activity in industries that rely heavily on equipment suppliers for research. As mentioned in Chapter One, industrial-environmental innovation complexes rely heavily on environmental equipment suppliers for research since polluting organizations often purchase control technology (such as FGD) from environmental equipment and service organizations (see Kemp 1997, p. 40).

Examiner Interview

Given the shortcomings of the patent identification methods used by these prominent previous studies of environmentally responsive innovation (particularly in the case of the SO_2 industrial-environmental innovation complex), patent identification expertise was sought from the main patent examiner in FGD control, Gary P. Straub (Straub, 1999). Mr. Straub has been either the primary or assistant examiner for at least 1,734 granted patents dating back at least to 1976, which is the earliest grant year for which USPTO electronic information is completely available. Mr. Straub recommended identifying relevant patents by searching the subclasses he regularly checks in order to determine the legal prior art of the patents he examines. Table 3.2 indicates these subclasses as well as a supplemental set of fuel treatment subclasses relevant to pre-combustion removal technologies (identified with an asterisk). For this research, a search was conducted of all USPTO patents based on the USPC subclasses contained in this table.

TABLE 3.2

U.S. Classes and Subclasses that Compose the Class-Based Dataset

USPC Class/ Subclasses	Definition of USPC Class/Subclasses
423/242.1-244.11	Class 423, the "chemistry of inorganic compounds," includes these subclasses representing the modification or removal of sulfur or sulfur-containing components of a normally gaseous mixture.
095/137	Class 095, "gas separation processes," includes this subclass representing the solid sorption of sulfur dioxide or sulfur trioxide.
110/345	Class 110, "furnaces," includes this subclass representing processes to treat fuel combustion exhaust gases, for example, in order to control pollution.
44/622-5*	Class 044, "fuel and related compositions," includes these subclasses to treat coal or a product thereof in order to remove "undesirable" sulfur.

Source: U.S. Patent and Trademark Office (2000c)

Method and Time Series Results

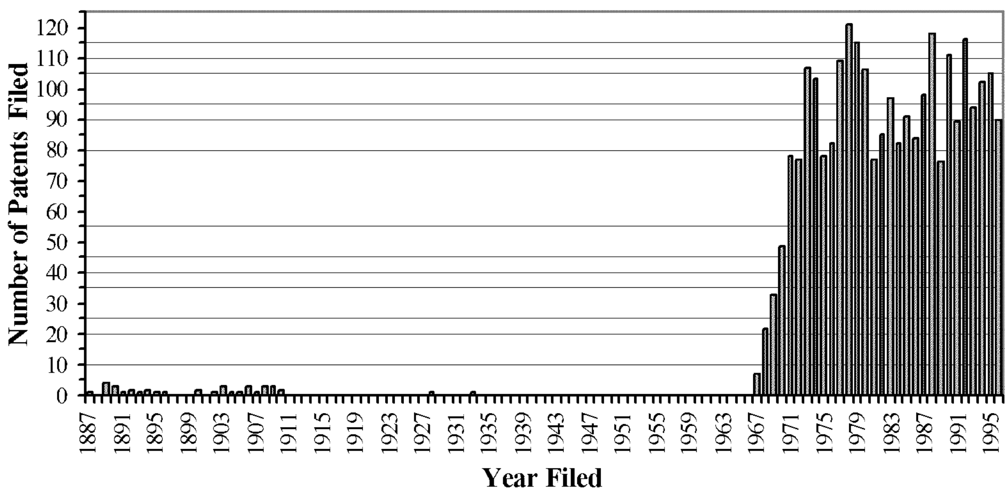
The result of this search of USPC subclasses was the capture of 2,681 patents dating back to the nineteenth century, which will be called the "subclass-based dataset." USPTO patent information for patents granted before 1976 is available through two sources: incomplete electronic information for patents beginning with patent 3,552,244, which was granted on January 5, 1971, and manual information for all patents, based on a file system organized by subclass. This subclass-based file system allows the creation of a consistent patent dataset for over one hundred years. Unfortunately, the various data formats of different segments of this dataset make detailed technological and organizational analysis a labor-intensive proposition. Without a detailed technological analysis, an overall patent activity analysis can be conducted with the accepted disadvantage of including some irrelevant patents while excluding some relevant patents filed in subclasses other than those included in the creation of the dataset. According to Mr. Straub, however, inaccuracies in patent examiner allocations to subclasses are less likely for patents filed before the advent of electronic searching because examiners had to be more careful in searching and cross-referencing patents.

Figure 3.3 displays the number of patents filed over time in SO_2 control technologies as defined by the subclasses listed in Table 3.2.[53] Note that prior to 1967, there were never more than four patents filed in a given year. This supports the idea that inventive activity in SO_2 control can be portrayed as a step-function divided into two main periods. In the first period, which includes the years before 1971, patenting activity was low despite government legislation dating back to 1955 that authorized research into air pollution abatement methods. In the second period, which includes 1971 and all the years succeeding it (here, 1971 to 1996), patenting activity never falls below the minimum activity threshold of seventy-six patents per year. The pivotal patent filing year that marks the difference between the two periods, 1971, coincides with the passage of the 1970 CAA and associated 1971 NSPS for power plant emissions. Precise correlation of patent filing activity with legislative dates is difficult as well as potentially misleading because of timing issues related both to the inventive and strategic process underlying a patent filing decision and to the various twists and turns in the legislative and regulatory process. The more than ten-fold increase in patenting activity between 1967 and 1971, however, is the type of sudden large burst in patenting activity that Griliches (1990) suggests is certain to indicate a change in external events relevant to the patented technology.

[53] File dates are used for display purposes since these dates are the earliest possible dates linked consistently to a patent application and, therefore, to the underlying invention.

FIGURE 3.3

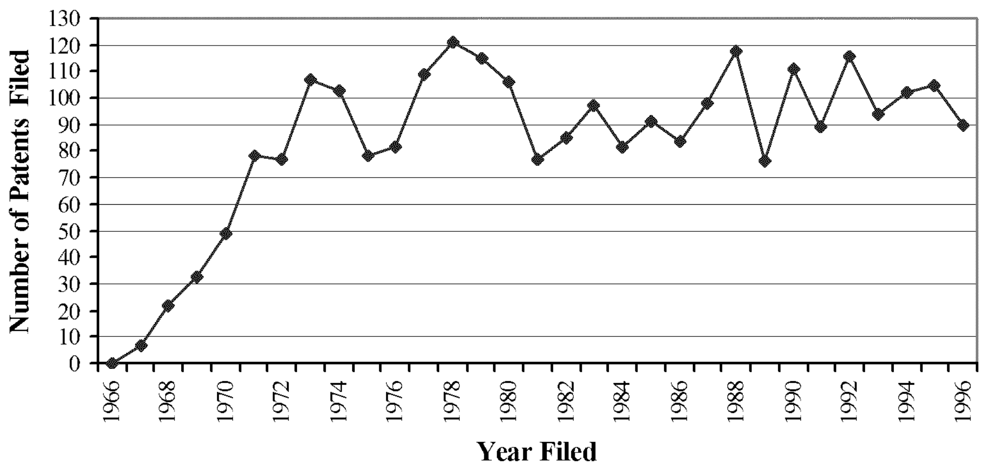
U.S. Patents Relevant to SO_2 Control Technology as Identified with the Patent Subclass Method



Unfortunately, the pattern of alternating peaks in patenting activity in the second period, 1971 to 1996 (which is revealed in greater detail in Figure 3.4), does not allow a simple identification of other obvious bursts in patenting activity. The average number of patents filed in a given year from 1971 to 1996 is ninety-six, with a standard deviation of fourteen. Of the twenty-six years represented in the 1971 to 1996 period, ten years show patenting levels that exceed the average by greater than one standard deviation, for a total of 40% of all the years represented. Attempting to associate with external events the four years with the highest patent activity levels in this period – 1978, 1979, 1988, and 1992 – is ill-advised because of this variation.

FIGURE 3.4

Second Period of U.S. Patents Relevant to SO_2 Control Technology as Identified with the Patent Subclass Method



Link to Commercial Technology

In order to gain a rough understanding of the private value of patents in the subclass-based dataset, the patents in this dataset were compared against the patents embodied in the commercial technologies of three prominent organizations in the FGD equipment and services industry. The commercially embodied patents were obtained by querying a number of FGD industry actors about the patents in their portfolios that covered their commercially successful technologies. The three companies that responded together held almost 40% of the U.S. FGD market between 1973-93, based on an analysis of Soud (1994).[54] Table 3.3 shows the moderate percentages of commercially important patents from these companies that were identified through the subclass-based search.

[54] These companies are not identified here for confidentiality reasons.

TABLE 3.3

Percent of Patents Covering "Commercially Successful" Technologies found in Subclass-Based Dataset

	Company A Commercially Successful Patents (16)	Company B Commercially Successful Patents (69)	Company C Commercially Successful Patents (15)	Total Patents From the 3 Portfolios
Subclass-Based Dataset (2,681 Patents Total) Finds:	56%	46%	87%	54%

Although the subclass-based dataset provided a very important insight into the two-period step-function of patent activity in SO_2 control (divided by the 1970 CAA and its associated 1971 NSPS), its high level of variance and only moderate success in identifying patents of private value limits its usefulness in this research. In future work, more effort may be expended to refine this dataset further. In this research, however, more detailed technological and organizational consideration is given to a dataset that does not exclude as many patents of private value in order to obtain subtler insights into the relationship between environmentally responsive invention and government actions.

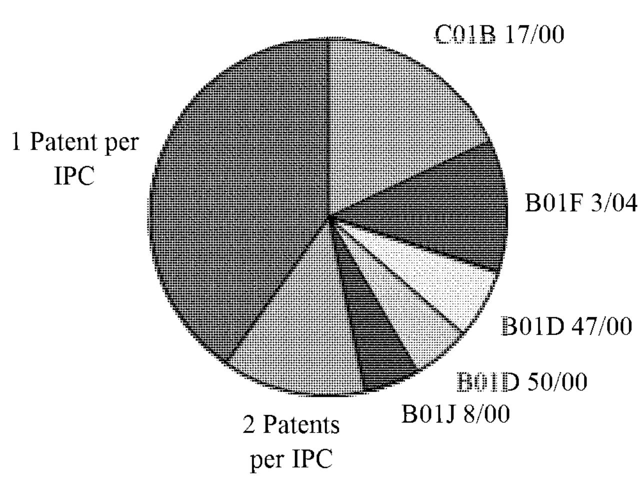
Abstract-Based Dataset

This section focuses on crafting and analyzing such a patent dataset. As mentioned previously, the dataset discussed here is created based on an electronic search of patent abstracts that is relevant for U.S. patents granted in the 1970s through 1990s. The analysis in this section spotlights correlations between patent activity and government actions as well as technological and organizational details of inventive activity that are relevant to consideration of the effects of a variety of government actions on innovation in SO_2 control.

Method and Link to Commercial Technology

The breadth of mechanical and chemical technologies embodied in FGD systems is an important foil to developing a patent dataset of SO_2 control technologies that includes a high percentage of commercially valuable patents. This breadth is illustrated in Figure 3.5, which depicts the wide range of IPC subclasses assigned to the commercially important patent portfolio of just one of the three companies that responded to queries. Over 40% of this company's seventy-seven patents are assigned to completely separate and unique IPC subclasses, while an additional 13% of its patents only share an IPC subclass with one other company-owned patent. In comparison to the thirty-six USPC subclasses used to generate the dataset graphed in Figure 3.3, this company's commercially relevant patents are filed in forty-one IPC categories (recall that IPC subclasses are more general than USPC subclasses). This indicates that a dataset based solely on subclasses, regardless of the classification system, is highly unlikely to generate a commercially validated patent dataset.

FIGURE 3.5
Distribution of One Company's Patents by IPC Subclass



Note: Total number of patents is seventy-seven.

Therefore, a different patent identification strategy was developed based on the abstracts of granted patents. With the assistance of CHI Research, a firm that specializes in using patent bibliometrics to help corporate and government clients, an electronic search was developed and conducted to filter out SO_2-relevant patents from the full set of U.S. patents granted between January 1, 1975 and December 1, 1996 (Albert, 1996; Narin, 1996).[55] After deriving likely keywords for electronic searching from a consultation of relevant chemical engineering texts on FGD process chemistry and design, the search filter algorithm was constructed in two parts. First, the search filter eliminated patents with USPC and IPC categories deemed likely to come up erroneously in searches based on these keywords. Second, the search filter identified and captured patents with abstracts in which these keywords were present in a grouping specified by advanced Boolean logic. The result was the creation of an "abstract-based" dataset of 1,593 patents, which CHI research supplemented with a secondary dataset that was accurately predicted to yield a small number of relevant patents (this dataset was based on a keyword search of subclass descriptions). Table 3.4 shows the comparative percentages of commercially validated patents that were identified in the abstract-based and supplemental datasets, in contrast with the subclass-based dataset. The abstract-based and supplemental datasets proved to be more effective in identifying relevant patents, although some patents of private value were not identified in either dataset.

[55] Complete electronic information for USPTO patents is available only for patents granted after January 1, 1975.

TABLE 3.4

Percent of Patents Covering "Commercially Successful" Technologies found in Abstract-Based and Supplemental Datasets, versus Subclass-Based Dataset

	Company A Commercially Successful Patents (16)	Company B Commercially Successful Patents (69)	Company C Commercially Successful Patents (15)	Total Patents From the 3 Portfolios
Abstract-Based Dataset (1,593 Patents Total) + Secondary Subclass Dataset (1,240 Patents Total) Finds:	64%	71%	100%	75%
Subclass-Based Dataset (2,681 Patents Total) Finds:	56%	46%	87%	54%

For each dataset, CHI Research provided summary front page patent and citation information generated by three programs run on official weekly USPTO data tapes. The citation information went beyond USPTO generated data fields, and included the number of other patents in the U.S. patent system which cite the patent in question ("successor" patents) and the number of patent and non-patent references of the patent in question ("precursor" patents). These data were obtained in a database-ready format.

Once the abstract-based patent dataset was imported into a relational database, these patents were analyzed for their relevance to SO_2 control technology. Irrelevant patents, as judged by a lengthy and labor-intensive reading of the patent abstracts on the basis of their intention (to remove SO_2 emissions from stationary sources) and their technical content, were discarded.[56, 57] This was an important process since it ensured the most accurate abstract-based dataset possible for purposes of association with external events and detailed technological and

[56] Focusing on the patent abstract as the gauge of relevance was effective since, as mentioned previously, the abstract summarizes the usefulness of the invention.
[57] In order to avoid interrater reliability problems and simplify the logistics of this process, the patent coder used for this research was the author.

organizational analysis. The total number of relevant patents in the final abstract-based dataset was 1,237. Each of these patents was coded with a general "technology type" and an "assignee type," as listed in Table 3.5. These categories were used to generate time series and histograms.

TABLE 3.5

Categories Used to Distinguish Relevant Patents

Technology Categories & Abbreviations		**Assignee Categories & Abbreviations**	
Post-combustion desulfurization	Post	Firms	Firms
Pre-combustion desulfurization	Pre	Individual	Indiv
During combustion desulfurization	During	Government agencies	Gov
Desulfurized coal gas and synthetic fuels	Gas	Universities	Univ
Fluidized-bed combustion	FBC	Contract research organizations	Joint
Desulfurizing agent modification	Sorb		
Desulfurization byproduct modification	By		
Measurement technologies	Measure		

Link between Private and Social Returns to R&D

In addition to the commercial validation of the patents in the abstract-based dataset, the qualitative homogeneity problem concerning the use of patents in research was addressed through two further approaches. In the first approach, the private value of patents in the abstract-based dataset was considered through the use of patent renewal data, in the tradition of Lanjouw, Pakes, and Putnam (1998), Pakes and Schankerman (1984), Pakes and Simpson (1989). In the second approach, the social value, or technological importance, of these patents was considered through their citation rates in other U.S. patents. This follows the tradition of Albert et. al. (1991); Carpenter, Narin, and Woolf (1981); Jaffe, Trajtenberg, and Henderson (1993); Narin (1994a); Narin (1994b); Narin and Olivastro (1988); and Trajtenberg (1990).

a) Private Returns – Patent Renewal Data

As mentioned in the "Patents and the Patenting Process" section above, patent renewal fees were first introduced for U.S. patents filed on and after December 12, 1980. A number of previous researchers have used the payment of patent renewal fees due 3 ½, 7 ½, and 11 ½ years from the patent grant date as an indicator of the private value of patenting. The payment of the renewal fee after the first 3 ½ year period was the test of private value used in this dissertation (in order to keep the sample of patents eligible for renewal fee testing large enough for a useful comparison). This limited the number of SO_2-relevant patents for which renewal data would be useful to those filed after December 12, 1980 and before April 2, 1994, for a total of 608 patents.

Table 3.6 displays the percentages of relevant patents that were renewed after the first 3 ½ year maintenance fee period, as broken down by technology type, assignee type, and inventor nation of origin. The overall percentage of patents that were renewed after the first 3 ½ year period was 84%, which is in line with the finding in Griliches (1990, p. 1681) that 84% of all USPTO patents filed between 1981 and 1984 were renewed after the same first maintenance period. A continued comparison to the Griliches (1990) data shows that a slightly higher percentage of U.S.-owned SO_2-control relevant patents were renewed compared to the USPTO average (86% versus 83%), while a lower percentage of foreign-owned SO_2-relevant patents were renewed compared to the USPTO average (80% versus 85%). Griliches (1990) also cites an unpublished manuscript by Manchuso, Masuck, and Woodrow (1987) that analyzed a smaller sample of USPTO data. A comparison to this Manchuso, Masuck, and Woodrow (1987) study shows a smaller gap between the percentage of U.S.-owned patents renewed in the SO_2-relevant and overall USPTO datasets (86% versus 87%). A wide disparity is seen, however, between the Manchuso, Masuck, and Woodrow (1987) data on the renewal of individually owned patents. In the SO_2-relevant dataset, 100% were renewed after the first 3 ½ year period while in the overall USPTO dataset, only 61% were renewed. The high percentages of SO_2-relevant patents renewed may, however, be consistent with the finding in Manchuso, Masuck, and Woodrow (1987) that "chemical" patents are maintained at the highest rates in the USPTO dataset, since SO_2-control processes are large chemical engineering systems.

TABLE 3.6

Relevant Abstract-Based Patent Renewal Percentages by Category after First 3 ½ Year Period

Percent of Patents Renewed by Technology Category		Percent of Patents Renewed by Assignee Category		Percent of Patents Renewed by Inventor Nation	
Post	85.3	Firms	83.3	U.S.	86.1
Pre	82.1	Indiv	100.0	Germany	71.9
During	86.8	Gov	78.9	Japan	97.6
Gas	82.6	Univ	95.0	Canada	90.0
FBC	78.6	Joint	84.4	Other Nations	77.1
Sorb	85.2				
By	81.0				
Measure	100.0				

b) Social Returns – Citation Data

A number of previous studies have used counts of the patents that cite a given patent in their prior art in order to indicate the social value, or importance to technological knowledge, of that patent. Those patents with higher citation rates in later patents are considered more important to the overall technical community. In this analysis, highly cited patents were used to refine the understanding of the technical focus of inventive activity as well as the locus of that activity in SO_2 control technology.

Table 3.7 indicates the range of citations the SO_2-relevant dataset received from other patents in the USPTO database at the time of this analysis. The average number of cites received by these patents was five.

TABLE 3.7

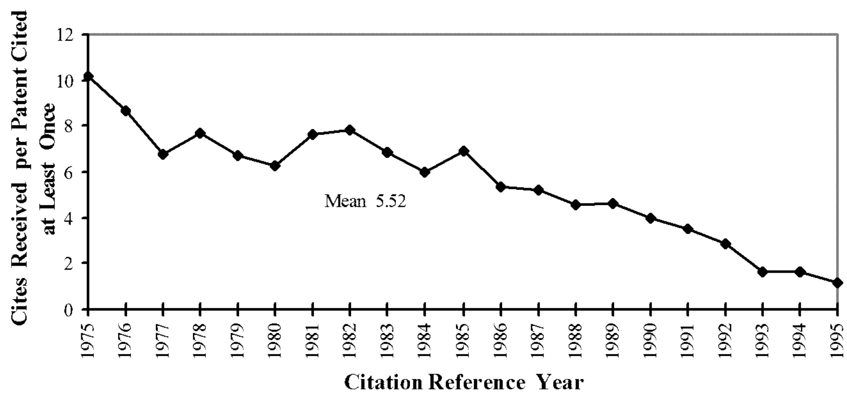
Distribution of Cites Received for SO_2-Relevant Patents

Cites Received	Number of Patents	Cites Received	Number of Patents	Cites Received	Number of Patents	Cites Received	Number of Patents
0	240	5	53	10-14	117	50-59	0
1	157	6	69	15-19	54	60-69	1
2	153	7	46	20-29	27		
3	123	8	61	30-39	3		
4	98	9	33	40-49	2		

Since patents with older grant dates have a longer period of time in the public domain than patents with newer grant dates, and thus have a greater opportunity for being cited by later patents, these citation numbers could not be used as a direct measure of the social value of patents. Scaling each SO_2-relevant patent's citation number by a "grant year specific adjuster" made it possible to create a "highly cited" patent dataset of 110 patents that could be used for comparative purposes against the technology, assignee, and geographic statistics of the overall abstract-based dataset. Two steps underlay the construction of the grant-year specific adjusters. First, for each grant year in the abstract-based dataset, the total number of references (in patents from 1975-1995) to patents granted in that year was divided by the total number of patents granted in that year that were cited at least once. The results of this stage in the adjuster creation process are displayed in Figure 3.6. Second, the mean value of the time series displayed in Figure 3.6 (5.52) was then divided by each year's Figure 3.6 y-value to derive the grant year specific adjuster.

FIGURE 3.6

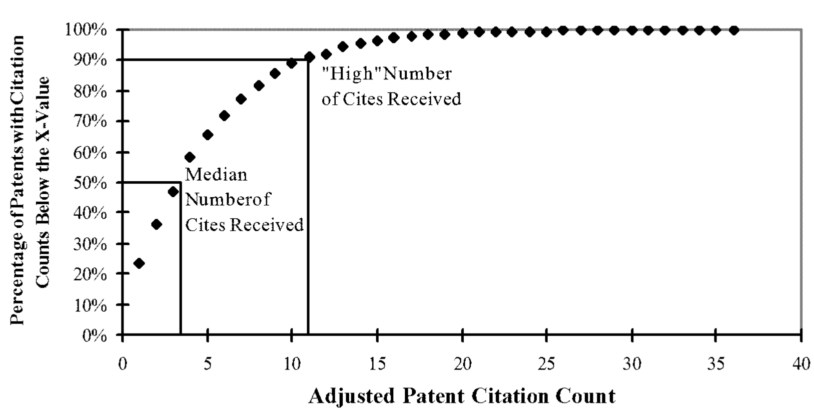
Cites Received per Patent based on Patent Grant Year



Each patent's number of cites received was then multiplied by its grant year-specific adjuster to arrive at a scaled number of cites received. The patents were then sorted by their scaled number of cites received, in ascending order, and a cumulative distribution function was created (as shown in Figure 3.7). The patents with adjusted citation numbers greater than 90% of all other patents (at an adjusted citation rate of 11 or more cites received) were chosen for the highly cited data set.

FIGURE 3.7

Cumulative Distribution Function of SO_2-Relevant Patents by Adjusted Citation Numbers



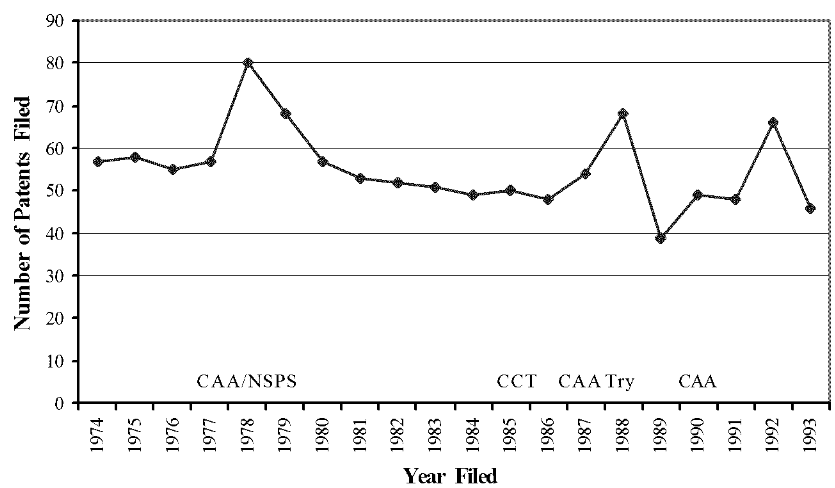
Results

a) Overall Inventive Activity

Figure 3.8 displays the time series, by file date, of overall patenting activity in SO_2-relevant technologies as identified through the manual examination of the patents in the abstract-based dataset. Although the patents in the abstract-based dataset were granted between January 1, 1975 and December 1, 1996, these patents were *filed* between 1969 and 1995. Figure 3.8 only captures those granted patents that were filed between 1974 and 1993, however, in order to avoid "lag effects" at either end of this trend line.

FIGURE 3.8

Trend in U.S. Patents relevant to SO_2 Control Technology as Identified in the Abstract-Based Dataset



These lag effects exist because of the varying length of time it takes to grant a patent after its application is first filed. Table 3.8 demonstrates the variation in the time lag between the filing and granting of patents in the SO_2-relevant abstract-based dataset. The average percent of patents granted in a given year that were filed within the previous three years is 91.2%, while the average lag for all patents in the dataset was almost two-and-a-half years. In order to avoid lag effects at either end of the trend line in Figure 3.8, patents granted in 1976 and 1977 are included only if they have a file year of 1974 or later, while patents granted in 1995 and 1996 are included only if they have a file year of 1993 or earlier.

TABLE 3.8

Lags Between File Dates and Grant Dates for SO_2-Relevant Patents Over Time

Patents Granted / Lag Between File Date and Grant Date	Over Entire Time Period	1975-80	1981-85	1986-90	1991-96
0-1 Years	88	16	13	29	30
1-2 Years	740	214	177	155	194
2-3 Years	299	103	77	60	59
3-4 Years	76	34	17	14	11
4-5 Years	21	11	2	3	5
5-6 Years	5	1	3	1	0
6-7 Years	5	1	0	4	0
7-8 Years	3	0	0	3	0
Total Patents	1,237	380	289	269	299
Average Patent Lag in Years	**2.4**	**2.5**	**2.4**	**2.4**	**2.2**

The abstract-based patent dataset depicted in Figure 3.8 for 1974 to 1993 displays considerably less variation than the second patent activity period (1971 to 1996) of the dataset of SO_2-relevant USPC subclasses depicted in Figure 3.4.[58] Of the 1,105 patents displayed in Figure 3.8, the average number of patents filed in a given year is fifty-five patents, with a standard deviation of nine. Only five of the twenty years represented in Figure 3.8 show patenting levels that exceed the average by greater than one standard deviation. This is a lower proportion (25%) than was exhibited in Figure 3.4, where 40% of the years showed fluctuations exceeding one standard deviation (fourteen) over the average number of patents (ninety-six). A further indication of the comparative lack of variation of Figure 3.8 is the fact that the highest yearly percentage increases in patent filing activity occur in 1978 (40.4%), 1988 (25.9%), and 1992 (37.5%), which coincide with the highest absolute levels of patenting activity in Figure 3.8. This

[58] This patent activity period is more useful for comparison with the abstract-based dataset than the entire subclass-based dataset because it addresses a similar time frame.

behavior was not seen in 1971 to 1996 in the subclass-based dataset, where the highest yearly percentage increases in patent filing activity occur in 1971 (59.2%), 1973 (39.0%), 1977 (32.9%), and 1990 (46.1%) while the peak patenting years occur in 1978, 1979, 1988, and 1992.

It is interesting to note a further difference between the abstract-based and subclass-based datasets. When computing an average trend line for both datasets based on the same time period (1974 to 1993), the abstract-based dataset exhibits a slightly negative slope (-0.59) while the subclass-based dataset shows a roughly flat, although positive slope (0.09).

b) Regression Analysis of the Abstract-Based Dataset

The two datasets share a very interesting similarity: both exhibit peak patent filing activity in the same four years (1978, 1979, 1988, and 1992). This lends credence to the existence of these peaks and the likelihood that they represent true "bursts" in patenting activity that Griliches (1990) suggests is indicative of a change in external events relevant to the patented technology. In this research, however, only limited attempts have been made to model patent filing activity as a result of inventor awareness of specific government actions (the change in external events predicted to be most relevant to patents in SO_2 control technology). This is because the number of valid years for the dependent variable of patent filing activity in the more refined, abstract-based dataset is only twenty. As befits the limited statistical power of a model of this dataset, a simple least-squares regression approach was used in which a dummy variable is "turned on" when the inventor is likely to be showing strong responses to a government action and then "turned off" when the situation returns to the status quo. The potential national government actions that an inventor may respond to are listed in Table 3.9, with summary information encapsulated from Chapter Two. They are also indicated on the X-axis of Figure 3.8. For the purpose of associating these government actions with the patent file years in Figure

3.8, the enactment date of each action is roundedto the nearest January, and the enactment year is defined as the year in which that January occurs.

TABLE 3.9

Government Actions with Potential for Modeling against Patent Filing Activity

Government Action Title and Abbreviation	Enactment Date and Year for Analysis	Summary and Implications
1971 New Source Performance Standard (1971 NSPS)	December 1971 (1972)	Maximum allowable emission rate for new and modified sources was 1.2 lbs of SO_2 /MBTU heat input. This effectively required a 0-85% SO_2 removal, depending on coal properties.
1977 Clean Air Act Amendments (1977 CAA)	August 1977 (1978)	Directed EPA to implement new source performance standard for SO_2 based on a percentage reduction from uncontrolled levels. This was intended to promote universal scrubbing at new plants.
1979 New Source Performance Standard (1979 NSPS)	June 1979 (1979)	SO_2 limit of 1.2 lb/MBTU and a 90 percent reduction, or 0.6 lb/MBTU and a 70 percent reduction for new sources. This sliding scale favored wet scrubbing for high sulfur coals and dry scrubbing for low sulfur coals.
1985 Clean Coal Technology Demonstration Program (1985 CCT)	December 1985 (1986)	$2.5 billion government cost-sharing program operated by DOE in order to demonstrate advanced coal technologies at a commercially-relevant scale. Some of these technologies addressed SO_2 control.
1987 Clean Air Act Amendments Senate Attempt (1987 CAA Try)	(1987)	Serious but unsuccessful attempt to overhaul the CAA, with particular emphasis on tightening acid rain precursor controls. Federal government would subsidize the capital cost of installing scrubbers.
1990 Clean Air Act Amendments (1990 CAA)	November 1990 (1991)	Uses emission allowance trading to achieve a cap in 2010 of 8.95 million annual tons of SO_2 through two phases. Phase I (1995-1999) applied aggregate emission limit of 2.5 lb/MBTU to 261 existing generating units. Phase II (2000-10) applies aggregate emission limit of 1.2 lb/MBTU to about 2,500 existing generating units.

Three sets of government actions were chosen for analysis. In the first, "Enacted" set, only enacted legislative and regulatory government actions were considered (the 1970, 1977, and 1990 CAAs were eligible for this set of government actions, along with the 1971 and 1979 NSPS). In the second, "Enacted Plus CCT" set of government actions, the enacted legislative and regulatory government actions were considered and supplemented with the government subsidy of the 1985 Clean Coal Technology Demonstration Program. In the third, "Enacted Plus Anticipated" set of government actions, enacted legislative and regulatory events were considered and supplemented with a prominent legislative action that ultimately did not succeed, the 1987 Senate attempt to reform the CAA.

Equation 3.1 depicts the regression equations of these three sets of government actions against patent activity levels, based on two inventor-awareness dummy variable windows associated with different types of government actions. These dummy variable windows were assigned based on simple assumptions about the inventive and legislative processes.[59] First, for enacted legislative and regulatory events, the dummy variable was activated both during the year of enactment and during the year directly after enactment, then deactivated for the rest of the time period. Activating the inventor-awareness window during the year of enactment allowed for one year of anticipative invention to lead to a patent application, with that year beginning one year prior to enactment (in other words, invention occurred while the legislative or regulatory event was under consideration). Continuing the inventor-awareness dummy variable activation into the year after enactment allowed the impetus for invention sparked by the government action to continue but also to be only temporary. It also reflected the two-year lag between pollution abatement expenditures and patent activity found across environmental media in Lanjouw and Mody (1996). Second, for anticipated legislative events (only considered to apply in the case of the 1987 attempt to reform the CAA), the dummy variable was activated only during the year after legislative consideration. The activation of this shortened inventor-awareness window allowed for one year of invention during the year of legislative consideration to lead to a patent application, as in the enacted legislative case. It also gave less weight to the impetus for invention sparked by the anticipation, rather than the enactment, of legislation.

[59] Assumptions had to be made to combat uncertainties revolving around both the length of these processes and the fact that not every patent application is filed as the result of new inventive activities.

EQUATION 3.1

Regression Equations with Dummy Variables based on Sets of Government Actions

(a) Government Actions: Enacted Set. Dummy variables activated during the year of enactment and in the year following the year of enactment, as defined in Table 3.9.

$$y = B_0 + B_1D_1 + B_2D_2 + B_3D_3 + \varepsilon$$

where

y = number of patents filed
D_1 = 1 for 1978 and 1979, 0 otherwise (enactment of the 1977 CAA)
D_2 = 1 for 1979 and 1980, 0 otherwise (enactment of the 1979 NSPS)
D_3 = 1 for 1991 and 1992, 0 otherwise (enactment of the 1990 CAA)

(b) Government Actions: Enacted Plus CCT Set. Dummy variables activated during the year of enactment and in the year following the year of enactment, as defined in Table 3.9.

$$y = B_0 + B_1D_1 + B_2D_2 + B_3D_3 + B_4D_4 + \varepsilon$$

where

y = number of patents filed
D_1 = 1 for 1978 and 1979, 0 otherwise (enactment of the 1977 CAA)
D_2 = 1 for 1979 and 1980, 0 otherwise (enactment of the 1979 NSPS)
D_3 = 1 for 1986 and 1987, 0 otherwise (enactment of the 1985 CCT)
D_4 = 1 for 1991 and 1992, 0 otherwise (enactment of the 1990 CAA)

(c) Government Actions: Enacted Plus Anticipated Set. Dummy variables activated during the year of enactment and in the year following the year of enactment, as defined in Table 3.9. In the case of the anticipated government action, dummy variable activated in the year after legislative consideration.

$$y = B_0 + B_1D_1 + B_2D_2 + B_3D_3 + B_4D_4 + \varepsilon$$

where

y = number of patents filed
D_1 = 1 for 1978 and 1979, 0 otherwise (enactment of the 1977 CAA)
D_2 = 1 for 1979 and 1980, 0 otherwise (enactment of the 1979 NSPS)
D_3 = 1 for 1988, 0 otherwise (the 1987 CAATry)
D_4 = 1 for 1991 and 1992, 0 otherwise (enactment of the 1990 CAA)

Note: In each dummy variable set, the 1970 CAA and 1971 NSPS were excluded from consideration because they were outside the Figure 3.8 time frame.

The results of this model for the three sets of government actions are shown in Table 3.10. For the Enacted and Enacted Plus CCT sets of government actions, the square of correlation (r^2 value) shows that almost half of the variance in Figure 3.8 can be explained by the (a) and (b) dummy variable regressions depicted in Equation 3.1. Interestingly, the fraction of the variance accounted for (0.49) does not change regardless of whether the 1985 CCT subsidization program is included in the set of government actions. The Enacted Plus Anticipated set of government actions, however, demonstrates that a higher fraction of the variance in Figure 3.8 (0.64) can be explained through the (c) dummy variable model in Equation 3.1. In addition, note that the Enacted Plus Anticipated set of government actions also has a higher (and more significant) ANOVA F-Statistic result than the other two sets of government actions (6.64 versus 5.13 and 3.67).[60] Both results indicate that this set of government actions appears to correlate more strongly with patent activity levels than the other two sets of government actions.

TABLE 3.10

Model Results for Regressions in Equation 3.1

	Regression (a)	**Regression (b)**	**Regression (c)**
Government Action Set	**Enacted**	**Enacted Plus CCT**	**Enacted Plus Anticipated**
Intercept	52.76	53.03	51.70
Coefficients	$\beta_1 = 21.82$ $\beta_2 = -1.17$ $\beta_3 = 4.24$	$\beta_1 = 21.65$ $\beta_2 = -1.35$ $\beta_3 = -2.03$ $\beta_4 = 3.98$	$\beta_1 = 22.53$ $\beta_2 = -0.47$ $\beta_3 = 16.30$ $\beta_4 = 5.30$
Square of Correlation (r^2)	0.49	0.49	0.64
ANOVA F-Statistic	5.13	3.67	6.64
F-Statistic Significance	0.01	0.03	0.00

[60] Recall that the ANOVA F-Statistic is a test of structural change in which the estimated model is compared against a model in which the dependent variable is regressed on a constant.

c) Expert Analysis of the Abstract-Based Dataset

Because the regression analysis of patent filing activity as a result of government actions is somewhat limited by the small number of observations in Figure 3.8, expert opinion was solicited to help interpret the pattern exhibited in Figure 3.8. Only one of the twelve experts interviewed, expert D, refused to make any suppositions about Figure 3.8. For both the 1978 peak and the 1992 peak in patent filing activity, ten of the remaining eleven experts supported the regression results by suggesting independently that the peaks were due to related legislative and regulatory events (for the 1978 peak, the 1977 CAA and the 1979 NSPS, and for the 1992 peak, the 1990 CAA).[61] In the case of the 1978 peak, the eleventh expert (expert E) suggested that this peak could have resulted from inventive activity from a few years earlier when there was a strong expectation of a big potential SO_2 control market in the U.S., as described in Chapter Two. In the case of the 1992 peak, the eleventh expert (expert H) did not attempt to explain it.

The peak in patent filing activity in 1988 elicited a more varied range of explanations from experts, however. In the context of this peak, nine of the eleven experts – A, C, E, F, H, I, J, K, L – mentioned a heightened public and legislative awareness of acid rain in the mid- to late-1980s. Eight of these experts (all but expert I) mentioned an anticipation of legislation related to this problem (that might potentially take the form of an overhauled CAA), and explained that the result of this anticipation was an intensification of technological demonstrations and testing of moderate SO_2 removal technologies. Expert K directly related the 1988 peak to an anticipation

[61] In addition, experts A and G gave the 1990 CAA credit for renewing interest in SO_2 control technologies, especially in the area of lowering costs to compete with fuel switching, while expert K attributed the drop-off in patenting activity after 1992 to the growing awareness that the scrubber market was not going to be as large as had been initially anticipated.

of legislation that was likely to result from the findings of the National Acid Precipitation Assessment Program.[62] Although no expert specifically mentioned the 1987 Senate effort to overhaul the CAA, these statements about the anticipation of legislation lend support to the regression results based on the Enacted Plus Anticipated set of government actions. Two experts did not mention acid rain legislation in the context of the 1988 peak in patent filing activity, however. One had no suggestion to explain the peak (expert B) and the other tied the peak to the R&D results of EPRI and Radian (a major architect and engineering firm) at the time (expert G). Expert G's statement, of course, does not exclude the possibility that anticipation of acid rain control legislation was behind some of this R&D.

In addition to these explanations of the peaks in patent filing activity, in their discussion of the trend line in Figure 3.8 the experts spoke to a limited extent on what factors contribute to patent activity in the SO_2 industrial-environmental innovation complex. The experts appear to believe both that patent filing activity in SO_2 control reflects the perception of demand for SO_2 control technologies (which is shaped by government actions), while it also reflects the level of new ideas and technological changes in SO_2 control. This is particularly clear in the statements of two experts who discussed the overall negative slope of patent filing activity in Figure 3.8. Expert A explained the gradual decline of patenting activity after the peak in 1978 as representing a dearth of new technological changes, while expert J explained the phenomenon as representing an absence of new technological ideas worth patenting. These same two experts, however, concur with the interpretation of the majority of the experts that patent peaks were related to government actions or the anticipation of government actions. This raises the question

[62] The U.S. National Acid Precipitation Assessment Program (NAPAP) was established in the Acid Precipitation Act of 1980. The NAPAP program was a ten-year, $500 million, multidisciplinary study of the science and technology issues involved in acid precipitation (Irving, 1990).

of whether government actions inspire new ideas beyond simply motivating profit-seeking inventors to escalate inventive activities in the anticipation of an increased government-action-induced demand for SO_2 control technologies.

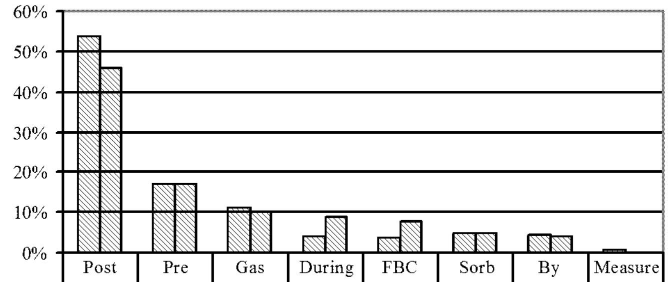
d) Inventive Activity by Technology, Assignee, and Inventor Nation of Origin

This section considers the technologies and organizations underlying the patents in the SO_2-relevant dataset. It specifically pursues the question of how inventive activity in SO_2 control differs by technology and assignee type, as well as by the inventor's nation of origin. Figures 3.9 through 3.11 show the proportional representation, according to technology, assignee, and geographic categories, of the 1,237 abstract-based patents in comparison with the 110 highly cited patents.[63] Note the dominance of post-combustion control technology as the major focus of inventive activity among the various technology categories, with pre-combustion technology the second most important type of patented technology. Also note the dominance of firms among the various assignee types granted SO_2-relevant patents (although the U.S. Department of Energy is the specific assignee with the highest number of patents).

[63] Recall that these categories are listed in Table 3.5 and that highly-cited patents are considered to be particularly important technologically.

FIGURE 3.9

Proportions of Abstract-Based and Highly Cited Patent Datasets by Technology Type

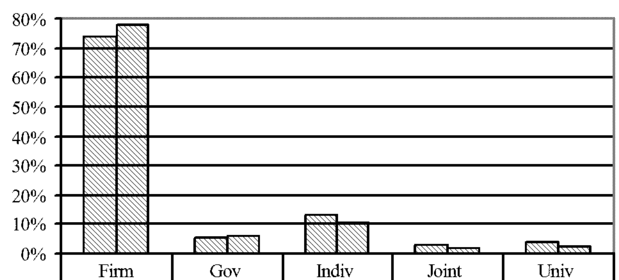


	Post	Pre	Gas	During	FBC	Sorb	By	Measure
% of 1237 Patents	54%	17%	11%	4%	4%	5%	4%	1%
% of 110 Highly Cited Patents	46%	17%	10%	9%	8%	5%	4%	0%

Patented Technology Types

FIGURE 3.10

Proportions of Abstract-Based and Highly Cited Patent Datasets by Assignee Type

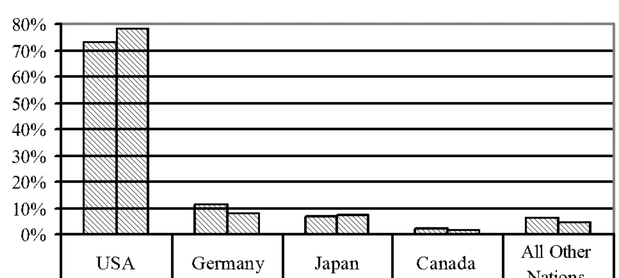


	Firm	Gov	Indiv	Joint	Univ
% of 1237 Patents	74%	5%	13%	3%	4%
% of 110HighlyCitedPatents	78%	6%	11%	2%	3%

Patent Owner Type

FIGURE 3.11

Proportions of Abstract-Based and Highly Cited Patent Datasets by Inventor Nation of Origin



	USA	Germany	Japan	Canada	All Other Nations
% of 1237 Patents	73%	11%	7%	2%	6%
% of 110HighlyCitedPatents	78%	8%	7%	2%	5%

Inventor Nation of Origin

In Figure 3.9, the abstract-based dataset and the highly cited dataset demonstrate that they consist of roughly similar proportions of patents related to specific technologies. Z-tests were conducted to determine the statistical significance of the differences between the two datasets of values for a given technology type.[64] Only during-combustion technology and fluidized-bed combustion technology exhibited statistically significant differences in proportions between the two datasets (at the 99% and 98% confidence levels, respectively). While there is no definitive explanation for this, one possible reason for the smaller percentages in the larger dataset is the absence of many new or major technical changes in these technologies. Those technical changes that do occur in these technologies appear to be important, however, considering the greater proportion of highly cited patents attributed to these technologies. Another possible explanation for the proportional discrepancy is that patenting activity in these technologies may reveal more information to other innovating entities than patenting activity in other types of technologies, so patent protection is only sought for important innovations.

In both Figure 3.10 and Figure 3.11, the abstract-based dataset and the highly cited datasets demonstrate that they consist of quite similar proportions of patents related to specific types of assignee and inventor nations of origin. According to Z-tests, no differences in proportions between these two datasets were statistically significant for any type of assignee or specific inventor nation of origin.

The USPTO reports statistics for individually-owned, government-owned, and university-owned patents for the overall USPTO dataset based on assignee categories defined in the same way as in this research. Data in National Science Board (1999) reveal some differences in the

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[64] The Z-statistic calculation is: $Z = (\hat{p} - p)/\sqrt{\frac{p(1-p)}{n}}$. In this calculation, the proportion of the sample population (the highly cited dataset) with a characteristic of interest is standardized by subtracting the mean of the sampling distribution. The result is then divided by the standard deviation of the sampling distribution, with the final Z-statistic compared against the standard normal distribution in order to determine significance (Moore, 1995, 269-71).

proportions of these assignee categories with respect to all USPTO patents versus SO_2-relevant abstract-based patents. First, after business entities, individuals are the preeminent owners of USPTO patents with origins in the U.S., with an average of 24% of all patents granted prior to 1982 and 23-27% of patents granted since then (National Science Board, 1999). In contrast, only 13% of SO_2-relevant patents are assigned to individuals. Second, in the 1963-82 period, government-owned patents consisted of 3.4% of U.S. originated patents in the USPTO, with declining proportions since 1982. In contrast, government-owned patents consist of 5% of SO_2-relevant patents. Finally, about 3.3% of the U.S.-owned patents granted in the USPTO in 1995 were assigned to universities and colleges, while 4% of SO_2-relevant patents are thus assigned.

Table 3.11 summarizes the proportions of individual, government, and university-owned patents in the USPTO dataset and in the SO_2-relevant abstract-based dataset. The proportion in parentheses in Table 3.11 is the value used to run z-statistic tests of significant differences between the two datasets. These differences are indeed significant at the 99% level for all three assignee categories. Although there are no definite explanations for these differences, two hypotheses seem plausible. First, the lower proportion of patent ownership by individuals in the SO_2-relevant dataset is probably attributable to the size and complexity of FGD systems. Second, the higher proportion of patent ownership by government agencies and universities in the SO_2-relevant dataset is probably due to the importance of non-market incentives for innovation in SO_2 control.

TABLE 3.11

Proportions of U.S.-Owned USPTO and SO_2-Relevant Patents by Assignee Type

Assignee Type	Proportion in Overall USPTO Dataset[a]	Proportion in SO_2-Relevant Abstract-Based Dataset
Individuals	23-27% (25%)	13%
Government	~3% (3%)	5%
Universities	~3% (3%)	4%

[a] Data from National Science Board (1999)

Just as the USPTO reports patent statistics for assignee categories, it also reports patent statistics for various inventor nations of origin. Table 3.12 indicates the comparative proportions of American, Japanese, and German-owned patents in the overall USPTO dataset and in the SO_2-relevant abstract-based dataset. The differences between the proportions in the two datasets are all statistically significant. One particular difference between these two datasets is interesting: the SO_2-relevant abstract-based dataset exhibits a much higher percentage of U.S.-invented patents than the USPTO dataset. This is of note since Japanese and German innovations and companies played important roles in the development of SO_2 control technology. Japan was an early user of FGD systems in the 1960s and 1970s, while Germany became a major FGD user in the mid-1980s. Despite these important roles, however, archival information and expert testimony support the U.S. dominance in SO_2-related patents when they point to the leadership role of the EPA, EPRI, and U.S. FGD equipment and services organizations in R&D and in meeting U.S. electric utility needs.

TABLE 3.12

Proportions of USPTO and SO_2-Relevant Patents by Inventor Nation of Origin

Inventor Nation of Origin	Proportion in Overall USPTO Dataset[a]	Proportion in SO_2-Relevant Abstract-Based Dataset
U.S.	54%	73%
Japan	23%	7%
Germany	15%	11%

[a] Data from National Science Board (1999)

e) Technology-Specific Inventive Activity

This section further investigates the question of how inventive activity in SO_2 control differs by technology type. In previous sections, analysis was based either on the subclass-based patent dataset, the SO_2-relevant abstract-based patent dataset, the highly cited abstract-based patent dataset, or the entire USPTO system. In this section, analysis is based only on the SO_2-relevant abstract-based patent dataset as broken down by technology category. Table 3.13 displays the breakdown of each technology type by assignee type and inventor nation of origin. Boldfaced figures in this table indicate the highest percentages achieved by each assignee type or inventor nation in any of the seven technology type datasets. Italicized numbers in this table indicate the lowest percentages.

TABLE 3.13

SO_2-Relevant Abstract-Based Dataset Technology Types Broken Down by Assignee Type and Inventor Nation of Origin

	Post	Pre	Gas	During	FBC	Sorb	By
Assignee Types							
Firm	75%	66%	**84%**	77%	63%	*60%*	78%
Gov't	*3%*	8%	9%	4%	**17%**	12%	4%
Indiv	15%	16%	*5%*	15%	7%	7%	**19%**
Joint	3%	2%	2%	4%	**11%**	3%	*0%*
Univ	4%	8%	*0%*	*0%*	2%	**18%**	*0%*
Inventor Nations							
U.S.A.	69%	**91%**	68%	77%	65%	75%	*57%*
Germany	13%	*3%*	9%	6%	4%	10%	**26%**
Japan	9%	1%	7%	*0%*	**11%**	7%	7%
Canada	2%	2%	1%	**8%**	2%	3%	*0%*
Others	6%	*2%*	16%	10%	**17%**	5%	9%

From these data, two main observations can be made regarding the nature of inventive activity and how it differs according to the type of SO_2 technology. The first relates to the nature of patenting in SO_2 control technologies by the federal government. Of the various assignees in the abstract-based dataset, the U.S. Department of Energy (DOE) directly holds the highest number of patents (38), while the U.S. Environmental Protection Agency (EPA) directly holds a non-negligible number of patents (4).[65] Table 3.13 shows the types of technology patents that government actors hold in the abstract-based dataset. Note that the government owns only 3% of all patents in the commercially dominant post-combustion control technology category, but owns 17% of the patents in the much less commercially prevalent fluidized-bed combustion SO_2 technology. Figure 3.12 casts light on this finding, as it demonstrates the percentages of DOE and EPA R&D spending on basic research, applied research, and development in 1985 to 1995.[66] Note the large proportions of DOE and EPA R&D spent on (officially non-commercial) basic research (DOE 16%, EPA 25%).[67] These percentages are much higher than the 7% of R&D spending on basic research during this time period for all U.S. industry (based on similar National Science Board (1999) figures in millions of constant 1987 dollars).[68] The most commercial R&D activity, development, shows the converse relationship between government and industry expenditures (DOE 26%, EPA 51%, industry 70%). These expenditure figures

[65] Recall that prior to the Federal Technology Transfer Act of 1986 and Executive Order 12591 of April 1987, agencies like EPA and DOE were not subject to considerable pressure to obtain patents. In the case of the EPA, its history of engaging in cooperative R&D activities with utility/vendor teams influenced its typical patent strategy. According to expert K, the EPA prefers to have private partners assigned its patented inventions (with a statement of government interest at the bottom of the patent that gives the government the right to retain use of the invention). Either the private partner will be identified before the patent application is filed or a partner will be found after the patent application is filed and then announced to the public through publications such as the Federal Register.

[66] The National Science Board (1999, p. 4-9) provides definitions of these R&D activities, which are based on the somewhat unrealistic linear model of the innovation process (origins in Bush, 1945) that is still used in government data collection. Basic research "advances scientific knowledge but does not have specific immediate commercial objectives, although it may be in fields of present or potential commercial interest." Applied research is "oriented to discovering new scientific knowledge that has specific commercial objectives with respect to products, processes, or services." Development is "the systematic use of the knowledge or understanding gained from research directed toward the production of useful materials, devices, systems, or methods, including the design and development of prototypes and processes."

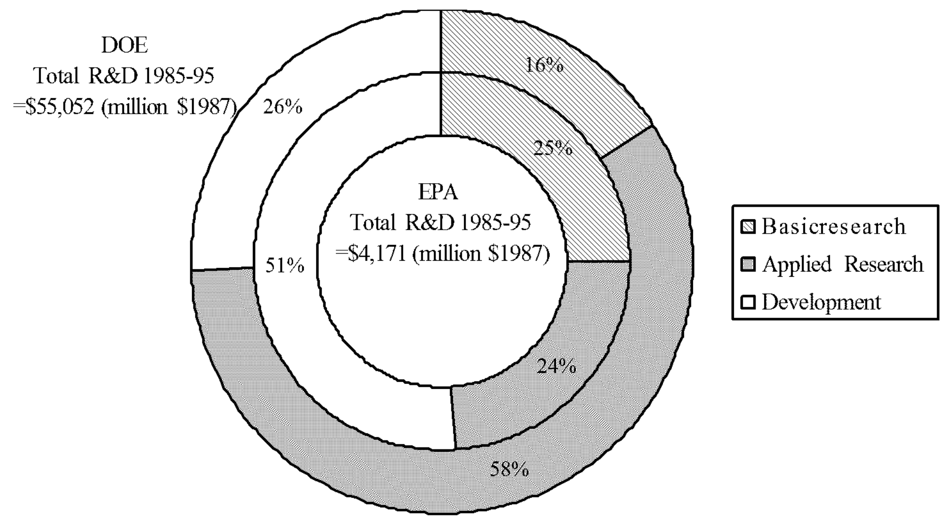
[67] In more complex views of the relationship between science and the commercialization of technology than the linear model of basic research, applied research, and development that originated with Bush (1945), basic research is seen to have potential practical application beyond that gained from pure science (see, among others, Stokes, 1997).

[68] Data are not available solely for utilities and FGD equipment and services organizations.

point to a stronger interest by the DOE and EPRI in research with less immediately practical implications, and this interest is born out in the patent ownership figures above.

FIGURE 3.12

DOE and EPA R&D by Character of Work, 1985-95



Source: National Science Board (1999)

Table 3.13 also provides the opportunity to consider the nature of patenting in SO_2 control technologies by various countries. Note that the highest percentage of SO_2-related patents invented in the U.S. is in pre-combustion technology (91%), while the lowest U.S. percentage is in byproduct modification (57%). This is particularly interesting since German inventive activity shows the exact opposite pattern (3% of pre-combustion patents, 26% of byproduct modification patents). These inventive activity patterns support a consistent story behind innovation in these technological pathways. The U.S. has historically relied on eastern coal reserves that have relatively high sulfur content, with a high proportion of pyritic sulfur that is amenable to physical separation (or coal cleaning). Germany, on the other hand, has predominantly low pyrite coals that are not readily cleanable. It is to be expected, then, that U.S. inventors would be disproportionately interested in researching ways to remove sulfur from U.S.

coal. Meanwhile, Germany, unlike the U.S., has geographic and political constraints against large landfills of FGD by-product. Germany also has a dearth of natural gypsum, and has found a good use for FGD byproduct as a substitute for this resource. It is to be expected, then, that German inventors would engage in a higher level of research into the technologies that would make FGD byproduct useful.

f) Regression Analysis of Technology-Specific Inventive Activity

Inventive activity in SO_2 control by technology type varies not just according to assignee type and inventor nation of origin, but also across time. Table 3.14 provides some basic statistics for each technology type for the 1974 to 1993 time period. This table demonstrates that, with the exception of sorbent modification technologies, each of these technology datasets exhibits the same overall degree of variation as the full dataset of SO_2-relevant abstract-based patents depicted earlier in Figure 3.8.

TABLE 3.14

Size and Noise of Datasets Based on Technology Type drawn from SO_2-Relevant Abstract-Based Dataset

Technology Type in Patent Dataset	Patents, 1974-93 (out of 1,105 Total)	Years (out of 20) when Patents exceed Average by at least one Standard Deviation
Post-combustion desulfurization (Post)	574	5
Pre-combustion desulfurization (Pre)	196	5
During combustion desulfurization (During)	126	5
Desulfurized coal gas and synthetic fuels (Gas)	49	5
Fluidized-bed combustion (FBC)	44	5
Desulfurizing agent modification (Sorb)	55	7
Desulfurization byproduct modification (By)	50	5
Measurement technologies (Measure)	6	5

Each of these technology types (except for measurement technologies, due to their small number of observations) can be a patent dataset analyzed according to regression techniques such as those in section (b) above. Recall that three sets of government actions were defined in that section, the Enacted, Enacted Plus CCT, and Enacted Plus Anticipated sets.[69] In addition, two inventor-awareness dummy variable windows were defined in Equation 3.1 that corresponded with either enacted or anticipated government actions. Overall, three regression equations were run against the dependent variable of the total number of patents filed in a given year. Table 3.10 demonstrated that regression (c), which corresponded with the Enacted Plus Anticipated set of government actions, best explained the variance of patent activity in the overall abstract-based dataset.

Even though the Enacted Plus Anticipated set of government actions proved most explanatory for the combined set of technologies in the abstract-based dataset, this set of government actions might not explain the variance in individual technologies equally well. For this reason, regression equations identical to those in Equation 3.1 (except for the dependent variable) were run against the total number of patents filed in a given year in each technology-specific dataset. Table 3.15 indicates the results of these regression analyses. The Enacted Plus Anticipated set of government actions explains a high fraction of the variance in the pre-combustion technology dataset (0.66) and a moderate level of the variance the fluidized-bed combustion technology dataset (0.41) at a 95% confidence level or better. In addition, the Enacted Plus CCT set of government actions significantly explains a high fraction of variance in both the pre-combustion (0.66) and the fluidized-bed combustion (0.59) technology datasets. The Enacted set of government actions significantly explains an even higher fraction of the

[69] Again, the Enacted set of government actions includes only the enacted legislative and regulatory government actions of the 1977 and 1990 CAAs and the 1979 NSPS. The Enacted Plus CCT set includes these enacted legislative and regulatory actions in addition to the government subsidy of the 1985 Clean Coal Technology Demonstration Program. The Enacted Plus Anticipated set includes the enacted legislative and regulatory events as well as the prominent attempt to reform the CAA in the Senate in 1987.

variance in the pre-combustion technology dataset (0.68). Unfortunately, none of these sets of government actions explains at a 95% confidence level or better the variance in post-combustion, gasification, during-combustion, sorbent modification, or by-product technology patents as defined in this research. This may well be because of the fairly simple regression equations executed here (due to the small number of observations in these patent datasets over time), which are only able to take into consideration the existence, rather than the characteristics, of government actions.

TABLE 3.15

Model Results for Regressions in Equation 3.1, According to Technology Type

	Regression (a): Enacted Gov't Action Set	**Regression (b): Enacted Plus CCT Gov't Action Set**	**Regression (c): Enacted Plus Anticipated Gov't Action Set**
Intercept and Coefficients			
Post Tech. Type	Intercept = 27.93 $ß_1$ =5.04; $ß_2$ = -1.96; $ß_3$ = 4.57	Intercept = 27.70 $ß_1$ = 5.20; $ß_2$ = -1.80; $ß_3$ = 1.80; $ß_4$ = 4.80	Intercept = 27.51 $ß_1$ = 5.33; $ß_2$ = -1.67; $ß_3$ = 6.49; $ß_4$ = 4.99
Pre Tech. Type	**Intercept = 8.95** **$ß_1$ =15.70; $ß_2$ = -2.30;** **$ß_3$ = -5.95**	**Intercept = 8.86** **$ß_1$ = 15.76; $ß_2$ = -2.24;** **$ß_3$ = 0.64; $ß_4$ = -5.86**	**Intercept = 9.25** **$ß_1$ = 15.50; $ß_2$ = -2.50;** **$ß_3$ = -4.25; $ß_4$ = -6.25**
Gas Tech Type	Intercept = 6.74 $ß_1$ = 0.17; $ß_2$ = -0.83; $ß_3$ = -3.74	Intercept = 6.70 $ß_1$ = 0.20; $ß_2$ = -0.80; $ß_3$ = 0.30; $ß_4$ = -3.70	Intercept = 6.65 $ß_1$ = 0.23; $ß_2$ = -0.77; $ß_3$ = 1.35; $ß_4$ = -3.65
During Tech Type	Intercept = 2.43 $ß_1$ = -0.96; $ß_2$ = 0.04; $ß_3$ = 1.07	Intercept = 2.58 $ß_1$ = -1.05; $ß_2$ = -0.05; $ß_3$ = -1.08; $ß_4$ = 0.93	Intercept = 2.26 $ß_1$ = -0.84; $ß_2$ = 0.16; $ß_3$ = 2.74; $ß_4$ = 1.24
FBC Tech Type	Intercept = 1.80 $ß_1$ = 2.13; $ß_2$ = 1.13; $ß_3$ = 0.70	**Intercept = 1.55** **$ß_1$ = 2.30; $ß_2$ = 1.30;** **$ß_3$ = 1.95; $ß_4$ = 0.95**	**Intercept = 1.86** **$ß_1$ = 2.09; $ß_2$ = 1.09;** **$ß_3$ = -0.86; $ß_4$ = 0.64**
Sorb Tech Type	Intercept = 2.50 $ß_1$ = 0.00; $ß_2$ = 0.00; $ß_3$ = 2.50	Intercept = 2.58 $ß_1$ = -0.05; $ß_2$ = -0.05; $ß_3$ = -0.58; $ß_4$ = 2.43	Intercept = 2.40 $ß_1$ = 0.07; $ß_2$ = 0.07; $ß_3$ = 1.60; $ß_4$ = 2.60
By Tech Type	Intercept = 2.26 $ß_1$ = -2.17; $ß_2$ = 2.83; $ß_3$ = 1.74	Intercept = 2.23 $ß_1$ = -2.15; $ß_2$ = 2.85; $ß_3$ = 0.28; $ß_4$ = 1.78	Intercept = 2.28 $ß_1$ = -2.19; $ß_2$ = 2.81; $ß_3$ = -0.28; $ß_4$ = 1.72
ANOVA F-Statistic (with Significance); Square of Correlation (r^2)			
Post Tech. Type	1.16 (0.26); 0.28	0.90 (0.49); 0.19	1.47 (0.35); 0.18
Pre Tech. Type	**9.76 (0.00); 0.68**	**6.85 (0.00); 0.66**	**7.57 (0.00); 0.66**
Gas Tech Type	0.97 (0.58); 0.16	0.69 (0.61); 0.15	0.74 (0.43); 0.15
During Tech Type	0.39 (0.51); 0.19	0.43 (0.79); 0.10	0.87 (0.76); 0.07
FBC Tech Type	3.64 (0.07); 0.43	**5.48 (0.01); 0.59**	**2.78 (0.04); 0.41**
Sorb Tech Type	2.67 (0.08); 0.40	2.02 (0.14); 0.35	2.55 (0.08); 0.33
By Tech Type	1.69 (0.35); 0.24	1.20 (0.35); 0.24	1.19 (0.21); 0.24

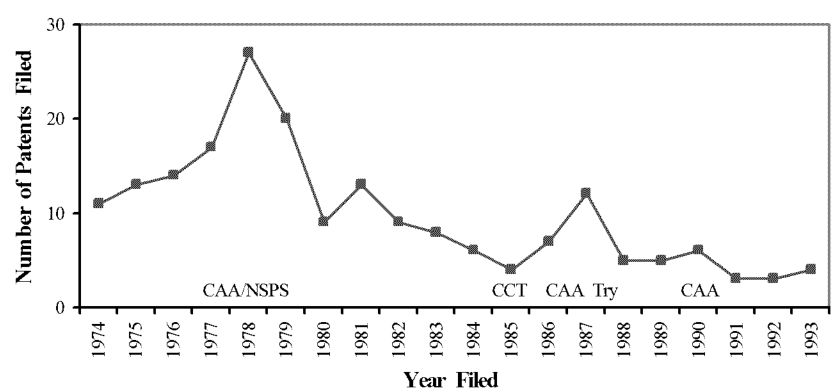
Note: Regression results are given in boldface if the ANOVA F-Statistic is statistically significant at a confidence level of at least 95%.

g) Expert Analysis of the Pre-Combustion Dataset

Since the pre-combustion patent dataset appears to be tied most closely to the existence of government actions, it is worth further discussion here in an attempt to better understand the relationship of government actions to this type of technology. Figure 3.13 displays the trend of pre-combustion patenting activity in 1974 to 1993. During the 1974 to 1978 period, pre-combustion patenting activity increased annually. At its highest point in 1978, inventive activity in pre-combustion technologies (which comprise only 17% of the abstract-based patent dataset), almost reached the level of inventive activity of post-combustion technologies (which comprise 54% of the abstract-based patent dataset). After 1978, however, pre-combustion patenting activity dropped off dramatically and never returned to the levels seen in 1974 to 1978.

FIGURE 3.13

Trend in Pre-Combustion Patents Identified in the SO_2-Relevant Abstract-Based Dataset



The years 1974 to 1978 occurred not only after the passage of the 1970 CAA and 1971 NSPS (which could be met with a range of SO_2-control technologies, as detailed in Chapter Two) but also after the Arab oil embargo of October 1973. This time period is particularly known for heightened and continuing national energy concerns that were responded to in part by the promotion of coal as a fuel source by the federal government. Thus, pre-combustion, or coal cleaning, technologies were favored by both the environmental and energy situations of this time period. The 1979 NSPS significantly altered the environmental situation, however, by requiring more stringent SO_2 removal efficiencies than those achievable by pre-combustion technology alone. In effect, the 1979 NSPS required the use of post-combustion technology.

Experts, although not as familiar with pre-combustion technology as with post-combustion FGD technologies, tended to agree with this description of the situation of pre-combustion control technology when discussing the patent activity pattern exhibited in Figure 3.13. Eight of the twelve experts – A, C, D, G, H, I, J, K – discussed the pre-1978 period in the development of pre-combustion control technology (the other four experts contributed to discussions of the 1979-93 period). Seven of these eight experts (all but C) explained that pre-combustion technologies were pursued as one of many possible SO_2-control technologies in the early 1970s. In addition, expert K also mentioned that the Arab oil embargo provided an incentive for these technologies as part of alternative fuel scenarios while experts I and J explained that the promise of these technologies was economic, since sulfur removal from coals was potentially less costly than cleaning stack gas or buying lower sulfur coals. Expert C suggested that government was probably funding much of the R&D activity in pre-combustion control, a view supported by expert H when he mentioned that the EPA had a coal-cleaning program during this time period. The existence of government funding enhances the idea that these technologies were favored by the environmental and energy situations of the early 1970s.

Three experts – B, K, L – specifically discussed the role of the 1977 CAA and 1979 NSPS in pre-combustion inventive activity, and two of these three described incentives for pre-combustion inventive activity inherent in these legislative and regulatory events.[70] Expert B suggested that the lower SO_2 removal threshold in the 1979 NSPS of 0.6 lb/MBTU and a 70 percent reduction might have provided an incentive for inventors with chemical cleaning technologies. Expert L suggested that the 1978 peak, which occurs during the period in which the NSPS was being developed, could be due to the fact that the NSPS allows polluters to take

[70] Four other experts (A, F, G, I) described the period immediately following these government actions without mentioning them specifically.

credit for any coal cleaning performed. Neither of these suggestions seems to suit fully the chronology of the evolution of the 1979 NSPS as described in Chapter Two. Expert K, however, explained that universal scrubbing and continuous compliance was an enormous deterrent for pre-combustion technologies, which typically have removal efficiencies of less than 30%. These pre-combustion technologies were too limited to offer much towards the effort to reach the higher SO_2 removal level required in the 1979 NSPS. For eastern coals, the effective emissions limit was 0.6 lbs SO_2/MBTU, requiring removal efficiencies of 85 to 90 percent (Rubin, 1989).

The limitations of pre-combustion technologies were well understood by the experts, and expert statements about these limitations imply the deterrent effect of the 1979 NSPS without mentioning it specifically. The four experts who did not specifically mention the 1979 NSPS discussed the technological and economic limitations of pre-combustion technologies and explained that these technologies did not meet utility needs in the post-1979 NSPS period. According to experts F and G, utilities realized this in the late 1970s and early 1980s. Expert A further explained that pre-combustion control never "worked out," and expert I explained that the utilities realized that with scrubbing, no pre-combustion control was necessary. Three of these same four experts (A, G, I) had earlier explained that pre-combustion technologies were being explored in the early 1970s, with the implication that they *were* meeting utility needs in this earlier period. Utility needs had apparently changed as a result of the 1977 CAA and its associated 1979 NSPS, although none of these four experts mentioned either government action specifically. In addition to these four experts, expert B, who described the positive influence of the lower threshold of SO_2 removal in the 1979 NSPS for chemical coal cleaning, also recalled doing a lot of work evaluating (with a negative outcome) physical and chemical coal cleaning in the 1978-81 period.

Finally, four experts – B, C, E, L – discussed the status of pre-combustion patenting activity in the late 1980s and early 1990s. Experts B, C, and L focused on the 1987 peak in pre-combustion patenting activity and explained that it was due to anticipation of a new CAA for acid rain. Experts C and L supplemented their statements by stating that the DOE's work in limestone furnace injection technologies and other mid-level removal technologies helped shape anticipation of the direction the new CAA would take. The anticipated direction was for low cost, low- to mid- level removal technologies, which could potentially have provided a market for pre-combustion technologies. Expert E focused on the reduced level of patenting activity in the 1990-93 period. He explained that this was not surprising, since incremental increases in SO_2 removal such as those achieved by pre-combustion technology would be particularly disadvantaged by the flexible trading concept of the 1990 CAA, in which "getting one more plant at 99% would offset five plants [using pre-combustion control technologies]."

Conclusions

The first part of this chapter defined patents and discussed the patenting process, explored some of the advantages and disadvantages of using patents as an innovation measure, and discussed expert perceptions of the role of patents in the SO_2 industrial-environmental innovation complex. The second and third sections of this chapter described two different approaches pursued in this dissertation to create and analyze patent datasets as indicators of the influence of government action on inventive activity. The subclass-based patent dataset described in the second section of this chapter demonstrated that, despite the existence of government legislation dating back to 1955 that authorized research into air pollution abatement methods, patent activity in SO_2 control did not really begin until after the introduction of a regulatory regime. Patent activity levels for this consistent dataset of over one hundred years can be portrayed as a step-function divided into two main periods by the 1970 CAA and its associated 1971 NSPS. In the first period, no more than four patents were filed in a given year, while in the second period, 1971 to 1996, patenting activity never fell below a minimum activity threshold of seventy-six patents per year. The subclass-based dataset also demonstrated that patent activity in the second period peaked in the years 1978, 1979, 1988, and 1992. These peaks were not modeled against government actions because of the lack of refinement of the subclass-based dataset.

The third section of this chapter introduced an abstract-based search methodology in order to obtain a clean dataset of commercially validated SO_2-relevant patents. Three sets of analyses of this dataset provided several insights into the inventive processes involved in SO_2 control technologies over time. First, a time series of these patents was analyzed both through simple models based on government actions and through expert elicitation. Both types of analyses arrived at similar conclusions that the existence of government actions positively, although temporarily, affected SO_2-relevant patenting activity.

Second, the abstract-based patent dataset was also analyzed in order to gain insights into the sources of innovation in SO_2 control and how these sources might differ according to the social value of patents. A dataset of 110 highly cited patents was developed to represent technologically important patents. Few differences were seen between the proportion of patents attributed to technology type, assignee type, and inventor nation of origin in the overall SO_2-relevant dataset and the highly-cited dataset. Significant differences were seen, however, between certain assignee and inventor nation of origin proportions of patents in the abstract-based SO_2-relevant dataset versus the overall USPTO dataset. Individuals owned less and government and universities owned more SO_2-relevant patents than their share of all USPTO patents. Similarly, U.S. inventors patented more and German and Japanese inventors patented less in SO_2 control than they patented in the overall USPTO dataset.

In a third set of analyses, SO_2-relevant patents were broken down into datasets based on technology type in order to investigate how the inventive process differs among the various technological pathways pursued to address SO_2 pollution. Patenting activity in these technology types was shown to vary according to assignee type and inventor nation of origin. In addition, regression analysis showed that not all technological pathways could be explained equally well by the various sets of government actions analyzed. Patent activity in pre-combustion control technology was particularly well explained, however, by the existence and nature of government actions both in regression analysis and in interviews with experts.

All of these results contribute to a growing understanding of inventive activity in SO_2 control technologies, as measured by patents, and how this activity relates to government actions. The next chapter will address the importance of government actions in inventive activity and the diffusion of SO_2 control technology by focusing on the evolution of technical papers presented at conferences sponsored by EPA, EPRI, and DOE in order to advance this technology.

Chapter 4 Network Analysis

Activity in Technical Conferences as a Method of Evaluating Invention and Diffusion

Chapter Three focused primarily on invention in SO_2 control technologies, as measured through patenting activity. In the innovation literature, other approaches have been taken to investigate inventive activities that do not necessarily meet the strict conditions required for a patent to be granted. Instead of patents, researchers focus on such indicators of innovative activity as journal articles or advertisements in trade publications (for a brief review of literature-based innovation research and some of the difficulties involved in its use for measuring innovative output, see Santarelli and Piergiovanni, 1996).

This chapter focuses on activity in technical conferences as a measure of inventive activity and technology diffusion (see Figure 4.1).[71] In particular, this chapter highlights the evolution of technical papers presented at an important SO_2 control technology conference held regularly between 1969 and 1995. This conference, the "SO_2 Symposium," brought together such technological actors as government, utilities, FGD equipment vendors, architect-engineering firms, university researchers, and other contract researchers in order to share information on the use of SO_2 control technologies. Table 4.1 lists the dates and locations of these symposia. In its early years, the U.S. Environmental Protection Agency (EPA) sponsored the SO_2 Symposium by itself; in 1982 the Electric Power Research Institute (EPRI) joined EPA as a co-sponsor; and in 1991, U.S. Department of Energy (DOE) also became a co-sponsor. In 1997, the SO_2 Symposium was folded into a broader conference, known as the "Mega

[71] Technical conferences and consortia have been previously considered as knowledge transfer mechanisms in such studies as Appleyard (1996) and Browning, Beyer, and Shetler (1995).

Symposium," that included control technologies dealing with other air pollutants, such as nitrogen oxides, particulates, and toxics. The Mega Symposium was held in 1997 and 1999.

FIGURE 4.1

Activity in Technical Conferences as a Measure of Inventive Activity and Adoption & Diffusion Strategy

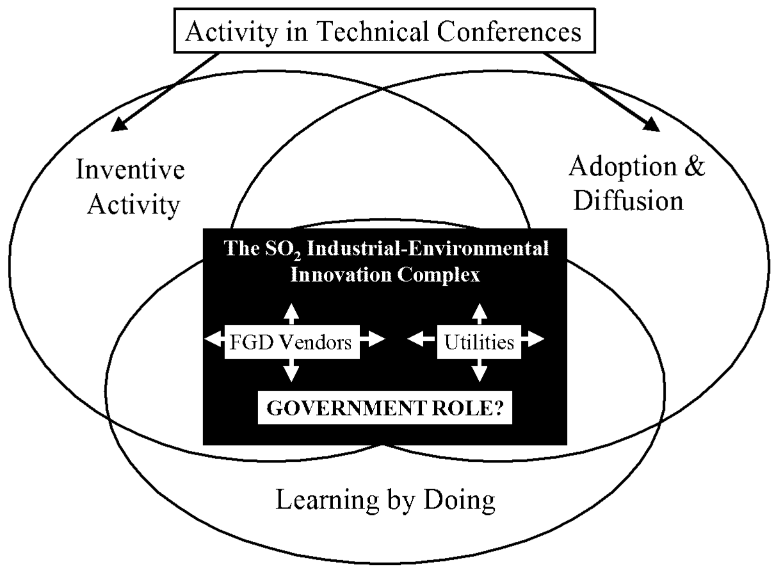


TABLE 4.1

Year and Location of SO_2 Symposium Conferences Considered in this Chapter

Year	Location	Year	Location
1973	New Orleans, LA	1985	Cincinnati, OH
1974	Atlanta, GA	1986	Atlanta, GA
1976	New Orleans, LA	1986[D]	Raleigh, NC
1977	Hollywood, FL	1988	St. Louis, MO
1979	Las Vegas, NV	1990	New Orleans, LA
1980	Houston, TX	1991	Washington, D.C.
1982	Hollywood, FL	1993	Boston, MA
1983	New Orleans, LA	1995	Miami, FL
1984[D]	San Diego, CA		

[D] A separate conference was held in this year to focus entirely on dry and combination SO_2/NO_x technology rather than the wet FGD technology that was the mainstay of the SO_2 Symposium.

The SO_2 Symposium conveys two types of information that provide useful backdrops for observing the government role in innovation in SO_2 control technologies. First, the number and topics of the technical papers presented over the years at the SO_2 Symposium reflect changing inventive activity that is not necessarily captured by patents. Second, the individuals and organizations involved in the SO_2 Symposium form a technical communication network. The knowledge-based interactions that can be observed through co-authorship patterns in the SO_2 Symposium over time provide insights into the diffusion processes occurring in the SO_2 industrial-environmental innovation complex. This second type of information is better understood in the context of the SO_2 Symposium rather than in the context of selected trade or technical journals, because the participation of the various public and private actors involved in SO_2 control is assured in the SO_2 Symposium.

These two types of information – the number and topics of technical papers and the patterns of coauthorship in these papers – will be the focus of the second and third sections of this chapter. In the rest of this introductory section, expert opinion will be related as it pertains to the role of the SO_2 Symposium in the SO_2 industrial-environmental innovation complex and in advancing the technology.

Perception of the Role of the SO_2 Symposium in Advancing the Technology

As discussed in Chapter One, twelve experts were identified for extended interviews as part of the research methods used in this dissertation.[72] During the structured two-hour interview process, the twelve experts were asked their informed opinion about the impact of the SO_2 Symposium on the SO_2 industrial-environmental innovation complex and on SO_2 control technology. Ten of the experts – A, B, D, F, G, H, I, J, K, L – described the conference as having a positive influence on the development of the technology. The high regard of these

[72] The characteristics of these experts appear in Table 1.1, where they are listed in conjunction with their identification labels in the dissertation.

experts for the conference can be seen in the excerpts in Table 4.2. Expert C did not have considerable experience with FGD technology before 1990 but attributed a probable positive role to the symposium before 1990 in terms of international information exchange and the dissemination of information from FGD vendors to utilities. Expert E did not address this question.

TABLE 4.2

Excerpts of Expert Statements on the Importance of the SO_2 Symposium

"A tremendous resource." (A)	"I've been to all of them over the past 10-20 years. … There isn't any other meeting where the same level of exchange occurs." (H)
"… it was excellent, it had a big impact back in the '70s and early '80s." (B)	"Over the years, it's been very helpful." (I)
"It's been fabulous." (D)	"If you were in the business, this would certainly be the one to go to." (J)
"The [SO_2] Symposiums were essential to the whole evolution of the technology..." (F)	"…Major impact …" (K)
"…A good interchange … the biggest help [is that] some of the people have already walked the path and can share information." (G)	"This symposium and its predecessors really have been significant in terms of the free exchange of information …"(L)

In order to organize the discussion of expert opinion on the SO_2 Symposium, this introductory section explores the following three general theses derived from the expert interviews. First, the influence of the SO_2 Symposium on the industrial-environmental innovation complex and the technology varied over time. Second, there was variation in the level, type, and manner of information exchange facilitated by the SO_2 Symposium. Third, the SO_2 Symposium was especially important in the evolution of SO_2 control technology when compared to other relevant conferences.

The first thesis derived from the expert interviews is that the conference had a shifting role in the SO_2 industrial-environmental innovation complex over time. A number of experts agreed with expert B that the SO_2 Symposium had an especially important impact in the 1970s and 1980s, although they believed that its influence diminished in the 1990s. Expert K provides one perspective of the changing role of the conference over the last three decades. In the 1970s, expert K described the SO_2 Symposium as the main information dissemination source on the status of research for FGD vendors and utilities. During this period, the Japanese and Germans attended the Symposium to gain information. In the 1980s, as other information outlets like reports from subscription newsletters and government organizations (e.g., EPA, the International Energy Agency (IEA)) emerged, the conference evolved to a forum for new and emerging developments in FGD technologies. In this time period, the Japanese and Germans became important contributors of information to the SO_2 Symposium. Expert K explained that by the 1990s, other air pollutants had increased in importance over SO_2 at the same time that FGD technologies had generally matured into reliable, efficient systems. At the 1999 Mega Symposium, expert K described the admission of a utility representative, "We're all going to have scrubbers in twenty years anyway," as a dramatic development made possible by the maturing of FGD. In expert K's opinion, the Mega Symposium is now less important as a technology forum for SO_2 than as an issues forum for upcoming regulation on other pollutants.

The view that the SO_2 Symposium has become less important in the 1990s is also supported by experts B, C, D, F, G, I, and L. Experts B, D, and F agree with expert K in their emphasis on the maturing of the technology, which in their view has led to less important technical work being needed or done in SO_2 in the 1990s. Experts D and F also placed emphasis on the relatively lower maturity of technologies designed to combat other air pollutants as a reason for the decline of the SO_2 Symposium and the emergence of the Mega Symposium. Expert F, however, emphasized the continued importance of the Mega Symposium for SO_2, since it is now "almost the only place where people who are interested in FGD get together anymore on a regular basis." Experts C, D, G, and L also pointed to changes in the SO_2 industrial-environmental innovation complex as contributing to the decreased importance of the SO_2 Symposium in the 1990s. Expert L mentioned that downsizing, competition, and cost-cuts in the utility industry as a result of deregulation have reduced SO_2 Symposium attendance in the 1990s, although the level of information exchange has been as high as ever. In contrast, experts D and G pointed to deregulation as potentially contributing to a reduction in the level of information exchanged in the conferences in the 1990s. Expert D stated that now that utilities are paying more directly for research (instead of DOE and EPRI), less know-how is being shared than in the first twenty years of the conference. Expert G pointed to similar utility self-interest in a competitive industry as a potential threat to cooperation among FGD operators. Expert C pointed to increased FGD vendor competition in a tighter market since 1990 as a reason why FGD vendors are concerned more about competitor intelligence in the late 1990s than in previous years. According to expert C, this concern about competitor intelligence is reducing the vendors' willingness to share know-how in presentations, rather than simply share the results of research efforts.

One final expert observation about the changing importance of the SO_2 Symposium over time deserves particular attention. Expert L noted that the conference was particularly popular right before and during the implementation of the 1977 and 1990 Clean Air Act Amendments (CAA), when utilities needed to determine their technological options. This observation is important because it potentially ties changes in the nature of the researcher network created by the SO_2 Symposium to the existence of government actions to control SO_2. This point will be explored further in section three of this chapter.

The second thesis derived from expert discussions about the SO_2 Symposium is that there was variation in the level, type, and manner of information exchange in the SO_2 Symposium over time. Opinions about the level of information exchanged, particularly with regard to know-how, are generally described above. More can be said, however, about expert opinion on the level of *international* information exchange in the SO_2 Symposium. Experts G and L both refer to the value that international FGD vendors have placed (and continue to place) on the information exchanged in the SO_2 Symposium and its successor, the Mega Symposium. Expert G described an incident in which a materials problem he described at an SO_2 Symposium prompted action by a European company within a week of the conference. Expert L related discussions with international FGD vendors who said that they considered the SO_2 Symposium to be "the most important symposium that they can possibly come toor participate in." Expert H, on the other hand, considered the information exchange with Germany and Japan to be somewhat incomplete in the SO_2 Symposium. He believed that a fuller exchange of information probably occurs between U.S. FGD vendors and their European and Japanese peers, since U.S. vendors have had to survive almost solely on the international market since the U.S. market tightened ten to fifteen years ago.

Experts generally categorize the type of information exchanged through the SO_2 Symposium as either operating experience (and sometimes related know-how) or new developments in FGD. Experts A, F, G, I, and K particularly identified operating experience as an important type of information shared through the SO_2 Symposium, while experts A, D, F, I, and K particularly mentioned new developments in FGD technology. In addition to these two main types of information, expert G also mentioned what could be deemed a third type of information exchanged in the SO_2 Symposium: information on the research activities of EPA, DOE, and EPRI that assisted the coordination of these activities.

Experts F, G, J, and H touched upon the manner with which the SO_2 Symposium facilitated high levels of information exchange of at least these three different types. Expert G, who described the speed with which information about his materials problem was diffused internationally after his description of the problem at an SO_2 Symposium, also related an instance of a similar rapid technology diffusion event that occurred domestically. According to expert G, the SO_2 Symposium made it possible for the use of thiosulfate additives as an oxidation inhibitor to diffuse across roughly thirty utilities within a year or two of theoretical and practical information exchange among utilities, EPRI, FGD vendors, and academic researchers. Experts F, J, and H identified elements of the SO_2 Symposium that were particularly important for supporting such an effective technology-based knowledge network. All three of these experts pointed to the venues for informal interpersonal information exchange at the conferences as very important. Expert F also identified the technical research in conference papers as important. Expert H, however, saw these papers as considerably less important than the "rubbing of noses" of researchers, both at the conference and more importantly *after* the conference when more know-how could be transferred effectively [see von Hippel (1988) on informal trading of technical know-how among rivals; also Argote (1999) pg. 146, on conference presentations as an important source of knowledge]. Expert A also observed a "flurry" of innovative activity after every symposium, although he did not specifically mention enhanced researcher cooperation as an aspect of this activity.

The third and final thesis that can be derived from expert discussions is that the SO_2 Symposium appears to be more relevant to the evolution of research in SO_2 control than other conferences. Experts G, H, and J specifically mentioned the existence of other conferences that were germane to SO_2 control technology. Expert G has been a regular attendee of a utility FGD user's group conference (the "FGD User's Conference") at which no government actors were present. He considered the FGD User's Conference to be more open to an uncensored discussion of operating experience problems, and thus found it very useful in transferring operational know-how. The current need for the FGD User's Conference seems strong since expert G described a considerable recent turnover of utility FGD operators due to restructuring in the power sector. Unfortunately, this same restructuring has made organizing the FGD User's Conference more difficult in recent years. The SO_2 Symposium (and its successor, the Mega Symposium), on the other hand, is designed to interest multiple actors in the SO_2 industrial-environmental innovation complex, as shown by the co-sponsorship of these symposia by EPA, EPRI, and DOE. Expert G expressed a hope that the joint sponsorship of these symposia would demonstrate to regulatory agencies that the utility industry is really trying to work with environmental control technologies. The opportunity the SO_2 Symposium and the Mega Symposium have provided for the utility industry to demonstrate its cooperativeness is a continuing incentive for utility operator participation in these symposia. This participation also ensures consistency in the coverage of symposia program topics relevant to these operators, and makes the SO_2 Symposium an effective source of information on the evolution of FGD technology.

Experts H and J underscored two other reasons why the SO_2 Symposium is the most relevant conference to understand the evolution of the technology. Expert H mentioned that the DOE and EPA used to hold industry briefings in the 1970s to disseminate information from completed research topics. Although these meetings were undoubtedly important in diffusing innovative information, the SO_2 Symposium has covered not only the same time frame as these meetings, but has outlasted them by a considerable amount. This demonstrates the long-standing interest in and relevance of the SO_2 Symposium. Expert J, meanwhile, indicated that the SO_2

Symposium was the conference with the greatest depth on the topic of SO_2 control. Whereas other technical conferences might have had a couple of sessions on SO_2 control over several days, the SO_2 Symposium has been distinguished by its length and the intensity of its spotlight on this topic.

According to expert E, responsibility for the research presented at the SO_2 Symposium over time tended to shift to the organizations that were most influential in FGD research funding at different time periods, which further indicates that the SO_2 Symposium reflected leading SO_2 control research. For example, the period in which the EPA was the sole sponsor of the SO_2 Symposium was only slightly longer than theperiod in which EPA had a large budget for FGD research, as discussed in Chapter Two.[73] Similarly, the DOE was brought into the SO_2 Symposium as a co-sponsor at about the same time that EPRI funding for FGD was considerably diminished. Prior to that, expert E stated that EPRI "pretty much controlled the symposium program, and certainly controlled the funds" of both the conference and much of the research presented at the conference in the 1980s. In the 1990s, there is some intimation from expert C that the architect and engineering (A&E) firms probably dominated "what comes out of these symposia." It was not clear from expert C's discussion, however, whether this dominance was exercised over the formal content of the SO_2 Symposium or simply the projects that were awarded as a result of marketing opportunities arising from the conference. It does make intuitive sense that A&E firms would be prominent in the more private market of the utility industry in a time of deregulation and minimal public funding for SO_2 control research.

Expert F bypassed specific arguments as to why the SO_2 Symposium was the most relevant conference to the understanding of the evolution of FGD technology. Instead, he simply

[73] Besides the transfer of a major FGD research program from EPA to DOE in 1979, recall that EPA's operating budget was cut by more than one-third between 1981 and 1983, with personnel cuts of 20%.

stated that the story of FGD research is in the tables of contents of the SO_2 Symposium over time. This statement prompted a follow-up question about what happened in the history of FGD research when the SO_2 Symposium briefly split into two smaller conferences focusing on dry and combined SO_2/NO_x technologies in the period between 1984 and 1986. Expert F related this split to an exceptional market that emerged for dry SO_2 technologies as a result of the 1979 NSPS.[74] In expert F's opinion, spray dryer technologies held a unique position in the history of FGD because the diffusion of these technologies was very different from the normal adoption and diffusion process among electric utilities. According to expert F, utilities "simply don't install systems [that] don't have a track record, [but] they probably had seven or eight spray dryers being installed before one of them was demonstrated on a full scale." Different actors were involved in this exceptional market, which dissipated due to skepticism about the technology's effectiveness on high sulfur coal applications.

In conclusion, most interviewed experts perceived the SO_2 Symposium to have had an important positive impact on the SO_2 industrial-environmental innovation complex and on advancing FGD technology, although the influence of the conference did change over time. The level of information exchanged in the SO_2 Symposium through the researcher network established by this conference was generally considered to be high and of two types: the results of operating experience, with various degrees of accompanying know-how, and new developments in FGD research. Experts have observed that information can traverse the knowledge-network defined by the SO_2 Symposium with considerable speed. Experts also observed that informal meetings of researchers were particularly important to the successful information exchange facilitated by this conference. Finally, expert opinion supports the thesis

[74] When asked a similar question, expert E attributed this split to increased funding by EPRI for dry and combination SO_2/NO_x technology during this time period.

that the SO_2 Symposium is the most relevant conference to study in order to understand the evolution of FGD technology, and several experts suggested that the tables of contents of the SO_2 Symposium reveal the history of SO_2 control research. The second section of this chapter attempts to use these tables of contents to investigate this history to a limited extent, while the third section explores changes in the network of researchers defined by the SO_2 Symposium over time.

Inventive Activity Analysis

The purpose of this section is to understand changes in inventive activity over time, as analyzed by the topics of session papers presented at the SO_2 Symposium. In addition, this section deals with attribute data regarding authorship statistics. This section's efforts to link the content analysis of text with authorship analysis is in the tradition of Lievrouw (1987) and Hill (1999).[75] Relational data about authorship are dealt with in the next section on network analysis.[76]

Method

Analysis of the tables of contents of the SO_2 Symposium over time required a lengthy process of interlibrary loan requests and coding of the resulting conference proceedings. Each of the 1,116 papers presented in the eighteen conference proceedings obtained in this process was coded by year, session topic, paper number, paper title, authors, affiliations of authors, and geographic location of authors. Author affiliations were further coded for the following six

[75] Attribute data refers to "the behavior of agents … regarded as the properties, qualities, or characteristics which belong to them as individuals or groups (Scott, 1991, pg. 2)."
[76] Relational data are "the contacts, ties and connections, the group attachments and meetings, which relate one agent to another (Scott, 1991, pg. 2)." Network analysis techniques are a common method of analyzing relational data.

"affiliation types": trade associations, firms (general), universities, contract nonprofit research and development organizations, government agencies, and utilities.

The eighteen conference proceedings obtained included every SO_2 Symposium between 1973 and 1995, as well as the 1997 Mega Symposium and the 1984 and 1986 conferences on dry FGD and combined SO_2/NO_x removal technologies ("Dry Symposium"). Since the Mega Symposium cannot be directly compared with the SO_2 Symposium for many attributes because of its considerably reduced focus on SO_2, it was dropped from consideration for the results that follow. Similarly, the Dry Symposium cannot be directly compared with the SO_2 Symposium; some information about the session titles and number of papers presented in these conferences, however, was relevant to the history of FGD research emphases and will be included in selected results as indicated later. In addition, it might be expected that the 1985 and 1986 SO_2 Symposium conferences that were contemporary with the Dry Symposium conferences would not be comparable with other years of the SO_2 Symposium, since they were ostensibly missing the dry and combined SOx/Nox technologies of other symposia. In fact, these two conferences still included some sessions on dry technologies, and for this reason were considered comparable to the other SO_2 Symposium conferences.

Results and Implications

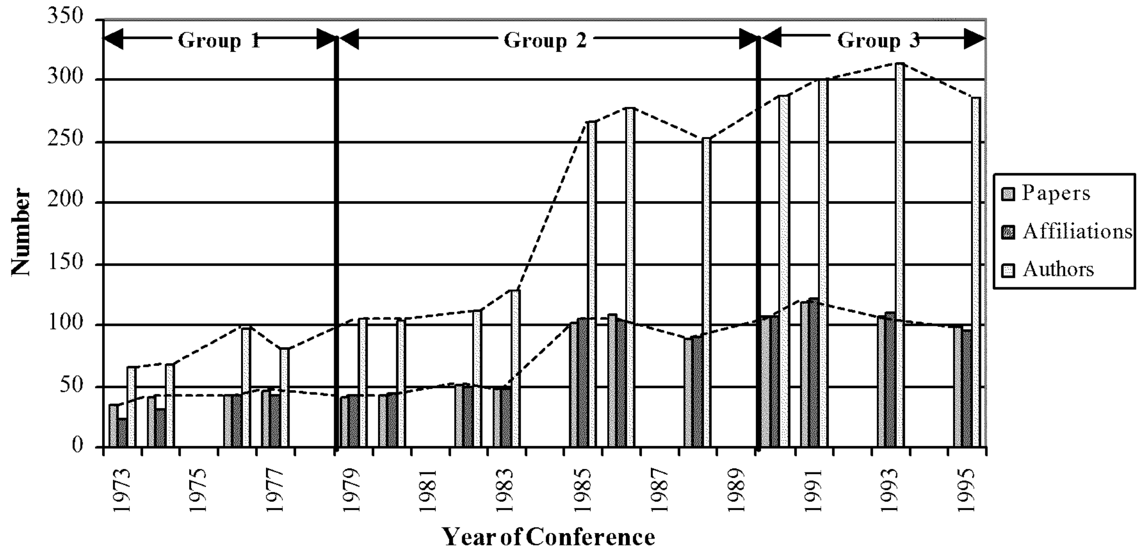
The influence of government actions on inventive activity in the SO_2 industrial-environmental innovation complex is likely to be seen in the research activity reported at the SO_2 Symposium, and particularly at those conferences that occurred around the time of a real or anticipated government action. In order to determine this effect, the fifteen conference proceedings under general consideration were divided into three groups demarked by the dates of the 1979 NSPS and 1990 CAA. These two government actions were selected because they had particular importance to the dominant technological options in SO_2 control in different periods of time. Thus, Group 1 conferences include those in 1973, 1974, 1976, and 1977, before serious consideration of the details of the 1979 NSPS. Group 2 conferences include those in 1979, 1980, 1982, 1983, 1985, 1986, and 1988, before serious consideration of the 1990 CAA.[77] Group 3 conferences include those in 1990, 1991, 1993, and 1995.

Three consistent indicators of research activity in the SO_2 industrial-environmental innovation complex and the size of the SO_2 researcher community over time are the number of papers presented in a symposium, the number of authors involved in the writing of papers, and the number of affiliations that these authors represent.[78] Figure 4.2 shows the breakdown of the 1,075 papers presented in the conferences in time periods 1-3. These 1,075 papers were written by 1,825 authors representing 501 affiliations.[79]

[77] When included in the results, the Dry Symposium conferences in 1984 and 1986 are part of Group 2.
[78] Another measure of the scale of the SO_2 researcher community over time is attendance figures at the various conferences. Unfortunately, these figures are not available for all the SO_2 Symposium conferences.
[79] Affiliations could not be determined for twenty-nine of the 112 coauthors in 1979.

FIGURE 4.2

Time Series of SO_2 Symposium Papers, Affiliations, and Authors



In Figure 4.2, the Dry Symposium conferences are merged with the two SO_2 Symposium conferences that occurred contemporaneously. The result is that the largest increase in conference activity occurred between 1983 and 1985, when the number of papers, affiliations, and authors more than doubled (i.e., increased from 200 to 220% for all three measures). When the SO_2 Symposium is considered alone (without the Dry Symposium conferences), conference activity doubles between 1986 and 1988 (i.e., increases 170% in the number of papers, 210% in the number of affiliations, and 190% in the number of authors). It is interesting to note that this increase in conference activity corresponds with the 1988 peaks seen in overall and pre-combustion patenting activity (seen earlier in Figure 3.8 and Figure 3.13).

It is clear from the above results that research activity in SO_2 control technology increased significantly between 1973 and 1995, with the largest rate of increase occurring in the mid- to late-1980s. The interview testimony in this chapter and in Chapter Three supports the idea that the mid-1980s was a time of growing anticipation of new acid rain regulation that was expected to focus on low to moderate SO_2 removal requirements. This would explain the split between the main SO_2 Symposium and the Dry Symposium at this time, since dry FGD technologies were of particular interest for low- to mid-level SO_2 removal (i.e., removal efficiencies of roughly 30-70%).

Table 4.3 demonstrates that the average number of conference papers, author affiliations, and authors all increased sharply between each of the three time periods of the SO_2 Symposium. The number of authors involved in conference presentations grew most rapidly, followed by growth in the number of affiliations they represent (which tripled over the full time period of interest). Table 4.4 shows the number of papers in each time period that had various numbers of authors. This table demonstrates that just as the total number of papers increased and the total number of authors increased, the total number of authors per paper also increased across the three time periods.

TABLE 4.3

Change in Number of Papers, Affiliations, and Authors between Groups Bounded by Government Actions

Conference Group	Average No. of Papers per Conference	Percent Increase from Previous Group	Average No. of Affiliations	Percent Increase from Previous Group	Average No. of Authors	Percent Increase from Previous Group
Group 1	41		35		78	
Group 2	69	69%	69	96%	178	128%
Group 3	108	57%	108	57%	297	67%

TABLE 4.4

Distribution of Paper Authors Across Time Period Groups

Conference Group Papers	Number of Authors								
	One	**Two**	**Three**	**Four**	**Five**	**Six**	**Seven**	**Eight**	**Nine**
Papers in Group 1	76 (47%)	42 (26%)	27 (17%)	12 (7%)	6 (4%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Papers in Group 2	97 (20%)	109 (23%)	131 (27%)	72 (15%)	40 (8%)	24 (5%)	5 (1%)	2 (0%)	1 (0%)
Papers in Group 3	62 (14%)	87 (20%)	123 (29%)	86 (20%)	35 (8%)	23 (5%)	8 (2%)	5 (1%)	2 (0%)

Note: Percentages in parentheses are of all papers in a time period group.

Since the purpose of the SO_2 Symposium was to bring together actors in the SO_2 industrial-environmental innovation complex to tackle technical problems and advance the technology (primarily wet FGD), the research session titles of the SO_2 Symposium indicate the most important technical issues in SO_2 control as determined by contemporary experts. The majority of session titles reflect technical aspects of wet FGD lime/limestone systems, although some deal with other types of systems. Besides the technical session titles, some session titles reflect the concern of the SO_2 industrial-environmental innovation complex about SO_2 control economics and new and anticipated regulation. Table 4.5 displays the compiled list of eighteen recurring session titles of the SO_2 Symposium that are of interest for understanding the changes in research emphasis in SO_2 control over time. These session titles are grouped in Table 4.5 first by titles that cut across the three time period groups, and then by titles specific to each of these groups.

TABLE 4.5

Recurring SO_2 Symposium Session Titles of Interest, with Appearances and Notes

Session Focus	Number of Conference Appearances	SO_2 Symposium Appearances and Notes
Group 1, 2, and 3 Conferences (1973 to 1995)		
Byproduct (or waste) disposal and utilization	16	1973-95, except for 1979
Group 2 and 3 Conferences (1979 to 1995)		
Dry FGD technologies	12	1980 to 1995, including Dry Symposia
Combined SO_x/NO_x technologies	7	1982, 1983, 1990, 1991, 1995, Dry Symposia
Furnace sorbent injection technologies[a]	5	1983, 1988, 1990, 1991, 1984 Dry Symposia
Materials of FGD construction	5	1982, 1983, 1985, 1993, 1995
Organic acid/wet FGD additives	4	Organic acid 1983, 1985; additives 1986, 1993
"Reliability" specifically in session title	4	1982, improvements reported in 1985, 1986, 1990
Economic issues (not opening sessions)	8	1979, 1983, 1986, 1988, 1990, 1995, Dry Symposia
Legislation/regulation (not opening sessions)	5	1979, 1980, 1991, 1993, 1995
"Clean Coal" demonstrations	3	1986, 1991, 1993
"International Overview"	2	1988, 1990
Group 1 Conferences Only (1973 to 1977)		
Non-regenerable, regenerable processes	4	1973 to 1977
Group 2 Conferences Only (1979 to 1988)		
"Acid deposition" specifically in session title[b]	1	1986
Industrial applications	3	1979, 1980, 1986
Dual alkali	3	1982, 1983, 1985
"Chemistry" specifically in session title	2	1983, 1985
"Retrofitting" specifically in session title	3	1985, 1986, 1988
Group 3 Conferences Only (1990 to 1995)		
Air toxics	2	1993, 1995

[a] Two sessions on this topic occurred in both 1988, 1990.
[b] Two sessions on this topic occurred in 1986.

These session titles illustrate the changing technological focus of the SO_2 industrial-environmental innovation complex over time. "Byproduct (or waste) disposal and utilization" is a recurring topic throughout the time period, while furnace sorbent injection technologies and related dry technologies for SO_2 removal appeared only during the 1980s. The prevalence of these three subjects as research areas in the conference proceedings was not implied by the small share of patents assigned to these technologies. For example, 9% of the papers presented at the SO_2 Symposium over time occurred in a byproduct (or waste) disposal and utilization session, while only 4% of the 1,237 SO_2-related patents in the abstract-based dataset were attributed to desulfurization byproduct modification patents. According to a Z-test performed on these relative percentages, this difference is statistically significant at greater than a 99% confidence level.[80] Although materials of construction were not similarly separated out in the patent analysis, it is clear from these session titles that improvement in materials was an important research emphasis of the SO_2 control community. In addition, session titles focusing on dry FGD and furnace sorbent injection enhance the qualitative understanding of the 4% of patents assigned to sorbent modification for use in SO_2 removal systems.

SO_2 Symposium sessions regularly addressed economic and political issues relevant to the SO_2 control community over time. These issues were typically featured in the opening plenary sessions of each conference. Economic issues were further elaborated on as a separate session beginning in 1979, after the passage of the 1977 CAA. It is interesting to note the recurrence of specific legislation- and regulation-based sessions in the first conferences to follow the August 1977 CAA, the June 1979 NSPS, the November 1990 CAA, and the January 1995 start of Phase I of the 1990 CAA. In light of this phenomenon, the appearance in 1986 of the only SO_2 Symposium sessions with "acid deposition" in the titles seems to indicate that the research community in that year was considering SO_2 as a regional air pollutant that might soon be regulated to control acid rain. This supports the view that the peak in patent filing activity in 1988 was likely due to anticipation of an impending revised CAA that addressed SO_2 regulation in the context of acid rain.

For more details on these session titles and how they changed over time, Appendix F contains a complete list of the SO_2 Symposium session titles and the number of papers presented per session for each of the conferences in the three time period groups (including the Dry Symposium conferences).

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[80] The Z-test calculation is given in footnote 64 in Chapter Three.

Network Analysis

Background

The discussions of quantitative measures of innovation in this chapter and in Chapter Three have focused primarily on various inventive activities that helped to bring about the improvements in performance and cost of the commercially deployed FGD technologies documented in Chapter Two. The SO_2 Symposium, however, provides an opportunity for the study of diffusion in the SO_2 industrial-environmental innovation complex. Many researchers consider diffusion to be a process of communication and influence through which potential users become informed about the availability of new technologies and are persuaded to adopt these technologies. This occurs, in part, through interaction with previous users [for reviews, see Attewell (1996); Rogers (1995); and Tornatzky and Fleischer (1990); also see Carley (1990); (1995); and (1996)].

Classical diffusion studies that emphasize how diffusion is limited by the timing and pattern of communication, such as Coleman, Katz, and Menzel (1966), have been criticized for not distinguishing between two types of information that may be communicated in the diffusion process. In the first, "signaling" information, the existence and potential gains of a particular innovation are communicated. In the second, "know-how" information, the technical knowledge needed to use a complex innovation – such as FGD – is communicated.[81] A number of studies in the innovation literature demonstrate that know-how about complex technologies is not easily transferred between individuals at different organizations; often, supplemental productivity-enhancing know-how must be developed within the user organization [see Argote (1999, 144-88)

[81] In the innovation literature, scientific or technical "tacit knowledge" can be seen as an important element of know-how (see discussion in Senker and Faulkner (1996), which also includes a discussion of the importance of informal networks in the transfer of tacit knowledge from public-sector research institutions).

for a review]. Chapter Five will discuss one method by which this know-how is developed within a user organization: organizational learning by the operators of FGD technologies.

Earlier in this chapter, expert perceptions were related concerning the value of the SO_2 Symposium as a forum for the exchange of information about operating experience and technical know-how. From expert comments, it appears that the opportunities the conference provided for informal interpersonal meetings between researchers were particularly useful for this information exchange. Although studies have been done to assess cooperative research and development in the form of informal know-how trading [a classic example is von Hippel (1988)], the SO_2 Symposium proceedings do not provide archival information on informal interactions at the many hospitality suites, luncheons, and other informal gatherings at the conference. The coauthorship patterns of papers presented at the SO_2 Symposium, however, provide a proxy source of information on the channels of interpersonal and interorganizational knowledge flow facilitated by the conference over time.[82] For previous research use of paper coauthorship as a measure of collaboration, see such articles as Cockburn and Henderson (1998); Liebskind et. al. (1995); Tijssen and Korevaar (1997); Zucker, Darby, and Armstrong (1994); Zucker and Darby (1995); and Zucker, Darby, and Brewer (1997).

The various coauthorship arrangements of each SO_2 Symposium can be used to define a network of technological collaborators. Networks and collaboration have been extensively discussed in the innovation literature in the 1980s and 1990s. Networked, rather than independent, organizations have been particularly shown to have opportunities to benefit from knowledge transfer [see discussion in Argote (1999, pp. 166-68)]. Also in the 1980s and 1990s,

[82] Many studies have addressed knowledge flow channels, including Carley and Hill (forthcoming) and Carley (1999). One of the seminal works to address coauthorship networks across scientists as important for generating new innovation and new technology was Crane (1969). Argote (1999) reviews many other studies involving the mechanisms of knowledge transfer.

evolutionary economic models of science and technology policy emerged that analyzed developments in terms of "interacting and coevolving networks of institutions and technoeconomic infrastructures (Tijssen and Korevaar, 1997)." For a good review of both the sociological and economic approaches to networks and technological collaboration, see Coombs et. al. (1996).

Relatively little use has been made in the innovation literature, however, of the formal network analysis techniques developed originally in the fields of ethnology and sociometry [exceptions include such articles as Coleman, Katz, and Menzel (1957); Leoncini et. al. (1996); Rogers (1979); and Tijssen and Korevaar (1997)]. As defined in Leoncini et. al. (1996), "network analysis uses quantitative techniques derived from graph theory to study and describe the structure of interactions between given entities." A comprehensive explanation of network analysis techniques will not be attempted here, since there are excellent reviews of the development of network analysis and guides to its use in research in sources such as Lincoln (1982), Scott (1991), and Wasserman and Faust (1997). Instead, these techniques will be discussed only in relationship to the method and results of the present analysis of the patterns of coauthorship within the SO_2 Symposium, and their relationship to government actions regarding SO_2 control.

Method

In this analysis, the basic relational data analyzed are the ties between the 1,825 authors of SO_2 Symposium papers between 1973 and 1995 that form as a result of paper coauthorship.[83] For a paper with three authors, there are three distinct ties between these authors because each

[83] The papers considered include those of the Dry Symposium conferences, which here are lumped together with the nearest SO_2 Symposium (as in Figure 4.2).

author is connected to each of the authors except him or herself. This is expressed mathematically in Equation 4.1.

EQUATION 4.1

Definition of Ties between Paper Authors

$$Ties = \frac{n * (n - 1)}{2}$$

where

n = The number of authors on a paper

Table 4.6 echoes Table 4.4 in its depiction of the distribution of the potential number of ties between paper authors across the three time period groups. Yet this table does not reflect the actual number of ties between all the paper authors of the SO_2 Symposium because it does not take into consideration the fact that some authors write papers for more than one conference. Those authors that present papers at greater numbers of conferences can be considered more "important" to the direction and content of the SO_2 Symposium over time than other authors.

TABLE 4.6

Potential Ties between Paper Authors Across Time Period Groups and in Total

Potential Ties between Paper Authors across Time Period Groups										Total Number of Potential Ties (Discounting Authorship in Multiple Conferences)
	Number of Authors on Papers									
	One	***Two***	***Three***	***Four***	***Five***	***Six***	***Seven***	***Eight***	***Nine***	
Group 1	0	42	81	72	60	0	0	0	0	255
Group 2	0	109	393	432	400	360	105	56	36	1,891
Group 3	0	87	369	516	350	345	168	140	72	2,047
Total										4,193

Table 4.7 shows the incidence of authorship in multiple conferences of the SO_2 Symposium, in decreasing order of author importance. Table 4.7 also demonstrates the potential

size of networks defined by authors of varying importance.[84] Note the very large network that results if all 1,825 authors are considered. This network is also quite sparse across time, as 74% (1,355) of the 1,825 authors only write papers in one conference. A standard network analysis practice when dealing with a potentially very large and sparse network is to limit the number of authors considered in analysis (Carley, 2000). As a first step in this limitation process, agents with no ties to other agents, known as "isolates," are typically discarded. As a first step in limiting network size in this analysis, 92 authors who never had paper coauthors were discarded. As a second step, the 1,355 authors who presented papers in only one conference were also discarded. The total number of discarded authors at this stage was thus 1,366 authors, since 81 of the isolates also presented in only one conference.

TABLE 4.7

Authorship in Multiple Conferences (Listed in Decreasing Order of Author Importance to the SO_2 Symposium) and Effect on Potential Network Size

Number of Conferences Author Wrote Papers for	Percent of All Conferences Author Wrote Papers for	Number of Authors	Cumulative Number of Authors, according to Importance (= a)	Size of Potential Network between Cumulative Number of Important Authors (= a * (a - 1))
13	81%	1	1	0
12	75%	2	3	6
11	69%	1	4	12
10	63%	1	5	20
9	56%	9	14	182
8	50%	6	20	380
7	44%	9	29	812
6	38%	20	49	2,352
5	31%	29	78	6,006
4	25%	46	124	15,252
3	19%	100	224	49,952
2	13%	246	470	220,430
1	6%	1,355	1,825	3,328,800

[84] A network's size is defined by: (the number of authors) times (the number of authors minus one).

Ultimately, the core group of authors analyzed in this dissertation (labeled the "important" innovative actors, with their corresponding affiliations) was defined as those authors involved in writing papers for at least 50% of the SO_2 Symposium conferences held between 1973 and 1995. Table 4.8 lists these important innovative authors and their affiliations, as well as the six affiliation types represented by all of the authors in the network. These six affiliation types are assigned abbreviations in this table; these abbreviations are then used to help identify the important affiliations and authors in Table 4.8. An additional piece of data in Table 4.8 is the number of SO_2-related patents each affiliation or author holds in the abstract-based dataset. The majority of important affiliations hold patents in this dataset, although most important authors do not hold patents.

TABLE 4.8

Affiliation Types, Important Affiliations, and Important Authors in the SO_2 Symposium

Affiliation Types with Affiliation Type Abbreviations		Important Affiliations with Affiliation Type Abbreviation and Number of Abstract-Based Patents			Important Authors with Affiliation Type Abbreviation and Number of Abstract-Based Patents		
Trade Assoc.	(A)	Acurex Corp.	F	2	Ando, Jumpei	R	0
Contract R&D	(C)	Babcock & Wilcox Co.	F	33	Blythe, Gary M.	F	0
Firm	(F)	Bechtel Corp.	F	7	Dene, Charles E.	C	0
Government	(G)	Burns & McDonnell	F	0	Ellison, William	F	0
University	(U)	Chiyoda Corp.	F	4	Hargrove Jr., O.W.	F	0
Utility	(P)	Chuo University	U	0	Jones, Julian W.	G	0
		Combustion Engineering	F	25	Kaplan, Norman	G	0
		DOE Pittsburgh Energy Technology Ctr	G	38[a]	Laseke, Bernard A.	F	0
		Dravo Lime Co.	F	14	Maxwell, Michael A.	G	0
		EPA	G	4	Owens, David R.	U,F,C	0
		EPRI	C	18	Rhudy, Richard G.	C	0
		Ellison Consultants	F	0	Rochelle, Gary T.	U	2
		Louisville Gas & Electric	P	0	Rosenberg, Harvey S.	C,F	3
		Northern Indiana Public Service	P	0	Sedman, Charles B.	G	0
		Northern States Power Co.	P	4			
		Radian Corp.	F	0			
		Southern Company Services, Inc.	P	0			
		Stone & Webster Engineering Corp.	F	0			
		Tennessee Valley Authority	P	4			
		University of Texas at Austin	U	3			

[a] These patents are held by the entire DOE, rather than just the Pittsburgh Energy Technology Center.

Despite their lack of patented inventions, the fourteen important authors listed in Table 4.8 are clearly significant actors in the SO_2 research community. These fourteen authors not only presented in at least 50% of the SO_2 Symposium conferences, but were also coauthors on one-sixth of all the papers presented in the history of the SO_2 Symposium. Collectively, they coauthored with one-eighth of the 1,825 authors of SO_2 Symposium papers.

The following three sections present network analysis results concerning the strength of coauthorship ties among the affiliation types, important affiliations, and important authors listed in Table 4.8. The process of constructing network graphs for these data is described in Appendix G. Note that the full set of 1,825 authors is only considered in the analysis of the affiliation type by affiliation type network.

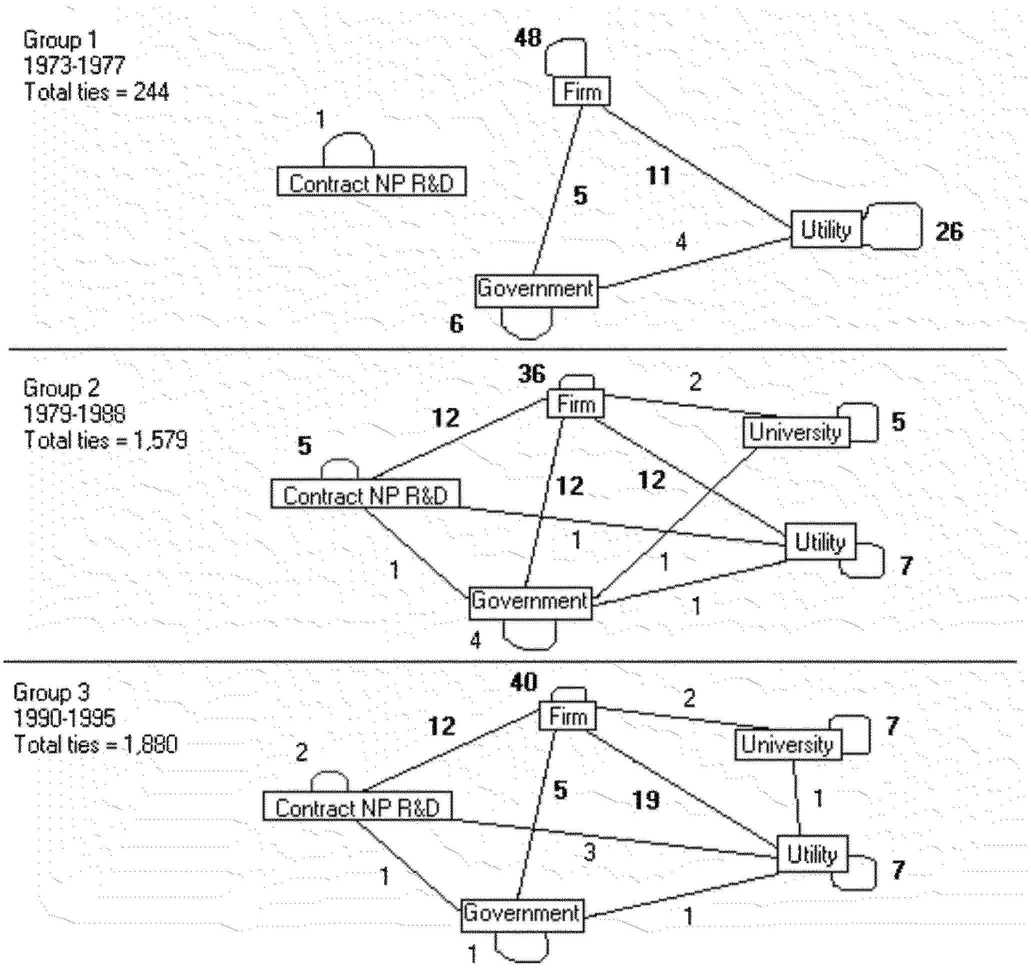
Affiliation Type by Affiliation Type Network Results

Figure 4.3 shows coauthorship ties between affiliation types, where each affiliation type is connected either reflexively (to the same affiliation type) or relationally (to other affiliation types) for at least 1% of all the coauthorship ties in each of the three time periods.[85] The numbers shown in this figure are the percentages of all coauthorship ties that occurred between researchers in the tied affiliation types during each time period. Group 1 conferences encompass 244 affiliation type ties, Group 2 conferences encompass 1,579 affiliation type ties, and Group 3 conferences encompass 1,880 affiliation type ties. Numbers in bold in Figure 4.3 indicate "strong" ties, which represent greater than 10% of all the coauthorship ties in each time period.

[85] Because they do not account for 1% of the ties in each period, trade associations are do not appear in this figure.

FIGURE 4.3

Evolving Coauthorship Ties between Affiliation Types for Three Time Period Groups



Notes: Numbers are percentages of total affiliation type coauthorship ties in each period. Numbers in bold are strong ties (greater than 10% of affiliation type ties).

The affiliation type network in the Group 1 conferences is quite different from that in the Group 2 and 3 conferences. In the Group 1 conferences (1973 to 1977), not every affiliation type is connected to others through coauthorship ties on papers. This is perhaps to be expected in this time period, which was marked by a particularly competitive SO_2 control market and litigation between regulated utilities and government.[86] In the affiliation type network in the Group 2 conferences (1979 to 1988), however, most affiliation types are connected, which provides evidence that a community of researchers is forming. It is interesting to note that this community emerged just after the passage of the 1977 CAA, which effectively required the utility industry to install FGD technology on all new and substantially modified capacity. The network formed in the Group 2 conferences remains fairly stable in the Group 3 conferences (1990 to 1995), although some density (defined here simply as the number of ties in the network) is lost. Nevertheless, no major changes are evident in the network after passage of the 1990 CAA, regardless of the initially high anticipated demand for FGD or the later absence of that demand.

With regard to specific features of the affiliation type network, the dominant characteristic is the consistently large reflexive coauthorship ties among private firms. Reflexive coauthorship ties among firm authors, which range from 36% to 48% of ties in all three conference time periods, are the strongest by far in the network. Reflexive coauthorship among utility authors is also strong in the Group 1 conference time period (26% of all ties), although it is diminished in the Group 2 and Group 3 conference time periods (7% of ties in both periods). The strength of utility coauthorship shifts from reflexive to relational ties between firms and utilities in these latter two periods, when this relational tie accounts for 12% of all ties in the Group 2 conferences and 19% of all ties in the Group 3 conferences.

[86] The perception of the scrubber market, which had experienced a tenfold increase in commercial scrubber unit installations between 1971-76 and a low but growing profitability between 1976-78, was that it would continue to improve due to new regulatory initiatives. This was an impetus to FGD equipment and services industry acquisitions and new entry (the number of firms in the utility FGD market between 1971-77 increased from one to thirteen).

It is interesting to compare the combined strength of firm and utility authorship to firm and utility patenting. In the patent analysis, firms and utilities were grouped together in one category, "firms," which accounted for 74% of the abstract-based SO_2-relevant patents. In comparison, reflexive firm ties, reflexive utility ties, and ties between firms and utilities alone account for 85% of the ties in the Group 1 conferences, 55% of the ties in the Group 2 conferences, and 66% of the ties in the Group 3 conferences. Firms and utilities have an even greater influence in coauthorship ties overall. If all the ties of firms and utilities are summed, these two affiliation types account for 94% of all Group 1 conference ties, 83% of all Group 2 conference ties, and 90% of all Group 3 conference ties.

In contrast with consideration of the strongest actors in the network, it is interesting to note which affiliation types are weak in a given time period. In the Group 1 conferences, researchers at contract nonprofit research and development organizations have no relational ties and relatively low reflexive ties. This is most likely due to the relative youth during the Group 1 conference years of the main contract nonprofit research and development organization involved in SO_2 control, EPRI.[87] Also in the Group 1 conferences, researchers at universities have no presence in the SO_2 Symposium coauthorship network. The emergence of both reflexive and relational ties between university researchers and other affiliation types is seen in the Group 2 conferences. This may have been the result both of trends in academic research and the contribution of one important author.

Table 4.9 presents the percentages of each affiliation type's total ties that are relational in nature, and how these percentages changed over the three time periods. It therefore provides information about the changing connectedness of this network and the changing influence of

[87] EPRI was founded in 1973 and it instituted its first FGD research program in 1974.

different affiliation types in this network. For example, it makes clear how involved in coauthorship the non-profit contract R&D organizations became over the years of the SO_2 Symposium. In both the Group 2 and 3 conferences (1979 to 1995), this affiliation type was one of the most connected to the overall coauthorship network. Table 4.9 also shows that utilities became more connected to other affiliation types through each of the three conference time periods. Firms similarly become more connected between the Group 1 (1973 to 1977) and Group 2 (1979 to 1988) conference time periods, although, as conveyed in the expert comments earlier in this chapter, firms became slightly less connected in the Group 3 (1990 to 1995) conference time period. Universities' connectedness level in the Group 2 conferences also declined in the Group 3 conferences.

TABLE 4.9

Relational Ties of Each Affiliation Type

	Group 1 Conferences 1973 to 1977 94 relational ties (39% of 244 total ties)	**Group 2 Conferences 1979 to 1988** 1,366 relational ties (87% of 1,579 total ties)	**Group 3 Conferences 1990 to 1995** 1,658 relational ties (88% of 1,880 total ties)
Contract Nonprofit R&D	0 (0%)	245 (76%)	296 (89%)
Firm	38 (25%)	598 (51%)	721 (49%)
Government	21 (58%)	237 (79%)	126 (89%)
University	NA	60 (43%)	65 (35%)
Utility	35 (36%)	226 (67%)	450 (78%)

Note: Percentages are of all of the ties of an affiliation type in a given time period.

According to Table 4.9, the most connected affiliation type throughout all three conference time periods was government. The importance for government of working together with utilities, equipment vendors, and others in research in SO_2 control technology is evidenced not only in this table, but also in the research histories of the EPA and DOE. The EPA's research history shows two good examples: first, it has been the longest sponsor of the SO_2 Symposium, and second, it was responsible for establishing the Shawnee test facility in April

1972. This facility, which was equipped with three 10 MW boilers and operated in partnership with Bechtel and TVA, was responsible for much of the early research in SO_2 control. The DOE's research history also shows a good example of government cooperation with industries in its management of the Clean Coal Technology (CCT) program beginning in December 1985. Industries provided over 50 percent of the cost of the CCT demonstrations and also played a major role in project definition and in ensuring eventual commercialization.

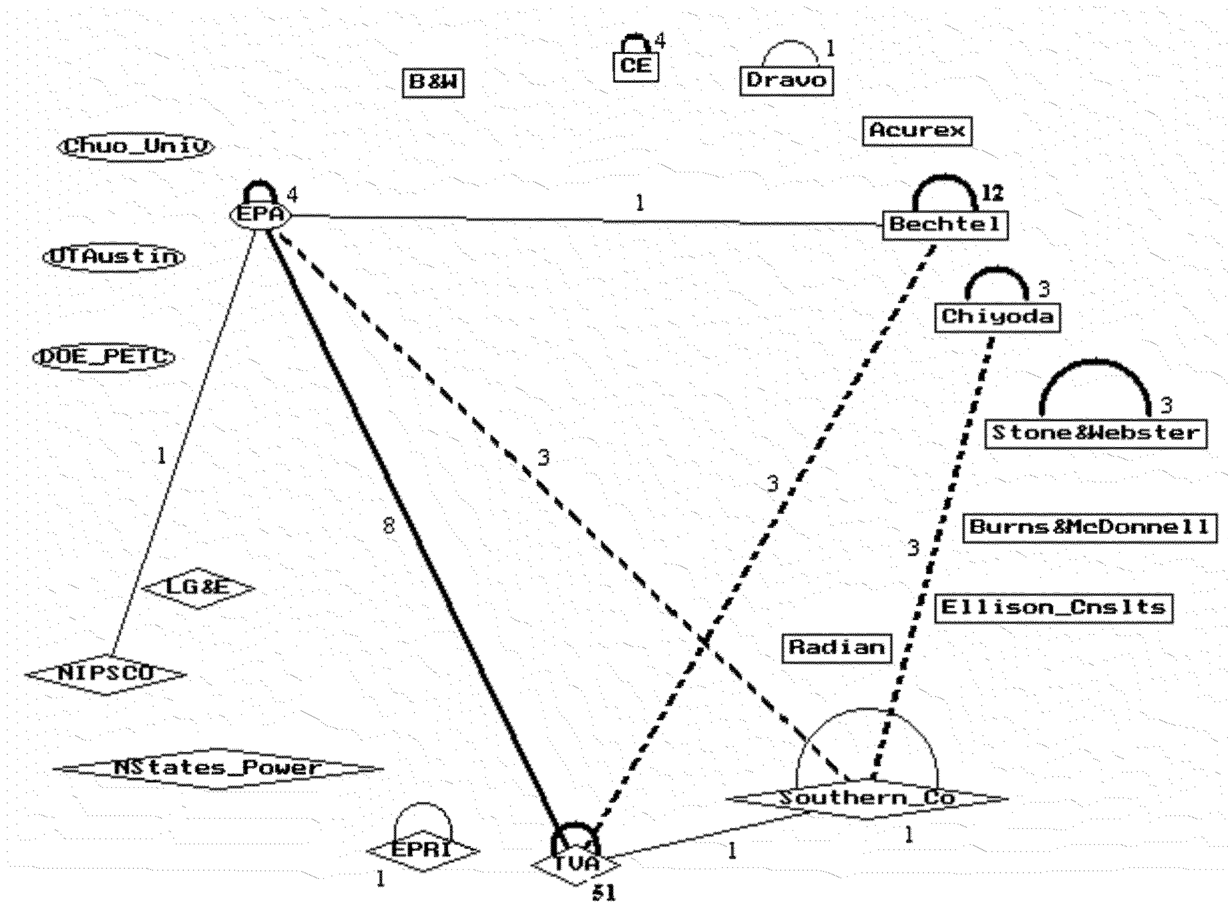
Important Organization by Important Organization Network Results

Figure 4.4, Figure 4.5, and Figure 4.6 are Krackplot 3.0 versions of the changing coauthorship patterns among the important affiliations listed in Table 4.8. The numbers accompanying various interorganizational ties in these figures again are the percentages (if at least equal to 1%) of all coauthorship ties that occurred between researchers in the important affiliations during each time period. Group 1 conferences encompass 75 important affiliation ties, Group 2 conferences encompass 481 important affiliation ties, and Group 3 conferences encompass 682 important affiliation ties. Numbers in bold indicate "strong" ties, which again are ties between important affiliations that represent at least 10% of all such ties in each time period. The boxes around the various affiliations indicate types of affiliations, in the following order (going clockwise): elliptical boxes indicate either universities or government agencies, rectangular boxes indicate firms including FGD vendors, boiler manufacturers, and consultants, and diamond boxes indicate utilities and contract nonprofit research and development organizations.[88]

[88] Krackplot 3.0 only has the graphic capability to show boxes of three different shapes.

FIGURE 4.4

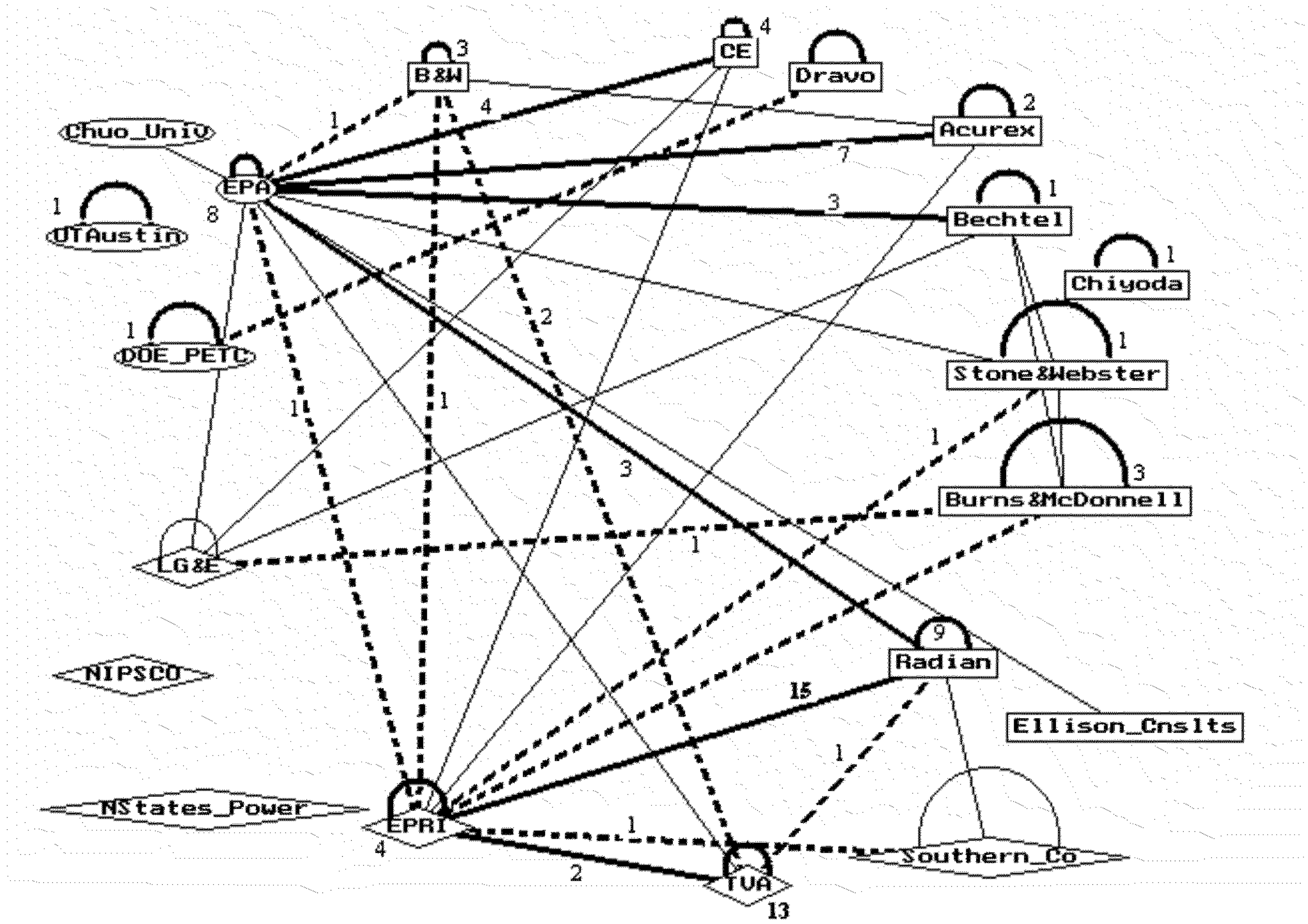
Coauthorship Ties between Important Affiliations in Group 1 Conferences (1973 to 1977)



Notes: Numbers are percentages of 75 total important affiliation coauthorship ties in this period. Numbers in bold are strong ties (greater than 10% of important affiliation ties).

FIGURE 4.5

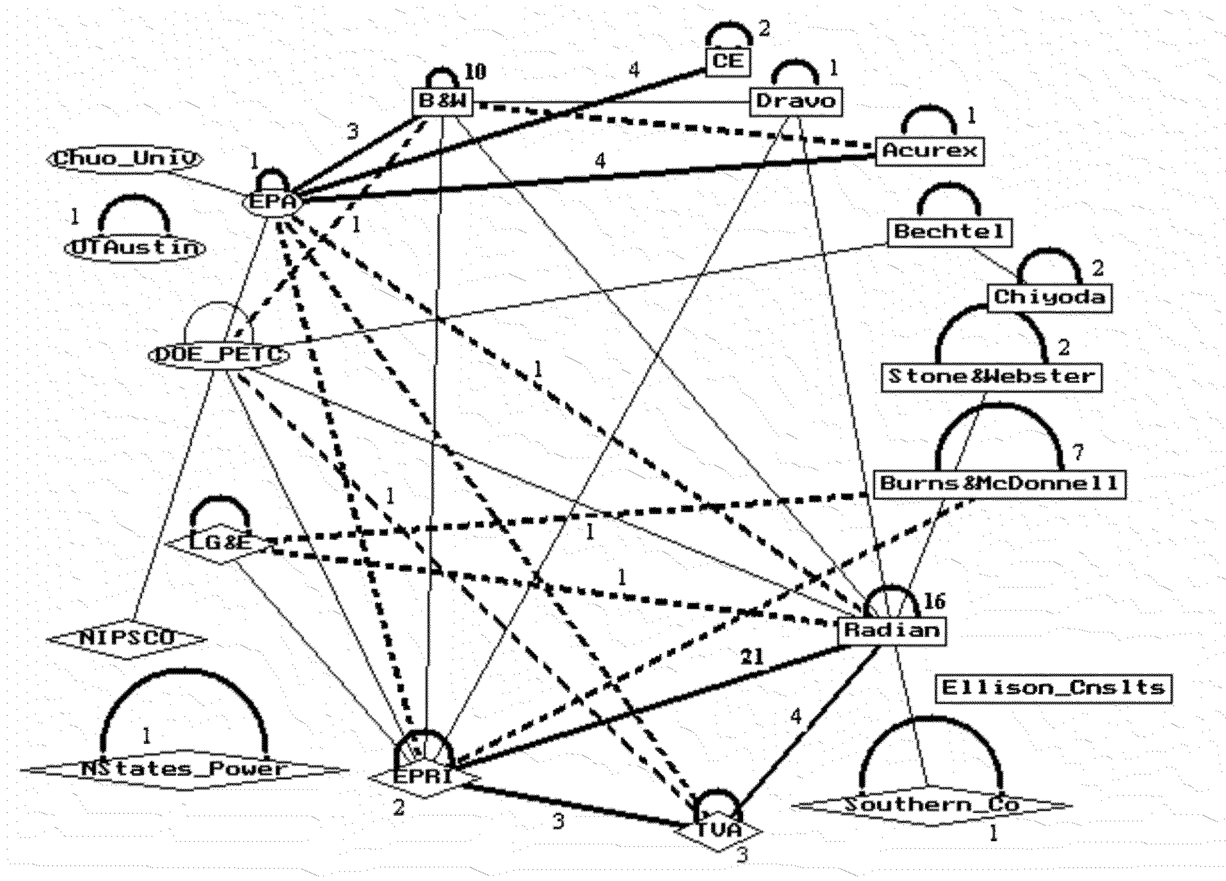
Coauthorship Ties between Important Affiliations in Group 2 Conferences (1979 to 1988)



Notes: Numbers are percentages of 481 total important affiliation coauthorship ties in this period. Numbers in bold are strong ties (greater than 10% of important affiliation ties).

FIGURE 4.6

Coauthorship Ties between Important Affiliations in Group 3 Conferences (1990 to 1995)



Notes: Numbers are percentages of 685 total important affiliation coauthorship ties in this period. Numbers in bold are strong ties (greater than 10% of important affiliation ties).

As was the case with Figure 4.4, Figure 4.5, and Figure 4.6, these figures show network relations becoming denser between the Group 1 and Group 2 conferences, and then stabilizing between the Group 2 and Group 3 conferences. The most prominent feature of these figures is the changing nature of strong ties, as summarized in Table 4.10. By far, the most dominant set of ties in any period is among researchers at the Tennessee Valley Authority in the 1973 to 1977 conference time period (51% of all important affiliation ties). Together with ties to other important government agencies, firms, and utilities, TVA accounts for two-thirds of all the important affiliation ties at the Group 1 conferences. TVA, again, partnered with EPA and Bechtel on the Shawnee test facility in the 1970s, and both of these partners are also strong players in the important affiliation coauthorship pattern of the Group 1 (1973 to 1977) conferences. EPA accounts for 17% and Bechtel accounts for 16% of all the ties between important affiliations in the Group 1 conferences (Bechtel's reflexive coauthorship ties alone account for 12% of important affiliation ties).

TABLE 4.10

Strong Coauthorship Ties between Important Affiliations

Group 1 Conferences (1973 to 1977)	**Group 2 Conferences (1979 to 1988)**	**Group 3 Conferences (1990 to 1995)**
TVA reflexive ties 38 (51%) of 75 important affiliation coauthorship ties (16% of 244 affiliation type ties of >1%)	TVA reflexive ties 63 (13%) of 481 important affiliation coauthorship ties (4% of 1,579 affiliation type ties of >1%)	Babcock & Wilcox reflexive ties 70 (10%) of 682 important affiliation coauthorship ties (4% of 1,880 affiliation type ties of >1%)
Bechtel reflexive ties 9 (12%) of 75 important affiliation coauthorship ties (4% of 244 affiliation type ties of >1%)	Radian to EPRI relational ties 74 (15%) of 481 important affiliation coauthorship ties (5% of 1,579 affiliation type ties of >1%)	Radian to EPRI relational ties 144 (21%) of 682 important affiliation coauthorship ties (8% of 1,880 affiliation type ties of >1%)
		Radian reflexive ties 111 (16%) of 682 important affiliation coauthorship_ties (6% of 1,880 affiliation type ties of >1%)

TVA's dominance begins to fade in the Group 2 conference time period, and disappears altogether in the Group 3 conference time period. Meanwhile, the Radian-EPRI tie increases in dominance, from non-existent in the Group 1 conferences, to the most dominant tie in the Group 2 and 3 conferences. Radian's reflexive ties also become a strong factor in the Group 3 conferences. These observations indicate that TVA was a very significant player in the SO_2 industrial-environmental innovation complex in the 1970s, while EPRI and Radian were very significant players in the 1980s and 1990s.

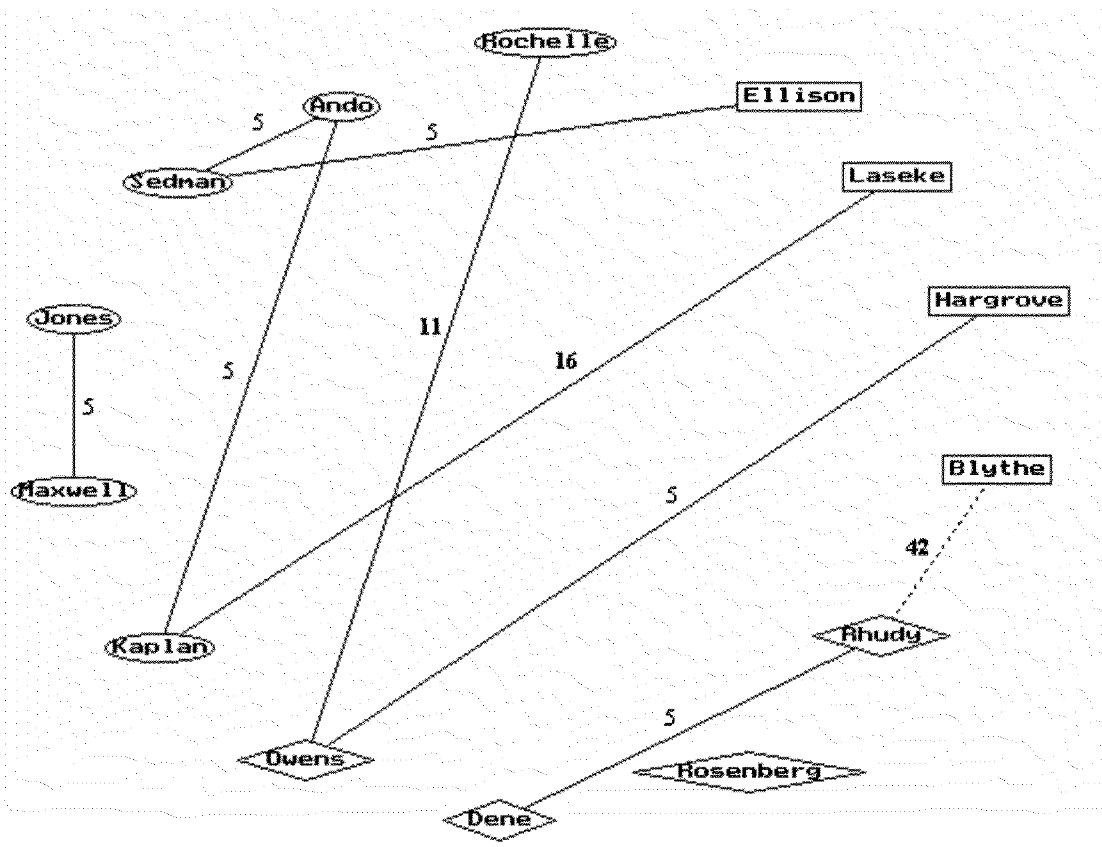
Another observation is that in both the Group 2 and 3 conferences, a few important affiliations were not connected to other important affiliations. In addition, several important organizations appear only in one or two time periods.

Important Author by Important Author Network Results

Figure 4.7 and Figure 4.8 show Krackplot 3.0 versions of the changing coauthorship pairings between the fourteen important authors listed in Table 4.8. Recall that these authors presented papers in over half of the SO_2 Symposium conferences and coauthored one-sixth of the conferences' 1,075 total papers with one-eighth of its 1,825 total authors. As these figures show, while these authors are highly connected within the general SO_2 research community, they had relatively little coauthorship interaction amongst themselves. The numbers accompanying various ties in these figures again are the percentages of all coauthorship ties that occurred between important authors during each time period. The Group 1 conferences had no coauthorship ties between these fourteen important authors; hence, there is no figure for the Group 1 conference time period of 1973 to 1977. The Group 2 conferences encompassed nineteen important author ties and the Group 3 conferences encompassed ten important author ties. Numbers in bold again indicate "strong" ties, which represent at least 10% of all the important author ties in the Group 2 conferences and at least 50% of these ties in the Group 3 conferences.[89] The boxes around the various author names indicate the affiliation types they were primarily associated with, in the following order (going clockwise): elliptical boxes indicate either universities or government agencies, rectangular boxes indicate firms including FGD vendors, boiler manufacturers, and consultants, and diamond boxes indicate utilities and contract nonprofit research and development organizations.

FIGURE 4.7

Coauthorship Ties Among Important Authors in Group 2 Conferences (1979 to 1988)

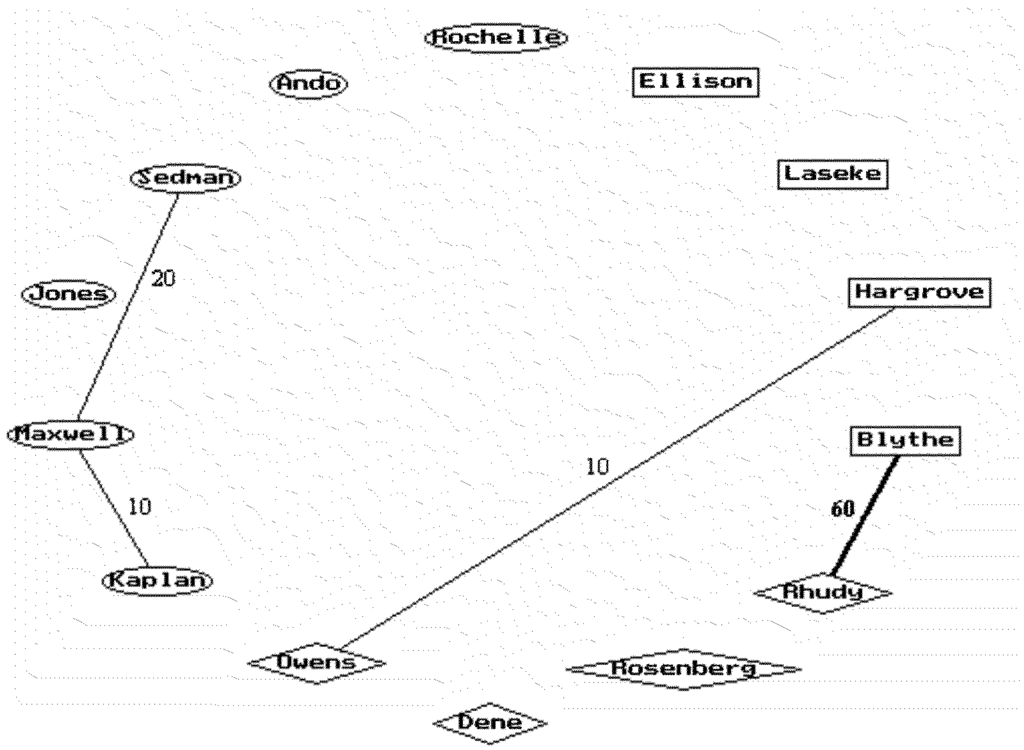


Notes: Numbers are percentages of nineteen total important author ties in this period. Numbers in bold are strong ties (greater than 10% of ties).

[89] This higher percentage cut-off for strong ties is a result of the concentration of strong important author ties in the Group 3 conferences.

FIGURE 4.8

Coauthorship Ties Among Important Authors in Group 3 Conferences (1990 to 1995)



Notes: Numbers are percentages of ten total important author ties in this period. The number in bold is a strong tie (greater than 50% of ties).

Whereas important affiliations coauthor papers together, important authors generally do not. Besides not coauthoring any papers together in the Group 1 (1973 to 1977) conference period, the important authors only coauthor together in the Group 3 (1990 to 1995) conference period in four distinct pairings. The most prominent of these pairings is that between Gary Blythe at the Radian Corporation and Richard Rhudy at EPRI. In the Group 2 (1979 to 1988) conference time period, important authors coauthor with one another a bit more often, with nine pairings of varying frequency strengths. The strongest tie in this period, as in the Group 3 (1990 to 1995) conference period, is the tie between Blythe and Rhudy. There are other strong ties in this period, however. Gary Rochelle at the University of Texas at Austin and David Owens at EPRI form one of these strong pairings, as do Bernard Laseke of PEDCo-Environmental Consultants, Inc. and Norman Kaplan at the EPA. The Laseke-Kaplan link is somewhat expected, since PEDCo-Environmental Consultants, Inc. ran a long-term database for the EPA on the commercial status of FGD technologies that frequently issued reports at the SO_2 Symposium.

Conclusions

In order to gain insights into the effects of government actions on the innovation process, this chapter has focused on research activity and communication patterns for the group of SO_2 control technology researchers that presented at the SO_2 Symposium between 1973 and 1995. Conference proceedings show that a large and diverse population of researchers presented papers in the SO_2 Symposium, with this population (and the number of papers they presented) increasing throughout the 1973 to 1995 time period. This population of authors was affiliated with such organization types as government, contract nonprofit research and development organizations, universities, utilities, and other types of firms.

As attested to by experts, the SO_2 Symposium was very important to the evolution of FGD technology. Although it was probably more influential before the 1990s, this conference facilitated a high level of information exchange in the SO_2 industrial-environmental innovation complex in such areas as operating experience, technical know-how, and new research. The information exchange facilitated particularly by the SO_2 Symposium's venues for informal meetings between researchers was observed to be fast and to have an international reach throughout the 1973 to 1995 time period.

The information contained in the SO_2 Symposium conference proceedings provides technical, organizational, and political insights into this information exchange and how it has and has not changed over the years. Technically, one constant throughout the 1973 to 1995 time period was the emphasis contemporaneous researchers placed on the disposal or utilization of FGD byproducts, a topic that has rated sessions in all but one of the SO_2 Symposium conferences analyzed. This fact adds another qualitative dimension to the understanding of technical change in SO_2 control as measured by patenting activity in Chapter Three, as does the prominence of session titles pertaining to furnace sorbent injection technologies, materials of construction, and chemical additives. The prominence of dry FGD technologies in the SO_2 Symposium, particularly in the 1979 to 1988 period when these technologies and combined SO_2/NO_x technologies were split into their own conference, is another important insight into inventive activity provided by these conference proceedings.

Organizationally, fourteen authors and twenty organizations emerged as consistently important to the diffusion of SO_2 control technology research due to their coauthorship of research papers presented in over 50% of the SO_2 Symposium conferences. The fourteen important authors further excelled both in the total number of papers they coauthored (one-sixth of the total 1,075) and in the total number of authors they wrote papers with (one-eighth of the 1,825 total). The number of authors that presented over time increased faster than the number of papers that were presented, which shows that the research community defined by the SO_2 Symposium grew over time.

Network analysis of conference paper coauthorship data provided further insight into the growth of this research community. In the Group 1 (1973 to 1977) conference time period, not every type of innovating organization reached beyond its boundaries in writing papers for the SO_2 Symposium.[90] This was not true in the Group 2 (1979 to 1988) or Group 3 (1990 to 1995) conference time periods, which is further evidence of SO_2 community growth over time. Information about important organizations also shows changes in the SO_2 community. Analysis showed that TVA was a very significant player in the SO_2 industrial-environmental innovation complex in the 1970s, while EPRI and Radian were very significant players in the 1980s and 1990s.[91] Analysis of coauthorship patterns among important authors revealed that important authors generally do not coauthor papers together, despite their centrality in the overall coauthorship network.

Politically, the SO_2 Symposium provides three lines of evidence that the information exchange that occurred through the conference was consistently influenced by the actions of government. The first line of evidence for this is the observation by expert L that the SO_2 Symposium was particularly popular right before and during the implementation of the 1977 and 1990 CAAs, as utilities needed to determine their technological options. The second line of evidence is the growth of coauthorship networks from the Group 1 (1973 to 1977) conferences to

[90] For example, universities and contract non-profit R&D organizations like Battelle and EPRI only had reflexive connections in this time period.
[91] Bechtel played a strong, but less significant role in the 1970s, as did Babcock & Wilcox in the 1990s.

the Group 2 (1979 to 1988) conferences for all affiliation types, important organizations, and important authors. This growth in the SO_2 research community after the 1977 CAA and 1979 NSPS befits a time period in which FGD technologies had been basically mandated for all new and significantly modified sources.

The third, and most important, line of evidence that the knowledge shared at the SO_2 Symposium was influenced by government actions is the existence of specific legislation- and regulation-based session titles in the proceedings of each conference that followed the passage of a national SO_2-related legislative or regulatory event.[92] The 1986 sessions on acid deposition retrofit applications and acid deposition issues are particularly informative on this account, as they were the only sessions in the history of the conference to treat acid rain in the session title. This fact, as well as the particularly large increase in conference research activity in the mid- to late-1980s, corresponds well with the attempts made in Congress in 1982, 1984, 1986, and 1987 to strengthen U.S. air legislation with respect to acid rain. All of these facts help to build the case, first posed in Chapter Three as an explanation of a 1988 peak in patent filing activity, that the SO_2 industrial-environmental innovation complex greatly anticipated pending acid rain-related regulation in the mid-1980s.

The SO_2 Symposium session titles and coauthorship patterns have been used in this chapter to increase the understanding of the technological and organizational changes accompanying the historical innovation processes underlying SO_2 control technologies. The next chapter will attempt to address the importance of government actions in innovation in SO_2 control by focusing on knowledge gained from operating experience and its contribution to innovative outcomes.

[92] These sessions were in addition to any discussions of government activity held in the opening plenary sessions.

Chapter 5 Learning Curve Analysis

Studies have shown that a considerable amount of innovative activity can be traced to the experience of operating personnel [for a discussion, see Cohen and Levin (1989)]. The information about technical operations developed by these personnel is likely to be especially important for both potential and actual utility adopters of FGD systems.[93] For potential utility users, operating experience information could contribute to the adoption decision and thus facilitate technology diffusion. For current utility users, this information could help them modify the operations of systems they already own in order to improve performance and/or reduce operating costs. It is this latter innovative activity – a type of post-adoption innovative activity referred to here as "learning by doing" – that is the focus of this chapter.

As mentioned in Chapter One, this type of innovative activity is discussed under a variety of names in the literature, including "learning by doing," "learning by using," or "reinvention." Learning by using or doing is the result of the observation of "difficulties or opportunities that emerge during the operation" of new equipment (Rosenberg, 1994). "Reinvention" is "the degree to which an innovation is changed or modified by the user in the process of its adoption and implementation (Rogers, 1995)." The basic principle behind learning by doing, however, is that production experience creates knowledge that improves productivity (Arrow, 1962). An important part of this knowledge acquired through organizational experience is tacit know-how (see Nonaka, 1991; Polanyi, 1966; Berry and Broadbent, 1984).

The SO_2 industrial-environmental innovation complex is a good candidate for studying learning by doing. According to Argote (1999, p. 199), learning by doing is especially effective

[93] The importance of this type of information to the development of FGD technology was indicated in Chapter Four in the expert discussions about the types of information exchanged in the SO_2 Symposium.

in industries in which "knowledge is uncertain, not well-understood, and highly dependent on the organizational context." The FGD equipment and services industry appears to be such an industry. The FGD operating problems of the 1970s and the fact that the knowledge required to simulate the effects and interactions of specific FGD process variables did not accumulate until the mid-1980s indicate that the knowledge base for FGD was historically uncertain and poorly understood. As discussed in the interview testimony to follow in this chapter, FGD operators were known for helping to improve the technology through trial and error, a behavior that fits the "improvisational approaches" proven to be effective in firms with an uncertain knowledge base. FGD-related knowledge is also highly "context-dependent," or likely to vary as a function of features which vary significantly from firm to firm, such as the structures and technologies in place at a given utility. The context-dependent nature of SO_2 control technology is also elaborated upon in interview testimony in this chapter. For example, one expert explained that FGD performance sometimes varies even at the plant level within a given utility company.

Given that post-adoption innovation appears likely to occur in the FGD equipment and services industry, it is important to find a measure that will capture it. Technological change attributed to operating experience is often measured through "learning curves," in which unit costs (or other features) of production decrease at a decreasing rate with increasing cumulative output.[94] As reviewed in Argote (1999, p. 1), learning curves have been found in a variety of industries, including those in which discrete products like ships, aircraft, trucks, and semiconductors are produced, as well as in industries in which continuous products like refined

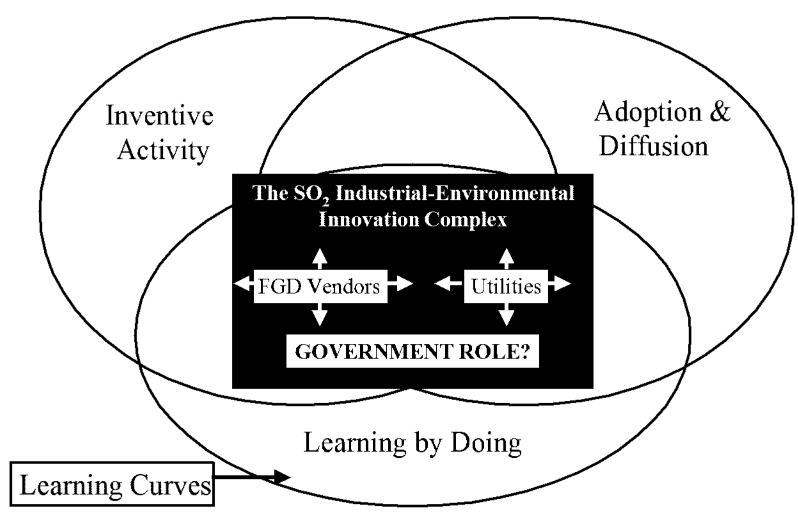
[94] This phenomenon is also sometimes given the names "progress curves" and "experience curves."

petroleum and chemicals are produced. In the electric power industry, learning curves have been found to characterize the construction cost of power plants (Joskow & Rose, 1985; Zimmerman, 1992) and plant operating reliability (Joskow & Rozanski, 1979).

This chapter focuses on searching for the existence of learning curves in the SO_2 industrial-environmental innovation complex in order to gain insight into the innovative activity of learning by doing in this complex (see Figure 5.1). If learning curves can be demonstrated in FGD technology and learning by doing is thus shown to have an important role in innovation in SO_2 control, it may ultimately be possible to link learning by doing to government actions ranging from regulation to knowledge transfer mechanisms such as the SO_2 Symposium.

FIGURE 5.1

Learning Curves as a Measure of Post-Adoption Innovation



The classical form of an organizational learning curve (Argote, 1999, pg. 13) is given in Equation 5.1. The estimation of this equation allows the empirical assessment of whether organizational behavior has changed as a function of experience. The estimation of the learning rate, b, in this equation can be used to calculate the progress ratio ($P = 2^{-b}$), or the rate at which unit costs decline each time cumulative output doubles (Argote, 1999, pg. 18). A progress ratio of 80%, for example, means that unit costs are reduced to 80% of their value each time cumulative production doubles. In a study by Dutton and Thomas (1984), progress ratios were shown to vary from 55% to 107% for over one hundred field studies in a variety of production programs in industries including electronics, machine tools, papermaking, aircraft, steel, and automotive.[95] The most frequently observed progress ratio in these industries, however, was 80% (Argote, 1999, p. 19).

EQUATION 5.1

The Classical Form of an Organizational Learning Curve

$$y_i = ax_i^{-b}$$

where:

y = the number of labor hours required to produce the ith unit
a = the number of labor hours required to produce the first unit
x = the cumulative number of units produced through time period i
b = the learning rate
i = a time subscript

It is important to note that learning curves typically use the predictor variable of cumulative output to reflect operating experience at a particular organization (or unit of an organization). As discussed in Argote (1999, pg. 15), as organizations acquire operating experience, "members might learn who is good at what, how to structure their work better, or how to improve the layout of the production area." These and other types of learning by doing activities are generally not included in direct organizational investments in technology. Predictor variables other than cumulative output have the potential to confuse the effects of learning by doing activities with the effects of other innovative processes that may be the result of more direct organizational investments. For example, the predictor variable of calendar time reflects

[95] Progress ratios over 100% indicate situations in which unit costs increase rather than decrease with cumulative output.

general technological advances in the external environment that may result in unit cost improvements at an organization that are indistinguishable from the effects of learning by doing (Solow, 1957).[96]

In this dissertation, learning curve analysis focuses strictly on the effects of learning by doing activities (resulting from operating experience) on FGD performance improvements by limiting the predictor and performance variables of Equation 5.1 to installed technologies. This is a departure from the way "learning curves" are often analyzed in the environmental technology literature. For example, Harmon (2000, pg. 8) attributes the cost decline in the learning curve equation to "a combination of production improvements (process innovations, learning effects, and scaling efforts), product development (product innovation, product redesign, and product standardization), and decreases in process input costs (parts and materials)." Harmon thus lumps together many innovative processes for consideration in his learning curve analysis, rather than limiting his analysis to the effects of the post-adoption innovative activity of learning by doing. As a result, his analysis of performance improvements does not distinguish between learning by doing effects over time on a single generation of technology versus overall innovation effects that manifest themselves in multiple generations of technology. In the framework of this dissertation, however, this distinction is made. Learning by doing effects on a single generation of technology are considered in this chapter, while the effects of the full set of innovative processes relevant to SO_2 control technologies on multiple generations of technology are considered at the end of Chapter Two in what is referred to as a "generational analysis."

The remainder of this chapter is divided into three sections. The first section relates expert opinion about the "big picture" behind the evolution of FGD technology, particularly as it

[96] As "general technological improvements," Argote (1999) gives the examples of improvements in materials properties and increases in computing power as time passes.

pertains to the role of operating experience in advancing the technology. The second section uses a learning curve methodology to analyze the operating experiences in the 1985 to 1997 period of U.S. FGD systems brought into service between 1971 and 1985. The third and final section discusses conclusions and possible future work in understanding the role of learning by doing in the SO_2 industrial-environmental innovation complex.

Perception of the Importance of Operating Experience

Operating experience was considered an essential part of the experts' descriptions of the story behind improvements in SO_2 control technology over the last thirty years.[97] As part of the interview protocol, therefore, experts were prompted for information regarding the importance of operating experience only if they did not address it fully in the course of relating this story. Of the twelve experts interviewed, nine had to be prompted.

In the experts' discussions of operating experience – ranging from the problems of the 1970s (touched upon by experts A, B, E, F, G, H, I, J, K, and L) to the building of a positive track record that is helping to change perceptions about FGD today – one major theme emerges. The experts describe complementary and interacting roles for both the operators and designers of FGD systems in advancing the technology over the last thirty years. Experts B and H characterized this relationship between operators and designers as *essential* to the advancement of FGD technology.

The experts paid special attention to the actions of FGD operators when faced with the operating problems of the 1970s. Utilities were credited with two major technological developments during this time period. First, expert E related that the Canadian utility Ontario

[97] The characteristics of the twelve experts interviewed appear in Table 1.1, where they are listed in conjunction with their identification labels in the dissertation.

Hydro developed the very important spray tower absorber that was later sold by General Electric Environmental Services (GEESI, now Marsulex) after the inventor went to work for GEESI.[98] Second, expert I explained that an engineer at Louisville Gas & Electric, either "by accident or by extremely clever intuition," was the first in the U.S. to get a scrubber working without scaling by using the inhibited oxidation effect. This scrubber, which expert I explained was built as a result of a county-level regulation, used carbide lime, a byproduct of a method of acetylene manufacture, as a reagent. Battelle, EPA, and Radian all later investigated carbide lime to understand its properties. This led to better understanding of inhibited oxidation and the usefulness of thiosulfate as a reagent.

Most of the other activities of utility personnel faced with the operating problems of the 1970s did not have as clearly identified benefits as the activities in these two examples, according to the experts. Expert D observed that FGD operators at plants within a utility sometimes learned to operate FGD systems more effectively than those at other plants owned by that utility. This knowledge was not always transferred across the utility either because of "islands" or "one plant wanting to be more efficient than the other."[99] Expert H identified operating personnel as helping to improve FGD technology through trial and error and testing in such areas as mist eliminator improvements and the development of corrosion-resistant materials and equipment. The testing of systems was a particularly important technology research area in which operators and designers interacted. As related by expert K, real time data on emissions and FGD chemistry were not available in the 1960s and 1970s, which hindered the development of more reliable and efficient scrubbers. Expert K explained that standard chemical technologies

[98] He was clearly appreciated by his new employer since he eventually became executive vice president.
[99] Note that competition among organizational subunits is a primary factor in impeding knowledge transfer within an organization [see Argote (1999, p. 177) for a brief review and discussion].

developed in the laboratory were unable to work for long in harsh scrubber environments, so cooperation between operators and outside FGD researchers was essential to developing better understanding of FGD chemistry.

A barrier to this cooperation was operator distrust of outside researchers. Expert H related that operators did not always believe that researchers "knew what we were talking about." This is not surprising considering the great efforts to which utility operators had to go to compensate for the operating problems of the early scrubbers. Experts G, H, and K all described some of the physical activities involved in this compensation and how these activities translated into higher maintenance costs for the utilities. Expert G explained that annual maintenance costs were "tremendous" and unpredictable in the early days, as "things dissolved away and pieces of ductwork fell off and we found big holes in them." Manpower needs were also particularly high when utilities treated scrubbers "as a piece of auxiliary equipment" that the boiler operators were told to make run. Expert G described scrubbers running for a few days at a time until they plugged up and then had to be shoveled out and worked on by maintenance personnel for one to two weeks in order to make them run again. Experts H and K similarly described high maintenance costs in the 1970s due to the large number of operating personnel needed to take scrubbers down, clean them, and replace parts. In one case, expert K told of a utility using about forty people in a shift, each with different jobs such as replacing nozzles or fan blades, in order to take a module off-line and service it for twenty-four hours before its next use. Expert K also related that utilities used jackhammers or small dynamite charges to clear out clogged scrubbers.[100]

[100] This was not a radical process for boiler operators, since they used similar charges to remove slag from the heat transfer surfaces inside boilers.

The magnitude of the operating problems experienced in the 1970s provided a strong incentive for utilities to resolve these operating problems. This incentive was reflected in the research priorities of many organizations involved in the SO_2 industrial-environmental innovation complex, and especially in those of EPRI (which was responsible for conducting research for its utility members). Experts A, F, J, and L all explained that the research priorities thus established in SO_2 control technology resulted in the development of a better understanding of the process chemistry of the scrubber system. Expert A specifically mentioned that an improved understanding of phase equilibria, dissolution kinetics, and precipitation resulted from these research priorities. Additional improvements occurred in materials, according to expert J, and in instrumentation, according to expert L.

New technologies evolved from these improvements. Experts E and J described a simplification in design that made the next generation of scrubbers (following early systems such as those using marble bed absorbers) much easier for utilities to operate. Expert A also stated that spray drying became popular in part because it demanded less of operators: "the liquid-based chemistry was less important and you could control it basically just by turning the knob, by adding more lime, [and] running high recycle rates." In the 1980s, utilities particularly considered ease of use important and were willing to pay higher capital costs for reliable wet systems. Expert A described "gold plated" scrubbers installed in this period that employed both higher quality alloys to reduce operating problems and more redundant designs than earlier scrubbers. As scrubbers evolved in the 1990s and reliability increased, however, capital costs declined since firms were able to dispose with redundancy.[101] Operating and maintenance costs for later scrubbers were also considerably lower than in earlier models.

[101] According to expert K, some of these cost savings were negated a bit by the addition of sophisticated equipment.

Experts D, G, and K explained that as FGD technology evolved, the training and selection of operating personnel changed. Expert G participated in this trend. In the early 1980s, he created a more dedicated staff that would treat the scrubber as a chemical plant and achieve higher reliability and slightly higher removal efficiencies. He took people who had been rotating through power plant operations and created a separate job category for them as chemical operators. This entailed specialized training on how to run a scrubber and how the chemistry behind it worked. Expert K similarly described a transition to a more dedicated staff in the utilities he visited. In 1978, the utility teams he met typically involved a mechanical engineer who supervised boiler-operating personnel to also run scrubbers. In the late 1990s, utility FGD teams involve chemists, chemical engineers, and trained instrument technicians, among others, which is a team composition that Expert K first saw in Germany in the 1980s.

Experts H and K also mentioned that the size of operating personnel teams has decreased over the years. This yielded operating cost savings; but in expert H's view, the number of engineers assigned to support FGD systems is "notoriously" low when compared to the engineering support provided for chemical plants of similar value in the chemical industry. Expert H stated that he believed that employing more engineers would likely result in money-making opportunities for the utilities, which have based their engineering staffing decisions not on these opportunities but on the smaller number of "fires" (i.e., problems) that FGD operators had to put out in the 1990s.

The additional enhancements that operating personnel can potentially make in the functioning of scrubbers are now being threatened due to increased personnel turnover as a result of utility deregulation and restructuring, according to experts D and G. Expert D explained that turnover is high both in operating personnel within utilities as well as in personnel within vendor firms. Particularly in Southeast Asia, where new scrubbers are being installed and no track record exists, mistakes from the past are being repeated, according to expert D. Both experts D and G, however, argued that this phenomenon is occurring in the U.S. as well.

Both experts emphasized that a mechanism of technology transfer for new operators is very important, and both mentioned conferences as one such mechanism. Both experts saw the apparent success of conferences as a technology transfer mechanism as under threat, however, due to restructuring in the electric utility industry. Expert D explained that plant cutbacks have changed the audience at the SO_2 (now Mega) Symposium, so that considerably fewer power plant superintendents, FGD superintendents, and FGD operators attended in the 1990s than in the early 1980s. Similarly, utility deregulation has made it more difficult to organize the "FGD User's Conference" expert G described in Chapter Four.

In summary, experts perceive that operating experience was important to the evolution of FGD technology. They relate that both major and incremental technological developments arose from operating experience, and particularly from the difficulties FGD operators faced in the 1970s. Such developments are reflected in the performance improvements and cost reductions for new systems seen earlier in Chapter Two (Figure 2.14 and Figure 2.15). These are the "generational" improvements noted previously. It is not clear, however, if measurable FGD performance improvements can be observed as a result of learning by doing activities. The next section deals with this issue in the effort to identify learning curve effects in utility FGD systems.

Learning Curve Analysis

The purpose of learning curve analysis for SO_2 control technology is to investigate whether FGD operating experience resulted in a measurable improvement in technological performance. Such a demonstration of the importance of learning by doing to innovation in FGD technology is the first step in investigating the influence of government action on learning by doing activities in SO_2 control. Unfortunately, this first step is highly dependent on the data available for learning curve analysis and the potential predictor and performance variables these data provide.

The data source used in this analysis was the EIA-767 form collected by the Energy Information Administration (EIA) of the Department of Energy since 1974 from all utility boilers above 50 MWe in size (Energy Information Administration, 1999). These data are currently available in computerized format from the EIA only for the operating years 1985 through 1997. This limits the scope of analysis for three reasons. First, the number of annual data points available to generate time series is small, which restricts the statistical power of learning curve regressions. Second, these annual data points fall relatively late in the development of FGD technology, which limits the opportunities to observe FGD performance improvements. Third, the time frame of analysis constricts the applicability of the potential findings of this analysis if these findings are to be directly compared to the major government regulatory actions in SO_2 control. Only one of these actions, the 1990 CAA, occurred during this time period.

Despite these problems, the EIA-767 dataset was analyzed for learning curves because it provided a wide range of consistent data. Table 5.1 lists some of the data in the EIA-767 dataset that were considered potentially relevant to the choice of predictor and performance variables that might result in demonstrable effects of learning by doing on FGD technological improvements. The cumulative output of an FGD system can be considered as the desulfurized gas that results from the combustion of fuel in the output of electrical generation. From the EIA-767 data, three potential information sources emerged that were hypothesized to be useful in expressing this output. For each power plant boiler unit, these were: (1) the amount of coal burned, (2) the amount of sulfur in the coals burned, and (3) the amount of electricity generated. Similarly, four potential information sources were hypothesized to be useful for the FGD performance variables that might demonstrate learning curve effects. For each FGD unit, these were: (1) the amount of sorbent used, (2) the electrical energy consumed, (3) the operating and maintenance costs experienced in the area of "labor and supervision," and (4) the operating and maintenance costs experienced in the area of "maintenance and all other costs."

TABLE 5.1

Some of the Relevant Data in the EIA-767 Dataset

Type of Data	Specific Information
Identifiers	Plant, boiler, and FGD units
Non-FGD Operating Data	Total annual coal burned
	Total sulfur content of coal
	Maximum generator nameplate rating
	Annual electrical generation
FGD Operating Data	Manufacturer and type of FGD
	Type of sorbent
	Operating status
	Initial inservice date
	Annual total hours inservice
	Estimated removal efficiency under full load
	Estimated removal efficiency under annual operating factor
	Amount of sorbent used
	Electrical energy consumed
	Operating & maintenance expenditures broken down by category
	Installed cost broken down by category
	Estimated FGD waste and salable byproduct produced
	Annual pond and landfill requirement
	Design fuel specifications for ash and sulfur
	FGD specifications at 100% load broken down by category

Source: Energy Information Administration, 1999

The first step in analysis was to translate these variables from the raw EIA-767 dataset into usable form.[102] The next step was to estimate learning curve effects using these variables on data for power plants with FGD system inservice dates before January 1, 1986. This set of eighty-eight plants had thirteen years of operating data in the years 1985 through 1997, which was the longest continuous operating period available in the EIA-767 dataset. Learning curve estimation of this full set of plant data using predictor and performance variable combinations based on the seven variables chosen might prove inefficient, however, if the variables chosen did not give signals of sufficient size. For this reason, a pilot set of eighteen utility plants with the popular spray tower, limestone sorbent type of FGD (the largest group of plants likely to exhibit similar effects based on operating parameters specific to the type of FGD unit) was analyzed first.

Equation 5.2 gives the learning curve equations estimated for some of the different variable combinations considered in analysis of these eighteen plants. Missing data affected the total number of plants considered in a number of variable combinations, as noted. Equation 5.2 also gives the condition for acceptance of the existence of a learning curve; if the coefficient of the X-variable (the value of the learning rate) is negative and statistically significant, learning is said to occur (see Argote, 1999). Note that the basic equation in Equation 5.2 is a logarithmic form of Equation 5.1 that facilitates ordinary least-squares regression. The X-variable in this equation is a proxy for knowledge acquired through production. It is computed by summing the total units of output produced from the start of production up to, but not including, the current year. In order to generate the appropriate X-variable data points, annual power plant data were

[102] Note that the original computer programs designed to tabulate the EIA-767 data were written for computers circa 1974, so the EIA-767 data had to be translated into a database-accessible format using the process described in Appendix D.

summed over the appropriate part of the 1985 to 1997 period, and the logarithm was computed. Each data point was lagged so that the value for year *i* was the value of year (*i*-1). The Y-variable data points were computed first by dividing the *i*th year's FGD performance variable by the cumulative output for the *i*th year, then by taking the logarithm.

EQUATION 5.2

Learning Curve Equation Estimated in this Analysis

$$\log y_i = c - b \log x_i$$

$$H_0 : b \geq 0$$

where:

y = the performance variable as the ith unit is produced
x = the cumulative number of units produced through time period i
b = the learning rate

(a) y = sorbent used in the FGD unit
x = coal burned by the boiler unit
For these variables, eighteen pilot plants of continuous data were analyzed.

(b) y = power consumed by the FGD unit
x = coal burned by the boiler unit
For these variables, thirteen pilot plants of continuous data were analyzed.

(c) y = sorbent used in the FGD unit
x = sulfur processed in the boiler unit
where sulfur processed = (the amount of coal burned) * (the amount of sulfur in the coal)
For these variables, seventeen pilot plants of continuous data were analyzed.

(d) y = power consumed by the FGD unit
x = sulfur processed in the boiler unit
where sulfur processed = (the amount of coal burned) * (the amount of sulfur in the coal)
For these variables, thirteen pilot plants of continuous data were analyzed

(e) y = sorbent used in the FGD unit
x = power generated by the boiler
For these variables, eighteen pilot plants of continuous data were analyzed.

(f) y = power consumed by the FGD unit
x = power generated by the boiler
For these variables, thirteen pilot plants of continuous data were analyzed.

(g) y = adjusted "labor and supervision" costs
These were adjusted to constant 1997 dollars using the procedure given in Appendix E
x = power generated by the boiler
For these variables, eighteen pilot plants of continuous data were analyzed.

(h) y = adjusted "maintenance and all other costs"
These were adjusted to constant 1997 dollars using the procedure given in Appendix E
x = power generated by the boiler
For these variables, eighteen pilot plants of continuous data were analyzed.

(i) y = summation of adjusted "labor and supervision" and "maintenance and all other costs"
This summation, in constant 1997 dollars, is referred to as "LA+ MA"
x = power generated by the boiler
For these variables, eighteen pilot plants of continuous data were analyzed.

Table 5.2 displays the results of these pilot analyses. For each combination of predictor and performance variables in Equation 5.2, the percentage of pilot plants for which the estimation coefficient (learning rate b) is negative at the 90% confidence level is listed.[103] These plants exhibit learning curves. For most of the variable combinations in Equation 5.2, however, some plants definitely do exhibit learning curves while some plants definitely do not exhibit learning curves. Those plants that do not exhibit learning curves are seen in Table 5.2 in the percentage of pilot plants for which the estimation coefficient (learning rate b) is greater than or equal to zero at the 90% confidence level. The variable combinations that resulted in high percentages of learning curve plants with low percentages of non-learning curve plants, all of which deal with the FGD performance variable of operating and maintenance costs, are listed in boldface. The variable combination that resulted in the greatest percentage of learning curve plants and a very small percentage of non-learning curve plants, combination (i), was chosen for further analysis.[104]

TABLE 5.2

Results of Learning Curve Estimation using Combinations of Predictor and Performance Variables for Subset of Eighteen Plants

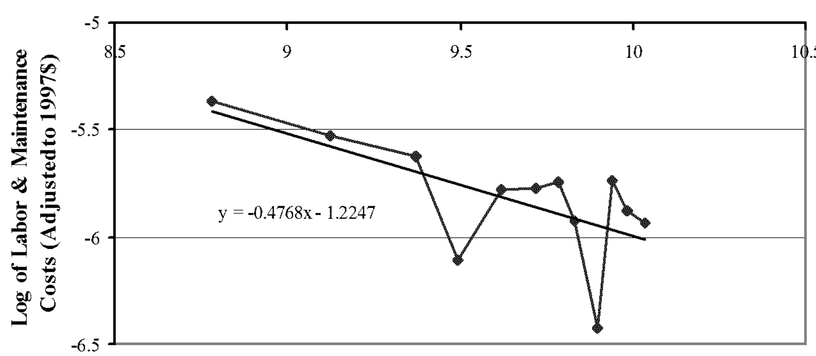
Learning Curve Variable Combination	Number of Plants of Total Relevant Pilot Plants for which b < 0 at 90% Confidence Level (Null Hypothesis Rejected)	Number of Plants of Total Relevant Pilot Plants for which b ≥ 0 at 90% Confidence Level (Null Hypothesis Accepted)
(a)	3/18 (17%)	3/18 (17%)
(b)	5/13 (38%)	3/13 (23%)
(c)	3/17 (18%)	3/17 (18%)
(d)	3/13 (23%)	4/13 (31%)
(e)	3/18 (17%)	3/18 (17%)
(f)	5/13 (38%)	3/13 (23%)
(g)	**8/18 (44%)**	**0/18 (0%)**
(h)	**5/17 (29%)**	**0/18 (0%)**
(i)	**10/18 (56%)**	**1/18 (6%)**

[103] The 90% confidence level was chosen because it indicates statistical significance, albeit at a somewhat forgiving level that befits a pilot analysis of plant data with a fairly small number of yearly observations. For explanation of the computation of the confidence level, see Appendix H.
[104] Recall that this combination uses the LA+MA summation of adjusted "labor and supervision" and "maintenance and all other costs" as the performance variable and power generation as the predictor variable.

The set of eighty-eight plants with thirteen years of operating data in the years 1985 through 1997 were estimated in two ways using the learning curve analysis variable combination (i). In the first method, estimation was performed on each plant separately.[105] Forty-five plants (51%) of the eighty-eight plants of various types analyzed exhibited statistically significant learning curve effects based on the predictor variable of cumulative electricity generation and the FGD performance variable of LA+MA for a given year. For these forty-five plants, the mean slope of the regression line (or learning rate) was -0.47, the median was -0.37, the maximum was -0.13, and the minimum was -1.48. Figure 5.2 displays the learning curve of the plant with the slope closest to the mean of the forty-five plants with significant learning curve effects. For this plant, the annual FGD-related labor and maintenance costs decreased by 52% from 1985 to 1997 as cumulative generation steadily increased.[106]

FIGURE 5.2

Sample Plant Time Series with Slope Closest to the Mean of the 45 Plants Exhibiting a Learning Curve Effect



In the second estimation method, the set of eighty-eight plants with thirteen years of operating data were pooled together. By running a fixed-effects model on these pooled

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[105] Note that these estimations ignored missing data at the beginning or end of a given plant's time series.
[106] This increase was relatively steep, since cumulative generation at the end of these thirteen years was twenty times that at the beginning of the period.

observations, the learning rate b was observed to be -0.265, which was statistically significant at the 99% confidence level.[107] The progress ratio P that results from this learning rate was therefore $2^{-0.265}$, or 0.83. This means that as cumulative output (power generation) doubles, the LA+MA operating and maintenance costs decline to 83% of their original level. This is in line with the Dutton and Thomas (1984) progress ratios for production programs in industries including electronics, machine tools, papermaking, aircraft, steel, and automotive, that were discussed earlier. The most frequently observed progress ratio in these industries, which arguably have less government influence on their innovative activities than the SO_2 industrial-environmental innovation complex, was 80% (Argote, 1999, p. 19).

Conclusion and Future Work

In this chapter, the presence of a learning curve effect was quantitatively demonstrated for the first time for FGD operations in the U.S. for the period 1985 to 1997. The progress ratio of 83% was determined for the FGD performance variable of combined labor and maintenance costs (adjusted to 1997 dollars) and the predictor variable of power generation. This progress ratio is very much in line with progress ratios determined in other industries.

The existence of the learning curve effect in the SO_2 industrial-environmental innovation complex was not totally unexpected. Experts interviewed in this dissertation noted the importance of operating experience in SO_2 control technology and the value of shared operating experience and know-how conveyed at forums like the heavily government-sponsored SO_2 Symposium. In addition, previous studies of learning by doing suggest that this effect is likely in industries in which the knowledge base is uncertain, poorly understood, or highly context-dependent, like the FGD equipment and services industry for much of its history.

[107] For more on the use and calculation of this model, see Appendix H.

Nonetheless, the finding of significant post-adoption learning activity in the SO_2 industrial-environmental innovation complex in the 1985-97 period is important for two reasons. First, policy-makers interested in promoting environmental technological innovation may find this information useful for predictions or assessments of technological change in other environmental areas. Second, identifying plants with learning curve effects is a useful first step in understanding whether and how government environmental actions affect successful learning by doing activities by utility plants.

In future research, the plants for which significant learning curves were identified in this analysis could be investigated using other analytic techniques such as surveys and interviews in order to gain insight into the influence of government actions on learning by doing activities in SO_2 control technology. One potentially interesting use of these analytic techniques would be to show whether facilities with greater learning effects participated heavily in the SO_2 Symposium or in government-sponsored R&D projects. If such correlations exist, they support the effectiveness of non-regulatory government actions in promoting the innovative activity of learning by doing in an environmental control technology. The converse correlations would also be interesting, as would a correlation between plants with strong learning effects and facilities that felt they gained the most knowledge from the FGD User's Conference, which did not include the input of government regulators. Another potentially interesting correlation would be between plants with strong learning effects and plants with low employee turnover, which may have weathered the storms of utility deregulation more successfully than other plants. The exact follow-up measurement techniques chosen for this follow-up work would be based on the identification and understanding of any common factors exhibited by these plants. Power plants that did not exhibit learning curves could also be useful in the process of identifying the factors necessary for successful learning by doing in this domain.

Finally, there is some possibility that a learning curve analysis similar to the one performed here but for a longer time series could provide the framework for a direct estimation of the effect on learning by doing activities of the major government regulatory actions in SO_2 control. For example, it might be possible to construct learning curves (either through the discovery and use of missing EIA-767 data from 1974 to 1984 or through estimates of FGD performance across this period) for the early years of FGD installation, when both SO_2 regulation and the SO_2 industrial-environmental innovation complex were young. If a progress rate based on this earlier period proved to be different from the progress rate calculated here, it would suggest that a predictive use of learning curves in models of environmental innovation would have to consider the maturity of the market for that technology. In addition, combining the data from 1974 through 1997 would make it easier to see if short-term "shocks" correlated with government regulatory actions occur in learning curves. These shocks might occur as a side effect of the temporary but intense interest in FGD operations that regulatory changes might spur in utility management. Such an analysis would not have been useful in this chapter because only one of the main government regulatory actions considered in this dissertation, the 1990 CAA, occurred during the time period analyzed here.

Chapter 6 Conclusions

When the New Source Performance Standards for the 1970 Clean Air Act were issued in December 1971, only three commercial scrubber units were operating in the United States. In hearings held in 1973, systems brought into service in 1972 and 1973 reported operating difficulties related to chemical scaling, demister pluggage, corrosion, reheater problems, and mechanical failures in equipment such as fans, pumps, and dryers. These early scrubbers had problematic reliability and low SO_2 removal efficiencies. A 1976 study by PEDCo-Environmental Consultants, Inc., reported that SO_2 removal efficiencies ranged from 40 to 90% during the 1970 to 1976 period. Figure 6.1 and Figure 6.2, however, demonstrate how quickly SO_2 control technologies diffused and improved as a result of innovative activities that occurred inside the black box of the SO_2 industrial-environmental innovation complex, as supported and spurred on by government actions.

FIGURE 6.1

Improvements in SO_2 Removal Efficiency of Commercial FGD systems as a Function of Cumulative Installed FGD Capacity in the U.S.

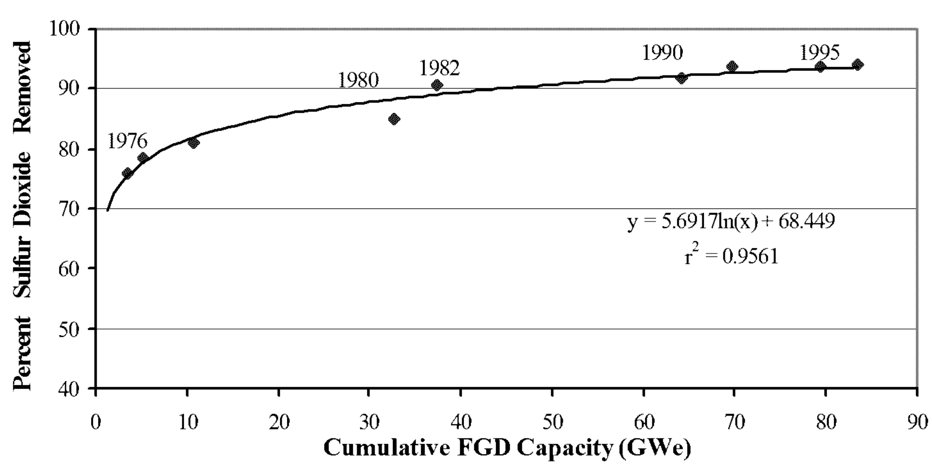
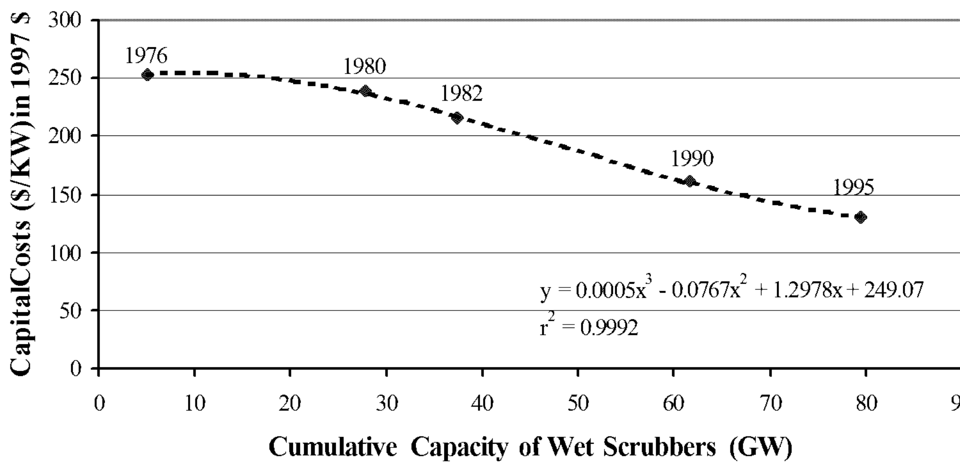


FIGURE 6.2

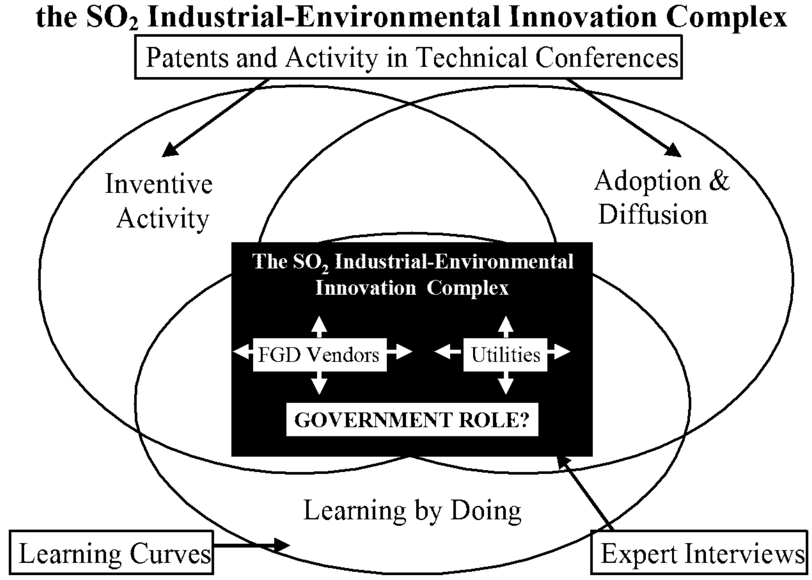
Reductions in Capital Cost of a New Wet Limestone FGD System for a Standardized Coal-fired Power Plant (500 MWe, 3.5% sulfur coal, 90% SO_2 removal)



This dissertation has explored the relationship between government actions and innovative activities in the industrial-environmental innovation complex built around the control of SO_2 emissions from electric power plants. It has applied complementary evaluation methods to the overlapping innovative activities of invention, adoption and diffusion, and learning by doing in this system. This research approach is depicted in Figure 6.3.

FIGURE 6.3

Dissertation Methods Used to Understand Innovative Activities in the SO_2 Industrial-Environmental Innovation Complex



In previous chapters, insights into the influence of government actions on innovative activities were related according to the three primary quantitative evaluation methods used in this dissertation: patenting activity, activity in technical conferences, and learning curves. In this chapter, however, these insights are integrated according to innovative activity in order to gain the greatest understanding of the influence of government actions on the innovative process. The final section of this dissertation discusses policy implications and future research.

Invention, Adoption, and Diffusion

The various data sources analyzed in this dissertation demonstrate the existence of inventive activity and characterize the adoption and diffusion of SO_2 control technologies. Figure 6.1, Figure 6.2, and much of Chapter Two demonstrate that SO_2 control technologies were adopted and diffused among electric utility plants. Chapter Three demonstrated that inventive activity occurred in SO_2 control technologies (at least as captured by patents), since thousands of patents exist in these technologies. These patents are also relevant for understanding the adoption and diffusion of these technologies, since firms typically anticipate commercial returns from patents. The research papers in the SO_2 Symposium also speak to invention, adoption, and diffusion. This conference's session titles are relevant for inventive research and operating experience in the industrial-environmental innovation complex, while the coauthorship patterns of the SO_2 Symposium touch on the communication channels for knowledge transfer in the diffusion of SO_2 control technologies.

Several veins of evidence discussed in this dissertation support the thesis that the existence of national government regulation for SO_2 emissions control affected innovation in SO_2 control technologies. Two different approaches to the creation and analysis of patent datasets showed patenting activity to be an indicator of the influence of regulation on inventive activity. First, the subclass-based patent dataset (which was consistent for over one hundred years) demonstrated that, despite the existence of government legislation dating back to 1955 that authorized research into air pollution abatement methods, patent activity in SO_2 control did not really begin until after the introduction of a regulatory regime. Patent activity levels for this dataset can be portrayed as a step-function divided into two main periods by the 1970 CAA and its associated 1971 NSPS (which effectively mandated the existence of a national market for FGD in the U.S.). In the first period, no more than four patents were filed in a given year, while in the second period, 1971 to 1996, patenting activity never fell below a minimum activity threshold of seventy-six patents per year. The subclass-based dataset also demonstrated that patent activity in the second period peaked in the years 1978, 1979, 1988, and 1992. This pattern of peaks was also exhibited in the second, abstract-based, patent dataset. Models of the abstract-based patent dataset and interview testimony support the idea that inventive activity, as measured by patents, is spurred temporarily by the existence and anticipation of government regulatory actions. These temporary spurts of patenting activity (associated with the 1977 and 1990 CAAs, as well as an anticipated CAA in the mid- to late-1980s) enhance the public good of knowledge from which new discoveries and innovations draw.

More evidence for the importance of government regulatory actions on the invention, adoption, and diffusion of SO_2 control technologies comes from the government-sponsored technology transfer mechanism of the SO_2 Symposium. For example, paper sessions specific to a new national legislative or regulatory event were held during the SO_2 Symposium that immediately followed the passage of the event. This implies that the SO_2 control community was quite aware that the details of government actions affected the direction of SO_2 control technologies. This supposition is supported by the heightened attendance at these post-government action conferences that was observed by one expert.

One particular technological pathway for SO_2 control, pre-combustion control technologies, was very strongly affected by the stringency and flexibility of SO_2 regulatory actions and their implications for potential technology markets. First, both models and expert testimony concerning patenting activity in pre-combustion control technology link the precipitous drop in this activity in 1978 to the 1979 NSPS. Although pre-combustion control technology was somewhat favored by the relatively flexible 1970 CAA and the government promotion of coal use after the Arab oil embargo of 1973, the stringency of the 1979 NSPS permanently and adversely altered this situation. Pre-combustion technologies were simply not robust enough to meet the new regulations; consequently, innovative activity in this technology declined markedly.

Ironically, other legislative details of the 1979 NSPS supported sustained innovative interest along a different technological pathway, dry FGD technologies. Throughout the time period between the 1979 NSPS and the 1990 CAA, but especially during a period of anticipation of acid rain regulation in the mid- to late-1980s, presentations at the SO_2 Symposium demonstrated a particular emphasis on these technologies. This emphasis, which was supported in expert testimony, was not prevalent before the 1979 NSPS and was greatly reduced after the more technologically “flexible” 1990 CAA was implemented. Incidentally, the effect on innovative outcomes of the 1990 CAA was not ultimately the commercialization of a greater variety of technological responses to the problem of SO_2 control. Instead, it resulted in a general utility industry convergence to fuel switching and to wet limestone forced oxidation FGD technologies. These FGD technologies had lower cost designs and operations made possible primarily through pre-1990 innovations and the legislative safeguard for utility reliability concerns of emissions trading.

The details of government actions did not simply affect innovative activities directed toward particular technological pathways. They also apparently affected the size of the innovative audience interested in sharing knowledge about SO_2 control technologies as well as the composition of inter-organizational coauthorship patterns. In the wake of the relatively less stringent and more flexible 1970 CAA, when considerable operating problems were experienced by FGD utility operators, analysis of the SO_2 Symposium from 1973 to 1977 reveals that not every type of innovating organization reached beyond its boundaries for research paper coauthorship. As seen in Chapter Four, those organizations that did cross affiliation boundaries did so at much lower levels in conferences held in the 1973 to 1977 time period than in later years. Litigation between regulated utilities and government during this time period was probably one cause of this. Litigation, however, would be an unlikely reason for researchers from Bechtel and TVA not to write papers with each other or with the EPA in these years, as all three organizations were partners in the influential Shawnee test facility that ran in the 1970s. Yet reflexive ties amongst Bechtel and TVA authors were dominant in the conferences held between 1973 and 1977.

With the implementation of the relatively more stringent 1979 NSPS, which affected a larger number of utilities than the 1971 NSPS, the innovative audience for knowledge about SO_2 control technologies grew. In the SO_2 Symposium conferences held between 1979 and 1988, the number of papers that were presented, the number of organizations and authors that presented, and the number of cross-affiliation coauthored papers grew. The largest increase in all of these numbers occurred in the mid- to late-1980s, during the same period of anticipation of acid rain regulation discussed above as important to patenting activity and to the interest in dry FGD technologies. The growth in cross-affiliation paper coauthorship in the conferences held between 1979 and 1995 is evidence that a denser communication network emerged during this time period for knowledge transfer relevant to the diffusion of SO_2 control technologies. The SO_2 Symposium conferences held between 1990 and 1995 were also characterized by a disproportionate growth in the number of authors that presented papers. This change may reflect heightened innovative interest in SO_2 control technologies during these years, which were marked by considerable uncertainty about the market implications of the 1990 CAA for FGD technologies.

Uncertainty about the implications of government actions for SO_2 control technology was not limited to the 1990 CAA. Archival evidence shows that, as early as the 1970s, firms entered the FGD equipment and services industry rapidly either through new ventures or acquisitions as a result of anticipated, although uncertain, growth in the industry due to potential new regulatory initiatives. These predictions of industry growth were partially based on the tenfold increase in commercial scrubber unit installations that occurred between 1971 and 1976 and the low but growing profitability of the industry between 1976 and 1978. This FGD industry growth did continue in the early 1980s (the peak years for commercial scrubber installations occurred between 1979 and 1983).

Rates of commercial FGD installation in the U.S. declined in the mid- to late-1980s, however, although levels of patenting and activity in technical conferences grew during this time period (almost certainly due to anticipation of new acid rain regulation). This anticipation is evidenced by expert testimony and the existence of SO_2 Symposium sessions in 1986 on “acid deposition retrofit applications” and “acid deposition issues” (the only sessions in the history of the conference to allude explicitly to acid rain in a session title). It can also be inferred from congressional attempts in 1982, 1984, 1986, and 1987 to strengthen U.S. air legislation with regard to SO_2. It thus appears that the anticipatory response of firms to the timing and market potential of predicted government regulatory actions can be seen in overall and technology-specific inventive activity, as well as in organizational aspects of innovation.

Innovative activities in SO_2 control are not limited solely to government regulation. Such institutionally focused environmental government actions as R&D support, research collaborations, and financial support for the SO_2 Symposium clearly had large effects on the evolution of SO_2 control technologies. The strongest evidence of the importance of these other government actions in the development of SO_2 control technologies (particularly the SO_2 Symposium) arose in expert testimony, although the network analysis of the SO_2 Symposium provided in Chapter Four also supports this conclusion.

In addition to these environmental government actions, there is one other type of government action that had implications for the SO_2 industrial-environmental innovation complex. Government actions that affect the utility industry have a strong potential influence on innovative activities in this complex. According to expert interviews, utility deregulation reduced the willingness of actors to share know-how and financial support for the SO_2 Symposium. In addition, reductions in EPRI funding due, in part, to utility deregulation, served to reduce its financing of general R&D efforts in the SO_2 industrial-environmental innovation complex as well as its support of the SO_2 Symposium. On the positive side, individual post-deregulation utilities continue to fund R&D in SO_2 control technology. These utilities also continued to collaborate with other affiliation types in the SO_2 Symposium in the 1990 to 1995 time period.

Learning by Doing

Unlike invention, adoption, and diffusion, the existence of learning by doing in the SO_2 industrial-environmental innovation complex is difficult to demonstrate. Qualitative evidence from expert interviews suggested that learning by doing, or performance improvements that occur as a result of a user's modifications of behavior or adopted equipment so as to correct difficulties observed during operation, occurred in SO_2 control technology. Numerous experts stated that operating experience was one of the most important types of knowledge shared as a result of the SO_2 Symposium and that both major and incremental technological developments arose from operating experience. Yet learning by doing is difficult to quantify.

This dissertation quantitatively demonstrated the existence of learning by doing in U.S. utility FGD operations for the period 1985 to 1997 as a necessary first step to understanding the influence of government actions on learning by doing. The progress ratio of 83%, which is very much in line with progress ratios determined in other industries, was determined for the FGD performance variable of combined labor and maintenance costs (adjusted to 1997 dollars) and the predictor variable of power generation.

By itself, the existence of learning by doing in SO_2 control technology is a useful finding for policy-makers interested in promoting environmental technological innovation. It shows that, unlike the curves depicted in Figure 6.1 and Figure 6.2 that result from new generations of equipment, quantifiable technological improvements can be shown to occur solely on the basis of the experience of operating an environmental control technology forced into being by government actions. It is important for policy-makers to note, however, that these improvements come at some pain to polluters and therefore involve a certain amount of political risk. As interview testimony, archival information about litigation and policy hearings, and perhaps the low incidence of cross-affiliation coauthorship in the 1973 to 1977 SO_2 Symposium conferences demonstrate, the high expense of maintaining early FGD systems at electric utilities generated considerable distrust and antagonism between utilities and government actors. This antagonistic relationship was less useful for FGD performance improvements than the more cooperative climate that developed later. Cooperation among utility operators and outside researchers, particularly as supported through institutions such as EPRI, the EPA, and their jointly sponsored SO_2 Symposium, was cited by most experts as important to FGD performance improvements.

The quantification of learning by doing through learning curves in the SO_2 industrial-environmental innovation complex for the years 1985 to 1997 provides some insights into the influence of government actions on environmental technological innovation. Richer insights may yet be obtained through future research. For example, it might be possible to construct learning curves (either through the discovery and use of missing EIA-767 data from 1974 to 1984 or through estimates of FGD performance across this period) for the early years of FGD installation, when both SO_2 regulation and the SO_2 industrial-environmental innovation complex were young. It is quite possible that a progress rate based on this earlier period would be different from the progress rate calculated here for the more mature SO_2 industrial-environmental innovation complex. If true, this would suggest that any predictive use of learning curves for future estimates of the characteristics of an environmental control technology would have to consider the maturity of the market for that technology. In addition, combining the data from 1974 through 1997 would make it easier to see if short-term "shocks" correlated with government regulatory actions occur in learning curves. These shocks might occur as a side effect of the temporary but intense interest in FGD operations that regulatory changes might spur in utility management. Finally, a more in-depth investigation of the plants that exhibited strong learning effects may reveal the effectiveness of non-regulatory government actions, such as facilitating technology transfer and funding R&D activities, in promoting the innovative activity of learning by doing in SO_2 control technologies.

Policy Implications and Future Work

This dissertation integrated several established and repeatable quantitative and qualitative innovation research methods and applied them to an extended case study of innovative responses to multiple U.S. government actions centered on the abatement of SO_2 emissions from stationary sources. This approach allowed the specifics of government actions, environmental technology features, and affected organizations within the industrial-environmental innovation complex to be considered in this analysis. Although these insights are particularly relevant to the case study of SO_2 control technologies and may not be considered fully generalizable, they do appear to have policy implications that may be reinforced in future research.

As stated in Chapter One, one instance in which case studies can have a generalizable impact is when a relatively large number of such studies show similar findings. The research methods used in this dissertation were chosen in part so that this case study could serve as a model for the conduct of similar case studies of other environmental control technologies. The findings of these future studies would then be able to be synthesized more readily with those of this dissertation, and the combined insights could then have a more generalized impact on policy discussions related to innovation, particularly in the environmental area. Two of these additional case studies, which focus on nitrogen oxide control technologies and carbon sequestration technologies, are newly underway in a follow-on study funded by the USDOE Office of Science (under Notice 00-08 for the Integrated Assessment of Global Climate Change Research).

Some of the major policy implications of this dissertation already appear to be generalizable because they are supported by other case studies. For example, this dissertation has shown that the existence of national government regulation for SO_2 emissions control stimulated innovation. This is supported by the case studies analyzed in Ashford, Ayers, and Stone (1985). It is interesting to note, however, that the patent analysis in this dissertation shows that national regulation is a more effective stimulant of inventive activity than national legislation in support of air pollution abatement research alone, with no regulatory requirements. This may well be particularly relevant to policy-makers interested in stimulating innovation in support of global warming mitigation, for which regulatory stimulus is lacking but research support is not.

A second policy implication of this dissertation is that regulatory stringency appears to be particularly important as a driver of innovation, both in terms of inventive activity and in terms of the communication processes involved in knowledge transfer and diffusion. In the Ashford, Ayers, and Stone (1985) case studies, they found that "a relatively high degree of [regulatory] stringency appears to be a necessary condition" for inducing higher degrees of innovative activities (Ashford, Ayers, and Stone, 1985, note 36 at 429). In this dissertation, regulatory stringency appeared to be particularly important in driving the innovative direction of technologies to control SO_2 emissions. The high stringency of the 1979 NSPS for high-sulfur coal applications ended the viability of one technological pathway that innovation had centered upon, pre-combustion control technology with low removal efficiencies. Meanwhile, the moderate degree of stringency of this regulatory event for low-sulfur coal applications focused innovative attention on dry FGD technologies. With the relatively less stringent 1990 CAA, coupled with the lower cost of non-technological alternatives (i.e., low-sulfur coal), this innovative attention faded.

Increased regulatory stringency may have helped stimulate the formation of communication channels important to knowledge transfer in the diffusion of SO_2 control technology. The 1979 NSPS, which was more stringent and affected a larger number of utilities than the 1971 NSPS, thereby creating a larger market for FGD in the U.S., coincided with the growth in cross-affiliation paper coauthorship in the conferences held between 1979 and 1995. In addition, it corresponded with the beginning of a major increase in the number of papers that were presented and the number of organizations and authors that presented at the SO_2 Symposium. All of these findings about the effects of regulatory stringency on innovation appear to be related to the finding in the mainstream innovation literature that demand is a major driver of innovation (see Mowery and Rosenberg, 1982). In an industrial-environmental innovation complex, the demand for various types of pollution control equipment is almost inseparable from the details of environmental legislation (see Kemp, 1997). The findings in this dissertation about regulatory stringency and innovation may be especially relevant to policy-makers considering a new national regulatory regime for a pollutant for which a dominant environmental control technology has not been established. Mercury air emissions from power plants might be considered such a pollutant today.

A third policy implication of this dissertation is that inventive activity, as captured by patents, is spurred temporarily by the existence and anticipation of government regulatory actions. This temporary spurt in inventive activity thus provides a brief burst in the stock of the public good of knowledge from which new discoveries and innovations (especially in SO_2 control technology) draw. Ashford, Ayers, and Stone (1985) also found that "anticipation of regulation stimulates innovation," and that while "excessive regulatory uncertainty may cause industry inaction, too much certainty will stimulate only minimum compliance technology" (Ashford, Ayers, and Stone, 1985 pg. 426). Taken together, these findings make a case for policy-makers to not be overly concerned with mapping many years' worth of environmental standards into law at a given time.

This dissertation also has other policy implications that have not arisen in previous environmental innovation case studies. First, it has shown that federal funding of a technology transfer mechanism such as the SO_2 Symposium has been extremely valuable to environmental innovation, according to experts in SO_2 control technologies. More specifically, these experts cited cooperation among utility operators and outside researchers as particularly important to FGD performance improvements. The facilitation of research cooperation and knowledge transfer of a variety of valuable forms, including operating experience, appears to be an important aspect of a well-designed effort on the behalf of policy-makers to drive environmental innovation. Policy-makers interested in driving environmental innovation for use in the electric power sector should pay particular attention to this recommendation, especially in light of the findings of this dissertation that utility deregulation has reduced the willingness of innovative actors in SO_2 control technologies to share technical know-how.

A second stand-alone finding of this dissertation that is relevant to policy-makers is the determination that as electric power generation doubles, the operating and maintenance costs of FGD systems decline to 83% of their original level. This finding, which is very much in line with progress ratios determined in other industries, shows that quantifiable technological improvements can be shown to occur solely on the basis of the experience of operating an environmental control technology forced into being by government actions. This finding, especially if reinforced by other case studies, can be useful to policy-makers interested in making cost projections about environmental technologies.

A third stand-alone finding of this dissertation, the logarithmic and polynomial equations fitted to the data in Figure 6.1 and Figure 6.2, may also be useful to policy-makers interested in projecting aspects of environmental innovation. These models characterize improvements in FGD performance and reductions in cost as a simple function of technology diffusion. Again, finding similar functions in other case studies of environmental innovation will be important to developing a more general, policy-relevant understanding of these rates of environmental innovation.

This dissertation has provided several insights into the complex influence of government actions on innovative activities and outcomes in an environmental control technology, but additional work could provide further insight. There are several avenues of future work, besides applying the research methods used in this dissertation to nitrogen oxide control and carbon sequestration technologies. First, it would be interesting to note how patent activity in SO_2 control changes as Phase II of the 1990 CAA progresses. Second, it would be interesting to see if the findings in this dissertation about the influence of government regulation on patenting activity hold true when considering the patent datasets of other countries. For example, while it might be expected that Germany would exhibit a patenting spike in the mid-1980s, to tie with its stringent 1983 acid rain program, both its government and its innovation patterns could confound the results.[108] Third, it would be interesting to observe whether learning curves change as their underlying data are updated to reflect an increasingly deregulated electric utility industry. Fourth, it would be interesting to see if an in-depth investigation of the plants identified in this

[108] This program resulted in 35,000 MWe of FGD systems being installed in four years, 33% of which was licensed from U.S. companies.

analysis as exhibiting learning curve effects demonstrated positive or negative correlations between high rates of learning and non-regulatory government actions. Finally, it would be interesting to observe whether learning curves that span the 1974 to 1997 period exhibit slope changes between the early and later years of FGD technological maturity or exhibit shocks correlated with government regulatory actions.

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Appendix A. Previous Case Studies of Technological Responses to Regulation

Substance	Application	Overview of Regulation	Regulatory Categories	Technology Response
PCBs	All	Prohibition of the manufacture of PCBs after January 1, 1980 by EPA under Toxic Substances Control Act (TSCA) after 12 years of regulatory surveillance	Product Regulation, Very Stringent	• Voluntary restriction by PCB manufacturer of PCB sales to closed electrical systems 10 years before prohibition of PCBs, based on anticipation of government concern • Introduction of a new, more biodegradable PCB mixture for use in capacitors together with a new capacitor design reducing PCB use by two-thirds • Development of PCB substitutes by outsiders
CFCs	Aerosol	Ban of use of CFCs in 1978 by Consumer Product Safety Commission and EPA under TSCA	Product Regulation, Very Stringent	• Product substitution in the form of a non-fluorocarbon propellant (CO_2) by non-CFC manufacturers • Development of a new pumping system without propellant by outsider firms
Lead	Paint	Limitations of lead content of household paint in 1970s under various acts that effectively prohibited the use of lead pigments after 1973 and the use of lead dryers in 1977	Product Regulation, Very Stringent	• Non-innovative substitution of lead by paint industry
	Fuel Additive	Requirement by EPA under Clean Air Act Amendments in 1970 for large gasoline retailers and oil producers to market by July 1, 1974 at least one grade of lead free gasoline to protect catalytic converters in automobiles; followed by requirement of reduction in the lead content of regular gasoline after October 1, 1979	Product Regulation, Very Stringent	• Unsuccessful substitution of existing manganese-based additive MMT for lead; banned by EPA due to damage to catalytic converters • Development of lead trap to capture the lead in exhaust; no commercial success • The use of new catalysts for cracking process

Substance	Application	Overview of Regulation	Regulatory Categories	Technology Response
	All Manufacture	Permissible exposure limits to lead of 50 $\mu g/m^3$ in working site under Occupational Safety and Health Act (OSHA) with ten year exemptions for primary smelting and five year exemptions for secondary smelting and battery manufacture	Process Regulation, Very Stringent	• Combination of source-reducing controls, worker isolation and improved work practices • Use of new direct smelting process • Development of new process technologies that reduce lead exposure • Acceleration of development of smaller batteries containing less lead relying on lead-calcium rather than lead-antimony alloys
Mercury	Paint	Ban by EPA in 1976 of phenyl mercurials in oil-based paint	Product Regulation, Very Stringent	• Substitution of existing organic compounds for mercurials
	Chloralkali	Establishment of effluent standards for chloralkali plants limiting mercury discharges to maximum of 0.28 grams per 1000 kg of products per day by July 1977 under Federal Water Pollution Act plus promulgation of emission standards limiting mercury under the Clean Air Act	Process Regulation, Stringent	• Separation of process and cooling water • Treatment of process water and cleaning of sewer pipes • Series of housekeeping improvements
Vinyl Chloride (VC)	All Manufacture	Setting of VC exposure limits under OSHA in 1970s plus emission standards for VCM and PVC after 1976 under Clean Air Act	Process Regulation, Very Stringent	• Acceleration of incremental process innovations
Cotton Dust	All Manufacture	Introduction of differing exposure limits for cotton dust in 1984 under OSHA	Process Regulation, Very Stringent	• Modernization of textile industry through diffusion of superior textile technology
Asbestos	All Manufacture	1972 OSHA limit of airborne asbestos to five fibers per cubic centimeter	Process Regulation, Mildly Stringent	• Adoption of pollution control technology

Source: Adapted from Ashford, Ayers, and Stone (1985) and Kemp (1997)

Appendix B. Expert Selection Procedure

The first step in the expert selection process was to analyze the SO_2 Symposium conference proceedings for 1973 to 1995 in order to understand the distribution of papers presented according to affiliation type. This distribution was used to suggest a likely distribution of expert affiliation types that should be represented in interviews. Organizations that presented often at the SO_2 Symposium were then categorized by affiliation type. Each of these organizations was then ranked according to its presentation frequency (versus other top organizations of similar type) in individual conferences in order to get a sense of the importance of various organizations over time. Based on these rankings, dominant organizations in each affiliation type category were targeted for interviews.

Prominent individual presenters for these dominant organizations were then listed and ranked across time for their presentation frequency at the SO_2 Symposium. These rankings were the basis of the initial list of experts to contact for potential interviews. In some cases, multiple individuals from an organization were listed as contacts if they were prominent presenters in a subset of the SO_2 Symposium conference years that was complementary to that of another expert from the same organization. In cases where more than one individual met the basic selection criteria, other factors were used to determine whether an individual would be contacted for an interview. One such factor was whether the individual was also listed as an inventor on an SO_2 control patent, since such individuals would bring additional insights to the overall dissertation.

The initial list of potential interviewees that emerged from this process included twenty experts. Due to a number of logistical difficulties, not all of these experts were interviewed for the dissertation. In two cases, experts were interviewed who had lower presentation frequency than experts on the initial list; these experts represented the same dominant organizations as the initially targeted experts and were active in the SO_2 control community for a similarly long period of time.

Finally, a few experts were interviewed who were not chosen primarily on the basis of presentation frequency at the SO_2 Symposium (although they were very active in this conference). These experts were identified by other experts as important to interview because of their knowledge about the SO_2 industrial-environmental innovation complex.

Appendix C. Interview Protocol

This interview protocol was informed by research on qualitative research methods (Rosenthal and Rosnow, 1991) and developed through an iterative process that included pilot testing.

The Influence of Government Action on Technological Change in SO_2 Control Technologies

Introduction

Thank you for taking the time to meet with me today. As I mentioned before, I would like to talk with you for a little over an hour about your experiences with the development of sulfur dioxide control technologies over the last three decades.

1. Why don't we start with you telling me about how you got involved in sulfur dioxide control technologies in the first place?

2. Did your formal schooling prepare you for the demands of working on these technologies?

3. Looking back at your experience with these technologies, if you had it all to do again, would you get involved in this area of research?

Technological change questions

I'm interested in getting expert opinions about how the technologies have changed over time, especially as regards the removal efficiencies, reliability, and cost aspects of some of the dominant technologies. Let's start by drawing some graphs.

ASK FOLLOWING QUESTIONS WHILE DRAWING GRAPHS AGAINST TIME AND CUMULATIVE OUTPUT ON X-AXIS.

1. What is your sense of the removal efficiencies of wet limestone scrubbers in the early days, say in the early 1970s? How about the late 1970s? The early 1980s? The late 1980s? The beginning of the 1990s? The end of the 1990s?

2. What is your sense of the reliability of wet limestone scrubbers in the early days, say in the early 1970s,? How about the late 1970s? The early 1980s? The late 1980s? The beginning of the 1990s? The end of the 1990s?

3. What is your sense of the capital costs of wet limestone scrubbers in the early days, say in the early 1970s,? How about the late 1970s? The early 1980s? The late 1980s? The beginning of the 1990s? The end of the 1990s?

4. What is your sense of the operating costs of wet limestone scrubbers in the early days, say in the early 1970s,? How about the late 1970s? The early 1980s? The late 1980s? The beginning of the 1990s? The end of the 1990s?

5. Are there other features of these technologies that have changed over time? If so, how would this (these) feature(s) have looked in the early 1970s, late 1970s, early 1980s, late 1980s, early 1990s, and late 1990s?

LOOKING AT GRAPHS WITH SUBJECT. So, how would you explain some of these trends?

6. Can you pinpoint the technological advancements that have affected these technological features?

MAKE LIST BASED ON THESE TECHNOLOGICAL GOAL AREAS:
- Removal efficiencies
- Reliability
- Capital costs
- Operating costs
- Other

7. What research trajectories were followed by the industry that are not reflected in these improving trends? In other words, what was tried but not commercialized?

ADD TO LIST

NOW, BASED ON TECHNOLOGY LIST, ASK QUESTIONS 8-16 FOR EACH ITEM ON THE LIST:

8. Which organizations and individuals have been responsible for these technological advancements?

9. How did these organizations/individuals communicate with the greater technical community working on these problems in SO2 control? Did they work in cooperation with individuals at other organizations (TYPES OF ORGANIZATION LIST TO REMIND, ALSO COUNTRIES)?

10. Were any individuals in the organizations you were involved with working on this technological advance? If so, what were their names and positions?

11. What is your recollection of the amount of research money directed towards the work these individuals were doing? If you had to estimate the amount of money devoted to research in these areas over time, what would the graph look like? Early 1970s, late 1970s, early 1980s, late 1980s, early 1990s, late 1990s? MAKE GRAPH

12. Why not extrapolate out to the universe of organizations working on these issues. What would a research money graph look like for this universe, with data points in the early 1970s, late 1970s, early 1980s, late 1980s, early 1990s, late 1990s? MAKE GRAPH

13. Would you be able to get any archival data on the amounts of research money directed toward these areas?

14. What recollections do you have about hiring and firing decisions on these technological advancements within the organizations you worked in?

15. Would you be able to get any archival data on hiring/firing trends?

16. What rationale do you recall there was for the research budget and hiring decisions for these technological advancements over time? Early 1970s, late 1970s, early 1980s, late 1980s, early 1990s, late 1990s.

Government action questions

17. What do you consider the major landmarks in legislation affecting SO2 control over the last 30 years?

MAKE LIST, HELPING REMIND THEM IF NECESSARY (INCLUDING GOING OVER TIME PERIOD).

18. Were there other legislative events that were widely believed to occur that never actually materialized.

ADD TO LIST
GO THROUGH LIST, ONE-BY-ONE

19. When did the organization you worked in first become aware that this legislative action was being considered?

20. How did the organization respond to first seeing this legislative action on the horizon? Formal procedures, informal procedures? R&D budgets or hiring?

21. When did the organization you worked in first become aware of the final stage details that were emerging about this legislative action?

22. How did the organization respond to first seeing this legislative action on the horizon? Formal procedures, informal procedures? R&D budgets or hiring?

23. After this legislative action was passed, how did your organization respond? Within 1 year, 2 years, 3 years, etc.

Patent questions

24. SHOWING PATENT CORRELATIONS I have conducted a patent search on the set of technologies pertaining to removing SO2 from stationary sources. There seem to be correlations between the timing of major legislative events and peaks in patenting activity in these areas. Do you have any possible explanations for why this pattern is observed?

25. How are patents applied for, seen, and used in the organizations you have worked in?

26. How important are patents to the organizations you have worked in? To the overall community, to the best of your knowledge?

27. Another finding from the patent study I did is that pre-combustion (coal cleaning) technologies were not patented in as much after 1979. Yet articles and books in the early 1980s were still very positive about these technologies and their potential importance in acid rain control. Do you have any ideas why these patents show this pattern?

End

Thank you for being so helpful today. Do you have any other major thoughts on this topic that you'd like to share?

If you have any thoughts on this later and you'd like to contact me, my contact info is:

Reference

Rosenthal, Robert, and Ralph L. Rosnow. *Essentials of Behavioral Research: Methods and Data Analysis*. Second ed. New York: McGraw-Hill, Inc., 1991.

Appendix D. Notes on Data Translation Process for Form EIA-767

In Chapter Two and Chapter Five, data were used from the EIA-767 form collected by the Energy Information Administration (EIA) of the Department of Energy since 1974 from all utility boilers above 50 MWe in size (USDOE/EIA, 1999). These data are currently available in computerized format only for the operating years 1985 through 1997.

The programs designed to tabulate the EIA-767 data originally were written for computers circa 1974, so these data needed to be translated into a more database-accessible format before any analysis could begin. Of the sixteen pages of data each utility plant contributes annually, of particular interest for translation and later analysis were the data on utility generators, boilers, and flue gas desulfurization systems. Translation and analysis focused on coal-fired boilers burning a non-zero amount of coal each year and employing a single FGD unit.[109]

The data-translation task posed some difficulties. First, typographical errors were encountered. For example, errors were occasionally detected in the FGD boiler identifier provided in form EIA-767 and were either corrected based on other information or the data associated with these errors were abandoned. Second, missing or impossible values were sometimes encountered, so null values had to be generated as placeholders in the translated data. Third, discrepancies were sometimes seen between an annual total and the monthly data underlying that total. As a rule, manually calculated summations of the monthly data were treated with greater respect than the stated annual totals. Fourth, the total sulfur content of coals is an important context variable for a utility FGD system, but this information was not given on

[109] No boilers that shared an FGD unit were considered in this analysis.

the annual basis needed for the learning curve analysis in Chapter Five. For this reason, monthly coal tonnage was multiplied by the percent sulfur content given for these coals and then summed to get annual sulfur.

Finally, in order to generate the variable of cumulative kilowatt-hours scrubbed as well as several of the FGD performance variables required for the learning curve analysis, plant generator, boiler, and FGD unit data needed to be linked by a one-to-one relationship. In cases with multiple boilers or FGD units, where it was impossible to relate plant power generation to FGD activities, these links could not be established. Only a small number of boilers were thus affected.

Appendix E. Cost Adjustment Process

The formula given here was used to adjust current dollar costs to constant 1997 dollar costs, based on two *Chemical Engineering* cost indices. Since an FGD unit is a type of chemical plant, the *Chemical Engineering* plant index, as previously compiled by Mike Berkenpas of Carnegie Mellon University for 1977-98, was used to adjust capital costs, maintenance costs, and "other" costs. Similarly, the *Chemical Engineering* hourly earnings index, updated on a semi-monthly basis, was collected for the years 1985-1998 and used to adjust labor costs.

$$Cost(1997\$) = Cost(i) * \frac{Indexvalue(1997)}{Indexvalue(i)}$$

i = the year of interest for adjustment
Cost = the labor or capital or maintenance cost
Indexvalue = the appropriate Chemical Engineering index (hourly earnings or plant cost)

Year	Labor Index (1977=100)	Plant Cost Index (1957-59=100)
1977	Not applicable to analyses	204.1
1978	Not applicable to analyses	218.8
1979	Not applicable to analyses	238.7
1980	Not applicable to analyses	261.1
1981	Not applicable to analyses	297.0
1982	Not applicable to analyses	314.0
1983	Not applicable to analyses	316.9
1984	Not applicable to analyses	322.7
1985	180.2	325.3
1986	186.1	318.4
1987	192.1	323.8
1988	196.9	342.5
1989	203.2	355.4
1990	210.6	357.6
1991	218.4	361.3
1992	224.8	358.2
1993	229.4	359.2
1994	235.8	368.1
1995	243.6	381.1
1996	251.7	381.7
1997	257.8	386.5
1998	263.4	386.5

Appendix F. SO_2 Symposium Session Titles

SO_2 Symposium Session Titles in Three Groups, as Delimited by the Implementation Dates of the 1979 NSPS and the 1990 CAA, with Parentheses Indicating the Number of Papers Presented in Each Session. Asterisks indicate difficulties identifying the exact number of presenters in a specific session.

Group 1			
May 1973	**Nov. 1974**	**March 1976**	**Nov. 1977**
Opening Session (**4**)	Opening Session (**4**)	Opening Session (**5**)	Opening Session (**8**)
Throwaway Processes (**10**)	Non-Regenerable Processes (**11**)	Non-Regenerable Processes (**14**)	Non-Regenerable Processes (**10**)
Regenerable Processes (**8**)	Regenerable Processes (**7**)	Regenerable Processes (**4**)	Regenerable Processes (**7**)
Disposal and Use of Byproducts from FGD Processes: Introduction & Overview (**6**)	FGD Byproduct Disposal/Utilization Panel (**6**)	Byproduct Disposal/ Utilization (**4**)	Byproduct Disposal/Utilization (**8**)
Advanced Processes (**6**)	Second Generation Processes (**8**)	Advanced Processes (**6**)	Advanced Processes (**7**)
		Unpresented Papers (**3**)	Unpresented Papers (**5**)

Group 2								
March 1979	**October 1980**	**May 1982**	**Nov. 1983**	**Nov. 1984 Dry & SOx/NOx**	**June 1985**	**Nov. 1986**	**June 1986 Dry & SOx/NOx**	**October 1988**
Opening Session: Energy and the Environment (4)	Opening Session (4)	Opening Session (5)	Opening Session (4)	Introduction (5)	Opening Session (3)	Opening Session: Clean Coal Programs (3)	Introduction (4)	Opening Remarks (*)
Impact of Recent Legislation (*)	Impact of Recent Legislation/ Regulations (*)	Materials of Construction (5)	Economics (4)	Fundamental Research (8)	Commercial Status of FGD (4)	Status of FGD (4)	Sorbents - Selection, Preparation, and Performance (7)	International Overview (6)
Economics and Options (4)	FGD R&D Plans (3)	Dual Alkali (4)	Materials of Construction (4)	Pilot-Scale Development of Furnace Injection (7)	Limestone FGD/Organic Acid Enhancement (4)	FGD Economics: General (2)	Sorbents - Promoters and Additives (3)	Retrofit Economics (3)
Utility Applications (22)	Utility Applications (13)	Special Studies (4)	Dry Furnace Absorbent Injection (3)	Burners for Simultaneous SO_2/NOx Control (3)	FGD Reliability Improvement (3)	FGD Economics: Acid Deposition Retrofit Applications (3)	Sorbents - Fundamentals (2)	Spray Dryer Technology (6)
FGD Current Status and Future Prospects - Vendor Perspectives (*)	Byproduct Utilization (6)	Panel: Reliability and Maintenance (6)	Dual Alkali (2)	Post-Furnace SO_2 Removal (4)	Chemistry/ Reagent Preparation (4)	Acid Deposition Issues (2)	Process Research (5)	Furnace Sorbent Injection: Demonstra-tions (8)
Industrial Applications (6)	Dry Scrubbing (6)	Flue Gas Treatment (Combined SOx/NOx Removal) (3)	Flue Gas Treatment (Combined SOx/NOx Removal) (2)	Process Integration and Economics (8)	Materials of Construction (5)	Industrial Applications (*)	Mixing/ Dispersion (3)	Integration/ Byproduct Utilization (8)

Unpresented Papers (4)	Industrial Applications (5)	Limestone/ Organic Acid (3)	Panel: The A&E: Middleman Between Utility and FGD Supplier (*)	Sorbent Availability and Costs (3)	Panel Discussion on Retrofitting FGD Systems (*)	Wet FGD: Additives (4)	Economics, Power Plant Integration and Commercial Applications (4)	FSI Impacts/ Enhancements (8)
	Unpresented Papers (4)	Lime/ Limestone Utility Applications (2)	FGD Chemistry (6)	Field Applications and Full-Scale Testing (8)	Dual Alkali (4)	Wet FGD: Operations and Flexibility (3)	Post-Furnace SO_2 Removal (7)	Wet FGD Operation (16)
		Byproduct Disposal/ Utilization (4)	Limestone/ Organic Acid (2)	Unpresented Papers (*)	Emerging Technologies (5)	Wet FGD: Operations and Reliability (2)	System Impacts (6)	Municipal Solid Waste Facilities (4)
		Dry FGD Systems (7)	Waste Disposal/ Utilization (4)		Spray Dryer FGD (7)	Spray Dryer FGD (4)	Commercial Scale Applications (8)	Dry FGD Fundamentals (6)
		Unpresented Papers (7)	Dry FGD: Pilot Plant Test Results (5)		FGD Byproduct Disposal/ Utilization (6)	Dry FGD Technologies (5)	Unpresented Papers (2)	New Technologies (6)
			Dry FGD: Full Scale Installations (5)		Unpresented Papers (7)	FGD Byproduct Disposal/ Utilization (6)		FGD Improvement (6)
			Unpresented Papers (5)			Poster Session (16)		Post-Combustion Dry Technologies (8)
								Unpresented Papers (3)

Group 3			
May 1990	**Dec. 1991**	**August 1993**	**March 1995**
Opening Remarks (**3**)	Opening Session (**6**)	Clean Air Act Regulatory Strategies (**3**)	Regulatory and Economic Issues (**4**)
International Overview (**4**)	Clean Air Act Compliance Issues Panel (**4**)	Phase I Designs (7)	Full-Scale Optimization (**6**)
Economics (**8**)	Clean Air Act Compliance Strategies (**9**)	Additives for High Efficiency FGD (**6**)	Phase I Startups (7)
Furnace Sorbent Injection – Demonstrations (**8**)	Wet FGD Process Improvements (**8**)	Materials for FGD (7)	Dry FGD (**6**)
FSI Recycle (**4**)	Furnace Sorbent Injection (**4**)	Clean Coal Demonstrations (7)	Operating Experiences and Recent Design (**6**)
Wet FGD Reliability (**8**)	Wet FGD Design Improvements (**8**)	Applied Research (7)	Emerging Processes (**6**)
Spray Dryers (**5**)	Dry FGD Technologies (**12**)	Dry FGD Technologies (7)	Wet FGD Advanced Design Issues (7)
Wet Full Scale Operation (**10**)	Wet Full Scale FGD Operations (**8**)	Wet FGD Process Issues (**6**)	Air Toxics (7)
Emerging Technologies (7)	Combined SOx/NOx Technologies (**8**)	Air Toxics Removal in FGD Systems (7)	Modeling and Fundamental Research (**6**)
Combined SOx/NOx Technologies (7)	Wet FGD Operating Issues (**8**)	Wet FGD Process Issues (7)	Combined SOx/NOx Removal (**6**)
Wet FGD Vendor Designs (7)	Clean Coal Demonstrations (**8**)	Emerging Technologies (**6**)	Materials for FGD (**8**)
Post Combustion Dry Technologies (**8**)	Emerging Technologies (**21**)	Waste Utilization and Disposal (**6**)	Byproducts and wastewater (**5**)
Wet FGD Research (7)	Commercial FGD Designs (7)	Poster Papers (**18**)	Poster Papers (**12**)
Byproduct Utilization (**8**)	Byproduct Utilization (7)		
Poster Session (**13**)	Poster Papers (7)		

Appendix G. Network Graph Construction Procedure

The first step in the process of constructing network graphs was to develop a computer program that was run on the coded SO2 Symposium data in order to list the year and the various authors on each paper in permuted pairs. The output of the program replaced the author names with their affiliation types. In Microsoft Excel, pivot tables were then created using these pairings in order to show reflexive ties (to the same affiliation type) and relational ties (to other affiliation types) for each year of the conference. The next step was to sum the various pivot tables into affiliation-type-by-affiliation-type, important organization by important organization, and important author by important author matrices for each of the three time period groups. The resulting matrices could then be graphed manually or with software such as Krackplot 3.0.

Appendix H. Statistics in Learning Curve Analyses

(1) The confidence levels associated with the learning curve analyses are computed in Microsoft Excel 2000 and listed as part of the regression results. They are based on the two-sided p-value obtained through the t-test of the null hypothesis of no linear relationship between the x and y variables in Equation 5.2. The t-statistic is:

$$t = \frac{b}{SE_b}$$

where:

b = the slope of the least-squares regression line
SE_b = the standard error of this slope

where: $$SE_b = \frac{\sqrt{\frac{1}{n-2}\sum (y - \hat{y})^2}}{\sqrt{\sum (x - \overline{x})^2}}$$

(2) Given that there is a relatively large number of power plants with relevant FGD operating data (88) and there is a relatively small number of observations for each power plant (13 years), a more powerful estimation technique is to consider these data as panel data. Recall that panel data are repeated observations on the same set of cross-sectional dependent and explanatory variables. The simplest estimation method for panel data is to essentially ignore the panel structure of the data and stack the data in the linear regression model with the assumptions that for a given plant, observations are serially uncorrelated and across plants and time, the errors are homoscedastic. The result is the pooled estimator.

There are two extensions to the pooled estimator. If the first, "random effects" model were applied to these data, it would be based on the assumption that the individual power plant is uncorrelated with the explanatory variables. Instead, we assume that the individual power plant is correlated with the explanatory variables and we use the second, "fixed effects" model, which has two important advantages. One is that the ordinary least-squares regression on the transformed data yields unbiased estimates of the coefficients on the X-variables. Another is that the fixed effects estimator is robust to the omission of any relevant time-invariant regressors.

The fixed effects model was run in Stata 6.0 for the pooled set of eighty-eight power plants with thirteen years of FGD operating data, with a group variable based on the plant-FGD identifier. For more information, see Johnston and DiNardo (1997, Ch. 12) and StataCorp (1999).

References

Johnston, J., & DiNardo, J. 1997. *Econometric Methods*. New York: McGraw Hill.

StataCorp. 1999. *Stata Statistical Software: Release 6.0.* College Station, TX: Stata Corporation.

LEXSEE 486 F.2D 375

PORTLAND CEMENT ASSOCIATION AN ILLINOIS NOT-FOR-PROFIT CORPORATION, PETITIONER, v. WILLIAM D. RUCKELSHAUS, ADMINISTRATOR, ENVIRONMENTAL PROTECTION AGENCY, RESPONDENT, MEDUSA PORTLAND CEMENT CO., and NORTHWESTERN STATES PORTLAND CEMENT CO., INTERVENORS

No. 72-1073

UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA CIRCUIT

486 F.2d 375; *158 U.S. App. D.C. 308*; *1973 U.S. App. LEXIS 9083*; *5 ERC (BNA) 1593*; *3 ELR 20642*

January 29, 1973, Argued
June 29, 1973, Decided

PRIOR HISTORY: **[**1]** Petition for Review of an Order of the Administrator, Environmental Protection Agency.

COUNSEL: Robert E. Haythorne, with whom Perry S. Patterson was on the brief for Petitioner.

James R. Walpole, Attorney, Department of Justice with whom Kent Frizzell, Assistant Attorney General, Edmund B. Clark and Martin Green, Attorneys, Department of Justice, were on the brief, for Respondent. Raymond N. Zagone, Attorney, Department of Justice also entered an appearance for Respondent.

Robert H. Shepard was on the brief for Intervenor, Northwestern States Portland Cement Company.

William H. Wallace was on the brief for Intervenor, Medusa Corporation.

Turner T. Smith, Jr., filed a brief on behalf of Long Island Lighting Company and National Asphalt Pavement Association, as Amici Curiae urging reversal.

Perry S. Patterson entered an appearance for Intervenors.

JUDGES: Fahy, Senior Circuit Judge, Leventhal and Robb, Circuit Judges. Opinion for the Court filed by Circuit Judge LEVENTHAL.

OPINION BY: LEVENTHAL

OPINION

[*377] LEVENTHAL, Circuit Judge:

Portland Cement Association seeks review [1] of the action of the Administrator **[*378]** of the Environmental Protection Agency (EPA) **[**2]** in promulgating stationary source standards for new or modified portland cement plants, pursuant to the provisions of Section 111 of the Clean Air Act. [2] Medusa Corporation and Northwestern States Portland Cement Company were granted leave to intervene by this court and they together with petitioner, will be referred to as the cement manufacturers. Long Island Lighting Company has filed a brief as an Amicus Curiae.

1 Section 307(b)(1) of the Clean Air Act, *42 U.S.C. § 1857h-5(b)(1)*, requires that a petition for review of the action of the Administrator in setting standards of performance under section

111 of the Act "be filed only in the United States Court of Appeals for the District of Columbia."

2 *42 U.S.C. § 1857c-6.*

I. STATEMENT OF THE CASE

Section 111 of the Clean Air Act directs the Administrator to promulgate "standards of performance" governing emissions of air pollutants by new stationary sources constructed or modified after the **[**3]** effective date of pertinent regulations. [3] The focus of dispute in this case concerns EPA compliance with the statutory language of Section 111(a) which defines "standard of performance" as follows: [4]

> (1) The term "standard of performance" means a standard for emissions of air pollutants which reflects the degree of emission limitation achievable through the application of the best system of emission reduction which (taking into account the cost of achieving such reduction) the Administrator determines has been adequately demonstrated.

3 The term "new source" is defined as:

> any stationary source, the construction or modification of which is commenced after the publication of regulations (or, if earlier, proposed regulations) prescribing a standard of performance under this section which will be applicable to such source. *42 U.S.C. § 1857c-6(a) (2).*

Modification is, in turn, defined as:

> any physical change in, or change in the method of operation of, a stationary source which increases the amount of any air pollutant emitted by such source or which results in the emission of any air pollutant not previously emitted. *42 U.S.C. § 1857c-6(a) (4).*

[4]**

4 *42 U.S.C. § 1857c-6(a) (1).*

After designating portland cement plants as a stationary source of air pollution which may "contribute significantly to air pollution which causes or contributes to the endangerment of public health or welfare", under Section 111 (b)(1)(A) of the Act, [5] the Administrator published a proposed regulation establishing standards of performance for portland cement plants. The proposed regulation was accompanied by a document entitled "Background Information For Proposed New-Source Performance Standards," which set forth the justification. [6] Interested parties were afforded an opportunity to participate in the rule making by submitting comments, and more than 200 interested parties did so. [7] The "standards of performance" were adopted by a regulation, issued December 16, 1971, which requires, inter alia, that particulate matter emitted from portland cement plants shall not be: [8]

> (1) In excess of 0.30 lb. per ton of feed to the kiln (0.15 Kg. per metric ton), maximum 2-hour average.
>
> (2) Greater than 10% opacity, except that where **[**5]** the presence of uncombined water is the only reason for failure to meet the requirements for this subparagraph, such failure shall not be a violation of this section.

[*379] The standards were justified by the EPA as follows: [9]

> The standards of performance are based on stationary source testing conducted by the Environmental Protection Agency and/or contractors and on data derived from various other sources, including the available technical literature. In the comments on the proposed standards, many questions were raised as to costs and demonstrated capability of control systems to meet the standards. These comments have been evaluated and investigated, and it is the Administrator's judgment that emission control systems capable of meeting the standards have been adequately demonstrated and that the standards promulgated herein are

achievable at reasonable costs.

5 *42 U.S.C. § 1857c-6(b)(1)(A)*. The designation of portland cement plant emissions was made on March 31, 1971, *36 Fed. Reg. 5931 (1971)*.

6 The proposed standards were issued on August 3, 1971 and published on August 17, 1971, *36 Fed. Reg. 15,704 (1971)*. The Background Document, prepared by the Environmental Protection Agency, Office of Air Programs, states: "The proposed standards . . . are being distributed concurrently with this document." (JA at 20).

[6]**

7 34 comments, specifically addressed to the Portland Cement standards, are at Tab VIII of the Certified Record (C.R.). They have been filed as a supplement to the Joint Appendix.

8 *36 Fed. Reg. 24,876 (1971)*.

9 Id. at para. 17.

On March 21, 1972, EPA published a "Supplemental Statement in Connection With Final Promulgation", [10] amplifying the justification for its standards and indicating that it had been prompted by the action of this court in *Kennecott Copper Corp. v. E.P.A., 149 U.S. App. D.C. 231, 462 F.2d 846 (1972)*, to offer "a more specific explanation of how [the Administrator] had arrived at the standard." This statement relied principally on EPA tests on existing portland cement plants to demonstrate that the promulgated standards were achievable.

10 *37 Fed. Reg. 5767 (1972)*.

The action of the Administrator has been challenged on the following grounds: **[**7]** (1) The Administrator did not comply with the National Environmental Policy Act of 1969 (NEPA). (2) Economic costs were not adequately taken into account and the standards unfairly discriminate against portland cement plants, in comparison with standards promulgated for power plants and incinerators. (3) The achievability of the standards was not adequately demonstrated.

II. COMPLIANCE WITH NEPA

Petitioners argue that EPA acted contrary to the requirements of the National Environmental Policy Act of 1969, *42 U.S.C. §§ 4321-35*, in failing to file a "NEPA" statement in conjunction with the promulgation of the stationary standards. They draw particularly on the language of § 102(2)(C) of NEPA which states: [11]

> The Congress authorizes and directs that, to the fullest extent possible: (1) the policies, regulations, and public laws of the United States shall be interpreted and administered in accordance with the policies set forth in this chapter, and (2) all agencies of the Federal Government shall --
>
> * * *
>
> (C) include in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the **[**8]** quality of the human environment, a detailed statement by the responsible official on --
>
> (i) the environmental impact of the proposed action . . . .

11 *42 U.S.C. § 4332 (2)(C)(1970)*.

1. Petitioners, in effect, predicate an EPA obligation to file an impact statement on this simple syllogism: (1) All federal agencies must file an impact statement; (2) EPA is a federal agency; (3) EPA must file an impact statement. *Anaconda Co. v. Ruckelshaus, 352 F. Supp. 697, 4 ERC 1817, 1828 (D. Col. 1972)*. If the premises be accepted, the logic is clear. But the argument is more simplistic than simple, for the premises require a more precise determination of legislative intent. In ascertaining congressional intent we begin with the language of a statute, [12] but this is subject to an overriding requirement of looking to all sources including purpose and legislative history, to ascertain discernible **[*380]** legislative purpose. [13] The question is whether EPA is a "federal **[**9]** agency" within the meaning of NEPA -- whether, and to what extent, Congress intended it to be subject to

the NEPA mandate concerning preparation of impact statements.

12 *Caminetti v. United States, 242 U.S. 470, 485, 61 L. Ed. 442, 37 S. Ct. 192 (1917).*

13 "The 'plain meaning' doctrine has always been subservient to a truly discernible legislative purpose however discerned," by equitable construction or recourse to legislative history. *Wilderness Society v. Morton, 156 U.S. App. D.C. 121, 479 F.2d 842, 855 (1973)* (en banc), cert. denied *411 U.S. 917, 36 L. Ed. 2d 309, 93 S. Ct. 1550 (1973)*; *District of Columbia v. Orleans, 132 U.S. App. D.C. 139, 141, 406 F.2d 957, 959 (1968).*

2. A primary purpose of NEPA, and specifically the impact statement requirement, was the design to co-ordinate disparate environmental policies of different federal agencies. [14] At the time NEPA was enacted on January 1, 1970, [15] EPA was not yet in existence. EPA was created **[**10]** by Reorganization Plan No. 3, submitted to Congress on July 9, 1970, [16] which was designed to bring under one roof the major environmental federal programs which until that time had been scattered throughout different agencies of the government. It is by no means clear, as will appear, that NEPA's impact statement requirement was intended at time of passage of NEPA to be applicable to such environmental agencies as the National Air Pollution Control Administration of the Department of Health, Education and Welfare or the Federal Water Quality Administration of the Department of the Interior. But even assuming it was applicable to them, it does not necessarily follow that NEPA is applicable to EPA, which Congress did not have before it, and which in its own organization accomplished the purpose of coordination of environmental approach. In statutory interpretation, the courts must often, in effect, consider what answer the legislature would have made as to a problem that was neither discussed nor contemplated. *Montana Power Co. v. F.P.C., 144 U.S. App. D.C. 263, 445 F.2d 739 (1970)* (en banc), cert. denied, *400 U.S. 1013, 27 L. Ed. 2d 627, 91 S. Ct. 566 (1971).* **[**11]**

14 *See Calvert Cliffs Coordinating Committee v. AEC, 146 U.S. App. D.C. 33, 47, 449 F.2d 1109, 1123 (1971)*; *National Resources Defense Council, Inc. v. Morton, 148 U.S. App. D.C. 5, 13, 458 F.2d 827, 835 (1972).*

15 83 Stat. 853.

16 The reorganization plan was effective December 2, 1970, *35 Fed. Reg. 15623 (1970). See 42 U.S.C. § 4321* note (1970).

3. The impact statement issue requires us to consider not only NEPA, but also the Clean Air Act and particularly the statutory scheme by which new stationary source standards are promulgated. [17]

17 In order to give full effect to the Clean Air Act, it must be read, at minimum *in pari materia* with NEPA. *See United States v. Stewart, 311 U.S. 60, 85 L. Ed. 40, 61 S. Ct. 102 (1940).* There is doctrine to the effect that in case of conflict between two federal laws, the later enactment is given precedence. *United States v. Wrightwood Dairy Co., 127 F.2d 907 (7th Cir. 1942).*

[12]** Section 111 of the Clean Air Act establishes precise time schedules for the promulgation of new source standards. [18] The Administrator was required to publish, 90 days after December 31, 1970, a list of categories of stationary sources which "contribute significantly to air pollution which causes or contributes to the endangerment of public health or welfare." Within 120 days of the inclusion of a category, the Administrator is required to propose standards, and 90 days thereafter the standards are to go into effect. Obviously, a strong argument can be made that the Clean Air Act, and the provisions for unusual expedition in disposing of the complex environmental and other problems faced by the agency, assumed that the agency would not be subject to the additional time required to prepare a "detailed" proposal of an impact statement, circulate the statement to the agencies for comment and assess the comments made.

18 *42 U.S.C. § 1857c-6(b) (1).*

[*381] The time constraint of **[**13]** the Clean Air Act is perhaps not decisive [19] but it is a substantial consideration and, as will be seen, an inter-related aspect of that Act reinforces the conclusion that NEPA is inapplicable to determinations under it.

19 The quality of a draft impact statement might be lessened to conform to the requirements of speedy action. NEPA requires compliance only "to the fullest extent possible", *42 U.S.C. § 4332*, and is subject to a construction of reasonableness. *National Resources Defense Council v. Morton,*

> *148 U.S. App. D.C. 5, 15, 458 F.2d 827, 837 (1972)*. The need for timely action is not exclusive with the Environmental Protection Agency. *See SCRAP v. United States, 346 F. Supp. 189, 199 (D.D.C. 1972)* (3-judge court), probable jurisdiction noted *409 U.S. 1073, 93 S. Ct. 683, 34 L. Ed. 2d 662 (1973)*.
>
> A major difficulty with this approach is that it tends to result in a group of second-class impact statements, ascribed to time urgencies. In contrast, the Council on Environmental Quality has established a relatively short comment time in the interest of a uniform procedure that can accommodate even agencies on a tight time table -- to avoid "a delay incompatible with the nature of some government programs." THIRD ANNUAL REPORT 237 (1972).
>
> The crunch under the Clean Air Act is that there is no legal latitude available to delay the action, in order to give more than lip service to the comment procedure.

[14]** Long Island Lighting Company argues that the Act could accommodate delay in the time allowed for publication of the list of categories of stationary sources until an impact statement had been duly prepared, in compliance with NEPA, and completed. This is at odds with the express language of the Act which specifies that any source which contributes to the endangerment of public health or welfare shall be placed on that list at the end of 90 days.

4. As we have already indicated, there is a serious question whether NEPA is applicable to environmentally protective regulatory agencies. There is no express exemption in the language of the Act or Committee Reports. [20] However, such an exemption is set forth in a document entitled "Major Changes in S. 1075 as passed by the Senate" introduced into the Congressional Record by Senator Jackson during debate over approval of the Conference Report. [21]

> 20 S. REP. No. 296, 91st Cong., 1st Sess. (1969); H. REP. No. 765, 91st Cong., 1st Sess. (1969).
>
> 21 115 CONG. REC. 40417 (1969).

[15]** The document, in analyzing Section 102 of NEPA, detailing the procedures and requirements of an impact statement, stated that the provisions were "not designed to result in any change in the manner in which [environmental agencies] carry out their environmental protection authority". It stated immediately thereafter:

> This provision is, however, clearly designed to assure consideration of environmental matters by all agencies in their planning and decision making -- especially those agencies who now have little or no legislative authority to take environmental considerations into account. [22]

Senator Muskie commented on this language as coming from his discussions with Senator Jackson, and then stated, in debate:

> It is clear then, and this is the clear understanding of the Senator from Washington [Jackson] and his colleagues, and of those of us who serve on the Public Works Committee, that the agencies having authority in the environmental improvement field will continue to operate under their legislative mandates as previously established, and that those legislative mandates are not changed in any way by section 102-5. [23]

Manifestly, the **[**16]** statements of these two Senators, who were among the most active in securing the passage of NEPA, [24] **[*382]** are entitled to weight in ascertaining legislative intent.

> 22 *Id.* at 40418.
>
> 23 *Id.* at 40423.
>
> 24 Senator Jackson, floor manager of the debate on the Conference Report, was the sponsor of the original Senate bill on NEPA, S. 1075, chaired the Senate Committee on Interior and Insular Affairs, which considered the bill, and was a member of the Conference Committee. Senator Muskie was the Chairman of the Subcommittee on Air Pollution of the Committee on Public Works.

However, their understanding was not formalized by any statement in the Conference Report or in the section-by-section analysis of the bill as reported by the Conference Committee. [25] Senator Allott, ranking minority member of the Interior Committee and of the

Conference Committee, also a supporter of NEPA, stated: 26

> . . . while the explanatory statements relative to the interpretation of the conference report **[**17]** language, as provided by the chairman, are useful, they have not been reviewed, agreed upon, and signed by the other Senate conferees. Only the conference report itself was signed by all the Senate conferees, and therefore, only it was agreed upon and is binding.

25 H.R. REP. No. 765, 91st Cong., 1st Sess. 7 (1969).
26 115 CONG. REC. 40422 (1969).

As for the House of Representatives, its action on the Conference Report was equally ambiguous. Representative Dingell submitted the Conference Report to the House on December 22, 1969, [27] two days after the report had been submitted to the Senate by Senator Jackson. As part of his opening remarks, Rep. Dingell introduced into the record the text of answers to certain questions posed to him by Rep. Fallon, the Chairman of the Committee on Public Works. His answer to one of those questions tracked the language of the "Major Changes" document submitted to the Senate, indicating no intended change in requirements for "environmental control" agencies. **[**18]** [28] There is no indication, however, of any debate or acceptance of Rep. Dingell's answer by any other member of the House.

27 *Id.* at 40922 (1969).
28 *Id.* at 40925.

5. We now turn to consideration of the import of subsequent congressional actions.

In the Federal Water Pollution Control Act Amendments of 1972 (FWPCA), Congress provided that NEPA did not control certain actions taken by EPA pursuant to their water pollution control activities. [29] The question arose in debate, and is carried on by the parties to this case, as to whether this was an "exemption" -- in which case the assumption would be that prior law generally intended NEPA to be applicable -- or an affirmative declaration that NEPA did apply to only a limited number of EPA activities specified in the amendments. Such debate of a later Congress have been described by the Supreme Court as offering a hazardous basis for inferring the intent of the earlier Congress; [30] and this is borne out by our analysis.

29 Pub. L. No. 92-500, 86 STAT. 816 (1972). Section 511 (c) (1) provides that NEPA is not applicable to EPA, at least as to impact statements, except in two cases: where grants are made for the construction of publicly owned waste treatment works and where the agency issues new source permits.

[19]**

30 *United States v. Southwestern Cable Co., 392 U.S. 157, 170, 20 L. Ed. 2d 1001, 88 S. Ct. 1994 (1968).*

Senator Muskie pointed during the 1972 debates to the Muskie-Jackson colloquy as expressing the intent to exempt EPA, and that the present legislation merely imposed some affirmative NEPA obligations, so as to narrow the exemption. [31] Others, such as Senator **[*383]** Nelson, clearly perceived the water pollution control amendments as, in fact, exempting EPA from NEPA. [32] Senator Jackson had doubts by 1972, as to the wisdom of his prior position on a broad exemption for "environmental control" agencies. [33]

31 118 CONG. REC. 16877-78 (daily ed., Oct. 4, 1972). Senator Muskie also referred to an intervening interpretation of the Council on Environmental Quality that EPA was exempt from NEPA, *36 Fed. Reg. 7724 (1971) § 5(d).* This CEQ interpretation as to EPA, reflected its earlier view that the Federal Water Quality Adminstration and the National Air Pollution Control Board were exempt from NEPA, *35 Fed. Reg. 7391 (1970) § 5(d).* The CEQ view was based on its reading of the legislative history of NEPA, which we find highly ambiguous, and cannot therefore assign this administrative determination controlling weight. At least part of the deference assigned to administrative construction of a statute, concerns the passage of time under which the agency view has become an accepted interpretation and in which the Congress has not acted to nullify the agency practice. Deference may also be accorded an administrative interpretation to avoid dislocation where agencies have shaped their actions in accordance with the

interpretation, and the court concludes that the interpretation is not inconsistent with discernible legislative intention. Here, however, the issue of meaning turns on statutory wording and legislative history, available in extenso to the court, and not affected by any considerations of special technical expertise of CEQ, which might lead to extra deference. *See Wilderness Society v. Morton, supra*, Slip Opinion at 40-51, for discussion of deference to be given administrative construction of statutes. We note that CEQ, in its latest Proposed Guidelines for Preparation of Environmental Impact Statements, *38 Fed. Reg. 10856, 10865 (1973)*, has retracted § 5d and its broad claim that EPA was exempt from all NEPA requirements. We do not reach the question as to the scope of authority of the Council on Environmental Quality to interpret the requirements of the Act.

[20]**

32 Senator Buckley viewed section 511(c)(1) as a provision "which grants broad exemptions", 118 CONG. REC. S16884 (daily ed., Oct. 4, 1972). Senator Nelson stated: "While this section [511(c)(1)] does specifically authorize some exemptions from the environmental policy act to avoid conflict with other key environmental aims, the reach of these exemptions would appear to be narrow." *Id.* at 16888.

33 *Id.* at 16886-88.

6. The matter resolves itself, as to this issue of exemption for environmental agencies, that we have items which are entitled to some weight as indicia of legislative intent, but cannot be taken as decisive. [34] It becomes appropriate, then, [35] to consider the policies underlying the legislation. [36] Here, again, we encounter competing considerations reflecting the difficulty in resolving the question; but perhaps they point the way toward a resolution.

34 *Compare United States v. Thompson, 147 U.S. App. D.C. 1, 13, 452 F.2d 1333, 1345 (1971)*, cert. denied, *405 U.S. 998, 31 L. Ed. 2d 467, 92 S. Ct. 1251 (1972). Also see Calvert Cliffs, supra, 146 U.S. App. D.C. at 49-50, 449 F.2d at 1125-26.*

[21]**

35 We think little guidance to the resolution of this issue is to be obtained from consideration of section 309 of the Clean Air Act, *42 U.S.C. § 1857h-7*, which petitioners greatly relied on during oral argument of this case. That section merely requires the Administrator to review and comment in writing on the impact on the environment of projects of another federal agency "[which contains] any matter related to duties and responsibilities granted [to the Administrator] pursuant to this chapter." The contention that this section implies the Administrator must file a draft impact statement can only be resolved in the framework of the legislative history which we have already reviewed.

36 *See United States v. Sisson, 399 U.S. 267, 297-98, 26 L. Ed. 2d 608, 90 S. Ct. 2117 (1970)*, where Justice Harlan stated: "The axiom that courts should endeavor to give statutory language that meaning that nurtures the policies underlying legislation is one that guides us when circumstances not plainly covered by the terms of the statute are subsumed by the underlying policies to which Congress was committed." *Also see District of Columbia v. Orleans, supra, 132 U.S. App. D.C. at 140-41, 406 F.2d at 958-59.*

[22]** The policy thrust toward exemption of the environmental agency is discernible from these factors, taken in combination: (1) An exemption from NEPA is supportable on the basis that this best serves the objective of protecting the environment which is the purpose of NEPA. (2) This comes about because NEPA operates, in protection of the environment, by a broadly applicable measure that only provides a first step. The goal of protecting the environment requires more than NEPA provides, i.e. specific assignment of duties to protection agencies, in certain areas identified **[*384]** by Congress as requiring extra protection. (3) The need in those areas for unusually expeditious decision would be thwarted by a NEPA impact statement requirement. [37] (4) An impact statement requirement presents the danger that opponents of environmental protection would use the issue of compliance with any impact statement requirement as a tactic of litigation and delay. [38]

37 Senator Muskie stated, during the debate on the applicability of NEPA statements to EPA, pursuant to the FWPCA amendments of 1972, 118 CONG. REC. 16878 (daily ed., Oct. 4, 1972): "If the general procedural or substantive reforms achieved in NEPA . . . were permitted to override,

supersede, broaden, or affect in any way the more specific environmental mandate of the FWPCA, the administration of the Act would be seriously impeded and the intent of Congress in passing it frustrated." For problems in complying with both NEPA and the Clean Air Act's requirements for speedy action, *see* note 19 *supra*.

[23]**

38 *Id.*

The policies against a NEPA exemption embrace the endemic question of "Who shall police the police"? As Senator Jackson stated, "It cannot be assumed that EPA will always be the good guy." [39] Concern was also voiced by petitioners in this case that EPA might wear blinders when promulgating standards protecting one resource as to effects on other resources, as is asserted in this case, that air standards may increase water pollution. Finally, it is argued that a NEPA statement's procedures, though burdensome, allow for needed input by other federal agencies and simultaneously open up the decision-making process to scrutiny by the public. [40]

39 *Id.* at 16887. Senator Jackson raised this pointed concern: "Since EPA was formed, they have done an admirable job and they are continuing to do so, at least for the present. However, it cannot be forgotten that EPA is a regulatory agency and in the past in Washington almost all regulatory agencies have eventually come under the control of those that they are charged with regulating," quoting from the September 22, 1972 National Wildlife Federation Conservation Report.

[24]**

40 *Id.* (Statement of Senator Jackson). We do not think that the post-decision reporting requirements of the Clean Air Act to Congress, pursuant to sections 312(a) and 313 of the Act, *42 U.S.C. §§ 1857j-1, 2 (1970)*, offer the same timely and substantive impact on decision making as would comments on possible adverse environmental impact during a rule-making proceeding. Section 312(a) calls for "Comprehensive economic cost studies", and EPA has already issued its first required report, which includes a discussion of portland cement. S. Doc. No. 92-67, Annual Report of the Administrator, The Economics of Clean Air, 92d Cong., 2d Sess. 4-36-43 (1972), which is based largely on a study made for the purpose of arriving at the promulgated standard and introduced into the rule-making record. ELIAS, J. R. AND J. M. DEMENT, THE FINANCIAL IMPACT OF AIR POLLUTION CONTROL UPON THE CEMENT INDUSTRY (1971) (prepared for EPA) (hereinafter FINANCIAL IMPACT). C.R. Tab V (f).

Section 313 of the Act requires, inter alia, a report on "the development of air quality criteria and recommended emission control requirements." Two reports have already issued. S. Doc. 92-66, Annual Report of the Administrator of the Environmental Protection Agency, Progress in the Prevention and Control of Air Pollution, 92 Cong., 2d Sess. (1972); S. Doc. 92-11, 92 Cong., 1st Sess. (1971 Annual Report). Both reports are summary in nature, and neither discusses portland cement.

It is, therefore, apparent that Congress receives no required information about the possible adverse environmental impact of proposed standards for new stationary sources.

[25]** 7. Our consideration of the complex questions raised by a broad exemption claim, reinforce our conclusion that these should not be decided in the present case, which may appropriately be determined upon the logic of a narrow exemption from NEPA applicable to determinations under section 111 of the Clean Air Act. What is decisive, ultimately, is the reality that, section 111 of the Clean Air Act, properly construed, requires the functional equivalent of a NEPA impact statement. Thus in this case, as in *International Harvester v. Ruckelshaus, 155 U.S. App. D.C. 411, 478 F.2d 615, 650 n.130* **[*385]** *(D.C. Cir. 1973)*, [41] we refrain from a determination of any broader claim of NEPA exemption.

41 To date, only a few cases have dealt with the application of NEPA to EPA. In *Getty Oil Co. (Eastern Operations) v. Ruckelshaus, 467 F.2d 349 (3rd Cir. 1972)*, cert. denied *409 U.S. 1125, 35 L. Ed. 2d 256, 93 S. Ct. 937 (1973)*, the issue was raised in the context of an enforcement proceeding by EPA of Delaware's approved implementation plan under § 110 of the Clean Air Act. Petitioners argued that the failure to file an impact statement rendered the compliance order

ultra vires. The Third Circuit held that this objection was improperly raised in an enforcement proceeding, thus not reaching the question, though noting that authority for application was "not persuasive", *citing Kalur v. Resor, 335 F. Supp. 1 (D.D.C. 1971).*

In *Kalur*, the court held that the Corps of Engineers was required to issue an impact statement before granting a permit to dump "refuse" into navigable waters, pursuant to its administration of the Rivers and Harbors Act of 1899, *33 U.S.C. § 407 (1971)*. This decision was partly responsible for the FWPCA Amendments of 1972, giving EPA authority over the issuance of discharge permits, and exempting issuance from NEPA. Pub. L. No. 92-500, 86 Stat. 816 (1972). *See* statement of Senator Hart, 118 CONG. REC. 16890 (daily ed. Oct. 4, 1972). *Kalur* was subsequently dismissed as moot on appeal to this court by order, following the enactment of the new legislation, and is of no precedential value.

The case most directly on point is *Anaconda Copper Co. v. Ruckelshaus, 352 F. Supp. 697, 4 E.R.C. 1817 (D. Colo. 1972)*. That case dealt with the ability of Anaconda's copper smelter, which emitted sulphur oxides, to conform with EPA standards under § 110 of the Clean Air Act. After the Governor of the State of Montana had deleted that portion of the State plan, relating to these emissions -- which affected only Anaconda -- EPA proposed its own standards. After administrative hearings, Anaconda brought suit in the district court to enjoin promulgation of the rule. The district court held that more than the minimal due process required in rule-making proceedings should have been afforded at the EPA hearing since the regulation in effect applied only to Anaconda, that there was insufficient evidence to support the standards, and that EPA should have been required to file an impact statement pursuant to NEPA. Leaving aside the threshold question as to whether the district court properly took jurisdiction of the proposed rule, *see Environmental Defense Fund et al. v. Enviromental Protection Agency, 158 U.S. App. D.C. 1, 485 F.2d 780 (1973)*, we think the thrust of the district court's concern, which we share, was the seeming refusal of the EPA to take into account possible adverse impact on water quality which might arise from its air standards. This problem was "not studied or considered by the Administrator" according to the findings of fact of the district court. This concern could have been reflected in a requirement that information be developed on this point in conjunction with the hearings on the standard, but instead the court chose to enjoin the rule on the basis of the failure to file an impact statement. We think the examination of support for this holding was myopic, and rested heavily on the logic of the words "all federal agencies" which, as we have indicated *infra*, text at notes 12, 13, is only itself dependent on the non-obvious premise that EPA is a "federal agency" within the meaning of NEPA.

See also Appalachian Power Co. v. EPA, 477 F.2d 495, 5 ERC 1222 (4th Cir. 1973) and *Duquesne Light Co. v. EPA, 481 F.2d 1 (3rd Cir. 1973)* holding NEPA inapplicable to actions of Administrator in approving state implementation plan under § 110 of the Clean Air Act.

[26]** Enlarging on our conclusion as to a narrower exemption, we note that section 111 of the Clean Air Act requires a "standard of performance" which reflects "the best system of emission reduction", and requires the Administrator to take "into account the cost of achieving such reduction." These criteria require the Administrator to take into account counter-productive environmental effects of a proposed standard, as well as economic costs to the industry. The Act thus requires that the Administrator accompany a proposed standard with a statement of reasons that sets forth the environmental considerations, pro and con which have been taken into account as required by the Act, and fulfillment of this requirement is reviewable directly by this Court. [42]

42 One of the major reasons Senator Muskie offered for not generally applying NEPA to EPA water pollution control activity, during the FWPCA amendments debate of 1972, was that the Federal Water Pollution Control Act "specifically identifies factors to be considered by the Administrator". 118 CONG. REC. 16878 (daily ed. Oct. 4, 1972). The standard of the "best system" is comprehensive, and we cannot imagine

that Congress intended that "best" could apply to a system which did more damage to water than it prevented to air.

[27]** **[*386]** Although the rule-making process may not import the complete advantages of the structured determinations of NEPA into the decision-making of EPA, it does, in our view strike a workable balance between some of the advantages and disadvantages of full application of NEPA. Without the problems of a NEPA delay conflicting with the constraints of the Clean Air Act, the ability of other agencies to make submissions to EPA concerning proposed rules, provides a channel for informed decision-making. These comments will be part of the record in the rule-making proceeding that EPA must take into account. [43]

43 This approach avoids the straitjacket that NEPA would impose on the time requirements mandated by the Clean Air Act. EPA would have 120 days to issue, as part of its reasons, its consideration of possible adverse environmental effects, along with its proposed standard. This need not be the "detailed" statement required by NEPA. We would expect, however, that all documents which supported its conclusion on this question be made available for comment. Standard CEQ guidelines, or those of the Environmental Protection Agency, for circulation of impact statements could be adapted to provide for circulation to other federal agencies of the statement of reasons and supporting documents. Time allowed for comment would be made to depend on the strict time requirements of the section 111 proceeding.

[28]** EPA's proposed rule, and reasons therefor, are inevitably an alert to environmental issues. The EPA's proposed rule and reasons may omit reference to adverse environmental consequences that another agency might discern, but a draft impact statement may likewise be marred by omissions that another agency identifies. To the extent that EPA is aware of significant adverse environmental consequences of its proposal, good faith requires appropriate reference in its reasons for the proposal and its underlying balancing analysis. While there is more flexibility than NEPA's requirement of an impact statement, this court has stated, and EPA has recognized, that an EPA statement of reasons for standards and criteria require a fuller presentation than the minimum rule-making requirement of the *Administrative Procedure Act. Kennecott Copper v. EPA, supra.*

Similarly, EPA's proposed rule, and reasons therefor, are an alert to the public and the Congress who will have the opportunity to comment as to possible adverse environmental effects of the proposed rule, during the pendency of the rule making proceeding. And finally, the courts will be able to scrutinize the analysis of environmental **[**29]** considerations, in assuring that a reasoned decision has been reached. [44]

44 The combination of reasons relating to possible adverse environmental impact with those justifying the standards generally, directs the attention of the reviewing court to the "reasoned basis" which supports the rule as a whole, rather than permitting challenges based on particular *per se* violations of NEPA.

The court's review guards against arbitrary disregard of environmental factors by EPA without significantly increasing the administrative burden on the agency. And since all environmental questions will have to be considered within the same review proceeding as other challenges to the validity of standards, the potential for incremental litigation delay is minimized.

As to the standard here at issue, petitioners raise possible adverse environmental impact questions in their briefs. [45] **[*387]** But they have not indicated that these problems were brought to the attention of the agency. Since we are remanding the case **[**30]** for other reasons subsequently discussed, EPA should respond to these questions on remand.

45 Petitioner Portland Cement Association asserts in its Brief at 34:

> Increased electricity needed to operate precipitators with greater collection capacity can create increased air pollution by the source of the electricity.

Also, stricter standards will result in the collection of more particulates. These must be disposed of somehow.

The alkaline content of cement must be

limited and, since much of the collected particulate is substantially alkaline, it cannot be used in production but must be discarded. This waste is usually combined with water and may cause alkaline pollution through direct discharge or the seepage of percolating waters into streams and rivers. Currently Petitioner is discussing with E.P.A. a study to determine what can be done to reduce or avoid this result.

We add, finally, a word of clarification: we establish a narrow exemption from NEPA, for EPA determinations under section **[**31]** 111 of the Clean Air Act. NEPA must be accorded full vitality as to non-environmental agencies, as established by our outstanding precedents. [46]

46 *Calvert Cliffs, supra.*

III. ECONOMIC COSTS

The objecting companies contend that the Administrator has not complied with the mandate of § 111 of the Act, which requires him to "[take] into account the costs" of achieving the emission reductions he prescribes, a statutory provision that clearly refers to the possible economic impact of the promulgated standards. [47] The nature of these cost and economic contentions is such that it is possible, and we find it convenient, to consider them now, before describing the industry's processes, which will be presented below in the consideration of other issues.

47 An amendment which would have deleted consideration of economic impact was proposed by Congressman Ryan of New York, who stated:

> I believe that the threat to our environment is so great that, as a matter of public policy, industry should be required to use the most advanced technology regardless of whether or not a particular industry finds it economically feasible.

This amendment was rejected on voice vote. 116 CONG. REC. 19242-43 (1970).

[32]** The Administrator found in the Background Document that, for a new wet-process plant with a capacity of 2.5 million barrels per year, the total investment for all installed air pollution control equipment will represent approximately 12 percent of the investment for the total facility. He also found that "annual operating costs for the control equipment will be approximately 7 percent of the total plant operating costs if a baghouse is used for the kiln, and 5 percent if an electrostatic precipitator is used." [48]

48 JA at 50.

Petitioners argue that this analysis is not enough -- that the Administrator is required to prepare a quantified cost-benefit analysis, showing the benefit to ambient air conditions as measured against the cost of the pollution devices. However desirable in the abstract, such a requirement would conflict with the specific time constraints imposed on the Administrator. The difficulty, if not impossibility, of quantifying the benefit to ambient air conditions, [49] further militates against **[**33]** the imposition of such an imperative on the agency. Such studies should be considered by the Administrator, if adduced in comments, but we do not inject them as a necessary condition of action.

49 *See* Note, Cost-Benefit Analysis and the National Environmental Policy Act of 1969, 24 STANF. L. REV. 1092, 1098ff (1972), and authorities cited therein.

The EPA contention that economic costs to the industry have been taken into account, derives substantial support from a study prepared for EPA, which was made part of the rule-making record and referred to in the Background Document, entitled "The Financial Impact of Air Pollution Control Upon the Cement Industry". [50] It concluded that the additional **[*388]** costs of control equipment could be passed on without substantially affecting competition with construction substitutes such as steel, asphalt and aluminum, because "demand for cement, derived for the most part from demand for public and private construction, is not highly elastic with regard **[**34]** to price and would not be very sensitive to small price changes." The study did note that individual mills may be closed in the years ahead, but observed that these plants were obsolete both from a cost and pollution point of view. Petitioners have not challenged these findings here. The Administrator has obviously given some consideration to economic costs.

50 FINANCIAL IMPACT, *supra* note 40, at 42.

2. Two questions related to economic considerations

remain: (1) the possible effect of the standards on the future building of wet-process plants generally, and the use of electrostatic precipitators as a control device; and (2) possible unfair discrimination between standards set for cement plants, and those set for power plants and incinerators.

As appears from our examination of technological feasibility, in Part IV of this opinion, a substantial question arises as to whether either wet process plants, or any process using electrostatic precipitators, will be able to achieve mandated pollution control. **[**35]** The HEW Atmospheric Emissions Study, relied on by EPA, reported that as of 1967 there were 110 wet process and 69 dry process plants in the United States, and that they were "expected to increase at a comparable rate." [51] As to exclusion of electrostatic precipitators, the record shows that they are a cheaper technology than fabric filters. Since remand is required for other reasons, as appear from Part IV, we confine our analysis at this juncture to a declaration that on remand the Administrator should consider, as a matter of economic costs, contentions and presentations submitting that the standard as adopted unduly precludes supply of cement, including whether it is unduly preclusive as to certain qualities, areas, or low-cost supplies.

51 KREICHELT, T. E., KEMNITZ, D. A., AND CUFFE, S. T., ATMOSPHERIC EMISSIONS FROM THE MANUFACTURE OF PORTLAND CEMENT, U.S. Dept. HEW, PHS, National Center for Air Pollution Control, PHS Publication No. 999-AP-17 (1967) (hereinafter ATMOSPHERIC EMISSIONS), at 6.

3. Petitioners **[**36]** also challenge the cement standards as unfair in light of lower standards mandated for fossil-fuel-fired steam generating power plants and incinerators. [52] They claim that while the cement standard, as expressed in grains of particulates allowed per standard cubic foot of gas (g/scf), requires a reduction to.03, [53] power plants are permitted to reach.12 and incinerators to be at.10. Also opacity standards differ, with no opacity standard set for incinerators, and with a 20% requirement for power plants (with 40% opacity permitted for not more than 2 minutes in any hour).

52 These standards were proposed jointly with those of portland cement, *36 Fed. Reg. 15704 (1971)*, and were adopted at the same time, *36 Fed. Reg. 24876 (1971)*. The standards for fossil fuel steam generators are challenged in appeal to this court in *Appalachian Power Co. v. EPA, 158 U.S. App. D.C. 360, 486 F.2d 427 (1973)*.

53 The promulgated standards for cement, expressed in particulate levels measured against pounds per ton of feed to the kiln, are convertible, for purposes of comparison, into grains of particulates per standard cubic foot of gas.

[37]** First, we identify petitioner's mistake in making a comparison of the proposed standards, whereas the standards as finally adopted permitted pollution standards of only.08 for incinerators and.10 for power plants, compared with.03 for cement plants.

EPA, in response to comments from petitioners on this issue of discrepancy, stated in its supplemental statement in March 1972: "The difference between the particulate standard for cement plants and those for steam generators and incinerators is attributable to the superior technology available therefor (that is, fabric filter technology has not **[*389]** been applied to coal-fired steam generators or incinerators)." [54]

54 *37 Fed. Reg. 5767 (1972)*. We also note that EPA disagreed with petitioners as to the relevant numbers to compare. EPA stated that the power plant standard was "0.06 grains per standard cubic foot at normal excess air rates", and that the incinerator standard, while.08 "corrected to 12 percent carbon dioxide", was.05 "uncorrected, at normal conditions of 7.5 percent carbon dioxide."

[38]** This statement seems to be supported by the Background Document. [55] It suggests that there has indeed been a difference in the extent of application of fabric filter technology to cement plants, on the one hand, and power plants and incinerators on the other, although we are not informed by the Administrator as to what characteristics of the concerned industries might account for such differences.

55 The August 1971 Background Document was used to support the incinerator and power plant standards, as well as cement standards. The statement is subject to the amplification (JA 29) that fabric filters "are scheduled to be installed" at a power station, though "no full scale fabric filters have been demonstrated on coal fired steam generators." As to municipal incinerators, the Document refers to a "small Swiss unit" with a

fabric filter tested with European sampling procedures, to lower emission in a "small pilot installation" operated by Pasadena in 1960, and to incinerators (over 50 tons per day) equipped with baghouses that "will be put into service in late 1971 in the United States and Switzerland." (JA at 40, 41). If the same technology is now available and in use for incinerators, steam power plants and cement plants, the Administrator on remand may wish to offer some further explanation of the difference in standards set simultaneously for the three industries.

[39]** This March 1972 statement of the Administrator was made in response to comments of the cement producers, and was not offered as justification for the cement standards, which were based solely on emission control available to that industry. Petitioners did not identify this part of the March 1972 supplemental statement as troublesome when they sought a remand from this court on other points. However, this is more a matter of atmosphere than dispositive ruling, for if the producers now gave significant indication that they had been dealt with unfairly or invalidly we could doubtless find a procedural path for consideration.

The core of our response to petitioners is that the Administrator is not required to present affirmative justifications for different standards in different industries. Inter-industry comparisons of this kind are not generally required, or even productive; and they were not contemplated by Congress in this Act. The essential question is whether the mandated standards can be met by a particular industry for which they are set, and this can typically be decided on the basis of information concerning that industry alone. This is not to say that evidence collected **[**40]** about the functioning of emission devices in one industry may not have implications for another. Certainly such information may bear on technological capability. But there is no requirement of uniformity of specific standards for all industries. The Administrator applied the same general approach, of ascertaining for each industry what was feasible in that industry. It would be unmanageable if, in reviewing the cement standards, the court should have to consider whether or not there was a mistake in the incinerator standard, with all the differences in parties, practice, industry procedures, and record for decision. Of course, the standard for another industry can be attacked, as too generous, and hence arbitrary or unsupported on the record, by those concerned with excessive pollution by that industry. There is, therefore, an avenue of judicial review and correction if the agency does not proceed in good faith to implement its general approach. But this is different from the supposition that a claim to the same specific treatment can be advanced **[*390]** by one who is in neither the same nor a competitive industry.

There is, of course, a significant and proper scope for inter-industry **[**41]** comparison in the case of industries producing substitute or alternative products. This bears on the issue of "economic cost". But this comparison was utilized in arriving at the agency decision, and no contention is raised in this court that such competitive-industry impact was either ignored or assessed invalidly.

IV. ACHIEVABILITY OF EMISSION STANDARD

Section 111 of the Act requires "the degree of emission limitation achievable [which] . . . the Administrator determines has been adequately demonstrated." Petitioners contend that the promulgated standard for new stationary sources has not been "adequately demonstrated", raising issues as to the interpretation to be given to this requirement, the procedures followed by the agency in arriving at its standard, and the scientific evidence upon which it was formulated. An examination of these questions requires a brief description of the process used to manufacture portland cement and the devices presently employed to control emissions.

A. *Present types of Emission Control in the Manufacture of Portland Cement*

In the manufacturing process for portland cement, [56] the principal ingredients, limestone and clay, are combined, **[**42]** after having been reduced to a powdery fineness, to make a substance known as raw feed. The powdered limestone and clay are mixed by either the wet process or the dry process. In the wet process, water is added to the limestone and clay to make a slurry, which is then introduced into a kiln. In the dry process, the two substances are mixed mechanically and by use of air before the mix is introduced into a kiln.

56 The following description of the manufacturing process is based on ATMOSPHERIC EMISSIONS, *supra* note 51, and the Affidavit of Ralph H. Striker, a

professional engineer, sworn on June 9, 1972. C.R., Tab IX, at 1. Striker described his background as follows:

> Since 1938 I have been engaged in various process phases of the cement industry; my professional specialty is the chemistry of portland cement manufacture, including process design and related instrumentation control. Within the scope of my specialty is the chemical processes occurring in the manufacture of portland cement and emissions and gas emanating therefrom. Presently I am Vice President of Bendy Engineering Company, St. Louis, Missouri, where I have participated in the design from a basic process standpoint of not less than ten kilns in the last ten years.

[43]** Raw feed is introduced to the kiln at ambient air temperature and is then heated to a temperature of about 2700 degrees Fahrenheit, produced within the kiln by the use of various fuels. The emission standards under challenge here relate solely to the control of particulate matter produced by the kiln operation.

The kiln operation involves the chemical process known as calcining limestone; carbon dioxide is driven from the limestone, converting calcium carbonate (CaCO[3]) into calcium oxide (CaO), (CaCO[3] yields CO[2] + CaO). The calcium oxide later combines with the clay to form a substance known as "clinker", the basic component of cement. The calcination process produces gases and dust as by-products. The particulate matter is suspended in the hot exhaust gas and the various types of emission control devices remove this matter from the gas, before it is emitted into the atmosphere through a stack.

The two types of equipment principally used in removing particulate matter from the exhaust gas are electrostatic precipitators and glass fabric bags, impregnated with graphite, located in a "bag house." When the precipitator is used, dust particles are charged and pass through **[**44]** an electrical field of the opposite charge, thus causing the dust to be precipitated out of the exhaust gas and thereafter collected by the device. When glass fabric bags are used, the exhaust **[*391]** gas is cooled, sometimes by a water spray, so that the bags will operate without damage from excessive heat. The bag filters out the particulate dust, though sometimes the coolant combines with the dust to form a gummy substance as residue in the bags, which must be continuously cleaned out in order to avoid impairing the permeability of the bag.

It is the ability of control devices such as precipitators and bags to separate out a sufficient amount of particulate from the exhaust -- in accord with the proposed standards -- which is under challenge by the manufacturers. The standard requires that the particulate matter emitted from portland cement plants not be "in excess of 0.30 lb. per ton of feed to the kiln . . . maximum 2-hour average".

B. *Technology Available For New Plants*

We begin by rejecting the suggestion of the cement manufacturers that the Act's requirement that emission limitations be "adequately demonstrated" necessarily implies that any cement plant now in **[**45]** existence be able to meet the proposed standards. Section 111 looks toward what may fairly be projected for the regulated future, rather than the state of the art at present, since it is addressed to standards for new plants -- old stationary source pollution being controlled through other regulatory authority. [57] It is the "achievability" of the proposed standard that is in issue.

> 57 Under §§ 109-110, *42 U.S.C. §§ 1857c-4, 5*, of the Clean Air Act the Administrator sets national primary and secondary ambient air standards relating to required air quality for each air pollutant. States must draw up a plan to comply with such standards, which in turn must be approved by EPA. These ambient air standards relate to pollution from any source, whether it be old or new, stationary or moving, but specific new or modified stationary sources are only regulated directly under § 111.

The language in section 111 was the result of a Conference Committee compromise, and did not incorporate the **[**46]** language of either the House or Senate bills. [58] The House bill would have provided that "the Secretary . . . [give] appropriate consideration to technological and economic feasibility", while the Senate would have required that standards reflect "the greatest degree of emission control which the Secretary determines to be achievable through application of the latest available control technology, processes, operating methods, or other alternatives."

58 The Conference Committee considered S.4358, 91st Cong., 2d Sess., 113 (1970) and H.R. 17255, 91st Cong., 2d Sess. sec. 112 (1970). The Report of the Conference does not discuss the language finally adopted, H. REP. No. 91-1783, 91st Cong., 2d Sess. 9, 45 (1970).

The Senate Report made clear that it did not intend that the technology "must be in actual routine use somewhere." [59] The essential question was rather whether the technology would be available for installation in new plants. The House Report also refers to "available" technology. Its caution that **[**47]** "in order to be considered 'available' the technology may not be one which constitutes a purely theoretical or experimental means of preventing or controlling air pollution" [60] merely reflects the final language adopted, that it must be "adequately demonstrated" that there will be "available technology".

59 S. REP. No. 9-1196, 91st Cong., 2d Sess. 16 (1970).

60 H. REP. No. 91-1146, 91st Cong., 2d Sess. 10 (1970).

The resultant standard is analogous to the one examined in *International Harvester, supra.* The Administrator may make a projection based on existing technology, though that projection is subject to the restraints of reasonableness and cannot be based on "crystal ball" inquiry. *478 F.2d at 629*. As there, the question of availability is partially dependent on "lead time", the time in which the technology will have to be available. Since the standards here put **[*392]** into effect will control new plants immediately, as opposed to one or two years in the future, the latitude **[**48]** of projection is correspondingly narrowed. If actual tests are not relied on, but instead a prediction is made, "its validity as applied to this case rests on the reliability of [the] prediction and the nature of [the] assumptions." *International Harvester* at 45.

C. *Right to Comment on EPA Methodology*

We find a critical defect in the decision-making process in arriving at the standard under review in the initial inability of petitioners to obtain -- in timely fashion -- the test results and procedures used on existing plants which formed a partial basis for the emission control level adopted, and in the subsequent seeming refusal of the agency to respond to what seem to be legitimate problems with the methodology of these tests.

1. *Unavailability of Test Methodology*

The regulations under review were first proposed on August 3, 1971 and then adopted on December 16, 1971. Both the proposed and adopted rule cited certain portland cement testing as forming a basis for the standards. In the statements accompanying the proposed rule, the Administrator stated: [61]

> The standards of performance set forth herein are based on stationary source testing conducted **[**49]** by the Environmental Protection Agency and/or contractors . . . .

61 *36 Fed. Reg. 15704 (1971).*

On December 16, this test reliance was reiterated: [62]

> The standards of performance are based on stationary source testing conducted by the Environmental Protection Agency and/or contractors . . . .

62 *36 Fed. Reg. 24876 (1971).*

As indicated in the earlier statement of the case, the proposed standard was accompanied by a Background Document which disclosed some information about the tests, but did not identify the location or methodology used in the one successful test conducted on a dry-process kiln. Further indication was given to petitioners that the Administrator was relying on the tests referred to in the Background Document, when the statement of reasons accompanying the adopted **[**50]** standard were expanded in mid-March of 1972, in the supplemental statement filed while this case was pending on appeal to our court. The Administrator there stated: [63]

> The proposed standard was based principally on particulate levels achieved at a kiln controlled by a fabric filter.

For the first time, however, another set of tests was referred to, as follows:

> After proposal [of the regulation], but prior to promulgation a second kiln controlled by a fabric filter was tested and found to have particulate emissions in excess of the proposed standard. However, based on the revised particulate test method, the second installation showed particulate emissions to be less than 0.3 pound per ton of kiln feed.

63 *37 Fed. Reg. 5767 (1972).*

These two testing programs were referred to in the March 1972 supplemental statement, but the details, aside from a summary of test results, were not made available to petitioners until mid-April 1972. At that time, it was revealed **[**51]** that the first set of tests was conducted April 29-30, 1971, by a contractor for EPA, at the Dragon Cement Plant, a dry process plant in Northampton, Pennsylvania, and that the second set was performed at the Oregon Portland Cement plant, at Lake Oswego, Oregon, a wet process plant, on October 7 and 8, 1971. The full disclosure of the methodology followed in these tests raised certain problems, in the view of petitioners, on which they had not yet had the opportunity to comment. Their original comments in the period between **[*393]** the proposal and promulgation of the regulation could only respond to the brief summary of the results of the tests that had been disclosed at that time.

After intervenor Northwestern States Portland Cement Company received the detailed test information in mid-April 1972, it submitted the test data, for analysis of reliability and accuracy, to Ralph H. Striker, an engineer experienced in the design of emission control systems [64] for portland cement plants. He concluded that the first series of tests run at the Dragon Cement Company were "grossly erroneous" due to inaccurate sampling techniques to measure particulate matter. [65] Northwestern States **[**52]** then moved this Court to remand the record to EPA so that the agency might consider the additional comments on the tests. This motion was granted on October 31, 1972. [66] This action by the Court was based on "the flexibility and capacity of reexamination that is rooted in the administrative process". *International Harvester, 478 F.2d at 632*. We considered this opportunity to make further comments necessary to sound execution of our judicial review function. [67]

64 *See* note 56 *supra*.

65 C.R. Tab IX, Striker Affidavit at 2.

66 A motion of similar effect was granted as to petitioner-intervenor Medusa Corp., to make additional presentations to the agency, on June 23, 1972.

67 Written comments were submitted as requested, and as required by the APA § 4(c), *5 U.S.C. § 553(c)*. Obviously a prerequisite to the ability to make meaningful comment is to know the basis upon which the rule is proposed.

We are aware that EPA was required to issue its standards **[**53]** within 90 days of the issuance of the proposed regulation, and that this time might not have sufficed to make an adequate compilation of the data from the initial tests, or to fully describe the methodology employed. This was more likely as to the second tests, which were begun during the pendency of the proposed regulation. In contrast, more than three months intervened between the conduct of the first tests and the issuance of the proposed regulation. Even as to the second tests however, as we indicated in *International Harvester*, which involved the issue of the availability of the Technical Appendix upon which the auto emission suspension decision was based, the fact that the agency chose to perform additional tests and release the results indicates that it did not believe possible agency consideration was frozen. Slip opin. at 26. It is not consonant with the purpose of a rule-making proceeding to promulgate rules on the basis of inadequate data, or on data that, critical degree, is known only to the agency.

2. The EPA response to the Remand

In this case, EPA made no written submission as to the additional comments made by petitioners. Our remand was ordered, as **[**54]** to Northwestern, on October 31, 1972. All that EPA did was to comply with the mandate that the analysis of Mr. Striker be added to the certified record. It may be that EPA considers Mr. Striker's analysis invalid -- but we have no way of knowing this. As the record stands, all we have is Mr. Striker's repudiation of the test data, without response. The purpose of our prior remand cannot be realized unless we hear EPA's response to his comments, and the record must be remanded again, for that purpose.

We are not establishing any broad principle that EPA must respond to every comment made by manufacturers on the validity of its standards or the methodology and scientific basis for their formulation. In the case of the Striker presentation, however, our prior remand reflects this court's view of the significance, or at least potential significance, of this presentation. If this were a private lawsuit, we might reverse the order under appeal for failure of its proponent to meet the burden of refutation or explanation. Since this is a matter involving the public interest, in which **[*394]** the court and agency are in a kind of partnership relationship for the purpose of effectuating **[**55]** the legislative mandate, we remand. This agency, particularly when its decisions can literally mean survival of persons or property, has a continuing duty to take a "hard look" at the problems involved in its regulatory task, and that includes an obligation to comment on matters identified as potentially significant by the court order remanding for further presentation. Manufacturers' comments must be significant enough to step over a threshold requirement of materiality before any lack of agency response or consideration becomes of concern. The comment cannot merely state that a particular mistake was made in a sampling operation; it must show why the mistake was of possible significance in the results of the test. This was certainly done by Mr. Striker, who on the basis of some extensive mathematical calculations stated:

> It is my personal opinion that the particulate matter emissions of.202 pounds in test 1 per ton of kiln feed reported in the summary sheet on Page vii and again on Page 6 of Exhibit 4-A is grossly erroneous, and that the correct emission of particulate matter is in the neighborhood of.404 pounds per ton of kiln feed.

In order that rule-making **[**56]** proceedings to determine standards be conducted in orderly fashion, information should generally be disclosed as to the basis of a proposed rule at the time of issuance. If this is not feasible, as in case of statutory time constraints, information that is material to the subject at hand should be disclosed as it becomes available, and comments received, even though subsequent to issuance of the rule -- with court authorization, where necessary. This is not a requirement that the rule be suspended, though the court may consider an application for stay based on probability of success and furtherance of the public interest. *Virginia Petroleum Jobbers v. F.P.C., 104 U.S. App. D.C. 106, 259 F.2d 921 (1958).*

Conversely, challenges to standards must be limited to points made by petitioners in agency proceedings. To entertain comments made for the first time before this court would be destructive of a meaningful administrative process.

There are claims made in this court which were not presented to EPA. For example, petitioner Portland Cement Association states in its brief, [68] in regard to the first set of tests at the Dragon Cement Plant:

> Mistakes and conditions **[**57]** occurred which prevented the test from using *observed, measured* values. Encrusted solids were thought to cause a high reading in Run 1 so lower readings from other tests were substituted. The area of a duct was calculated rather than measured due to the presence of deposits. And liquid from Run 3 was erroneously poured into a beaker from Run 2.

From the reference supplied in petitioner's brief, we discern that this criticism of testing procedure was based upon data released on the testing after the 45 day period of comment had passed, and so there was no opportunity at that time to bring this sampling error to the attention of the agency. However, our October 1972 remand gave EPA an opportunity, in its updating and ongoing reexamination, to make a specific comment on petitioner's objection to the Dragon plant test. Instead, only the comment of Mr. Striker was presented.

68 Portland Cement Association Brief at 17-18.

Ordinarily, we would not consider comments not presented to EPA. But here there **[**58]** was belated disclosure by EPA of back-up testing, and remand will be necessary concerning the Striker criticism. Accordingly, we will provide that EPA should, on remand, consider the contentions presented in briefs to this court, though not previously raised, unless EPA explains why they are not **[*395]** material. It will be for EPA, on the remand, to examine the relevancy and import of petitioners' criticisms of the Administrator's methodology.

3. Analysis of Support for Standards

A troublesome aspect of this case is the identification of what, in fact, formed the basis for the standards promulgated by EPA -- a question that must be probed prior to consideration of whether the basis or bases for the standards is reliable. Nominally, there would seem to be three major bases for the rule and its standards: (1) the tests run on the dry-process Dragon Cement Plant, (2) the tests run on the wet-process Oregon Cement Plant, and (3) literature sources. The two tests were discussed by EPA in the supplemental statement issued subsequent to the issuance of the rule. As to literature sources, the Background Document issued with the proposed rule identifies as "a principal literature **[**59]** source" a government study, undertaken under the auspices of HEW in 1967, entitled "Atmospheric Emissions from the Manufacture of Portland Cement".

In the briefs to this Court, EPA counsel disclaim reliance on these three sources, despite statements directly to the contrary accompanying the proposed and promulgated rule, and the supplementary statement of reasons issued on the basis of *Kennecott*.

In regard to the tests, the EPA brief states: [69]

> Since the tests conducted by EPA were used, *along with other items*, to assist in determining what emission levels were being achieved by properly maintained and operated control equipment, and were not used as the *primary* basis for the cement standards, petitioner's criticisms of such tests and testing procedures are irrelevant. (emphasis supplied)

The brief further states that the HEW study "was not relied upon to support the achievability of the cement standards". [70]

69 Brief at 21-22.
70 *Id. at 19.*

Counsel on appeal **[**60]** cannot substitute new reasons for those offered by the agency. [71] Certainly, counsel cannot disclaim reliance on reasons offered by the agency in its statement of reasons, except in the sense that errors may be asserted to fall within the limited "harmless error" doctrine applicable to administrative agencies.

71 *Burlington Truck Lines v. United States, 371 U.S. 156, 168-9, 9 L. Ed. 2d 207, 83 S. Ct. 239 (1962)*; *International Harvester, supra*, slip op. at 25; *Braniff Airways, Inc. v. CAB, 126 U.S. App. D.C. 399, 411, 379 F.2d 453, 465 (1967).*

We turn now to the specific technical problems raised by the cement manufacturers.

a. *Dragon Cement Plant tests* [72]

72 A description and analysis of these tests is in the Certified Record, Tab V (i). Emission Testing Report, ETB Test Number 71-MM-05. Emissions from Dry Process Cement Kiln at Dragon Cement Company, Northampton, Pennsylvania. Environmental Protection Agency, Office of Air Programs.

[61]** Two kilns were tested by the EPA contractor at the Dragon Cement Plant. [73] A test of a dry-process kiln controlled with a baghouse is used for support of the standard since testing "showed particulate emissions of 0.20 pound per ton of feed, which is below the proposed standard." [74] This particular plant was selected for testing on the **[*396]** basis that it was reportedly one of the 12 best controlled plants in the United States.

73 The Background Document indicates that two wet process kilns controlled by electrostatic precipitators were unable to meet the proposed standards, and they are not relied upon here. We are not supplied with an identification of the plant(s) where these tests were performed. The Background Document states that four kilns were tested but that "results of only three tests were available at the time the standards were proposed" and also discloses that the missing test was performed upon a dry process kiln. JA at 47-48. We are uncertain whether this fourth kiln was one of the two tested at the Dragon Plant or was located at still another plant.
74 *Id. at 48.*

[62]** The first point raised by petitioner, and included in the comments by cement manufacturers presented to the agency on its proposed standard, [75] was that a single test offered a weak basis for inferring that all new cement plants would be able to meet the proposed standards. As we stated in *International Harvester, supra, 478 F.2d at 647*, "It would . . . seem incumbent on the Administrator to estimate the possible degree of error [inherent] in his prediction." The significance of the lack of any indication of statistical reliability was underscored by T. E. Kreichelt, the author of the HEW study relied upon by the Administrator, in a letter, by way of comment, on the proposed standard. [76] He stated that "the emission limit was based on one (1) test, i.e. the fabric filter test. . . . I do not believe that the emission limits should be selected on only four tests, much less one test."

75 *See* Comments in C.R. Tab VIII, items 10 (Portland Cement Association), 14 (General Portland Cement Company), 20 (Ideal Basic Industries, Inc.).
76 Letter of Thomas E. Kreichelt, C.R. Tab VIII, item 27, at 2.

[63]** Mr. Kreichelt raised a second and related point addressed to the reliability of a prediction based on a successful dry-process plant, for a prediction that wet-process plants would be able to also meet the standard. He stated in this regard: [77]

> Another outcome of basing emission limits on insufficient data is that the limit may represent only part of a given industrial classification. For example, is 0.30 lb/ton of feed attainable only for dry-process kilns? Or is it also attainable for wet-process kilns? Probably both, but there is not even one test to substantiate the limit for wet-process kilns. For each variation of each process of each source classification, the number of tests required should be sufficient (say, three tests within the limit) to result in statistically sound limits.

77 *Id.*

We are not here considering a regulation that was issued in the contemplation that all new cement plants will be dry-process, and controlled by baghouses on the theory that this is the "best **[**64]** system" of emission control. Possibly such an approach would be feasible, but in any event it would require underlying reasons, by EPA, to terminate the process which the HEW had identified as major now and in future projection. [78]

78 *See* ATMOSPHERIC EMISSIONS, *supra* note 51, at 6-7.

A second objection is to the techniques used by the EPA to measure emissions from the Dragon plant.

These "sampling" techniques assume particular importance if they deviate from procedures, outlined by regulation, for ascertaining compliance with prescribed standards. Although this difference could be eliminated -- as the Administrator attempted to do in *International Harvester* -- by rewriting "sampling" techniques, rather than lowering standards, a significant difference between techniques used by the agency in arriving at standards, and requirements presently prescribed for determining compliance with standards, raises serious questions about the validity of the standard. [79]

79 "Sampling" techniques were modified by EPA between the date of the proposed rule and the promulgated rule in this case. The EPA stated in adopting the rule here under review, *36 Fed. Reg. 24876 (1971)*, at para. 1:

> Particulate matter performance testing procedures have been revised to eliminate the requirement for impinges in the sampling train. Compliance will be based only on material collected in the dry filter and the probe preceding the filter.

We speak here of inconsistencies between the revised standards and the tests performed on which the standards were based.

[65]** **[*397]** The cement manufacturers point, in this regard, to the absence of continuous sampling in the EPA data, since the "longest elapsed time of any sampling episode was 30 minutes", [80] whereas under the regulations promulgated, conformity is to be measured on the basis of maximum 2-hour averages. [81] It is incumbent on the Administrator to explain the discrepancy.

80 This claim is made on the basis of inspection of the full report of the EPA contractor. *See* C.R. Tab V (i), App. E, at 41.
81 § 60.62 (a) (1), *36 Fed. Reg. 24876 (1971).*

The second point raises the question, on the basis of a handwritten note made by the EPA contractor, as to whether the tested plant was operating at maximum performance during testing. The contractor had noted, "Baghouse is undersize and production is held back due to this." [82] Compliance tests under the regulation require, however, that "All performance tests shall be conducted while the affected facility is operating at or above the maximum **[**66]** production rate. . . ." [83]

82 C.R. Tab V (i), App. B, at 22. This notation was made on a form which required, in part, a "description of any unusual features about environment; height; odors; toxic conditions, temperature, dust, etc.
83 § 60.64 (b), *36 Fed. Reg. 24876 (1971).*

Thirdly, petitioner contends that mistakes made in the measurement process prevented the test from using observed, measured values. As previously noted, encrusted solids can collect in the bag, and must be constantly cleaned out if the baghouses are to operate with efficiency. In one of the runs conducted, the presence of the solids in the bag were thought to cause a high reading, so lower readings from other test runs were substituted. On another run, the liquid, which was to be the basis for a measurement of particulate concentration, was erroneously poured into a beaker from a previous run. [84] However, deviations from prescribed measurement techniques are not necessarily significant as to testing results, and **[**67]** if petitioners press this point on remand they must establish that such test deviations bear significant consequences.

84 C.R. Tab V (i), at 7.

Finally, engineer Striker claims significant errors of measurement were made in determining the measurement of the cubic feet of stack gas per minute, and a resulting understatement of the true volume of calcining carbon dioxide included in total stack gas. He states that commonly "35% (plus or minus 1%) of raw feed is converted into carbon dioxide in the burning process." [85] He then notes that an accurate measure of raw feed is the volume of calcining carbon dioxide [86] appearing in stack gas, which in turn depends on an accurate measurement of the volume of stack gas. His own calculations, based on EPA data showing a stack flow rate of 51,187 cubic feet per minute of dry gas, indicate that there were 2153 cubic feet per hour of stack gas in the test attributable to calcining carbon dioxide coming from the raw feed and that "as a matter of basic chemistry" 2153 cubic **[**68]** feet of calcining carbon dioxide "comes only from 22.11 tons of raw feed." [87] This was at variance from the kiln rate of 44.03 tons of raw feed per hour reported in the test. He concludes that the error lay not in the measurement of the raw feed, but in the test data reported on the stack gas volume -- flow rate of 51,187 -- which in his judgment requires more sophisticated equipment for recording than does the raw feed which is easily measurable. Having corrected the stack gas figure, he states his opinion that the EPA assumption of emissions satisfying **[*398]** its ultimate 0.30 standard was in error. [88] He concluded:

> It is my personal opinion that the particulate matter emissions of.202 pounds in test 1 per ton of kiln feed reported . . . is grossly erroneous and that the correct emission of particulate matter is in the neighborhood of.404 pounds per ton of kiln feed.

We are not competent to decide if Mr. Striker's methodology and conclusions are correct. We can note, however, that he claims that as a matter of "basic chemistry" two test values, for feed and gas volume, cannot co-exist. This is certainly the type of criticism EPA should be required to discuss **[**69]** on remand.

85 C.R. Tab IX, at 3.
86 The term calcining carbon dioxide is used to distinguish it from the carbon dioxide that is the result of burning fuel in the kiln.
87 C.R. Tab IX, at 4.
88 *Id. at 2.*

b. *Oregon Portland Cement Plant tests* [89]

89 A description and analysis of these tests is in the Certified Record, Tab V (h), Emission Testing Report, ETB Test Number 71-MM-15. Emissions from Wet Process Kiln at Oregon Portland Cement, Lake Oswego, Oregon. Environmental

Protection Agency, Office of Air Programs.

The Oregon plant was wet-process controlled by a baghouse. Three tests were made on the kiln operation. The brief of petitioner Portland refers to the test results of the EPA contractor, and points out that these show that in test 1 and 2, particulate emissions were.535 and.361 pounds per ton of kiln **[**70]** feed. Only in the third test was there a result of.291 pounds. Petitioners argue that when only one out of the three tests meet the EPA standards (0.3 percent), the data undercut the validity of the standard. EPA's brief did not address itself to this point, relying instead on its general expertise. If our study of the matter is accurate, it appears that petitioners failed to take into account that the standard, as promulgated, eliminated one of the sampling techniques required by the standard as proposed. This undercuts petitioner's contention. [90]

> 90 C.R. Tab V (h) at 5. Curiously EPA did not make the point that the test results of.535,.361,.291, showing only 1 out of 3 successful tests, were based on "total catch". This means that the results reflected readings based on probe, filter and impinger sampling techniques. As we observed however, note 79 *supra*, the adopted standard was based only on probe and filter sampling techniques. The Oregon test gave these results for tests conducted on that basis:.247,.309,.261, which shows two successful tests and one almost successful. C.R. Tab V (h), at 4-5.

[71]** A more serious matter is presented by intervenor Northwestern, which points to the fact that the EPA contractor's report indicates that sampling was not conducted when "process operation was interrupted" and that sampling was only conducted during the periods of "normal operation". The report states:

> Several conditions contributing to these interruptions were: (1) excessive pressure drop across bag house, (2) visible emissions from leaking bags, and (3) breakdown of dust removal equipment. (C.R. Tab V (h) at 9).

The concern of the manufacturers is that "start-up" and "upset" conditions, due to plant or emission device malfunction, is an inescapable aspect of industrial life, and that allowance must be made for such factors in the standards that are promulgated. On August 18, 1972, some eight months after the issuance of the standards under review, and prior to our October, 1972 remand, the EPA proposed a new regulation to take "startup, shutdown and malfunction" problems into effect. [91] The proposed **[*399]** regulation, which as yet has not been adopted, sets up a procedure by which emissions due to malfunction will not be the basis of an enforcement action. **[**72]** It requires reports from manufacturers in cases where emissions exceed standards, recording the "violation" and indicating what measures will be taken to correct or minimize the excess emission levels. The proposed regulation provides: [92]

> (f) Nothing in this section shall relieve a source from compliance with the standards set forth in this part unless the Administrator determines that (1) the occurrence in question did not result from the failure by the owner or operator of the source to operate and maintain properly the affected facility, (2) all reasonable steps were taken to correct, as expeditiously as practicable, the condition causing the emissions to exceed the standards, including the use of off-shift labor and overtime if necessary, and (3) all reasonable steps were taken to minimize the emissions resulting from the occurrence.

> 91 *37 Fed. Reg. 17214* (August 18, 1972). EPA admitted in its introduction to the proposed regulation that the standards here under review did not take into account this problem. EPA attempted to obviate the implicit criticism by stating in its proposal:
>
>> Such occurrences generally are dealt with by the exercise of discretion in the Agency's enforcement activities. The exercise of this discretion would have been accomplished by means of an informal process, in which, before the Agency took enforcement action, sources that had exceeded the standards would

> have attempted to demonstrate to the Agency that such excess emissions had been unavoidable.

Broadly read, however, this view of enforcement discretion would defer the question of "available" technology to the enforcement stage, an approach not contemplated by section 111. Companies must be on notice as to what will constitute a violation. Moreover, an excessively broad theory of enforcement discretion might endanger securing compliance with promulgated standards.

We do agree, however, with the policy reasons offered by EPA for moving from an informal to a formal system of regulation. EPA's explanation of its regulation stated:

> Three fundamental reasons suggested the correctness of this determination. First, the existence of a formal process better informs the public of the policy and factual issues which will underlie enforcement of the standards. Second, affected industries which are making good faith efforts to meet the standards will on the whole welcome a regularized means of informing the Agency in detail of the circumstances surrounding unavoidable emissions. Third, the Agency expects to benefit substantially from the information it will gain about the operation of the processes in question, for both future enforcement and standard setting.

[73]**

92 *Id.*

The proposed regulation, if adopted, may have consequences which go beyond mere provision for malfunctions. In some sense it imparts a construction of "reasonableness" to the standards as a whole and adopts a more flexible system of regulation than can be had by a system devoid of "give." As we noted in *International Harvester, supra*, a regulatory system which allows flexibility, and a lessening of firm proscriptions in a proper case, can lend strength to the system as a whole. "The limited safety valve permits a more rigorous adherence to an effective regulation." *478 F.2d at 641*, quoting from *WAIT Radio v. FCC, 135 U.S. App. D.C. 317, 323, 418 F.2d 1153, 1159*.

If the EPA adopts, or intends to adopt, this proposed regulation, it may take the attendant flexibility into account, on remand, as pertinent to the manufacturers' objections, even though the new regulation has been proposed in a proceeding with a different docket number and caption.

c. *Literature Sources*

The principal source in the scientific literature used by EPA, **[**74]** HEW's "Atmospheric Emissions from the Manufacture of Portland Cement", [93] is called into question by petitioner on the ground that the test methods used to compile the results of the study were at odds with those used by EPA in its own tests. [94] While counsel for EPA disclaims reliance on the source, the study was cited in the EPA's Statement of Reasons, and EPA should address itself to this contention on remand.

93 *See* note 51 *supra*.

94 As to how results might be skewed by different sampling methods, *see* note 90 *supra*, and Comments of Mr. Kreichelt on the proposed rule, C.R. Tab VIII, item 27, at 2-5.

[*400] In this connection, a comment on the proper use of scientific literature may be in order. If such literature is relied upon, the agency should indicate which particular findings of that literature are significant. A generalized reference, to a work as a whole, will avail the agency little if a problem arises on judicial review. On remand, any findings in the literature that **[**75]** are relied on by EPA should be specifically indicated. The same procedure is contemplated here as for the test data not submitted to the manufacturers prior to promulgation of the rule, that there be opportunity for comment, and an explanation presenting the EPA position on any challenge. [95]

95 There is evidence in the record furnished by vendors of emission control devices but not relied upon by the EPA to support its standard that, with proper allowance for malfunction problems, the standards can be met. By way of comment to the

proposed rule, Mr. R. E. Frey, Vice President, Mikro Pul Co., stated in a letter of September 20, 1971, C.R. Tab V (e), that: "A properly applied fabric filter (or bag house) will operate with no visible emission. Actual measured outlet loadings are almost always below 0.02 grains per cubic foot and often as low as 0.000 x grains per cubic foot." This would of course be below the required.03 grains per cubic foot standard, the converted measure of.30 lb. per ton of feed to the kiln.

Three letters were inserted into the record following our June 1972 remand of this case, following the motion of intervenor Medusa Corp. Mr. Jack C. Thomas, Sales Manager of Rock Products Industry represented to Medusa that:

> "We can and will guarantee that our Lurgi Electrostatic Precipitator will limit the effluent to less than .30 lbs. per ton of feed to the kiln. However, we cannot guarantee to meet this collection efficiency 100 per cent of the time. During kiln start-up and upset conditions and during possible malfunction, it is conceivable that the effluent would not be in compliance with the E.P.A. Code.

Similar guarantees were offered by Rock Creek for fabric filter bags.

Claims of capability to conform to the EPA standards were also in letters to Medusa -- though without mention of guarantees -- from Buell, Division of Envirotech Corp., and Kaiser Engineering. C.R. Tab X.

These claims by the vendors could not be responded to by way of comment, since they were themselves produced as comment, and can be considered on remand. We note, however, that if vendor representations were to be a principal source of reliance by the agency, representations peculiarly subject to considerations of self-interest, more might be required than mere comments. *See American Airlines v. CAB, 123 U.S. App. D.C. 310, 318-319, 359 F.2d 624, 632-33 (1966)* (en banc), cert. denied, *385 U.S. 843, 17 L. Ed. 2d 75, 87 S. Ct. 73 (1966). Compare International Harvester, supra*, slip op. at 22. *Also see Kennecott Copper supra, 149 U.S. App. D.C. at 235, 462 F.2d at 850*: "There are contexts, however, contexts of fact, statutory framework and nature of action, in which the minimum requirements of the Administrative Procedure Act may not be sufficient."

[76]** d. *Opacity Standard*

Apart from the standard directly regulating particulate concentration, EPA has adopted an opacity standard which provides that there shall be no discharge of particulate matter from the kiln which is: [96]

> Greater than 10 percent opacity, except that where the presence of uncombined water is the only reason for failure to meet the requirements for this subparagraph, such failure shall not be a violation of this section.

Opacity is defined by the regulation as "the degree to which emissions reduce the transmission of light and obscure the view of an object in the background." [97]

96 § 60.62(a) (2), *36 Fed. Reg. 24876 (1971).*
97 *Id.* at § 60.2(j).

It may be, as EPA argues, that the opacity test is an important enforcement tool, [98] and that the results of an opacity test, which is normally performed at some distance from the plant by trained observers, offers a cheaper **[*401]** and faster method of determining compliance than enforcement **[**77]** of the particulate concentration standard. [99] However, it is one thing to use a method of testing to observe possible violations of a standard; it is another to constitute that method as the standard itself. If the opacity test is to be a standard, and if violations can result in enforcement actions without further testing, the standard must be consistent with the statute and congressional intent.

98 *See* Comment of State of Maryland to the proposed rule: "Such a prohibition is one of the most effective tools available to state and local regulatory authorities." C.R. Tab VIII, item 24.

99 Although the revised sampling methods of EPA may have lowered the cost of testing for compliance, National Gypsum Co. commented to the agency on the proposed rule that "the cost of running a test by the proposed method on a single baghouse ranges in the neighborhood of $10,000 to $15,000. . . ." Tab VIII, item 6.

The thrust of the manufacturers' comments to EPA, and repeated here, is that the opacity test is arbitrary **[**78]** -- that inspectors will be unable within any reasonable degree of accuracy to determine whether permitted opacity is 10%.

The critical question is how accurate can opacity observations be. On this point we essentially have before us only the contentions of the parties. The manufacturers do point to a test conducted for the National Center for Air Pollution Control (U.S. Dept. H.E.W.), where six trained smoke inspectors evaluated a white training plume known to have 0% opacity. [100] All six inspectors rated the plume at more than 0% opacity and 3 evaluated it at more than 20%. A plume known to be at 20% opacity was rated higher than 20% by 5 of the 6 inspectors (one rated it lower) and 2 of them rated it at almost 40%. Problems may also be posed for deciding when opacity is due to water content and when it is not. [101]

100 *See* Optical Properties and Visual Effects of Smoke Stack Plumes, Pub. Health Serv. Pub. 999-AP-30 (1967 National Tech. Info. Serv. PB 174-705), at 28.

101 *Compare State v. Fry Roofing Co., 9 Ore. App. 189, 495 P.2d 751, 757-58 (1972).*

[79]** The difficulty is that this test has the thrust of indicating that opacity measurements are inherently inadequate, and does not seem to be probative of the manufacturer's quite different claim, namely, that it is at the low ranges that opacity tests become less reliable, and too unreliable to be a legal standard.

On the other hand, EPA's brief does nothing more than point to the fact that many states have required that the plumes from stack emissions conform to a specified percentage of opacity. We note, however, that the opacity standard is at least 20% in the states cited, which corresponds to No. 1 on the Ringelman Smoke Chart. [102]

102 *See* Arizona Rules and Regulations for Air Pollution, 1 BNA State Air Laws Environ. Reptr. (BNA Air) 311:0502 (40% for visible emission); Arkansas Air Pollution Control Code, 1 BNA Air 316:0504 (20% for new equipment used in a manufacturing process); *California Health and Safety Code § 24242* (1967) (40% for aircraft discharge). *Also see* Connecticut Administrative Regs., 1 BNA Air 331.0513 (20% for visible emissions); Delaware Administrative Regs., 1 BNA Air 336.0861 (20% for visible emissions).

[80]** We think the HEW test adduced by petitioners, though not decisive, suffices to require further consideration and explanation by EPA on remand, and a showing on the record that 10% opacity measurements can be made within reasonable accuracy. [103]

103 We think Congress anticipated, as in the National Traffic and Motor Vehicle Safety Act of 1966, that the standards be "objective", *15 U.S.C. § 1392(a)*, Otherwise "a manufacturer has no assurance that his own test results will be duplicated in tests conducted by the Agency." *Chrysler Corp. v. Dept. of Transportation, 472 F.2d 659, 675 (6th Cir. 1972).*

V. THE STANDARD OF JUDICIAL REVIEW AND CONCLUSIONS

We are quite aware that the standards promulgated and here under review are to be applied to *new* stationary sources. It would have been entirely appropriate **[*402]** if the Administrator had justified the standards, not on the basis of tests on existing sources or old test data in the literature, but on extrapolations **[**81]** from this data, on a reasoned basis responsive to comments, and on testimony from experts and vendors made part of the record. This course was not followed here. Instead, the Administrator in his statement of reasons relied on tests on existing plants and the literature, which EPA counsel now discounts without reference to other record support to take its place.

The Administrator's objectives are laudable, but the statute expressly requires, for the standards he promulgates, that technology be achievable. This record reveals a lack of an adequate opportunity of the manufacturers to comment on the proposed standards, due to the absence of disclosure of the detailed findings and procedures of the tests. This was not cured following our previous October 1972 remand to the agency.

We have identified a number of matters that require consideration and clarification on remand. While we remain diffident in approaching problems of this technical complexity, *see International Harvester, supra, 478 F.2d at 648*, the necessity to review agency decisions, if it is to be more than a meaningless exercise, requires enough steeping in technical matters to determine whether the **[**82]** agency "has exercised a reasoned discretion". *Greater Boston TV v. FCC (I), 143 U.S. App. D.C. 383, 392, 444 F.2d 841, 850*, cert. denied, *403 U.S. 923, 91 S. Ct. 2229, 29 L. Ed. 2d 701 (1971)*. We cannot substitute our judgment for that of the agency, but it is our duty to consider whether "the decision was based on a consideration of the relevant factors and whether there has been a clear error of judgment." *Citizens To Preserve Overton Park v. Volpe, 401 U.S. 402, 416, 28 L. Ed. 2d 136, 91 S. Ct. 814 (1971)*. Ultimately, we believe, that the cause of a clean environment is best served by reasoned decision-making. The record is remanded for further proceedings not inconsistent with this opinion.

So ordered.

LEXSEE

PORTLAND CEMENT ASSOCIATION, an Illinois not-for-profit Corporation, Petitioner, v. Russell E. TRAIN, Administrator, Environmental Protection Agency, Respondent, Medusa Portland Cement Company and Northwestern States Portland Cement Company, Intervenors

No. 72-1073

UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA CIRCUIT

513 F.2d 506*; *168 U.S. App. D.C. 248*; *1975 U.S. App. LEXIS 14587*; *7 ERC (BNA) 1941*; *5 ELR 20341

April 1, 1975, Argued
May 22, 1975, Decided

PRIOR HISTORY: **[**1]** On Hearing Subsequent to Remand Proceedings Before the Environmental Protection Agency.

DISPOSITION: Affirmed.

COUNSEL: Robert E. Haythorne, Chicago, Illinois with whom Edward W. Warren, Scranton, Pennsylvania was on the brief, for Petitioner.

William L. Want, Atty., Dept. of Justice, with whom Wallace H. Johnson, Asst. Atty. Gen., Edmund B. Clark and Martin Green, Attys., Dept. of Justice, were on the brief, for Respondent.

JUDGES: Fahy, Senior Circuit Judge, and Leventhal * and Robb, Circuit Judges.

* Circuit Judge Leventhal did not participate in this decision.

OPINION BY: PER CURIAM

OPINION

[*507] The court remanded to the Administrator of the Environmental Protection Agency, respondent, the case then before us involving the validity of the stationary source standards [1] he had promulgated [2] under section 111 of the Clean Air Act [3] for new or modified portland cement plants. *Portland Cement Association v. Ruckelshaus, 158 U.S.App.D.C. 308, 486 F.2d 375 (1973)*, cert. denied, *417 U.S. 921, 94 S. Ct. 2628, 41 L. Ed. 2d 226 (1974)*. Some of the matters the court then reviewed on the petition of the Portland Cement Association we concluded required **[**2]** further consideration and clarification, hence the remand. These matters have now been reconsidered and clarified in the Administrator's Response to the Remand Order, formulated after his draft of such Response had been the subject of comments by the Association and others. The Association has again petitioned this court, to decide whether the Administrator has complied with the remand order and whether the standards should be affirmed or set aside.

1 These standards prescribed a maximum emission limit of.03 gr/scf for particulates (cement dust) from newly-constructed or modified cement plants and a limit of 10% for the opacity of plumes from the stacks of such plants.

2 *40 C.F.R. § 60.62* (December 16, 1971).

3 *42 U.S.C. § 1857c-6*.

At argument petitioner's counsel relied upon a formulation of positions which he handed to the court and which reads as follows:

> 1. Do established constitutional guarantees against statutory discrimination apply to environmental **[**3]** regulations?
>
> 2. If so, may the victim of a discriminatory regulation have it set aside through direct judicial review?
>
> 3. Under what, if any, circumstances could economic considerations produce a standard lower than the highest technologically achievable?
>
> 4. How does a standard prohibiting *momentary* excessive emissions conform to a statute whose purpose is curbing the total volume of pollution?
>
> 5. How can plume opacity be [a] valid standard when pollution and plume opacity can not be reliably correlated and evaluations of the same plume by several qualified observers will vary substantially?

The issues raised in these questions are more limited than those presented by petitioner in its brief. Therefore, although the questions will form the frame of reference for this opinion, other issues will be touched upon as well.

Questions 1 and 2 are directed to petitioner's contention that the emission standard for cement plants is more stringent than those for incinerators and coal-fired power plants, and, also, for plants of the competing asphalt industry, as to which, however, no question had been raised at the agency level.

[*508] Petitioner's contention **[**4]** is weakened by its admission, made in its comments on the Administrator's draft response to the remand, that the standard for the portland cement industry is achievable by that industry. Moreover, our remanding opinion indicated our disagreement with petitioner on the subject of different emission standards for different industries. See, *486 F.2d at 389*. Amplifying upon what we there said, we find no reasonable basis for invalidating as discriminatory the achievable emission standard for cement plants. Proof of unreasonableness in the diversity of the standards referred to is lacking. No doubt the Administrator will be influenced by accumulating experience should it give rise to reasons for modification of the range now existing between the prescribed standards.

Petitioner's question No. 3 is very generally phrased. Neither the terms of our remand nor the proceedings now before us require an answer by the court. We note, however, that of course section 111 of the Act requires the Administrator to take into account the cost of achieving the emission reduction he prescribes. In our remanding opinion we did not require respondent to prepare a quantified cost-benefit analysis, **[**5]** showing the benefit to ambient air conditions as measured against the cost of the pollution control devises. We stated, however, that such studies as might be adduced in comments should be considered and that the Administrator should also consider contentions and presentations that the adopted standard unduly precludes the supply of cement, including whether it is unduly preclusive as to certain qualities, areas, or low-cost supplies. Though the Administrator found that "relating the cost of control to the benefits of the control at least at this time is a practical impossibility," he went on to state that where the costs of meeting standards would be greater than the industry could bear and survive, such standards could not be implemented by the industry regardless of technological feasibility, and, moreover, that a gross disproportion between achievable reduction in emission and cost of the control technique would not be required. Here too we find no reason to disagree with the Administrator's disposition of this aspect of the remand. The industry has not shown inability to adjust itself in a healthy economic fashion to the end sought by the Act as represented by the standards prescribed. **[**6]** [4]

> 4 The Administrator in his Response to the Remand Order has fully considered and rationally rejected the cost-benefit analysis which was submitted by petitioner.

Question No. 4 was not at issue on the remand and we accordingly do not feel called upon to deal with it. [5]

> 5 We add that the record before us affords no basis for holding that controlling momentary excessive emissions does not aid in curbing total

pollution.

As to question No. 5, we have considered the detailed analysis by the Administrator of numerous factors involved in the use of plume opacity to determine whether or not a portland cement plant achieves a prescribed standard of pollution control. We are not warranted on the basis of his analysis to find that plume opacity is too unreliable to be used either as a measure of pollution or as an aid in controlling emissions.

[7]** The Administrator, using trained plume observers, has enlarged upon the tests previously utilized, in the effort to reach a reasonably accurate standard of measurement of opacity. He sets forth in detail the results which led to his 10% standard "as the standard which may not be exceeded by new kilns at Portland cement plants," with a relaxation, however, now permitted, to 20% opacity "to accomodate certain extreme circumstances." His conclusions in resolving the opacity problem and the achievability of the prescribed opacity standard are well reasoned. The court finds no sound basis for rejecting them, remembering the tempered review we exercise in these matters of non-judicial expertise, and remembering too that in this, as in a **[*509]** somewhat related area which recently confronted the Supreme Court under the Clean Air Act, the courts cannot and do not "attempt to foresee, at this stage in the administration of the statute, all of the questions, say nothing of the answers, that may arise" -- in that case over the allocation of a limited number of available variances under section 110(a)(3) of the Act [6] -- in this case over the learning with respect to the value of plume **[**8]** opacity in measuring and controlling pollution.

6 *Train, Administrator v. Natural Resources Defense Council Inc., 421 U.S. 60, 94 n.28, 95 S. Ct. 1470, 43 L. Ed. 2d 731 (1975).*

We turn to another matter. In our remand decision we held that respondent was not required to file an impact statement pursuant to the National Environmental Policy Act, [7] but should set out "significant adverse environmental consequences" of its standards as a "functional equivalent" of an impact statement. We note now a contention raised by petitioner in this regard, namely, that water pollution will be aggravated as a result of the larger piles of kiln dust caused by the tight emission controls. We have no factual basis, however, for disagreeing with the position of the Administrator that petitioner's contention that the dispersal of the pollutants into the air would better serve the environment. The Administrator satisfactorily responds to this suggested alternative as follows, insofar as the record before us affords **[**9]** a basis for decision:

> . . . the total amount of particulates disposed of will be less if collected by emission control devices than if vented uncontrolled into the atmosphere.
>
> * * *
>
> To the extent there is a problem, it is the judgment of the Administrator that the problem of water run off from collected piles of particulate matter is less than the problem of uncontrolled releases of particulate matter into the atmosphere.

7 *42 U.S.C. §§ 4321-4335.*

Finally, we note the Administrator's response to the court's direction that the bases for the emission standard should be further identified. At the time of our remand tests on only two cement plants had been conducted. Since then the Administrator has tested five more plants. Although petitioner had an opportunity to comment on the results of only two of these, all seven tests have shown that the emission standard is achievable. The Administrator has in this as in other respects adequately responded to our remand.

[10]** The consequence is that we hold the standards prescribed to be valid. The action of the Administrator in promulgating them is, accordingly,

Affirmed.

To: Jonathan Averback/DC/USEPA/US@EPA;Rob Brenner/DC/USEPA/US@EPA;Jeneva Craig/DC/USEPA/US@EPA;Patricia Embrey/DC/USEPA/US@EPA;Arvin Ganesan/DC/USEPA/US@EPA;Eric Ginsburg/RTP/USEPA/US@EPA;Joseph Goffman/DC/USEPA/US@EPA;Joel Beauvais/DC/USEPA/US@EPA;Jim Ketcham-Colwill/DC/USEPA/US@EPA;Ellen Kurlansky/DC/USEPA/US@EPA;Adam Kushner/DC/USEPA/US@EPA;Janet McCabe/DC/USEPA/US@EPA;Gina McCarthy/DC/USEPA/US@EPA;David McIntosh/DC/USEPA/US@EPA;Sam Napolitano/DC/USEPA/US@EPA;Steve Page/RTP/USEPA/US@EPA;Peter Tsirigotis/RTP/USEPA/US@EPA;Lorie Schmidt/DC/USEPA/US@EPA;Mike Thrift/DC/USEPA/US@EPA;Lydia Wegman/RTP/USEPA/US@EPA;"McConville, Drew"
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From: "Walke, John"
Sent: Fri 4/29/2011 5:37:11 PM
Subject: AIR POLLUTION: Draft bill offers rule exemptions for coal-burning utilities (04/29/2011)
Draft AEP bill.pdf
Click here

Legislation drafted by AEP attached.

AIR POLLUTION: Draft bill offers rule exemptions for coal-burning utilities (04/29/2011)

Jean Chemnick, E&E reporter

Draft legislation being circulated on Capitol Hill would exempt utilities from a host of air pollution rules if they agree to retire older coal-fired power plants by the end of 2020 or if they submit an alternative plan to U.S. EPA for ratcheting down sulfur dioxide, nitrogen oxides and other pollutants.

Sources say the discussion draft was written by American Electric Power Co., a major multistate utility that has been lobbying Congress for more industry-friendly Clean Air Act rules and a longer time frame to comply with them. AEP spokeswoman Melissa McHenry was unable to confirm the draft was offered by her company but provided an outline that generally tracked with the bill.

The proposal would give utilities until January 1, 2014, to commit to retiring older coal plants by the end of 2020 or to replacing them with units that run on natural gas or renewable fuel or use "advanced coal-fueled technology" to reduce emissions.

The measure lists the emission technologies, including carbon capture and storage, scrubbers, selective catalytic reduction or "any other control technology" as determined by EPA.

Utilities that submit an alternative schedule and plan for compliance would receive an exemption from nearly all new federal air pollution rules that pertain to power plants -- for SO2 and NOx, particulates, ozone and lead. Also on the list are EPA's mercury and air toxics standards.

The bill would also provide an exemption from EPA's New Source Performance Standards not only for conventional pollutants like SO2, ozone and particulates, but also for carbon dioxide. It would also place a stay on the prevention of significant deterioration or new source review requirements for carbon dioxide.

In exchange for the exemptions, a utility would be required to reduce SO2 emissions by 90 percent, NOx by 80 percent and mercury by either 70 percent or 85 percent depending on the type of coal burned by the power plant.

These reductions would be made in full by the end of 2020. No exemptions would be provided for emissions laws that were in place at the beginning of 2010.

John Walke, a senior attorney on air quality issues for the Natural Resources Defense Council, called the bill "grossly excessive and greedy."

"There's never been a bill in Congress to even contemplate eliminating those standards," he said, adding that the draft, if it became law, would cause thousands of premature deaths and unnecessary illnesses.

A Republican Senate aide said the draft was one of several proposals aimed at combating what he called a regulatory "train wreck" -- rules that EPA plans to finalize in the next year or so. The rules would cause the coal-fired electrical industry to take a major hit, he said, taking 60 to 100 gigawatts of power offline in a short period of time.

"That has enormous implications for electrical reliability, as well as the electricity rates that people have to pay, because this stuff has got to be replaced in some fashion, whether it's new coal, nuclear, natural gas," the aide said. "Take your pick."

He described the draft as a composite of ideas floated on Capitol Hill.

"Really right now, there is a dialogue," he said. "It's in a discussion phase.

"Folks are looking at EPA's rules, which haven't even been noticed in the Federal Register yet," he said. "They're trying to understand what the implications of the proposal would be. ... They're trying to assess 'What do they need to get by here?' -- and I think that's why a company or two has an affinity for a certain policy. But senators have their own ideas."

Click here to read the draft.

Best,

John Walke

Natural Resources Defense Council

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Read my blog on clean air policy and law at http://switchboard.nrdc.org/blogs/jwalke/.

112TH CONGRESS
1ST SESSION

S. | |

To provide for coordination of certain new Federal environmental requirements to achieve environmental goals and objectives while promoting a sound national energy policy, ensuring the supply of affordable, reliable electricity in all regions of the United States, minimizing loss of jobs and other adverse economic impacts on the United States economy, and enhancing the international competitiveness and the productive capacity of the United States manufacturing industry, and for other purposes.

IN THE SENATE OF THE UNITED STATES

| | | | | | | | | |

| | | | | | | | | | introduced the following bill; which was read twice and referred to the Committee on | | | | | | | | | |

A BILL

To provide for coordination of certain new Federal environmental requirements to achieve environmental goals and objectives while promoting a sound national energy policy, ensuring the supply of affordable, reliable electricity in all regions of the United States, minimizing loss of jobs and other adverse economic impacts on the United States economy, and enhancing the international competitiveness and the productive capacity of the United States manufacturing industry, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

(a) SHORT TITLE.—This Act may be cited as the "Electric Power Regulatory Coordination Act of 2011".

(b) TABLE OF CONTENTS.—The table of contents of this Act is as follows:

SEC. 2. PURPOSE.

The purpose of this Act is to coordinate new Federal environmental requirements that apply to electric utility steam generating units in a balanced and even-handed manner that—

(1) achieves the environmental goals and objectives of the new Federal environmental requirements, while minimizing adverse economic impacts;

(2) promotes sound national energy policy, including the continued reliance of coal to meet the growing energy needs of the United States;

(3) ensures the supply of affordable, reliable electricity in all regions of the country;

(4) limits the premature retirement of the existing fleet of electric utility steam generating units;

(5) minimizes loss of jobs and other adverse economic impacts on the United States economy, including reductions in production levels and labor demands in manufacturing, commercial, and other sectors of the economy; and

(6) enhances, to the maximum extent practicable, the international competitiveness and the productive capacity of the United States manufacturing industry.

SEC. 3. DEFINITIONS.

In this Act:

(1) ADMINISTRATOR.—The term "Administrator" means the Administrator of the Environmental Protection Agency.

(2) AFFECTED UNIT.—The term "affected unit" means an electric generating unit that is subject to regulation under the Clean Air Interstate Rule or any subsequent rule that the Administrator may promulgate to remedy or otherwise address the interstate transport of air pollution under sections

110(a)(2)(D) and 126 of the Clean Air Act (42 U.S.C. 7410(a)(2)(D), 7426).

(3) AUXILIARY POWER DEMAND.—The term "auxiliary power demand" means the total quantity of electricity and thermal energy generated by an electric utility steam generating unit that is—

(A) consumed by equipment, activities, or other processes that are necessary to operate a pollution control project; or

(B) lost as a result of conversion of a once-through cooling system to either a wet or dry cooling tower system in which cooling water is constantly recirculated from the condenser to a cooling tower where the water cools by evaporation or convection.

(4) CLEAN AIR INTERSTATE RULE.—The term "Clean Air Interstate Rule" means the regulations to regulate sulfur dioxide and nitrogen oxide emissions from affected units that the Administrator promulgated on May 12, 2005 (70 Fed. Reg. 25162), April 28, 2006 (71 Fed. Reg. 25288 and 25328), October 19, 2007 (72 Fed. Reg. 59190), November 2, 2007 (72 Fed. Reg. 62338), April 28, 2008 (73 Fed. Reg. 22818), and November 3, 2009 (74 Fed. Reg. 56721).

(5) COAL COMBUSTION RESIDUALS.—The term "coal combustion residuals" means fly ash, bottom ash, flue gas desulfurization byproducts, and boiler slag that are produced by a coal-fired electric utility steam generating unit.

(6) DESIGNATED UNIT.—The term "designated unit" means an existing electric utility steam generating unit for which the owner or operator of the unit has submitted to the Administrator a compliance plan that contains a legally binding commitment to perform, by not later than December 31, 2020, 1 or more of the alternative control options specified in section 101(c)(2).

(7) DISPOSAL FACILITY.—The term "disposal facility" means a landfill or surface impoundment that receives for disposal large volumes of coal combustion residuals from coal-fired electric utility steam generating units.

(8) ELECTRIC UTILITY STEAM GENERATING UNIT.—The term "electric utility steam generating unit" has the meaning given the term in section 112(a)(8) of the Clean Air Act (42 U.S.C. 7412(a)(8)).

(9) ELIGIBLE PROJECT.—The term "eligible project" means any project—

(A) to perform 1 of the alternate control options specified in section 101(c)(2)(B) at a designated unit;

(B) to construct a new electric utility steam generating unit that replaces a designated unit that is being permanently retired under section 101(c)(2)(A); or

(C) to undertake a project to install and operate an advanced coal-fueled technology at a new or existing electric utility steam generating unit.

(10) EXISTING ELECTRIC UTILITY STEAM GENERATING UNIT.—

(A) IN GENERAL.—The term "existing electric utility steam generating unit" means an electric utility steam generating unit that commenced commercial operation before the date of enactment of this Act.

(B) INCLUSIONS.—The term "existing electric utility steam generating unit" includes a electric utility steam generating unit that—

(i) commenced commercial operation before the date of enactment of this Act; and

(ii) is modified, reconstructed, or repowered after that date.

(11) EXISTING ENVIRONMENTAL REQUIREMENTS.—The term "existing environmental requirements" means any rule, regulation, permit condition, or other requirement that—

(A) is established pursuant to Federal or State law;

(B) pertains to air pollution control, wastewater and thermal discharges, regulation of cooling water intake structures, disposal of solid waste, or any other environmental matter; and

(C) applied to an affected unit as of January 1, 2010.

(12) FEDERAL AUTHORIZATION.—

(A) IN GENERAL.—The term "Federal authorization" means any authorization required under Federal law, whether administered by a Federal or State agency, with respect to the siting, construction, or operation of an eligible project.

(B) INCLUSIONS.—The term "Federal authorization" includes any permit, license, special use authorization, certification, opinion, concurrence, or other approval that may be required under Federal law with respect to the siting, construction, or operation of an eligible project.

(13) NEW FEDERAL ENVIRONMENTAL REQUIREMENT.—The term "new Federal environmental requirement" means any regulation, rule, requirement, or interpretative guidance that—

(A) is promulgated or issued by the Administrator or a State or local government, or becomes effective, after January 1, 2010;

(B) applies to 1 or more affected units; and

(C) except as provided under section 104, implements any provision or requirement relating to—

(i) interstate transport of air pollution under section 110(a)(2)(D) or section 126(b) of the Clean Air Act (42 U.S.C. 7410(a)(2)(D), 7426(b)) with respect to any national ambient air quality standard;

(ii) the attainment or maintenance of any national ambient air quality standard;

(iii) new source performance standards under section 111 of the Clean Air Act (42 U.S.C. 7411), including an performance standard for existing sources under section 111(d) (42 U.S.C. 7411(d));

(iv) regional haze or reasonably attributable visibility impairment under section 169A or section 169B of the Clean Air Act (42 U.S.C. 7491, 7492);

(v) hazardous air pollutants under section 112 of the Clean Air Act (42 U.S.C. 7412);

(vi) greenhouse gas emissions under title I and title V of the Clean Air Act (42 U.S.C. 7401 et seq.), including the requirements for—

(I) new source performance standards under section 111 of the Clean Air Act (42 U.S.C. 7411), including a performance standard for existing sources under section 111(d) of that Act (42 U.S.C. 7411(d)); and

(II) preconstruction review permits under section 165 of the Clean Air Act (42 U.S.C. 7475);

(vii) cooling water intake structures under section 316(b) of the Federal Water Pollution Control Act (33 U.S.C. 1326(b));

(viii) effluent guidelines for regulating the discharge of pollutants under section 304 of the Federal Water Pollution Control Act (33 U.S.C. 1314); or

(ix) the handling and disposal of coal combustion residuals under subtitle C or D of the Solid Waste Disposal Act (42 U.S.C. 6921 et seq.).

(14) NEW ELECTRIC UTILITY STEAM GENERATING UNIT.—The term "new electric utility steam generating unit" means an electric utility steam generating unit that commences commercial operation on or after the date of enactment of this Act.

(15) POLLUTION CONTROL PROJECT.—

(A) IN GENERAL.—The term "pollution control project" means any activity or project undertaken at an electric utility steam generating unit that involves—

(i) the installation, replacement, or upgrade of an eligible pollution control technology that is listed under subparagraph (B); or

(ii) the switching (or partially switching) to an inherently less polluting fuel.

(B) ELIGIBLE TECHNOLOGIES.—Eligible pollution control technologies under subparagraph (A) shall include—

(i) carbon capture and sequestration technologies that are used for the capture, compression, transportation, or injection of carbon dioxide into underground formations;

(ii) conventional or advanced flue gas desulfurization or sorbent injection systems for the control of sulfur dioxide or other air pollutants;

(iii) electrostatic precipitators or baghouses for the control of particulate matter or other air pollutants;

(iv) selective noncatalytic reduction, selective catalytic reduction, and burner systems designed for the control of nitrogen oxides or other air pollutants;

(v) the injection of activated carbon or other sorbent designed to control mercury or other air pollutants; or

(vi) any other control technology, technique, or measure that reduces emissions of air pollutants from an electric utility steam generating unit, as determined by the Administrator.

(16) QUALIFIED EFFICIENCY OR MAINTENANCE PROJECT.—The term "qualified efficiency or maintenance project" means any physical change, or change in method of operation, to an existing electric utility steam generating unit that—

(A) is implemented for the purpose of maintaining, restoring, or improving the generating efficiency of the electric utility steam generating unit, measured in terms of net electricity generated per energy consumed; and

(B) does not result in an increase in the maximum hourly emissions of any regulated air pollutant, as compared to the maximum hourly emissions of that air pollutant that was achievable at that unit during the 5-year period before the change.

(17) SECRETARY.—The term "Secretary" means the Secretary of Energy.

(18) TRANSPORT RULE.—The term "Transport Rule" means the regulations to reduce the sulfur dioxide and nitrogen oxide emissions from affected units that the Administrator may promulgate based

on the proposed rule published on August 2, 2010 (75 Fed. Reg. 45210).

(19) WELL-CONTROLLED UNIT.—The term "well-controlled unit" means an existing coal-fired electric utility steam generating unit that enters into a binding commitment to achieve the emission control requirements that are established for sulfur dioxide, nitrogen oxides, and mercury under section 102(b).

TITLE I—COORDINATION OF NEW ENVIRONMENTAL REQUIREMENTS

SEC. 101. ALTERNATIVE COMPLIANCE PROGRAM.

(a) IN GENERAL.—The Administrator shall establish an alternative compliance program for existing electric utility steam generating units in accordance with the provisions of this section to establish alternative compliance options that the owner or operator of any existing electric utility steam generating unit may elect to perform in lieu of complying with applicable new Federal environmental requirements.

(b) ELECTION.—

(1) IN GENERAL.—By not later than January 1, 2014, the owner or operator of an existing electric utility steam generating unit may elect to classify

the unit as a designated unit for purposes of meeting the applicable new Federal environmental requirements.

(2) SUBMISSION OF PLAN.—An election under this subsection shall be made through the submission of a compliance plan for the particular unit to the Administrator in accordance with the requirements and procedures specified in subsection (c).

(c) COMPLIANCE PLAN.—

(1) IN GENERAL.—A compliance plan submitted to the Administrator under subsection (b) shall establish the alternative regulatory compliance obligations and conditions that shall apply to a designated unit in lieu of the new Federal environmental requirements that would otherwise apply to the designated unit under current Federal and State law, which compliance obligations and conditions shall include—

(A) a requirement for the designated unit to perform 1 of the alternative control options identified in paragraph (2); and

(B) an alternative compliance schedule, as described in paragraph (3).

(2) ALTERNATIVE CONTROL OPTIONS.—Each compliance plan submitted under subsection (b) shall

contain a binding commitment that requires the owner or operator of the designated unit to perform 1 of the following alternative compliance options by not later than December 31, 2020:

(A) Permanent retirement of the designated unit, along with the surrender of all permits, licenses, and other Federal or State authorizations necessary for the operation of the unit.

(B) In the case of a designated unit that combusts coal for more than ø90¿ percent of the average annual heat input during the 3 consecutive calendar years immediately before the date of the election under subsection (b), the replacement or repowering of that designated unit with a new or modified electric generating unit that—

(i) consumes natural gas, biomass, or other renewable fuel; or

(ii) employs an advanced coal-fueled technology.

(3) ALTERNATIVE COMPLIANCE SCHEDULE.—

(A) IN GENERAL.—The compliance plan shall contain a federally enforceable alternative compliance schedule, as described in subparagraph (B), that shall apply to the designated unit in lieu of the otherwise applicable new Federal environmental requirements, from the date that owner or operator submitted the compliance plan for the designated unit, to a date that is not later than December 31, 2020.

(B) KEY ELEMENTS.—An alternative compliance schedule required under subparagraph (A) shall contain the following elements:

(i) Legally binding conditions that require the owner or operator of the designated unit—

(I) to perform 1 of the alternative compliance options specified in paragraph (2) by not later than December 31, 2020;

(II) to submit periodic progress reports on the achievement of reasonable milestones for the completion of the alternative compliance option for which the owner or operator has made a binding commitment to perform under this subsection;

(III) to limit annual emissions of sulfur dioxide and nitrogen oxide from the designated unit to the annual average emissions levels of the unit during the base period, as determined under paragraph (4); and

(IV) to comply with all applicable Federal and State environmental requirements in existence on January 1, 2010.

(ii) A regulatory variance providing that the designated unit is considered to be in compliance with all new applicable Federal environmental requirements so long as the designated unit remains in compliance with the applicable existing environmental requirements.

(iii) An exemption from the new source review permitting requirements that are established under parts C and D of title I of the Clean Air Act (42 U.S.C. 7470 et seq.) for all physical or operational changes undertaken at the designated unit that do not result in an increase in the maximum hourly emissions of any regulated air pollutant, as compared to the maximum hourly emissions of that air pollutant that was achievable at that unit during the 5-year period before the change.

(4) BASE PERIOD.—The base period shall be any 3 consecutive years during the period of calendar years 2005 through 2010 that the owner or operator of the designated unit selects to establish the annual emission limitations for sulfur dioxide and nitrogen oxides under paragraph (3)(B)(i)(III).

SEC. 102. WELL-CONTROLLED UNITS.

(a) CLASSIFICATION.—Each existing coal-fired electric utility steam generating unit that is not a designated unit under section 101 shall be classified as a well-controlled unit that is subject to the emission control requirements established under this section.

(b) EMISSION CONTROL REQUIREMENTS.—

(1) ESTABLISHMENT.—The Administrator shall establish by rule federally enforceable emission control requirements for limiting the emissions of sulfur dioxide, nitrogen oxides, and mercury from each well-controlled unit that require the unit to achieve—

(A) with respect to emission control levels for sulfur dioxide—

(i) a 90-percent reduction in sulfur dioxide emissions on an annual basis, as compared to uncontrolled emissions, through the operation of either a wet flue gas desulfurization system or a spray dryer flue gas desulfurization system; or

(ii) an annual emission rate of 0.2 lbs/MMBtu for sulfur dioxide;

(B) with respect to emission control levels for nitrogen oxides—

(i) an 80-percent reduction in nitrogen oxide emissions on an annual basis, as compared to uncontrolled emissions, through the operation of a selective catalytic reduction system; or

(ii) an annual emission rate of 0.1 lbs/MMBtu for nitrogen oxides; and

(C) with respect to emission control levels for mercury through the operation of pollution control equipment or the performance of other emission control measures or techniques—

(i) in the case of a coal-fired electric utility steam generating unit that primarily combusts bituminous coal, a 85-percent reduction in mercury emissions on an annual basis, as compared to uncontrolled levels;

(ii) in the case of a coal-fired electric utility steam generating unit that primarily combusts subbituminous coal, a 80 percent reduction in mercury emissions on an annual basis, as compared to uncontrolled levels; or

(iii) in the case of a coal-fired electric utility steam generating unit that primarily combusts lignite coal, a 70-percent reduction in mercury emissions on an annual basis, as compared to uncontrolled levels.

(2) LIMITATION.—The Administrator may not set any performance standard, emissions limitation, or other requirement for a well-controlled unit that could have the effect of requiring the installation of any additional pollution control technology or the achievement of emission reductions that are more stringent than the applicable emission control requirements established for the well-controlled unit under this subsection.

(c) PHASE-IN OF EMISSION CONTROL REQUIREMENTS.—

(1) COMPLIANCE PLAN.—By not later than January 1, 2014, the owner or operator of each existing coal-fired electric utility steam generating unit

that is classified as a well-controlled unit under subsection (a) shall submit to the Administrator a compliance plan for phasing in the emission control requirements established under subsection (b) that—

(A) applies to all of the well-controlled units that are under the common control of the owner or operator;

(B) identifies, for each well-controlled unit covered under the compliance plan, the pollution control equipment and other control measures or techniques that the owner or operator plans to use to meet the emission control requirements that are applicable to that particular unit under subsection (b); and

(C) contains a phase-in schedule that establishes the date by which each well-controlled unit covered under the plan shall comply with the applicable emission control requirements of subsection (b) in accordance with timetable established under paragraph (2).

(2) TIMETABLE.—

(A) IN GENERAL.—Except as provided in subparagraph (B), the phase-in schedule contained in each compliance plan submitted under paragraph (1) shall require the owner or operator to comply with the applicable emission control requirements of subsection (b) for all well-controlled units covered under the compliance plan in accordance with the following timetable:

(i) 60 percent of the total nameplate generating capacity of all of the well-controlled units within the compliance plan by December 31, 2016.

(ii) 80 percent of the total nameplate generating capacity of all of the well-controlled units within the compliance plan by December 31, 2018.

(iii) 100 percent of the total nameplate generating capacity of all of the well-controlled units within the compliance plan by December 31, 2020.

(B) EXCEPTION FOR SMALL GENERATING SYSTEMS.—In the case of an electric utility system with a combined nameplate generating capacity of less than ø1500¿ MW, the phase-in schedule contained in the compliance plan submitted under paragraph (1) shall require compliance with the applicable emission control requirements of subsection (b) for all well-controlled units within the electric utility system and covered under the compliance plan such that the electric utility system has—

(i) by not later than December 31, 2017—

(I) 50 percent of the total nameplate generating capacity of all well-controlled units within compliance plan; or

(II) 50 percent of the total number of well-controlled units within the compliance plan; or

(ii) by not later than December 31, 2020, 100 percent of the total nameplate generating capacity of all affected units within the compliance plan.

(3) MULTIPLE OWNERS.—

(A) IN GENERAL.—Only 1 compliance plan may be submitted under paragraph (1) for a well-controlled unit that has multiple owners.

(B) REPRESENTATIVE.—In a case in which a well-controlled unit has multiple owners as described in subparagraph (C), the multiple owners of the well-controlled unit shall select a designated representative to submit 1 compliance plan for phasing in the emission control requirements of subsection (b) for that well-controlled unit.

(C) DESCRIPTION OF MULTIPLE OWNERS.—

(i) IN GENERAL.—For purposes of this paragraph, a well-controlled unit shall be considered to have multiple owners if—

(I) there are multiple holders of a legal or equitable title to, or a leasehold interest in, the well-controlled unit; or

(II) some or all of the electricity generated by a well-controlled unit is sold to another entity under a long-term power purchase contract.

ø(ii) EXCLUSION.—A passive lessor, or a person who has an equitable interest through such a lessor, whose rental payments are not based, either directly or indirectly, upon the revenues or income from the well-controlled unit shall not be considered to be a holder of a legal, equitable, leasehold, or contractual interest in that well-controlled unit under this paragraph.¿

(d) EMISSION AVERAGING.—

(1) SULFUR DIOXIDE AND NITROGEN OXIDES.—Any owner or operator of well-controlled unit may elect to comply with the applicable emission control requirements for sulfur dioxide or nitrogen oxides under subsection (b) through an averaging plan that—

(A) allows for the averaging of emissions of sulfur dioxide or nitrogen oxides (as the case may be) among multiple well-controlled units, each of which is—

(i) subject to the emission control requirements that are established for sulfur dioxide and nitrogen oxides under subsection (b);

(ii) under the control of the same owner or operator; and

(iii) included in only 1 averaging plan for sulfur dioxide or nitrogen oxides (as the case may be);

(B) establishes for sulfur dioxide or nitrogen oxides (as the case may be) an alternative contemporaneous emission control level for each well-controlled unit that is included in the averaging plan; and

(C) demonstrates, for sulfur dioxide or nitrogen oxides (as the case may be), that the actual emission control level averaged over all of the well-controlled units included in the averaging plan is less than, or equal to, the Btu weighted average emission control level for the same units if the units had been operated, during the same period of time, in compliance with the applicable emission control levels established under subsection (b).

(2) MERCURY.—Any owner or operator of a well-controlled unit may elect to comply with the applicable mercury emission control requirements of subsection (b) through an averaging plan that—

(A) meets each of the criteria established under paragraph (1); and

(B) requires that each of the well-controlled units included in the averaging plan shall be located at the same facility.

(e) DELEGATION TO STATES.—

(1) IN GENERAL.—Each State may develop and submit to the Administrator a plan for administering and enforcing the emission control requirements that are established sulfur dioxide, nitrogen oxides, and mercury under subsection (b).

(2) DELEGATION.—If the Administrator determines that a State plan submitted under paragraph (1) is adequate, the Administrator shall delegate to the State the authority necessary to administer and enforce emission control requirements for well-controlled units located within the State.

(3) NO EFFECT ON AUTHORITY OF ADMINISTRATOR.—Nothing in this paragraph prevents the Administrator from enforcing any applicable emission control requirements or other obligations that may apply under this section.

SEC. 103. REGULATION OF HAZARDOUS AIR POLLUTANTS.

(a) MERCURY.—The mercury emission control requirements established for well-controlled units under section 102(b) shall apply in lieu of any performance standards or other emission reduction requirements that may otherwise apply to mercury emitted from those well-controlled units under section 112 of the Clean Air Act (42 U.S.C. 7412).

(b) NONMERCURY HAZARDOUS AIR POLLUTANTS.—Except as provided for mercury under section 102, the Administrator shall not regulate hazardous air pollutants that are listed under section 112(b) of the Clean Air Act (42 U.S.C. 7412(b)) and emitted from coal-fired electric utility steam generating units under that section 112 of that Act (42 U.S.C. 7412) until such time as—

(1) emission reductions required by this Act have been fully implemented;

(2) the Administrator has performed an assessment of the remaining risks to human health, as described in subsection (c), that demonstrates that the regulation of 1 or more nonmercury hazardous air pollutants is necessary and appropriate to ensure the protection of human health, taking into account energy, economic, environmental, and other relevant factors;

(3) based on the risk assessment performed described in paragraph (2), the Administrator has submitted to Congress a report that contains recommendations for the enactment of Federal legislation to regulate 1 or more specified nonmercury hazardous air pollutants; or

(4) Congress has failed to enact into law legislation requiring the regulation of each identified nonmercury hazardous air pollutant by the date that is 2 years after the date on which the Administrator submitted that report to Congress.

(c) RISK ASSESSMENT.—

(1) IN GENERAL.—The Administrator shall assess, on a pollutant-by-pollutant basis, the remaining risks to human health that are reasonably anticipated to occur as a result of nonmercury hazardous air pollutants emitted from coal-fired electric utility steam generating units.

(2) METHODOLOGY.—

(A) IN GENERAL.—In performing the risk assessment under paragraph (1), the Administrator shall make an affirmative determination to regulate 1 or more nonmercury hazardous air pollutants only if the Administrator determines that such regulation is necessary and appropriate to address any significant remaining risks to human health resulting from the emissions from coal-fired electric utility steam generating units.

(B) REQUIREMENTS.—A risk assessment performed under paragraph (1) shall—

(i) be based on the projected actual emissions from coal-fired electric utility steam generating units after full implementation of the emission reductions and other obligations required by this Act;

(ii) evaluate only incremental protection of human health that is expected to occur as a result of additional reductions of nonmercury hazardous air pollutants emitted from coal-fired electric utility steam generating units, if the Administer were to require further emission reductions of nonmercury hazardous air pollutants under this section; and

(iii) take into account the energy, economic, environmental, and other relevant factors of regulating nonmercury hazardous air pollutants.

(3) PUBLIC NOTICE AND COMMENT.—The Administrator shall provide public notice and an opportunity to comment on the results of the risk assessment performed under paragraph (1).

(4) REPORT TO CONGRESS.—By not later than January 1, 2020, the Administrator shall submit to Congress a report that—

(A) presents the findings of the risk assessment performed under paragraph (1); and

(B) contains recommendations on whether Congress should enact into law Federal legislation that regulates 1 or more specified nonmercury hazardous air pollutants from coal-fired electric utility steam generating units.

(d) EMISSION STANDARDS.—

(1) IN GENERAL.—Subject to paragraph (2), the Administrator may promulgate emission standards under this section for each nonmercury hazardous air pollutant—

(A) that is emitted from coal-fired electric utility steam generating units within the listed source category; and

(B) for which the Administrator has made an affirmative determination that such regulation is necessary and appropriate under subsection (b).

(2) CONDITIONS.—The Administrator may promulgate emission standards under paragraph (1) only if—

(A) 2 or more years have passed since the date on which the Administrator submitted the report to Congress under subsection (c)(4); and

(B) during that same 2-or-more-year period, Congress has not enacted into law specific legislation to regulate the particular nonmercury hazardous air pollutant emitted from coal-fired electric utility steam generating units.

SEC. 104. REGULATION OF SULFUR DIOXIDE AND NITROGEN OXIDE EMISSIONS.

(a) REGIONAL TRANSPORT CONTROL REQUIREMENTS.—

(1) CLEAN AIR INTERSTATE RULE.—Notwithstanding any other provision of law and except as otherwise provided under this section, the Clean Air Interstate Rule shall remain in force and effect with respect to all provisions relating to the regulation of sulfur dioxide and nitrogen oxide emissions from affected units.

(2) SUBSEQUENT TRANSPORT RULES.—Neither the Transport Rule nor any other regulation that the Administrator may promulgate after January 1, 2011, to remedy interstate transport of air pollution under sections 110(a)(2)(D) and 126 of the Clean Air Act (42 U.S.C. 7410(a)(2)(D), 7426) shall take effect or otherwise impose an enforceable requirement on affected units until not earlier than the dates that are specified under subsection (d).

(b) REVISIONS TO THE CLEAN AIR INTERSTATE RULE.—

(1) IN GENERAL.—The Administrator shall promulgate regulations to revise and implement the Clean Air Interstate Rule in accordance with this subsection.

(2) DESIGNATED UNITS AND WELL-CONTROLLED UNITS.—

(A) TERMINATION OF CLEAN AIR INTERSTATE RULE.—Beginning on January 1, 2021, designated units and well-controlled units shall not be subject to the allowance holding requirements of the Clean Air Interstate Rule for—

(i) annual sulfur dioxide emissions;

(ii) annual nitrogen oxide emissions; and

(iii) ozone season nitrogen oxide emissions during the 5-month period beginning on May 1st and ending on September 30th of any calendar year.

(B) ADJUSTMENT OF EMISSION BUDGETS.—

(i) IN GENERAL.—For calendar year 2021 and each year thereafter, the Administrator shall reduce the State emission budgets for annual sulfur dioxide, annual nitrogen oxides, and ozone-season nitrogen oxides to reflect the termination of the allowance-holding requirements for designated units and well-controlled units under subparagraph (A).

(ii) REDUCTION.—The amount of the reduction from each State budget shall be equal to tonnage quantity of allowances allocated to the designated units and well-controlled units within the particular State for calendar year 2020 under the Clean Air Interstate Rule.

(3) OIL-FIRED AND GAS-FIRED AFFECTED UNITS.—

(A) IN GENERAL.—The Administrator shall not terminate the allowance-holding requirements applicable to oil-fired and gas-fired affected units under the Clean Air Interstate Rule.

(B) NO EXPIRATION.—Requirements for oil-fired and gas-fired units shall not expire, but shall remain in full force and effect until the Administrator determines that the emission reduction requirements for annual sulfur dioxide, annual nitrogen oxides, and ozone season nitrogen oxides under the Clean Air Interstate Rule are not necessary to ensure attainment and maintenance of any national ambient air quality standard.

(c) EMISSION TRADING.—A State may implement the emission reduction requirements of the Clean Air Interstate Rule, or other emission reduction requirements that are necessary to carry out the requirements of sections 110(a)(2)(D) and 126 of the Clean Air Act (42 U.S.C. 7410(a)(2)(D), 7426), through a regional emission trading program that—

(1) places no restrictions on trading of emissions allowances between affected units located within different States; and

(2) contains other provisions and requirements that are modeled after the sulfur dioxide allowance trading program established under title IV of the Clean Air Act (42 U.S.C. 7651 et seq.).

(d) PROHIBITION.—

(1) IN GENERAL.—Except as provided in subsection (b)(1)(B) and paragraph (2) of this subsection, the Administrator shall not seek to remedy or otherwise address the interstate transport of air pollution under sections 110(a)(2)(D) and 126 of the Clean Air Act (42 U.S.C. 7410(a)(2)(D), 7426) by reducing the State emission budgets that the Clean Air Interstate Rule establishes for annual sulfur dioxide, annual nitrogen oxides, and ozone-season nitrogen oxides.

(2) ADDITIONAL REDUCTIONS.—The Administrator may reduce the State emission budgets referred to in paragraph (1), or otherwise further limit annual sulfur dioxide emissions, annual nitrogen oxide emissions, or ozone season nitrogen oxides emissions from any affected unit, to carry out the requirements of sections 110(a)(2)(D) and 126 of the Clean Air Act (42 U.S.C. 7410(a)(2)(D), 7426)—

(A) only after—

(i) December 31, ø2017¿, in the case of the State emission budgets that the Clean Air Interstate Rule establishes for ozone season nitrogen oxide; and

(ii) December 31, ø2020¿, in the case of the State emission budgets that the Transport Rule establishes for annual sulfur dioxide and annual nitrogen oxides; and

(B) only to the extent that—

(i) the Administrator determines that additional reductions in emissions from affected units within a State will significantly contribute to the attainment of an area within any other State that is designated as nonattainment for ozone or fine particulate matter; and

(ii) the improvements in air quality under clause (i) could be achieved at least as cost-effectively as such air quality improvements that could be achieved by reductions in emission compounds from other principal source categories of those emissions.

(3) DETERMINATION.—

(A) IN GENERAL.—The Administrator shall make a determination under paragraph (2)(B) based on—

(i) a comparison of the incremental cost of improving air quality in any nonattainment area of a State by requiring additional emission reductions from electric utility steam generating units and other principal source categories of emissions; and

(ii) the use of the best available peer reviewed models and methodology that—

(I) consider the proximity of the source or sources to the nonattainment area in any State; and

(II) incorporate other source characteristics relevant for assessing air quality impacts of emissions from those sources.

(B) METHODOLOGY.—The Administrator shall—

(i) develop an appropriate peer-reviewed methodology for making determinations under this paragraph by not later than January 1, 2015; and

(ii) update the methodology periodically thereafter.

(4) LIMITATION.—

(A) REQUIREMENT.—Neither the Administrator nor any State may adopt or implement any rule, as specified in subparagraph (B), that requires a well-controlled unit to achieve before January 1, 2025, emission reductions in annual sulfur dioxide, annual nitrogen oxides, or ozone season nitrogen oxides that are more stringent than the emission control requirements established for well-controlled units under subsection 102(b).

(B) SPECIFIED RULES.—The rules subject to the limitation under subparagraph (A) shall include any rule, regulation, requirement, or interpretative guidance that the Administrator or a State may promulgate or adopt before January 1, 2025, to remedy or otherwise address—

(i) the interstate transport of air pollution under sections 110(a)(2)(D) and 126 of the Clean Air Act (42 U.S.C. 7410(a)(2)(D), 7426); and

(ii) regional haze or reasonably attributable visibility impairment under section 169A or section 169B of the Clean Air Act (42 U.S.C. 7491 and 7492).

TITLE II—OTHER PROVISIONS FOR COORDINATION AND IMPLEMENTATION

SEC. 201. REGULATION OF COAL COMBUSTION RESIDUALS.

(a) ESTABLISHMENT OF GUIDELINES.—

(1) IN GENERAL.—Not later than 18 months after the date of enactment of this Act, the Administrator shall by regulation establish Federal guidelines for States to regulate the disposal of coal combustion residuals produced from coal-fired electric utility steam generating units.

(2) REQUIRED CLASSIFICATION.—The guidelines shall require States to classify and regulate

coal combustion residuals described in paragraph (1) as a nonhazardous waste under subtitle D of the Solid Waste Disposal Act (42 U.S.C. 6941 et seq.) in accordance with subsection (b).

(b) REQUIREMENTS FOR FEDERAL GUIDELINES.—

(1) PURPOSE.—The purpose of the Federal guidelines established under subsection (a) is to ensure State implementation of nonhazardous waste regulations for the disposal of coal combustion residuals that—

(A) provide adequate protection to human health and the environment;

(B) minimize the economic, energy, and operational impacts of the regulations described in subsection (a)(1) on the electric power sector;

(C) ensure the continued operation of each existing disposal facility for the remainder of the useful life of the facility so long as that facility does not pose any significant risk to human health and the environment; and

(D) maximize the beneficial use of coal combustion residuals for a wide variety of bound and unbound applications in which the coal combustion residuals could be safely used.

(2) CRITERIA.—

(A) IN GENERAL.—The Administrator shall establish Federal guidelines under subsection (a) that meet each of the criteria described in subparagraph (B).

(B) DESCRIPTION OF CRITERIA.—

(i) COAL COMBUSTION RESIDUALS.—With respect to coal combustion residuals produced from a coal-fired electric utility steam generating unit—

(I) the coal combustion residuals shall be classified as a nonhazardous waste; and

(II) the disposal of the coal combustion residuals shall be regulated under Subtitle D of the Solid Waste Disposal Act (42 U.S.C. 6941 et seq.).

(ii) PROTECTION.—The structure, management, and operation of each new disposal facility and existing disposal facility shall provide adequate protection to human health and the environment.

(iii) COLLECTION AND REMOVAL SYSTEM.—Each new disposal facility shall employ a liner and leachate collection and removal system that is sufficient to minimize ground and surface water contamination.

(iv) GROUND WATER MONITORING.—Each new and existing disposal facility shall employ ground water monitoring to detect contamination and measure compliance with applicable ground water protection criteria, and provide measures for implementing corrective action, when necessary, to ensure compliance with applicable ground water criteria.

(v) CONDITIONS AND CIRCUMSTANCES.—The performance standards, permitting requirements, and other provisions established for new and existing disposal facilities shall reflect the varying regional, hydrogeological, and climatic conditions, and other circumstances under which different management and disposal practices for coal combustion residuals are necessary to protect—

(I) ground and surface water from leachate contamination; and

(II) surface water from surface runoff contamination.

(vi) DESIGN AND INSPECTION STANDARDS.—Appropriate design and inspection standards shall be established to ensure the stability and safety of surface impoundments that receive coal combustion residuals.

(vii) SCHEDULES FOR MEETING REQUIREMENTS.—Reasonable schedules shall be established for existing disposal facilities to meet the performance standards, permitting requirements, and other provisions that are required through the implementation of the Federal guidelines.

(c) STATE PLANS.—

(1) SUBMISSION.—

(A) IN GENERAL.—Not later than 2 years after the date of promulgation of Federal guidelines under subsection (a), each State shall submit to the Administrator a plan for regulating the disposal of coal combustion residuals from a coal-fired electric utility steam generating unit in any disposal facility located within the State.

(B) REQUIREMENTS.—The State plan submitted under this paragraph—

(i) shall contain performance standards, permitting requirements, and other provisions that are necessary to implement the Federal guidelines for the disposal of coal combustion residuals in the facilities; but

(ii) may deviate from the Federal guidelines to the extent that the Administrator determines that the State plan establishes alternate provisions that protect human health and the environment with an adequate margin of safety.

(2) ADEQUACY OF STATE PLANS.—

(A) REVIEW.—Not later than 180 days after the date of submission of a State plan under paragraph (1), the Administrator shall review the plan to determine whether the plan satisfies the minimum requirements of the Federal guidelines.

(B) APPROVAL AND DISAPPROVAL.—

(i) IN GENERAL.—The Administrator shall approve a State plan submitted under paragraph (1) if the plan satisfies the minimum requirements of the Federal guidelines, as determined by the Administrator.

(ii) PARTIAL APPROVAL AND DISAPPROVAL.—If a portion of a State plan meets the requirements of the Federal guidelines, the Administrator may approve the plan in part and disapprove the plan in part.

(iii) SUBSTANTIAL INADEQUACY.—If the Administrator determines that a State plan is substantially inadequate to implement the Federal guidelines and the State fails to submit a revised plan to correct the major inadequacies of the plan by the date that is 18 months after the date of the finding of the Administrator, the Administrator—

(I) may implement and enforce the Federal guidelines for the disposal of coal combustion residuals within the State; and

(II) in any such case, shall have the same authorities and powers as those that are provided under sections 3007 and 3008 of the Solid Waste

Disposal Act (42 U.S.C. 6927, 6928) to implement and enforce the Federal guidelines promulgated under subsection (a) with respect to disposal facilities for coal combustion residuals within the State.

SEC. 202. PERFORMANCE STANDARDS FOR CARBON DIOXIDE.

(a) WORK PRACTICE STANDARDS.—With respect to carbon dioxide emitted from existing electric utility steam generating units, any performance standard promulgated under section 111(d) of the Clean Air Act (42 U.S.C. 7411(d)) before December 31, 2020, shall consist of work practice standards that require the performance of—

(1) an annual tune-up of the boiler to optimize the combustion process and the efficiency of the boiler in accordance with procedures specified by the Administrator; and

(2) a periodic energy assessment that identifies energy savings that can be achieved through conservation measures, optimization of the boiler and associated equipment, and improved efficiencies of major energy-consuming systems at the facility.

(b) IMPLEMENTATION.—The performance of an annual boiler tune-up and the implementation of the energy saving measures identified through the energy assessment, as required by subsection (a), shall not be considered to be a modification under sections 111(a)(4), 169(2)(C), or 171(4) of the Clean Air Act (42 U.S.C. 7411(a)(4), 7479(2)(C), and 7501(4)).

SEC. 203. POLLUTION CONTROL PROJECTS AND EFFICIENCY IMPROVEMENTS.

(a) PURPOSE.—The purpose of this section is to encourage and expedite projects and measures undertaken at any existing electric utility steam generating unit that involve—

(1) the installation of pollution control equipment to reduce air emissions from the unit; and

(2) the implementation of measures to restore or enhance the efficiency of the existing electric utility steam generating.

(b) EXCLUSIONS.—The implementation of any 1 of the following activities at an existing electric utility steam generating unit after the date of enactment of this section shall not be considered to be a modification under sections 111(a)(4), 169(2)(C), or 171(4) of the Clean Air Act (42 U.S.C. 7411(a)(4), 7479(2)(C), and 7501(4)):

(1) A pollution control project.

(2) A project to restore electricity output that was lost as a result of auxiliary power demand at the site of the electric utility steam generating unit.

(3) A qualified efficiency or maintenance project.

(4) Any physical change, or change in method of operation, that—

(A) is undertaken at a designated unit; and

(B) does not result in an increase in the maximum hourly emissions of any regulated air pollutant, as compared to the maximum hourly emissions of that air pollutant that was achievable at that unit during the 5-year period before the change.

(c) SAVINGS CLAUSE.—Except as provided in subsection (b), nothing in this section revises or otherwise affects any Federal or State regulation for determining whether any physical change in, or change in the method of operation of, a major stationary source constitutes a modification under sections 111(a)(4), 169(2)(C), and 171(4) of the Clean Air Act (42 U.S.C. 7411(a)(4), 7479(2)(C), and 7501(4)).

SEC. 204. EXPEDITED REVIEW OF FEDERAL AUTHORIZATIONS.

(a) DESIGNATION AS LEAD AGENCY.—

(1) IN GENERAL.—The Department of Energy shall act as the lead agency for the purposes of coordinating all applicable Federal authorizations and related environmental reviews with respect to an eligible project, including any requirements under—

(A) the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.);

(B) the Federal Water Pollution Control Act (33 U.S.C. 1251 et seq.);

(C) the Safe Drinking Water Act (42 U.S.C. 300f et seq.);

(D) the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.); and

(E) the Clean Air Act (42 U.S.C. 7401 et seq.).

(2) OTHER AGENCIES.—Each Federal and State agency required to provide a Federal authorization for an eligible project shall cooperate with the Secretary and comply with the deadlines established by the Secretary under subsection (b).

(b) COORDINATION AND EXPEDITED REVIEW.—

(1) SCHEDULE.—As the head of the lead agency, and in consultation with other agencies, the Secretary shall—

(A) establish a schedule for all Federal authorizations with respect to each eligible project; and

(B) in establishing the schedule—

(i) set binding intermediate milestones and deadlines to ensure the expeditious completion of all proceedings and final action on all Federal authorizations relating to the eligible project;

(ii) require that all permit decisions and related environmental reviews under applicable Federal laws shall be completed—

(I) by not later than 1 year after the submission of a complete application for each permit decision or environmental review; or

(II) if a requirement of another provision of Federal law does not permit compliance with the 1-year deadline in subclause (I), as soon thereafter as is practicable; and

(iii) coordinate, to the maximum extent practicable, any permitting and environmental reviews that apply to the eligible project only under State law.

(2) MEMORANDUM OF UNDERSTANDING.—Not later than 1 year after the date of enactment of this Act, the Secretary and the heads of all Federal agencies with authority to issue Federal authorizations shall enter into a memorandum of understanding to ensure the coordinated and streamlined review and prompt issuance of Federal authorizations for eligible projects.

(3) PREAPPLICATION REVIEW.—

(A) IN GENERAL.—The Secretary shall establish and facilitate a preapplication review process to expedite the review of all Federal authorizations, including permit decisions and related environmental reviews, for any eligible project under applicable Federal laws.

(B) REQUIREMENTS.—The preapplication review process shall require each agency involved in the review process—

(i) to confer with prospective applicants and identify each issue of major concern to the agency and the general public regarding the eligible project; and

(ii) to provide a written response to an inquiry from a prospective applicant by not later than 60 days after the completion of the preapplication review process.

(4) CONSOLIDATION OF ENVIRONMENTAL REVIEWS.—

(A) IN GENERAL.—The Secretary, in consultation with affected agencies, shall prepare a single environmental review document for assessing all major Federal actions relating to any eligible project under the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.).

(B) USE BY AGENCIES.—Each agency covered by environmental review requirements under the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.) shall use the document prepared by the Secretary under subparagraph (A) as the basis for all decisions relating to the eligible project.

(5) FAILURE TO MEET SCHEDULE.—If a Federal or State agency does not complete a proceeding for an approval that is required for a Federal au-

thorization in accordance with the schedule established by the Secretary under this subsection, the applicant may pursue remedies under subsection (d).

(c) CONSOLIDATED RECORD.—

(1) IN GENERAL.—The Secretary shall, in cooperation with Federal and State agencies, maintain a complete consolidated record of all decisions made or actions taken by the Secretary or by a Federal agency (or State agency acting under delegated Federal authority) with respect to any Federal authorization.

(2) USE OF RECORD.—

(A) IN GENERAL.—Subject to subparagraph (B), a consolidated record described in paragraph (1) shall be the record for judicial review under subsection (d) of decisions made or actions taken by Federal and State agencies.

(B) REMAND.—If a court of competent jurisdiction determines, with respect to an eligible project, that the consolidated record described in subparagraph (A) for the eligible project does not contain sufficient information, the court may remand the action to the Secretary for further development of the consolidated record.

(d) JUDICIAL REVIEW.—

(1) JURISDICTION.—

(A) IN GENERAL.—The United States Court of Appeals for the circuit in which an eligible project is proposed to be constructed shall have original and exclusive jurisdiction over any civil action for the review of—

(i) an order or action relating to a Federal authorization issued or taken by a Federal agency (other than the Secretary) or by a State agency acting pursuant to Federal law, including any order or action to condition or deny any Federal authorization; and

(ii) an alleged failure to act by a Federal or State agency with respect to a Federal authorization.

(B) FAILURE TO ACT.—The failure of an agency to take action on a Federal authorization in accordance with the schedule established by the Secretary under subsection (b)(1) shall be considered to be inconsistent with Federal law for the purposes of paragraph (2) of this subsection.

(2) COURT ACTION.—

(A) IN GENERAL.—A court of jurisdiction described in paragraph (1)(A) shall remand a proceeding for a particular eligible project to the appropriate agency if the court finds that—

(i) there has occurred either—

(I) an order or action described in paragraph (1)(A) that is inconsistent with the Federal law governing the Federal authorization for the eligible project; or

(II) a failure to act as described in paragraph (1)(B) with respect to the eligible project; and

(ii) the order, action, or failure to act would prevent the siting, construction, or operation of the eligible project.

(B) REMAND.—If the court remands the order or action to the appropriate Federal or State agency under subparagraph (A), the court shall—

(i) provide specific direction to remedy any inconsistency with Federal law; and

(ii) set a reasonable schedule and appropriate deadlines for the agency to act on remand.

(3) FILING CONSOLIDATED RECORD.—For any civil action described in this subsection, the Secretary shall promptly file with the court the consolidated record of the order or action to which the appeal relates, as compiled by the Secretary pursuant to subsection (c).

(4) EXPEDITED REVIEW.—The court shall schedule a civil action brought under this subsection for expedited consideration.

(e) REGULATIONS.—Not later than 18 months after the date of enactment of this Act, the Secretary shall, after providing public notice and an opportunity to comment, promulgate such regulations as are necessary to implement this section.

(f) RELATIONSHIP TO OTHER LAWS.—Except as specifically provided in this section, nothing in this section affects any requirement of any Federal or State law, including the Federal laws described in subsection (a)(1).

To: Joseph Goffman/DC/USEPA/US@EPA;Lorie Schmidt/DC/USEPA/US@EPA;Howard Hoffman/DC/USEPA/US@EPA;Joel Beauvais/DC/USEPA/US@EPA;Kevin Culligan/DC/USEPA/US@EPA[]; orie Schmidt/DC/USEPA/US@EPA;Howard Hoffman/DC/USEPA/US@EPA;Joel Beauvais/DC/USEPA/US@EPA;Kevin Culligan/DC/USEPA/US@EPA[]; oward Hoffman/DC/USEPA/US@EPA;Joel Beauvais/DC/USEPA/US@EPA;Kevin Culligan/DC/USEPA/US@EPA[]; oel Beauvais/DC/USEPA/US@EPA;Kevin Culligan/DC/USEPA/US@EPA[]; evin Culligan/DC/USEPA/US@EPA[]
Cc: Mark MacLeod [mmacleod@edf.org]; ickie Patton [vpatton@edf.org]
From: Megan Ceronsky
Sent: Wed 5/18/2011 8:58:23 PM
Subject: Re: GHG NSPS
Environmental Defense Fund, NSPS as a Stimulus for Innovation, Docket No. EPA-HQ-OAR-2011-0090.pdf

All:

We have further developed the GHG NSPS regulatory design concepts we discussed on April 22nd in the hope that it might be helpful to you. Please let us know if you have any questions.

Best regards,
Megan

Megan Ceronsky
Attorney
Environmental Defense Fund
(303) 447-7224 (P)
(303) 440-8052 (F)
2060 Broadway
Suite 300
Boulder, CO 80302

From: Vickie Patton
Sent: Sunday, April 24, 2011 10:51 PM
To: Joseph Goffman/DC/USEPA/US; Lorie Schmidt/DC/USEPA/US; Howard Hoffman/DC/USEPA/US; beauvais.joel@epa.gov; culligan.kevin@epa.gov
Cc: Megan Ceronsky; Mark MacLeod
Subject: CRS Report, NSPS Case Study, Adequately Demonstrated

Here are some additional materials for your consideration.

The CRS report on the regulation of stationary source greenhouse gases that includes an examination of NSPS issues.

The CRS report draws from the attached Carnegie Mellon PhD dissertation by Margaret Taylor (The

Influence of Government Actions on Innovative Activities in the Development of Environmental Technologies to Control Sulfur Dioxide Emissions from Stationary Sources). Taylor examines in detail the convergence of policy and technological innovation associated with Agency's 1971 SO2 NSPS, 1978 SO2 NSPS and 1990 CAAA Title IV program for SO2 including the policy genesis of the SO2 controls, the nascent stages of FGD technology, and the acceleration of technological progress resulting from EPA's policies. One note is her explanation that the German acid rain protection requirements adopted in 1983 resulted in the installation of 35,000 MW of FGD in four years -- 33 percent of which were licensed from US companies (see ps. 56 & 223, n. 108).

<< File: CRS - Potential Regulation of Stationary Greenhouse Gas Sources Under the CAA - May 14 - 2009 (parker, mccarthy).pdf >> << File: Margaret Taylor - Government Actions, Technology Innovation, SO2 Controls - Carnegie Mellon Dissertation - Jan 2001.pdf >>

We have also attached Judge Leventhal's 1973 opinion in Portland Cement re the contours of "adequately demonstrated" under the NSPS (as well as the DC Circuit decision affirming the standards on remand).

<< File: Portland Cement Assn v. EPA 486 F.2d 375 (DC Cir 1973).pdf >> << File: Portland Cement Assn v. Train 513 F2d 506 (DC Cir 75) (aff'd on remand).pdf >>

Thank you again for your precious time.

Sincerely yours,
Vickie

From: Mark MacLeod
Sent: Friday, April 22, 2011 12:51 PM
To: Joseph Goffman/DC/USEPA/US; Lorie Schmidt/DC/USEPA/US; Howard Hoffman/DC/USEPA/US; beauvais.joel@epa.gov; culligan.kevin@epa.gov
Cc: Vickie Patton; Megan Ceronsky
Subject: WRI facilitated 111(d) Principles

All,

Thanks again for your valuable time today. Here is the WRI facilitated document we discussed. The membership is listed in #2. We will follow up with some of the other references cited in today's call.

Have a great weekend.

Mark

<< File: WRI DIalogue Comments Final 4 18 2011.pdf >>

EDF
ENVIRONMENTAL DEFENSE FUND®
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18 May 2011

Re: Docket ID No. EPA-HQ-OAR-2011-0090; Greenhouse Gas New Source Performance Standards for Fossil Fuel Fired Power Plants

NSPS as a Stimulus for American Technological Innovation

Judicial explications of Clean Air Act § 111 as well as the relevant regulatory precedents and legislative history establish New Source Performance Standards as an innovation-focused regulatory framework. This memo briefly outlines this aspect of the NSPS legal framework and history for the Agency's consideration in promulgating standards under § 111(b).

Legal Foundation

The Senate Report issued prior to passage of the Clean Air Act in 1970 stated that "[s]tandards of performance should provide an incentive for industries to work toward constant improvement in techniques for preventing and controlling emissions from stationary sources."[1] The Senate Report also clarified that an emergent control technology used as the basis for standards of performance need not "be in actual routine use somewhere."[2] Consistent with this Congressional intent, the courts have held that NSPS are to be based on innovative, cutting-edge technologies that will be available when the standards apply to new and modified sources. In *Portland Cement Association v. Ruckelshaus*, the D.C. Circuit stated plainly:

> We begin by rejecting the suggestion of the cement manufacturers that the Act's requirement that emission limitations be "adequately demonstrated" necessarily implies that any cement plant now in existence be able to meet the proposed standards. <u>Section 111 looks toward what may fairly be projected for the regulated future, rather than the state of the art at present</u>, since it is addressed to standards for new plants.[3]

The court went on to hold that:

---

[1] S.Rep. No. 91-1196, 91st Cong., 2d Sess. 17 (1970). The D.C. Circuit interpreted the Senate's intent to provide that "[t]he essential question was [] whether the technology would be available for installation in new plants." *Portland Cement Ass'n v. Ruckelshaus*, 486 F.2d 375, 391 (D.C. Cir. 1973).
[2] S.Rep. No. 91-1196, 91st Cong., 2d Sess. 16 (1970).
[3] 486 F.2d 375, 391 (D.C. Cir. 1973) (emphasis added).

> The resultant standard is analogous to the one examined in *International Harvester, supra.* The Administrator may make a projection based on existing technology, though that projection is subject to the restraints of reasonableness and cannot be based on "crystal ball" inquiry. *478 F.2d at 629*. As there, the question of availability is partially dependent on "lead time", the time in which the technology will have to be available. Since the standards here put into effect will control new plants immediately, as opposed to one or two years in the future, the latitude of projection is correspondingly narrowed. If actual tests are not relied on, but instead a prediction is made, "its validity as applied to this case rests on the reliability of [the] prediction and the nature of [the] assumptions." *International Harvester* at 45.[4]

Therefore under this legal standard, if EPA issues NSPS regulations that apply one standard to facilities built within the next few years and apply a more restrictive standard to facilities built five or nine years in the future, the latter standard and the "adequately demonstrated" projection upon which it is based are to be given relatively wide latitude by reviewing courts. A standard that will be effective some years into the future that is based on emergent technologies is acceptable provided the Agency's assumptions about technology availability at that future date are reasonable.

The court in *Portland Cement* also provided guidance on what such an innovation-focused determination could rely upon: "It would have been entirely appropriate if the Administrator had justified the standards, not on the basis of tests on existing sources or old test data in the literature, but on extrapolations from this data, on a reasoned basis responsive to comments, and on testimony from experts and vendors made part of the record."[5] The standards at issue in *Portland Cement* were finalized after the Agency conducted testing at seven plants, which the D.C. Circuit found sufficient.[6]

Historical Precedent

The Congressional Research Service (CRS) Report on the potential regulation of GHG sources under the Clean Air Act notes that the flexibility inherent in the Administrator's authority to determine which technologies have been adequately demonstrated "has been used to authorize control regimes that extended beyond the merely commercially available to those technologies that have only been demonstrated, and thus are considered by many to have been 'technology-forcing.'"[7]

The CRS report focuses on the 1971 and the 1978 NSPS for SO_2 emitted by coal-fired electric generating units as a prime example of the Agency incentivizing technology development and thereby facilitating ambitious emission reductions through NSPS. The 1971 NSPS required a 70% reduction in new power plant emissions, on average, and could be met initially only by burning low-sulfur coal or by using an emergent technology known as flue gas desulfurization (FGD). When the 1971 utility SO_2 NSPS was promulgated, there

[4] *Id.* at 391-92 (emphasis added).
[5] *Id.* at 401-402.
[6] *Portland Cement Association v. Train*, 513 F.2d 506, 509 (D.C. Cir. 1975).
[7] Larry Parker and James E. McCarthy, "Climate Change: Potential Regulation of Stationary Greenhouse Gas Sources Under the Clean Air Act," Congressional Research Service, R40585, at 12 (May 14, 2009).

was only one FGD vendor and only three FGD units in operation. The 1979 NSPS retained the 1971 emission standard but also required a 70-90% reduction in emissions, depending upon the sulfur content of the coal. This requirement could then only be met by using an FGD device.

A history of the development of FGD devices (cited in the CRS report) further illustrates how much the SO_2 NSPS motivated the development of this technology:

> The Standards of Performance for New Sources are technology-forcing, and for the utility industry they forced the development of a technology that had never been installed on facilities the size of utility plants. That technology had to be developed, and a number of installations completed in a short period of time. The US EPA continued to force technology through the promulgation of successive regulations. The development of this equipment was not an easy process.
>
> . . .
>
> Chemical and mechanical engineers had never dealt with the challenges they faced in developing FGD systems for utility plants during this period. Chemical engineers had never designed process equipment as large as was required, nor had they dealt with the complex chemistry that occurred in the early FGD systems. Mechanical engineers were faced with similar challenges. While they had designed equipment for either acid service or slurry service, they typically had not designed for a combination of the two. Generally, equipment was larger than what they normally dealt with in chemical plants and refineries.
>
> It is an understatement to say that the new source performance standards promulgated by the EPA were technology-forcing. Electric utilities went from having no scrubbers on their generating units to incorporating very complex chemical processes. Chemical plants and refineries had scrubbing systems that were a few feet in diameter, but not the 30- to 40-foot diameters required by the utility industry. Utilities had dealt with hot flue gases but not with saturated flue gases that contained all sorts of contaminants. Industry, and the US EPA, has always looked upon new source performance standards as technology-forcing, because they force the development of new technologies in order to satisfy emission requirements.[8]

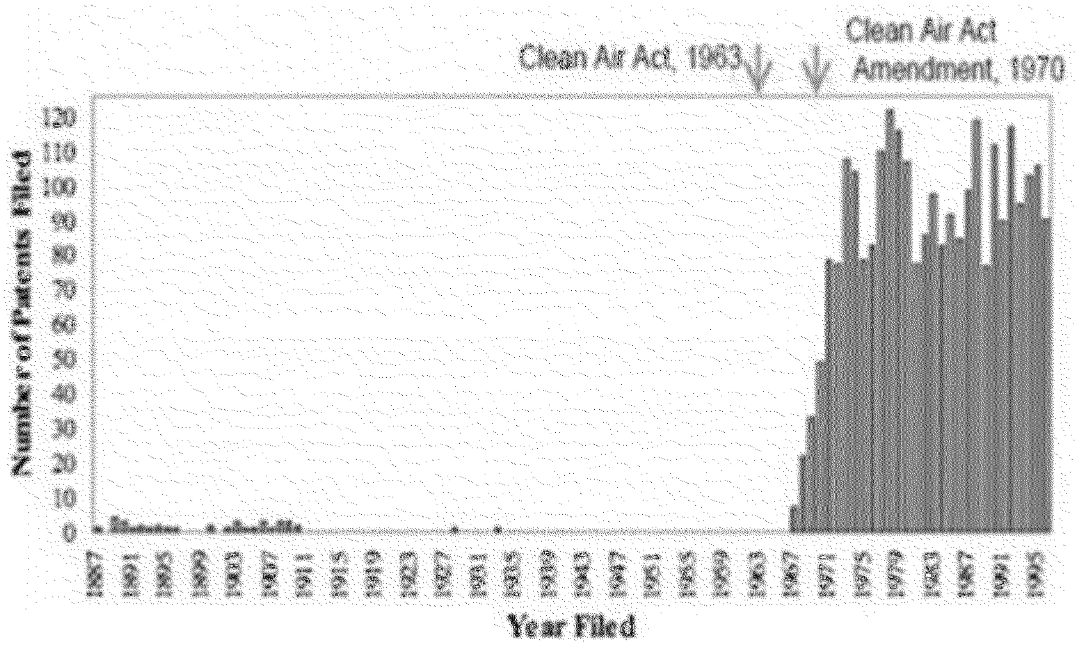
This example demonstrates that under Section 111, the Agency has based an NSPS on a technology that: (1) was sold by only a single vendor at the time the standards go into effect; (2) required the design of equipment with multiple functionalities in a single piece of equipment when existing equipment types only performed one of the functionalities; (3) existed in some form at other types of units but had to operate at units of different size and provide different capacities at the units subject to the NSPS. This is a compelling example

[8] Donald Shattuck, Ken Campbell, Michael Czuchna, Mary Graham, and Andrea Hyatt, "A History of Flue Gas Desulfurization (FGD) – The Early Years," at 15, 3.

of both the flexibility of the Agency's authority under Section 111 and the efficacy of innovation-focused standards at incentivizing technology development.

As can be seen in the Figure 1 below, analysis of patenting activity further demonstrates the dramatic rise in control technology innovation in the U.S. that followed the 1971 SO_2 NSPS promulgation.[9]

Figure 1: U.S. Patents Relevant to SO_2 Control Technology as Identified with the Patent Subclass Method[10]



Thanks to these technology advances, when Germany subsequently implemented a program to control acid rain, 33% of the FGD systems installed were licensed from U.S. companies.[11] Researchers of this and similar regulatory initiatives have observed that stringent regulation is required to stimulate significant innovation in control technologies; neither modest regulation nor legislation supporting control technology research have this effect.[12]

Application to the GHG Context

To translate the legal authorities and historical precedents discussed above into the GHG mitigation context, we believe that the Agency's Section 111 authority would support the

---

[9] Taylor, M., "The Influence of Government Actions on Innovative Activities in the Development of Environmental Technologies to Control Sulfur Dioxide Emissions from Stationary Sources," PhD Thesis, Carnegie Mellow University, (Jan. 2001), p. 211-212 (hereinafter "Taylor PhD"). *See also* ICF Consulting, "The Clean Air Act Amendments: Spurring Innovation and Growth While Cleaning the Air," (2005), p. 106-108, 118-120, 211-212.
[10] Taylor PhD at 107.
[11] Taylor PhD at 56; *see also* p. 131.
[12] *Id.* at 220; Taylor, M., Rubin, E.S., and Hounshell, D.A., "Control of SO2 Emissions from Power Plants: A Case of Induced Technological Innovation in the U.S.," *Technological Forecasting & Social Change* (July 2005), p. 697.

following regulatory frameworks, and respectfully urge the Agency to give these proposals serious consideration:

- Setting an NSPS under 111(b) that applies different levels of stringency to units built or modified at different times.
    - The agency has discretion to make a finding of "adequately demonstrated" that applies to a future date under *Portland Cement*. Any finding that a technology will be adequately demonstrated by a future date must be based on sufficient supporting information to justify the finding as reasonable.
    - The Agency can base its finding that a technology will be adequately demonstrated at a future date on real-world test data, extrapolations from existing test data, projections based on existing technologies, and evidence provided by experts and vendors.
    - Any such finding must be reasonable and based on defensible assumptions.
- Setting an NSPS that is technology-forcing at the time it becomes effective. This could include a standard based on a technology that:
    - Is only sold by a single vendor when the standard becomes effective.
    - Is used at other types of units, but must be altered significantly to work at a unit of the size and with the characteristics of those in the regulated sector.

Thank you for your consideration of our views. If you have any questions about the content of these comments, please contact:

Megan Ceronsky
Attorney
Environmental Defense Fund
(303) 447-7224
mceronsky@edf.org

To: Joseph Goffman/DC/USEPA/US@EPA[]
Cc: Cate Hight/DC/USEPA/US@EPA;Jared Snyder [jjsnyder@gw.dec.state.ny.us]; ared Snyder [jjsnyder@gw.dec.state.ny.us]
From: Brian Turner
Sent: Thur 12/9/2010 5:13:11 PM
Subject: Comments and Letter to EPA on GHG BACT/PSD
EPA-HQ-OAR-2010-0841_11-30-10.pdf
Letter to McCarthy w attachment_cc.pdf

Joe, Cate, Jared,
I meant to send the note below to you last week, and to my frustration just found it in my draft box (I was wondering why I hadn't heard back from you...)
I apologize this is now much less timely. But Joe, I would like to see if we can schedule a conversation in the near future - preferably sometime next week? My schedule is relatively open, please let me know what might work for you.
Also, to put something on your radar, I would like to briefly discuss another issue relating to CAA Section 185, to which CA is working on some solutions and would appreciate your insight.
Please let me know what might be a good time to meet.
Thanks,
Brian

FYI, attached is a letter that went out Monday from Mary to Gina re: our comments on the GHG BACT guidance. I hope it is mostly helpful and supportive.

I'd particularly draw your attention to the part:
"My staff is also working to ensure that our program also satisfies Clean Air Act requirements that we expect U.S. EPA to promulgate over the next few years, including under section 165, Prevention of Significant Deterioration, and section 111, New Source Performance Standards.

I would welcome the opportunity to provide you with more detail of how the concept of a cap-and-trade program can be addressed in the context of these federal programs. I will be calling you in the next few weeks to set up a mutually convenient time to discuss this further."

To be clear, I think this was phrased poorly – I think that what we meant by "satisfies" was "coordinates with". However, this was provided to InsideEPA, and as we saw with the Bloomberg piece yesterday (below), there's interest in this notion.
Along those lines, I'd love to schedule another time for us to talk in the near future, to fill you in on the status of our thinking and discussions and get your feedback. Unfortunately, I'm traveling all next week (COP), so unless you're free late this afternoon (after 4 pm EDT) for a call, can we schedule a meeting the week of December 13? My schedule is pretty open, so please let me know you're availability. Hopefully Jared would also be able to join us or call in.

Linda S. Adams
Secretary for Environmental Protection

Air Resources Board

Mary D. Nichols, Chairman
1001 I Street • P.O. Box 2815
Sacramento, California 95812 • www.arb.ca.gov

Arnold Schwarzenegger
Governor

Via email to a-and-r-docket@epa.gov submission
Attention Docket ID No. EPA–HQ–OAR–2010–0841

Date: November 30, 2010

RE: PSD and Title V Permitting Guidance for Greenhouse Gases

Pursuant to the solicitation for public comment published in the Federal Register on November 17, 2010 (75 FR 70254), the California Air Resources Board (ARB) respectfully submits the following comments on the U.S. Environmental Protection Agency's (U.S. EPA) PSD and Title V Permitting Guidance for Greenhouse Gases.

ARB SUPPORTS U.S. EPA'S PERMITTING GUIDANCE FOR GREENHOUSE GASES

U.S. EPA has taken important first steps to initiate a national program to regulate greenhouse gases (GHG) as required under the Clean Air Act, and ARB strongly supports your efforts. We also agree on the importance of continued, strong state-federal collaboration that maximizes California's long-standing and growing investments in low-carbon technologies, fuels, and energy efficiency. Working together, we can advance climate policies that significantly reduce GHGs while re-invigorating our industrial base and energy sector.

U.S. EPA SHOULD RECOGNIZE INNOVATIVE STATE GHG PROGRAMS TO SATISFY FEDERAL GHG PERMITTING REQUIREMENTS

The new federal permitting guidance does not establish a binding requirement on any state authorized PSD or Title V permit. Nevertheless, we believe it is critical that federal climate permitting policies recognize and support unique state climate programs that satisfy federal requirements. Particularly in the early years, as federal climate policies are launched, U.S. EPA can optimize cost-effective emission reductions by inviting new approaches to supplement more conventional ones. Several states, including California, have embarked in the development of a wide portfolio of innovative climate investment strategies. If allowed to foster and grow, these initiatives in the nation's greatest laboratories for innovation can significantly reduce GHG emissions.
U.S. EPA's climate policies should be developed and clarified with this objective in mind.

ARB WILL CONTINUE TO BE AN ENDURING PARTNER IN OUR MUTUAL EFFORT TO REDUCE GHGs

California has made a strong commitment to do our share over the long haul to reduce its contribution to GHGs. This is the beginning of a long journey and we are eager to engage with U.S. EPA in achieving our mutual goals.

In conclusion, ARB reiterates its support of U.S. EPA's action to regulate emissions from major stationary sources, and to do so in an administratively feasible and cost-effective way. Absent comprehensive federal climate change legislation, using the Clean Air Act to effect national GHG reductions is an important step to put the United States on the road to nationwide climate change action. These efforts can be optimized by using the states to bring about reductions that are tailored to their industries using unique and cost-effective climate investment strategies. If you have any questions regarding these comments, please contact me at (916) 445-8449.

Sincerely,

Robert Fletcher for

James N. Goldstene
Executive Officer

Air Resources Board

Mary D. Nichols, Chairman
1001 I Street • P.O. Box 2815
Sacramento, California 95812 • www.arb.ca.gov

Linda S. Adams
Secretary for Environmental Protection

Arnold Schwarzenegger
Governor

November 30, 2010

Ms. Gina McCarthy
Assistant Administrator
Air and Radiation
U.S. Environmental Protection Agency
Ariel Rios Building
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460

Dear Ms. McCarthy:

Pursuant to the solicitation for public comment published in the Federal Register on November 17, 2010 (75 FR 70254), the California Air Resources Board (ARB) has submitted comments in support of U.S. Environmental Protection Agency's (U.S. EPA) PSD and Title V Permitting Guidance for Greenhouse Gases (GHGs).

I wanted to send you a brief letter to reinforce the message contained in our formal comment letter (see attachment). California appreciates the challenge that we as a nation must address to reduce GHGs, using cost-effective measures that are also mindful of the difficult economic times we are facing. You can count on our full support in the design of national strategies that will achieve this goal.

I also wanted to take this opportunity to initiate a dialogue between our respective agencies on the work ahead. California is in a unique position to ground test nontraditional regulatory approaches similar to those that have already been applied successfully in other Clean Air Act initiatives. These include the lead phase-out in fuels, motor vehicle fleet standards, the Acid Rain Program, alternative compliance based mechanisms for performance-based standards, and economic incentive provisions for State Implementation Plans.

In December of this year, my Board will consider a ground-breaking cap-and-trade program to reduce GHG emissions from industrial sources, the electricity sector, and transportation and natural gas fuel providers. In the aggregate, covered sources—emitting about 85 percent of the State's GHGs—will have to reduce emissions by 15 percent between 2010 and 2020. The first phase of the program, covering power plants and large industrial sources, will begin in 2012.

This program fulfills requirements in the California Global Warming Solutions Act of 2006 (Assembly Bill 32). My staff is working to ensure that our program also satisfies Clean Air Act requirements that we expect U.S. EPA to promulgate over the next few years, including section 165, Prevention of Significant Deterioration, and section 111, New Source Performance Standards.

I would welcome the opportunity to provide you with more detail on how the concept of these federal requirements could be addressed within the framework of a cap-and-trade program. I will be calling you in the next few weeks to set up a mutually convenient time to discuss this further.

If you have any questions, please contact me at (916) 322-5840, or via email at mnichols@arb.ca.gov. Alternatively, your staff may wish to contact Mr. Brian Turner, ARB's Assistant Executive Officer for Federal Climate Policy at (202) 624-5273, or via email at brian.turner@wdc.ca.gov, or Ms. Lucille van Ommering with ARB's Office of Climate Change at (916) 324-5931, or via email at lvanomme@arb.ca.gov.

Sincerely,

Mary D. Nichols
Chairman

Attachment

cc: (with attachment)

James N. Goldstene
Executive Officer

Ellen M. Peter
Chief Counsel

Brian Turner
Assistant Executive Officer

Air Resources Board

Mary D. Nichols, Chairman
1001 I Street • P.O. Box 2815
Sacramento, California 95812 • www.arb.ca.gov

Linda S. Adams
Secretary for Environmental Protection

Arnold Schwarzenegger
Governor

Via email to a-and-r-docket@epa.gov submission
Attention Docket ID No. EPA–HQ–OAR–2010–0841

Date: November 30, 2010

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In conclusion, ARB reiterates its support of U.S. EPA's action to regulate emissions from major stationary sources, and to do so in an administratively feasible and cost-effective way. Absent comprehensive federal climate change legislation, using the Clean Air Act to effect national GHG reductions is an important step to put the United States on the road to nationwide climate change action. These efforts can be optimized by using the states to bring about reductions that are tailored to their industries using unique and cost-effective climate investment strategies. If you have any questions regarding these comments, please contact me at (916) 445-8449.

Sincerely,

Robert Fletcher for
James N. Goldstene
Executive Officer

To: Joseph Goffman/DC/USEPA/US@EPA[]
Cc: "Susan Durbin" [Susan.Durbin@doj.ca.gov]
From: "Cliff Rechtschaffen"
Sent: Sat 1/8/2011 8:18:47 PM
Subject: Moving ON

Hi Joe:

Happy new year, hope you're doing well. I wanted to let you know that I've left the CA Attorney General's Office and that as of Monday, I'll be working for Jerry Brown on energy & environmental issues in the governor's office. My new email is cliff.rechtschaffen@gov.ca.gov. I hope/trust we'll have occasion to continue to work together.

Congratulations on the recent NSPS/GHG settlements, that's great. Related, I wanted to make sure that you close the loop about my inquiry a couple of months back about possible state intervention in the environmental group's unreasonable delay case against EPA dealing with GHG controls for vessels, aircraft and nonroad vehicles. Could you please follow up with Susan Durbin in the CA AG's Office, susan.durbin@doj.ca.gov?

Thanks & best

Cliff

To: Lorie Schmidt/DC/USEPA/US@EPA;Joel Beauvais/DC/USEPA/US@EPA;Kevin Culligan/DC/USEPA/US@EPA[]; oel Beauvais/DC/USEPA/US@EPA;Kevin Culligan/DC/USEPA/US@EPA[]; evin Culligan/DC/USEPA/US@EPA[]
From: Megan Ceronsky
Sent: Tue 6/28/2011 9:30:40 PM
Subject: GHG NSPS 111(d) framework
Section 111(d) GHG NSPS Design Framework (6.28.2011, detailed).docx

Dear Lorie, Joel, and Kevin--

We wanted to send you the latest version of our thinking for the design of the power plant GHG NSPS under Sec. 111(d). We would welcome an opportunity to discuss this with you and get your thoughts.

Best,
Megan

Megan Ceronsky
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Boulder, CO 80302

Section 111(d) of the Clean Air Act

This short paper outlines a 111(d) GHG NSPS structure for existing fossil-fired EGUs, including: (1) the establishment of the 111(d) standard on the basis of available efficiency improvements at power plants and reductions in utilization from demand-side efficiency improvements; (2) an alternative compliance pathway for the GHG NSPS for plants that commit to retire by 2020; (3) a regulatory design that incorporates all fossil fuel fired EGUs; and (4) implementation flexibility for State programs. The Addendum considers implementation of the suggested framework in more detail. By relying on energy efficiency this framework mobilizes a highly cost-effective and widely available resource across the nation that secures multi-pollutant benefits in protecting human health and the environment.

1. Establishment of the default 111(d) standard:
EPA establishes an emission rate standard that gradually declines over time to achieve substantial near-term emission reductions and to guide efficient utility investment decisions to secure long-term pollution reductions protective of human health and the environment. We believe the analyses outlined below would support a reduction in the sector's overall emission rate on the order of 10-15% by 2020. This standard would serve as the default regulatory framework provided in the emission guidelines, and establish the level of emission reductions that a State program must meet in an equivalency determination (even though presumably the State programs will utilize different regulatory frameworks with additional flexible compliance mechanisms.) The standard would be based on:

(a) An average [x%] onsite efficiency improvement requirement, where on-site efficiency improvements are found to be an adequately demonstrated component of the best system of emission reduction. Note that the percentage improvement required could be higher for certain subcategories and lower for others if the technological analysis found that the capacity for improvement varied. The design of the standard and subcategories would reflect differences in utilization that affect efficiency and would ensure that units that have already made significant investments in efficiency would not be penalized. The design of the standard also could spur significant improvement in the most inefficient units currently operating given the potential for near-term progress in reducing pollution at these units.

(b) Reductions in utilization achieved via demand side management and demand side energy efficiency investments that achieve quantifiable, surplus, enforceable, and permanent emission reductions. Reducing electricity demand via energy efficiency and demand side management—with available technologies--has been demonstrated to be one of the most cost-effective means of reducing GHG emissions from the power sector. Because reductions in demand lead to reductions in utilization within the regulated sector, there is a close legal connection between the regulated source and the system of emission reduction that is relied upon. The framework assumes that each plant can meet the applicable emission rate standard through a combination of on-site efficiency improvements and investments in demand-side energy efficiency and demand side management. Reductions in emissions due to the demand-side interventions would be credited in the responsible unit's emission rate. There are a number of different ways that demand reduction and associated emission reduction could be quantified, credited, and verified, which are explored further in the Addendum. Note, however, that the proposal assumes that any generator selling electricity into a State could invest in demand-side efficiency improvements or demand management that would reduce demand and emissions, and be able to take credit for those reductions. For example, the Forward Capacity Market operated by the New England ISO establishes an enforceable framework for States to bid demand-side efficiency investments into the market as capacity resources. We also assume that third parties would offer demand reduction and demand management services to generators. Available utility-scale studies on the potential for energy efficiency could help inform the default emission rate including the pace of reductions as some new efficiency measures may require a phase in period.

2. Alternative compliance pathway:

Any source that elects to commit to a near term retirement (by 2020) is placed in a separate subcategory with an alternate NSPS compliance pathway that entails making the commitment to retire enforceable under the law. Sources in this subcategory would be exempted from the emission rate reduction requirements outlined under section 1 above, with reliance on § 111(d)'s directive to consider the "remaining useful life" of a source when designing the NSPS. (This is similar to the approach used in EPA's regional haze BART guidelines.) Note, however, that these units would still be required to meet the emission reduction requirements established by separate Clean Air Act regulatory programs and to reduce GHG emissions through available, low cost efficiency adjustments at the unit even though exempted from the default emission rate reduction requirements.

3. Implementation flexibility:

The structure described above could form the backstop, default § 111(d) standards. States could then choose to demonstrate that they would achieve equal or greater emission reductions via an alternate framework utilizing flexible compliance mechanisms. EPA could also propose an opt-in regulatory framework utilizing emissions trading or averaging with an appropriate concomitant increase in required emission reductions, as the Agency did under the MWC NO_x emission guidelines. Under these frameworks utilities would have considerable flexibility in how they would achieve the standard including plant efficiency improvements, demand side efficiency, retirement of aging inefficient units and replacement with modern infrastructure, co-firing with renewables, and other solutions. The declining emission rate standard established in the emission guidelines, however, would provide a long-term price signal to guide utility investment decisions and compliance strategies.

4. Incorporating all fossil fuel fired EGUs:

It will be important for the GHG NSPS regulatory framework to incorporate all fossil fuel fired EGUs (either through one overarching sector category or through linked sectors) in order to allow states and utilities to optimize utilization of different plants and fuels to achieve cost-effective emission reductions.

Addendum: Implementation Considerations

Calculation of Energy Efficiency Potential:

From EPA's 2007 Guide for Conducting Energy Efficiency Potential Studies:

In general, a potential analysis involves the following steps:[1]

- Identify the baseline energy consumption forecast, including a specific understanding of what it does and does not include in terms of future changes to codes and standards, natural efficiency adoption, planned efficiency programs, etc. (Presumably this is already done through the IPM modeling.)
- Disaggregate the baseline forecast into customer and other segments (e.g., end uses) appropriate for the analysis.
- Characterize efficiency measures:
    - Identify energy, demand, and other savings (e.g., operations and maintenance) of each measure, including changes over time.[5]
    - Identify costs associated with each measure, including changes over time, such as prices coming down because of greater volume sold and technology improvements.
- Screen measures for economic effects, cost-effectiveness, and other resource effects.
- Develop program designs, in terms of bundled measures targeting particular customer groups and/or end-uses.
- Estimate measure penetrations for baseline and efficient scenarios for each program year using program design information, available studies, past program results, understanding of the specific markets, etc.
- Calculate total savings for all efficiency measures.
- The quantity of emission reductions available via demand-side energy efficiency investments that would be incorporated into the NSPS as "adequately demonstrated" could be established based on a subset of the total potential savings (similar to the way in which not all reasonably available control measures are presumed to be implemented in a nonattainment area even if available or in which the Agency accounts for the NAS

[1] *See also* ICF International, Energy Efficiency Potential Model, http://www.icfi.com/insights/products-and-tools/eepm; Federal Energy Regulatory Commission, *A National Assessment of Demand Response Potential* (June 2009), http://www.ferc.gov/legal/staff-reports/06-09-demand-response.pdf; McKinsey & Company, *Reducing U.S. Greenhouse Gas Emissions: How Much at What Cost?* (December 2007), http://www.edf.org/documents/9665_McKinsey%20GHG%20Report.pdf; Energy Center of Wisconsin, *A Review and Analysis of Existing Studies of the Energy Efficiency Resource Potential in the Midwest* (August 2009), http://www.midwesterngovernors.org/Energy/EEResourcePotential.pdf; Georgia Institute of Technology, Meta-Review of Efficiency Potential Studies and Their Implications for the South (August 2009), http://www.spp.gatech.edu/faculty/workingpapers/wp51.pdf .

analysis on available greenhouse gas mitigation from a new heavy-duty diesel truck even while setting a standard that could be achieved based on a subset of the available technologies).

Quantification of avoided emissions (lbs CO_2):

One method of quantifying the emissions avoided due to a demand-side energy efficiency intervention would be to follow the approach recommended in the 2004 guidance to States and local areas on crediting emission reductions from energy efficiency and renewable energy measures in State Implementation Plans.[2] This guidance recommends using dispatch and emission reduction models to calculate the reduction in emissions that occurs based on demand reductions in a specific service territory. Note that other proxies can be used to conservatively estimate the reductions in emissions that would result from a reduction in demand, including reliance on data indicating which units are marginal and likely to be displaced. Under the SIP guidance, states can only take credit for emission reductions that are projected to occur within the non-attainment area, unless reductions outside the non-attainment area can be shown to affect air quality within the non-attainment. In the latter case, the amount of potential credit is determined by the extent to which reductions will improve air quality in the nonattainment area.[3] In the context of GHG emissions, any reduction improves atmospheric GHG concentrations equally, so all emission reductions achieved by these programs should be counted. This approach aligns with the § 111 legal framework, which (unlike § 110) does not require emission reductions to occur within a specific geographic area.

Distributing credit for achieved emission reductions:

One approach to allocate credit for reductions in emissions from reductions in energy demand or demand side management would be to allow whichever entity funds a demand-based emission reduction to claim credit for reduced emissions (e.g. to subtract the lbs CO_2 from the numerator in its emissions rate). Only generators that sell power into the state in which the demand reduction was achieved would be eligible to claim the reduced emissions, in order to retain a nexus between the reduction in utilization and the demand reduction or demand management intervention. Because power generation and electricity grids cross state boundaries, note that any state equivalency framework must be capable of distinguishing between reductions in utilization due to demand side efficiency and demand side management investments and reductions in utilization due to other factors, and attribute credit accordingly.

Another approach would be to use the modeling quantification approach described above but only to allow those plants projected to reduce utilization to claim credit, and to do so proportionately to dispatch reduction projections. This will make the design of the emission reduction requirements (and the incentive structure for investment in these improvements) more complex.

[2] EPA, Office of Air and Radiation, "Guidance on State Implementation Plan (SIP) Credits for Emission Reductions from Electric-Sector Energy Efficiency and Renewable Energy Measures," (August 2004).
[3] *Id.* at 21 (No. 27).

To: Megan Ceronsky [mceronsky@edf.org]
Cc: CN=Kevin Culligan/OU=DC/O=USEPA/C=US@EPA;CN=Lorie Schmidt/OU=DC/O=USEPA/C=US@EPA[]; N=Lorie Schmidt/OU=DC/O=USEPA/C=US@EPA[]
From: CN=Joel Beauvais/OU=DC/O=USEPA/C=US
Sent: Wed 6/29/2011 5:18:50 PM
Subject: Re: GHG NSPS 111(d) framework

Thanks, Megan

Joel

From: Megan Ceronsky <mceronsky@edf.org>
To: Lorie Schmidt/DC/USEPA/US@EPA, Joel Beauvais/DC/USEPA/US@EPA, Kevin Culligan/DC/USEPA/US@EPA
Date: 06/28/2011 05:30 PM
Subject: GHG NSPS 111(d) framework

Dear Lorie, Joel, and Kevin--

We wanted to send you the latest version of our thinking for the design of the power plant GHG NSPS under Sec. 111(d). We would welcome an opportunity to discuss this with you and get your thoughts.

Best,
Megan

Megan Ceronsky
Attorney
Environmental Defense Fund
(303) 447-7224 (P)
(303) 440-8052 (F)
2060 Broadway
Suite 300
Boulder, CO 80302

 [attachment "Section 111(d) GHG NSPS Design Framework (6.28.2011, detailed).docx" deleted by Joel Beauvais/DC/USEPA/US]

To: Michael Goo/DC/USEPA/US@EPA;"Barron, Alex" [Alex.Barron@mail.house.gov]; Barron, Alex" [Alex.Barron@mail.house.gov]; tsirigotis.panagiotis@epa.gov>;Joseph Goffman/DC/USEPA/US@EPA;Jim Ketcham-Colwill/DC/USEPA/US@EPA;Lorie Schmidt/DC/USEPA/US@EPA;Kevin Culligan/DC/USEPA/US@EPA[]; oseph Goffman/DC/USEPA/US@EPA;Jim Ketcham-Colwill/DC/USEPA/US@EPA;Lorie Schmidt/DC/USEPA/US@EPA;Kevin Culligan/DC/USEPA/US@EPA[]; im Ketcham-Colwill/DC/USEPA/US@EPA;Lorie Schmidt/DC/USEPA/US@EPA;Kevin Culligan/DC/USEPA/US@EPA[]; orie Schmidt/DC/USEPA/US@EPA;Kevin Culligan/DC/USEPA/US@EPA[]; evin Culligan/DC/USEPA/US@EPA[]
Cc: "Doniger, David" [ddoniger@nrdc.org]; Hawkins, Dave" [dhawkins@nrdc.org]; Yeh, Starla" [syeh@nrdc.org]
From: "Lashof, Dan"
Sent: Fri 7/22/2011 10:10:51 PM
Subject: Updated IPM modeling on NSPS options
EPA WG June 14 Option 2 7-22-2011 v2.pptx

Dear EPA NSPSers-

I'm attaching an updated power point presentation that incorporates into the presentation we made to the Administrator new IPM modeling results for what we have called "Option 2" for the 111(d) standard. We found that this option, which sets state-level emission rate standards for all fossil generating units, produced greater emission reductions at lower cost than our original proposal based on remaining useful life ("option 1").

The new results for Option 2 begin with slide 12. The key new emission results appear on Slide 13 and the new electricity price results appear on slide 14.

Note that for modeling purposes the "option 2" standards were implemented at a regional (rather than state) level and that banking of emission credits was not allowed. Detailed model specs are pasted below.

Let me know if you have any questions and want additional information.

-Dan

Daniel A. Lashof, Ph.D.

Director, NRDC Climate Center

202-289-6868

The NSPS Case includes regional NSPS requirements based on a formula developed by NRDC. It does not include any other treatment of CO_2 emissions performance at the national level. The regional NSPS standards are a function of the historical fossil fuel generation mix in the region and national historical emission rates. The standards are set based on an initial rate for each region and a schedule of reductions in the national emissions rates used in the formula over time, as established by NRDC.

The historical regional emission rates to be used in the calculation of the program standards were developed from the following components:

1. State/regional generation mix – Using historical generation data from EPA and FERC for the years 2008 to 2010, ICF calculated the average share of fossil generation attributable to coal and to combined oil and gas generation. These shares were developed at the state or model region level, consistent with the model regions currently used in IPM©.

2. National coal and oil/gas CO_2 emission rates –Based on national EPA data for the period 2008 to 2010, ICF calculated the average emission rate, in lbs/MWh, for coal-fired generation and for combined oil- and gas-fired generation at 2063 lbs/MWh and 1065 lbs/MWh, respectively.

NRDC specified the initial emission rates for use in the development of the standard for each state/region as the average national emission rate for coal and oil/gas, weighted by the share of generation of each fuel by region over the 2008-2010 period, based the following formula:

Initial Regional Rate = [National coal CO_2 emission rate * coal generation share by region] + [National oil/gas CO_2 emission rate * oil/gas generation share by region]

For each compliance period, the standard for each region will be based on the initial emission rate calculated above adjusted downward by the following factors:

1. For 2015-2019, the annual emission rate used for the coal share declines by 5% relative to the initial emission rate and the rate used for oil and gas declines by 2.5% relative to the initial emission rate. The annual rate standards are flat during this 5-year period.

2. For 2020 and onwards, the emission rate is kept flat and reflects a 15% decline relative to the initial emission rate for coal and a 5% decline relative to the initial emission rate for oil and gas.

All other assumptions in the Option 2 NSPS Case, including other environmental regulations and natural gas prices, are identical to those in the Option 1 NSPS Case. As such, any decrease in natural gas generation and natural gas demand in this case was assumed to not have any material impact on natural gas prices.

Options for Achieving Meaningful Carbon Emissions Reductions Through Section 111 of the Clean Air Act

July 22, 2011

Key Goals

- Avoid New High Emission Power Plants
- Cut Average Emission Rate of Fossil Fuel Generating Fleet 10-15% by 2020
- Establish Robust Framework That is Technically, Legally, and Politically Defensible

→ Set Standards for Combined Fossil EGU Source Category (i.e., merge Da with KKKK)

Title Page Photo Credit: http://www.sciencenews.org/view/access/id/32053/title/Clear_sky%3F

Legal and Policy Considerations
Selecting the Category: All Fossil-Fueled Power Plants

NRDC
THE EARTH'S BEST DEFENSE

* "All fossil" category critical to harness all real-world control options, and achieve significant near- and mid-term GHG reductions
* EPA has broad authority under (b)(1)(A) to define source categories to fit the factual circumstances of specific industries
* "All fossil" category – for both (b) and (d) standards – reflects real-world operational and investment decisions
  - Power plants operated as an integrated system – interdependent management decisions on when to operate, build, upgrade, and retire units
  - Walling off coal plants in separate category arbitrarily restricts control options, yields small near-term reductions, and closes off longer-term reduction options
* "All fossil" consistent with *New York* settlement, which does not limit a broader-than-coal approach

New Units -- 111(b)
Key Design Features

- Combine Coal (Da) and Gas (KKKK) categories
  - (Subcategory for Peakers)
- Set Standard for Fossil Units at 850 lbs/MWh (except peakers)
- Allow Option to Time-Average Over First 30 Years of Operations
- Technically and Economically Feasible Based On:
  - Natural Gas Combined Cycle

  OR
  - Coal with CCS Installed After 10 years

    (1850 lbs/MWh for 10 years; 350 lbs/MWh for 20 years)

Legal and Policy Considerations – 111(b)
"All Fossil," BDT, and 30-Yr Average Standard Go Together

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* 850 lbs/MWh new source standard for "all fossil" category achievable at reasonable cost by combined cycle gas turbines
* Also achievable by new coal with CCS on time average basis over first 30 years
  - E.g., 1850 lbs/MWh for 10 years, 350 lbs/MWh for 20 years
  - Other averaging profiles possible, allowing earlier or later adoption of CCS
* Source commits to an enforceable averaging profile in permit at start-up, with penalties for "excess" emissions in early years held in abeyance as long as source performs "on profile"
  - Penalties enforced for accumulated excess emissions if source fails to perform on profile
* *Portland Cement:* "Section 111 looks toward what may fairly be projected for the regulated future;" "Administrator may make a projection based on existing technology, though that projection is subject to the restraints of reasonableness and cannot be based on 'crystal ball' inquiry"

Existing Units -- 111(d)
Key Design Options

NSPS Option 1 (abbreviated NSPS-1)

- Set Performance Standard at New Source Rate, Phased In at End of Remaining Useful Life

NSPS Option 2 (abbreviated NSPS-2)

- Set State Average Fossil Fuel Emission Rates Based on Fuel-Specific Performance Standards and Fuel Mix in Baseline Period

NSPS Option 3 (abbreviated NSPS-3)

- Set Performance Standard at 15% Below Current Coal Average Rate, Allow Compliance by Averaging with Cleaner Generation that Replaces Part of Generation from Source

Legal and Policy Considerations – 111(d)
"All Fossil," BDT, and Emission-Rate Averaging Go Together

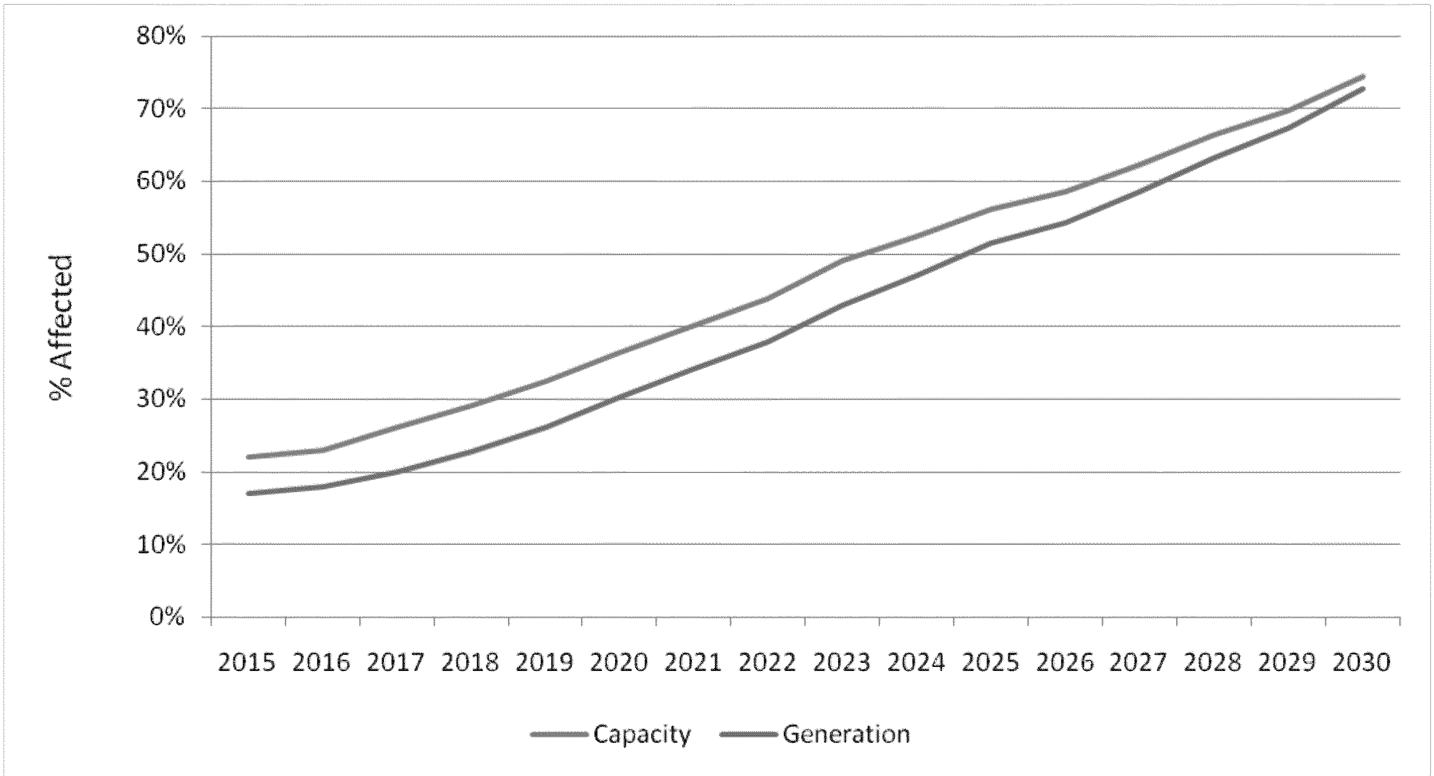
NRDC
The Earth's Best Defense

* What's BDT depends on how compliance is defined
  - Unit-by-unit: Each unit has to comply with emission rate on its own
  - Emission-rate averaging: Provides additional compliance option for each unit
  - Emission-rate averaging across "all fossil" category: Provides broadest compliance options for each unit
* Narrower compliance options mean BDT achieves less emission reduction
  - Sources can't adopt lower cost compliance options
  - EPA's ability to "find" all available, reasonable-cost options is limited
* Broader compliance options mean BDT can – and must – achieve more reductions
  - Sources have more options at given cost; easier for EPA to identify and support them

Existing Units -- 111(d)
NSPS Option 1

- Required to Meet New Source Standard Within 3 years
- Safe Harbor Until End of Remaining Useful Life
  - Provided No Increase in Emissions Above Baseline
- Allow Emission Averaging Among All Fossil Units
- Credit for Early Retirement
- Optional: Credit for Incremental Renewables & DSM

Phase In Based on End of Remaining Useful Life (Age 50)
NSPS-1: Percentage of Coal Fleet Affected Over Time

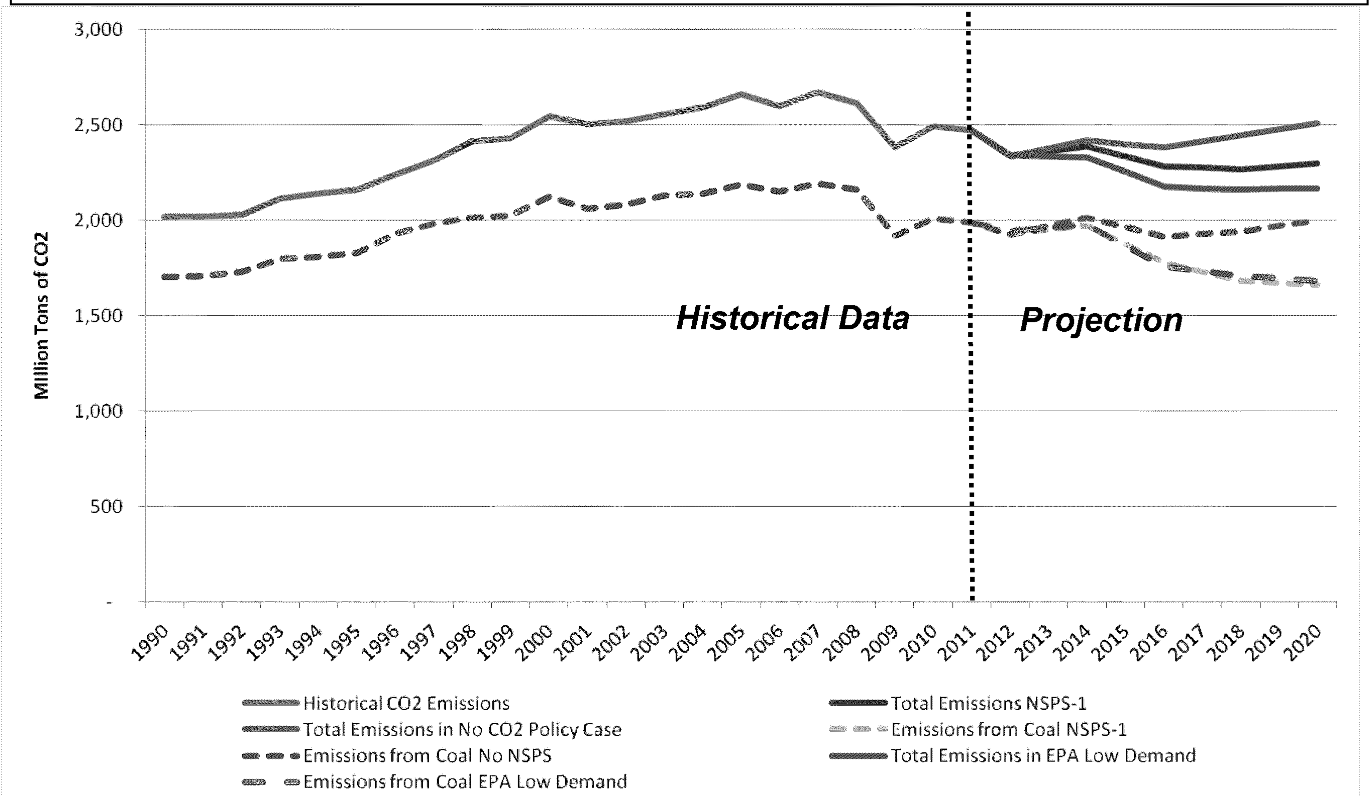


Source: EPA NEEDS 4.1 data; Calculations based on trigger date of 50 years.

NSPS-1 and No NSPS and EPA Low Demand Cases

U.S. EGU CO2 Emissions (Million Short Tons)

Historical CO2 Emissions and NRDC Projected CO2 Emissions



Source for historical CO2 emissions data: EIA. 2011 Figure derived from AEO 2011.

Existing Units -- 111(d)
Key Design Features

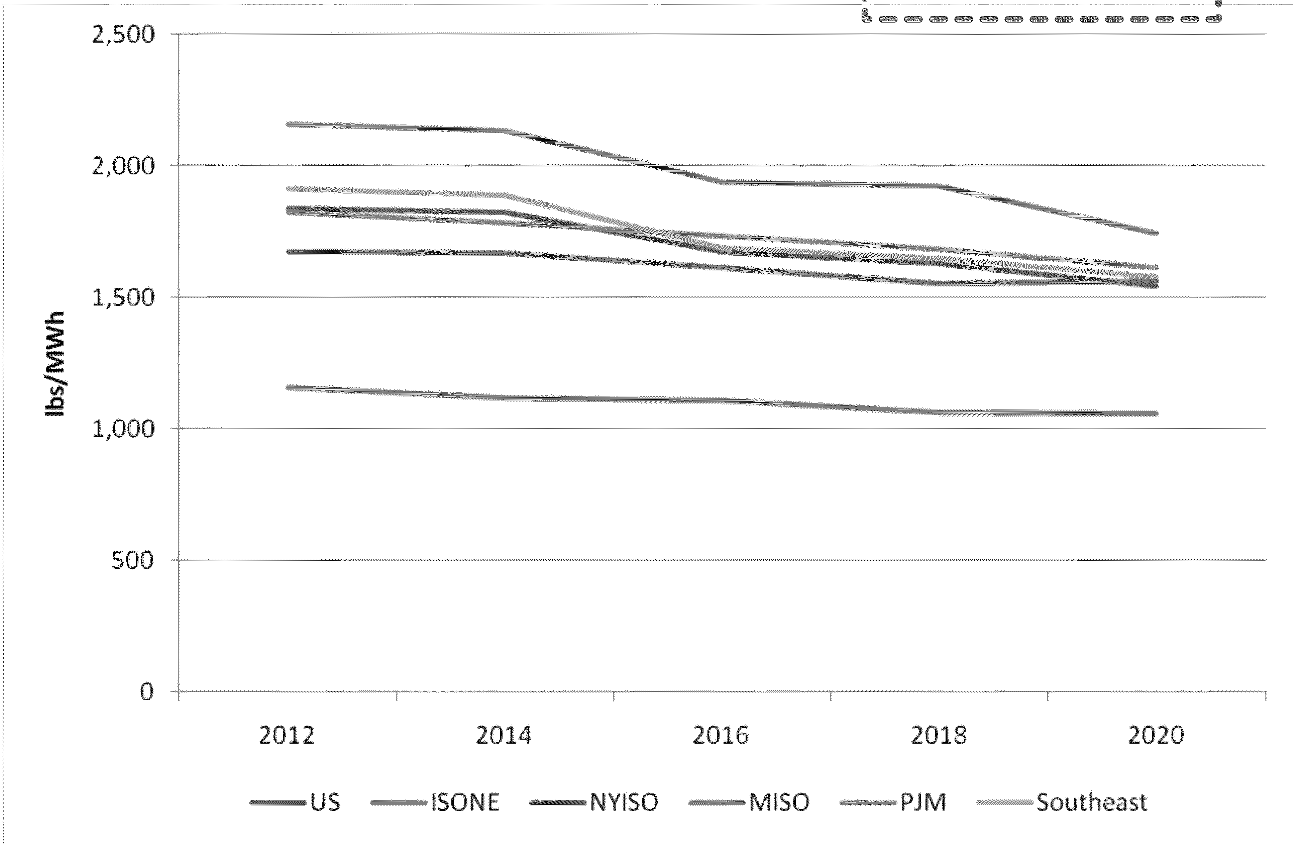
NSPS Option 2

- Phase In Performance Standard for Coal
  - 5% below the current coal average in 2015
  - 15% below the current coal average in 2020
- Phase In Performance Standard for Gas
  - 2.5% below the current gas average in 2015
  - 5% below the current gas average in 2020
- State Standard Based on Fuel Mix in Baseline Period [2008-10]
- Averaging Among All Fossil Units in State
- Optional: Credit for Incremental Renewables & DSM

State Emission Standards Based on Fuel Mix

NSPS-2: Fossil Fuel Emission Rates (US and by Focal Region)

UPDATED



NSPS-2 Emissions Results of NSPS-2 Model Run

U.S. EGU Emissions (Million Short Tons)

UPDATED

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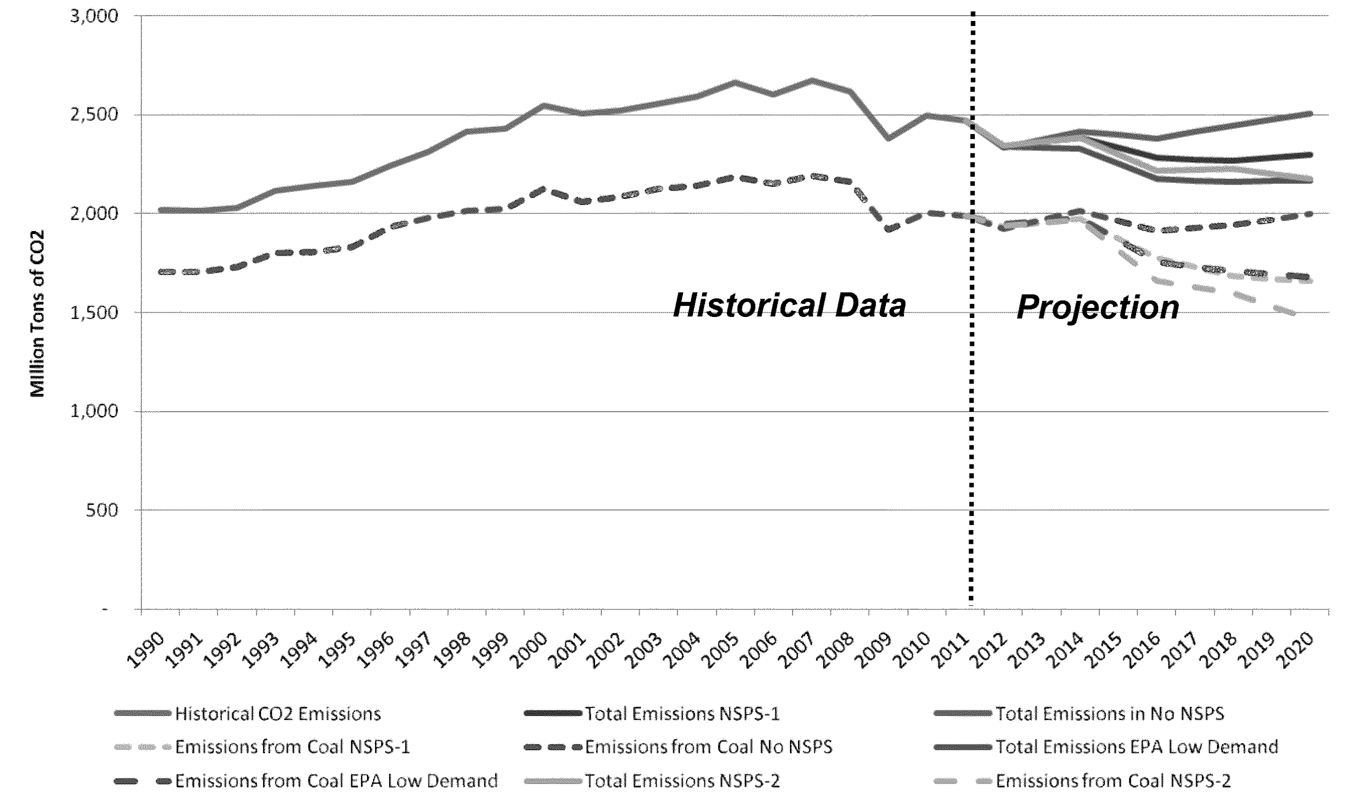
The Earth's Best Defense

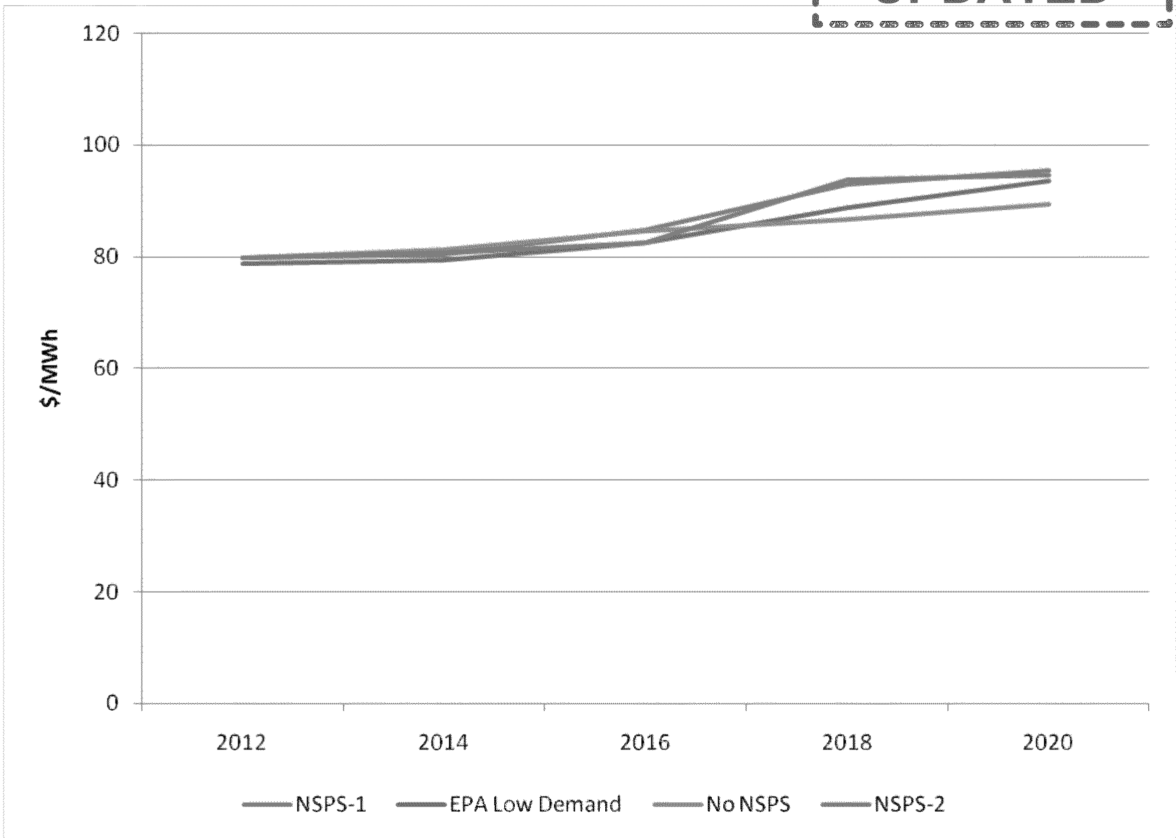
Historical CO2 Emissions and NRDC Projected CO2 Emissions



Source for historical CO2 emissions data: EIA. 2011 Figure derived from AEO 2011.

U.S. Retail Electricity Price Impacts (National Average)

UPDATED



Note: National average based on generation-weighted average of PJM, Southeast, MISO, NYISO, ISONE, accounting for 60% of national generation

Existing Units -- 111(d)
Key Design Features

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NSPS Option 3

- Phase In Performance Standard
  - 5% Below Current Coal Average in 2015
  - 15% Below Current Coal Average in 2020
- Safe Harbor If Unit Accepts Obligation to Retire by 2020
  - Binding Obligation Not to Increase Emissions Prior to Shutdown
- Allow Averaging with Incremental Cleaner Generation that Replaces Part of Generation at Unit through Ownership or Contract
  - Leakage Avoided by Requirement to Reduce On Site Emissions
  - Emissions from Replacement Gas Generation Averaged into Rate
  - Optional: Replacement Renewables or DSM Lowers Rate

NSPS Option 3
Compliance Examples

Illustrative On-Site Compliance Path:

* Combustion Controls Reduce Heat Rate by 5%
* Co-fire 10% Sustainable Biomass or 24% Gas

Alternative Compliance Path

* Reduce Coal Unit's Generation by 24%
* Replace Generation with Increased Utilization of NGCC

Alternative Compliance Path Likely Much Cheaper

* No Investment Required at Coal Unit
* NGCC Uses Gas Much More Efficiently, So Lower Fuel Costs

Contact Information

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dhawkins@nrdc.org | www.nrdc.org

Dan Lashof | Climate Center | Natural Resources Defense Council
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David Doniger | Climate Center | Natural Resources Defense Council
Office: 202-289-6868 | 1200 New York Avenue, NW, Suite 400, Washington, DC 20005
ddoniger@nrdc.org | www.nrdc.org

To: Joseph Goffman/DC/USEPA/US@EPA[]
From: "Hawkins, Dave"
Sent: Tue 2/8/2011 10:35:14 PM
Subject: FW: White House blog on EPA carbon pollution standards
The White House. President Barack Obama
were actually the result

This is a nice development

http://m.whitehouse.gov/sites/default/themes/wh_mobile/img/mobile_banner.jpgThe White House. President Barack Obama

THE WHITE HOUSE BLOG

You Can't Believe Everything You Read

February 04, 2011 at 04:55 PM EST

As valuable as the internet can be in helping to spread information, most people know that you can't believe everything you read, and they should check the source before relaying every alarming story they read. One such story is going around the internet over the past two days claiming that the Obama Administration is somehow responsible for the rolling blackouts in Texas that have caused terrible hardship for so many Texans. The source is questionable and the story is unquestionably false.

According to the Electric Reliability Council of Texas, these blackouts were actually the result of extreme cold temperatures and high winds, which led to a variety of mechanical failures at more than 50 power plants around the state.

Anytime communities experience major outages, it is a cause for concern, and major utilities and regulators are investigating steps that can be taken to decrease any weather related vulnerability of power generating plants in the state that, unlike their northern counterparts which experience extreme cold every winter, are often not designed to withstand such rare weather conditions.

Some are trying to blame these blackouts – which the industry has already provided explanation for – on Clean Air Act standards under consideration to curb dangerous pollution, including carbon pollution. While these claims gained traction on the internet, there is a major problem with this theory – no power plant in Texas has yet been required to do anything to control carbon pollution.

In December the EPA announced its intent to update important Clean Air Act standards that for decades have decreased harmful pollution and protected public health. In the coming months the EPA will work closely with key stakeholders, including industry, to develop a commonsense standard for currently unchecked, dangerous carbon pollution. Any standard, which will leverage existing technologies and only apply to the largest polluters, will not be proposed until later this year, allowing an extensive public comment period, and following that additional input no final rule is scheduled to be in place until late 2012.

Despite these modest steps, many continue to mischaracterize this process – making unsubstantiated claims about the impact this will have on everything from industry to energy prices. This most recent effort simply underscores a willingness to ignore the facts to further an agenda that seeks to stop the EPA from sensible updates to the Clean Air Act.

Dan Pfeiffer is White House Communications Director

To: hwang.cindy@epa.gov[hwang.cindy@epa.gov]
Cc: Joseph Goffman/DC/USEPA/US@EPA;"Adhar, Radha" [radhar@nrdc.org]; Adhar, Radha" [radhar@nrdc.org]
From: "Doniger, David"
Sent: Mon 3/21/2011 10:40:44 PM
Subject: Meeting request
ddoniger@nrdc.org
www.nrdc.org
http://switchboard.nrdc.org/blogs/ddoniger/

Cindy,

I am following up a conversation with Joe Goffman to ask for a meeting as soon as feasible with Gina McCarthy, Joe, and whomever they want to include, on the subject of the Section 111 standards for power plants.

Attendees on our side would include David Hawkins, Dan Lashof, Meleah Geertsma, and myself.

You could be in touch with me or (probably more productively) with our assistant, Radha Adhar, who is copied above. Radha's number is 202 289-2413.

David D. Doniger

Policy Director, Climate Center

Natural Resources Defense Council

1200 New York Ave., NW

Washington, DC 20005

Phone: (202) 289-2403

Cell: (202) 321-3435

Fax: (202) 789-0859

ddoniger@nrdc.org

on the web at www.nrdc.org

read my blog: http://switchboard.nrdc.org/blogs/ddoniger/

To: Joseph Goffman/DC/USEPA/US@EPA[]
From: "Doniger, David"
Sent: Mon 3/21/2011 10:44:27 PM
Subject: FW: Meeting request
ddoniger@nrdc.org
www.nrdc.org
http://switchboard.nrdc.org/blogs/ddoniger/
ddoniger@nrdc.org
www.nrdc.org
http://switchboard.nrdc.org/blogs/ddoniger/

Joe, sorry to bother you with this. I must have miscopied Gina's assistant's name and the email bounced. Could you please send me her correct name and email?

David D. Doniger

Policy Director, Climate Center

Natural Resources Defense Council

1200 New York Ave., NW

Washington, DC 20005

Phone: (202) 289-2403

Cell: (202) 321-3435

Fax: (202) 789-0859

ddoniger@nrdc.org

on the web at www.nrdc.org

read my blog: http://switchboard.nrdc.org/blogs/ddoniger/

From: Doniger, David
Sent: Monday, March 21, 2011 6:41 PM
To: hwang.cindy@epa.gov
Cc: Goffman.Joseph@epamail.epa.gov; Adhar, Radha
Subject: Meeting request

Cindy,

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To: Joseph Goffman/DC/USEPA/US@EPA;Cindy Huang/DC/USEPA/US@EPA[]; indy Huang/DC/USEPA/US@EPA[]
Cc: "Adhar, Radha" [radhar@nrdc.org]
From: "Doniger, David"
Sent: Mon 3/21/2011 10:56:36 PM
Subject: Re: Meeting request
ddoniger@nrdc.org
www.nrdc.org
http://switchboard.nrdc.org/blogs/ddoniger/

Thanks.

David Doniger, NRDC
(202) 321-3435
Sent from Blackberry

From: Goffman.Joseph@epamail.epa.gov [mailto:Goffman.Joseph@epamail.epa.gov]
Sent: Monday, March 21, 2011 06:53 PM
To: Doniger, David; Cindy Huang <Huang.Cindy@epamail.epa.gov>
Cc: Adhar, Radha
Subject: Re: Meeting request

Adding Cindy.

From: "Doniger, David" [ddoniger@nrdc.org]
Sent: 03/21/2011 06:40 PM AST
To: <hwang.cindy@epa.gov>
Cc: Joseph Goffman; "Adhar, Radha" <radhar@nrdc.org>
Subject: Meeting request

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To: Joseph Goffman/DC/USEPA/US@EPA;Cindy Huang/DC/USEPA/US@EPA[]; indy Huang/DC/USEPA/US@EPA[]
From: "Adhar, Radha"
Sent: Tue 3/22/2011 4:17:04 PM
Subject: RE: Meeting request
ddoniger@nrdc.org
www.nrdc.org
http://switchboard.nrdc.org/blogs/ddoniger/

Good Afternoon Cindy, Joe,

I hope you both are doing well. Are you both free on April 1st? If not, please let me know when works best for you both and I will coordinate with the NRDC team.

Thanks for your help,

Radha

From: Goffman.Joseph@epamail.epa.gov [mailto:Goffman.Joseph@epamail.epa.gov]
Sent: Monday, March 21, 2011 6:53 PM
To: Doniger, David; Cindy Huang
Cc: Adhar, Radha
Subject: Re: Meeting request

Adding Cindy.

From: "Doniger, David" [ddoniger@nrdc.org]
Sent: 03/21/2011 06:40 PM AST
To: <hwang.cindy@epa.gov>
Cc: Joseph Goffman; "Adhar, Radha" <radhar@nrdc.org>
Subject: Meeting request

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David D. Doniger

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Fax: (202) 789-0859

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read my blog: http://switchboard.nrdc.org/blogs/ddoniger/

To: "Adhar, Radha" [radhar@nrdc.org]
Cc: CN=Joseph Goffman/OU=DC/O=USEPA/C=US@EPA[]
From: CN=Cindy Huang/OU=DC/O=USEPA/C=US
Sent: Tue 3/22/2011 4:25:28 PM
Subject: RE: Meeting request
ddoniger@nrdc.org
www.nrdc.org
http://switchboard.nrdc.org/blogs/ddoniger/

Hi Ms. Adhar,

Thanks for reaching out - They are both free that day. The morning at 10 or 11 is available for Gina and Joe.

Sincerely,
Cindy

Cindy Huang
(202) 564-7404

From: "Adhar, Radha" <radhar@nrdc.org>
To: Joseph Goffman/DC/USEPA/US@EPA, Cindy Huang/DC/USEPA/US@EPA
Date: 03/22/2011 12:17 PM
Subject: RE: Meeting request

Good Afternoon Cindy, Joe,

I hope you both are doing well. Are you both free on April 1st? If not, please let me know when works best for you both and I will coordinate with the NRDC team.

Thanks for your help,
Radha

From: Goffman.Joseph@epamail.epa.gov [mailto:Goffman.Joseph@epamail.epa.gov]
Sent: Monday, March 21, 2011 6:53 PM
To: Doniger, David; Cindy Huang
Cc: Adhar, Radha
Subject: Re: Meeting request

Adding Cindy.

From: "Doniger, David" [ddoniger@nrdc.org]
Sent: 03/21/2011 06:40 PM AST
To: <hwang.cindy@epa.gov>
Cc: Joseph Goffman; "Adhar, Radha" <radhar@nrdc.org>
Subject: Meeting request

Cindy,

I am following up a conversation with Joe Goffman to ask for a meeting as soon as feasible with Gina McCarthy, Joe, and whomever they want to include, on the subject of the Section 111 standards for power plants.

Attendees on our side would include David Hawkins, Dan Lashof, Meleah Geertsma, and myself.

You could be in touch with me or (probably more productively) with our assistant, Radha Adhar, who is copied above. Radha's number is 202 289-2413.

David D. Doniger
Policy Director, Climate Center
Natural Resources Defense Council
1200 New York Ave., NW
Washington, DC 20005
Phone: (202) 289-2403
Cell: (202) 321-3435
Fax: (202) 789-0859
ddoniger@nrdc.org
on the web at www.nrdc.org
read my blog: http://switchboard.nrdc.org/blogs/ddoniger/

To: Cindy Huang/DC/USEPA/US@EPA[]
Cc: Joseph Goffman/DC/USEPA/US@EPA[]
From: "Adhar, Radha"
Sent: Tue 3/22/2011 4:28:54 PM
Subject: RE: Meeting request

Hi Cindy,

Great! Can we please plan for 10:00am? Also, will this be an in person meeting at EPA or via conference call? Please let me know and thanks again for your help.

Best,
Radha

-----Original Message-----
From: Huang.Cindy@epamail.epa.gov [mailto:Huang.Cindy@epamail.epa.gov]
Sent: Tuesday, March 22, 2011 12:25 PM
To: Adhar, Radha
Cc: Goffman.Joseph@epamail.epa.gov
Subject: RE: Meeting request

Hi Ms. Adhar,

Thanks for reaching out - They are both free that day. The morning at 10 or 11 is available for Gina and Joe.

Sincerely,
Cindy

Cindy Huang
(202) 564-7404

From: "Adhar, Radha" <radhar@nrdc.org>
To: Joseph Goffman/DC/USEPA/US@EPA, Cindy Huang/DC/USEPA/US@EPA
Date: 03/22/2011 12:17 PM
Subject: RE: Meeting request

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Radha

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Subject: Meeting request

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on the web at www.nrdc.org
read my blog: http://switchboard.nrdc.org/blogs/ddoniger/

To: ddoniger@nrdc.org;CN=Ellen Kurlansky/OU=DC/O=USEPA/C=US@EPA;CN=Howard Hoffman/OU=DC/O=USEPA/C=US@EPA;CN=Janet McCabe/OU=DC/O=USEPA/C=US@EPA;CN=Joseph Goffman/OU=DC/O=USEPA/C=US@EPA;CN=Peter Tsirigotis/OU=RTP/O=USEPA/C=US@EPA;CN=Rob Brenner/OU=DC/O=USEPA/C=US@EPA;CN=Sam Napolitano/OU=DC/O=USEPA/C=US@EPA[]; N=Ellen Kurlansky/OU=DC/O=USEPA/C=US@EPA;CN=Howard Hoffman/OU=DC/O=USEPA/C=US@EPA;CN=Janet McCabe/OU=DC/O=USEPA/C=US@EPA;CN=Joseph Goffman/OU=DC/O=USEPA/C=US@EPA;CN=Peter Tsirigotis/OU=RTP/O=USEPA/C=US@EPA;CN=Rob Brenner/OU=DC/O=USEPA/C=US@EPA;CN=Sam Napolitano/OU=DC/O=USEPA/C=US@EPA[]; N=Howard Hoffman/OU=DC/O=USEPA/C=US@EPA;CN=Janet McCabe/OU=DC/O=USEPA/C=US@EPA;CN=Joseph Goffman/OU=DC/O=USEPA/C=US@EPA;CN=Peter Tsirigotis/OU=RTP/O=USEPA/C=US@EPA;CN=Rob Brenner/OU=DC/O=USEPA/C=US@EPA;CN=Sam Napolitano/OU=DC/O=USEPA/C=US@EPA[]; N=Janet McCabe/OU=DC/O=USEPA/C=US@EPA;CN=Joseph Goffman/OU=DC/O=USEPA/C=US@EPA;CN=Peter Tsirigotis/OU=RTP/O=USEPA/C=US@EPA;CN=Rob Brenner/OU=DC/O=USEPA/C=US@EPA;CN=Sam Napolitano/OU=DC/O=USEPA/C=US@EPA[]; N=Joseph Goffman/OU=DC/O=USEPA/C=US@EPA;CN=Peter Tsirigotis/OU=RTP/O=USEPA/C=US@EPA;CN=Rob Brenner/OU=DC/O=USEPA/C=US@EPA;CN=Sam Napolitano/OU=DC/O=USEPA/C=US@EPA[]; N=Peter Tsirigotis/OU=RTP/O=USEPA/C=US@EPA;CN=Rob Brenner/OU=DC/O=USEPA/C=US@EPA;CN=Sam Napolitano/OU=DC/O=USEPA/C=US@EPA[]; N=Rob Brenner/OU=DC/O=USEPA/C=US@EPA;CN=Sam Napolitano/OU=DC/O=USEPA/C=US@EPA[]; N=Sam Napolitano/OU=DC/O=USEPA/C=US@EPA[]

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From: CN=Cindy Huang/OU=DC/O=USEPA/C=US
Sent: Tue 3/22/2011 8:50:36 PM
Subject: Meeting with NRDC on Section 111 Standards for Power Plants

From: "Doniger, David" [ddoniger@nrdc.org]
Sent: 03/21/2011 06:40 PM AST
To: <hwang.cindy@epa.gov>
Cc: Joseph Goffman; "Adhar, Radha" <radhar@nrdc.org>
Subject: Meeting request

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Miller/OU=DC/O=USEPA/C=US@EPA;radhar@nrdc.org[]; adhar@nrdc.org[]
From: CN=Cindy Huang/OU=DC/O=USEPA/C=US
Sent: Thur 3/24/2011 8:59:34 PM
Subject: Rescheduled: Meeting with NRDC on Section 111 Standards for Power Plants (Apr 1 02:45 PM EDT in Ariel Rios North room 5400, 1200 Pennsylvania Ave. NW Conference: Ex. 6 - Personal Privacy
Ex. 6 - Personal Privacy

From: "Doniger, David" [ddoniger@nrdc.org]
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Fax: (202) 789-0859
ddoniger@nrdc.org
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To: Joseph Goffman/DC/USEPA/US@EPA;David McIntosh/DC/USEPA/US@EPA[]; avid McIntosh/DC/USEPA/US@EPA[]
From: "Michael Myers"
Sent: Tue 3/29/2011 8:38:06 PM
Subject: Letter to Congress re. EPA GHG Authority
032911 Senate Letter re Anti-EPA Bills final.pdf
michael.myers@ag.ny.gov

Please see the attached correspondence on behalf of the Attorneys General of New York, Connecticut, Delaware, Iowa, Massachusetts, Rhode Island, and Vermont, and the Corporation Counsel of the City of New York.

Sincerely,

Michael J. Myers
Chief, Affirmative Litigation Section
Environmental Protection Bureau
New York State Attorney General
The Capitol
Albany, NY 12224
(518) 402-2594
michael.myers@ag.ny.gov

ATTORNEYS GENERAL OF NEW YORK, CONNECTICUT, DELAWARE, IOWA, MASSACHUSETTS, RHODE ISLAND, AND VERMONT, AND THE CORPORATION COUNSEL OF THE CITY OF NEW YORK

March 29, 2011

The Honorable Harry Reid
Majority Leader
United States Senate
522 Hart Senate Office Building
Washington, D.C. 20515

The Honorable Mitch McConnell
Minority Leader
United States Senate
361-A Russell Senate Office Building
Washington, D.C. 20515

Re: Opposition to Proposed Legislation that Would Block or Delay U.S. EPA Regulations That Combat Climate Change Pollution

Dear Majority Leader Reid and Minority Leader McConnell:

The States of New York, Connecticut, Delaware, Iowa, Massachusetts, Rhode Island, and Vermont, and the City of New York ("States") write to voice our strong opposition to proposed legislation that would prohibit or delay the Environmental Protection Agency (EPA) from taking action to address climate change under the existing authority provided by the Clean Air Act. Specifically, we oppose the "Energy Tax Prevention Act of 2011" (S. 482), sponsored by Senator Inhofe, and proposed amendments to the "SBIR/STTR Reauthorization Act of 2011" (S. 493) offered by Senators McConnell and Rockefeller. These bills would negate the hard-fought successes, achieved after years of litigation by States, that are only now beginning to bear fruit with EPA's development of common-sense and cost-effective regulations to begin to address climate change pollution from motor vehicles and power plants, the two sectors with the largest climate change emissions in the United States.

The legislation proposed by Sens. Inhofe and McConnell would specifically override EPA's determination, based on solid, sound science, that climate change pollutants endanger the public health and welfare of current and future generations. 74 Fed. Reg. 66496 (Dec. 15, 2009). That determination followed in the wake of the Supreme Court's decision in *Massachusetts v. EPA*, 549 U.S. 497 (2007), that greenhouse gases fit well within the definition of "air pollutant" under the Clean Air Act. Many of the undersigned States participated in that litigation. EPA's exhaustive scientific review and subsequent studies by leading scientists demonstrate that emissions of carbon dioxide (CO_2) and other heat-trapping gases have warmed the oceans and atmosphere and have led to an energy imbalance that is causing, and will continue to cause, significant changes in climate, increasing the urgency of reducing CO_2 emissions now. *See, e.g.*, National Research Council, *Advancing the Science of Climate Change* (2010). Unless steps are taken immediately to reduce the emission of CO_2 and other greenhouse gases, the nation will continue to face, among other impacts: water shortages and more severe storms; reduced crop and livestock yields; rising sea levels that could swamp coastal infrastructure; and dangerous smog and heat waves. The longer we wait to take action to address climate change, the more difficult it will be to avoid the worst consequences.

By repealing the Endangerment Finding, which serves as the basis for EPA's regulation of greenhouse gases from motor vehicles, the proposed legislation by Senator Inhofe and Senator McConnell threatens to undermine an historic agreement among the States, automakers and the federal government, potentially upending the settled expectation of the automobile industry in nationwide uniformity. This proposed legislation also would separately eliminate EPA's authority over greenhouse gas emissions from vehicles, which, along with power plants, are the largest sources of greenhouse gas emissions in the nation.

In addition, the proposed legislation by Senators Inhofe, McConnell, and Rockefeller would prevent or substantially delay EPA's issuance of new source performance standards (NSPS) for fossil fuel-fired power plants under Section 111 of the Clean Air Act, effectively scuttling a settlement agreement secured by the States after lengthy litigation. Fossil fuel-fired power plants are the nation's leading source of CO_2 emissions. Currently, the electricity sector is responsible for approximately 40 percent of the nation's CO_2 emissions and, in the absence of new limits, emissions are expected to grow another 10 percent by 2035. In an attempt to slow the power sector's increasing contribution to climate change, ten States and the City of New York sued EPA in April 2006, challenging EPA's failure to promulgate performance standards for CO_2 emissions from power plants. *New York, et al. v. EPA* (D.C. Cir. 06-1322). To settle the litigation, EPA and the States signed a settlement agreement, in which EPA has agreed to propose performance standards by July 2011, and take final action on the rulemaking by May 2012. 75 Fed. Reg. 82,392 (Dec. 30, 2010).

We support congressional action to pass comprehensive climate change legislation. However, given the imminent threat that climate change poses, the Clean Air Act's existing provisions should and must be used now to begin addressing climate change pollution. EPA has applied the Clean Air Act in a flexible, cost-effective manner specifically tailored to address industry-specific concerns and stated its intent to continue on that path. Taking action now under the Act can provide an effective bridge to a more comprehensive federal climate policy and allow us to begin building the regulatory infrastructure needed to transition to a low carbon economy.

In closing, we oppose proposals that would block or delay EPA's development of greenhouse gas regulations pursuant to its obligations under the Clean Air Act and its recent settlement with the States. These regulations are not only crucial to efforts to control increasing greenhouse gas emissions, but also to our efforts to safeguard our citizens from the many dire environmental, health, safety and economic harms related to climate change.

Thank you for your consideration of this letter.

Respectfully submitted,

Eric Schneiderman

Eric T. Schneiderman
Attorney General of the State of New York

George C. Jepson
Attorney General of Connecticut

Joseph R. "Beau" Biden, III
Attorney General of Delaware

Thomas J. Miller
Attorney General of Iowa

Martha Coakley
Attorney General of the Commonwealth of Massachusetts

Peter F. Kilmartin
Attorney General of Rhode Island

William H. Sorrell
Attorney General of Vermont

Michael A. Cardozo
Corporation Counsel of the City of New York

cc: Senator Max Baucus
Senator Richard Blumenthal
Senator Scott P. Brown
Senator Barbara Boxer
Senator Benjamin L. Cardin
Senator Thomas R. Carper
Senator Christopher A. Coons
Senator Dianne Feinstein
Senator Kirsten E. Gillibrand
Senator Chuck Grassley
Senator Tom Harkin
Senator James N. Inhofe
Senator John F. Kerry
Senator Frank R. Lautenberg
Senator Patrick J. Leahy
Senator Joseph I. Lieberman

Senator Jeff Merkley
Senator Jack Reed
Senator Bernard Sanders
Senator Charles E. Schumer
Senator Tom Udall
Senator Sheldon Whitehouse

To: "Michael Myers" [Michael.Myers@ag.ny.gov]
Cc: CN=Joseph Goffman/OU=DC/O=USEPA/C=US@EPA[]
From: CN=David McIntosh/OU=DC/O=USEPA/C=US
Sent: Tue 3/29/2011 8:47:19 PM
Subject: Re: Letter to Congress re. EPA GHG Authority
032911 Senate Letter re Anti-EPA Bills final.pdf
michael.myers@ag.ny.gov

Thanks for forwarding this Mike.

From: "Michael Myers" <Michael.Myers@ag.ny.gov>
To: Joseph Goffman/DC/USEPA/US@EPA, David McIntosh/DC/USEPA/US@EPA
Date: 03/29/2011 04:38 PM
Subject: Letter to Congress re. EPA GHG Authority

Please see the attached correspondence on behalf of the Attorneys General of New York, Connecticut, Delaware, Iowa, Massachusetts, Rhode Island, and Vermont, and the Corporation Counsel of the City of New York.

Sincerely,

Michael J. Myers
Chief, Affirmative Litigation Section
Environmental Protection Bureau
New York State Attorney General
The Capitol
Albany, NY 12224
(518) 402-2594
michael.myers@ag.ny.gov

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The legislation proposed by Sens. Inhofe and McConnell would specifically override EPA's determination, based on solid, sound science, that climate change pollutants endanger the public health and welfare of current and future generations. 74 Fed. Reg. 66496 (Dec. 15, 2009). That determination followed in the wake of the Supreme Court's decision in *Massachusetts v. EPA*, 549 U.S. 497 (2007), that greenhouse gases fit well within the definition of "air pollutant" under the Clean Air Act. Many of the undersigned States participated in that litigation. EPA's exhaustive scientific review and subsequent studies by leading scientists demonstrate that emissions of carbon dioxide (CO_2) and other heat-trapping gases have warmed the oceans and atmosphere and have led to an energy imbalance that is causing, and will continue to cause, significant changes in climate, increasing the urgency of reducing CO_2 emissions now. *See, e.g.*, National Research Council, *Advancing the Science of Climate Change* (2010). Unless steps are taken immediately to reduce the emission of CO_2 and other greenhouse gases, the nation will continue to face, among other impacts: water shortages and more severe storms; reduced crop and livestock yields; rising sea levels that could swamp coastal infrastructure; and dangerous smog and heat waves. The longer we wait to take action to address climate change, the more difficult it will be to avoid the worst consequences.

By repealing the Endangerment Finding, which serves as the basis for EPA's regulation of greenhouse gases from motor vehicles, the proposed legislation by Senator Inhofe and Senator McConnell threatens to undermine an historic agreement among the States, automakers and the federal government, potentially upending the settled expectation of the automobile industry in nationwide uniformity. This proposed legislation also would separately eliminate EPA's authority over greenhouse gas emissions from vehicles, which, along with power plants, are the largest sources of greenhouse gas emissions in the nation.

In addition, the proposed legislation by Senators Inhofe, McConnell, and Rockefeller would prevent or substantially delay EPA's issuance of new source performance standards (NSPS) for fossil fuel-fired power plants under Section 111 of the Clean Air Act, effectively scuttling a settlement agreement secured by the States after lengthy litigation. Fossil fuel-fired power plants are the nation's leading source of CO_2 emissions. Currently, the electricity sector is responsible for approximately 40 percent of the nation's CO_2 emissions and, in the absence of new limits, emissions are expected to grow another 10 percent by 2035. In an attempt to slow the power sector's increasing contribution to climate change, ten States and the City of New York sued EPA in April 2006, challenging EPA's failure to promulgate performance standards for CO_2 emissions from power plants. *New York, et al. v. EPA* (D.C. Cir. 06-1322). To settle the litigation, EPA and the States signed a settlement agreement, in which EPA has agreed to propose performance standards by July 2011, and take final action on the rulemaking by May 2012. 75 Fed. Reg. 82,392 (Dec. 30, 2010).

We support congressional action to pass comprehensive climate change legislation. However, given the imminent threat that climate change poses, the Clean Air Act's existing provisions should and must be used now to begin addressing climate change pollution. EPA has applied the Clean Air Act in a flexible, cost-effective manner specifically tailored to address industry-specific concerns and stated its intent to continue on that path. Taking action now under the Act can provide an effective bridge to a more comprehensive federal climate policy and allow us to begin building the regulatory infrastructure needed to transition to a low carbon economy.

In closing, we oppose proposals that would block or delay EPA's development of greenhouse gas regulations pursuant to its obligations under the Clean Air Act and its recent settlement with the States. These regulations are not only crucial to efforts to control increasing greenhouse gas emissions, but also to our efforts to safeguard our citizens from the many dire environmental, health, safety and economic harms related to climate change.

Thank you for your consideration of this letter.

Respectfully submitted,

Eric Schneiderman

Eric T. Schneiderman
Attorney General of the State of New York

George C. Jepson
Attorney General of Connecticut

Joseph R. "Beau" Biden, III
Attorney General of Delaware

Thomas J. Miller
Attorney General of Iowa

Martha Coakley
Attorney General of the Commonwealth of Massachusetts

Peter F. Kilmartin
Attorney General of Rhode Island

William H. Sorrell
Attorney General of Vermont

Michael A. Cardozo
Corporation Counsel of the City of New York

cc: Senator Max Baucus
Senator Richard Blumenthal
Senator Scott P. Brown
Senator Barbara Boxer
Senator Benjamin L. Cardin
Senator Thomas R. Carper
Senator Christopher A. Coons
Senator Dianne Feinstein
Senator Kirsten E. Gillibrand
Senator Chuck Grassley
Senator Tom Harkin
Senator James N. Inhofe
Senator John F. Kerry
Senator Frank R. Lautenberg
Senator Patrick J. Leahy
Senator Joseph I. Lieberman

Senator Jeff Merkley
Senator Jack Reed
Senator Bernard Sanders
Senator Charles E. Schumer
Senator Tom Udall
Senator Sheldon Whitehouse

To: ddoniger@nrdc.org;dhawkins@nrdc.org;dlashof@nrdc.org;CN=Ellen Kurlansky/OU=DC/O=USEPA/C=US@EPA;CN=Elliott Zenick/OU=DC/O=USEPA/C=US@EPA;CN=Howard Hoffman/OU=DC/O=USEPA/C=US@EPA;CN=Janet McCabe/OU=DC/O=USEPA/C=US@EPA;CN=Jim Ketcham-Colwill/OU=DC/O=USEPA/C=US@EPA;CN=Joseph Goffman/OU=DC/O=USEPA/C=US@EPA;CN=Patricia Embrey/OU=DC/O=USEPA/C=US@EPA;CN=Peter Tsirigotis/OU=RTP/O=USEPA/C=US@EPA;CN=Rob Brenner/OU=DC/O=USEPA/C=US@EPA;CN=Sam Napolitano/OU=DC/O=USEPA/C=US@EPA[]; hawkins@nrdc.org;dlashof@nrdc.org;CN=Ellen Kurlansky/OU=DC/O=USEPA/C=US@EPA;CN=Elliott Zenick/OU=DC/O=USEPA/C=US@EPA;CN=Howard Hoffman/OU=DC/O=USEPA/C=US@EPA;CN=Janet McCabe/OU=DC/O=USEPA/C=US@EPA;CN=Jim Ketcham-Colwill/OU=DC/O=USEPA/C=US@EPA;CN=Joseph Goffman/OU=DC/O=USEPA/C=US@EPA;CN=Patricia Embrey/OU=DC/O=USEPA/C=US@EPA;CN=Peter Tsirigotis/OU=RTP/O=USEPA/C=US@EPA;CN=Rob Brenner/OU=DC/O=USEPA/C=US@EPA;CN=Sam Napolitano/OU=DC/O=USEPA/C=US@EPA[]; lashof@nrdc.org;CN=Ellen Kurlansky/OU=DC/O=USEPA/C=US@EPA;CN=Elliott Zenick/OU=DC/O=USEPA/C=US@EPA;CN=Howard Hoffman/OU=DC/O=USEPA/C=US@EPA;CN=Janet McCabe/OU=DC/O=USEPA/C=US@EPA;CN=Jim Ketcham-Colwill/OU=DC/O=USEPA/C=US@EPA;CN=Joseph Goffman/OU=DC/O=USEPA/C=US@EPA;CN=Patricia Embrey/OU=DC/O=USEPA/C=US@EPA;CN=Peter Tsirigotis/OU=RTP/O=USEPA/C=US@EPA;CN=Rob Brenner/OU=DC/O=USEPA/C=US@EPA;CN=Sam Napolitano/OU=DC/O=USEPA/C=US@EPA[]; N=Ellen Kurlansky/OU=DC/O=USEPA/C=US@EPA;CN=Elliott Zenick/OU=DC/O=USEPA/C=US@EPA;CN=Howard Hoffman/OU=DC/O=USEPA/C=US@EPA;CN=Janet McCabe/OU=DC/O=USEPA/C=US@EPA;CN=Jim Ketcham-Colwill/OU=DC/O=USEPA/C=US@EPA;CN=Joseph Goffman/OU=DC/O=USEPA/C=US@EPA;CN=Patricia Embrey/OU=DC/O=USEPA/C=US@EPA;CN=Peter Tsirigotis/OU=RTP/O=USEPA/C=US@EPA;CN=Rob Brenner/OU=DC/O=USEPA/C=US@EPA;CN=Sam Napolitano/OU=DC/O=USEPA/C=US@EPA[]; N=Elliott Zenick/OU=DC/O=USEPA/C=US@EPA;CN=Howard Hoffman/OU=DC/O=USEPA/C=US@EPA;CN=Janet McCabe/OU=DC/O=USEPA/C=US@EPA;CN=Jim Ketcham-Colwill/OU=DC/O=USEPA/C=US@EPA;CN=Joseph Goffman/OU=DC/O=USEPA/C=US@EPA;CN=Patricia Embrey/OU=DC/O=USEPA/C=US@EPA;CN=Peter Tsirigotis/OU=RTP/O=USEPA/C=US@EPA;CN=Rob Brenner/OU=DC/O=USEPA/C=US@EPA;CN=Sam Napolitano/OU=DC/O=USEPA/C=US@EPA[]; N=Howard Hoffman/OU=DC/O=USEPA/C=US@EPA;CN=Janet McCabe/OU=DC/O=USEPA/C=US@EPA;CN=Jim Ketcham-Colwill/OU=DC/O=USEPA/C=US@EPA;CN=Joseph Goffman/OU=DC/O=USEPA/C=US@EPA;CN=Patricia Embrey/OU=DC/O=USEPA/C=US@EPA;CN=Peter Tsirigotis/OU=RTP/O=USEPA/C=US@EPA;CN=Rob

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Cc: CN=Addie Johnson/OU=DC/O=USEPA/C=US@EPA;CN=Amit
Srivastava/OU=DC/O=USEPA/C=US@EPA;CN=Barbara
Morris/OU=DC/O=USEPA/C=US@EPA;CN=Cynthia
Browne/OU=DC/O=USEPA/C=US@EPA;CN=Don
Zinger/OU=DC/O=USEPA/C=US@EPA;CN=Julia
Miller/OU=DC/O=USEPA/C=US@EPA;radhar@nrdc.org[]; N=Amit
Srivastava/OU=DC/O=USEPA/C=US@EPA;CN=Barbara
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Miller/OU=DC/O=USEPA/C=US@EPA;radhar@nrdc.org[]; adhar@nrdc.org[]
From: CN=Cindy Huang/OU=DC/O=USEPA/C=US
Sent: Fri 4/1/2011 1:46:29 PM
Subject: Rescheduled: Meeting with NRDC on Section 111 Standards for Power Plants (Apr 1 04:30 PM EDT in Ariel Rios North room 5400, 1200 Pennsylvania Ave. NW Conference: Ex. 6 - Personal Privacy
Ex. 6 - Personal Privacy

From: "Doniger, David" [ddoniger@nrdc.org]
Sent: 03/21/2011 06:40 PM AST
To: <hwang.cindy@epa.gov>
Cc: Joseph Goffman; "Adhar, Radha" <radhar@nrdc.org>
Subject: Meeting request

Cindy,

I am following up a conversation with Joe Goffman to ask for a meeting as soon as feasible with Gina McCarthy, Joe, and whomever they want to include, on the subject of the Section 111 standards for power plants.

Attendees on our side would include David Hawkins, Dan Lashof, Meleah Geertsma, and myself.

You could be in touch with me or (probably more productively) with our assistant, Radha Adhar, who is copied above. Radha's number is 202 Ex. 6 - Personal Privacy

David D. Doniger
Policy Director, Climate Center
Natural Resources Defense Council
1200 New York Ave., NW
Washington, DC 20005
Phone: (202) 289-2403
Cell: (202) 321-3435
Fax: (202) 789-0859
ddoniger@nrdc.org
on the web at www.nrdc.org
read my blog: http://switchboard.nrdc.org/blogs/ddoniger/

To: Michael Goo/DC/USEPA/US@EPA;Lorie Schmidt/DC/USEPA/US@EPA;Shannon Kenny/DC/USEPA/US@EPA;Alex Barron/DC/USEPA/US@EPA[]; orie Schmidt/DC/USEPA/US@EPA;Shannon Kenny/DC/USEPA/US@EPA;Alex Barron/DC/USEPA/US@EPA[]; hannon Kenny/DC/USEPA/US@EPA;Alex Barron/DC/USEPA/US@EPA[]; lex Barron/DC/USEPA/US@EPA[]
From: John Coequyt
Sent: Tue 9/20/2011 1:37:08 PM
Subject: NSPS green group letter.
CEO NSPS GHG Let Final Ver 8 am 9-20-11.pdf

FYI.

John Coequyt
202.669.7060

AMERICAN RIVERS * CENTER FOR INTERNATIONAL ENVIRONMENTAL LAW
CLEAN AIR TASK FORCE * CLEAN WATER ACTION
EARTHJUSTICE * ENVIRONMENT AMERICA * ENVIRONMENTAL DEFENSE FUND
FRIENDS OF THE EARTH * GREEN FOR ALL * GREENPEACE
LEAGUE OF CONSERVATION VOTERS
LEAGUE OF WOMEN VOTERS * NATIONAL AUDUBON SOCIETY
NATIONAL PARKS CONSERVATION ASSOCIATION
NATIONAL WILDLIFE FEDERATION * NATURAL RESOURCES DEFENSE COUNCIL
PHYSICIANS FOR SOCIAL RESPONSIBILITY * SIERRA CLUB
UNION OF CONCERNED SCIENTISTS

September 20, 2011

President Barack Obama
The White House
1600 Pennsylvania Avenue
Washington, DC 20500

Dear Mr. President:

On behalf of our millions of members, our organizations are deeply concerned to learn that your Environmental Protection Agency will not meet its commitment to propose long-overdue Clean Air Act standards limiting dangerous carbon pollution from new and existing power plants by September 30th. This marks the second delay in fulfilling your administration's promise, made in settlement of litigation and in representations to the Supreme Court, to address power plants' enormous contribution to the air pollution that drives climate change.

Power plants are the nation's largest source of dangerous carbon pollution. Today, 40 years after passage of the Clean Air Act, they are still free to dump unlimited amounts of that pollution into the air. Americans are already suffering from the impacts of climate change. More extreme weather – like the recent floods and storms in the Northeast and extreme drought and wildfires in Texas – is expected from a continually warming world. Many lives have been lost, dozens of communities flooded or burned, thousands of people have lost homes or other property, and damages have totaled in the tens of billions of dollars.

Limiting the carbon pollution from power plants will protect our children's health, our coastlines, rivers, forests, wildlife, and our economy. Moving forward to modernize our aging energy infrastructure will protect our health and well-being, save families and small businesses money through more efficient generation and use of electricity, and contribute to our economic recovery and create thousands of new jobs.

Clean Air Act standards for power plant carbon pollution are years overdue. Earlier this year, your administration assured the Supreme Court that EPA was committed to issue them on a specific schedule. On the strength of those assurances, in June the Court unanimously reaffirmed that it is EPA's job to protect Americans from climate-changing pollution. EPA, however, has acknowledged that the promised schedule will not be met.

Accordingly, we ask that you reaffirm the administration's commitment to issue strong standards that significantly reduce carbon emissions from both new and existing power plants as the Clean Air Act requires. We ask that the administration announce and stick to a remedial schedule requiring proposal of these standards without further delay and completion of them as soon as possible in 2012.

Your administration's leadership in carrying out the law, without delay, is essential to securing a stronger, safer and more prosperous America.

Sincerely,

Wm. Robert Irvin
President
American Rivers

Carroll Muffett
President
Center for International Environmental Law

Armond Cohen
Executive Director
Clean Air Task Force

Robert Wendelgass
President and CEO
Clean Water Action

Trip Van Noppen
President
Earthjustice

Margie Alt
Executive Director
Environment America

Fred Krupp
President
Environmental Defense Fund

Erich Pica
President
Friends of the Earth

Phaedra Ellis-Lamkins
Chief Executive Officer
Green For All

Philip D. Radford
Executive Director
Greenpeace USA

Gene Karpinski
President
League of Conservation Voters

Elisabeth MacNamara
President
League of Women Voters

David Yarnold
President and CEO
National Audubon Society

Thomas C. Kiernan
President
National Parks Conservation Association

Larry Schweiger
President and CEO
National Wildlife Federation

Frances Beinecke
President
Natural Resources Defense Council

Peter Wilk
Executive Director
Physicians for Social Responsibility

Michael Brune
Executive Director
Sierra Club

Kevin Knobloch
President
Union of Concerned Scientists

To: Alex Barron/DC/USEPA/US@EPA;Michael Goo/DC/USEPA/US@EPA;Joel Beauvais/DC/USEPA/US@EPA;Lorie Schmidt/DC/USEPA/US@EPA[]; ichael Goo/DC/USEPA/US@EPA;Joel Beauvais/DC/USEPA/US@EPA;Lorie Schmidt/DC/USEPA/US@EPA[]; oel Beauvais/DC/USEPA/US@EPA;Lorie Schmidt/DC/USEPA/US@EPA[]; orie Schmidt/DC/USEPA/US@EPA[]
From: John Coequyt
Sent: Wed 12/5/2012 1:45:55 PM
Subject: Fwd: Using the Clean Air Act to Sharply Reduce Carbon Pollution from Existing Power Plants -- news from Dan Lashof
dlashof@nrdc.org
ggill@nrdc.org
planning model
full report
issue brief
http://www.nrdc.org/air/pollution-standards/
press release
http://www.nrdc.org/media/2012/121204.asp
We Know Where the Carbon Pollution is Coming From – Here is How We Get After It
It's Time to Cut Carbon Pollution from Power Plants, Here's How We Do It
Obama can tackle climate in his second term, and he doesn't need Congress to do it
Using Federalism to Reduce Carbon Emissions
Obama could cut emissions without Congress, group says
Environmental group seeks to curb emissions from existing power plants
U.S. Could Cut Power Plant Pollution 26%, NRDC Says

Thought this might be useful.

John Coequyt
Cell. 202.669.7060
Direct. 202.675.7916

Begin forwarded message:

From: "Lashof, Dan" <dlashof@nrdc.org>
Date: December 5, 2012 8:17:46 AM EST
To: "Gill, Grace" <ggill@nrdc.org>
Subject: Using the Clean Air Act to Sharply Reduce Carbon Pollution from Existing Power Plants -- news from Dan Lashof

Yesterday at the National Press Club, NRDC unveiled a groundbreaking proposal to use the Clean Air Act to take a big bite out of carbon pollution from the nation's fleet of existing power plants, by far the largest source of global warming pollution in the country. Our report overturns the conventional wisdom that relying on the Clean Air Act to address climate change has to be expensive and won't have much impact. In fact, the analysis described in the report shows that we can achieve big reductions at low cost, using flexible solutions that drive investment in clean energy to reduce emissions, protecting public health and creating benefits that exceed the costs by more than a factor of 6. To reach these conclusions NRDC developed a specific proposal for setting power plant carbon pollution standards and analyzed it using a sophisticated electricity system planning model also used by industry and the EPA.

The full report and a summary issue brief are available at: http://www.nrdc.org/air/pollution-standards/

NRDC's press release is here: http://www.nrdc.org/media/2012/121204.asp

NRDC blog posts on the report so far:

We Know Where the Carbon Pollution is Coming From – Here is How We Get After It – Dan Lashof

It's Time to Cut Carbon Pollution from Power Plants, Here's How We Do It – Frances Beinecke

Other early coverage includes a great piece by David Roberts at Grist, which has my favorite graphic:

Obama can tackle climate in his second term, and he doesn't need Congress to do it – David Roberts, Grist

Description: obama-unicorn-hplead

And an editorial at Bloomberg View:

Using Federalism to Reduce Carbon Emissions – Mary Duenwald, Bloomberg View

News stories include:

Obama could cut emissions without Congress, group says – Wendy Koch, USA Today

Environmental group seeks to curb emissions from existing power plants – Steven Mufson, Washington Post

U.S. Could Cut Power Plant Pollution 26%, NRDC Says – Kim Chipman, Businessweek

NOTE: You are receiving this email because I added you to my personal distribution list (this is not a listserve). I plan to send out updates approximately once per week (although I have fallen behind recently). I look forward to any feedback you have.

If you would prefer not to receive future messages please contact Grace Gill and we will gladly remove you from the list.

-Dan

Daniel A. Lashof, Ph.D.

Director, Climate and Clean Air Program

Natural Resources Defense Council

40 West 20th St., NY NY 10011

Direct: 202-289-2399

Mobile: 703-522-0787

*********************** ATTACHMENT NOT DELIVERED *******************

This Email message contained an attachment named
image001.jpg
which may be a computer program. This attached computer program could contain a computer virus which could cause harm to EPA's computers, network, and data. The attachment has been deleted.

This was done to limit the distribution of computer viruses introduced into the EPA network. EPA is deleting all computer program attachments sent from the Internet into the agency via Email.

If the message sender is known and the attachment was legitimate, you should contact the sender and request that they rename the file name extension and resend the Email with the renamed attachment. After receiving the revised Email, containing the renamed attachment, you can rename the file extension to its correct name.

For further information, please contact the EPA Call Center at (866) 411-4EPA (4372). The TDD number is (866) 489-4900.

*********************** ATTACHMENT NOT DELIVERED ***********************

To: Gina McCarthy [Gina.Mccarthy@ct.gov]
Cc: Teri Porterfield/RTP/USEPA/US@EPA;Cindy Huang/DC/USEPA/US@EPA;Joseph Goffman/DC/USEPA/US@EPA[]; indy Huang/DC/USEPA/US@EPA;Joseph Goffman/DC/USEPA/US@EPA[]; oseph Goffman/DC/USEPA/US@EPA[]
From: Franz Litz
Sent: Mon 4/25/2011 2:57:36 PM
Subject: Time to Meet with Coalition Members?
WRI Dialogue Comments Final 4 18 2011.pdf
franz@wri.org

Gina,

Hope this note finds you well.

I am following up on behalf of the states, power companies and environmental groups that came together to submit the attached comments to EPA following a fairly intense 6-week effort that we convened. We'd be grateful for an opportunity to meet with you to discuss these comments. We'd bring representatives of the companies, states and environmental groups with us to the meeting. If this is something you have time to do, I can follow up with your schedulers to set a date and time.

Thanks, Gina, for considering this request.

Happy spring!

Franz

Franz Litz | Senior Fellow
World Resources Institute | franz@wri.org | 202-729-7740

DIALOGUE ON PERFORMANCE STANDARDS FOR EXISTING POWER PLANTS

PARTICIPANT COMMENTS TO EPA

April 18, 2011

1. Introduction

EPA has announced that it will proceed with the design and proposal of performance standards for the electric power sector this year, with promulgation anticipated in May 2012. In response to that announcement, a number of leadership states, clean energy companies, environmental advocates and advisory non-profit organizations began a dialogue on how best to design and implement greenhouse gas standards of performance for existing electric generating units. While many of the participants have long supported Congressional action on climate change, the participants are committed to engaging with EPA to ensure the development of reasonable greenhouse gas regulations. Participants in the dialogue have sought to identify areas of agreement, including principles for the design of performance standards and flexibility to allow for cost-effective compliance. The comments highlight a number of issues on which participants have not settled on a single approach but on which participants suggest EPA take comment on a range of options during the rulemaking process. This document contains the participants' input to EPA on the implementation of section 111(d) of the Clean Air Act.

2. Dialogue Participants

The World Resources Institute convened the Dialogue with the following participants:

2.1. State Participants: California Air Resources Board, Minnesota Pollution Control Agency, and the New York Department of Environmental Conservation.

2.2. Companies: Calpine Corporation, Consolidated Edison, Inc., Constellation Energy, Entergy Corporation, Exelon Corporation, National Grid, NextEra Energy, New York Power Authority, PG&E Corporation, Public Service Enterprise Group, Inc., Seattle City Light and Sempra Energy.

2.3. National environmental organizations: Environmental Defense Fund (EDF) and Natural Resources Defense Council (NRDC).

2.4. Advisory organizations and think tanks: Center for Clean Air Policy (CCAP), Georgetown Climate Center, and M.J. Bradley & Associates.

3. Principles for Development of Standards of Performance

3.1. Standards of performance under section 111 of the Clean Air Act have the potential to drive reductions of greenhouse gas emissions from the electric sector while maintaining system reliability.

3.2. In establishing standards of performance under section 111, EPA should use a forward-looking assessment with the goal of providing long-term investment signals and define a pathway to assure meaningful, cost-effective limits on greenhouse gas emissions from the electric sector over time.

3.3. In devising the federal guidelines states must follow in their plans to cover existing power plants under section 111(d), EPA should provide states substantial flexibility, as is contemplated by the Clean Air Act, in how any required reductions are achieved.

3.4. To maximize the cost effectiveness of the greenhouse gas regulations, states should be able to utilize market-based programs that reduce these emissions from electricity generating units by at least as much as would otherwise be achieved by application of EPA's guidelines.

3.5. EPA rules and guidelines to states and state programs should be as cost-effective and legally durable as possible within the requirements of the Clean Air Act.

3.6. EPA rules and guidelines should support, and not create barriers to, harmonization across state boundaries while permitting individual states to exceed federal requirements.

3.7. EPA rules and guidelines should promote regulatory certainty.

3.8. The standards should avoid creating unintended incentives to continue the operation of inefficient and higher emitting electric generating units beyond when they might otherwise repower or retire.

3.9. EPA guidelines should be designed to encourage energy efficiency and the transition to cleaner energy sources.

3.10. EPA guidelines should not penalize early greenhouse gas emissions reduction actions undertaken by states and affected sources.

4. Defining the Affected Source Category

The category of affected sources should cover all fossil-fuel-fired electric generating units that exceed a specific threshold. EPA should seek comment on at least the following alternatives:

4.1. A nameplate capacity threshold (in megawatts of thermal equivalent output), such as 25 MW. The Regional Greenhouse Gas Initiative (RGGI) uses a 25 MW nameplate capacity threshold, which has the advantage of being a threshold that is not dependent on how much the affected units operate.

4.2. An annual emissions threshold in tons, such as 25,000 tons per year. California's emissions trading program has a 25,000-ton annual threshold, which has the advantage of only covering sources that actually operate to emit significant amounts of greenhouse gases.

4.3. A state should have flexibility to apply its requirements to a wider scope of existing electric generating units.

5. Considerations for Form and Stringency

EPA should establish the minimum stringency states must meet but allow states the flexibility to achieve greater reductions.

5.1. If EPA sets a rate-based standard, that standard should be based on electricity output.

5.2. EPA should consider whether to set a single standard for the entire category, for subcategories, or for individual units. In proposing the level of the standard, EPA should consider the availability of averaging and/or crediting programs that may enable greater reductions including the reasonable assumption that states will adopt plans containing one or more flexibility mechanisms to lower costs.

5.3. EPA should assess what emission reductions are achievable based on a number of factors, including but not limited to: technology type, fuel, plant in-service date, historic emission rates, utilization or annual capacity factor, the impact of new and forthcoming non-GHG environmental regulations and their effect on utilization, and availability of GHG pollution control technologies.

5.4. EPA should take comment on a phased approach under which standards predictably become more stringent over time.

5.4.1. Such a phased approach could be based on expected technology availability, including improving efficiency, increased use of lower emitting fuels, and post-combustion measures (e.g., carbon capture and sequestration). Additionally, as stated in section 111(d), EPA could consider other factors, including "remaining useful life" of affected sources.

5.4.2. EPA should also consider whether to include different approaches for initial standards, intermediate standards, and longer-term standards. For example, EPA could set initial standards based on units or subcategories and transition to a single standard or fewer sub-categories, in anticipation of availability of additional pollution control options and increased participation by states using flexibility mechanisms that may be harmonized across state boundaries.

6. State Plans under Section 111(d)

6.1. EPA should propose a clear methodology by which states may demonstrate that their programs achieve emission reductions equal to or greater than any reductions required by the EPA guideline. The methodology should be flexible enough to accommodate state plans that differ in manner of regulation from those described by EPA in its emissions guidelines or those EPA might impose under section 111(d)(2) of the Act. EPA should take comment on whether to provide the states with one or more templates that states may implement.

6.2. Any state program that expressly limits emissions should be allowed to serve as the basis for a state's 111(d) plan if it can demonstrate reductions equal or greater than any emission reductions required by the EPA guideline. EPA should take comment on whether and under what circumstances other programs (such as renewable energy standards) may serve as the basis for all or part of a state's 111(d) plan.

6.3. EPA should take comment on various flexibility mechanisms that states could utilize in their section 111(d) plans, including but not limited to: (a) averaging (e.g., facility, fleet, or across a sector); (b) credits generated by, among other things, emissions performance that is better than the required emissions rate and better than the unit's historical performance, non-emitting electric output or end-use efficiency, plant retirements before the end of a plant's "remaining useful life," and reductions from other sectors covered by section 111(d) plans; (c) banking and use of multiyear compliance periods; (d) use of emission allowances; (e) auctions; and (f) new entrant measures.

6.4. EPA should explain the bases on which a state can demonstrate that its plan will achieve equivalent or greater emission reductions. EPA should:

6.4.1. Explain how to translate a rate-based standard into a mass-based standard and *vice versa.* For example, if the standards designated by EPA are rate-based standards, EPA should identify a methodology for determining equivalent mass-based standards, using modeling and other tools.

6.4.2. Consider increasing the stringency required for plans that include flexibility elements beyond those used by EPA in setting the minimum standards in the guidelines. Increased stringency could offset potential uncertainties in emissions reductions within a given compliance period or reflect the additional emission reductions achievable under a program with flexibility. EPA took a similar approach in the Large Municipal Waste Combustor guidelines.[1]

6.4.3. Explain how a state implementing a multi-sector program or participating in a multistate program can establish equivalency. EPA should explain under what circumstances states may rely on a multi-sector/multistate equivalency analysis, or may submit multi-sector/multistate plans.

6.4.4. EPA should take comment on whether to set state emission budgets for use in determining equivalence with the standard, using modeling analyses (such as the Integrated Planning Model (IPM), for example) that incorporate a phased reduction pathway and consider recently proposed and upcoming rulemakings.

6.4.5. A state should be required to demonstrate that its plan will achieve emission reductions equal to or greater than would be achieved by the application of EPA's standards. Some participants believe that if a state's program includes sources from uncovered sectors or uncovered jurisdictions, the state should be required to demonstrate that its plan will achieve the required emission reductions from the affected categories of sources. Other participants believe EPA should consider whether reductions from outside the affected categories of sources should be taken into account in the equivalency determination.

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[1] *See* 40 C.F.R. 60.33b, subpart Cb tables 1 and 2 (compare emissions standards in table 1 with more stringent standards in table 2 for facilities using an averaging approach); 60 Fed. Reg. 65387, 65402.

6.5. EPA should propose a process for determining state equivalency:

6.5.1. EPA should evaluate under what circumstances states take into account the projected impact of flexibility measures such as banking. EPA should take comment on whether states should conservatively value such impacts relative to any accompanying uncertainties.

6.5.2. A state should subsequently be required to periodically demonstrate (e.g., every three to five years) that its plan is achieving actual emission reductions equal to or greater than EPA standards, similar to the State Implementation Plan process. EPA should also propose a process for remedying any shortfall. *See, e.g.,* the assurance mechanism in the Clean Air Transport Rule, 75 Fed. Reg. 45210, 45133.

6.5.3. In developing a state equivalency methodology, EPA should consider factors that would change a state's equivalency requirements over time. EPA should consider a process for periodically adjusting each state's emissions reduction obligation based on technological improvements, changes in fuel mix and changes made in the fleet of covered sources in each state. EPA should also take comment on whether to provide states with guidance on the interpretation and implementation of "remaining useful life" provision.

6.6. EPA should consider the availability of emissions averaging and other flexible approaches when deciding, in its guidelines, whether to allow states to apply less stringent standards to particular facilities under 40 CFR 60.24(f), which allows for potential unit exemptions.

To: Gina McCarthy/DC/USEPA/US@EPA[]
Cc: Joseph Goffman/DC/USEPA/US@EPA[]
From: "Jared Snyder"
Sent: Tue 5/10/2011 12:57:47 AM
Subject: letter from RGGI states on section 111(d)
RGGI states ltr on 111(d) final.pdf

Dear Gina,

Attached is a letter from seven RGGI states regarding EPA's development of guidelines for regulation of greenhouse gas emissions from the power sector under CAA section 111(d). Please let me know if you'd like to discuss.

By the way, I stumbled upon your talk at Duke University a couple of weeks back when I was visiting the campus with my sons. But my shorts and t-shirt may not have been appropriate seminar attire.

I hope all is well. Jared

Jared Snyder
Assistant Commissioner
Air Resources, Climate Change and Energy
625 Broadway, 14th Floor
Albany, New York 12233-1010
(518) 402-8537 phone
(518) 402-9016 fax

May 9, 2011

Ms. Regina McCarthy
Assistant Administrator
Office of Air and Radiation
Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC, 20460

Re: Emission Standards Under Clean Air Act Section 111(d)

Dear Ms. McCarthy:

We write to you as the heads of environmental agencies for states that participate in the Regional Greenhouse Gas Initiative (RGGI) to offer our support and preliminary recommendations as EPA develops guidelines for state programs to reduce emissions from power plants under Clean Air Act section 111(d). The Clean Air Act has provided an effective framework for achieving cost-effective reductions in emissions of many different pollutants and we commend EPA for its measured approach to the regulation of greenhouse gas (GHG) pollution under the Act to date. EPA now has an opportunity to use its authority under section 111 of the Clean Air Act in an efficient and flexible manner to encourage and empower states to develop GHG emission reduction programs that will enable the transition to a lower-emitting and more efficient power sector while creating jobs across the United States.

The states involved in RGGI are demonstrating that environmental protection can go hand-in-hand with economic development and job creation. In operation since 2009, RGGI is the first *cap-and-invest* program in the United States – it *caps* GHG emissions from the power sector and reduces those emissions over time. The states participating in RGGI are *investing* the proceeds generated from auctioning emission allowances in developing the clean energy economy in the region. The RGGI participating states are using those proceeds to fund energy efficiency and renewable energy programs that put their residents to work and reduce electricity bills for homeowners and businesses across our region.1 Many of the RGGI investments also have a multiplier effect as they leverage additional public and private investments. As EPA proceeds with its section 111 rulemaking, it should strive to create a regulatory framework that empowers all states to reap similar benefits.

Section 111 requires EPA to set emissions standards for new sources under section 111(b) and to establish guidelines for state regulation of existing sources under section 111(d). We do not comment on

1 On February 28, 2011, RGGI Inc. issued a report documenting the investment of RGGI proceeds, which explains how the RGGI participating states have invested the proceeds in energy efficiency, renewable energy, job training and community-based clean energy programs, creating thousands of jobs in the process. *See* http://www.rggi.org/rggi_benefits.

the new source standards under section 111(b) other than to urge EPA to adhere to its traditional approach of setting numerical standards that are applicable to each new or modified power plant. This approach provides certainty that each new source of GHG emissions is clean and efficient, thereby reducing emissions from the covered sector over time as old facilities are replaced with new facilities. The remainder of this letter presents our recommendations on the section 111(d) guidelines.

Recommendations for EPA Guidelines under Section 111(d)

EPA's section 111(d) guidelines should set clear emission goals and empower RGGI states, and states with their own or regional market-based regulatory programs, to take advantage of and build on such programs, so long as those programs achieve or exceed the emission targets of the federal guidelines. Providing states with the flexibility to utilize existing state and regional programs to comply with the section 111(d) guidelines reduces the possibility of redundant and overlapping federal and state programs directed at the same sources and same emissions. This approach will reduce the regulatory burden on industry and enable efficient commitment of limited state resources, while achieving at least an equivalent level of environmental benefit. It is also consistent with the language of section 111(d) that provides for state implementation plans similar to those developed under section 110.

1. The Section 111(d) guidelines should achieve emission reductions

In developing the guidelines that form the floor for state action, EPA should strive to reap the emission- and cost-reducing benefits of market forces. For example, EPA could evaluate incorporating averaging into the standards it sets, allowing source owners to average emissions across a fleet of sources. Flexibility mechanisms will enable EPA to set the guidelines at a more protective level than can be achieved with more rigid one-size-fits-all emission standards.

EPA should also explore ways to reduce emissions from the power sector over time as technology evolves, older inefficient plants are retired or repowered, and more carbon-free renewables are sited. EPA could accomplish this in part by providing states with guidance on how to consider the "remaining useful life" of existing plants, as provided by Section 111(d).

2. Demonstrating equivalency of state programs

EPA should provide clear direction to the states on demonstrating the equivalency of state programs. EPA's guidelines should identify the tools that states can use to demonstrate that state emission reduction programs will achieve equal or greater reductions in pollution than the base standards set by EPA. Those tools may include modeling to show, for example, that mass-based state limitations (tonnage based caps) will achieve emission reductions equal to or greater than the application of federal emission rate-based standards.

EPA should make clear in the guidelines that states have substantial flexibility in establishing state programs under section 111(d). Although EPA should not try to define the range of types of standards that states can implement, it should provide some general direction regarding the types of state programs that may qualify. For example, EPA should provide guidance on whether and when states may include emission reductions from sources that are not covered by the section 111(d) guidelines because they are different sectors, smaller size or are in a different jurisdiction.

Conclusion

We encourage EPA to complete this rulemaking on the schedule set forth in the settlement announced in December 2010. We look forward to continue working with EPA to develop a regulatory program that empowers states to achieve substantial emissions reductions of greenhouse gases, in addition to other pollutants, in a cost-effective manner through the application of innovative emissions reduction programs.

Very truly yours,

Daniel Esty
Commissioner
Connecticut Department of Energy and Environmental Protection

Collin O'Mara
Secretary
Delaware Department of Natural Resources and Environmental Control

Robert M. Summers
Acting Secretary
Maryland Department of the Environment

Ken Kimmell
Commissioner
Massachusetts Department of Environmental Protection

Joseph Martens
Commissioner
New York Department of Environmental Conservation

Janet Coit
Director
Rhode Island Department of Environmental Management

Justin Johnson
Deputy Commissioner
Vermont Department of Environmental Conservation

cc: Air and Radiation Docket and Information Center, *a-and-r-Docket@epa.gov*
Docket ID: EPA-HQ-OAR-2011-0090

To: "Jared Snyder" [jjsnyder@gw.dec.state.ny.us]
Cc: CN=Joseph Goffman/OU=DC/O=USEPA/C=US[]
From: CN=Gina McCarthy/OU=DC/O=USEPA/C=US
Sent: Tue 5/10/2011 3:22:09 AM
Subject: Re: letter from RGGI states on section 111(d)

Wish you had dropped in. Will take a look. Thx Jared.

From: "Jared Snyder" [jjsnyder@gw.dec.state.ny.us]
Sent: 05/09/2011 08:57 PM AST
To: Gina McCarthy
Cc: Joseph Goffman
Subject: letter from RGGI states on section 111(d)

Dear Gina,

Attached is a letter from seven RGGI states regarding EPA's development of guidelines for regulation of greenhouse gas emissions from the power sector under CAA section 111(d). Please let me know if you'd like to discuss.

By the way, I stumbled upon your talk at Duke University a couple of weeks back when I was visiting the campus with my sons. But my shorts and t-shirt may not have been appropriate seminar attire.

I hope all is well. Jared

Jared Snyder
Assistant Commissioner
Air Resources, Climate Change and Energy
625 Broadway, 14th Floor
Albany, New York 12233-1010
(518) 402-8537 phone
(518) 402-9016 fax

To: Megan Ceronsky [mceronsky@edf.org]
Cc: CN=Joel Beauvais/OU=DC/O=USEPA/C=US@EPA;CN=Joseph Goffman/OU=DC/O=USEPA/C=US@EPA;CN=Kevin Culligan/OU=DC/O=USEPA/C=US@EPA;CN=Lorie Schmidt/OU=DC/O=USEPA/C=US@EPA;Mark MacLeod [mmacleod@edf.org]; N=Joseph Goffman/OU=DC/O=USEPA/C=US@EPA;CN=Kevin Culligan/OU=DC/O=USEPA/C=US@EPA;CN=Lorie Schmidt/OU=DC/O=USEPA/C=US@EPA;Mark MacLeod [mmacleod@edf.org]; N=Kevin Culligan/OU=DC/O=USEPA/C=US@EPA;CN=Lorie Schmidt/OU=DC/O=USEPA/C=US@EPA;Mark MacLeod [mmacleod@edf.org]; N=Lorie Schmidt/OU=DC/O=USEPA/C=US@EPA;Mark MacLeod [mmacleod@edf.org]; ark MacLeod [mmacleod@edf.org]; ickie Patton [vpatton@edf.org]
From: CN=Howard Hoffman/OU=DC/O=USEPA/C=US
Sent: Wed 5/18/2011 9:53:08 PM
Subject: Re: GHG NSPS
Environmental Defense Fund, NSPS as a Stimulus for Innovation, Docket No. EPA-HQ-OAR-2011-0090.pdf

Thanks very much.

Howard J. Hoffman EPA-OGC-ARLO
(202) 564-5582 (v); -5603 (fax); (240) 401-9721 (cell)
The contents of this e-mail and any attachments to it
may be attorney-client or deliberative-process privileged.

From: Megan Ceronsky <mceronsky@edf.org>
To: Joseph Goffman/DC/USEPA/US@EPA, Lorie Schmidt/DC/USEPA/US@EPA, Howard Hoffman/DC/USEPA/US@EPA, Joel Beauvais/DC/USEPA/US@EPA, Kevin Culligan/DC/USEPA/US@EPA
Cc: Mark MacLeod <mmacleod@edf.org>, Vickie Patton <vpatton@edf.org>
Date: 05/18/2011 04:59 PM
Subject: Re: GHG NSPS

All:

We have further developed the GHG NSPS regulatory design concepts we discussed on April 22nd in the hope that it might be helpful to you. Please let us know if you have any questions.

Best regards,
Megan

Megan Ceronsky
Attorney
Environmental Defense Fund
(303) 447-7224 (P)
(303) 440-8052 (F)
2060 Broadway

Suite 300
Boulder, CO 80302

From: Vickie Patton
Sent: Sunday, April 24, 2011 10:51 PM
To: Joseph Goffman/DC/USEPA/US; Lorie Schmidt/DC/USEPA/US; Howard Hoffman/DC/USEPA/US; beauvais.joel@epa.gov; culligan.kevin@epa.gov
Cc: Megan Ceronsky; Mark MacLeod
Subject: CRS Report, NSPS Case Study, Adequately Demonstrated

Here are some additional materials for your consideration.

The CRS report on the regulation of stationary source greenhouse gases that includes an examination of NSPS issues.

The CRS report draws from the attached Carnegie Mellon PhD dissertation by Margaret Taylor (The Influence of Government Actions on Innovative Activities in the Development of Environmental Technologies to Control Sulfur Dioxide Emissions from Stationary Sources). Taylor examines in detail the convergence of policy and technological innovation associated with Agency's 1971 SO2 NSPS, 1978 SO2 NSPS and 1990 CAAA Title IV program for SO2 including the policy genesis of the SO2 controls, the nascent stages of FGD technology, and the acceleration of technological progress resulting from EPA's policies. One note is her explanation that the German acid rain protection requirements adopted in 1983 resulted in the installation of 35,000 MW of FGD in four years -- 33 percent of which were licensed from US companies (see ps. 56 & 223, n. 108).

<< File: CRS - Potential Regulation of Stationary Greenhouse Gas Sources Under the CAA - May 14 - 2009 (parker, mccarthy).pdf >> << File: Margaret Taylor - Government Actions, Technology Innovation, SO2 Controls - Carnegie Mellon Dissertation - Jan 2001.pdf >>

We have also attached Judge Leventhal's 1973 opinion in Portland Cement re the contours of "adequately demonstrated" under the NSPS (as well as the DC Circuit decision affirming the standards on remand).

<< File: Portland Cement Assn v. EPA 486 F.2d 375 (DC Cir 1973).pdf >> << File: Portland Cement Assn v. Train 513 F2d 506 (DC Cir 75) (aff'd on remand).pdf >>

Thank you again for your precious time.

Sincerely yours,
Vickie

From: Mark MacLeod
Sent: Friday, April 22, 2011 12:51 PM
To: Joseph Goffman/DC/USEPA/US; Lorie Schmidt/DC/USEPA/US; Howard Hoffman/DC/USEPA/US; beauvais.joel@epa.gov; culligan.kevin@epa.gov
Cc: Vickie Patton; Megan Ceronsky
Subject: WRI facilitated 111(d) Principles

All,

Thanks again for your valuable time today. Here is the WRI facilitated document we discussed. The membership is listed in #2. We will follow up with some of the other references cited in today's call.

Have a great weekend.

Mark

<< File: WRI DIalogue Comments Final 4 18 2011.pdf >>

EDF
ENVIRONMENTAL DEFENSE FUND
Finding the ways that work

18 May 2011

Re: Docket ID No. EPA-HQ-OAR-2011-0090; Greenhouse Gas New Source Performance Standards for Fossil Fuel Fired Power Plants

NSPS as a Stimulus for American Technological Innovation

Judicial explications of Clean Air Act § 111 as well as the relevant regulatory precedents and legislative history establish New Source Performance Standards as an innovation-focused regulatory framework. This memo briefly outlines this aspect of the NSPS legal framework and history for the Agency's consideration in promulgating standards under § 111(b).

Legal Foundation

The Senate Report issued prior to passage of the Clean Air Act in 1970 stated that "[s]tandards of performance should provide an incentive for industries to work toward constant improvement in techniques for preventing and controlling emissions from stationary sources."[1] The Senate Report also clarified that an emergent control technology used as the basis for standards of performance need not "be in actual routine use somewhere."[2] Consistent with this Congressional intent, the courts have held that NSPS are to be based on innovative, cutting-edge technologies that will be available when the standards apply to new and modified sources. In *Portland Cement Association v. Ruckelshaus*, the D.C. Circuit stated plainly:

> We begin by rejecting the suggestion of the cement manufacturers that the Act's requirement that emission limitations be "adequately demonstrated" necessarily implies that any cement plant now in existence be able to meet the proposed standards. <u>Section 111 looks toward what may fairly be projected for the regulated future, rather than the state of the art at present</u>, since it is addressed to standards for new plants.[3]

The court went on to hold that:

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[1] S.Rep. No. 91-1196, 91st Cong., 2d Sess. 17 (1970). The D.C. Circuit interpreted the Senate's intent to provide that "[t]he essential question was [] whether the technology would be available for installation in new plants." *Portland Cement Ass'n v. Ruckelshaus*, 486 F.2d 375, 391 (D.C. Cir. 1973).
[2] S.Rep. No. 91-1196, 91st Cong., 2d Sess. 16 (1970).
[3] 486 F.2d 375, 391 (D.C. Cir. 1973) (emphasis added).

> The resultant standard is analogous to the one examined in *International Harvester, supra.* The Administrator may make a projection based on existing technology, though that projection is subject to the restraints of reasonableness and cannot be based on "crystal ball" inquiry. *478 F.2d at 629*. As there, the question of availability is partially dependent on "lead time", the time in which the technology will have to be available. Since the standards here put into effect will control new plants immediately, as opposed to one or two years in the future, the latitude of projection is correspondingly narrowed. If actual tests are not relied on, but instead a prediction is made, "its validity as applied to this case rests on the reliability of [the] prediction and the nature of [the] assumptions." *International Harvester* at 45.[4]

Therefore under this legal standard, if EPA issues NSPS regulations that apply one standard to facilities built within the next few years and apply a more restrictive standard to facilities built five or nine years in the future, the latter standard and the "adequately demonstrated" projection upon which it is based are to be given relatively wide latitude by reviewing courts. A standard that will be effective some years into the future that is based on emergent technologies is acceptable provided the Agency's assumptions about technology availability at that future date are reasonable.

The court in *Portland Cement* also provided guidance on what such an innovation-focused determination could rely upon: "It would have been entirely appropriate if the Administrator had justified the standards, not on the basis of tests on existing sources or old test data in the literature, but on extrapolations from this data, on a reasoned basis responsive to comments, and on testimony from experts and vendors made part of the record."[5] The standards at issue in *Portland Cement* were finalized after the Agency conducted testing at seven plants, which the D.C. Circuit found sufficient.[6]

Historical Precedent

The Congressional Research Service (CRS) Report on the potential regulation of GHG sources under the Clean Air Act notes that the flexibility inherent in the Administrator's authority to determine which technologies have been adequately demonstrated "has been used to authorize control regimes that extended beyond the merely commercially available to those technologies that have only been demonstrated, and thus are considered by many to have been 'technology-forcing.'"[7]

The CRS report focuses on the 1971 and the 1978 NSPS for SO_2 emitted by coal-fired electric generating units as a prime example of the Agency incentivizing technology development and thereby facilitating ambitious emission reductions through NSPS. The 1971 NSPS required a 70% reduction in new power plant emissions, on average, and could be met initially only by burning low-sulfur coal or by using an emergent technology known as flue gas desulfurization (FGD). When the 1971 utility SO_2 NSPS was promulgated, there

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[4] *Id.* at 391-92 (emphasis added).
[5] *Id.* at 401-402.
[6] *Portland Cement Association v. Train*, 513 F.2d 506, 509 (D.C. Cir. 1975).
[7] Larry Parker and James E. McCarthy, "Climate Change: Potential Regulation of Stationary Greenhouse Gas Sources Under the Clean Air Act," Congressional Research Service, R40585, at 12 (May 14, 2009).

was only one FGD vendor and only three FGD units in operation. The 1979 NSPS retained the 1971 emission standard but also required a 70-90% reduction in emissions, depending upon the sulfur content of the coal. This requirement could then only be met by using an FGD device.

A history of the development of FGD devices (cited in the CRS report) further illustrates how much the SO_2 NSPS motivated the development of this technology:

> The Standards of Performance for New Sources are technology-forcing, and for the utility industry they forced the development of a technology that had never been installed on facilities the size of utility plants. That technology had to be developed, and a number of installations completed in a short period of time. The US EPA continued to force technology through the promulgation of successive regulations. The development of this equipment was not an easy process.
>
> . . .
>
> Chemical and mechanical engineers had never dealt with the challenges they faced in developing FGD systems for utility plants during this period. Chemical engineers had never designed process equipment as large as was required, nor had they dealt with the complex chemistry that occurred in the early FGD systems. Mechanical engineers were faced with similar challenges. While they had designed equipment for either acid service or slurry service, they typically had not designed for a combination of the two. Generally, equipment was larger than what they normally dealt with in chemical plants and refineries.
>
> It is an understatement to say that the new source performance standards promulgated by the EPA were technology-forcing. Electric utilities went from having no scrubbers on their generating units to incorporating very complex chemical processes. Chemical plants and refineries had scrubbing systems that were a few feet in diameter, but not the 30- to 40-foot diameters required by the utility industry. Utilities had dealt with hot flue gases but not with saturated flue gases that contained all sorts of contaminants. Industry, and the US EPA, has always looked upon new source performance standards as technology-forcing, because they force the development of new technologies in order to satisfy emission requirements.[8]

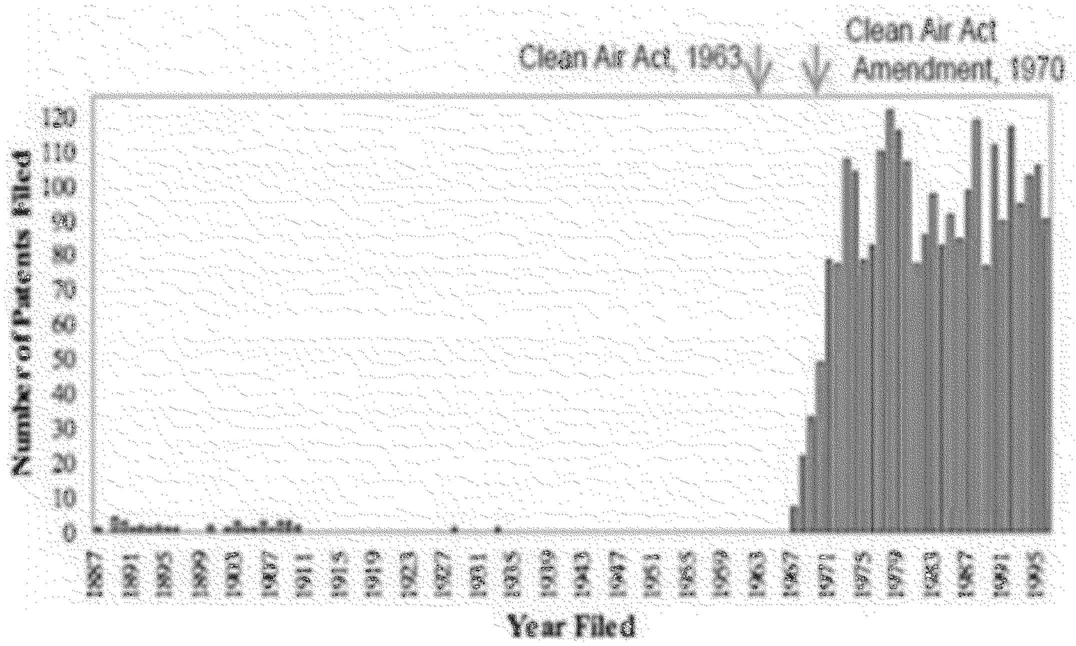
This example demonstrates that under Section 111, the Agency has based an NSPS on a technology that: (1) was sold by only a single vendor at the time the standards go into effect; (2) required the design of equipment with multiple functionalities in a single piece of equipment when existing equipment types only performed one of the functionalities; (3) existed in some form at other types of units but had to operate at units of different size and provide different capacities at the units subject to the NSPS. This is a compelling example

[8] Donald Shattuck, Ken Campbell, Michael Czuchna, Mary Graham, and Andrea Hyatt, "A History of Flue Gas Desulfurization (FGD) – The Early Years," at 15, 3.

of both the flexibility of the Agency's authority under Section 111 and the efficacy of innovation-focused standards at incentivizing technology development.

As can be seen in the Figure 1 below, analysis of patenting activity further demonstrates the dramatic rise in control technology innovation in the U.S. that followed the 1971 SO_2 NSPS promulgation.[9]

Figure 1: U.S. Patents Relevant to SO_2 Control Technology as Identified with the Patent Subclass Method[10]



Thanks to these technology advances, when Germany subsequently implemented a program to control acid rain, 33% of the FGD systems installed were licensed from U.S. companies.[11] Researchers of this and similar regulatory initiatives have observed that stringent regulation is required to stimulate significant innovation in control technologies; neither modest regulation nor legislation supporting control technology research have this effect.[12]

Application to the GHG Context

To translate the legal authorities and historical precedents discussed above into the GHG mitigation context, we believe that the Agency's Section 111 authority would support the

[9] Taylor, M., "The Influence of Government Actions on Innovative Activities in the Development of Environmental Technologies to Control Sulfur Dioxide Emissions from Stationary Sources," PhD Thesis, Carnegie Mellow University, (Jan. 2001), p. 211-212 (hereinafter "Taylor PhD"). *See also* ICF Consulting, "The Clean Air Act Amendments: Spurring Innovation and Growth While Cleaning the Air," (2005), p. 106-108, 118-120, 211-212.
[10] Taylor PhD at 107.
[11] Taylor PhD at 56; *see also* p. 131.
[12] *Id.* at 220; Taylor, M., Rubin, E.S., and Hounshell, D.A., "Control of SO2 Emissions from Power Plants: A Case of Induced Technological Innovation in the U.S.," *Technological Forecasting & Social Change* (July 2005), p. 697.

following regulatory frameworks, and respectfully urge the Agency to give these proposals serious consideration:

- Setting an NSPS under 111(b) that applies different levels of stringency to units built or modified at different times.
    - The agency has discretion to make a finding of "adequately demonstrated" that applies to a future date under *Portland Cement*. Any finding that a technology will be adequately demonstrated by a future date must be based on sufficient supporting information to justify the finding as reasonable.
    - The Agency can base its finding that a technology will be adequately demonstrated at a future date on real-world test data, extrapolations from existing test data, projections based on existing technologies, and evidence provided by experts and vendors.
    - Any such finding must be reasonable and based on defensible assumptions.
- Setting an NSPS that is technology-forcing at the time it becomes effective. This could include a standard based on a technology that:
    - Is only sold by a single vendor when the standard becomes effective.
    - Is used at other types of units, but must be altered significantly to work at a unit of the size and with the characteristics of those in the regulated sector.

Thank you for your consideration of our views. If you have any questions about the content of these comments, please contact:

Megan Ceronsky
Attorney
Environmental Defense Fund
(303) 447-7224
mceronsky@edf.org

To: Joseph Goffman/DC/USEPA/US@EPA[]
From: Mark MacLeod
Sent: Wed 6/15/2011 8:07:50 PM
Subject: shorter version (without the addendum)
Section 111(d) GHG NSPS Design Framework (6 15 2011) short.docx

If this is better for Gina. I will be seeing her at 8:00 tomorrow morning.

Mark

Section 111(d) of the Clean Air Act

This short paper outlines a 111(d) GHG NSPS structure for existing fossil-fired EGUs, including: (1) the establishment of the 111(d) standard on the basis of available efficiency improvements at power plants and reductions in utilization from demand-side efficiency improvements; (2) an alternative compliance pathway for plants that commit to retire by 2020; (3) a regulatory design that incorporates all fossil fuel fired EGUs; and (4) implementation flexibility. The Addendum considers implementation of the suggested framework in more detail. By relying on energy efficiency this framework mobilizes a highly cost-effective and widely available resource across the nation that secures multi-pollutant benefits in protecting human health and the environment.

1. Establishment of the default 111(d) standard:
EPA establishes an emission rate standard that gradually declines over time to achieve significant emission reductions based on:

(a) An average [x%] onsite efficiency improvement requirement, where on-site efficiency improvements are found to be an adequately demonstrated component of the best system of emission reduction. Note that the percentage improvement required could be higher for certain subcategories and lower for others if the technological analysis found that the capacity for improvement varied.

(b) Reductions in utilization achieved via demand side management and demand side energy efficiency investments that achieve quantifiable, surplus, enforceable, and permanent emission reductions. Reducing electricity demand via energy efficiency and demand side management—with available technologies--has been demonstrated to be one of the most cost-effective means of reducing GHG emissions from the power sector. Because reductions in demand lead to reductions in utilization within the regulated sector, there is a close legal connection between the regulated source and the system of emission reduction that is relied upon. The framework assumes that each plant can meet the applicable emission rate standard through a combination of on-site efficiency improvements and investments in demand-side energy efficiency and demand side management. Reductions in emissions due to the demand-side interventions would be credited in the responsible unit's emission rate. There are a number of different ways that demand reduction and associated emission reduction could be quantified, credited, and verified, which are explored further in the Addendum.

2. Alternative compliance pathway:
Any source that elects to commit to a near term retirement (by 2020) is placed in a separate subcategory with an alternate NSPS compliance pathway that entails making the commitment to retire enforceable under the law. Sources in this subcategory would be exempted from the emission rate reduction requirements outlined under section 1 above, with reliance on § 111(d)'s directive to consider the "remaining useful life" of a source when designing the NSPS. (This is similar to the approach used in EPA's regional haze BART guidelines.)

3. Implementation flexibility:
The structure described above could form the backstop, default § 111(d) standards. States could then choose to demonstrate that they would achieve equal or greater emission reductions via an alternate framework. EPA could also propose an opt-in regulatory framework utilizing emissions trading or averaging with an appropriate concomitant increase in required emission reductions, as the Agency did under the MWC NO_x emission guidelines. Utilities would have considerable flexibility in how they would achieve the standard including plant efficiency improvements, demand side efficiency, retirement of aging inefficient units and replacement with modern infrastructure, co-firing with renewables, and other solutions.

4. Incorporating all fossil fuel fired EGUs:
It will be important for the GHG NSPS regulatory framework to incorporate all fossil fuel fired EGUs (either through one overarching sector category or through linked sectors) in order to allow states and utilities to optimize utilization of different plants and fuels to achieve cost-effective emission reductions.

To: Vickie Patton [vpatton@edf.org]; oe Bryson/DC/USEPA/US@EPA;Joseph Goffman/DC/USEPA/US@EPA[]; oseph Goffman/DC/USEPA/US@EPA[]
Cc: Jim Ketcham-Colwill/DC/USEPA/US@EPA;Megan Ceronsky [mceronsky@edf.org]; egan Ceronsky [mceronsky@edf.org]
From: Mark MacLeod
Sent: Wed 6/15/2011 8:07:43 PM
Subject: latest version of 111(d) thoughts
Section 111(d) GHG NSPS Design Framework (6 15 2011) long.docx

Joe, Joe, and Jim,

Here is the latest version of our 111 paper.

Mark

Section 111(d) of the Clean Air Act

This short paper outlines a 111(d) GHG NSPS structure for existing fossil-fired EGUs, including: (1) the establishment of the 111(d) standard on the basis of available efficiency improvements at power plants and reductions in utilization from demand-side efficiency improvements; (2) an alternative compliance pathway for plants that commit to retire by 2020; (3) a regulatory design that incorporates all fossil fuel fired EGUs; and (4) implementation flexibility. The Addendum considers implementation of the suggested framework in more detail. By relying on energy efficiency this framework mobilizes a highly cost-effective and widely available resource across the nation that secures multi-pollutant benefits in protecting human health and the environment.

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(b) Reductions in utilization achieved via demand side management and demand side energy efficiency investments that achieve quantifiable, surplus, enforceable, and permanent emission reductions. Reducing electricity demand via energy efficiency and demand side management—with available technologies--has been demonstrated to be one of the most cost-effective means of reducing GHG emissions from the power sector. Because reductions in demand lead to reductions in utilization within the regulated sector, there is a close legal connection between the regulated source and the system of emission reduction that is relied upon. The framework assumes that each plant can meet the applicable emission rate standard through a combination of on-site efficiency improvements and investments in demand-side energy efficiency and demand side management. Reductions in emissions due to the demand-side interventions would be credited in the responsible unit's emission rate. There are a number of different ways that demand reduction and associated emission reduction could be quantified, credited, and verified, which are explored further in the Addendum.

2. *Alternative compliance pathway:*

Any source that elects to commit to a near term retirement (by 2020) is placed in a separate subcategory with an alternate NSPS compliance pathway that entails making the commitment to retire enforceable under the law. Sources in this subcategory would be exempted from the emission rate reduction requirements outlined under section 1 above, with reliance on § 111(d)'s directive to consider the "remaining useful life" of a source when designing the NSPS. (This is similar to the approach used in EPA's regional haze BART guidelines.)

3. *Implementation flexibility:*

The structure described above could form the backstop, default § 111(d) standards. States could then choose to demonstrate that they would achieve equal or greater emission reductions via an alternate framework. EPA could also propose an opt-in regulatory framework utilizing emissions trading or averaging with an appropriate concomitant increase in required emission reductions, as the Agency did under the MWC NO_x emission guidelines. Utilities would have considerable flexibility in how they would achieve the standard including plant efficiency improvements, demand side efficiency, retirement of aging inefficient units and replacement with modern infrastructure, co-firing with renewables, and other solutions.

4. *Incorporating all fossil fuel fired EGUs:*

It will be important for the GHG NSPS regulatory framework to incorporate all fossil fuel fired EGUs (either through one overarching sector category or through linked sectors) in order to allow states and utilities to optimize utilization of different plants and fuels to achieve cost-effective emission reductions.

Addendum: Implementation Considerations

Calculation of Energy Efficiency Potential:

From EPA's 2007 Guide for Conducting Energy Efficiency Potential Studies:

In general, a potential analysis involves the following steps:[1]

- Identify the baseline energy consumption forecast, including a specific understanding of what it does and does not include in terms of future changes to codes and standards, natural efficiency adoption, planned efficiency programs, etc. (Presumably this is already done through the IPM modeling.)

- Disaggregate the baseline forecast into customer and other segments (e.g., end uses) appropriate for the analysis.

- Characterize efficiency measures:
  - Identify energy, demand, and other savings (e.g., operations and maintenance) of each measure, including changes over time.[5]

[1] *See also* ICF International, Energy Efficiency Potential Model, http://www.icfi.com/insights/products-and-tools/eepm; Federal Energy Regulatory Commission, *A National Assessment of Demand Response Potential* (June 2009), http://www.ferc.gov/legal/staff-reports/06-09-demand-response.pdf; McKinsey & Company, *Reducing U.S. Greenhouse Gas Emissions: How Much at What Cost?* (December 2007), http://www.edf.org/documents/9665_McKinsey%20GHG%20Report.pdf; Energy Center of Wisconsin, *A Review and Analysis of Existing Studies of the Energy Efficiency Resource Potential in the Midwest* (August 2009), http://www.midwesterngovernors.org/Energy/EEResourcePotential.pdf; Georgia Institute of Technology, Meta-Review of Efficiency Potential Studies and Their Implications for the South (August 2009), http://www.spp.gatech.edu/faculty/workingpapers/wp51.pdf .

    - Identify costs associated with each measure, including changes over time, such as prices coming down because of greater volume sold and technology improvements.

- Screen measures for economic effects, cost-effectiveness, and other resource effects.

- Develop program designs, in terms of bundled measures targeting particular customer groups and/or end-uses.

- Estimate measure penetrations for baseline and efficient scenarios for each program year using program design information, available studies, past program results, understanding of the specific markets, etc.

- Calculate total savings for all efficiency measures.

- The quantity of emission reductions available via demand-side energy efficiency investments that would be incorporated into the NSPS as "adequately demonstrated" could be established based on a subset of the total potential savings (similar to the way in which not all reasonably available control measures are presumed to be implemented in a nonattainment area even if available or in which the Agency accounts for the NAS analysis on available greenhouse gas mitigation from a new heavy-duty diesel truck even while setting a standard that could be achieved based on a subset of the available technologies).

Quantification of avoided emissions (lbs CO_2):

One method of quantifying the emissions avoided due to a demand-side energy efficiency intervention would be to follow the approach recommended in the 2004 guidance to States and local areas on crediting emission reductions from energy efficiency and renewable energy measures in State Implementation Plans.[2] This guidance recommends using dispatch and emission reduction models to calculate the reduction in emissions that occurs based on demand reductions in a specific service territory. Under the SIP guidance, states can only take credit for emission reductions that are projected to occur within the non-attainment area, unless reductions outside the non-attainment area can be shown to affect air quality within the non-attainment. In the latter case, the amount of potential credit is determined by the extent to which reductions will improve air quality in the nonattainment area.[3] In the context of GHG emissions, any reduction improves atmospheric GHG concentrations equally, so all emission reductions achieved by these programs should be counted. This approach aligns with the § 111 legal framework, which (unlike § 110) does not require emission reductions to occur within a specific geographic area.

Distributing credit for achieved emission reductions:

One approach to allocate credit for reductions in emissions from reductions in energy demand or demand side management would be to allow whichever entity funds a demand-based

[2] EPA, Office of Air and Radiation, "Guidance on State Implementation Plan (SIP) Credits for Emission Reductions from Electric-Sector Energy Efficiency and Renewable Energy Measures," (August 2004).
[3] *Id.* at 21 (No. 27).

emission reduction to claim credit for reduced emissions (e.g. to subtract the lbs CO_2 from the numerator in its emissions rate). Only generators that sell power into the state in which the demand reduction was achieved would be eligible to claim the reduced emissions, in order to retain a nexus between the reduction in utilization and the demand reduction or demand management intervention. Because power generation and electricity grids cross state boundaries, note that any state equivalency framework must be capable of distinguishing between reductions in utilization due to demand side efficiency and demand side management investments and reductions in utilization due to other factors, and attribute credit accordingly.

Another approach would be to use the modeling quantification approach described above but only to allow those plants projected to reduce utilization to claim credit, and to do so proportionately to dispatch reduction projections. This will make the design of the emission reduction requirements (and the incentive structure for investment in these improvements) more complex.

To: Mark MacLeod [mmacleod@edf.org]
Cc: CN=Jim Ketcham-Colwill/OU=DC/O=USEPA/C=US@EPA;CN=Joseph Goffman/OU=DC/O=USEPA/C=US@EPA;Megan Ceronsky [mceronsky@edf.org]; N=Joseph Goffman/OU=DC/O=USEPA/C=US@EPA;Megan Ceronsky [mceronsky@edf.org]; egan Ceronsky [mceronsky@edf.org]; ickie Patton [vpatton@edf.org]
From: CN=Joe Bryson/OU=DC/O=USEPA/C=US
Sent: Wed 6/15/2011 8:29:54 PM
Subject: Re: latest version of 111(d) thoughts

Thanks Mark. We'll take a look.

Joe Bryson
EPA/Climate Protection Partnerships Division
(202) 343-9631

From: Mark MacLeod <mmacleod@edf.org>
To: Vickie Patton <vpatton@edf.org>, Joe Bryson/DC/USEPA/US@EPA, Joseph Goffman/DC/USEPA/US@EPA
Cc: Jim Ketcham-Colwill/DC/USEPA/US@EPA, Megan Ceronsky <mceronsky@edf.org>
Date: 06/15/2011 04:07 PM
Subject: latest version of 111(d) thoughts

Joe, Joe, and Jim,

Here is the latest version of our 111 paper.

Mark

 [attachment "Section 111(d) GHG NSPS Design Framework (6 15 2011) long.docx" deleted by Joe Bryson/DC/USEPA/US]

To: Joseph Goffman/DC/USEPA/US@EPA[]
From: Megan Ceronsky
Sent: Tue 6/28/2011 9:06:35 PM
Subject: GHG NSPS
Section 111(d) GHG NSPS Design Framework (6.28.2011, detailed).docx

Hi Joe—

We wanted to get you the latest version of our GHG NSPS Sec. 111(d) thoughts. We would, as always, welcome the opportunity to discuss these with you and/or any of your colleagues and get your feedback.

I hope all is well!

Best,
Megan

Megan Ceronsky
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Environmental Defense Fund
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2060 Broadway
Suite 300
Boulder, CO 80302

Section 111(d) of the Clean Air Act

This short paper outlines a 111(d) GHG NSPS structure for existing fossil-fired EGUs, including: (1) the establishment of the 111(d) standard on the basis of available efficiency improvements at power plants and reductions in utilization from demand-side efficiency improvements; (2) an alternative compliance pathway for the GHG NSPS for plants that commit to retire by 2020; (3) a regulatory design that incorporates all fossil fuel fired EGUs; and (4) implementation flexibility for State programs. The Addendum considers implementation of the suggested framework in more detail. By relying on energy efficiency this framework mobilizes a highly cost-effective and widely available resource across the nation that secures multi-pollutant benefits in protecting human health and the environment.

1. Establishment of the default 111(d) standard:
EPA establishes an emission rate standard that gradually declines over time to achieve substantial near-term emission reductions and to guide efficient utility investment decisions to secure long-term pollution reductions protective of human health and the environment. We believe the analyses outlined below would support a reduction in the sector's overall emission rate on the order of 10-15% by 2020. This standard would serve as the default regulatory framework provided in the emission guidelines, and establish the level of emission reductions that a State program must meet in an equivalency determination (even though presumably the State programs will utilize different regulatory frameworks with additional flexible compliance mechanisms.) The standard would be based on:

(a) An average [x%] onsite efficiency improvement requirement, where on-site efficiency improvements are found to be an adequately demonstrated component of the best system of emission reduction. Note that the percentage improvement required could be higher for certain subcategories and lower for others if the technological analysis found that the capacity for improvement varied. The design of the standard and subcategories would reflect differences in utilization that affect efficiency and would ensure that units that have already made significant investments in efficiency would not be penalized. The design of the standard also could spur significant improvement in the most inefficient units currently operating given the potential for near-term progress in reducing pollution at these units.

(b) Reductions in utilization achieved via demand side management and demand side energy efficiency investments that achieve quantifiable, surplus, enforceable, and permanent emission reductions. Reducing electricity demand via energy efficiency and demand side management—with available technologies--has been demonstrated to be one of the most cost-effective means of reducing GHG emissions from the power sector. Because reductions in demand lead to reductions in utilization within the regulated sector, there is a close legal connection between the regulated source and the system of emission reduction that is relied upon. The framework assumes that each plant can meet the applicable emission rate standard through a combination of on-site efficiency improvements and investments in demand-side energy efficiency and demand side management. Reductions in emissions due to the demand-side interventions would be credited in the responsible unit's emission rate. There are a number of different ways that demand reduction and associated emission reduction could be quantified, credited, and verified, which are explored further in the Addendum. Note, however, that the proposal assumes that any generator selling electricity into a State could invest in demand-side efficiency improvements or demand management that would reduce demand and emissions, and be able to take credit for those reductions. For example, the Forward Capacity Market operated by the New England ISO establishes an enforceable framework for States to bid demand-side efficiency investments into the market as capacity resources. We also assume that third parties would offer demand reduction and demand management services to generators. Available utility-scale studies on the potential for energy efficiency could help inform the default emission rate including the pace of reductions as some new efficiency measures may require a phase in period.

2. Alternative compliance pathway:
Any source that elects to commit to a near term retirement (by 2020) is placed in a separate subcategory with an alternate NSPS compliance pathway that entails making the commitment to retire enforceable under the law. Sources in this subcategory would be exempted from the emission rate reduction requirements outlined under section 1 above, with reliance on § 111(d)'s directive to consider the "remaining useful life" of a source when designing the NSPS. (This is similar to the approach used in EPA's regional haze BART guidelines.) Note, however, that these units would still be required to meet the emission reduction requirements established by separate Clean Air Act regulatory programs and to reduce GHG emissions through available, low cost efficiency adjustments at the unit even though exempted from the default emission rate reduction requirements.

3. Implementation flexibility:
The structure described above could form the backstop, default § 111(d) standards. States could then choose to demonstrate that they would achieve equal or greater emission reductions via an alternate framework utilizing flexible compliance mechanisms. EPA could also propose an opt-in regulatory framework utilizing emissions trading or averaging with an appropriate concomitant increase in required emission reductions, as the Agency did under the MWC NO_x emission guidelines. Under these frameworks utilities would have considerable flexibility in how they would achieve the standard including plant efficiency improvements, demand side efficiency, retirement of aging inefficient units and replacement with modern infrastructure, co-firing with renewables, and other solutions. The declining emission rate standard established in the emission guidelines, however, would provide a long-term price signal to guide utility investment decisions and compliance strategies.

4. Incorporating all fossil fuel fired EGUs:
It will be important for the GHG NSPS regulatory framework to incorporate all fossil fuel fired EGUs (either through one overarching sector category or through linked sectors) in order to allow states and utilities to optimize utilization of different plants and fuels to achieve cost-effective emission reductions.

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- Screen measures for economic effects, cost-effectiveness, and other resource effects.
- Develop program designs, in terms of bundled measures targeting particular customer groups and/or end-uses.
- Estimate measure penetrations for baseline and efficient scenarios for each program year using program design information, available studies, past program results, understanding of the specific markets, etc.
- Calculate total savings for all efficiency measures.
- The quantity of emission reductions available via demand-side energy efficiency investments that would be incorporated into the NSPS as "adequately demonstrated" could be established based on a subset of the total potential savings (similar to the way in which not all reasonably available control measures are presumed to be implemented in a nonattainment area even if available or in which the Agency accounts for the NAS

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[1] *See also* ICF International, Energy Efficiency Potential Model, http://www.icfi.com/insights/products-and-tools/eepm; Federal Energy Regulatory Commission, *A National Assessment of Demand Response Potential* (June 2009), http://www.ferc.gov/legal/staff-reports/06-09-demand-response.pdf; McKinsey & Company, *Reducing U.S. Greenhouse Gas Emissions: How Much at What Cost?* (December 2007), http://www.edf.org/documents/9665_McKinsey%20GHG%20Report.pdf; Energy Center of Wisconsin, *A Review and Analysis of Existing Studies of the Energy Efficiency Resource Potential in the Midwest* (August 2009), http://www.midwesterngovernors.org/Energy/EEResourcePotential.pdf; Georgia Institute of Technology, Meta-Review of Efficiency Potential Studies and Their Implications for the South (August 2009), http://www.spp.gatech.edu/faculty/workingpapers/wp51.pdf .

analysis on available greenhouse gas mitigation from a new heavy-duty diesel truck even while setting a standard that could be achieved based on a subset of the available technologies).

Quantification of avoided emissions (lbs CO_2):

One method of quantifying the emissions avoided due to a demand-side energy efficiency intervention would be to follow the approach recommended in the 2004 guidance to States and local areas on crediting emission reductions from energy efficiency and renewable energy measures in State Implementation Plans.[2] This guidance recommends using dispatch and emission reduction models to calculate the reduction in emissions that occurs based on demand reductions in a specific service territory. Note that other proxies can be used to conservatively estimate the reductions in emissions that would result from a reduction in demand, including reliance on data indicating which units are marginal and likely to be displaced. Under the SIP guidance, states can only take credit for emission reductions that are projected to occur within the non-attainment area, unless reductions outside the non-attainment area can be shown to affect air quality within the non-attainment. In the latter case, the amount of potential credit is determined by the extent to which reductions will improve air quality in the nonattainment area.[3] In the context of GHG emissions, any reduction improves atmospheric GHG concentrations equally, so all emission reductions achieved by these programs should be counted. This approach aligns with the § 111 legal framework, which (unlike § 110) does not require emission reductions to occur within a specific geographic area.

Distributing credit for achieved emission reductions:

One approach to allocate credit for reductions in emissions from reductions in energy demand or demand side management would be to allow whichever entity funds a demand-based emission reduction to claim credit for reduced emissions (e.g. to subtract the lbs CO_2 from the numerator in its emissions rate). Only generators that sell power into the state in which the demand reduction was achieved would be eligible to claim the reduced emissions, in order to retain a nexus between the reduction in utilization and the demand reduction or demand management intervention. Because power generation and electricity grids cross state boundaries, note that any state equivalency framework must be capable of distinguishing between reductions in utilization due to demand side efficiency and demand side management investments and reductions in utilization due to other factors, and attribute credit accordingly.

Another approach would be to use the modeling quantification approach described above but only to allow those plants projected to reduce utilization to claim credit, and to do so proportionately to dispatch reduction projections. This will make the design of the emission reduction requirements (and the incentive structure for investment in these improvements) more complex.

[2] EPA, Office of Air and Radiation, "Guidance on State Implementation Plan (SIP) Credits for Emission Reductions from Electric-Sector Energy Efficiency and Renewable Energy Measures," (August 2004).
[3] *Id.* at 21 (No. 27).

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From: "Lashof, Dan"
Sent: Wed 6/29/2011 7:49:12 PM
Subject: FW: Posted: President Obama is Writing the Climate Legacy of his First Term Now
http://switchboard.nrdc.org/blogs/dlashof/president_obama_is_writing_the.html
President Obama is Writing the Climate Legacy of his First Term Now
Dan Lashof
Solving Global Warming
60mpg
carbondioxide
carbonpollution
cleanairact
cleancars
climatechange
EPA
Obama
pnp
budget deal
reiterated
determination to veto
Section 111
Section 202
Roland Hwang
cautiously optimistic
called on Congress
emissions from the electric sector

FYI--

http://switchboard.nrdc.org/blogs/dlashof/president_obama_is_writing_the.html

President Obama is Writing the Climate Legacy of his First Term Now

Posted June 29, 2011 by Dan Lashof in Solving Global Warming

Tags:

60mpg, carbondioxide, carbonpollution, cleanairact, cleancars, climatechange, EPA, Obama, pnp

Al Gore's essay about climate change in Rolling Stone last week was mostly about how the news media have utterly failed to be an effective referee of the phony debate over science, but most of the attention it generated (predictably) focused on his criticisms of President Obama's handling of climate policy. Gore encapsulated the conventional wisdom: Obama failed to use his bully pulpit to educate the public about climate change, failed to deliver comprehensive clean energy and climate legislation, and failed to deliver a strong international agreement in Copenhagen.

True enough, but it's not the end of the story. Neither the fate of climate legislation nor Copenhagen was entirely within the president's control. No doubt President Obama could have done more to push the Senate and the international negotiations, but whether that would have changed the outcomes is impossible to determine.

On the other hand, President Obama stood up to House Republicans and some Democrats to successfully defend EPA's authority to regulate global warming pollution in the April budget deal to fund the government through the end of this fiscal year. The Supreme Court has reiterated that it is EPA's job to set standards to limit heat-trapping pollutants. And the president's chief of staff, Bill Daley, recently reiterated the administration's determination to veto any legislation that would undermine EPA's ability to protect public health.

Now the question is what will the Obama administration do with its authority. The administration is currently developing standards addressing the two biggest sources of global warming pollution: Power plants and cars. Together these standards address about 60% of U.S. CO_2 emissions and they have the potential to reduce overall U.S. emissions significantly. Both of these standards (for power plants under Section 111 of the Clean Air Act, and for passenger vehicles under Section 202) are being drafted right now and will be proposed in September and finalized next spring.

When it comes to reducing emissions from power plants and automobiles using the Clean Air Act the president is master of his own (and our) fate. The climate legacy of his first term can still be very positive if he delivers strong standards and defends them.

Recent reports about the administration's proposal for vehicle standards, which will increase the fuel efficiency and reduce heat-trapping pollution from model year 2017-2025 vehicles, make my colleague, Roland Hwang, cautiously optimistic that the final rule will continue the significant progress currently being made by the automobile industry and bring the average fuel economy of new cars close to 60 miles per gallon by 2025.

No details have been reported about the administration's approach to the power plant rule, but during his State of the Union Address this year the president called on Congress to pass a "clean energy standard" to ensure that at least 80 percent of America's electricity will come from low carbon sources by 2035. There is no evidence that this Congress will heed that call. Fortunately, power plant pollution standards under the Clean Air Act can set us on a path toward that goal, and all Congress has to do is stay out of the way. As with automobiles, the power plant standards simply need to continue the progress we have seen over the last few years: Between 2005 and 2010 emissions from the electric sector declined by 6 percent (this is not primarily due to the recession—GDP is 5 percent higher than it was in 2005 and total electricity generation is 2 percent higher).

Here's the bottom line: The jury is still out on President Obama's climate record. The verdict depends on the power plant and automobile standards the administration is writing now.

Daniel A. Lashof, Ph.D.

Director, NRDC Climate Center

202-289-6868

To: Lorie Schmidt/DC/USEPA/US@EPA;Jim Ketcham-Colwill/DC/USEPA/US@EPA[]; im Ketcham-Colwill/DC/USEPA/US@EPA[]
Cc: Vickie Patton [vpatton@edf.org]
From: Megan Ceronsky
Sent: Fri 1/6/2012 8:15:47 PM
Subject: RGGI, EE materials
Industrial Energy Consumers of America, 11 11 11_Letter to Obama Jackson re Energy Efficiency.pdf
50+ businesses write Obama urging utilization of energy efficiency in GHG NSPS (11.14.2011).pdf
Analysis Group, The Economic Impacts of RGGI on Ten NE and Mid-Atlantic States (11.15.2011).pdf

Dear Lorie and Jim—

Jim, welcome back! We were horrified to hear from Lorie about what you have been dealing with, and are so relieved to hear that you are feeling better.

If at any point we do anything to give you a headache, please let us know and we will cease and desist immediately.

We wanted to send along some energy efficiency materials that might be of interest.

The report is by Sue Tierney et al. at Analysis Group, on the economic impact of RGGI for participating states. Some highlights:

· RGGI produced $1.6 billion in net present value economic value to the 10 state region. Each state's economy experienced a net benefit from participation. P.2, 8

· "[E]lectricity consumers overall – households, businesses, government users, and others – enjoy a net gain of nearly $1.1 billion, as their overall electric bills drop over time." P.4

· "RGGI investment in energy efficiency depresses regional electrical demand, power prices, and consumer payments for electricity. This benefits all consumers through downward pressure on wholesale prices, yet it particularly benefits those consumers who actually take advantage of such programs, implement energy efficiency measures, and lower both their overall energy use and monthly energy bills. These savings stay in the pocket of electricity users. But positive macroeconomic impacts exist as well: the lower energy costs flow through the economy as collateral reductions in natural gas and oil consumption in buildings and increased consumer disposable income (from fewer dollars spent on energy bills), lower payments to out-of-state energy suppliers, and increased local spending or savings. Consequently, there are multiple ways that investments in energy efficiency lead to positive economic impacts; this reinvestment thus stands out as the most economically beneficial use of RGGI dollars." P.7

· "Taking into account consumer gains, lower producer revenues, and net positive macroeconomic impacts, RGGI led to overall job increases amounting to thousands of new jobs over time. RGGI job impacts may in some cases be permanent; others may be part-time or temporary. But according to our analysis, the net effect is that the first three years of RGGI led to over 16,000 new "job years," with each of the ten states showing net job additions." P. 7-8

· "RGGI helped lower the total dollars these states sent outside their region in the form of payments for fuel by over $765 million." P.6

The two letters (one signed by 53 businesses, one signed by IECA) are strongly supportive of the Administration utilizing demand-side energy efficiency in achieving GHG emission reductions under the NSPS. Some highlights:

· IECA letter: "Energy efficiency is a superb measure because once implemented it typically reduces energy consumption and related power plant emissions year after year without additional capital costs. The industrial sector strongly supports cost - effective and verifiable energy efficiency as a way to reduce its energy costs, improve competitiveness, and to achieve emissions reductions required under the Clean Air Act."

· 50+ businesses letter: "As the Administration adopts greenhouse gas emission standards for power plants under the Clean Air Act, we respectfully write to request that you take full advantage of the emission-reducing potential of energy efficiency. Section 111 New Source Performance Standards for new and existing power plants offer the opportunity to marshal made-in-America solutions to address climate change. We will export these technologies to the world.

. . .

Reducing energy use lowers energy bills for American businesses and families, freeing up much-needed funds, and protecting industry from volatility in fossil fuel markets. Energy efficiency investments will give the power sector greater flexibility in meeting air pollution emission standards, achieve multi-pollutant emission reductions, and help America to be more energy secure."

I hope you both have a wonderful weekend.

Best,

Megan

Megan Ceronsky

Attorney

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Industrial Energy Consumers of America
The Voice of the Industrial Energy Consumers

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November 11, 2011

The Honorable Barack Obama
President of the United States
The White House
1600 Pennsylvania Avenue, NW
Washington, DC 20500

Dear Mr. President:

The Industrial Energy Consumers of America (IECA) requests that, as the Environmental Protection Agency (EPA) moves to establish greenhouse gas emission standards under the Clean Air Act for power plants, refineries and other large emitting sources, EPA prioritize low-cost and "cost-effective" energy efficiency from every sector as a means of achieving the emissions reductions to be required by those standards. And EPA should let energy efficiency compete with all other emissions reduction technologies, including renewable energy because competition will drive down both costs and emissions.

The Industrial Energy Consumers of America is a nonpartisan association of leading manufacturing companies with $700 billion in annual sales and with more than 650,000 employees nationwide. It is an organization created to promote the interests of manufacturing companies through research, advocacy, and collaboration for which the availability, use and cost of energy, power or feedstock play a significant role in our members' ability to compete in domestic and world markets. IECA membership represents a diverse set of industries including: plastics, cement, paper, food processing, brick, chemicals, fertilizer, insulation, steel, glass, industrial gases, pharmaceutical, aluminum and brewing.

This request is consistent with the January 18, 2011 Executive Order "Improving Regulation and Regulatory Review" that requires the EPA to pursue the least cost and most flexible alternative. The Pollution Prevention Act also requires EPA to consider first how to avoid pollution (e.g., via energy efficiency) before they consider how to treat it.

It is important for the Administration to remember that State regulations allow all costs imposed upon the electric generating sector to be passed on to us, the consumer. It is for this reason that the Administration must ensure that the lowest cost options are included in the GHG regulation.

It is critically important that EPA greenhouse gas regulation of the power generating sector not increase the cost of electricity. The manufacturing sector competes globally and is under enormous competitive pressure. The manufacturing sector has lost 5.7 million jobs or 31 percent of its workforce since 2000. Low-cost electricity (and fuels such as natural gas) is essential in our ability to compete globally.

Energy efficiency is a superb measure because once implemented it typically reduces energy consumption and related power plant emissions year after year without additional capital costs. The industrial sector strongly supports cost-effective and verifiable energy efficiency as a way to reduce its energy costs, improve competitiveness, and to achieve emissions reductions required under the Clean Air Act.

However, as a word of caution, industrial energy efficiency is not “free” as some parties have reported. The cost and the time to obtain a return on investment can vary significantly and are highly dependent upon a variety of factors, including changing cost of capital and the cost and time delay of environmental regulations.

Industrial energy efficiency options should include proven measures such as advanced electric motors and pumps but also the cogeneration of power and steam as well as use of waste heat recovery or “hot stack gas” recovery and use.

Industrial cogeneration can vary in operating efficiency from 60 to very close to 80 percent and waste heat recovery utilizes a free fuel to produce useful products such as electric power. We urge you to place a special emphasis on these measures because they simultaneously improve energy efficiency and reduce emissions while producing high quality distributed power generation. Cogeneration and waste heat recovery can be a superior substitute for power produced from inefficient conventional electric power generation. It can also offset the need for costly investment in new transmission infrastructure.

Existing buildings consume 40 percent of our nation’s electricity and thus offer a huge opportunity for energy savings and attendant reductions in indirect emissions. Simple low-cost options like insulation for attics and walls, insulated doors and windows are a common sense priority. These measures are literally off-the-shelf technologies made and installed by American workers and which improve the health and comfort of Americans. Energy efficiency in this area, including the retrofitting of the tens of millions of under-insulated American homes, will reduce demand for power, decrease power plant emissions and help reduce electricity costs. And lower electricity demand will help delay expensive new conventional electric power generation facilities. These types of indirect energy efficiency measures should be part of the suite of options available for demonstrating reductions in greenhouse gas emissions.

There is one important caveat. The industrial sector opposes policy that requires industrial energy users to subsidize increases in residential and commercial energy efficiency. We also oppose the decoupling of purchased electricity volume from price as utilities should be able to make up lost revenues through load growth that is incentivized by lower rates. Fortunately, the potential energy and financial savings are large enough that all ratepayer classes will benefit.

Sincerely,

Paul Cicio
President

cc: The Honorable Lisa Jackson

November 14, 2011

President Barack Obama
The White House
1600 Pennsylvania Avenue
Washington, D.C. 20500

Cc:
The Honorable Lisa Jackson, Administrator
Environmental Protection Agency
Room 3000, Ariel Rios Building
1200 Pennsylvania Avenue
Washington, D.C. 20460

Dear Mr. President:

We, the undersigned businesses and associations, share an interest in advancing energy efficiency and making US manufacturers more competitive.

As the Administration adopts greenhouse gas emission standards for power plants under the Clean Air Act, we respectfully write to request that you take full advantage of the emission-reducing potential of energy efficiency. Section 111 New Source Performance Standards for new and existing power plants offer the opportunity to marshal made-in-America solutions to address climate change. We will export these technologies to the world.

Study after study has demonstrated the potential for demand-side energy efficiency, demand management, combined heat and power, and waste heat recovery to reduce greenhouse gas emissions cost-effectively and improve grid reliability while creating jobs. For example, a 2008 review of 48 studies of state-level energy efficiency initiatives found that the policies could achieve an average 23% gain in efficiency with a benefit-cost ratio of nearly 2:1. The same review estimated that a 20 to 30% improvement in energy efficiency in the United States could generate an aggregate 0.5 to 1.5 million jobs and a 0.1% increase in GDP by 2030.[1] A study by the Oak Ridge National Laboratory found that the deployment of combined heat and power to provide 20% of U.S. electric capacity by 2030 would create one million new highly skilled jobs throughout the United States, save an estimated 5.3 quadrillion Btu of fuel annually, and reduce CO_2 emissions by more than 800 million metric tons every year—the equivalent of taking more than half of the current passenger vehicles in the U.S. off the road.[2] EPA itself has documented the value of energy efficiency in generating cost-effective air pollution reductions in other regulatory contexts.[3]

Reducing energy use lowers energy bills for American businesses and families, freeing up much-needed funds, and protecting industry from volatility in fossil fuel markets. Energy efficiency investments will give the power

---

[1] JOHN A. "SKIP" LAITNER AND VANESSA MCKINNEY, POSITIVE RETURNS: STATE ENERGY EFFICIENCY ANALYSES CAN INFORM US ENERGY POLICY ASSESSMENTS (2008), *available at* www.aceee.org/sites/default/files/publications/researchreports/e084.pdf.

[2] OAK RIDGE NATIONAL LABORATORY, COMBINED HEAT AND POWER: EFFECTIVE ENERGY SOLUTIONS FOR A SUSTAINABLE FUTURE (2008) at 4, *available at* http://info.ornl.gov/sites/publications/files/Pub13655.pdf.

[3] In proposing toxic emission standards for utilities EPA noted that even very modest energy efficiency investments could reduce the cost of meeting the standards by $2 billion in 2015, $6 billion in 2020, and $11 billion in 2030. U.S. Environmental Protection Agency, 76 Fed. Reg. 24,976, 25,074 (Table 23), May 3, 2011, "National Emission Standards for Hazardous Air Pollutants From Coal and Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units."

sector greater flexibility in meeting air pollution emission standards, achieve multi-pollutant emission reductions, and help America to be more energy secure.

For all these reasons, we ask the Administration to recognize and incorporate energy efficiency when it is crafting greenhouse gas emission standards for power plants. Such standards will be a critical step toward making American manufacturers more competitive while addressing climate change. These standards will save Americans money, create jobs, and reduce air pollution. This is not an opportunity we can afford to miss.

Sincerely,

Access Energy, LLC
Alliance for Industrial Efficiency
Alliance to Save Energy
California Business Alliance for a Green Economy
Calnetix Technologies, LLC
Capital Communications/ Phanes Solar
Capstone Turbine Corporation
Cascade Power Group LLC
CFC Chiller Replacement Task Force
Conservation Services Group
Continuum Energy Solutions
Danfoss Turbocor Compressors, Inc.
Direct Energy
E-Finity Distributed Generation
ElectraTherm
Energy Future Coalition
EnergyNext, Inc.
EnerNOC
Ernest D. Menold, Inc.
Facility Strategies Group
FLS Energy
Gulf Coast Green Energy
Health and Energy Company
Heat Is Power
ImbuTec
Ingersoll Rand
KGRA Energy
Kiltech Controls, Inc.
LighTec, Inc.
Montana SMACNA
NewLoop Energy
Ormat Technologies
Pharmaceutical Industry Labor-Management Association (PIL-MA)
Primary Energy Recycling Corp.
Recycled Energy Development (RED)
The ServiceMaster Company
Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
Sheet Metal Contractors of Iowa
Sheet Metal Engineering, Inc.
SMACNA of Southern Nevada
Smardt Chillers, Inc.
SunRise Solar Inc.
TAS Energy
TerraScapes Environmental
The Ohio Business Council for a Clean Economy
Trieste Associates, Inc.
Turbo Thermal LLC
U.S. Clean Heat & Power Association (USCHPA)
Veolia Energy North America
Verdicorp, Inc.
Vidimos, Inc.

ANALYSIS GROUP
ECONOMIC, FINANCIAL and STRATEGY CONSULTANTS

The Economic Impacts of the Regional Greenhouse Gas Initiative on Ten Northeast and Mid-Atlantic States

Review of the Use of RGGI Auction Proceeds from the First Three-Year Compliance Period

Paul J. Hibbard
Susan F. Tierney
Andrea M. Okie
Pavel G. Darling

November 15, 2011

Acknowledgments

This report on the economic impacts of RGGI program implementation was completed by Analysis Group with funding from four foundations:

The Merck Family Fund

The Barr Foundation

The Chorus Foundation

The Henry P. Kendall Foundation

The authors wish to thank the foundations for their support. In addition, we would like to thank Laurie Burt for her input and assistance throughout the project, and also the members of the Technical Advisory Group (TAG), listed on the next page. TAG members provided important substantive and high-quality feedback on data clarity and assumptions, modeling inputs and scenarios, and evaluation of the results.

The report, however, reflects the analysis and judgment of the authors only, and does not necessarily reflect the views of the foundations, Ms. Burt, or any TAG member.

Finally, the authors would like to recognize and thank Bentley Clinton and Sam Lilienfeld of Analysis Group for significant analytic support throughout the project.

Analysis Group

Analysis Group provides economic, financial, and business strategy consulting to leading law firms, corporations, and government agencies. The firm has more than 500 professionals, with offices in Boston, Chicago, Dallas, Denver, Los Angeles, Menlo Park, New York, San Francisco, Washington, D.C., and Montreal.

Analysis Group's energy and environment practice area is distinguished by expertise in economics, finance, market analysis, regulatory issues, and public policy, as well as significant experience in environmental economics and energy infrastructure development. The practice has worked for a wide variety of clients including energy producers, suppliers and consumers; utilities; regulatory commissions and other public agencies; tribal governments; power system operators; foundations; financial institutions; and start-up companies, among others.

Technical Advisory Group

David Conover	Senior Vice President, Bipartisan Policy Center
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Alexander ("Sandy") Taft	Director, U.S. Climate Change Policy, National Grid

1. EXECUTIVE SUMMARY

Overview and Results

In 2009, ten Northeastern and Mid-Atlantic states began the Regional Greenhouse Gas Initiative (known as RGGI), the country's first market-based program to reduce emissions of carbon dioxide (CO_2) from power plants. Understanding the program's performance and outcomes is important given that RGGI states account for one-sixth of the population in the US and one-fifth of the nation's gross domestic product. Through the development of the RGGI program, these states have gained first-mover policy experience and have collaborated to merge a common policy into well-functioning electricity markets. Insights and observations gleaned from an analysis of the program's performance will be valuable in evaluating past policy decisions and future policy recommendations.

RGGI has now been operating for nearly three years. The rights to emit CO_2 have been auctioned off. Power plant owners have spent roughly $912 million to buy CO_2 allowances. Consumers now pay regional electricity rates that reflect a price on CO_2 emissions. These emissions have gone down, affected by both RGGI and larger economic conditions.[1] States have received, programmed, and disbursed virtually all the $912 million in allowance proceeds[2] back into the economy in myriad ways – on energy efficiency measures, community-based renewable power projects, assistance to low-income customers to help pay their electricity bills, education and job training programs, and even contributions to a state's general fund. Figure ES1 shows RGGI proceeds by state and region.

Looking back, how has the RGGI program affected electricity markets, power producers' costs, electricity prices, and consumers' electricity bills? What happened to the $912 million in proceeds from the sale of CO_2 allowances? Has the program produced net economic benefits to these states in its first three years, or otherwise helped them pursue their goals for "continued overall economic growth" and reliable electric supply, while also reducing CO_2 emissions? What has been learned to date? These are the principal questions this study set out to address.

At the request of four foundations,[3] Analysis Group has measured the economic impacts of RGGI's first three years. Our analysis tracks the path of RGGI-related dollars as they leave the pockets of generators who buy CO_2 allowances, show up in electricity prices and customer bills, make their way into state expenditure accounts, and then roll out into the economy in one way or another. Our analysis is unique in this way – it focuses on the actual impacts of economic activity: known CO_2 allowance prices; observable CO_2 auction results; dollars distributed to the RGGI states; actual state-government decisions about how to spend the allowance proceeds; measurable reductions in energy

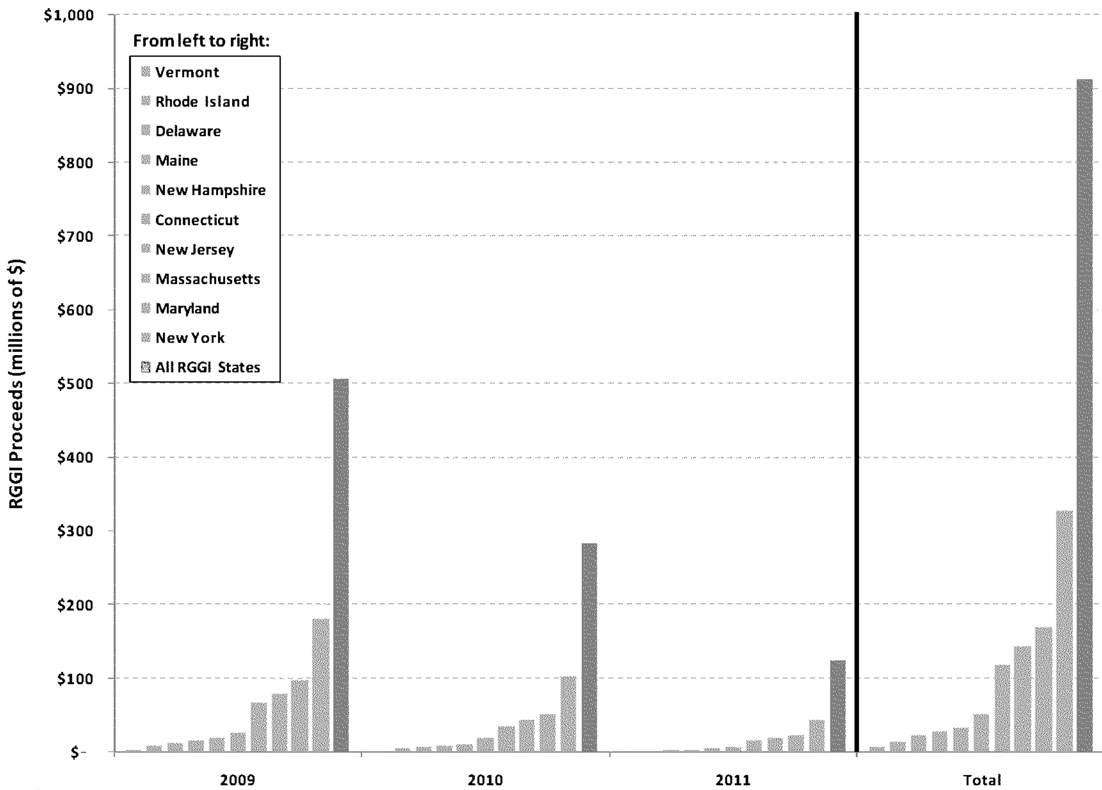
[1] RGGI, Inc. has reported that between 2008 and 2009, electric generation from RGGI-affected electric generation sources decreased by 17.9 million MWh, or 9.1 percent. During that same time period CO_2 emissions from RGGI electric generation sources decreased by 27.6 million short tons, or 18.4 percent. "CO_2 Emissions from Electricity Generation and Imports in the 10-State Regional Greenhouse Gas Initiative: 2009 Monitoring Report," RGGI, Inc., September 14, 2011.

[2] Of the $912 million paid for CO_2 allowances (through 13 auctions from Q3 2008 through Q3 2011 and through a small amount of direct sales to qualifying emitters), 0.7 percent was used for administering the RGGI program; the remaining proceeds were disbursed to the RGGI states.

[3] The foundations are the Merck Family Fund, the Barr Foundation, the Chorus Foundation, and the Henry P. Kendall Foundation.

use from energy efficiency programs funded by RGGI dollars; traceable impacts of such expenditures on prices within the power sector; and concrete value added to the economy. By carefully examining the states' implementation of RGGI to date, based on real data, we hope to provide a solid foundation for observations that can be used by others in future program design and to inform deliberations about RGGI going forward.

Figure ES1
RGGI Allowance Proceeds by State



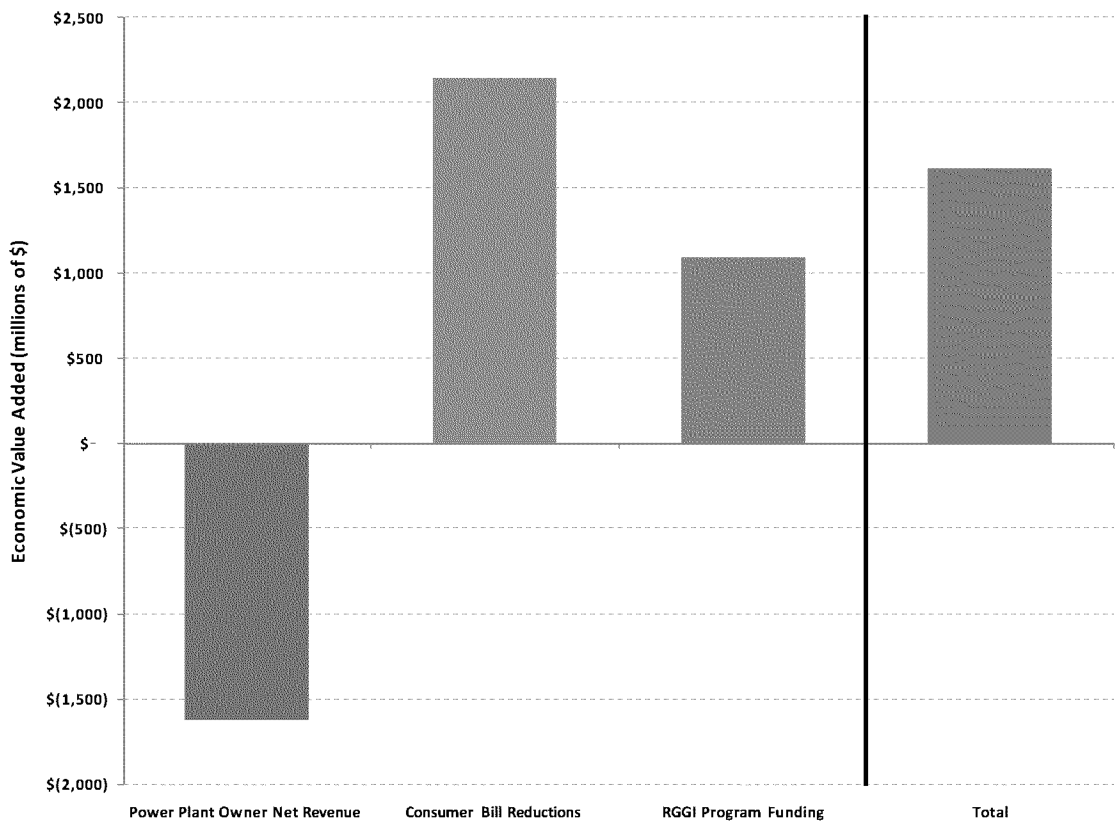
Source: RGGI Inc.
Notes: Figures include Auctions 1-13 and direct sales proceeds for New Jersey (2009) and Connecticut (2009/2010). Auction proceeds from Auctions 1 and 2 are reflected in the 2009 values.

What happened to the dollars? First, RGGI produced $1.6 billion in net present value (NPV) economic value added to the ten-state region.[4] The region's economy – and each state's as well – benefits from the RGGI program expenditures. When spread across the region's population, these economic impacts amount to nearly $33 per capita in the region.[5] Figure ES2 shows the net economic

[4] This reflects a 3 percent social discount rate to put benefits and costs occurring in different time frames into a common reference point, which is 2011. We present results using the public rate in the body of this report, while noting the private rate results and providing further details in the Appendix. All figures show 2011 dollars discounted using a 3 percent social discount rate, unless otherwise noted.
[5] Using a 7 percent private discount rate, RGGI produced $1.0 billion in net economic value, amounting to nearly $21 per capita in the region.

value broken out by the macroeconomic effects of the impacts of RGGI on consumers and power plant owners, as well as effects that flow from direct spending of RGGI allowance revenues.

Figure ES2
Net Economic Impact to States in the RGGI Region (2011$)



Notes: Figures represent dollars discounted to 2011 using a 3% public discount rate.

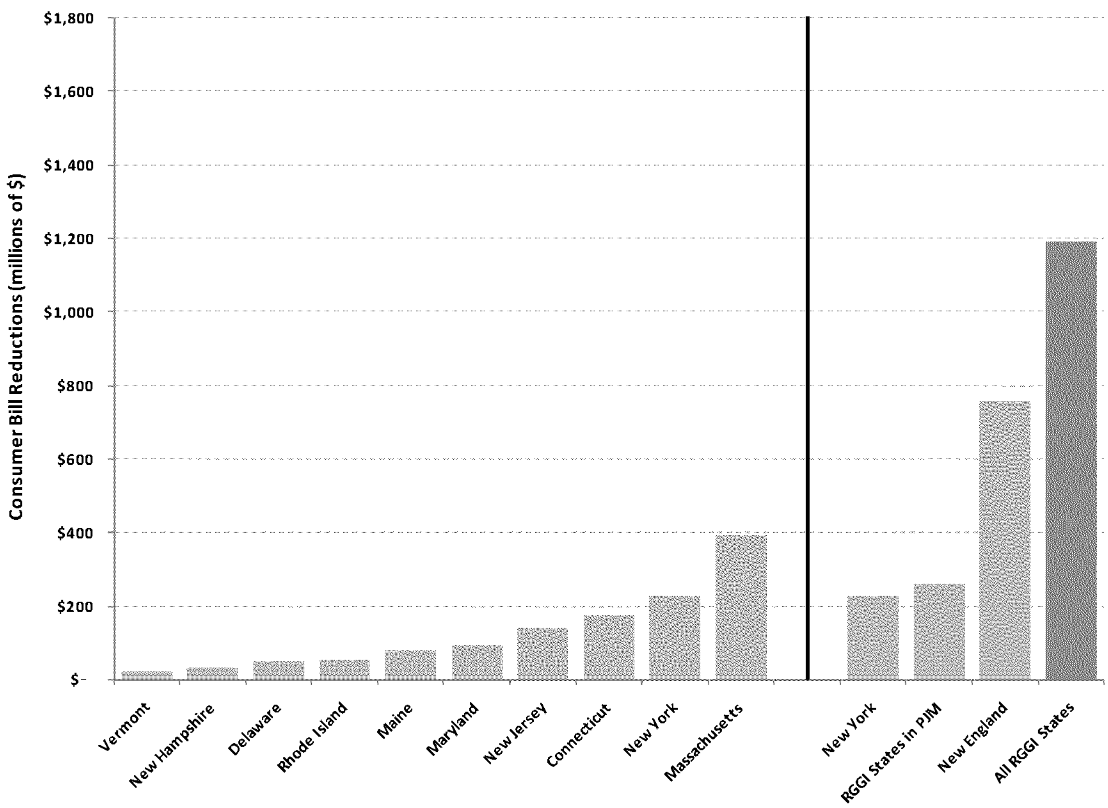
This economic benefit reflects the complex ways that RGGI dollars interact with local economies: the states' use of RGGI auction proceeds on programs leads to more purchases of goods and services in the economy (e.g., engineering services for energy audits, more sales of energy efficiency equipment, labor for installing solar panels, dollars spent to train those installers and educators, and so forth). Together, these dollar flows have direct and indirect multiplier effects locally and regionally.

RGGI has also produced changes in consumers' overall expenditures on electricity. Although CO_2 allowances tend to increase electricity prices in the near term, there is also a lowering of prices over time because the states invested a substantial amount of the allowance proceeds on energy efficiency programs that reduce electricity consumption.[6] After the early impacts of small electricity price

[6] During the 2009–2011 period, we estimate that RGGI increased consumers' overall payments for electricity by 0.7 percent; over the long run, however, this investment, which states used to support a variety of economic activity (of which approximately 48 percent went to

increases, consumers gain because their overall electricity bills go down as a result of this investment in energy efficiency. All told, electricity consumers overall – households, businesses, government users, and others – enjoy a net gain of nearly $1.1 billion, as their overall electric bills drop over time.[7] This reflects average savings of $25 for residential consumers, $181 for commercial consumers, and $2,493 for industrial consumers over the study period. Consumers of natural gas and heating oil saved another $174 million. Figure ES3 shows the net bill reductions to consumers.

Figure ES3
Net Bill Reductions to Consumers (2011$)



Notes: Figures include GE MAPS outputs, non-electric benefit calculations, and capacity market gain calculations.
Figures represent dollars discounted to 2011 using a 3% public discount rate.

Although power plant owners have to purchase CO_2 allowances, they recover all of their early expenditures through the increase in electricity prices during the 2009–2011 period; in the long run, however, RGGI-driven energy efficiency leads to lower sales of electricity, which ends up eroding power plant owners' electric market revenues. On an NPV basis, RGGI means that, in total, the power generation sector will experience a decrease in revenues of $1.6 billion.[8] Figure ES4 shows the

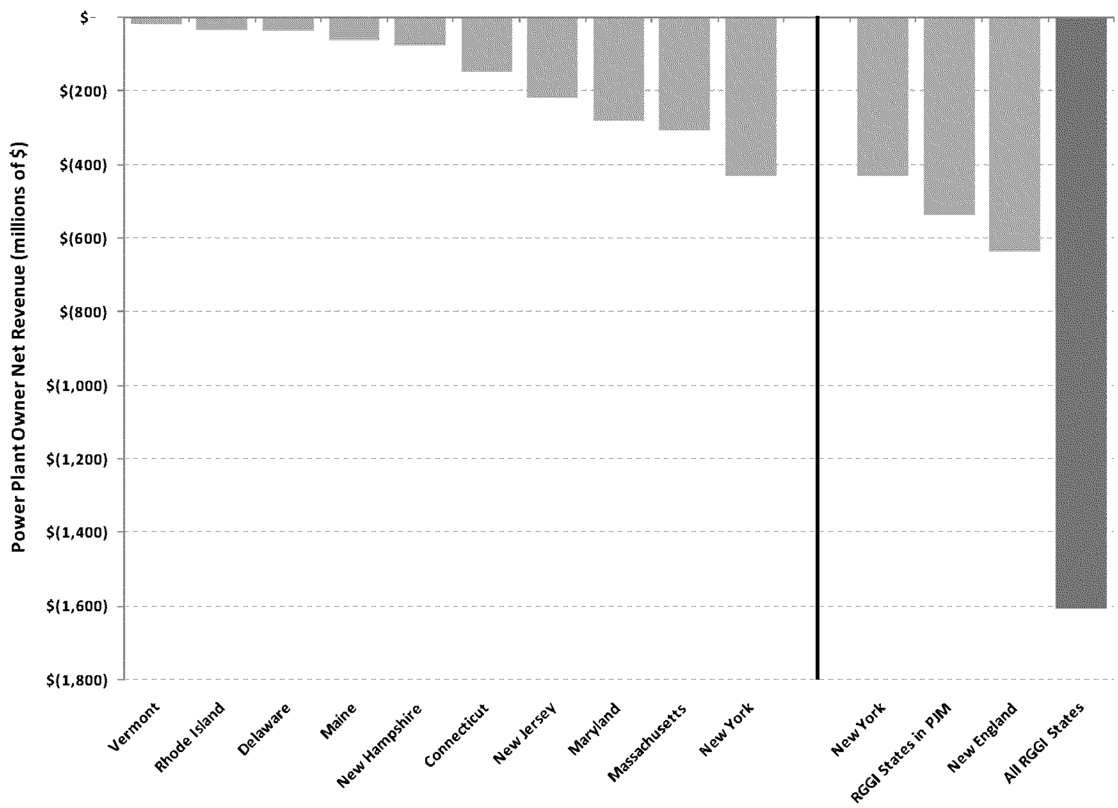
support energy efficiency programs) led to net savings in electricity bills to all consumers in all states, relative to an electric system that did not include RGGI for the 2009–2011 period.

[7] Using a 7 percent private discount rate, RGGI produced an overall net bill reduction of nearly $600 billion to consumers.

[8] Using a 7 percent private discount rate, the decrease in net revenues to power plant owners is $1.3 billion.

net revenue impact on power plant owners. Among the power plant owners, RGGI afforded a competitive advantage to power plants with lower CO_2 emissions.

Figure ES4
Net Revenue Change for Power Plant Owners (2011$)



Notes: Figures include GE MAPS outputs, allowance true-up calculations, and capacity market loss calculations. Figures represent dollars discounted to 2011 using a 3% public discount rate.

Second, the scope of RGGI's positive economic benefits varies by state and region, in large part because the states spent the RGGI allowance proceeds differently.[9] Different expenditures have different multiplier effects in their economies and different impacts on their electric systems. For example, a state's use of RGGI dollars to reduce energy use in the electric sector lightened the early-years' cost impact for electricity consumers by turning the RGGI program into a down payment on lower overall bills for electricity in the longer-term. The New England states, for example, spent much of their RGGI dollars on energy efficiency programs, and so New England's electric system realizes overall benefits from RGGI, even before looking at the macroeconomic impacts. In the other regions, use of RGGI dollars to pay for general-taxpayer-funded programs ends up transferring

[9] Overall, the distribution of spending across the states was as follows: 48 percent on energy efficiency and other utility programs; 20 percent on general fund and other government support; 14 percent on bill-payment assistance to energy consumers; 9 percent on other greenhouse gas programs and program administration; 7 percent on renewable energy projects; and 2 percent on education, outreach, and job training. Individual state's expenditures ranged significantly across these categories.

dollars from the electric system to the other sectors of the economy. The gains in the larger economy (from re-circulating RGGI auction proceeds broadly) offset the negative impacts in the electric sector in these other RGGI states (New York, New Jersey, Delaware, and Maryland (in PJM)).

Also, the ten RGGI states reside in one of three "electrical regions," each with a different generating mix. The extent of a state/region's reliance on natural gas and other forms of low-carbon electric generation (such as nuclear and renewables) lessens the impact of CO_2 allowance purchases on prices. Practically speaking, this means that New York and the New England states experience lower price impacts than Maryland, New Jersey, and Delaware.

Insights and Observations

These patterns, and the others described in more detail in our report, suggest a number of themes emerging from the RGGI experience to date. Some are important for providing the RGGI states with information about how the policy is performing relative to some (but not all) of its original goals. The observations are also relevant to other states and national policy makers if and when they decide to adopt a CO_2 control program.

Mandatory, Market-Based Carbon Control Mechanisms Are Functioning Properly and Can Deliver Positive Economic Benefits

Based on the initial three years of experience from the nation's first mandatory carbon control program, market-based programs are providing positive economic impacts while meeting emission objectives. The pricing of carbon in Northeast and Mid-Atlantic electricity markets has been seamless from an operational point of view and successful from an economic perspective.

The States Have Used CO_2 Allowance Proceeds Creatively – Supporting Diverse Policy and Economic Outcomes

The states' use of allowance proceeds not only provides economic benefits, but also has helped them meet a wide variety of social, fiscal, and environmental policy goals, such as addressing state and municipal budget challenges, assisting low-income customers, achieving advanced energy policy goals, and restoring wetlands, among other things.

RGGI Has Reduced the Region's Payments for Out-Of-State Fossil Fuels

RGGI helped lower the total dollars these states sent outside their region in the form of payments for fuel by over $765 million. Most of the RGGI states' electricity comes from fossil fuels, even though these states produce virtually no coal, natural gas, or oil locally. Since RGGI helped the states lower total fossil-fired power production and lower use of natural gas and oil for heating, RGGI reduced the total dollars sent out of state for energy resources.

The Design of the CO_2 Market in the RGGI States Affects the Size, Character, and Distribution of Public Benefits

The joint decision by the RGGI states to make their CO_2 allowances available to the market through a unified auction ended up generating substantial revenues for public use. This approach transferred emissions rights from the public sector to the private sector at a monetary cost (rather than transferring them for free). Had these allowances been given away for free, the states would not have had the benefit of the auction proceeds, and instead would have transferred that economic value to owners of power plants (which in the RGGI region are merchant generators, not owned by electric distribution utilities). In the end, the combination of the cap level, the design of the auction mechanism, and the depressed economy, reduced the challenge of meeting the RGGI cap, and CO_2 allowance prices decreased over time. Decreasing allowance prices also made it harder for power plant owners to recoup early purchase of higher-priced allowances, and reduced the funding available for public investment.

How Allowance Proceeds Are Used Affects Their Economic Impacts

The RGGI Memorandum of Understanding (MOU) fully anticipates – if not encourages – states to place different weights on economic, environmental, social, energy security, and other goals as they implement the program. But from a strictly economic perspective, some uses of proceeds clearly deliver economic returns more readily and substantially than others. For example, RGGI investment in energy efficiency depresses regional electrical demand, power prices, and consumer payments for electricity. This benefits all consumers through downward pressure on wholesale prices, yet it particularly benefits those consumers who actually take advantage of such programs, implement energy efficiency measures, and lower both their overall energy use and monthly energy bills. These savings stay in the pocket of electricity users. But positive macroeconomic impacts exist as well: the lower energy costs flow through the economy as collateral reductions in natural gas and oil consumption in buildings and increased consumer disposable income (from fewer dollars spent on energy bills), lower payments to out-of-state energy suppliers, and increased local spending or savings. Consequently, there are multiple ways that investments in energy efficiency lead to positive economic impacts; this reinvestment thus stands out as the most economically beneficial use of RGGI dollars. Other uses also provide macroeconomic benefits, even if they do not show up in the consumers' pocket in the form of lower energy bills.

RGGI Produced New Jobs

Taking into account consumer gains, lower producer revenues, and net positive macroeconomic impacts, RGGI led to overall job increases amounting to thousands of new jobs over time. RGGI job impacts may in some cases be permanent; others may be part-time or temporary. But according to our analysis, the net effect is that the first three years of RGGI led to over 16,000 new "job years,"[10] with

[10] In the context of the entire workforce in the ten-state RGGI region, 16,000 new job-years is small (about 1/10th of one percent of the total employment in September 2011). But considering the fact that the ten states' civilian labor force dropped by 73,400 from September 2010

each of the ten states showing net job additions. Jobs related to RGGI activities are located around the economy, with examples including engineers who perform efficiency audits; workers who install energy efficiency measures in commercial buildings; staff performing teacher training on energy issues; or the workers in state-funded programs that might have been cut had a state not used RGGI funds to close budget gaps.

Timing Differences in Program Costs versus Benefits Affects Results

Lags between CO_2 allowance auctions and the expenditure of allowance proceeds back into the economy can significantly delay the realization of benefits. The delay stems from the time it takes RGGI, Inc. to administer allowance auctions and transfer proceeds to states, for the states to distribute funds to the program agencies and make grants to recipients, and then for the grant recipients to put those funds to productive use in the economy. Inevitably, the various steps in this programmatic chain follow after the time period in which the purchases of allowances end up in electricity prices. Because the first step of transferring auction proceeds to the states occurs quite quickly, deliberate efforts by states to re-circulate the funds back into the economy as quickly as possible could reduce the lag and increase the economic returns of the RGGI program.

A Region's Pre-Existing Generating Mix Affects Economic Impacts

Since power generation resources have different CO_2 emission impacts – with coal-fired generation having higher combustion-related CO_2 emissions than other electricity generating resources – the amount of coal in a particular state's generating mix affects the costs of the RGGI program. Even so, every state experiences net positive benefits from RGGI, including in the more coal-heavy region (i.e., in the PJM states, New Jersey, Delaware and Maryland).

RGGI's First Three Years of Program Investments Point to Some Best Practices

Based on our review of state program investments, it is clear that some states' practices can serve as best practices for others. First, speeding up the timing of when RGGI auction proceeds are used reduces the lag between CO_2 costs showing up in electricity prices and the time when benefits begin to flow to the region. Second, re-circulating RGGI auction proceeds back into the economy in the form of energy efficiency programs can dramatically increase the value of the RGGI program for electricity consumers and for the larger economy. Finally, standardizing the collection, measurement and verification of data on RGGI dollar flows could significantly improve the ability to quickly translate program lessons into improved program design. Our economic impact analysis involved significant effort to collect, organize, and process the data on how states disburse and spend RGGI allowance revenues and on the character of program impacts on various recipients in the larger economy. Greater consistency in data collection and reporting would add more transparency and accountability for these expenditures.

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to September 2011 (from 25,165,100 to 25,091,700), the number of RGGI-related jobs (or, conversely, the potential loss of thousands of additional jobs absent RGGI) is significant. Source: Bureau of Labor Statistics, http://www.bls.gov/news.release/pdf/laus.pdf.

2. THE REGIONAL GREENHOUSE GAS INITIATIVE

Overview and Purpose

Starting with the first auction of CO_2 allowances in 2008, ten states in the Northeast and Mid-Atlantic regions initiated RGGI, a multi-state market-based program to reduce emissions of CO_2.[11] The program created the country's first mandatory program to cap emissions of CO_2 from power generation sources, with the cap set initially at 188 million short tons of CO_2 annually across the ten-state RGGI region. The regional cap is apportioned to states in a manner based generally on emissions from the affected sources (fossil fuel power plants that are 25 megawatts or over in size), and in accordance with specific state allowance budgets agreed upon by the states. As originally designed, the cap would decline by 2.5 percent per year beginning in 2015, to reach an overall reduction of 10 percent of CO_2 emissions by 2018.[12] Although they had the option to distribute allowances for free, the states decided to distribute the vast majority of CO_2 emission allowances into the market through a centralized auction, administered by RGGI, Inc., the non-profit organization they set up to run the program.

The states developed the RGGI program over several years, starting in late 2003, in order to begin to address the risks associated with climate change. The specific goal of RGGI is to seek stabilization and reduction of CO_2 emissions within the signatory states, based on the conclusion among state signatories that: (1) climate change is occurring; (2) it poses serious potential risks to human health and the environment; (3) delay in addressing CO_2 emissions will make later investments in mitigation and adaptation more difficult and costly; and (4) a market-based carbon allowance trading program will create strong incentives for the development of lower-emitting energy sources and energy efficiency, and reduce dependence on imported fossil fuels.[13]

Market-Based Mechanism

RGGI is a market-driven emissions control program. Similar to that of other market-based programs administered for control of nitrogen oxides (NO_x) and sulfur dioxide (SO_2), the foundation of the RGGI program is an annual cap on emissions of CO_2 in aggregate for all affected sources. Affected or "regulated" sources in a given state generally include all fossil-fueled electric power generators with a capacity of equal to or greater than 25 megawatts. Program compliance is relatively straightforward: shortly after the end of each 3-year compliance period (with the first being 2009–2011), every affected source must retire a number of allowances equal to the total tons of CO_2 emissions from the source over the three-year period (one allowance equals one ton of emissions).

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[11] The ten states are Connecticut, Delaware, Massachusetts, Maryland, Maine, New Hampshire, New Jersey, New York, Rhode Island, and Vermont. On May 26, 2011 New Jersey announced its intention to withdraw from the RGGI program, at the end of 2011. Baxter, Christopher, "Gov. Christie Announces N.J. Pulling Out of Regional Environmental Initiative," May 26, 2011, http://www.nj.com/politics/index.ssf/2011/05/gov_christie_to_announce_nj_pu.html.

[12] Information on RGGI is drawn from various fact sheets on the website of RGGI, Inc., the non-profit organization established by the states to administer the RGGI program. http://www.rggi.org/design/fact_sheets.

[13] Regional Greenhouse Gas Initiative Memorandum of Understanding, December 20, 2005, pages 1-2.

The states' selection of a market-based control program for CO_2 emissions from the power sector reflects the history and success within this region of market-based programs established under the federal Clean Air Act for control of SO_2 and NO_x emissions. It is also a natural fit for the electric industry given the ease with which allowance costs can be rolled into competitive wholesale electricity market price signals. This mechanism allows prices to reflect CO_2 emissions, leading over time to industry operational decisions (relating to power plant dispatch) and investment decisions that reflect the most efficient long-run compliance path for the industry. In this context, the use of a market-based control program for CO_2 encourages efficiency in power dispatch decisions and long-run efficiency for achieving compliance with the market-based cap on emissions.[14]

The CO_2 emissions cap is administered through limiting the quantity of allowances issued for a given year. For example, 188 million allowances were available for the year 2009. The owners of affected power plants generally obtain CO_2 allowances by purchasing them through the initial auctions (held quarterly), or by purchasing/transferring them in a secondary market.[15]

RGGI allows for flexible compliance in a number of ways. First, recognizing the long-lived nature of CO_2 in the atmosphere, compliance is required not annually, but on a three-year basis. That is, sources can purchase, bank, and use allowances bought at any auction for a given compliance period within the three-year compliance period, and need only demonstrate compliance (through retiring allowances in amounts equal to emissions) shortly after the end of that same period. Second, sources can meet up to 3.3 percent of their CO_2 compliance obligation through the purchase of offsets – greenhouse gas (GHG) reduction projects outside the power sector.

Allowance Disbursement to the RGGI States

Allowances are made available primarily through central auctions that are conducted quarterly by RGGI, Inc. on behalf of the RGGI states. An independent market monitor assesses the auctions to ensure that they are administered according to auction rules, and that there is no anti-competitive behavior in the market. Approximately 99 percent of allowances are initially distributed via RGGI auctions, with the remainder sold directly by selected states (Connecticut and New Jersey) to qualifying affected sources. Participation in the auctions is open to any company or person meeting qualification requirements (e.g., financial security requirements), with a ceiling of 25 percent placed on purchases by a single buyer or group of affiliated buyers in each auction. Proceeds from the quarterly auctions – which are determined by quantities sold and auction clearing price (subject to a reserve (floor) price that is currently \$1.89 per allowance) – are distributed to states, and states determine how to use the funds.

[14] In all three of the power regions where RGGI states are located, the wholesale power market has evolved over time into a comprehensive electricity market construct (including energy, capacity, and ancillary services) that shapes the dispatch of power plants in an efficient and reliable way in real time as well as affecting the near-term and long-term price signals for the addition of new generating capacity. These regions are centrally administered wholesale markets operated by three entities: ISO-New England (for the six New England states); the New York Independent System Operator (NYISO) (which is a single-state market); and PJM (for New Jersey, Delaware and Maryland, along with 10 other states and the District of Columbia outside of the RGGI MOU).

[15] In addition, Connecticut and New Jersey disburse a small amount of allowances through direct sales to qualifying emitters.

The initial auction occurred in September 2008, before the commencement of the compliance period in 2009; all 12.56 million allowances offered for sale were sold at a single clearing price of $3.07 per allowance.[16] The most recent auction as of this writing occurred in September 2011, with approximately 18 percent of the 42.19 million allowances offered for sale selling for $1.89 per allowance.[17] Thus during the first compliance period, allowance auction prices trended downward and ultimately reached the reserve price level, due primarily to the decrease in emissions associated with diminished economic output and lower-than expected power sector demand.

Use of Auction Proceeds and Other Allowance Revenues

The use of auction proceeds varies by state, consistent with enabling state legislation, regulation, and policy. Examples of how the states used their funds include investment in energy efficiency programs, investment in community-based or private-sector installation of renewable or advanced power generation systems, direct reductions in electricity bills, funding of state government operations through allocation to state general funds, education and job training programs, and administration of the RGGI program or other greenhouse gas reduction initiatives. How states have used the auction proceeds during the time period reviewed in this study (that is, the first compliance period, 2009–2011) is discussed in detail below.

RGGI Program Review

The RGGI program was designed with a number of specific elements of review and evaluation. In particular, the RGGI agreement provided for a comprehensive program review in 2012, which is currently underway. The comprehensive program was designed to review, at a minimum, program success and impacts, imports and emissions leakage, the integrity of the offset program, and whether additional reductions beyond 2018 should be implemented.

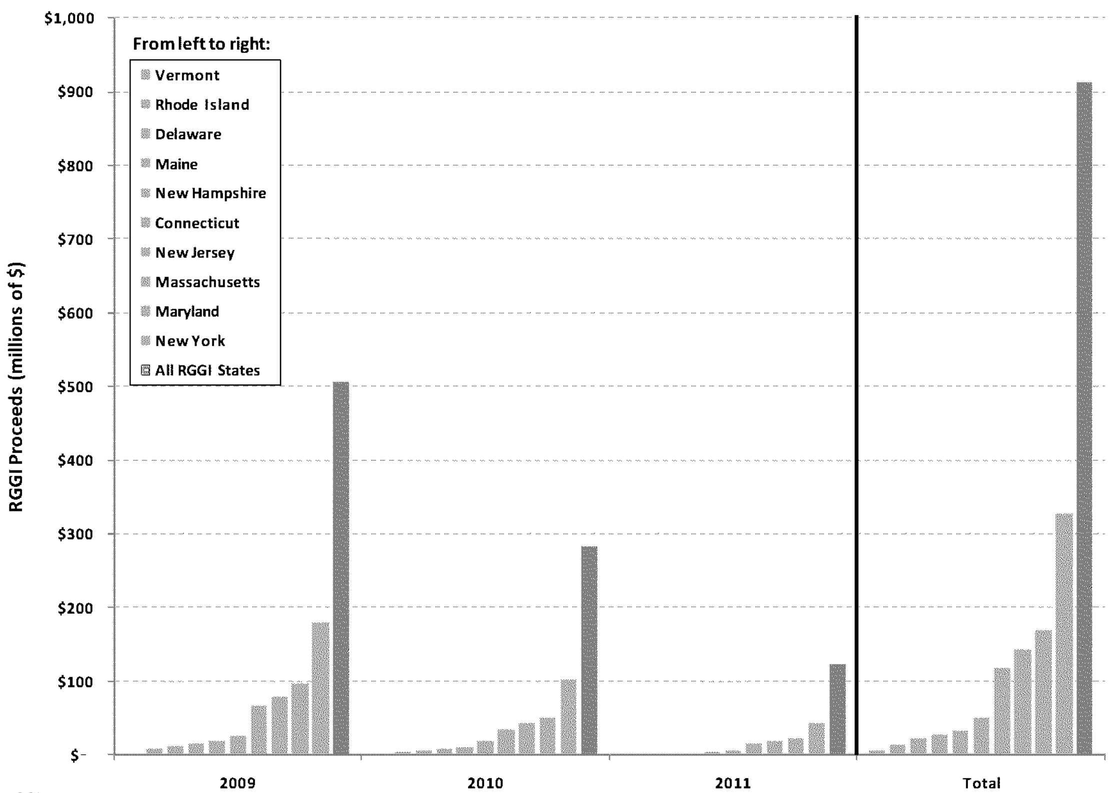
[16] http://www.rggi.org/docs/rggi_press_9_29_2008.pdf.
[17] http://www.rggi.org/docs/Auction_13_Release_Report.pdf.

3. STUDY METHOD OF ECONOMIC IMPACTS OF RGGI PROGRAM TO DATE

Overview

From Q3 2008 through the present, the auction or direct sale of RGGI CO_2 emission allowances has resulted in the collection and disbursement to states of nearly $1 billion. See Figure 1.

Figure 1
RGGI Allowance Proceeds by State



Source: RGGI Inc.
Notes: Figures include Auctions 1-13 and direct sales proceeds for New Jersey (2009) and Connecticut (2009/2010). Auction proceeds from Auctions 1 and 2 are reflected in the 2009 values.

The purpose of our analysis is to follow this money and identify the economic impacts of its use. Namely, we track the path of RGGI-related dollars as they leave the pockets of power plant owners who buy CO_2 allowances, show up in electricity prices and customer bills, make their way into state expenditure accounts, and then roll out into the economy in one way or another. This analysis is unique in this way: it focuses on the actual impacts of economic activity; known CO_2 allowance prices; observable CO_2 allowance proceeds ($912 million); dollars distributed to the RGGI states; actual state-government decisions about how to spend the allowance proceeds; measurable reductions in energy use from energy efficiency programs funded by RGGI dollars; traceable impacts of such expenditures on prices within the power sector; and concrete value added to the economy. By carefully examining the states' implementation of RGGI to date, based on real data about both the expenditures inside and outside of the electric sector, and value added from RGGI program implementation, we track the extent to which RGGI program implementation represents a positive or negative impact on the economies of the RGGI states.

There were five major elements of our review, each of which is discussed in more detail in the sections that follow:

1. We first established the **scope and overall framework of the analysis**, to create as much as was possible an integrated analytic framework that separates and highlights RGGI-state impacts based on known historical program implementation data (i.e., during the first compliance period), from other factors and impacts outside the region or associated with forecasts or projections. This scope of analysis thus included modeling of actual funds received and spent by the states, and actual impacts on electricity markets, as well as an assessment of the impacts of RGGI program expenditures on the larger economy. The analysis aimed at providing a better understanding of uses of funds by developing a number of illustrative case studies to provide some indication of the wide variety of programs that have been funded in the first compliance period.
2. Next we conducted a thorough review of **data and information on use of revenues collected from the sale of RGGI allowances**. These data were gathered from public sources: RGGI, Inc. reports, RGGI state agency documentation, and other industry documents and studies of the RGGI program. We used these data to develop a comprehensive catalogue of how each state used its RGGI allowance proceeds, and supplemented this effort through comprehensive interviews with and collection of data from representatives of implementing agencies in the RGGI states. The purpose of this step was to track with as much accuracy as possible exactly how RGGI revenues have been allocated and disbursed over the first compliance period, how disbursed funds were used, and what the impacts were of associated program implementation. Part of this analysis resulted in information about the use of allowance proceeds that affected activity in the electric sector (e.g., how expenditures on energy efficiency programs affected the level of energy use in various portions of the day and in different seasons of the year) and in other parts of the economy (e.g., how those same energy efficiency programs affected buildings' use of oil or natural gas for heating purposes; how different program expenditures provided job training, purchases of equipment, and so forth, as described further below).[18]
3. Third, we modeled **electric sector outcomes** from both the incurrence of increased costs associated with affected facilities' compliance obligations (namely, the purchase of allowances and pricing of power consistent with those CO_2 allowance costs), and the effect of changes in electric generation and demand associated with the use of funds to spur

[18] These various uses of allowance proceeds are described in the Appendix.

investment in energy efficiency and advanced energy technologies. Our electric sector analysis was conducted using the GE Multi-Area Production Simulation (MAPS) model.[19]

4. Fourth, we modeled **macroeconomic outcomes**, combining electric sector outcomes – positive and negative – with expenditures in all sectors of the economy associated with the use of RGGI funds in the ten states. This produced an overall picture of how RGGI program implementation has affected the economy, including multiplier effects associated with the impacts on consumer electricity payments, power plant owners' costs and revenues, and the flow of RGGI-related dollars through other sectors of the economy. Our macroeconomic analysis was conducted using the IMPLAN model.[20]
5. Finally, we identified and collected information on specific examples of how RGGI funds were spent, and produced 11 **case studies** designed to provide an illustrative cross-section of how programs resulted in actual impacts on households, community, companies, and others in the RGGI region. These cases reveal only a small sampling of how the states used RGGI proceeds, the larger effects of which are tracked in the macroeconomic analysis.[21]

It is clear from our program research and results that different investment vehicles have vastly different impacts from both economic and non-economic perspectives. Because our analysis focuses only on economic impacts, it does not shed light on all of the objectives and outcomes of the RGGI program (e.g., addressing climate change risk, etc.).

Scope of Analysis

Overview

In order to carry out our analysis of economic impacts of RGGI, we ran power system dispatch and macroeconomic models under two scenarios: the "RGGI case," which is effectively the world as it actually evolved; and the counterfactual "no-RGGI case," which involves changes to model inputs and assumptions to create conditions as if the RGGI program never happened. The difference in economic impacts between the two cases reflects the incremental impacts of the RGGI program to date.

In constructing the scope of our analysis, we were guided by three key objectives: First, we wanted to focus on impacts only within the RGGI states (the geographic perspective). Second, we wanted to identify near-term and longer-term impacts associated with RGGI's implementation during the first compliance period only (2009–2011) (the temporal perspective). Third, we wanted results that were grounded as much as feasible in actual, known expenditures, programs, and impacts (the empirical perspective).

[19] The MAPS model and our analysis of electric sector impacts are described in detail in the Appendix.
[20] The IMPLAN model and our analysis of macroeconomic impacts are described in detail in the Appendix.
[21] The case studies, along with the full list of all RGGI program grants we considered, are in the Appendix.

From a geographic perspective, we focused our analyses on the activities and impacts exclusively within the RGGI states. While some money from RGGI spending that flows outside of the RGGI states affects the economies of states outside the RGGI region (for example, for the manufacture of light bulbs or insulation used in energy efficiency programs, or flows of dollars to the federal government associated with changes in income), we did not try to capture or report those impacts in our analysis. Similarly, in the power system modeling, our evaluation of impacts on power plant owners (also referred to as producers or generators here) and energy consumers was limited to those located within RGGI states.

From a temporal perspective, we focused our analysis on the first RGGI compliance period. We tracked the impacts of RGGI-related dollars associated with the first three years of implementation. This means that we included in power pricing the cost to power producers of obtaining RGGI allowances in the first three years, and we included in power and economic sectoral investments only RGGI revenues that were collected during the first three years of the program.

Focusing on these initial three years of RGGI dollars required incorporating nuanced timing adjustments. We tracked actual dollars collected from power producers during the 13 auctions that have occurred to date: these 13 auctions took place from Q3 2008 through Q3 2011. The funds from these auctions flowed to the states immediately, with states spending them (or programming them for expenditures) during the 2009–2012 time period. Within the electric system, the impacts of these initial auctions show up during the 2009–2011 period, as power plant owners priced the value of CO_2 allowances into prices they bid in regional wholesale markets. The macroeconomic impacts occur over the time period that allowance proceeds are spent (2009–2012), but there are tail-end effects associated with the imprint of energy efficiency expenditures made during that period on energy use for the following decade (through 2021). We thus track these direct effects of RGGI to date in the near term (i.e., the first compliance period), and in the long term track indirect impacts from expenditure of RGGI dollars by the states (for energy efficiency expenditures from 2009–2012, and from the implications of those energy efficiency measures on electricity use from 2009–2021).

Consequently, from the perspective of modeling data and assumptions, we focus our analysis on known quantities associated with actual results from the first three years. That is, we do not forecast allowance prices; we use actual allowance prices as they revealed themselves through the auctions. We do not estimate future program revenues, since we were focused on actual RGGI auction proceeds to date. We do not project how future revenues will be spent by states, since we rely entirely upon how the states have actually decided to spend allowance proceeds received to date. We make no assumptions about states' participation in RGGI going forward. Nor do we project impacts associated with programs funded through RGGI dollars collected in future years.

The goal of our analysis is thus to identify economic impacts associated with historical implementation: known allowance prices and revenues; known distribution of revenues to states; actual or committed expenditures associated with state proceeds; and observable impacts associated with past or current RGGI-funded program implementation. In this sense, our analysis should be viewed as a snapshot of impacts associated with a finite period – the initial compliance period – of RGGI program administration, and not a projection or forecast of how RGGI may, could, or should evolve. To accomplish our goal, however, we did have to establish what these programs meant from an economic perspective, in order to create the "no-RGGI" counterfactual case, against which to compare the actual economy that included RGGI during the 2009–2011 time period.

Data Collection and Processing

Overview

Our analysis began with the collection and processing of data related to RGGI program implementation in each of the ten states. Identifying and tracking the use of RGGI proceeds is fundamental to our analysis, yet it was somewhat challenging due to the newness of the RGGI program, as well as to the complexity of tracing dollars through each state's different administrative channels. This process also involved the translating of expenditures for energy efficiency measures into impacts on power system energy consumption and electricity peak loads in various seasons and days of the year.

In each state in the past three years, RGGI funds sometimes supported new programs in many functional areas of state government. In most cases, even the underlying state laws and regulations governing administration of the RGGI program were new, and the states needed to set up new programs with new state employees in new divisions. Reporting procedures and records had to be established and put into effect. All of that has affected the availability and form of program-specific information from the states.

In the end, we were able to obtain most of the necessary information from the states. Where information was missing or incomplete, we took successively deeper steps (including follow-up interviews with agency staff and reviews of enabling legislation and regulations) to fill in data holes, sort out inconsistencies, and arrive at a workably complete data set for use in the study.

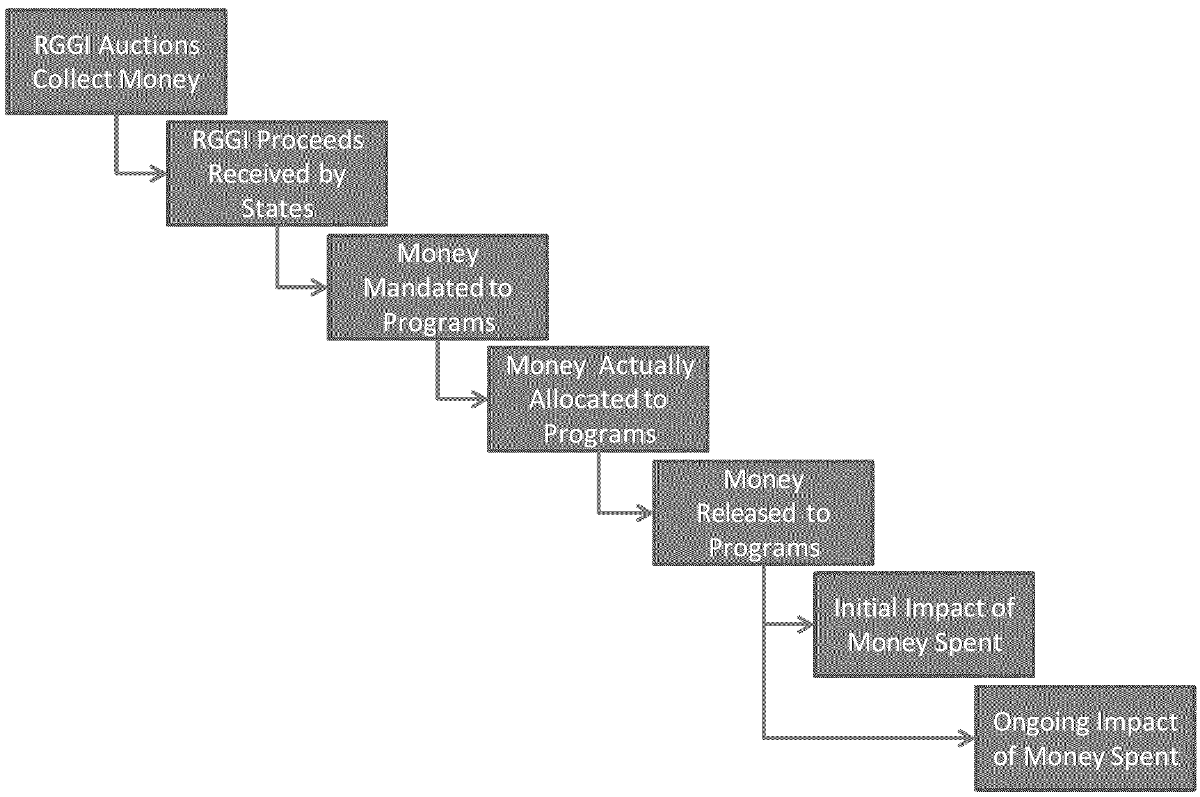
Data Gathering

Our data gathering and processing effort focused on identifying the use of RGGI allowance proceeds in as complete and accurate a manner as possible, to ensure a good match between revenues collected and expenditures tracked. We gathered, processed, and audited the data using a methodological approach that "follows the money" through the sequence of steps that begin with the creation of a pot of auction proceeds that then goes to the states for programming and expenditure through grants of one form or another (see Figure 2). Once we were able to track monies into different expenditure pots, we then processed the result for input into the MAPS and IMPLAN models.

Approach

The first anchor point for our data analysis is the level of revenues collected through the quarterly auctions of allowances ($900.6 million), and through the direct sale of allowances ($11.8 million). This was the target amount of revenues that, in the end, we needed to match up with state program expenditures. Our first point of data collection and verification with states was with the collection of revenue information related to sales of allowances into the market, and then allocation of those revenues to states. Total revenue allocations to states are shown in Figure 1.

Figure 2
Representation of Dollar Flows from RGGI Auctions through State Spending Impacts



Much of the challenge in data collection and verification involved tracking the flow of money once received by the states through various programs, channels, and agencies. Once we knew the amounts allocated and released by states to programs, we then tracked dollar flows to determine whether and how the dollars were actually disbursed. We traced and categorized in some detail the actual use of program dollars for funding to various types of recipients, activities, measures, or completed installations (e.g., numbers of energy efficiency measures by type of measure and by type of customer).

Finally, we identify the effects of the funded activities, programs, and investments. By "effects," we mean the tangible results of the expenditures that are significant or important from the standpoint of measuring economic impact through the MAPS and IMPLAN modeling effort. For example, what are the annual household electricity savings, on- and off-peak, associated with an appliance rebate program to replace old air conditioners with new, efficient ones? How many MWh of generation will flow annually from a solar photovoltaic system installed on a capped municipal landfill using RGGI dollars? Identifying such effects involved (1) collecting data and estimates by states on such effects, (2) reviewing and processing these estimates for consistency of assumptions and calculations across states for similar programs, and (3) applying "best-practice" estimation methods where data across states were missing, incomplete, or inconsistent.

Process

Our process for cataloguing the collection, allocation, disbursement, and use of RGGI allowance revenues involved three basic steps:

- We first collected and reviewed all data on RGGI program expenditures and on estimated effects of RGGI-funded programs from all public sources. The public sources of information were RGGI, Inc., the state agencies, and various publicly available reports on the RGGI program.
- We organized and recorded the data in a manner designed to achieve consistency in data documentation across the states. Based on this step, we developed a survey to support the gathering of data from states to fill in where there were holes in reported data gathered from public sources.
- Using the existing public data and survey information collected through interviews with state officials, we obtained all of the remaining data available, and organized it for consistency. Since the information came from many sources, the data reflected varying levels of detail, requiring us to process the data to place expenditures into consistent spending categories across the RGGI states, and to format the data for input into the MAPS and IMPLAN models.

Based on our review of the data, the similarities in spending vehicles across RGGI states, and the levels of disaggregation needed for model inputs, we divided program spending into six categories. These categories are described below, and expenditures by category for each electric market region (New England, New York, and PJM RGGI states[22]), as well as for the entire RGGI footprint, are presented in Figures 3 through 6.

1) *General Fund/State Government Funding* – includes money used to fund state agencies, programs, and other expenses not necessarily tied to RGGI program activities, through use of RGGI allowance revenues as a contribution to meeting overall state budget requirements.
2) *Energy Efficiency and Other Utility Programs* – described further below.
3) *Renewable Investment* – includes grants to programs and investments focused on the development, distribution, and installation of renewable or advanced energy technologies (e.g., a program to support installation of rooftop photovoltaic systems).
4) *Education, Outreach, and Job Training* – includes monies used for programs (i) to educate business and residential consumers about energy consumption and the

[22] As described in further detail below, the ten RGGI states are located in three electrical regions: the six New England states are together part of the unified electric grid/market administered by the ISO-New England; New York has a single-state wholesale market/grid; and Delaware, Maryland and New Jersey are part of a larger electrical market administered by PJM.

availability of programs to reduce consumption, and (ii) train workers with new skills and knowledge in industries and activities that contribute to lowering energy use (e.g., energy efficiency measure installation) or the production and distribution of renewable or other advanced energy technologies.

5) *Direct Energy Bill Assistance* – includes use of RGGI funds to reduce bills paid by consumers for electricity and heating/cooling. Most significantly, investments in this category were targeted to low-income households.

6) *Other GHG Reduction Programs and Program Administration* – The GHG reduction programs include a variety of expenditures aimed at reducing GHG emissions [such as research and development grants for carbon emission abatement technologies, direct investment in "green" start-up companies, direct GHG emissions reduction measures (e.g., efforts to reduce vehicle miles traveled and programs to increase carbon sequestration), climate change adaption measures and investments in existing fossil-fuel fired power plants to make them cleaner and/or more efficient (e.g., installing pollution controls and installing technologies to increase plant efficiency)]. RGGI Program Administration refers to RGGI auction proceeds used by each RGGI state to cover costs associated with the administration of the state's CO_2 Budget Trading Program and/or related consumer benefit programs.

Because so much of the RGGI funds were spent on energy efficiency ("EE") measures, and because different measures lead to different impacts on consumers' demand for electricity, we grouped information on energy efficiency programs into several expenditure categories. This enabled us to use the data at a more granular level in the MAPS and IMPLAN models. EE categories include the following:

É Audits and Benchmarking – Expenditures associated with the energy auditing function (initial visits to homes or businesses to provide some initial EE measures and to refer the owner to additional EE programs and/or to estimate self-funding measures) and the measurement and verification of energy use and program impacts to guide future program design.

É Installations and Retrofits – The vast majority of EE funds involved direct expenditures for installations and retrofits. Within this category, we collected data by program type (e.g., residential retrofit, residential new construction, appliances, commercial retrofit, commercial new construction). Disaggregation of information at this level was needed to be able to assign "load profiles" to the various types of EE programs for modeling program load reductions in the MAPS model.

É Demand Response and Management of Consumption – Expenditures on demand response measures, smart meters, and the use of other technologies designed to manage customer consumption of electricity in response to various supply conditions. This includes programs where there is a dispatch signal provided to a consumer of electricity to modify consumption under certain conditions, technologies that inform consumers about electric price signals (which may lead to modified behavior), and other programs that can shift or curtail loads.

Figure 3
Summary of RGGI Proceed Spending
All RGGI States

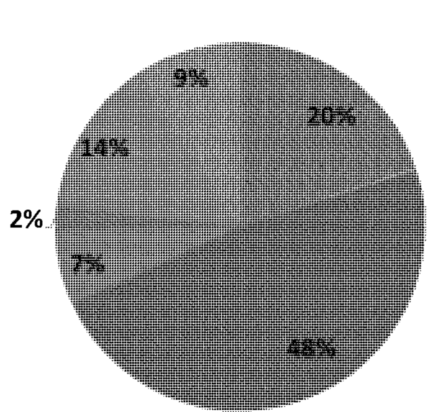


Figure 4
Summary of RGGI Proceed Spending
New England

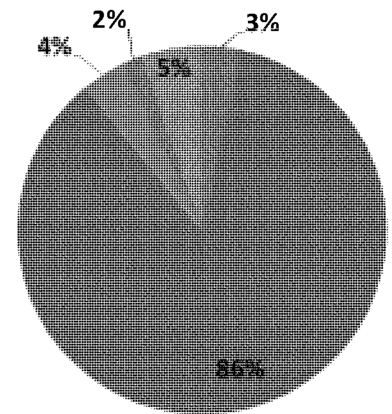


Figure 5
Summary of RGGI Proceed Spending
New York

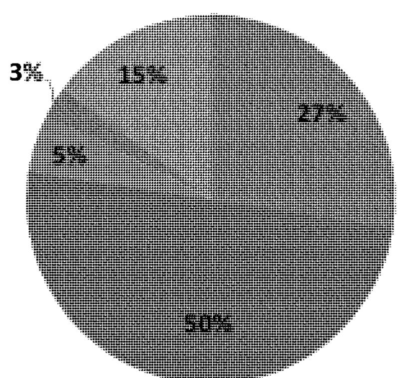
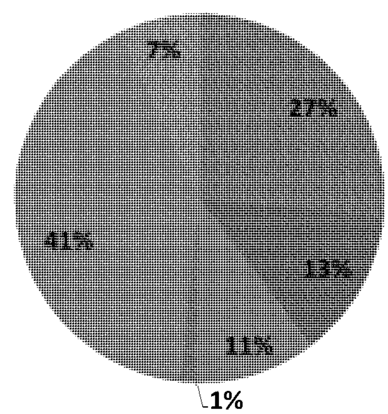


Figure 6
Summary of RGGI Proceed Spending
RGGI States in PJM



General Fund/State Government Funding
EE and other Utility Programs and Audits & Benchmarking
Renewable Investment
Education & Outreach and Job Training
Direct Bill Assistance
GHG Programs and Program Administration

Source: Individual state reports and interviews.
Note: Certain grant programs may include multiple components, and are categorized in the figure above based on the largest share of spending.

The amounts of funds spend by program category by region (and in the ten RGGI states as a whole) are show in Table 1, below.

Table 1
Spending of RGGI Proceeds by State and Category

	General Fund/State Government Funding	EE and other Utility Programs and Audits & Benchmarking	Renewable Investment	Education & Outreach and Job Training	Direct Bill Assistance	GHG Programs and Program Administration	Total
Connecticut	$ -	$ 37,667,961	$ 10,705,482	$ 337,290	$ -	$ 3,020,516	$ 51,731,248
Maine	-	22,831,749	-	-	-	4,398,768	27,230,517
Massachusetts	-	133,960,304	325,324	3,108,774	17,083	5,093,587	142,505,072
New Hampshire	9,272,116	21,483,151	-	1,181,506	-	998,939	32,935,712
Rhode Island	-	13,210,854	-	314,528	-	744,155	14,269,538
Vermont	-	6,496,814	-	-	-	102,630	6,599,444
New England Subtotal	**$ 9,272,116**	**$ 235,650,833**	**$ 11,030,806**	**$ 4,942,097**	**$ 17,083**	**$ 14,358,596**	**$ 275,271,531**
New York	$ 90,000,000	$ 163,660,609	$ 16,800,000	$ 8,600,000	$ -	$ 48,588,106	$ 327,648,716
New York Subtotal	**$ 90,000,000**	**$ 163,660,609**	**$ 16,800,000**	**$ 8,600,000**	**$ -**	**$ 48,588,106**	**$ 327,648,716**
Delaware	$ -	$ 13,977,755	$ -	$ -	$ 1,663,210	$ 6,809,816	$ 22,450,780
Maryland	7,770,000	26,840,847	5,471,340	4,181,160	115,465,494	9,871,582	169,600,424
New Jersey	74,950,622	-	27,089,246	-	10,185,525	6,069,154	118,294,547
RGGI States in PJM Subtotal	**$ 82,720,622**	**$ 40,818,602**	**$ 32,560,586**	**$ 4,181,160**	**$ 127,314,229**	**$ 22,750,552**	**$ 310,345,751**
All RGGI States	**$ 181,992,738**	**$ 440,130,044**	**$ 60,391,392**	**$ 17,723,257**	**$ 127,331,312**	**$ 85,697,254**	**$ 913,265,997**

Source: Individual state reports and interviews.
Note: NY dollars include interest earned in addition to proceeds from the RGGI auctions.

Modeling Approach

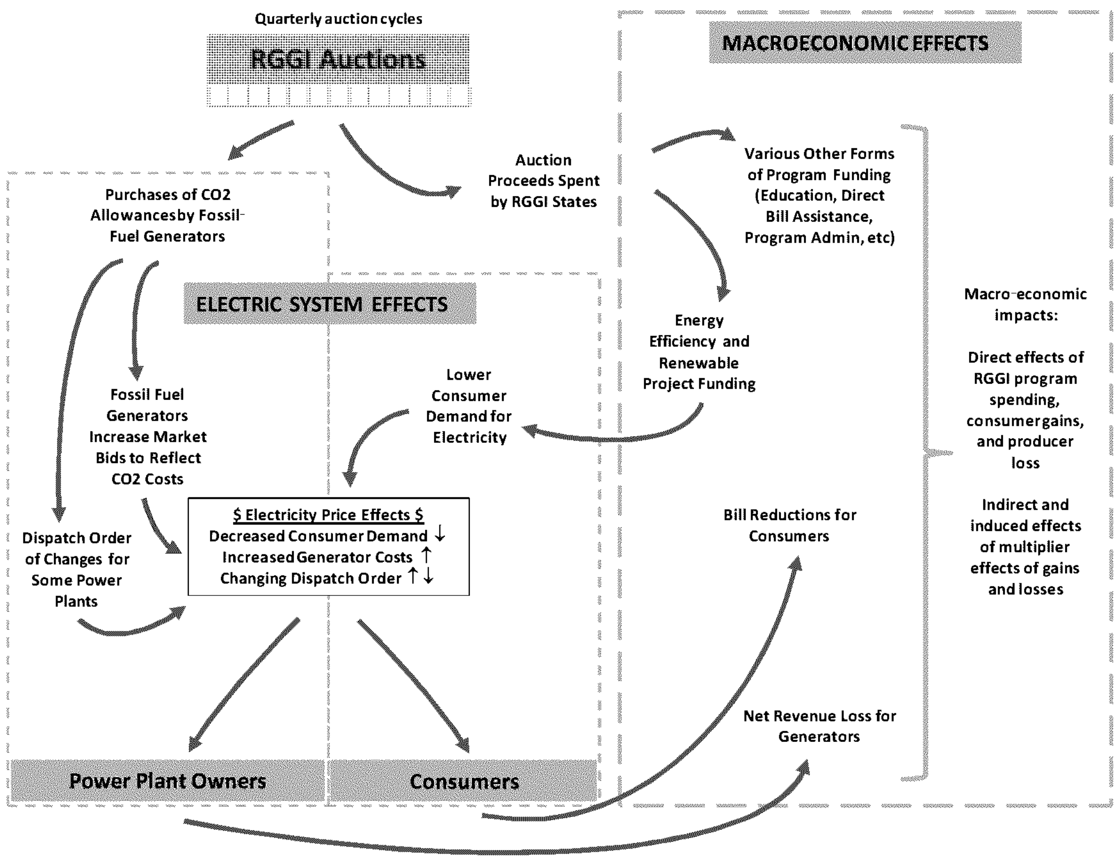
Overview

Given that our goal was to track the impact on the economy of the states' use of RGGI allowance proceeds, we needed to construct a counterfactual electric system that did not reflect RGGI funding and develop an analysis that followed the RGGI funds through the economy. We provide the details of our assessment tools in the Appendix, which describes the IMPLAN and MAPS models in greater detail.

With respect to impacts on the general economy, RGGI allowance proceeds have two effects. First, when the states use RGGI proceeds to fund an activity (such as energy efficiency), those monies have a direct impact in the form of purchases of goods and services in the economy. Second, the compliance obligation and the use of RGGI proceeds create changes in the power sector, in the form of changes in power plant owners' costs, prices bid into wholesale electricity markets, and consumer spending for power. In aggregate, these changes in spending lead to revenue gains and losses (to power plant owners) and gains and losses (to consumers), which, in turn, affect economic flows in the macroeconomy.

To estimate these impacts on the economies of RGGI states, we model changes to the electric system and macroeconomic outcomes. The general flow of data and modeling outcomes is depicted in Figure 7.

Figure 7
Flow of Data and Modeling Outcomes



Our modeling approach combines analysis of power sector affects (through modeling using MAPS), and analysis of macroeconomic effects (through use of IMPLAN). The foundation of our modeling analysis is, in effect, a comparison between two scenarios run through the models. In the IMPLAN analysis, we start with economic relationships that exist among providers and users of goods and services in the ten RGGI states, and then we introduce the direct expenditures (RGGI proceeds) and the revenue gains and losses to electricity consumers and power producers. In the MAPS model, we run a dispatch of the ten-states' power systems "with" and "without" RGGI, and include in each run the same core conditions: power system infrastructure both in place and as it evolves over the modeling period (that is, transmission configurations and power plant additions and retirements); local and regional forecasts of electric energy and peak load by service territory over the modeling period; projections of fuel prices and allowance prices for NO_x and SO_2; etc.

The two cases in MAPS can be described as follows:

É RGGI Scenario – In the RGGI scenario, the power system is modeled as is. That is, the RGGI case represents the world as it has evolved with RGGI in place and operating. It includes all of the programs, measures, investments, and funding that are associated with the first three years of RGGI program implementation, and all of the impacts on the power system and economy associated with the use of RGGI funds.

É No-RGGI Scenario – In order to create the counterfactual against which we compare and contrast the RGGI case, we create a scenario configured to represent the power system and economy as it would have progressed absent expenditure of RGGI-related dollars. In order to do this, we relied on all of the data and representations of RGGI investments and associated effects described in the previous section, and removed those investments and effects from the RGGI scenario.

We then traced the dollar differences in these two MAPS runs (with and without RGGI) through the macroeconomic IMPLAN model to capture the impacts of these electric sector outcomes; we also injected funds related to the states' direct expenditures of RGGI program dollars in IMPLAN.

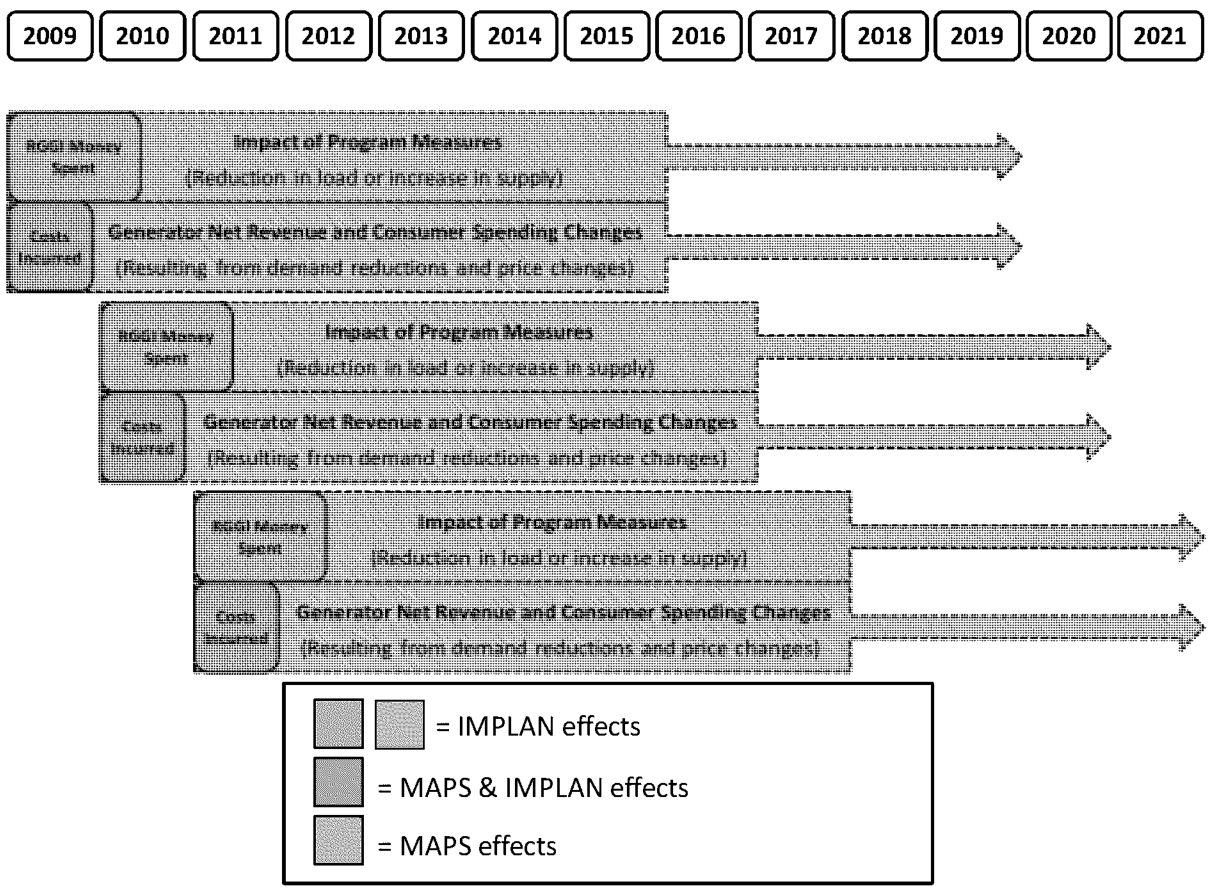
Modeling Timeframe

Figure 8 captures in schematic form how RGGI program costs and effects are represented in the MAPS and IMPLAN modeling. More detail on how the modeling is carried out is presented in the Appendix, but in summary the items to note in this figure are the following:

1. The 13 auctions (Q3 2008 through Q3 2011) provide CO_2 allowances into the markets, which are then used by affected power plant owners during the first compliance period from 2009–2011. During this period, CO_2 allowances affected the prices at which fossil-fueled power plant owners offered to supply their power into regional electric energy markets, with offer prices also tied to their fuel cost (e.g., natural gas or coal or oil), variable operations and maintenance expense, and generating efficiency (heat rate). At times (when the affected producers are on the margin) the cost of CO_2 allowances increases the wholesale price for power – and thus electricity costs – to all customers. These effects are represented as red blocks in Figure 8. This incremental impact of CO_2 prices in electricity markets stops after this first three-year period; that is, our analysis does not make any assumption about the RGGI program going forward, which is important for isolating the effects of the first three years of the program.
2. The money collected from CO_2 allowance sales (from Q3 2008 through Q3 2011) are spent on various programs. These expenditures are represented as blue blocks in Figure 8. (Note that the lag between revenue collection from auctions in the first three years and program expenditures by the states means that some portion of revenues collected during that period is actually spent in the economy in 2012, with programming of the monies by the states reflecting decisions made in 2011. Consequently, the blue blocks extend into 2012.) These expenditures are one-time events in those years – program administration, rate relief to electric utility ratepayers, construction, maintenance or purchases, energy efficiency program implementation, energy audits or measurement, verification and benchmarking, education

investments, etc. These all represent single purchases or expenses that *directly* affect economic activity only in the year in which they occur.

Figure 8
Representation of RGGI Program Costs and Impacts through MAPS and IMPLAN Modeling



3. Some of these one-time expenditures (e.g., on CO_2 allowances, on purchases of electricity, on expenditures of RGGI-funded activities) lead to impacts (e.g., energy use, energy costs, energy savings) beyond the year of incurrence. This results fundamentally from the use of RGGI funds on energy efficiency and new renewable generating capacity. Once made, such investments continue to produce reductions in load or shifting of generation for many years beyond the investment. This in turn affects how RGGI expenditures to date affect (a) current-period and later-term revenues to owners of power plants (which, over the long term, realize negative impacts in the form of decreased revenues due to producing less power because demand is lower compared to the "no RGGI" case) and (b) current-period and later-term expenditures on electricity (and natural gas and oil for heating purposes) by consumers (who realize lower wholesale electricity prices and lower energy bills in the "with RGGI" case).

These long-term impacts of one-time expenditures are reflected both in changes to power system dispatch over the period of study and changes in economic activity over the same time period.

By constructing the analysis in this way, we were able to isolate our measurement of impacts to "known" outcomes, with the assessment grounded in known information from the first compliance period, and with impacts limited to those occurring in the RGGI states.

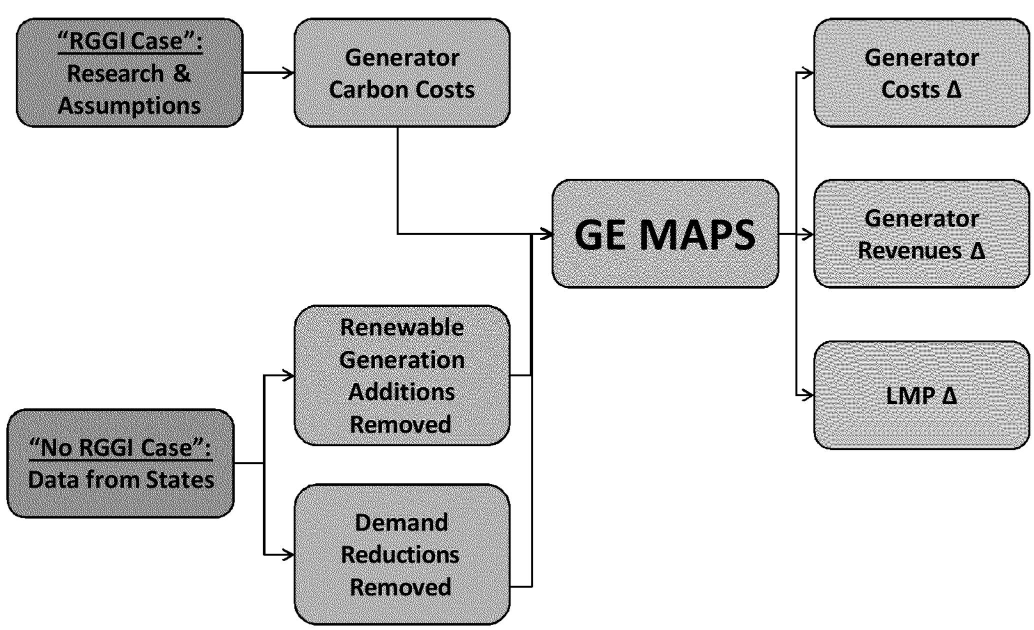
In the following sections, we summarize the power system and macroeconomic models, and highlight a few key factors of the modeling approach that help to interpret the results.

Power Sector Analysis

RGGI has two primary effects in wholesale power markets. First, marginal power prices are at times increased by the additional CO_2 allowance cost to affected (fossil-fired) power generating facilities. Second, load, demand, and marginal prices are at times decreased by energy efficiency measures installed with the use of RGGI allowance proceeds.

Using the MAPS power system dispatch simulation model, we quantified these net impacts on regional and local system loads, power prices, and revenues to power producers associated with implementation of the RGGI program. (See the Appendix for a detailed description of the MAPS modeling platform, whose core logic is explained briefly below.) These relationships are summarized in Figure 9. Using MAPS, we created the "with RGGI" case (benchmarking the modeling results to the actual electric output) and then constructed a counterfactual "no-RGGI" case. Comparing the results of the two cases provided information about the incremental effect of RGGI on power system users and producers.

Figure 9
Diagram of MAPS Modeling Inputs and Outputs



Traditional cost-minimizing strategies in the dispatch of power systems involve use of production-cost information to determine which power plants operate at different times of the day to meet changing load conditions. In competitive wholesale electric market regions like the Northeast and Mid-Atlantic regions, decisions on which power plants to turn on and off are made based primarily on bids submitted by power plant owners indicating the price at which they are willing to supply power into the markets. Provided the market is sufficiently competitive, price bids should approximate marginal production costs of the facilities in the system. Generally, prices in wholesale markets are set hourly based on the last generating unit dispatched – that is, the most expensive unit that was needed to meet hourly load.

The GE MAPS power system model is configured to comprehensively simulate the dispatch of the power system on an hourly basis based on power plant marginal costs, subject to various operational and transmission system constraints that can alter dispatch order (and thus prices) in real time. The MAPS model simulates system dispatch based on, and reflecting: (1) the operational characteristics and marginal production costs of every generating facility in the power region being studied (in this case, New England, New York, and PJM); (2) the configuration of, and limits on transfers of power across, the transmission system, comprising every transmission line and other system components in place; and (3) algorithms designed to reflect the operational constraints of power plants, such as the time it takes to start units and to ramp them up to various power levels, the minimum time they must be on, and the minimum time they must be off. Given the level of detail in how MAPS represents the power system – that is, down to very small power plants and specific transmission system components and limits – it is able to model and represent power prices, unit output, emissions, consumer costs, producer revenues and other factors on an hour-by-hour basis, and with a high degree of geographic resolution (that is, down to a utility's service territory, or a specific substation).

Given this level of detail, we are able to model investments in energy efficiency and the development of new generation using RGGI funds at a detailed state- and utility-specific level. This allowed us to capture the impact of such investments on the prices that consumers pay – and that power producers are paid – on hourly and locational bases. As shown in Figure 9 above, we simulated the dispatch of the three regional power systems that contain the RGGI states for each hour of the modeling period (January 2009 through December 2021) for both the "with RGGI" and "no-RGGI" cases. Based on the output of those two cases, we calculate changes in (1) unit dispatch, (2) wholesale electric prices, (3) payments to power producers, and (4) payments by consumers.

We used the MAPS output and associated calculations of changes in generator and consumer prices, revenues, and payments in two ways. First, the data are used to describe the impacts on generators and consumers from the perspective of the electric system only – that is, how much more or less do power plant owners get paid as a result of RGGI program investment effects? How much more or less do consumers pay for electricity as a result of RGGI program investment effects? How does that differ by state and region? How do these electric system impacts change with time? The impact on power plant owners and consumers associated with the RGGI program – which is focused on the electric sector only – is an important consideration in program design and effectiveness.

Additionally, we used the output data from MAPS as inputs to the IMPLAN model. From a macroeconomic perspective, the end result of changes in power system costs, revenues, and payments are (a) changes in economic conditions for power plant owners (affecting their ability to spend and save in the general economy), and (b) changes in the level of disposable income enjoyed by consumers as a result of RGGI (e.g., relating to their having higher or lower electric bills), which affects their spending and saving in the general economy. Consequently, changes in these two factors serve as inputs to the general economic model (described below), along with other categories of RGGI program investment.

Macroeconomic Model

As previously noted, changes in power producer revenues and consumer incomes associated with electric system impacts lead to these larger direct and indirect impacts in the economy as a whole. Other economic impacts also need to be taken into account: those related to the actual direct spending of RGGI auction proceeds by government agencies (and in turn, indirectly by the recipients of the RGGI-funded grants). Additionally, these other impacts result from the multiplier effects of these changes in consumer income and producer revenues and from the purchases of goods and services in the economy by those who receive RGGI-related grants from the states.

Consequently, in order to model macroeconomic impacts, we combine the changed revenues and spending that come from the MAPS model with all categories of the direct investment of RGGI allowance revenues in the macroeconomic model, IMPLAN. The relationship between MAPS and IMPLAN, and the source of additional inputs to IMPLAN, are shown in Figure 7 (and explained in more detail in the Appendix).

IMPLAN is a social accounting/input-output model that attempts to replicate the structure and functioning of a specific economy, and is widely used in public and private sector economic impact analyses. It estimates the effects on a regional economy of a change in economic activity by using baseline information capturing the relationships among businesses and consumers in the economy based on historical economic survey data that track flows of money through the economy. IMPLAN tracks dollars spent in a region, including dollars that circulate within it (e.g., transfers of dollars from consumers to producers), dollars that flow into it (e.g., purchases of goods and services from outside the local economy), and dollars that flow outside of it (e.g., payments to the federal government). The model thus examines inflows, outflows, and interactions within the economy under study.

The IMPLAN model allows one to investigate interactions in the RGGI region and the individual states within it, and to calculate various economic impacts in that economy when a new activity (such as investments in energy efficiency, use of funds for government programs supported by the general fund, assistance in helping customers pay their energy bills, or lost revenues for owners of power plants) involves money flows around the economy. Specifically, the model captures various impacts, including:

É *Employment impacts* (the total number of jobs created or lost);

É *Income impacts* (the total change in income to employees that results from the economic activity); and

É *"Value-added" impacts* (the total economic value added to the economy, which reflects the gross economic output of the area less the cost of the inputs).

In our analysis, we report employment impacts but focus primarily on the "value-added" impacts produced by the model, reflecting the combination of the following economic effects of the change in money flow associated with RGGI:

- *Direct effects:* the initial set of inputs that are being introduced into the economy. In our study, this included the direct effects of RGGI on owners of power plants as a whole, on energy "consumers" (end users of electricity, natural gas and heating oil), and use of RGGI proceeds to buy goods and services in the economy (e.g., investment in energy efficiency, work training programs, contributions to the general fund, bill payment assistance for low-income consumers).
- *Indirect effects:* the new demand for local goods, services and jobs as a result of the new activity, such as the purchase of labor to retrofit buildings with energy efficient measures, or to train workers in these skills. Some RGGI auction proceeds lead to payments for things outside the local region (e.g., the purchase of efficient lighting equipment or solar panels manufactured outside of the RGGI region), and thus represents a way that such funds do not stay within the local economy after having been generated by power plant owners' purchases of CO_2 allowances.
- *Induced effects:* the increased spending of workers resulting from income earned from direct and indirect economic activity.

Modeling Factors

To calculate the impacts of RGGI, we needed to make a number of simplifying assumptions about the systems and economies that we are studying. These assumptions relate to: (1) the relevant (geographic, temporal) boundaries around the analysis, (2) the methods for putting dollar flows occurring during different time periods into a common economic framework; (3) key modeling parameters in the power system; and so forth. We highlight a few of these below.

Focus on the First Compliance Period

First, the analysis assumes neither pricing for carbon nor any additional RGGI-funded investments in energy efficiency or generation beyond the program's first compliance period. For modeling purposes alone, and in order to isolate the incremental effects of the first three years of RGGI, we made no assumptions about RGGI continuing beyond 2011. Further, we do not assume that there is a price on carbon through other regional, state, or federal legislation at any point during the modeling period (through 2021). Neither assumption should be interpreted as a judgment or expectation about the likelihood one way or the other of continued RGGI program implementation, or the emergence of a national carbon pricing regime. Constructing the analysis in this way limits the impact on power plant owner revenues and consumer savings associated with continued increases in energy efficiency and new carbon-free generation investments relative to what will actually result over time, should RGGI continue forward in some form in the region.

Discount Rate

Our analysis involves the assessment of costs (e.g., expenditures and investments, decreases in revenues) and benefits (e.g., lower electricity bills for consumers, added value in the economy) that occur in different periods of time. We examine the flow of dollars associated with the purchase of CO_2 emissions allowances in 13 RGGI auctions that took place in Q3 2008 through Q3 2011, the impact of these allowances in electricity prices in 2009–2011, and the impact of RGGI-funded programs on electric system outcomes and the macroeconomy from 2009–2021. Thus, the study period, in one way or another, spans from 2008–2021.

To compare these benefits and costs properly, we discount all dollar flows into net present values as of 2011. We calculate the net present value by applying an appropriate discount rate to dollar flows in different years, and then subtracting the sum total of discounted costs from the sum total of discounted benefits.

Our analysis requires choosing an appropriate discount rate, one that must reflect the preferences for money today versus in the future for various constituencies – power producers, who are largely private enterprises, consumers (e.g., households, businesses, government energy users), and others. RGGI-funded activities add value to the macroeconomy of a wide range of actors in the Northeast and Mid-Atlantic region. Choice of appropriate discount rate needs to properly reflect the opportunity costs of these various private and public entities in society.

We have chosen to use two discount rates, as recommended in situations where an analysis involves money flows to various entities in society over different periods of time, especially when "there is a significant difference in the timing of costs and benefits, such as with policies that require large initial outlays or that have long delays before benefits are realized."[23] First, we calculate net present values using a "social" or public discount rate of 3 percent. Second, we also calculate net present values using the opportunity cost of capital to private entities (at 7 percent).[24] These choices are described in more detail in the Appendix.

In our results, we do not choose one or the other discount rate as being the one appropriate for review and interpretation of RGGI's economic impacts. Since the use of RGGI allowance proceeds has some characteristics that would suggest use of the public rate, yet others that would suggest use of the private rate, we present results using the public rate in the body of this report, while noting the private rate results and providing further details in the Appendix. Importantly, while the use of different rates affects the magnitude of impacts we found, in no case does the use of one rate over the other qualitatively change our findings.

Timing of Economic Impacts that Affect the Power Sector

The focus on actual expenditures and impacts in only the first three years of program implementation, in combination with the application of a social and private discount rate, ends up highlighting the fact that RGGI benefits lag behind RGGI costs. The costs show up in electric system impacts to consumers in the first three years of the program, with benefits flowing to them over the entire study period

[23] "Guidelines for Preparing Economic Analyses," U.S. Environmental Protection Agency, EPA 240-R-10-001, December 2010, page 6-5 (hereafter, "EPA Guidelines").
[24] EPA Guidelines, page 6-23.

(through 2021). Conversely, the benefits flow to owners of power plants early on, with outer-year effects diminishing those net positive revenues received in the first compliance period.

Indeed, there is a significant lag between the incurrence of costs in the "with RGGI" case and the timeframe in which installation of energy efficiency measures funded through RGGI allowance revenues begin to affect demand, supply, and prices in the outer years.

Representation of Energy Efficiency Programs

A significant percentage of RGGI allowance proceeds went to funding investments in energy efficiency programs across the RGGI states. Programs included auditing and benchmarking efforts, investments in retrofit measures for existing homes (e.g., window and door treatments, insulation); residential lighting and appliance change-out (replacing refrigerators, washers, dryers or air conditioners with more efficient ones); commercial building shell, lighting, and equipment replacement; and new building measures (e.g., funding for more efficient materials and appliances at the time of new construction).

Given these various uses of RGGI funds for EE, there are two major analytic challenges in the MAPS modeling effort: First, we needed to determine an assumed duration or lifetime for savings from particular measures (for example, for how long does installation of insulation continue to produce savings?). Second, we needed to develop a way to map annual energy and peak load savings onto estimates of impacts on load in every hour of the year.

In all of the RGGI states where EE programs are in place, there is substantial documentation of estimates of annual energy savings and, in some cases, contributions to reductions in peak loads. There is a long history of EE implementation and measurement and verification efforts to support engineering and statistical estimates of how the installation of a given EE measure actually translates into annual savings, distribution of savings across the hours of the year, and measure lifetimes. We relied on this literature to calculate the lifetime and load-impact characteristics of the various EE programs funded by RGGI dollars.

Where available, we reviewed on a program-by-program, measure-by-measure basis, the estimates of measure lives developed by states and utilities and currently used in programs, based on the past few decades' of experience in administering EE programs. We calculated weighted average measure life assumed by states and utilities across the range of measures, and found that virtually all programs have measure lives in excess of ten years; on average, measure lives were 12–13 years. In our modeling, we conservatively truncated measure savings at ten years.

In some areas of the RGGI region, states have estimated how EE-related savings break down on a seasonal basis (summer or winter) and on a daily basis (on- or off-peak). Based upon a review of these estimates where available, we developed representative distributions of savings across seasonal and daily categories, and assigned annual energy savings to a given distribution on a company-by-company and program-by-program (and in some cases, measure-by-measure) basis.

Using these characterizations of EE program impacts, we calculated hourly adjustments to load for each EE program, and in aggregate for all programs used these to adjust hourly load in the MAPS model.

4. RESULTS

Overview

Although the RGGI program was developed in response to concerns over the socioeconomic and environmental risks associated with climate change, our analysis focused exclusively on economic impacts of the program as a result of its first three years of operation. Thus, it sheds light only on economic issues, and does not address the many other objectives that underpinned the RGGI states' adoption of the program.[25]

By contrast with the approach used in many other allowance trading programs (such as ones developed under the Clean Air Act for SO_2 and NO_x emissions), the RGGI states decided to distribute virtually all of the CO_2 allowances through quarterly auctions, with auction revenues distributed to states in accordance with the RGGI state budget allocation.[26] Auctioning allowances and distributing allowance proceeds to states in this way had an important impact on program outcomes since it meant, in effect, that the public benefitted by transferring the value of allowances to market at market prices (rather than for free, as was done in the SO_2 and NO_x allowance programs). The decisions to distribute allowances in this manner reflected complex decisions by each state which allowed for the use of auction proceeds to pursue specific energy- and non-energy-related public policies there was an opportunity to both address some of the potential cost impacts of RGGI program implementation, and to pursue other key public policy objectives.

The first 13 RGGI auctions produced $912 million dollars. This sum includes just over $900 million from the auctioning of allowances, and just under $12 million from the direct sale of allowances to affected sources.[27] These allowances revenues were distributed to (or held by) states in the following amounts:

[25] The RGGI States' Memorandum of Understanding ("MOU") has a preamble that recognizes the common objectives of the states' own policies "to conserve, improve, and protect their natural resources and environment in order to enhance the health, safety, and welfare of their residents consistent with continued overall economic growth and to maintain a safe and reliable electric power supply system." Additionally, the MOU declares as common goal of the states of "reducing our dependence on imported fossil fuels will enhance the region's economy by augmenting the region's energy security and by retaining energy spending and investments in the region…" Additionally, the original RGGI MOU starts with the states' premises that: (1) climate change is occurring; (2) it poses serious potential risks to human health and the environment (including severe droughts and floods, changes in forests and fisheries, sea level rise); (3) delay in addressing greenhouse gas emissions will make later investments in mitigation and adaptation more difficult and costly; and (4) a market-based carbon allowance trading program will create strong incentives for the development of lower-emitting energy sources and energy efficiency, and reduce dependence on imported fossil fuels. RGGI States' Memorandum of Understanding, December 20, 2005, pp. 1-2.

[26] Where allowances were not distributed via auction, they were sold directly to affected sources, again retaining the value of the allowances sold for public purpose.

[27] This includes all revenues collected from allowance auctions and direct sales through the first 13 auctions. The fourteenth and final auction in the first compliance period is scheduled to happen on December 7, 2011, and so could not be accounted for in our analysis.

- $52 million for Connecticut
- $22 million for Delaware
- $27 million for Maine
- $170 million for Maryland
- $143 million for Massachusetts
- $33 million for New Hampshire
- $118 million for New Jersey
- $327 million for New York
- $14 million for Rhode Island
- $7 million for Vermont

See Figure 1 for proceeds received in each year by the ten states.

These dollars ended up having three types of economic impacts:

1. *Impact on the general economy.* This is the "bottom line" result of our analysis. These impacts include effects on overall economic value in the RGGI states from the following economic losses and gains:
   - the direct investment of RGGI allowance proceeds in various economic sectors (such as spending in government agencies, payments to individuals for training and educational initiatives, and direct payments to consumers of electricity, direct payments to builders and contractors installing energy efficiency measures or renewable systems); and
   - the *net* impact on power plant owner revenues and electricity consumer payments tied specifically to changes in the price of power and the quantity of power generated/consumed as a result of reinvesting dollars to reduce energy consumption or increase non-emitting generation.

   These economic "value added" impacts flow from both the direct effect of injecting RGGI dollars into various economic sectors, and the additional effects that flow from additional – or secondary – economic activity "induced" by the effects of direct injection of RGGI dollars.
2. *Impact on the electric sector.* These are observable impacts, which are part of the large impacts on the general economy noted above. Electric sector impacts include overall changes to power plant owner revenue streams (from increased costs for obtaining and using CO_2 allowances and changes in the price and quantity of power sales); and overall changes to payments by consumers for the purchase of electricity (from decreased consumption and changes in market prices).
3. *Other effects.* These include changes in employment and payments for fuel that flow from the impacts of the use of RGGI allowance revenues in the electric system and general economy.

Impacts

Our high-level results for each of the ten states, and for the RGGI region as a whole, are summarized in Table 2. This summary points out the bottom line: RGGI has produced positive economic outcomes for each state and for the region as a whole.

Table 2
Summary of Economic Impacts, by RGGI State and Region
Discounting Dollars Using a Social Discount Rate

		Value Added[1] (millions of $)	Employment[2]
Connecticut	$	189	1,309
Maine		92	918
Massachusetts		498	3,791
New Hampshire		17	458
Rhode Island		69	567
Vermont		22	195
New England Subtotal	**$**	**888**	**7,237**
New York	$	326	4,620
New York Subtotal	**$**	**326**	**4,620**
Delaware	$	63	535
Maryland		127	1,370
New Jersey		151	1,772
RGGI States in PJM Subtotal	**$**	**341**	**3,676**
Regional Impact[3]	$	57	601
Grand Total	**$**	**1,612**	**16,135**

Notes:
[1] Value Added reflects the actual economic value added to the state and regional economies, and therefore does not include the costs of goods purchased from or manufactured outside of the state or region.
[2] Employment represents job-years as outputted from IMPLAN.
[3] Regional Impact reflects the indirect and induced impacts resulting within the RGGI region as a result of state dollar impacts.
[4] Results are discounted to 2011 dollars using a 3% social discount rate.

The RGGI States Together

Impact on the General Economy

Overall, RGGI's first compliance period produced a net present value economic benefit of $1.6 billion, using a public discount rate.[28]

Generally speaking, this positive impact results from: the positive direct and induced impacts associated with the injection of RGGI dollars into economic goods and services; the net positive impacts associated with consumer savings on electric and non-electric energy supply expenditures; and the net negative impacts associated with a loss of power plant owner net revenues from allowance purchases and power

[28] Using a 7 percent private discount rate, the NPV benefit is $1.0 billion.

system dispatch and price effects (see below). The first two more than offset the latter, resulting in a net positive economic benefit.

Impact on the Electric Sector

From a consumer perspective, RGGI program impacts are net positive over the study period. Although CO_2 allowances tend to raise electricity prices in the near term,[29] there is also a lowering of prices over time because the states invested so much of the allowance proceeds on energy efficiency programs. RGGI expenditures on energy efficiency programs increase the opportunities for consumers to reduce their energy use and their energy bills. This occurs primarily for electricity, but also for fuel consumed for heating. Lower overall electric load levels resulting from RGGI-funded energy efficiency places downward pressure on electricity prices and energy payments for all electricity consumers, relative to a no-RGGI case. After the early impacts of small electricity price increases, consumers gain because their overall electricity bills go down as a result of this investment in energy efficiency. All told, electricity consumers overall – households, businesses, government users, and others – enjoy a net gain of nearly $1.1 billion, as their overall electric bills drop over time.[30]

This reflects average savings of approximately $25 for residential consumers, $181 for commercial consumers, and $2,493 for industrial consumers over the study period. Consumers who participate in an energy efficiency program funded by RGGI proceeds actually experience a level of savings much higher than the average savings for all consumers.

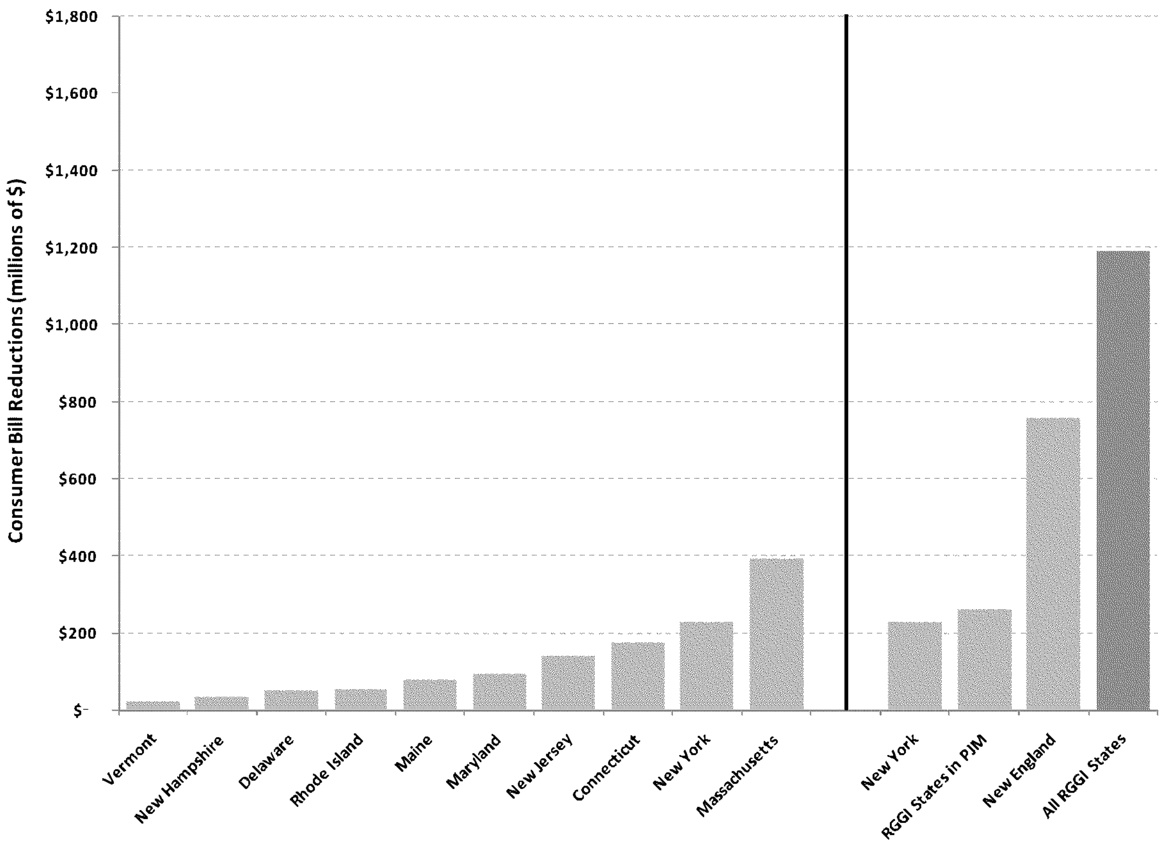
Note, that due to the energy efficiency programs supported by RGGI funds, energy consumers also save nearly $174 million through RGGI programs focused on reducing consumption of oil and natural gas heat homes; these savings are above and beyond those experienced in the electric system.

Figure 10 summarizes the overall gains to consumers by state and region, including bill savings in electricity, gas, and oil markets.

[29] During the 2009–2011 period, we estimate that RGGI increased consumers' overall payments for electricity by 0.7 percent; over the long run, however, investment of RGGI proceeds, which states used to support a variety of economic activity (of which approximately 48 percent went to support energy efficiency programs) lead to net savings in electricity bills to all consumers in all states, relative to an electric system that did not include RGGI for the 2009–2011 period.

[30] Under a 7 percent private discount rate, gains to electricity consumers overall are nearly $600 million.

Figure 10
Consumer Bill Reductions by State and Region (2011$)



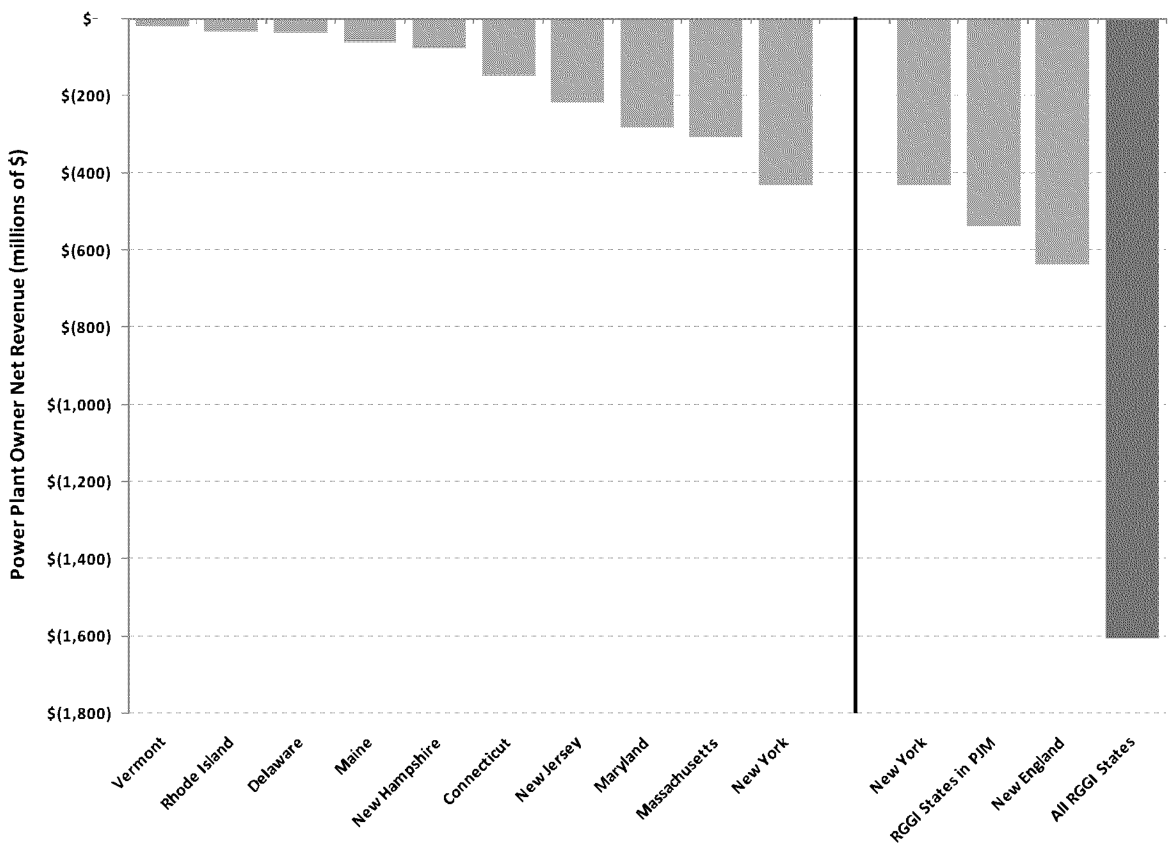
Notes: Figures include GE MAPS outputs, non-electric benefit calculations, and capacity market gain calculations. Figures represent dollars discounted to 2011 using a 3% public discount rate.

From the perspective of the power generation sector, the RGGI program leads to an overall drop (on an NPV basis) in electric market revenues, amounting to approximately $1.6 billion.[31] Although power plant owners have to purchase CO_2 allowances, they recover all of their early expenditures during the 2009–2011 period; in the long run, however, RGGI-driven energy efficiency leads to lower sales of electricity which ends up eroding power plant owners' electric market revenues. The net impact to electric power plant owners is summarized by state and region in Figure 11. However, these impacts are not distributed equally across power plant owners; RGGI affords a competitive advantage to power plants with lower CO_2 emissions.

Combining the power plant owner and consumer changes, net electric market impacts are negative for the RGGI region as a whole, amounting to a net loss of slightly over $500 million.[32]

[31] Under a 7 percent private discount rate, the net decrease in revenues for power plant owners is $1.3 billion.
[32] Under a 7 percent private discount rate, net electric market impacts are a net loss of just under $720 billion.

Figure 11
Net Revenue Change for Power Plant Owners (2011$)



Notes: Figures include GE MAPS outputs, allowance true-up calculations, and capacity market loss calculations.
Figuresrepresentdollars discounted to 2011 using a 3% public discount rate.

Non-Dollar Impacts

In addition to an economic benefit, the use of RGGI proceeds results in a positive employment impact through an increase of approximately 16,000 new job-years, and reduced payments to out-of-region providers of fossil fuels by just over $765 million.[33]

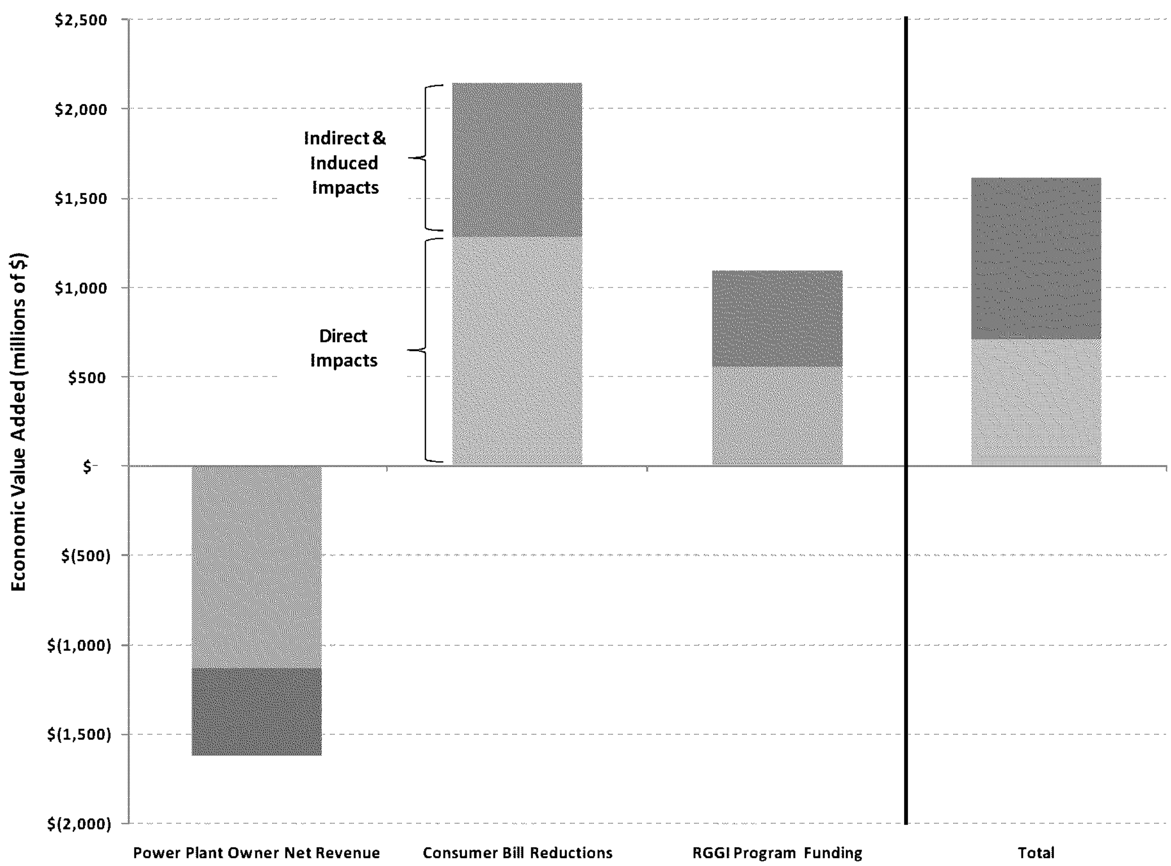
Overall Impact

Overall, RGGI's first compliance period produced a net present value economic benefit of $1.6 billion, using a public discount rate.[34] As previously mentioned, this includes electric sector impacts to consumers and power plant owners, in addition to the non-electric benefits and program spending that result from state spending of RGGI proceeds. As these individual impacts ripple through the economy,

[33] Under a 7 percent private discount rate, fossil fuel payments to out-of-region providers decreased by slightly over $755 million.
[34] Using a 7 percent private discount rate, the NPV benefit is $1.0 billion.

they have the net effect of producing positive economic value. This can be seen in Figure 12, which shows the direct, indirect, and induced economic impacts to the ten-state region from the individual components described above.

Figure 12
Net Economic Impacts for the Ten State RGGI Region

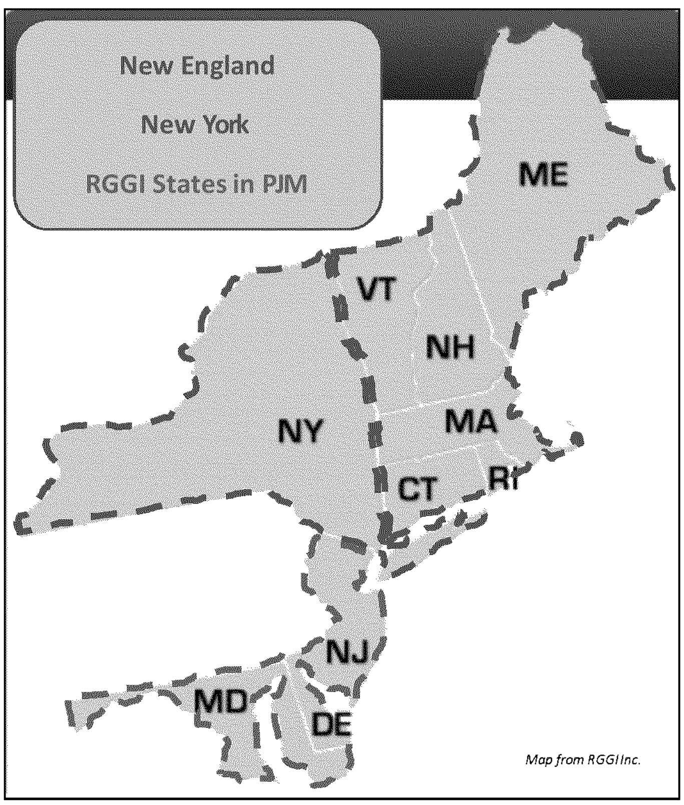


Notes: Figuresrepresentdollars discounted to 2011 using a 3% public discount rate.

Regional Differences

Because the ten RGGI states fall into three electrical regions, each with a common electric market, we also analyzed the impacts of RGGI on a regional basis. The three electric regions are: the New England states (with a market operated by ISO-NE); New York (with a market administered by NYISO); and Delaware, Maryland, and New Jersey (all part of the larger regional market administered by PJM). Figure 13 highlights the RGGI states included in each region.

Figure 13
RGGI States by Region



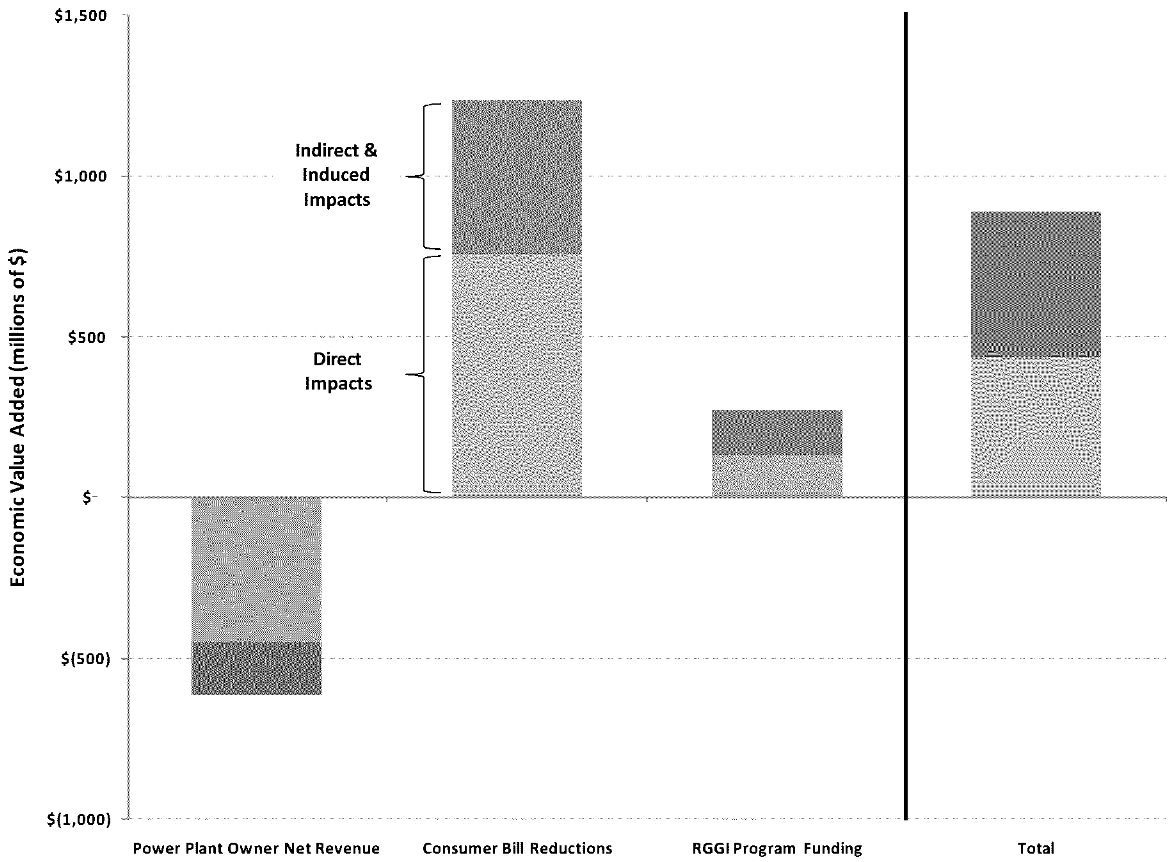
Every region experienced net positive macroeconomic effects. Even so, there are significant variations in both the overall level of impact and the magnitude of impact within each category, in each region.

Of the three regions, only in New England do the savings to electricity consumers outweigh the reduction in revenues by power generators. This is due to a combination of factors – most notably the much-higher level of investment in energy efficiency with RGGI allowance proceeds than the other regions. On the other hand, the higher level of direct spending on government funding and direct bill assistance in the New York and PJM RGGI states leads to relatively higher levels of economic return in the form of direct, indirect and induced macroeconomic impacts.

New England

In New England, the overall macroeconomic impacts are large: almost $900 million to the six-state region.[35] These effects include net positive electric sector impacts (see above) and the net positive impacts of direct spending on programs, rebates, administrative obligations, and government programs. See Figure 14.

Figure 14
Net Economic Impacts for the States in New England (2011$)



Notes: Figuresrepresentdollars discounted to 2011 using a 3% public discount rate.

As shown, net negative impacts to power producers[36] are offset by net positive impacts on consumer spending for electric and non-electric energy services.[37] Although the net electricity price increases to

[35] Under a 7 percent private discount rate, net economic impacts in New England are just over $675 million.

[36] From the perspective of New England's power generation sector, RGGI program compliance during the first compliance period decreased supplier revenues on a net present value basis by approximately $640 million. These reductions come in the form of costs incurred to purchase allowance that exceeded the recovery of such costs in wholesale markets, an overall reduced level of revenue due to the combination of lower overall load levels (due to energy efficiency investments) and lower prices for power sold, and reduced capacity market revenues.

New England consumers from 2009–2011 were relatively small (0.6 percent), the long-term gains more than offset these initial increases in electricity bills and also offset the net revenue losses to power producers. These combine with the direct and induced impacts associated with the injection of RGGI dollars into the purchase of economic goods and services with positive multiplier effects on the New England economy.

Additionally, RGGI proceeds end up producing positive employment impacts, amounting to an increase of approximately 7,200 new job-years in New England, and reduced payments to out-of-region providers of fossil fuels of approximately $210 million.[38]

New York

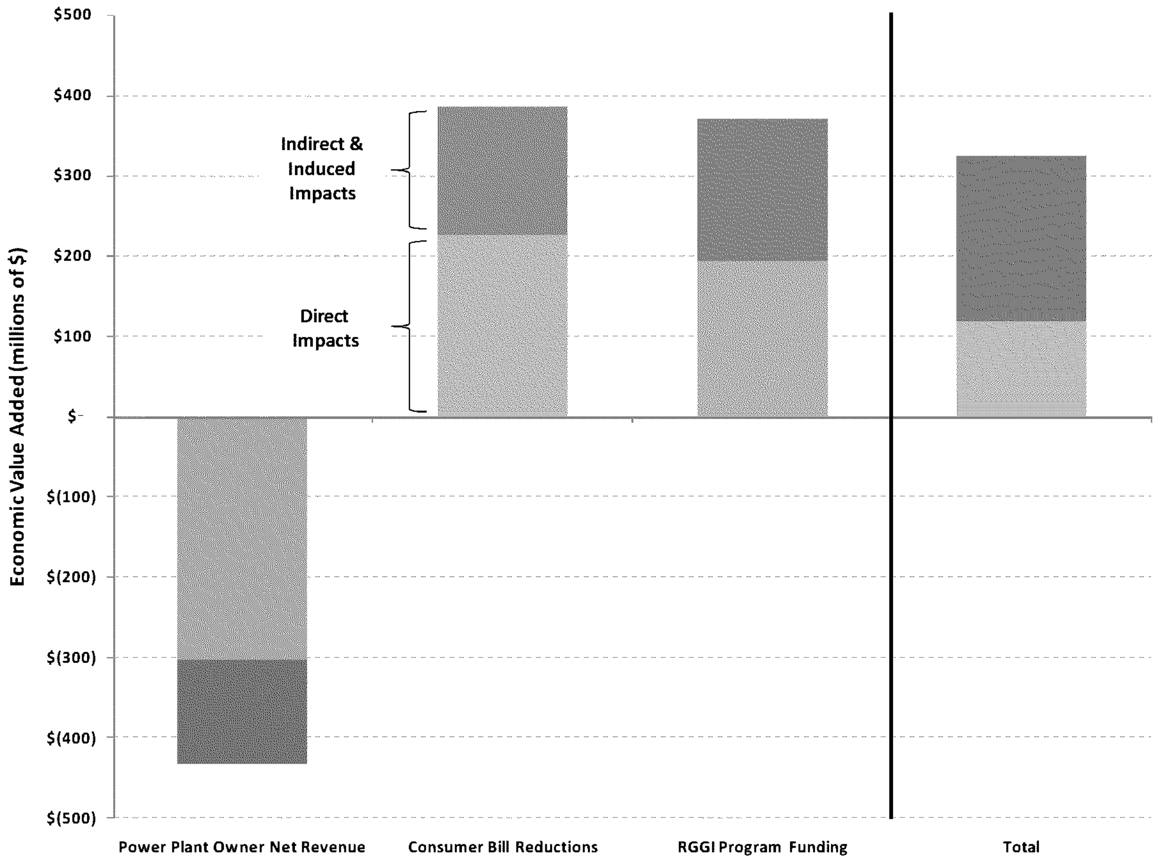
RGGI also resulted in positive economic value to the New York economy, amounting to $325 million.[39] The positive gains from recirculating RGGI funds through the economic offset the net negative impacts experienced in the electric sector. The overall result and the pieces contributing to it are presented in Figure 15.

[37] From the perspective of the New England residential and business energy consumer, the impact of the reduced consumption and price impacts on electricity consumers is a net present value benefit of approximately $720 million across the region. Consumers that participate in an energy efficiency program funded by RGGI proceeds would experience a level of savings much higher than the average savings for all consumers. In addition, consumers save approximately $38 million through RGGI programs focused on reducing consumption of oil and natural gas to heat homes in New England.

[38] Under a 7 percent private discount rate, fossil fuel payments to out-of-region providers decrease by approximately $195 million in New England.

[39] Under a 7 percent private discount rate, net economic impacts in New York are approximately $125 million.

Figure 15
Net Economic Impacts for New York (2011$)



Notes: Figuresrepresentdollars discounted to 2011 using a 3% public discount rate.

Although the net electricity price increases to New York consumers from 2009–2011 were relatively small (0.8 percent), because New York spent much of its RGGI funds outside the electric sector, the positive gains fell outside of the electric market impacts. (New York spent a large amount of RGGI funds for general fund purposes, in addition to supporting energy efficiency programs.) While electricity consumers enjoyed over time additional bill savings through reduced electricity purchases,[40] these savings did not offset the net present value of revenue loss experienced by power plant owners over the modeling period.[41]

[40] From the perspective of the New York residential and business energy consumer, the impact of the reduced consumption and price impacts on electricity consumers is a net present value benefit of approximately $145 million across the region. Consumers that participate in an energy efficiency program funded by RGGI proceeds would experience a level of savings much higher than the average savings for all consumers. In addition, consumers save approximately $85 million through RGGI programs focused on reducing consumption of oil and natural gas to heat homes in New York.

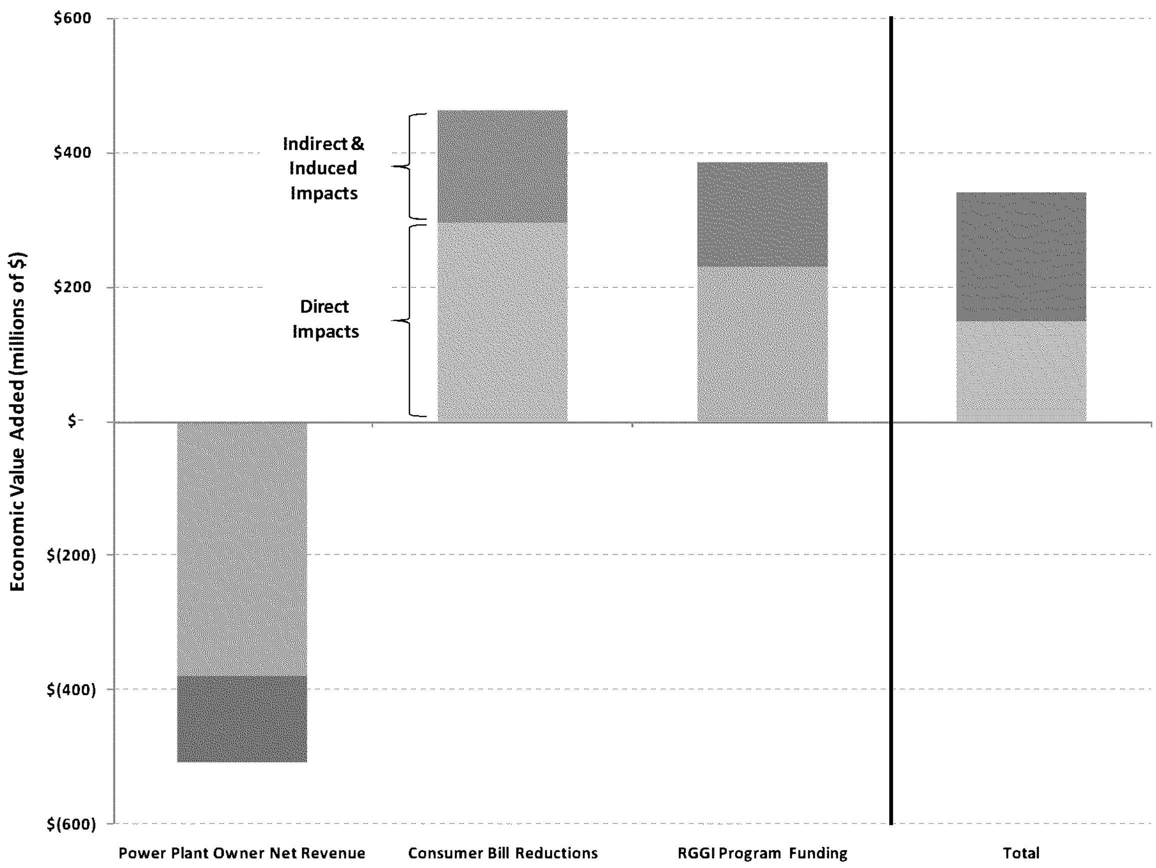
[41] From the perspective of New York's power generation sector, RGGI program compliance during the first compliance period decreased supplier revenues on a net present value basis by approximately $430 million. These reductions come in the form of costs incurred to purchase allowance that exceeded the recovery of such costs in wholesale markets, an overall reduced level of revenue due to the combination of lower overall load levels (due to energy efficiency investments) and lower prices for power sold, and reduced capacity market revenues.

In addition to an economic benefit, RGGI proceeds led to programs producing approximately 4,600 job-years in the region, and reduced payments to out-of-region providers of fossil fuels by approximately $120 million.[42]

RGGI States in PJM

The overall impact of RGGI on the economies of the PJM states (Delaware, Maryland, and New Jersey) was also positive, with $341 million in added value to these three states.[43] These impacts reflect the combined effects on the electric sector and the use of RGGI allowance proceeds on programs, rebates, administrative obligations, and government functions. The overall result and the pieces contributing to it are presented in Figure 16.

Figure 16
Net Economic Impacts for the RGGI States in PJM (2011$)



Notes: Figuresrepresentdollars discounted to 2011 using a 3% public discount rate.

[42] Under a 7 percent private discount rate, fossil fuel payments to out-of-region providers decrease by approximately $115 million in New York.
[43] Under a 7 percent private discount rate, net economic impacts in Delaware, Maryland, and New Jersey are approximately $180 million.

Consumers experienced longer term savings in electricity[44] and energy bills that offset the minor increases (0.7 percent) in electricity bills during 2009–2011. These savings were not large enough to fully offset the net revenue losses to power plant owners.[45] Even so, the overall macroeconomic impacts of RGGI-funded program expenditures did offset the revenue losses to producers.

Additionally, RGGI-funded programs resulted in a positive employment impact amounting to approximately 3,700 job-years in the region. RGGI also reduced payments to out-of-region providers of fossil fuels by approximately $435 million.[46]

Observations

These outcomes suggest a number of themes about the RGGI experience to date. Some are important for providing the RGGI states with information about how the policy is performing relative to some (but not all) of its original goals. The observations are also relevant to other states and national policy makers if and when they decide to adopt a CO_2 control program.

Mandatory, Market-Based Carbon Control Mechanisms are Functioning Properly and Can Deliver Positive Economic Benefits

Based on the initial three years of experience from the nation's first mandatory carbon control program, market-based programs are providing positive economic impacts while meeting emission objectives. The pricing of carbon in Northeast and Mid-Atlantic electricity markets has been seamless from an operational point of view, and successful from an economic perspective.

Our review of the first three-year compliance period from the first market-based carbon control program in the country found positive economic impacts. This result holds whether or not one believes there are other reasons for or benefits from carbon control (e.g., addressing climate change risks). The economic impacts we studied flow from the revenues generated from the sale of allowances, and how those revenues were redistributed in the economies of the RGGI states.

The use of RGGI allowance revenues has produced positive economic impacts while administration of the RGGI program has proceeded smoothly. Thirteen auctions have been held, and the auctions resulted in the distribution of the majority of available allowances. Allowances have been traded in the secondary market throughout the first compliance period, and the market monitor has found no evidence of market power in the RGGI auctions or the secondary market. Allowance revenues were quickly and efficiently distributed to states, and states have disbursed nearly all of the allowance revenues for various uses. The

[44] From the perspective of the PJM RGGI states' residential and business energy consumer, the impact of the reduced consumption and price impacts on electricity consumers is a net present value benefit of approximately $235 million across the region. Consumers that participate in an energy efficiency program funded by RGGI proceeds would experience a level of savings much higher than the average savings for all consumers. In addition, consumers save approximately $50 million through RGGI programs focused on reducing consumption of oil and natural gas to heat homes in the PJM RGGI states.

[45] From the perspective of the power generation sector in the PJM RGGI states, RGGI program compliance during the first compliance period decreased supplier revenues on a net present value basis by approximately $540 million. These reductions come in the form of costs incurred to purchase allowance that exceeded the recovery of such costs in wholesale markets, an overall reduced level of revenue due to the combination of lower overall load levels (due to energy efficiency investments) and lower prices for power sold, and reduced capacity market revenues.

[46] Under a 7 percent private discount rate, fossil fuel payments to out-of-region providers decrease by approximately $450 million in Delaware, Maryland, and New Jersey.

carbon cap established by RGGI has been met (in part because of stagnant economic conditions).[47] RGGI, Inc. and the states have effectively tracked the use of allowance proceeds, and states continue to work cooperatively towards evolution of the program.

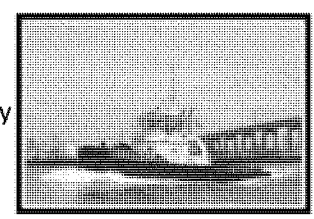
In short, based on a review of RGGI's first three years, it would seem that the design, administration, and implementation of a market-based carbon control mechanism can be an effective way to control carbon emissions, while potentially providing additional economic and policy benefits.

The States Have Used CO_2 Allowance Proceeds Creatively – Supporting Diverse Policy and Economic Outcomes

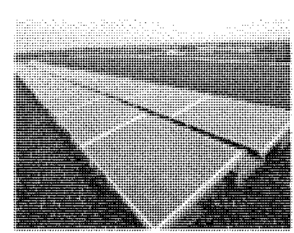
The states' use of allowance proceeds not only provides economic benefits, but also has helped them meet a wide variety of social, fiscal, and environmental policy goals, such as addressing state and municipal budget challenges, assisting low-income customers, achieving advanced energy policy goals, and restoring wetlands, among other things. While they started RGGI to address the impacts of climate change, they used auction proceeds to advance a wide variety of public policy interests of the states beyond mitigation of climate change risks, while achieving this economic benefit.

While we focus solely on economic benefit, we know that state interests legitimately go beyond this. We do not mean to suggest or imply that states should necessarily focus exclusively on economic impacts when deciding the proper use of allowance proceeds within a state's economic, environmental, and financial context. In fact, the evidence indicates that states have allocated RGGI funds to advance a number of different public policy objectives. For example, while the use of proceeds to provide rate relief for low-income customers may have a smaller multiplier effect in the economy than investments in energy efficiency, it supports an important public policy objective to assist customers that face default or increasing bill arrearages, and whose expenses for energy services are generally a disproportionate percentage of household expenses relative to non-low-income customers. Similarly, the retention of proceeds in the General Fund of a given state may help preserve critical

Case Studies:



- Supporting home energy improvements and "PACE" financing in VT
- Educating CT teachers and students on energy strategies
- Plugging budget shortfalls in NY, NJ, NH
- Assisting low-income customers in MD
- Modernizing energy-using equipment at ME paper mill
- Educating RI low-income customers on ways to save energy
- Providing seed-funding for new revolving load program for NH businesses
- Supporting new solar projects at colleges in NY & NJ
- Enabling efficiency actions to assist a MA town become a "green community"
- Helping operators at DE's ports reduce GHG through new motors and lamps



[47] RGGI, Inc. has reported that between 2008 and 2009, electric generation from RGGI-affected electric generation sources decreased by 17.9 million MWh, or 9.1 percent. During that same time period CO_2 emissions from RGGI electric generation sources decreased by 27.6 million short tons, or 18.4 percent. "CO_2 Emissions from Electricity Generation and Imports in the 10-State Regional Greenhouse Gas Initiative: 2009 Monitoring Report," RGGI, Inc., September 14, 2011.

state agency programs and services that otherwise would have to be reduced or eliminated in the face of budget challenges.

Finally, a common theme across many states is the use of RGGI proceeds as seed investments to communities or companies for the installation of renewable energy projects, in order to promote development of advanced energy sources and provide support for municipalities and businesses. These investments meet multiple policy objectives not necessarily or completely captured in a straight-up economic impact analysis. Consequently, by focusing on differences among allocation methods from the perspective of economic impacts only, we do not mean to suggest that that should be the only basis for determining the best use of RGGI allowance proceeds.

RGGI Reduces the Region's Payments for Out-of-State Fossil Fuels

RGGI helped lower the total dollars these states sent outside their region in the form of payments for fuel. The generating capacity mix in New England, New York, and the PJM RGGI states includes nuclear, hydro, and renewable resources in addition to the fossil-fueled resources that are subject to the requirements of RGGI. Note, in each of these regions, generation from the combined coal, oil, and natural gas fleets dominates the resource mix. However, nearly all of the fossil fuels that power these resources come from outside the RGGI states. This means that each year a significant portion of payments to power producers leaves the region in the form of payments for fuel coming from the U.S. Gulf, other coal-producing regions, Canada, or overseas.

Implementation of RGGI and the use of RGGI proceeds for energy efficiency and new renewable power production, through reducing generation and shifting the generation mix towards non-fossil resources (compared to the "without RGGI" case), reduces the flow of dollars that essentially pay for fossil fuels used in power production in the RGGI states.

The Design of the CO_2 Market in the RGGI States Affected the Size, Character, and Distribution of Public Benefits

The joint decision by the RGGI states to make their CO_2 allowances available to the market through a unified auction ended up generating substantial revenues for public use. This approach transferred emissions rights from the public sector to the private sector at a monetary cost (rather than transferring them for free). Had these allowances been given away for free, the states would not have had the benefit of the auction proceeds and instead would have transferred that economic value to owners of power plants (which, in the RGGI region, are merchant generators, not owned by electric distribution utilities). In the end, the cap level, the design of the auction mechanism, and the depressed economy meant that meeting the RGGI cap was not challenging, and CO_2 allowance prices decreased over time. This made it harder for power plant owners to recoup investment in purchasing allowances, and has reduced the funding available for public investment.

Notably, for a power plant owner, the value of an allowance – once in hand – is the same whether that allowance was received for free or purchased via auction. That is, the plant operator faces the same economic decision to price his/her power to recover the opportunity cost of the allowance, whether that owner bought or was given an allowance. Either way, the cost of generating power and emitting a ton of CO_2 is equal to the price of an allowance, either by needing to purchase it, or by losing the opportunity to sell it. However, how the allowances are distributed *does* affect who captures the initial value of the emission rights that allowances under a cap represents, and what the ultimate economic and policy impact of the program will be.

Previous market-based emission control programs for NO_x and SO_2 have distributed allowances for free to the affected sources through formulas tied to historical heat input, emissions, or electrical output. This form of allowance allocation transfers the value of the allowance to the plant owner. In contrast, the joint decision by the RGGI states to make their allowances available to the market through a unified auction administered on behalf of the states retained the value of emission rights for the benefit of public use. Over the course of the auctions held during the first compliance period, this generated substantial revenues for use by state governments to meet public policy objectives. The use of these revenues, in turn, substantially influenced the fact that RGGI program implementation over the first compliance period lead to net economic benefits and a wide array of ancillary public policy achievements.

In the end, the cap level, the design of the auction mechanism, and the sinking economy meant that meeting the RGGI cap was less challenging than it otherwise might have been over these three years, and allowance prices and revenues have decreased over time. While this may have reduced the overall magnitude of benefits achieved, it does not change the fact that the decision on whether to auction or allocate for free the allowances under a market-based allowance trading program was a key decision point affecting the relative economic and policy impact of the RGGI program over the first three years.

How Allowance Proceeds Are Used Affects Their Economic Impacts

The RGGI MOU fully anticipates – if not encourages – states to place different weights on economic, environmental, social, energy security, and other goals as they implement the program. The states have used their RGGI dollars very differently, in ways that affect the net benefits within the electric sector and in the larger state economy. While all states originally committed to using at least 25 percent of auction proceeds for "public benefit or strategic energy" purposes,[48] some states contributed a much larger amount to those ends.

But from a strictly economic perspective, some uses of proceeds clearly deliver economic returns more readily and substantially than others. For example, RGGI-funded expenditures on energy efficiency depress regional electrical demand, power prices, and consumer payments for electricity. This benefits all consumers through downward pressure on wholesale prices, even as it particularly benefits those consumers that actually take advantage of such programs, implement energy efficiency measures, and lower both their overall energy use and monthly energy bills. These savings stay in the pockets of electricity users directly. But there are also positive macroeconomic impacts as well: the lower energy costs flow through the economy as collateral reductions in natural gas and oil in buildings and increased consumer disposable income (from fewer dollars spent on energy bills), lower payments to out-of-state energy suppliers, and increased local spending or savings. Consequently, there are multiple ways that investments in energy efficiency lead to positive economic impacts; this reinvestment thus stands out as

[48] The RGGI MOU states that "Consumer benefit or strategic energy purposes include the use of the allowances to promote energy efficiency, to directly mitigate electricity ratepayer impacts, to promote renewable or non-carbon-emitting energy technologies, to stimulate or reward investment in the development of innovative carbon emissions abatement technologies with significant carbon reduction potential, and/or to fund administration of this Program."

the most economically beneficial use of RGGI dollars. Other uses also provide macroeconomic benefits, even if they do not show up in the consumers' pockets in the form of lower energy bills.

RGGI Produced New Jobs

Taking into account consumer gains, power plant owners' losses, and net positive economic impacts, RGGI led to overall job increases. Some may be permanent jobs; others may be part-time or temporary. But the net effect is that, according to our analysis, the first three years of RGGI will lead to over 16,000 new job-years, with each of the ten states showing net job additions.

In the context of the entire workforce in the ten-state RGGI region, 16,000 new job-years is small (about one tenth of one percent of the total employment in September 2011). But considering the fact that the ten states' civilian labor force dropped by 73,400 from September 2010 to September 2011 (from 25,165,100 to 25,091,700), the jobs produced by RGGI spending (or, conversely, the absence of thousands of additional jobs, had RGGI not been in place) is significant.[49]

Jobs related to RGGI activities are located around the economy, with examples including engineers who perform efficiency audits; workers who install energy efficiency measures in commercial buildings; staff performing teacher training on energy issues; the workers in state-funded programs that might have been cut had a state not used RGGI funds to close budget gaps.

Timing Differences in Program Costs Versus Benefits Affects Results

Costs associated with RGGI program implementation in the first compliance period were incurred by power generators – and to the extent possible passed on to consumers as incurred – during the years 2009–2011. Yet, positive economic impacts associated with the distribution and spending of allowance proceeds can lag these incurred costs by a year or more in many states. This is in part due simply to the time it takes to collect auction and allowance sale revenues, transfer them to states, distribute them to disbursement agencies, disburse the funds, make investments, and put the resulting resources, measures, or installations into service. Differences in lag times among the states affect results in a non-trivial way.

In addition, while the costs are incurred and passed on immediately, many of the economic impacts are stretched out over a relatively long period. For example, energy efficiency measures installed using RGGI allowance proceeds produce consumer savings, on average, for over 10 years; new renewable resources put into operation using RGGI proceeds continue to produce power for decades.[50]

Because the estimation of economic impacts over time involves discounting costs and benefits that occur in different timeframes, lags, or delays in program administration and installations tend to diminish the estimated net present value economic impact of RGGI proceed investment. Deliberate efforts by states to re-circulate RGGI allowance revenues back into the economy as quickly as possible could reduce the lag effects and increase the economic returns of the RGGI programs.

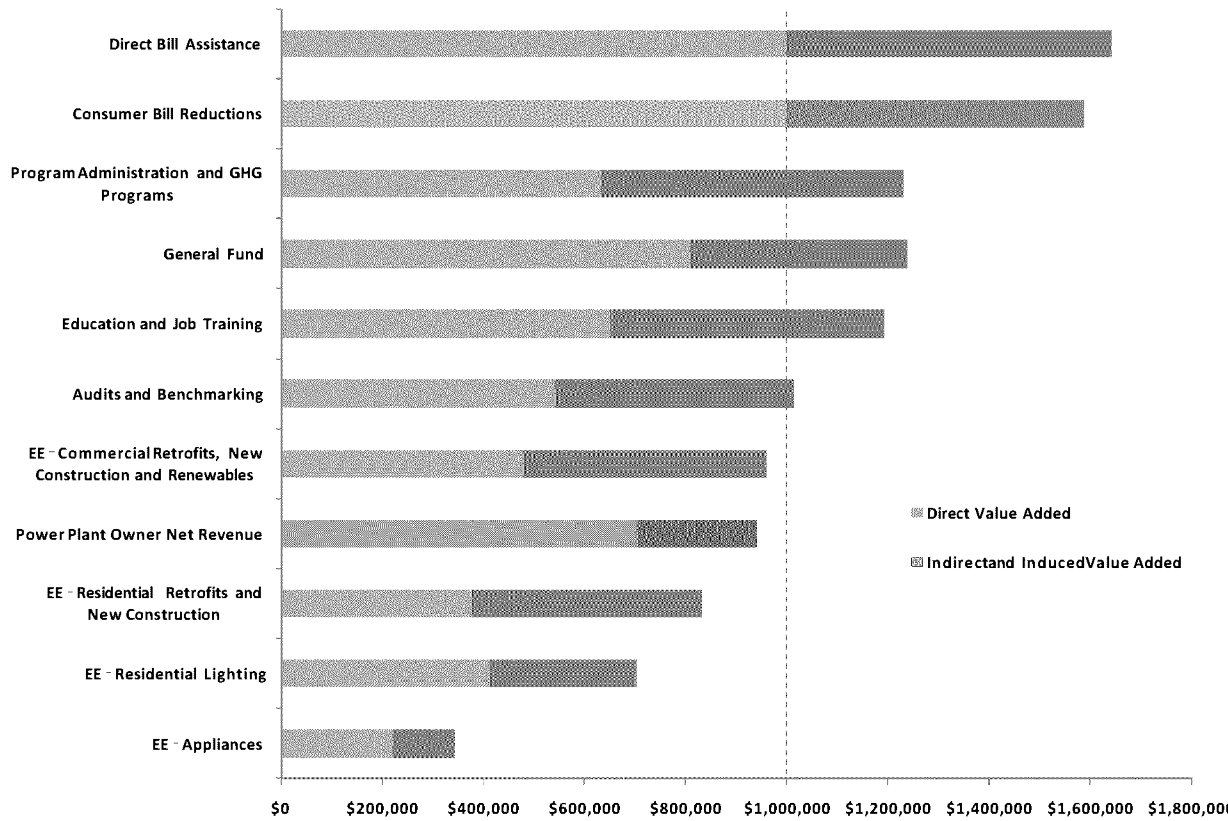
[49] Bureau of Labor Statistics, http://www.bls.gov/news.release/pdf/laus.pdf.
[50] As explained in more detail earlier, we truncate our economic analysis of program investments at ten years.

Value Added in the Economy for State Funding, Bill Reductions, and Education Strongly Outweigh the Direct and Induced Effects of Power Generator Revenue Loss

RGGI's impacts stretched in various corners of the economy. RGGI funds were spent on economic activities affecting the electric sector, other energy uses (e.g., natural gas and heating oil), support for low-income residents to meet their energy bills, educational activities, and general fund support. The positive economic multipliers associated with these expenditures contributed to net positive effects of the program for the RGGI states. These gains are larger than the direct impacts on the electric sector, where there were net positive consumer impacts but net revenue losses to power plant owners, from an NPV point of view.

Given the complex relationships within economies, the multiplier effects of the economic gains ends up having larger impacts that those attributable to power plant owners' revenue losses. For example, in the power generation sector, each $1 million of revenue loss leads to negative impacts on the economy – in the form of direct and induced effects – of approximately the same $1 million. By contrast, $1 million of added contribution to the general fund leads to positive impacts on the economy of approximately $1.2 million; $1 million going to directly reduce consumer electricity bills or into energy education programs generates positive economic impacts of approximately $1.6 and $1.2 million, respectively (see Figure 17). The relative magnitude of these economic multipliers strongly influences the overall positive economic impact of RGGI implementation in the first compliance period.

Figure 17
Average Multiplier Effects for RGGI Program Spending Categories



Note: Each bar represents the average value added to the ten RGGI states' economies as a result of spending $1 million in each of the areas that RGGI money is allocated in the states.

A Region's Pre-Existing Generating Mix Affects Economic Impacts

Since power generation resources have different CO_2 emission impacts – with coal-fired generation having higher combustion-related CO_2 emissions than other electricity generating resources – the amount of coal in a particular state's generating mix affects the costs of the RGGI program. Even so, every state experiences net positive benefits from RGGI, including in the more coal-heavy region (i.e., in the PJM states (New Jersey, Delaware, and Maryland)).

RGGI's First 3 Years of Program Investments Point to Some Best Practices

Based on our review of state program investments, it is clear that some states' practices can serve as best practices for others. First, speeding up the timing of when RGGI auction proceeds are used reduces the lag between CO_2 costs showing up in electricity prices and the time when benefits begin to flow to the region. Second, re-circulating RGGI auction proceeds back into the economy in the form of energy efficiency programs can dramatically increase the value of the RGGI program for electricity consumers and for the larger economy.

Finally, standardizing the collection, measurement and verification of data on RGGI dollar flows could significantly improve the ability to quickly translate program lessons into improved program design. Our economic impact analysis involved significant effort to collect, organize, and process the data on how states disburse and spend RGGI allowance revenues and on the character of program impacts on various recipients in the larger economy. The states and RGGI, Inc. have done a good job tracking expenditures and identifying or estimating program impacts, but there remain important differences in the level of detail of tracked data, collection of information on the effects of funded programs on energy generation and consumption, and the assumptions used to measure impacts with program implementation. Future program design efforts would be greatly facilitated by continued efforts to standardize the collection and centralization of data on the use of RGGI proceeds, the application of consistent reporting formats and underlying assumptions regarding program impacts, and the measurement and verification of results.

To: Joseph Goffman/DC/USEPA/US@EPA[]
From: "Doniger, David"
Sent: Thur 9/15/2011 8:55:44 PM
Subject: NRDC statement on power plant standard
sstruglinski@nrdc.org
www.nrdc.org

FOR IMMEDIATE RELEASE
Contact Suzanne Struglinski, (202) 289-2387, sstruglinski@nrdc.org

Carbon Standards Urgently Needed To Protect Kids, Planet

NRDC: EPA Should Not Delay Power Plant Standards

WASHINGTON (September 15, 2011) – In response to the Environmental Protection Agency's announcement that carbon pollution standards for power plants will not be issued this month, David Doniger, NRDC's Climate and Clean Air Program policy director, made the following statement:

"Right now, power companies can dump unlimited amounts of dangerous carbon pollution into the air. This year's unprecedented floods, storms, and fires tell us we are in a race against time to curb the dangerous pollution that is driving climate change.

"We are disappointed that EPA will not meet its commitment to propose clean-up standards this month for the carbon pollution coming from the nation's power plants, the largest polluters. It is not clear how long a delay EPA wants. Taking a little more time to get it done right is one thing. Punting on its duty to protect our children and our planet would be utterly unacceptable. Our reaction will depend on what they propose.

The Supreme Court has twice ruled that it is EPA's job under the Clean Air Act to protect Americans from dangerous carbon pollution. How many more delays does the EPA need before it does its job?"

###

The Natural Resources Defense Council (NRDC) is an international nonprofit environmental organization with more than 1.3 million members and online activists. Since 1970, our lawyers, scientists, and other environmental specialists have worked to protect the world's natural resources, public health, and the environment. NRDC has offices in New York City, Washington, D.C., Los Angeles, San Francisco, Chicago, Livingston, Montana, and Beijing. Visit us at www.nrdc.org.

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To: Gina McCarthy/DC/USEPA/US@EPA[]
Cc: "Daniel Esty" [Daniel.Esty@ct.gov]; oseph Goffman/DC/USEPA/US@EPA;"Ken (DEP) Kimmell" [ken.kimmell@state.ma.us]; Ken (DEP) Kimmell" [ken.kimmell@state.ma.us]
From: "Jared Snyder"
Sent: Fri 9/16/2011 1:01:54 PM
Subject: call on 111(d) standards?

Hi Gina,

Commissioners Dan Esty and Ken Kimmell and I would like to speak with you briefly about the timing of EPA's section 111(d) standards and the impact of EPA's schedule on RGGI program review. Can you give us a couple of times that you could be available for a short conversation next week?

Thanks, Jared

Jared Snyder
Assistant Commissioner
Air Resources, Climate Change and Energy
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From: CN=Gina McCarthy/OU=DC/O=USEPA/C=US
Sent: Fri 9/16/2011 7:45:23 PM
Subject: Re: call on 111(d) standards?

Happy to talk Jared. Will have Cindy schedule when she gets back on Monday.

From: "Jared Snyder" <jjsnyder@gw.dec.state.ny.us>
To: Gina McCarthy/DC/USEPA/US@EPA
Cc: "Daniel Esty" <Daniel.Esty@ct.gov>, Joseph Goffman/DC/USEPA/US@EPA, "Ken (DEP) Kimmell" <ken.kimmell@state.ma.us>
Date: 09/16/2011 09:02 AM
Subject: call on 111(d) standards?

Hi Gina,

Commissioners Dan Esty and Ken Kimmell and I would like to speak with you briefly about the timing of EPA's section 111(d) standards and the impact of EPA's schedule on RGGI program review. Can you give us a couple of times that you could be available for a short conversation next week?

Thanks, Jared

Jared Snyder
Assistant Commissioner
Air Resources, Climate Change and Energy
N.Y.S. Dept of Environmental Conservation
625 Broadway, 14th Floor
Albany, New York 12233-1010
(518) 402-8537 phone
(518) 813-1670 mobile
(518) 402-9016 fax

To: Gina McCarthy/DC/USEPA/US@EPA;Jared Snyder [jjsnyder@gw.dec.state.ny.us]; ared Snyder [jjsnyder@gw.dec.state.ny.us]; Doig, Rebecca (DEP)" [rebecca.doig@state.ma.us]
Cc: Daniel Esty [Daniel.Esty@ct.gov]; oseph Goffman/DC/USEPA/US@EPA;Cindy Huang/DC/USEPA/US@EPA;Don Zinger/DC/USEPA/US@EPA[]; indy Huang/DC/USEPA/US@EPA;Don Zinger/DC/USEPA/US@EPA[]; on Zinger/DC/USEPA/US@EPA[]
From: "Kimmell, Ken (DEP)"
Sent: Fri 9/16/2011 8:13:49 PM
Subject: RE: call on 111(d) standards?

Please work through Becky Doig for scheduling for me. Thanks and have a good weekend

Kenneth L. Kimmell

Commissioner

Massachusetts Department of Environmental Protection

One Winter Street

Boston, MA 02108

617 292-5856

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Subscribe to the MassDEP e-newsletter: mass.gov/dep/public/publications/enews.htm

Visit our website: mass.gov/dep

From: McCarthy.Gina@epamail.epa.gov [mailto:McCarthy.Gina@epamail.epa.gov]
Sent: Friday, September 16, 2011 3:45 PM
To: Jared Snyder
Cc: Daniel Esty; Goffman.Joseph@epamail.epa.gov; Kimmell, Ken (DEP); huang.cindy@epa.gov; Zinger.Don@epa.gov
Subject: Re: call on 111(d) standards?

Happy to talk Jared. Will have Cindy schedule when she gets back on Monday.

From: "Jared Snyder" <jjsnyder@gw.dec.state.ny.us>
To: Gina McCarthy/DC/USEPA/US@EPA

Cc: "Daniel Esty" <Daniel.Esty@ct.gov>, Joseph Goffman/DC/USEPA/US@EPA, "Ken (DEP) Kimmell" <ken.kimmell@state.ma.us>
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To: Gina McCarthy/DC/USEPA/US@EPA[]
Cc: Cindy Huang/DC/USEPA/US@EPA;Don Zinger/DC/USEPA/US@EPA;Joseph Goffman/DC/USEPA/US@EPA[]; on Zinger/DC/USEPA/US@EPA;Joseph Goffman/DC/USEPA/US@EPA[]; oseph Goffman/DC/USEPA/US@EPA[]
From: "Jared Snyder"
Sent: Fri 9/16/2011 9:14:04 PM
Subject: Re: call on 111(d) standards?

Thanks Gina. I'll be out of the office on Monday but Cindy should contact my assistant Kim Sarbo.

By the way, I want to pass on our great appreciation for the attention that Sam N and his staff have paid to addressing our CSAPR issues. I'm told that Sam has been terrific to work with.

Thanks and have a good weekend. J

>>> <McCarthy.Gina@epamail.epa.gov> 9/16/2011 3:45 PM >>>
Happy to talk Jared. Will have Cindy schedule when she gets back on Monday.

From: "Jared Snyder" <jjsnyder@gw.dec.state.ny.us>
To: Gina McCarthy/DC/USEPA/US@EPA
Cc: "Daniel Esty" <Daniel.Esty@ct.gov>, Joseph Goffman/DC/USEPA/US@EPA, "Ken (DEP) Kimmell" <ken.kimmell@state.ma.us>
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To: daniel.esty@ct.gov;jjsnyder@gw.dec.state.ny.us;CN=Joseph Goffman/OU=DC/O=USEPA/C=US@EPA;ken.kimmell@state.ma.gov[]; jsnyder@gw.dec.state.ny.us;CN=Joseph Goffman/OU=DC/O=USEPA/C=US@EPA;ken.kimmell@state.ma.gov[]; N=Joseph Goffman/OU=DC/O=USEPA/C=US@EPA;ken.kimmell@state.ma.gov[]; en.kimmell@state.ma.gov[]
Cc: Carmen.Colon@ct.gov;CN=Cynthia Browne/OU=DC/O=USEPA/C=US@EPA;CN=Don Zinger/OU=DC/O=USEPA/C=US@EPA;CN=Julia Miller/OU=DC/O=USEPA/C=US@EPA;kdsarbo@gw.dec.state.ny.us;CN=Kirsten King/OU=DC/O=USEPA/C=US@EPA;Rebecca.Doig@state.ma.us[]; N=Cynthia Browne/OU=DC/O=USEPA/C=US@EPA;CN=Don Zinger/OU=DC/O=USEPA/C=US@EPA;CN=Julia Miller/OU=DC/O=USEPA/C=US@EPA;kdsarbo@gw.dec.state.ny.us;CN=Kirsten King/OU=DC/O=USEPA/C=US@EPA;Rebecca.Doig@state.ma.us[]; N=Don Zinger/OU=DC/O=USEPA/C=US@EPA;CN=Julia Miller/OU=DC/O=USEPA/C=US@EPA;kdsarbo@gw.dec.state.ny.us;CN=Kirsten King/OU=DC/O=USEPA/C=US@EPA;Rebecca.Doig@state.ma.us[]; N=Julia Miller/OU=DC/O=USEPA/C=US@EPA;kdsarbo@gw.dec.state.ny.us;CN=Kirsten King/OU=DC/O=USEPA/C=US@EPA;Rebecca.Doig@state.ma.us[]; dsarbo@gw.dec.state.ny.us;CN=Kirsten King/OU=DC/O=USEPA/C=US@EPA;Rebecca.Doig@state.ma.us[]; N=Kirsten King/OU=DC/O=USEPA/C=US@EPA;Rebecca.Doig@state.ma.us[]; ebecca.Doig@state.ma.us[]
From: CN=Cindy Huang/OU=DC/O=USEPA/C=US
Sent: Mon 9/19/2011 6:26:06 PM
Subject: Conference Call on 111(d) standards

From: "Jared Snyder" <jjsnyder@gw.dec.state.ny.us>
To: Gina McCarthy/DC/USEPA/US@EPA
Cc: "Daniel Esty" <Daniel.Esty@ct.gov>, Joseph Goffman/DC/USEPA/US@EPA, "Ken (DEP) Kimmell" <ken.kimmell@state.ma.us>
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Cc: Carmen.Colon@ct.gov;CN=Cynthia Browne/OU=DC/O=USEPA/C=US@EPA;CN=Don Zinger/OU=DC/O=USEPA/C=US@EPA;CN=Julia Miller/OU=DC/O=USEPA/C=US@EPA;kdsarbo@gw.dec.state.ny.us;CN=Kirsten King/OU=DC/O=USEPA/C=US@EPA;Rebecca.Doig@state.ma.us[]; N=Cynthia Browne/OU=DC/O=USEPA/C=US@EPA;CN=Don Zinger/OU=DC/O=USEPA/C=US@EPA;CN=Julia Miller/OU=DC/O=USEPA/C=US@EPA;kdsarbo@gw.dec.state.ny.us;CN=Kirsten King/OU=DC/O=USEPA/C=US@EPA;Rebecca.Doig@state.ma.us[]; N=Don Zinger/OU=DC/O=USEPA/C=US@EPA;CN=Julia Miller/OU=DC/O=USEPA/C=US@EPA;kdsarbo@gw.dec.state.ny.us;CN=Kirsten King/OU=DC/O=USEPA/C=US@EPA;Rebecca.Doig@state.ma.us[]; N=Julia Miller/OU=DC/O=USEPA/C=US@EPA;kdsarbo@gw.dec.state.ny.us;CN=Kirsten King/OU=DC/O=USEPA/C=US@EPA;Rebecca.Doig@state.ma.us[]; dsarbo@gw.dec.state.ny.us;CN=Kirsten King/OU=DC/O=USEPA/C=US@EPA;Rebecca.Doig@state.ma.us[]; N=Kirsten King/OU=DC/O=USEPA/C=US@EPA;Rebecca.Doig@state.ma.us[]; ebecca.Doig@state.ma.us[]
From: CN=Cindy Huang/OU=DC/O=USEPA/C=US
Sent: Wed 9/21/2011 7:17:48 PM
Subject: Rescheduled: Conference Call on 111(d) standards (Sep 23 12:30 PM EDT in Conference line: Ex. 6 - Personal Privacy Access: Ex. 6 - Personal Privacy

From: "Jared Snyder" <jjsnyder@gw.dec.state.ny.us>
To: Gina McCarthy/DC/USEPA/US@EPA
Cc: "Daniel Esty" <Daniel.Esty@ct.gov>, Joseph Goffman/DC/USEPA/US@EPA, "Ken (DEP) Kimmell" <ken.kimmell@state.ma.us>
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(518) 402-8537 phone
(518) 813-1670 mobile
(518) 402-9016 fax

To: "'David (ENRD) Gunter'" [David.Gunter2@usdoj.gov]; oseph Goffman/DC/USEPA/US@EPA[]
Cc: "mceronsky@edf.org" [mceronsky@edf.org]; vpatton@edf.org" [vpatton@edf.org]; atricia Embrey/DC/USEPA/US@EPA;Scott Jordan/DC/USEPA/US@EPA;Elliott Zenick/DC/USEPA/US@EPA;Joanne Spalding [Joanne.Spalding@sierraclub.org]; cott Jordan/DC/USEPA/US@EPA;Elliott Zenick/DC/USEPA/US@EPA;Joanne Spalding [Joanne.Spalding@sierraclub.org]; lliott Zenick/DC/USEPA/US@EPA;Joanne Spalding [Joanne.Spalding@sierraclub.org]; oanne Spalding [Joanne.Spalding@sierraclub.org]; Thomas (ENRD) Lorenzen" [Thomas.Lorenzen@usdoj.gov]; avid Doniger [ddoniger@nrdc.org]
From: "Michael J. Myers"
Sent: Wed 11/30/2011 6:33:36 PM
Subject: Power Plant NSPS settlement

Settlement confidential communication

Dave and Joe--Following up on our call Monday, the states and environmental petitioners have had an opportunity to take EPA's counterproposal back to our colleagues and discuss. I've been authorized to represent on behalf of both state and environmental petitioners the following response: We cannot accept EPA's counterproposal given that it defers a rulemaking on existing power plants until 2013. We're not in a position to make a counteroffer at this time that we think the agency would entertain given what the agency communicated on the call Monday. Finally, although we don't believe that given the way things currently stand, there is a basis to execute an additional forbearance letter, we continue to be open to further discussions to arrive at a mutually acceptable resolution. We can schedule a call today to discuss further, if you'd like. Otherwise, we're prepared to the Nov. 30 deadline pass without further discussion today.--Mike

To: Vickie Patton [vpatton@edf.org]
Cc: CN=Joseph Goffman/OU=DC/O=USEPA/C=US@EPA[]
From: CN=John Millett/OU=DC/O=USEPA/C=US
Sent: Mon 1/30/2012 7:55:00 PM
Subject: Re: Fw: McCarthy Statement on NSPS?
07 DEN A-1, 1/12/12
William H. Carlile
Millett.John@epamail.epa.gov
Goffman.Joseph@epamail.epa.gov
Millett/DC/USEPA/US@EPA
vpatton@edf.org
Goffman/DC/USEPA/US@EPA

FYI -- BNA just posted this from the EUEC --

Subject: NSPS timing from BNA

EPA 'On Track' to Propose New Source Performance Standards in February
Posted: Jan 30, 2012, 1:44 PM -0500
PHOENIX—The Environmental Protection agency is "on track" for proposing its first source-specific emissions standard for greenhouse emissions from power plants sometime in February, Gina McCarthy, EPA assistant administrator for air and radiation, said Jan. 30.

No firm date was announced by McCarthy, who made the comment during the plenary session of the Jan. 30-Feb. 1 Energy, Utility, and Environment Conference 2012 meeting here.

EPA originally had planned to propose the new source performance standards for power plants in January. It has been at the Office of Management and Budget since Nov. 7 (07 DEN A-1, 1/12/12).

The agency agreed to issue new source performance standards for emissions from power plants and petroleum refineries as part of two separate settlements with states and environmental groups in 2010 (New York v. EPA, D.C. Cir., No. 06-1322, 12/23/10; American Petroleum Institute v. EPA, D.C. Cir., No. 08-1277, 12/23/10).

By William H. Carlile

~~~~~~~~~~~~~~~~~~~~

John Millett
Office of Air and Radiation Communications
U.S. Environmental Protection Agency
5411 Ariel Rios Building North
Washington, DC 20460
Phone: 202/564-2903
Cell: 202/510-1822

From: Vickie Patton <vpatton@edf.org>
To: John Millett/DC/USEPA/US@EPA, Joseph Goffman/DC/USEPA/US@EPA
Date: 01/30/2012 01:36 PM
Subject: Re: Fw: McCarthy Statement on NSPS?
~~~~~~~~~~~~~~~~~~~~

John, Thank you. Best wishes, Vickie

----- Original Message -----
From: Millett.John@epamail.epa.gov [mailto:Millett.John@epamail.epa.gov]
Sent: Monday, January 30, 2012 12:45 PM
To: Goffman.Joseph@epamail.epa.gov <Goffman.Joseph@epamail.epa.gov>; Vickie Patton
Subject: Re: Fw: McCarthy Statement on NSPS?

Hi Joe and Vickie -- Gina gave a speech this morning at the EUEC in Phoenix. Her talking points on the NSPS reflect this statement --

EPA is continuing to work with petitioners on a new schedule for issuing GHG standards for existing power plants. On November 7, EPA sent the proposed standards for new power plants to OMB for review. EPA is working with OMB through the interagency review process and expects to issue the proposal early this year. EPA has engaged in an extensive and open public process to gather the latest and best information. The agency is fully considering this input as it develops smart and cost-effective standards. The agency will be soliciting additional comment and information at the time that it proposes the new source rule and will take that input fully into account as it completes the rulemaking process.

~~~~~~~~~~~~~~~~~~~

John Millett
Office of Air and Radiation Communications
U.S. Environmental Protection Agency
5411 Ariel Rios Building North
Washington, DC 20460
Phone: 202/564-2903
Cell: 202/510-1822

From: Joseph Goffman/DC/USEPA/US
To: John Millett/DC/USEPA/US@EPA
Date: 01/30/2012 12:35 PM
Subject: Fw: McCarthy Statement on NSPS?

Joseph Goffman
Senior Counsel to the Assistant Administrator
Office of Air and Radiation
US Environmental Protection Agency
202 564 3201

----- Forwarded by Joseph Goffman/DC/USEPA/US on 01/30/2012 12:36 PM

~~~~~~~~~~~~~~~~~~~

From: Vickie Patton <vpatton@edf.org>
To: Joseph Goffman/DC/USEPA/US@EPA
Date: 01/30/2012 12:33 PM
Subject: McCarthy Statement on NSPS?

Hi Joe, Did the Assistant Administrator make a statement today? Is there a desk statement or anything in writing? Best wishes, Vickie

To: "Jared Snyder" [jjsnyder@gw.dec.state.ny.us]
Cc: []
Bcc: []
From: CN=Joseph Goffman/OU=DC/O=USEPA/C=US
Sent: Wed 9/22/2010 9:12:12 PM
Subject: Re: NSPS

just sent you a scheduler. I assume that the settlement discussions now ongoing with New York State via Mike Meyers and you continue to be kept absolutely confidential. thanks.

Joseph Goffman
Senior Counsel to the Assistant Administrator
Office of Air and Radiation
US Environmental Protection Agency
202 564 3201

From: "Jared Snyder" <jjsnyder@gw.dec.state.ny.us>
To: <goffman.joseph@epamail.epa.gov>, <Johnson.Addie@epamail.epa.gov>
Cc: <brian.turner@wdc.ca.gov>
Date: 09/22/2010 05:06 PM
Subject: Re: NSPS

Thanks Joe.

Addie, I'd like to do this on the 28th if possible. Would you like me to propose some times? Thanks, Jared
-----Original Message-----
From: <Goffman.Joseph@epamail.epa.gov>
Cc: Snyder, Jared <jjsnyder@gw.dec.state.ny.us>
To: <Johnson.Addie@epamail.epa.gov>

Sent: 9/21/2010 6:23:08 PM
Subject: Re: NSPS

Addie can set something up for the three of us. Gina will join us if her schedule permits (she might be traveling or getting ready to on the 28th/29th).. Thanks.

Joseph Goffman
Senior Counsel to the Assistant Administrator
Office of Air and Radiation
US Environmental Protection Agency
202 564 3201

From: Joseph Goffman/DC/USEPA/US

To: "Jared Snyder" <jjsnyder@gw.dec.state.ny.us>

Date: 09/21/2010 11:27 AM

Subject: Re: NSPS

Thanks for this and for your vmail. Let me touch base with Gina.
Thanks.

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Senior Counsel to the Assistant Administrator
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202 564 3201

From: "Jared Snyder" <jjsnyder@gw.dec.state.ny.us>

To: Joseph Goffman/DC/USEPA/US@EPA

Date: 09/20/2010 12:18 PM

Subject: NSPS

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Thanks, Jared

To: "Jared Snyder" [jjsnyder@gw.dec.state.ny.us]
Cc: []
Bcc: []
From: CN=Joseph Goffman/OU=DC/O=USEPA/C=US
Sent: Wed 9/22/2010 9:31:01 PM
Subject: Re: NSPS

Yep. I think you're right. Is NY/Mike representing them in the discussions we're having?

Joseph Goffman
Senior Counsel to the Assistant Administrator
Office of Air and Radiation
US Environmental Protection Agency
202 564 3201

From: "Jared Snyder" <jjsnyder@gw.dec.state.ny.us>
To: Joseph Goffman/DC/USEPA/US@EPA
Date: 09/22/2010 05:26 PM
Subject: Re: NSPS

Yes, of course. You might think about letting Brian know the schedule you have in mind when we meet, but I leave that to you. Cal is a litigant, I believe. J
-----Original Message-----
From: <Goffman.Joseph@epamail.epa.gov>
To: Snyder, Jared <jjsnyder@gw.dec.state.ny.us>

Sent: 9/22/2010 5:12:12 PM
Subject: Re: NSPS

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From: Joseph Goffman/DC/USEPA/US

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Date: 09/21/2010 11:27 AM

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Cc: "Jared Snyder" [jjsnyder@gw.dec.state.ny.us]
Bcc: []
From: CN=Joseph Goffman/OU=DC/O=USEPA/C=US
Sent: Wed 9/22/2010 9:41:57 PM
Subject: Re: NSPS

just got a vmail form Mike which, as it happens, answered my question......

Joseph Goffman
Senior Counsel to the Assistant Administrator
Office of Air and Radiation
US Environmental Protection Agency
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Sent: 9/22/2010 5:12:12 PM
Subject: Re: NSPS

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Date: 09/20/2010 12:18 PM

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Cc: []
Bcc: []
From: CN=Joseph Goffman/OU=DC/O=USEPA/C=US
Sent: Tue 9/21/2010 3:27:45 PM
Subject: Re: NSPS

Thanks for this and for your vmail. Let me touch base with Gina. Thanks.

Joseph Goffman
Senior Counsel to the Assistant Administrator
Office of Air and Radiation
US Environmental Protection Agency
202 564 3201

From: "Jared Snyder" <jjsnyder@gw.dec.state.ny.us>
To: Joseph Goffman/DC/USEPA/US@EPA
Date: 09/20/2010 12:18 PM
Subject: NSPS

Joe, Would you and Gina be available to discuss 111(d) with Brian Turner of California and me on September 28 (or maybe Sept 29 if 9/28 is unavailable)? I'll call you to discuss.

Thanks, Jared

To: CN=Addie Johnson/OU=DC/O=USEPA/C=US@EPA[]
Cc: "Jared Snyder" [jjsnyder@gw.dec.state.ny.us]
Bcc: []
From: CN=Joseph Goffman/OU=DC/O=USEPA/C=US
Sent: Tue 9/21/2010 10:23:08 PM
Subject: Re: NSPS

Addie can set something up for the three of us. Gina will join us if her schedule permits (she might be traveling or getting ready to on the 28th/29th).. Thanks.

Joseph Goffman
Senior Counsel to the Assistant Administrator
Office of Air and Radiation
US Environmental Protection Agency
202 564 3201

From: Joseph Goffman/DC/USEPA/US
To: "Jared Snyder" <jjsnyder@gw.dec.state.ny.us>
Date: 09/21/2010 11:27 AM
Subject: Re: NSPS

Thanks for this and for your vmail. Let me touch base with Gina. Thanks.

Joseph Goffman
Senior Counsel to the Assistant Administrator
Office of Air and Radiation
US Environmental Protection Agency
202 564 3201

From: "Jared Snyder" <jjsnyder@gw.dec.state.ny.us>
To: Joseph Goffman/DC/USEPA/US@EPA
Date: 09/20/2010 12:18 PM
Subject: NSPS

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Thanks, Jared

To: "Doniger, David" [ddoniger@nrdc.org]; Cindy Huang" [Huang.Cindy@epamail.epa.gov]
Cc: "Adhar, Radha" [radhar@nrdc.org]
From: CN=Joseph Goffman/OU=DC/O=USEPA/C=US
Sent: Mon 3/21/2011 10:53:19 PM
Subject: Re: Meeting request
ddoniger@nrdc.org
www.nrdc.org
http://switchboard.nrdc.org/blogs/ddoniger/

Adding Cindy.

From: "Doniger, David" [ddoniger@nrdc.org]
Sent: 03/21/2011 06:40 PM AST
To: <hwang.cindy@epa.gov>
Cc: Joseph Goffman; "Adhar, Radha" <radhar@nrdc.org>
Subject: Meeting request

Cindy,

I am following up a conversation with Joe Goffman to ask for a meeting as soon as feasible with Gina McCarthy, Joe, and whomever they want to include, on the subject of the Section 111 standards for power plants.

Attendees on our side would include David Hawkins, Dan Lashof, Meleah Geertsma, and myself.

You could be in touch with me or (probably more productively) with our assistant, Radha Adhar, who is copied above. Radha's number is 202 289-2413.

David D. Doniger

Policy Director, Climate Center

Natural Resources Defense Council

1200 New York Ave., NW

Washington, DC 20005

Phone: (202) 289-2403

Cell: (202) 321-3435

Fax: (202) 789-0859

ddoniger@nrdc.org

on the web at www.nrdc.org

read my blog: http://switchboard.nrdc.org/blogs/ddoniger/

To: Michael Myers [Michael.Myers@ag.ny.gov]
Cc: []
Bcc: []
From: CN=Joseph Goffman/OU=DC/O=USEPA/C=US
Sent: Fri 10/14/2011 10:56:49 PM
Subject: just got your vmail

many meetings today. wanted to call you any way to thank you for the help with the settlement agreement and with the letter. very much appreciated. I will be around on Monday to follow up on the other subject you wanted to talk about. have a good weekend.

Joseph Goffman
Senior Counsel to the Assistant Administrator
Office of Air and Radiation
US Environmental Protection Agency
202 564 3201

To: "Michael J. Myers" [Michael.Myers@ag.ny.gov]
From: CN=Joseph Goffman/OU=DC/O=USEPA/C=US
Sent: Sun 10/16/2011 5:11:25 PM
Subject: Fw: just got your vmail

----- Original Message -----
From: Joseph Goffman
Sent: 10/14/2011 06:56 PM EDT
To: Michael Myers <Michael.Myers@ag.ny.gov>
Subject: just got your vmail

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Joseph Goffman
Senior Counsel to the Assistant Administrator
Office of Air and Radiation
US Environmental Protection Agency
202 564 3201

To: "Doniger, David" [ddoniger@nrdc.org]
Cc: []
Bcc: []
From: CN=Gina McCarthy/OU=DC/O=USEPA/C=US
Sent: Thur 6/9/2011 1:46:11 AM
Subject: Re: Our briefing
EPA WG June 6.pptx
ddoniger@nrdc.org
www.nrdc.org
http://switchboard.nrdc.org/blogs/ddoniger/

Thanks David. Let me take a quick look. I would never say no to a meeting with you. Let me see what my time looks like but its pretty tight. Will get back to you.

From: "Doniger, David" <ddoniger@nrdc.org>
To: Gina McCarthy/DC/USEPA/US@EPA
Date: 06/08/2011 02:53 PM
Subject: Our briefing

Hi Gina,

Nice to bump into you yesterday. Here is the presentation we gave to the work group. I want to draw your attention especially to option 2 for existing sources (see pages 7 and 13). This is an approach that would achieve reasonable-cost reductions from the existing fossil power plant fleet on a continuing basis. It is state-oriented, respects differences in state starting points, and avoids big transfers between states. It has other advantages. We'd like the opportunity to brief you before coming in to see the Administrator next Tuesday. Is that possible?

David

David D. Doniger
Policy Director, Climate Center
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1200 New York Ave., NW
Washington, DC 20005
Phone: (202) 289-2403
Cell: (202) 321-3435
Fax: (202) 789-0859
ddoniger@nrdc.org
on the web at www.nrdc.org
read my blog: http://switchboard.nrdc.org/blogs/ddoniger/

Technical and Legal Framework for Power Plant Carbon Emissions Standards Under Clean Air Act Section 111

June 6, 2011

Key Goals

- Avoid New High Emission Power Plants
- Cut Fossil Fuel Fleet Avg Emission Rate 10-15% by 2020
- Establish Robust Framework That Gets Tighter with Time

→ Set Standards for Combined Fossil EGU Source Category (i.e., merge Da with KKKK)

Title Page Photo Credit: http://www.sciencenews.org/view/access/id/32053/title/Clear_sky%3F

Legal Considerations
Selecting the Category: All Fossil-Fueled Power Plants

NRDC
The Earth's Best Defense

* "All fossil" category critical to harness all real-world control options, and achieve significant near- and mid-term GHG reductions
* EPA has broad authority under (b)(1)(A) to define source categories to fit the factual circumstances of specific industries
* "All fossil" category – for both (b) and (d) standards – reflects real-world operational and investment decisions
  - Power plants operated as an integrated system – interdependent management decisions on when to operate, build, upgrade, and retire units
  - Walling off coal plants in separate category arbitrarily restricts control options, yields small near-term reductions, and closes off longer-term reduction options
* "All fossil" consistent with *New York* settlement, which does not limit a broader-than-Da approach

Legal Considerations
Contribution Determination

* No new "endangerment" determination needed under (b)(1)(A)
  - 2009 decision covered GHG air pollution in atmosphere from all sources
* Question re: need for new "contributes significantly" determination
  - May be needed whether or not categories are merged
  - Easy to make for "all fossil" category (40% U.S. CO_2)
* Similar result if analyzed as (b)(1)(B) "revision"
  - Long-standing EPA interpretation requires "significant" emissions when adding new pollutant
* "Significant" is a low threshold, easy to clear either way

New Units -- 111(b)
Key Design Features

- Combine Da and KKKK, Separate Category for Peakers
- Set Standard for Fossil Units at 850 lbs/MWh (except peakers)
- Allow Units to Time-Average Over First 30 Years of Operations
- Technically and Economically Feasible Based On:
  - Natural Gas Combined Cycle

  OR

  - Coal with CCS Installed After 10 years

    (1850 lbs/MWh for 10 years; 350 lbs/MWh for 20 years)

Legal Considerations – 111(b)
"All Fossil," BDT, and 30-Yr Average Standard Go Together

NRDC
THE EARTH'S BEST DEFENSE

* 850 lbs/MWh new source standard for "all fossil" category achievable at reasonable cost by combined cycle gas turbines
* Also achievable by new coal with CCS on time average basis over first 30 years
  - E.g., 1850 lbs/MWh for 10 years, 350 lbs/MWh for 20 years
  - Other averaging profiles possible, allowing earlier or later adoption of CCS
* Source commits to an enforceable averaging profile in permit at start-up, with penalties for "excess" emissions in early years held in abeyance as long as source performs "on profile"
  - Penalties enforced for accumulated excess emissions if source fails to perform on profile
* *Portland Cement:* "Section 111 looks toward what may fairly be projected for the regulated future;" "Administrator may make a projection based on existing technology, though that projection is subject to the restraints of reasonableness and cannot be based on 'crystal ball' inquiry"

Existing Units -- 111(d)
Key Design Features

- Combine Da and KKKK
- Allow Emission Averaging Among All Fossil Units
- Credit for Incremental Renewables & DSM

OPTION 1

- Required to Meet New Source Standard Within 3 years
- Safe Harbor Until End of Remaining Useful Life
- Credit for Early Retirement

OPTION 2

- Set Statewide Average Fossil Fuel Emission Rates
- Start at Current Rate and Decline [2%] per Year on Average
- Converge Toward National Average in [2050]

Legal Considerations – 111(d)
"All Fossil," BDT, and Emission-Rate Averaging Go Together

NRDC
THE EARTH'S BEST DEFENSE

* What's BDT depends on how compliance is defined
  - Unit-by-unit: Each unit has to comply with emission rate on its own
  - Emission-rate averaging: Provides additional compliance option for each unit
  - Emission-rate averaging across "all fossil" category: Provides broadest compliance options for each unit
* Narrower compliance options mean BDT achieves less emission reduction
  - Sources can't adopt lower cost compliance options
  - EPA's ability to "find" all available, reasonable-cost options is limited
* Broader compliance options mean BDT can – and must – achieve more reductions
  - Sources have more options at given cost; easier for EPA to identify and support them

Legal Considerations
Emission-Rate Averaging, Safe Harbor in 111(d) State Plans

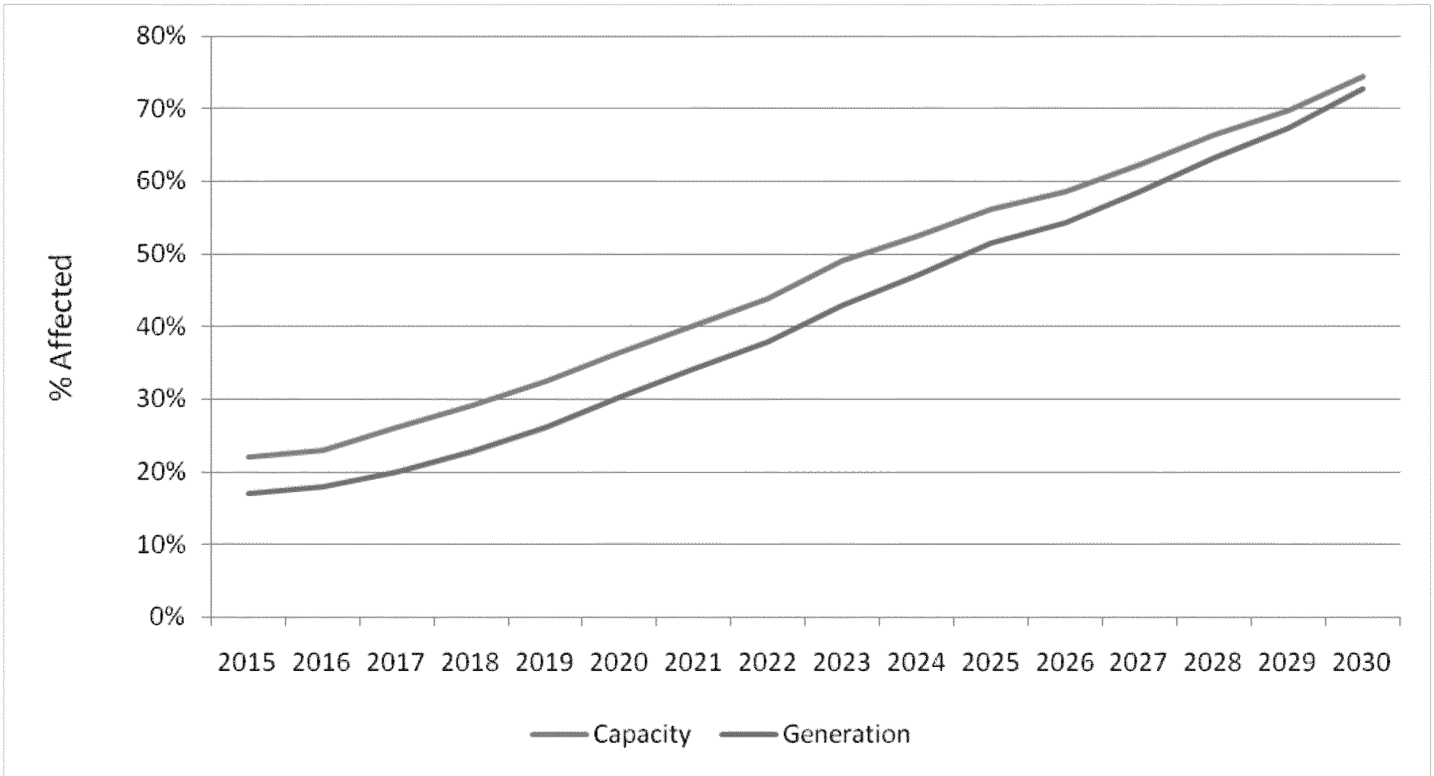
NRDC
THE EARTH'S BEST DEFENSE

* 111(d) : EPA regulations to provide for state plan procedure similar to Section 110
* 110(a)(2)(A): To meet "applicable requirements *of this chapter*" SIPs must include enforceable measures "including economic incentives … as may be necessary or appropriate to meet *the applicable requirements of this chapter*."
  - States may use SIPs to meet state plan requirements of 111(d); emission-rate averaging is a permissible economic incentive
* Emission-rate averaging limited to existing sources (i.e., not based on "best system")
* Precedent of NOx averaging in MWC rules
* Not reasonable for pollutants with location-specific impacts (e.g., mercury)
* Safe harbor for under-50-year plants implements "remaining useful life"
  - EPA emission guideline can specify terms for approvable plans and prohibit other unit-specific exemptions

Existing Units -- 111(d)
OPTION 1

- Required to Meet New Source Standard Within 3 years
- Safe Harbor Until End of Remaining Useful Life
  - Provided No Increase in Emissions Above Baseline
- Allow Emission Averaging Among All Fossil Units
- Credit for Early Retirement
- Credit for Incremental Renewables & DSM

Phase In Based on End of Remaining Useful Life (Age 50)
OPTION 1: Percentage of Coal Fleet Affected Over Time



Source: EPA NEEDS 4.1 data; Calculations based on trigger date of 50 years.

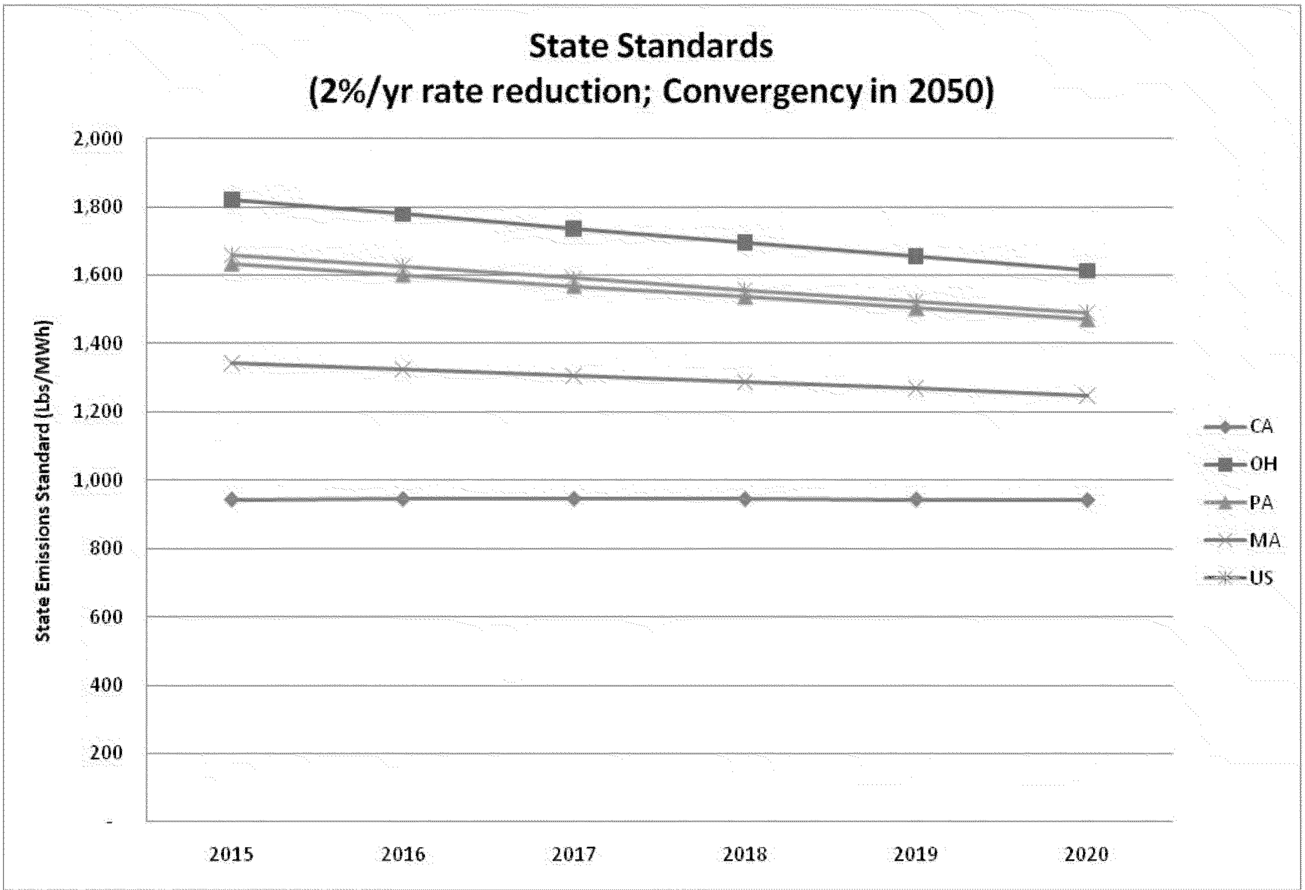
Existing Units -- 111(d)
OPTION 2

NRDC
THE EARTH'S BEST DEFENSE

- Each State Sets Fossil Emission Rate Baseline [2008-10 Avg.]
- State Emission Rates Start at Baseline & Decline by [2%] per Year on Average
- State Emissions Converge Toward National Average [in 2050]
- Allow Emission Averaging Among All Fossil Units
- Optional: Credit for Incremental Renewables & DSM

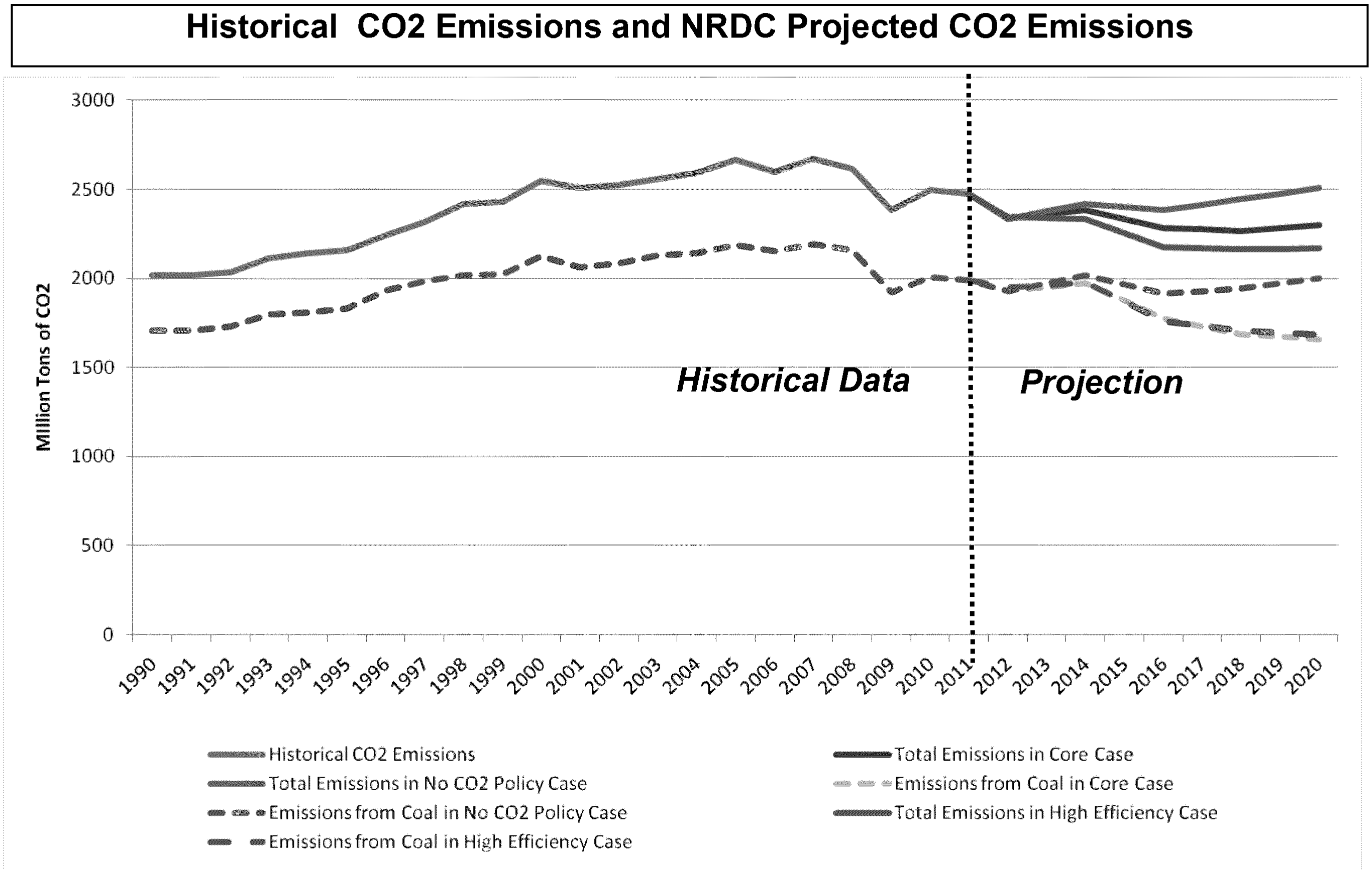
Converging State Emission Standards

OPTION 2: Fossil Fuel Emission Rates, Sample States and National Avg.



OPTION 1 Results No CO2 Policy, Core, High Efficiency Cases

U.S. EGU CO2 Emissions (Million Short Tons)

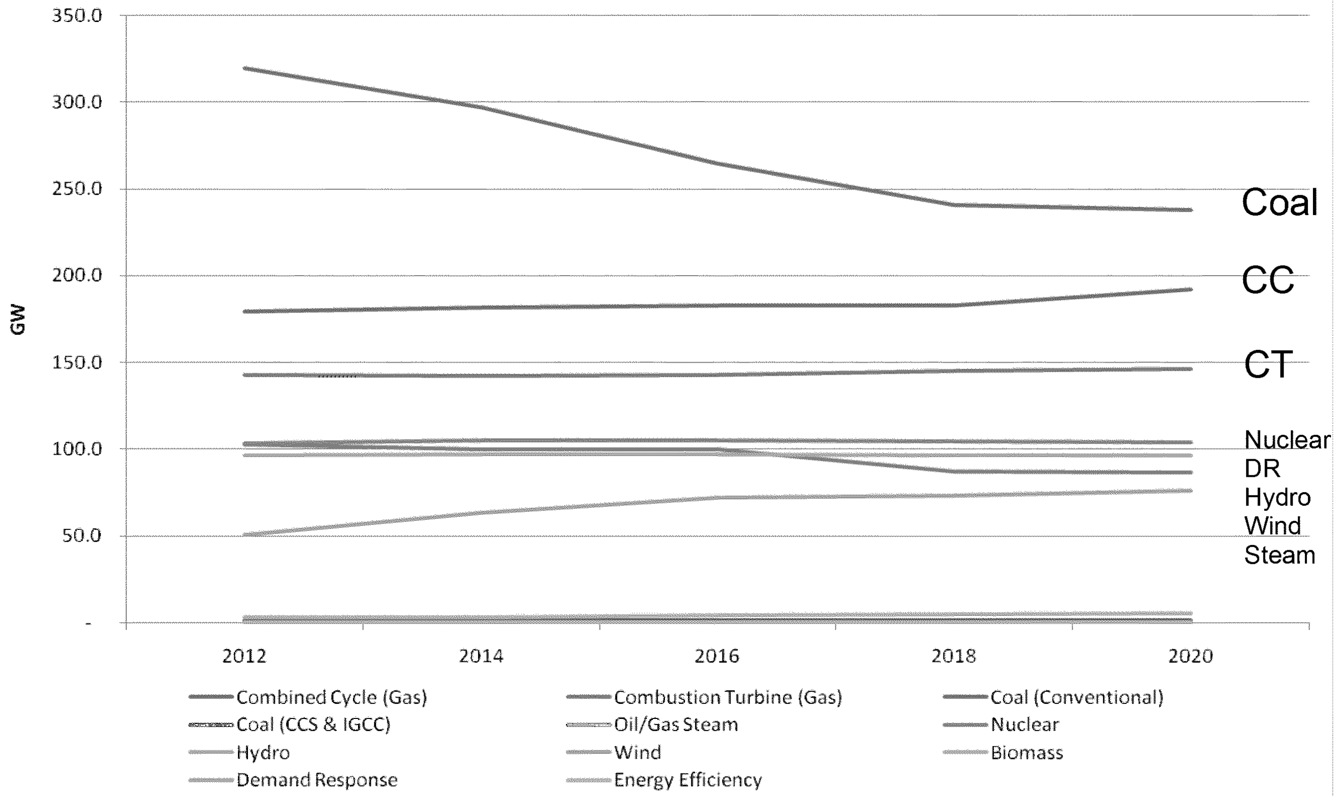


Source for historical CO2 emissions data: EIA. 2011 Figure derived from AEO 2011.

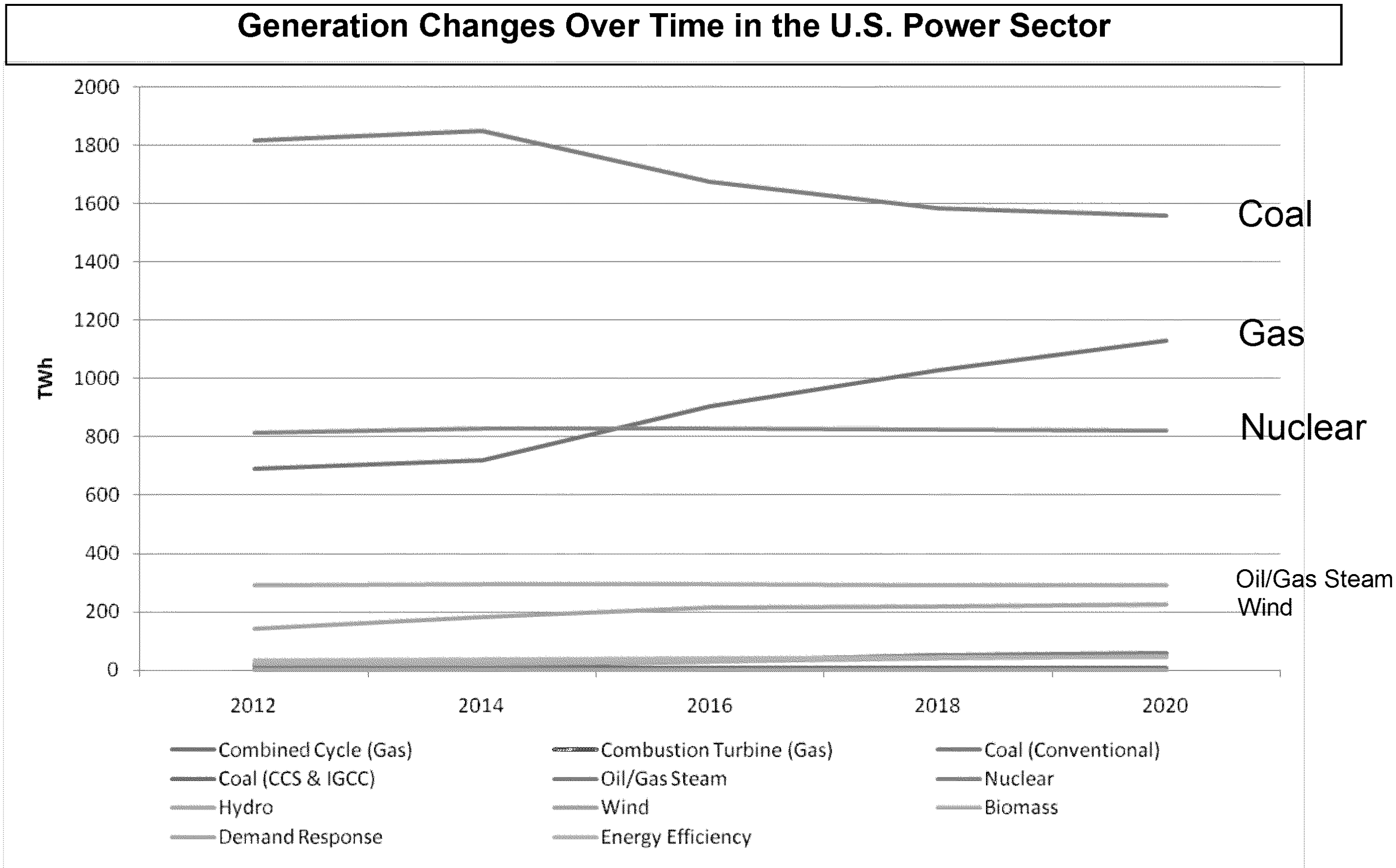
Results of Core Case Model Run

U.S. Capacity

Capacity Changes Over Time in the U.S. Power Sector



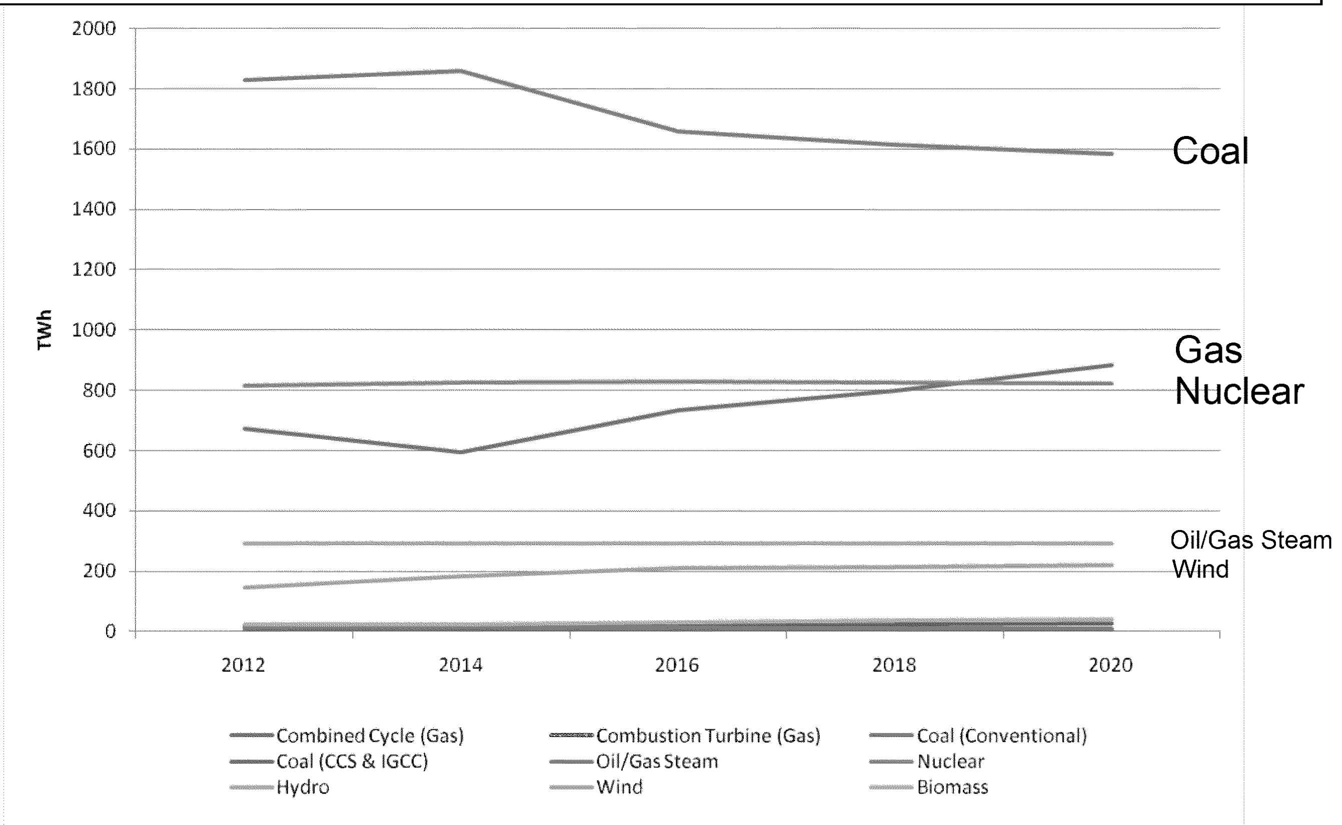
Results of Core Case Model Run
U.S. Generation



Results of High Efficiency Case Model Run

U.S. Generation

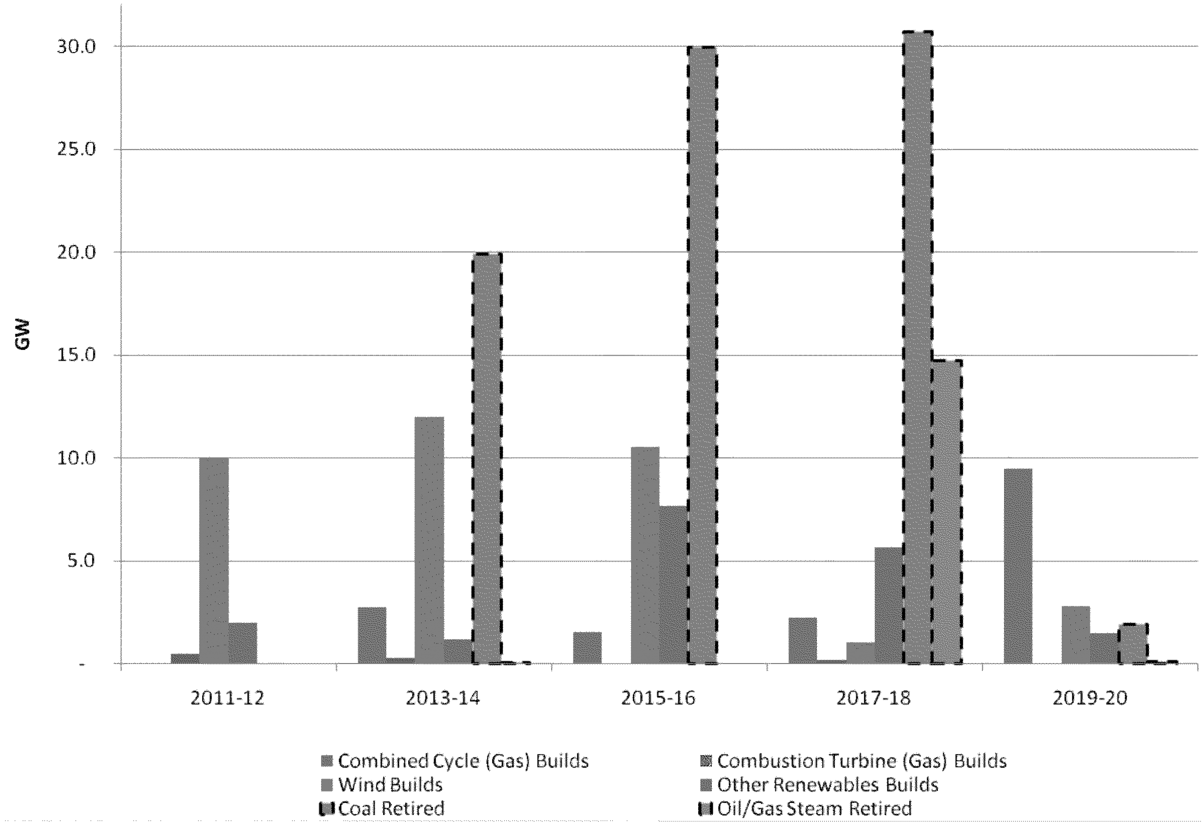
Generation Changes Over Time in the U.S. Power Sector



Results of Core Case Model Run

U.S. Retirements and New Builds

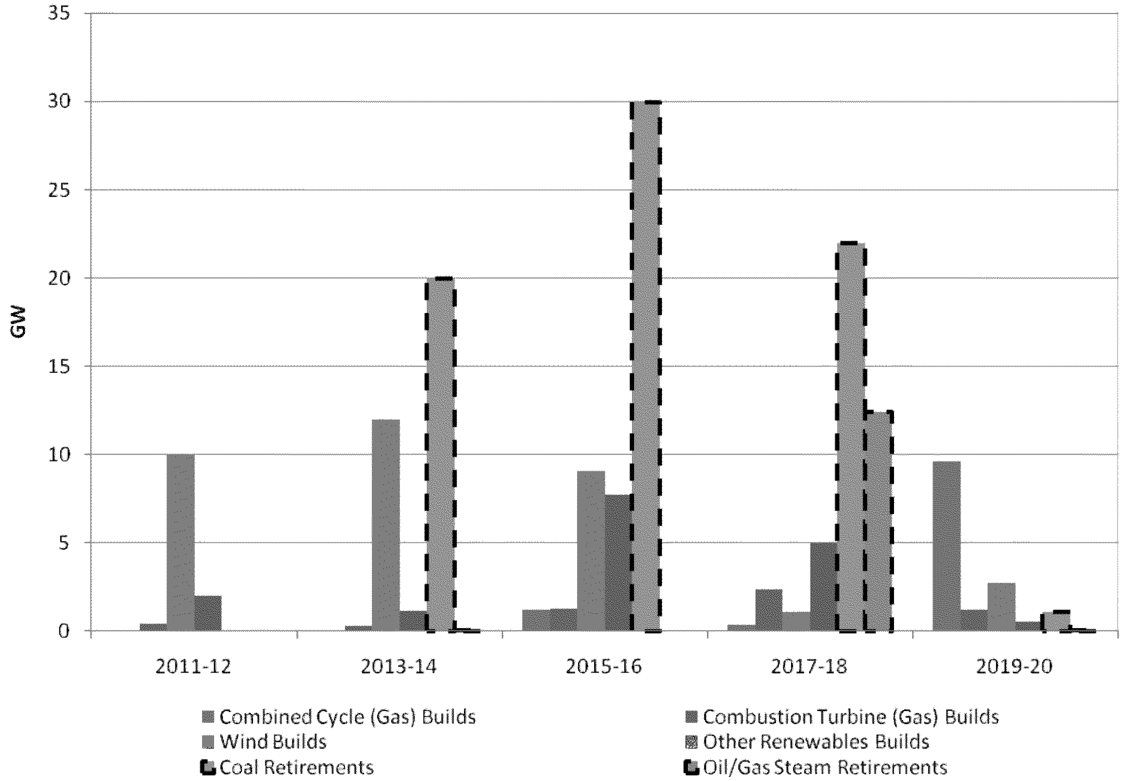
Power Plant Retirements and New Builds



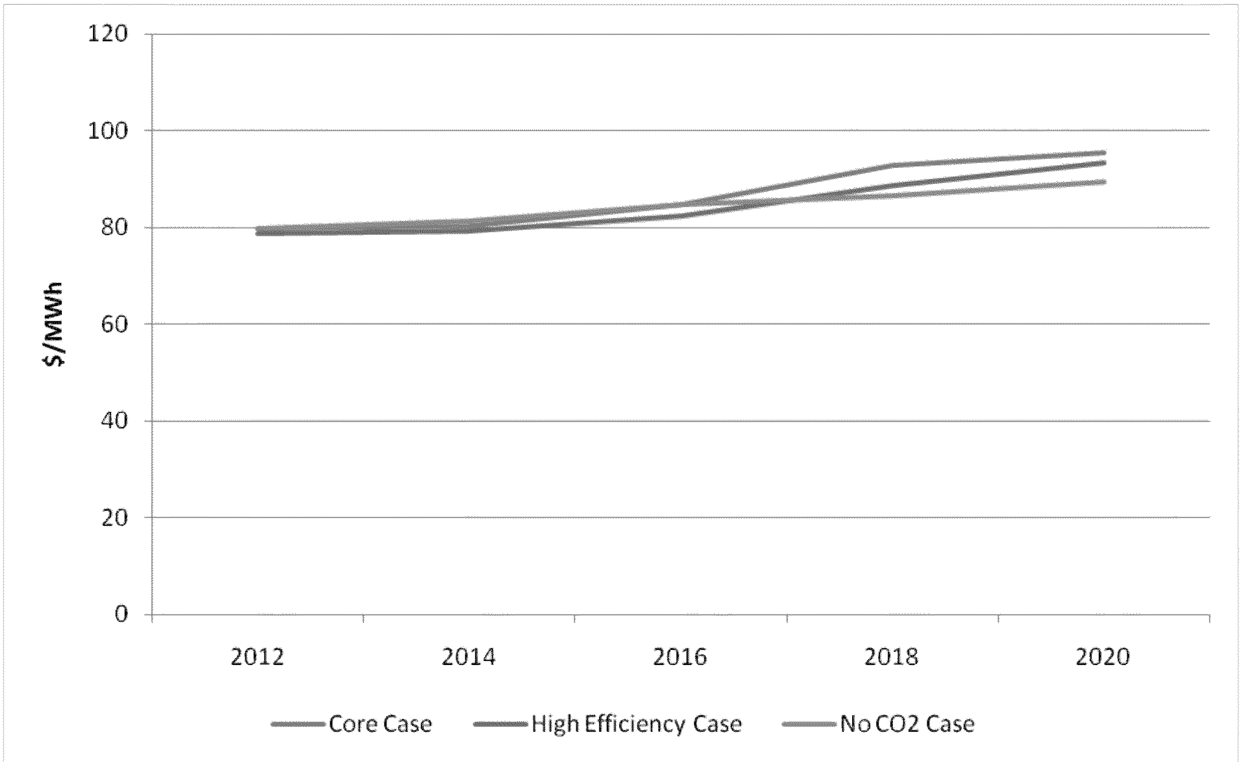
Results of High Efficiency Case Model Run

U.S. Retirements and New Builds

Power Plant Retirements and New Builds



U.S. Retail Electricity Price Impacts (National Average)



Note: National average based on generation-weighted average of PJM, Southeast, MISO, NYISO, ISONE, accounting for 60% of national generation

Contact Information

David Hawkins | Climate Center | Natural Resources Defense Council
Office: 202-289-6868 | 1200 New York Avenue, NW, Suite 400, Washington, DC 20005
dhawkins@nrdc.org | www.nrdc.org

Dan Lashof | Climate Center | Natural Resources Defense Council
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dlashof@nrdc.org | www.nrdc.org

David Doniger | Climate Center | Natural Resources Defense Council
Office: 202-289-6868 | 1200 New York Avenue, NW, Suite 400, Washington, DC 20005
ddoniger@nrdc.org | www.nrdc.org

To: "Jared Snyder" [jjsnyder@gw.dec.state.ny.us]
Cc: "Daniel Esty" [Daniel.Esty@ct.gov]; N=Joseph Goffman/OU=DC/O=USEPA/C=US@EPA;"Ken (DEP) Kimmell" [ken.kimmell@state.ma.us]; Ken (DEP) Kimmell" [ken.kimmell@state.ma.us]; uang.cindy@epa.gov;Zinger.Don@EPA.GOV[]; inger.Don@EPA.GOV[]
Bcc: []
From: CN=Gina McCarthy/OU=DC/O=USEPA/C=US
Sent: Fri 9/16/2011 7:45:23 PM
Subject: Re: call on 111(d) standards?

Happy to talk Jared. Will have Cindy schedule when she gets back on Monday.

From: "Jared Snyder" <jjsnyder@gw.dec.state.ny.us>
To: Gina McCarthy/DC/USEPA/US@EPA
Cc: "Daniel Esty" <Daniel.Esty@ct.gov>, Joseph Goffman/DC/USEPA/US@EPA, "Ken (DEP) Kimmell" <ken.kimmell@state.ma.us>
Date: 09/16/2011 09:02 AM
Subject: call on 111(d) standards?

Hi Gina,

Commissioners Dan Esty and Ken Kimmell and I would like to speak with you briefly about the timing of EPA's section 111(d) standards and the impact of EPA's schedule on RGGI program review. Can you give us a couple of times that you could be available for a short conversation next week?

Thanks, Jared

Jared Snyder
Assistant Commissioner
Air Resources, Climate Change and Energy
N.Y.S. Dept of Environmental Conservation
625 Broadway, 14th Floor
Albany, New York 12233-1010
(518) 402-8537 phone
(518) 813-1670 mobile
(518) 402-9016 fax

To: "Jared Snyder" [jjsnyder@gw.dec.state.ny.us]
From: CN=Gina McCarthy/OU=DC/O=USEPA/C=US
Sent: Fri 9/16/2011 9:27:20 PM
Subject: Re: call on 111(d) standards?

Enjoy the weekend Jared. Thanks for the kind words re: Sam. He is working like crazy to resolve these issues.

----- Original Message -----
From: "Jared Snyder" [jjsnyder@gw.dec.state.ny.us]
Sent: 09/16/2011 05:14 PM AST
To: Gina McCarthy
Cc: Cindy Huang; Don Zinger; Joseph Goffman
Subject: Re: call on 111(d) standards?

Thanks Gina. I'll be out of the office on Monday but Cindy should contact my assistant Kim Sarbo.

By the way, I want to pass on our great appreciation for the attention that Sam N and his staff have paid to addressing our CSAPR issues. I'm told that Sam has been terrific to work with.

Thanks and have a good weekend. J

>>> <McCarthy.Gina@epamail.epa.gov> 9/16/2011 3:45 PM >>>
Happy to talk Jared. Will have Cindy schedule when she gets back on Monday.

From: "Jared Snyder" <jjsnyder@gw.dec.state.ny.us>
To: Gina McCarthy/DC/USEPA/US@EPA
Cc: "Daniel Esty" <Daniel.Esty@ct.gov>, Joseph Goffman/DC/USEPA/US@EPA, "Ken (DEP) Kimmell" <ken.kimmell@state.ma.us>
Date: 09/16/2011 09:02 AM
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Thanks, Jared

Jared Snyder
Assistant Commissioner
Air Resources, Climate Change and Energy
N.Y.S. Dept of Environmental Conservation

625 Broadway, 14th Floor
Albany, New York 12233-1010
(518) 402-8537 phone
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To: LisaP Jackson/DC/USEPA/US@EPA;Gina McCarthy/DC/USEPA/US@EPA;David McIntosh/DC/USEPA/US@EPA;"Goo, Michael" [Michael.Goo@mail.house.gov]; ina McCarthy/DC/USEPA/US@EPA;David McIntosh/DC/USEPA/US@EPA;"Goo, Michael" [Michael.Goo@mail.house.gov]; avid McIntosh/DC/USEPA/US@EPA;"Goo, Michael" [Michael.Goo@mail.house.gov]; Goo, Michael" [Michael.Goo@mail.house.gov]
From: "Doniger, David"
Sent: Wed 4/6/2011 4:53:20 AM
Subject: Blog: Congressional Carbon Circus
http://switchboard.nrdc.org/blogs/ddoniger/congressional_carbon_circus.html
promised to veto
spoke out
national
district-by-district
Assessing the Impact of EPA's Greenhouse Gas Regulations on Small Business
here
here
ddoniger@nrdc.org
www.nrdc.org
http://switchboard.nrdc.org/blogs/ddoniger/

http://switchboard.nrdc.org/blogs/ddoniger/congressional_carbon_circus.html

Congressional Carbon Circus

There's lots going on in the center ring of the Congressional Carbon Circus today. Both the House and Senate are expected to vote this afternoon on bills to block the Environmental Protection Agency (EPA) from doing its job under the Clean Air Act to safeguard Americans from the dangerous carbon pollution that drives global warming. And Republicans keep trying to force EPA-blocking "riders" onto funding legislation that must pass this week to avoid shutting down the government.

To their credit, the Obama administration and Congressional Democrats appear to be standing firm. Yesterday the administration promised to veto the EPA-blocking bill that will hit House floor today, and the President spoke out against the budget riders: "What we can't be doing is using last year's budget process to have arguments about abortion; to have arguments about the Environmental Protection Agency."

While the Republicans appeal to their base, polls show that the president and the Democrats are on surer political ground. In both national and district-by-district polls, Americans strongly back EPA authority to protect their health from carbon pollution, by margins of well over 60 percent.

As this high drama plays out in the center ring, I'll be testifying in one of the circus's smaller side rings, at a hearing on "Assessing the Impact of EPA's Greenhouse Gas Regulations on Small Business." This is another in a series of when-did-you-stop-beating-your-wife hearings on the costs (but never the benefits) of government regulations, before subcommittees of House Oversight and Investigations Committee chaired by Rep. Darrell Issa (R-CA).

The script calls for the majority's witnesses to expound on how EPA's carbon safeguards are killing the job generators of our economy. I will offer the token dissenting view. Here are highlights of what I'll say (my full statement is posted here and you can watch live here):

Mr. Chairman, the other witnesses you have heard are pursuing a false story-line that demonizes the Environmental Protection Agency and the modest steps it is taking to begin reducing dangerous carbon pollution. Contrary to that false story-line, EPA is doing just what Congress told the agency to do when it wrote the Clean Air Act. Congress gave EPA the duty to keep abreast of developing science, and to act when science shows that pollution endangers our health and welfare.

The EPA endangerment finding is backed by solid scientific authority. America's own most authoritative scientific body, the National Academy of Sciences (NAS), concluded in 2010:

"Some scientific conclusions or theories have been so thoroughly examined and tested, and supported by so many independent observations and results, that their likelihood of subsequently being found to be wrong is vanishingly small. Such conclusions and theories are then regarded as settled facts. This is the case for the conclusions that the Earth system is warming and that much of this warming is very likely due to human activities."

H.R. 910, the extreme bill that the House of Representatives is on the verge of adopting, would take the unprecedented step of repealing an expert agency's formal scientific finding of a threat to health and welfare. Congress has never done this before, and you should not start now. Politicians do not prosper long when they put themselves in the position of denying modern science. Repealing EPA's scientific determination that carbon pollution causes dangerous climate change would be like repealing the Surgeon General's finding that tobacco smoke causes cancer. H.R. 910 will harm the health and the pocketbook of millions of Americans. It is both bad policy and deeply unpopular.

The Clean Air Act's critics get the economics of environmental safeguards completely backwards. Rather than hurting economic growth, four decades of data show that the Clean Air Act helps our economy grow while it protects the health of millions of Americans. Over the past 40 years, the American economy has tripled in size while we've cut some forms of pollution by more than 60 percent. That's because the Clean Air Act does not demand the impossible – it requires only pollution controls that are achievable and affordable. That's just as true when setting carbon pollution standards as it has been for other kinds of pollution.

EPA is taking great care to protect American families and American small businesses that are the focus of this hearing. In fact, EPA has set carbon pollution standards for new cars, SUVs, and over-the-road trucks that will save billions of dollars for American families and small businesses by cutting their gasoline and diesel fuel bills. And EPA has gone to great lengths to exempt the millions of American small businesses from any obligations as it begins to address carbon pollution from only the very largest industrial sources, such power plants and oil refineries.

Thanks to EPA's landmark clean car standards, small businesses will save big-time at the gas pump. Under the Clean Car Agreement brokered by the Obama administration, EPA, acting together with the Department of Transportation (DOT) and California, has set combined carbon pollution and fuel economy standards that will lower gasoline bills for American small businesses and families by billions of dollars. The first round of standards, for 2012-2016 model cars, SUVs, vans, and pick-ups, will save small business owners as much as $3,000 over the life the vehicle. EPA's clean car standards for 2017-2025 will save small businesses even more – as much as another $7,400 per car. I should note that these calculations were based on gasoline costs starting at $2.61/gallon! At today's and tomorrow's higher gas prices, the savings will be even greater.

EPA is also working with DOT and California on the first-ever carbon pollution and fuel economy standards for over-the-road trucks. Those standards, proposed last year, will save the owner of a heavy-duty truck up to $74,000 over the truck's useful life. The money saved on diesel fuel will stay in the pockets of truck and fleet owners and will enable them to pass on savings to every American in lower costs for food and other goods.

Lobbyists for some of America's biggest polluters are falsely claiming that the Clean Air Act's carbon requirements will fall on millions of apartment buildings, office buildings, farms, and even churches. The truth is otherwise: EPA has exempted all small sources of carbon pollution from permit requirements for new and expanded sources. Instead, directly in line with congressional intent, EPA has focused those permit requirements on only the largest new and expanded sources of carbon pollution, such as power plants, oil refineries, and other big polluters.

When a company wants to build or expand a big plant that will operate for decades, it is only common sense to take reasonable steps to reduce how much dangerous pollution it will put into the air. So for decades, the Clean Air Act has required that someone – either the state's environmental agency or the EPA as a last resort – review what the new or expanded plant can reasonably do to reduce its pollution, and put achievable and affordable emission limits into a construction permit. But this review of available and affordable pollution control measures applies only to the largest sources of carbon pollution, like new power plants, oil refinery expansions, or other large projects. This is the same review that has been undertaken for decades for similar sources of other pollutants.

EPA has been sued by dozens of trade associations, companies, and right-leaning advocacy groups representing the country's biggest polluters. But when put to the test of proving their claims, they failed. The courts have found no merit in their claims of harm. This is no surprise, because the court challengers – like the lobbyists who come up to the Hill – are seeking not relief for the small fries, but special favors for the biggest polluters – power plants, oil refineries, and the like. These pollution giants cannot complain to the courts about EPA's exempting smaller sources. Their attempt to hide behind the skirts of small businesses should fare no better here on the Hill.

Congressmen, you deny the science at your peril. Likewise, you buy into phony story-lines about burdens on small business at your peril. As I mentioned, large majorities of the American people support the Clean Air Act and want EPA to do its job to control air pollution. They specifically want EPA to do its job to safeguard us from carbon pollution. I've appended this polling data to my testimony as food for thought, and I welcome your questions.

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To: Gina McCarthy/DC/USEPA/US@EPA[]
From: "Adhar, Radha"
Sent: Tue 3/22/2011 9:16:40 PM
Subject: Accepted: Meeting with NRDC on Section 111 Standards for Power Plants

To: Gina McCarthy/DC/USEPA/US@EPA[]
From: "Doniger, David"
Sent: Tue 3/22/2011 9:21:41 PM
Subject: Accepted: Meeting with NRDC on Section 111 Standards for Power Plants

To: Gina McCarthy/DC/USEPA/US@EPA[]
From: "Doniger, David"
Sent: Tue 3/22/2011 9:21:48 PM
Subject: Accepted: Meeting with NRDC on Section 111 Standards for Power Plants

To: Gina McCarthy/DC/USEPA/US@EPA[]
From: "Hawkins, Dave"
Sent: Thur 3/24/2011 9:00:49 PM
Subject: Accepted: Meeting with NRDC on Section 111 Standards for Power Plants

To: Gina McCarthy/DC/USEPA/US@EPA[]
From: "Hawkins, Dave"
Sent: Thur 3/24/2011 9:03:42 PM
Subject: Accepted: Meeting with NRDC on Section 111 Standards for Power Plants

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From: "Adhar, Radha"
Sent: Thur 3/24/2011 9:03:47 PM
Subject: Accepted: Meeting with NRDC on Section 111 Standards for Power Plants

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From: "Lashof, Dan"
Sent: Thur 3/24/2011 9:03:45 PM
Subject: Accepted: Meeting with NRDC on Section 111 Standards for Power Plants

To: Gina McCarthy/DC/USEPA/US@EPA[]
From: "Lashof, Dan"
Sent: Fri 4/1/2011 1:47:07 PM
Subject: Accepted: Meeting with NRDC on Section 111 Standards for Power Plants

To: Gina McCarthy/DC/USEPA/US@EPA[]
From: "Adhar, Radha"
Sent: Fri 4/1/2011 1:47:04 PM
Subject: Accepted: Meeting with NRDC on Section 111 Standards for Power Plants

To: Gina McCarthy/DC/USEPA/US@EPA[]
From: "Hawkins, Dave"
Sent: Fri 4/1/2011 1:47:09 PM
Subject: Accepted: Meeting with NRDC on Section 111 Standards for Power Plants

To: Gina McCarthy/DC/USEPA/US@EPA[]
From: "Doniger, David"
Sent: Fri 4/1/2011 3:02:10 PM
Subject: Accepted: Meeting with NRDC on Section 111 Standards for Power Plants

To: Gina McCarthy/DC/USEPA/US@EPA[]
From: "Doniger, David"
Sent: Wed 6/8/2011 6:52:39 PM
Subject: Our briefing
EPA WG June 6.pptx
ddoniger@nrdc.org
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http://switchboard.nrdc.org/blogs/ddoniger/

Hi Gina,

Nice to bump into you yesterday. Here is the presentation we gave to the work group. I want to draw your attention especially to option 2 for existing sources (see pages 7 and 13). This is an approach that would achieve reasonable-cost reductions from the existing fossil power plant fleet on a continuing basis. It is state-oriented, respects differences in state starting points, and avoids big transfers between states. It has other advantages. We'd like the opportunity to brief you before coming in to see the Administrator next Tuesday. Is that possible?

David

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Technical and Legal Framework for Power Plant Carbon Emissions Standards Under Clean Air Act Section 111

June 6, 2011

Key Goals

NRDC
THE EARTH'S BEST DEFENSE

- Avoid New High Emission Power Plants
- Cut Fossil Fuel Fleet Avg Emission Rate 10-15% by 2020
- Establish Robust Framework That Gets Tighter with Time

→ Set Standards for Combined Fossil EGU Source Category (i.e., merge Da with KKKK)

Title Page Photo Credit: http://www.sciencenews.org/view/access/id/32053/title/Clear_sky%3F

Legal Considerations
Selecting the Category: All Fossil-Fueled Power Plants

* "All fossil" category critical to harness all real-world control options, and achieve significant near- and mid-term GHG reductions
* EPA has broad authority under (b)(1)(A) to define source categories to fit the factual circumstances of specific industries
* "All fossil" category – for both (b) and (d) standards – reflects real-world operational and investment decisions
  - Power plants operated as an integrated system – interdependent management decisions on when to operate, build, upgrade, and retire units
  - Walling off coal plants in separate category arbitrarily restricts control options, yields small near-term reductions, and closes off longer-term reduction options
* "All fossil" consistent with *New York* settlement, which does not limit a broader-than-Da approach

Legal Considerations
Contribution Determination

* No new "endangerment" determination needed under (b)(1)(A)
  - 2009 decision covered GHG air pollution in atmosphere from all sources
* Question re: need for new "contributes significantly" determination
  - May be needed whether or not categories are merged
  - Easy to make for "all fossil" category (40% U.S. CO_2)
* Similar result if analyzed as (b)(1)(B) "revision"
  - Long-standing EPA interpretation requires "significant" emissions when adding new pollutant
* "Significant" is a low threshold, easy to clear either way

New Units -- 111(b)
Key Design Features

- Combine Da and KKKK, Separate Category for Peakers
- Set Standard for Fossil Units at 850 lbs/MWh (except peakers)
- Allow Units to Time-Average Over First 30 Years of Operations
- Technically and Economically Feasible Based On:
  - Natural Gas Combined Cycle

  OR

  - Coal with CCS Installed After 10 years

    (1850 lbs/MWh for 10 years; 350 lbs/MWh for 20 years)

Legal Considerations – 111(b)
"All Fossil," BDT, and 30-Yr Average Standard Go Together

NRDC
THE EARTH'S BEST DEFENSE

* 850 lbs/MWh new source standard for "all fossil" category achievable at reasonable cost by combined cycle gas turbines
* Also achievable by new coal with CCS on time average basis over first 30 years
  - E.g., 1850 lbs/MWh for 10 years, 350 lbs/MWh for 20 years
  - Other averaging profiles possible, allowing earlier or later adoption of CCS
* Source commits to an enforceable averaging profile in permit at start-up, with penalties for "excess" emissions in early years held in abeyance as long as source performs "on profile"
  - Penalties enforced for accumulated excess emissions if source fails to perform on profile
* *Portland Cement:* "Section 111 looks toward what may fairly be projected for the regulated future;" "Administrator may make a projection based on existing technology, though that projection is subject to the restraints of reasonableness and cannot be based on 'crystal ball' inquiry"

Existing Units -- 111(d)
Key Design Features

- Combine Da and KKKK
- Allow Emission Averaging Among All Fossil Units
- Credit for Incremental Renewables & DSM

OPTION 1

- Required to Meet New Source Standard Within 3 years
- Safe Harbor Until End of Remaining Useful Life
- Credit for Early Retirement

OPTION 2

- Set Statewide Average Fossil Fuel Emission Rates
- Start at Current Rate and Decline [2%] per Year on Average
- Converge Toward National Average in [2050]

Legal Considerations – 111(d)
"All Fossil," BDT, and Emission-Rate Averaging Go Together

NRDC
THE EARTH'S BEST DEFENSE

* What's BDT depends on how compliance is defined
  - Unit-by-unit: Each unit has to comply with emission rate on its own
  - Emission-rate averaging: Provides additional compliance option for each unit
  - Emission-rate averaging across "all fossil" category: Provides broadest compliance options for each unit
* Narrower compliance options mean BDT achieves less emission reduction
  - Sources can't adopt lower cost compliance options
  - EPA's ability to "find" all available, reasonable-cost options is limited
* Broader compliance options mean BDT can – and must – achieve more reductions
  - Sources have more options at given cost; easier for EPA to identify and support them

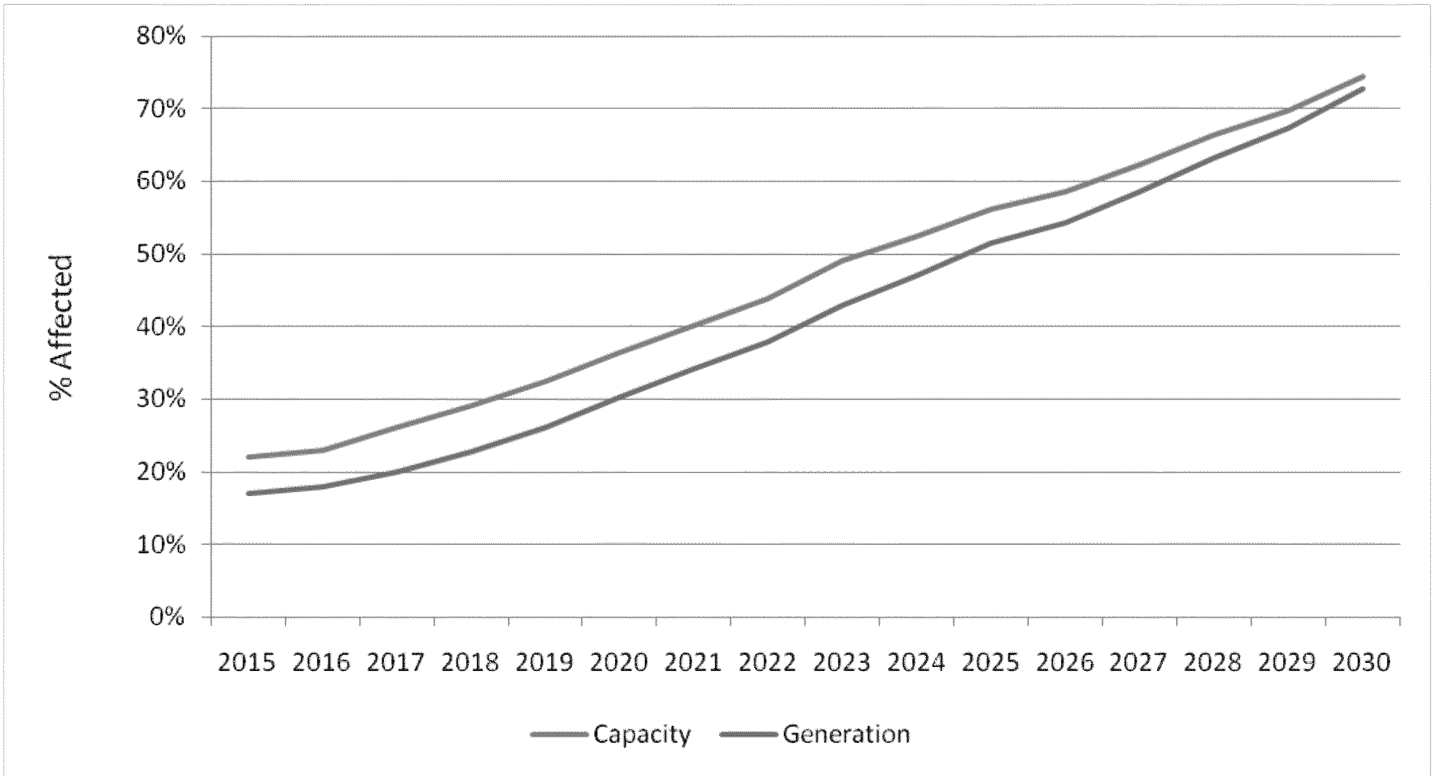
Legal Considerations
Emission-Rate Averaging, Safe Harbor in 111(d) State Plans

* 111(d) : EPA regulations to provide for state plan procedure similar to Section 110
* 110(a)(2)(A): To meet "applicable requirements *of this chapter*" SIPs must include enforceable measures "including economic incentives … as may be necessary or appropriate to meet *the applicable requirements of this chapter*."
  – States may use SIPs to meet state plan requirements of 111(d); emission-rate averaging is a permissible economic incentive
* Emission-rate averaging limited to existing sources (i.e., not based on "best system")
* Precedent of NOx averaging in MWC rules
* Not reasonable for pollutants with location-specific impacts (e.g., mercury)
* Safe harbor for under-50-year plants implements "remaining useful life"
  – EPA emission guideline can specify terms for approvable plans and prohibit other unit-specific exemptions

Existing Units -- 111(d)
OPTION 1

- Required to Meet New Source Standard Within 3 years
- Safe Harbor Until End of Remaining Useful Life
  - Provided No Increase in Emissions Above Baseline
- Allow Emission Averaging Among All Fossil Units
- Credit for Early Retirement
- Credit for Incremental Renewables & DSM

Phase In Based on End of Remaining Useful Life (Age 50)
OPTION 1: Percentage of Coal Fleet Affected Over Time



Source: EPA NEEDS 4.1 data; Calculations based on trigger date of 50 years.

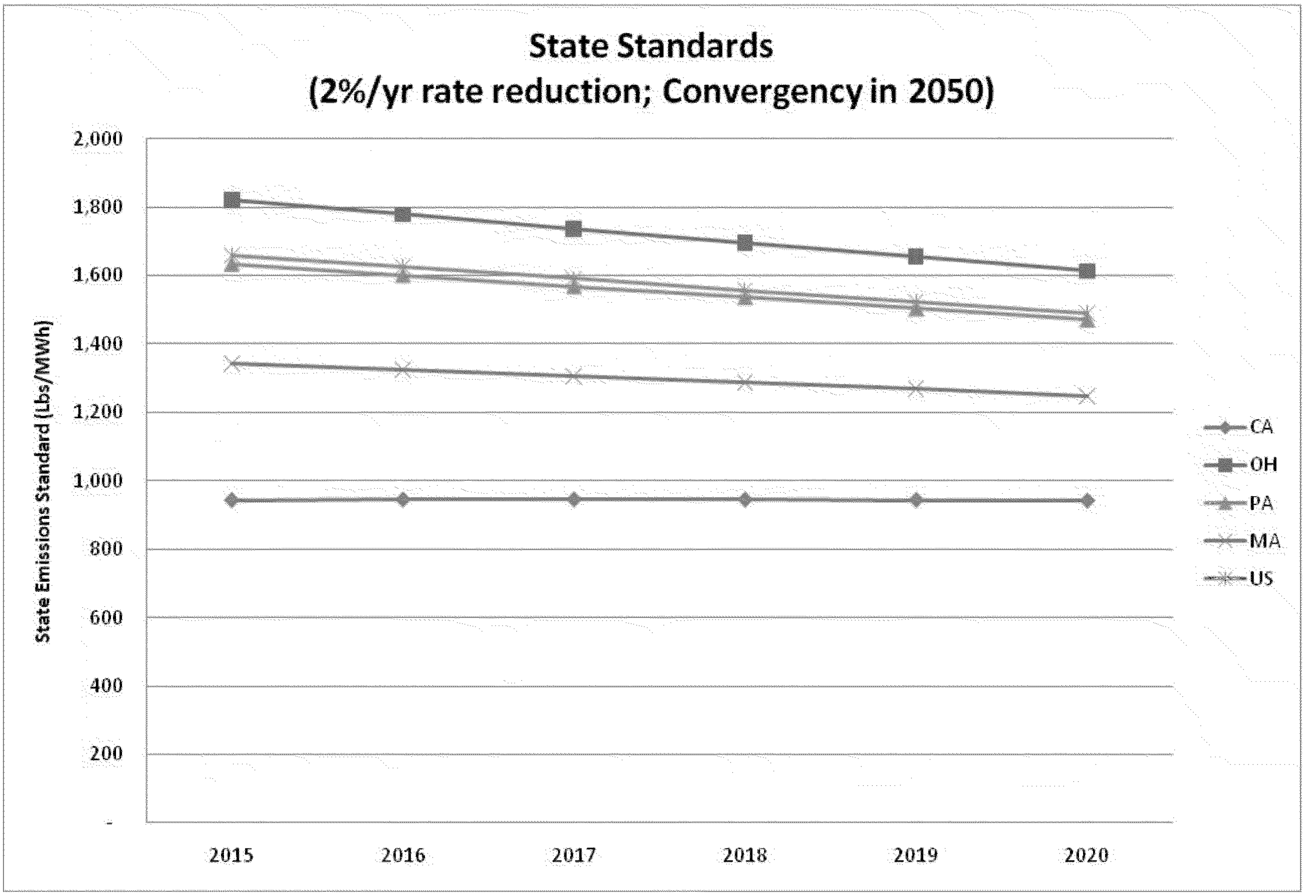
Existing Units -- 111(d)
OPTION 2

- Each State Sets Fossil Emission Rate Baseline [2008-10 Avg.]
- State Emission Rates Start at Baseline & Decline by [2%] per Year on Average
- State Emissions Converge Toward National Average [in 2050]
- Allow Emission Averaging Among All Fossil Units
- Optional: Credit for Incremental Renewables & DSM

Converging State Emission Standards

OPTION 2: Fossil Fuel Emission Rates, Sample States and National Avg.

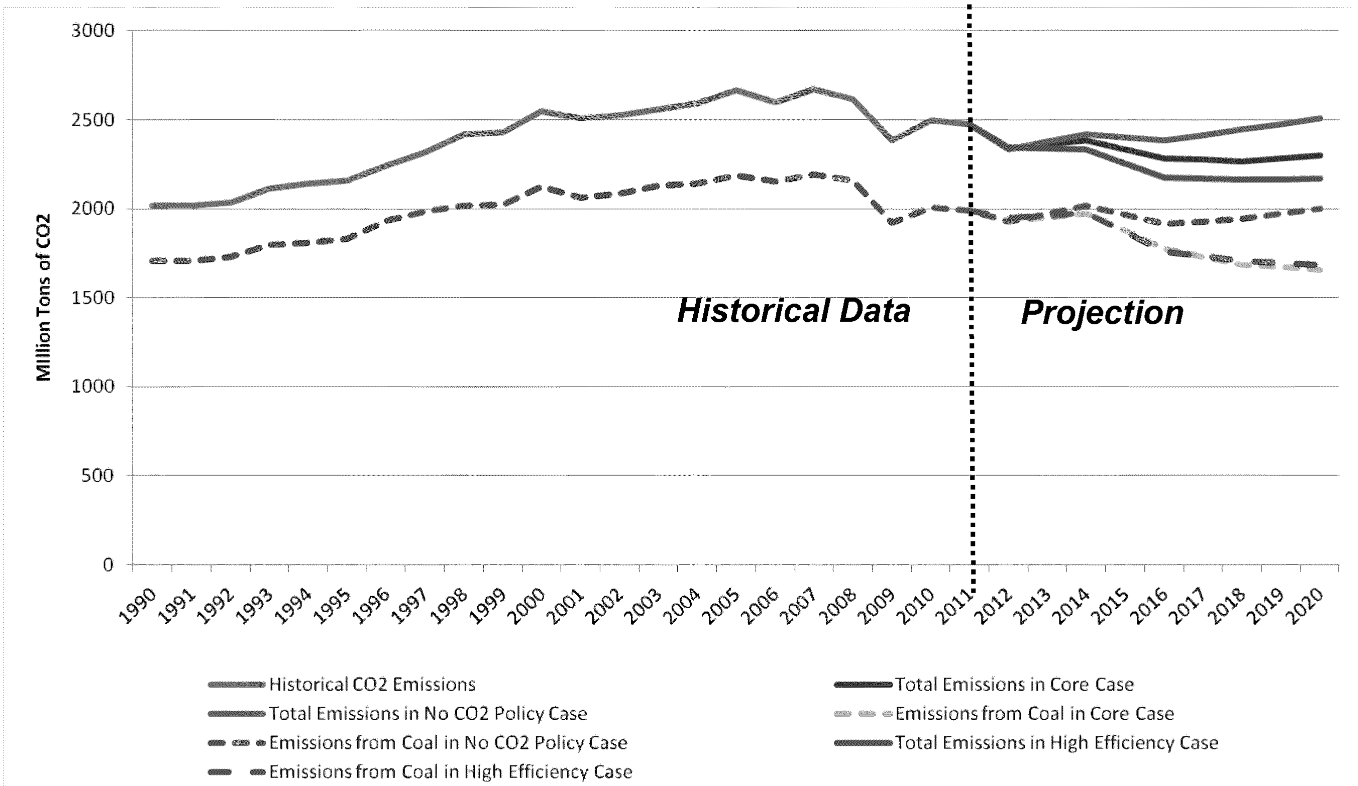
NRDC
THE EARTH'S BEST DEFENSE



OPTION 1 Results No CO2 Policy, Core, High Efficiency Cases

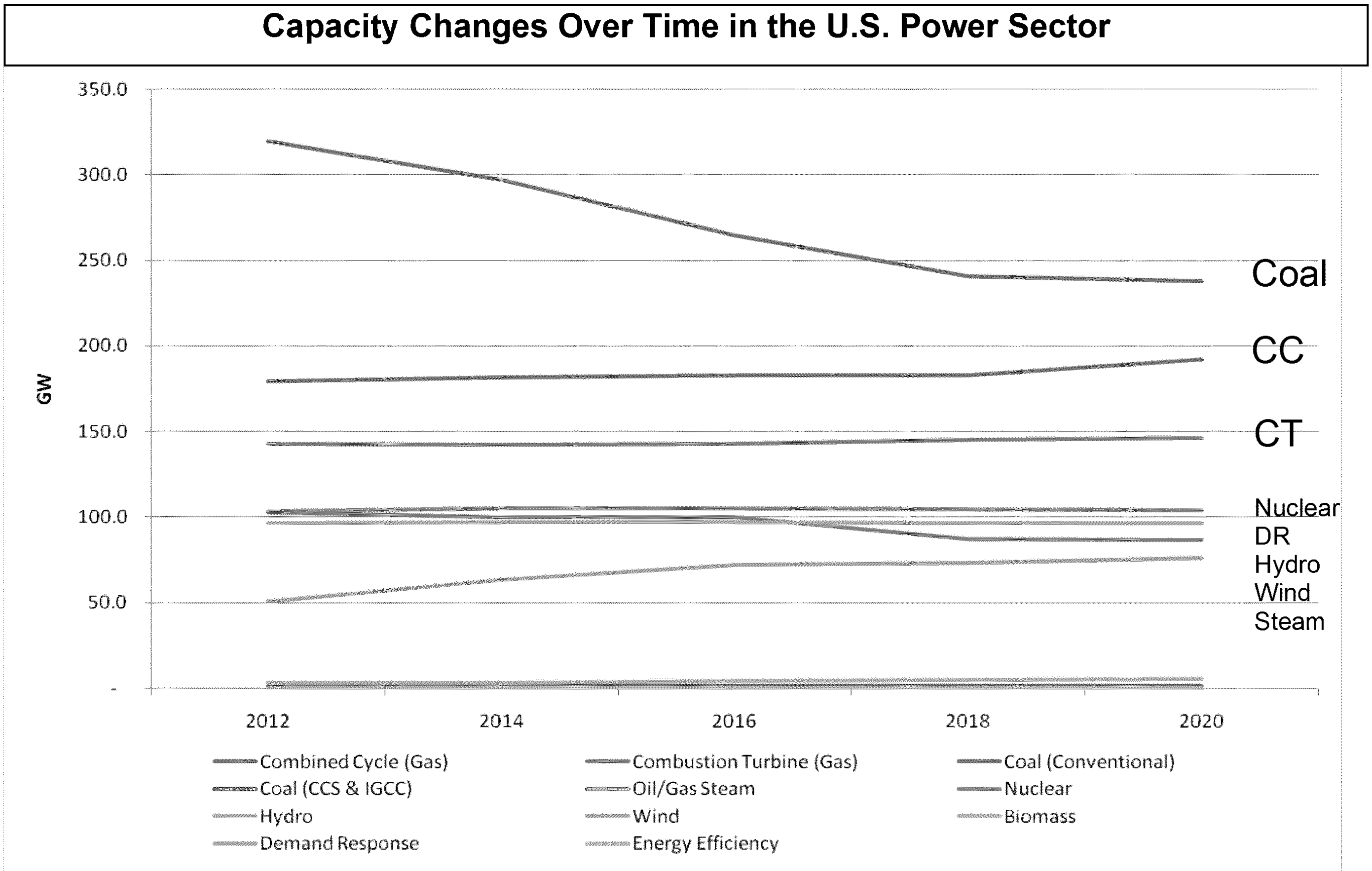
U.S. EGU CO2 Emissions (Million Short Tons)

Historical CO2 Emissions and NRDC Projected CO2 Emissions



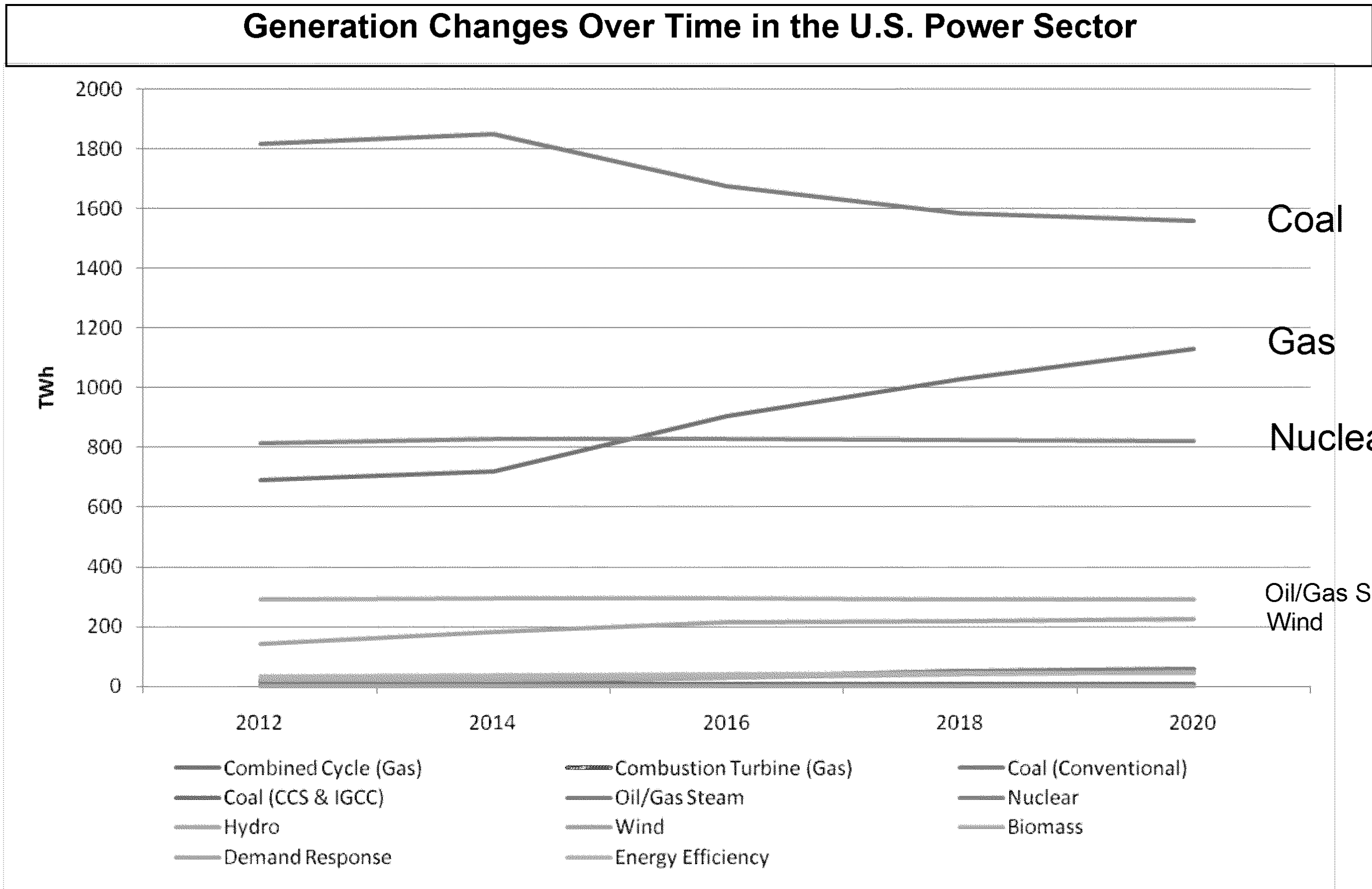
Source for historical CO2 emissions data: EIA. 2011 Figure derived from AEO 2011.

Results of Core Case Model Run
U.S. Capacity



Results of Core Case Model Run

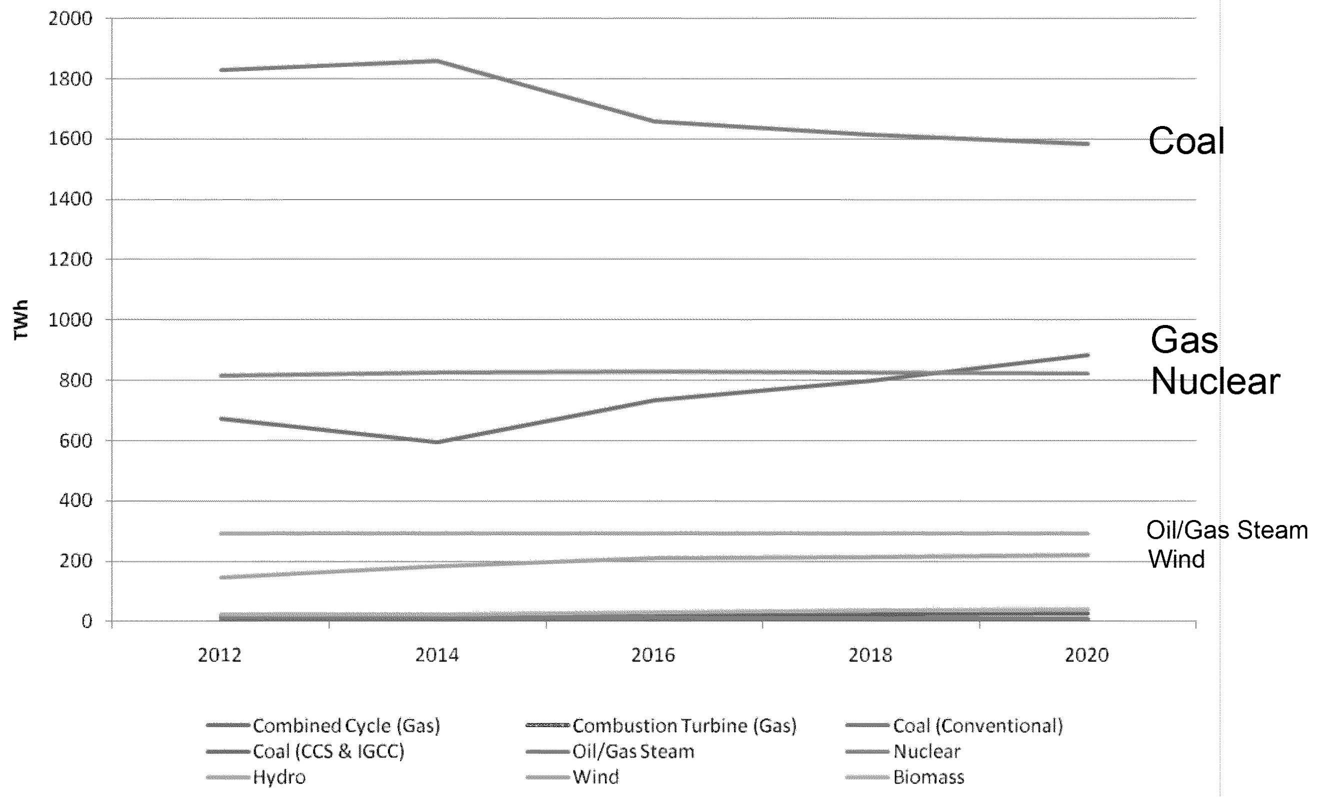
U.S. Generation



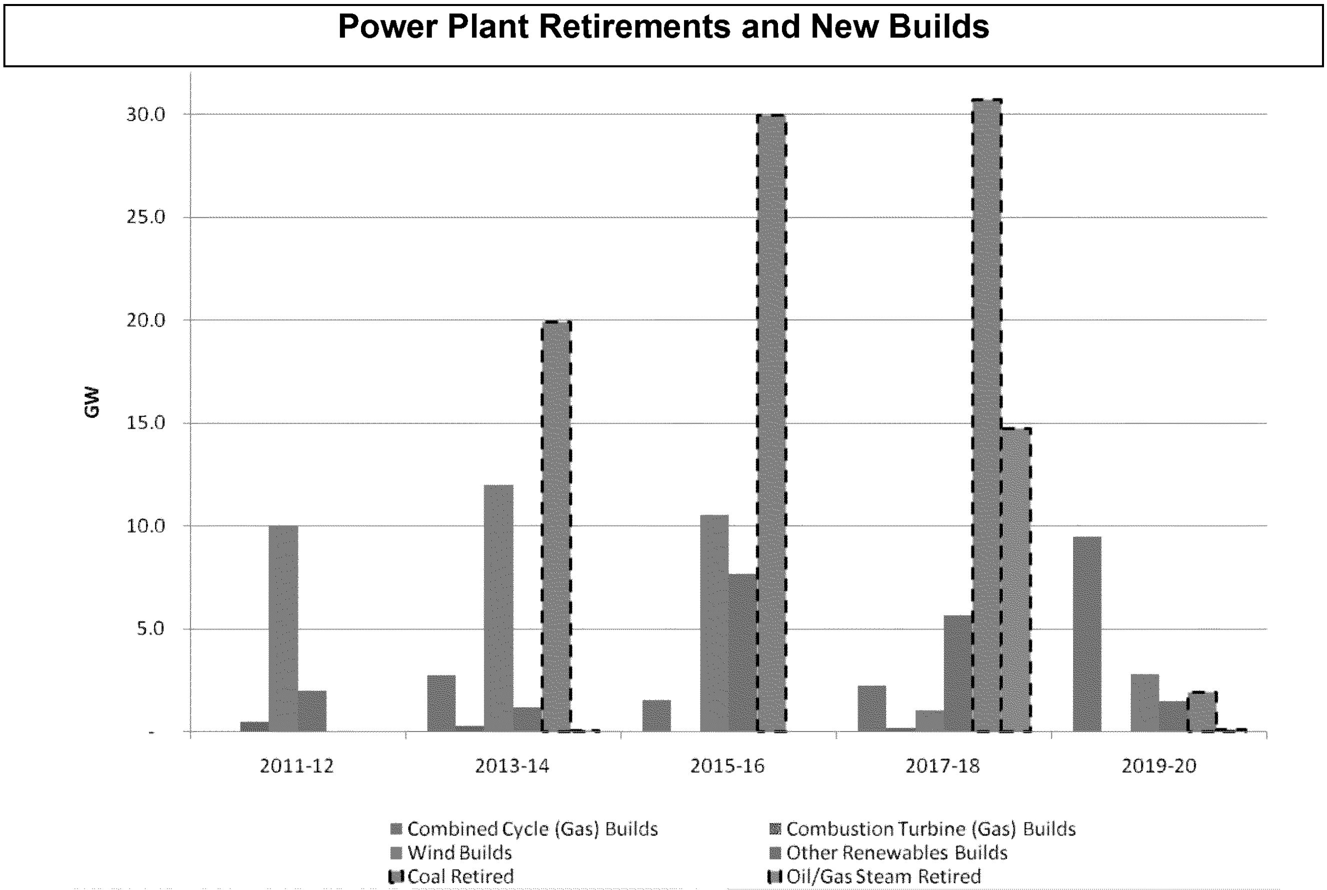
Results of High Efficiency Case Model Run

U.S. Generation

Generation Changes Over Time in the U.S. Power Sector



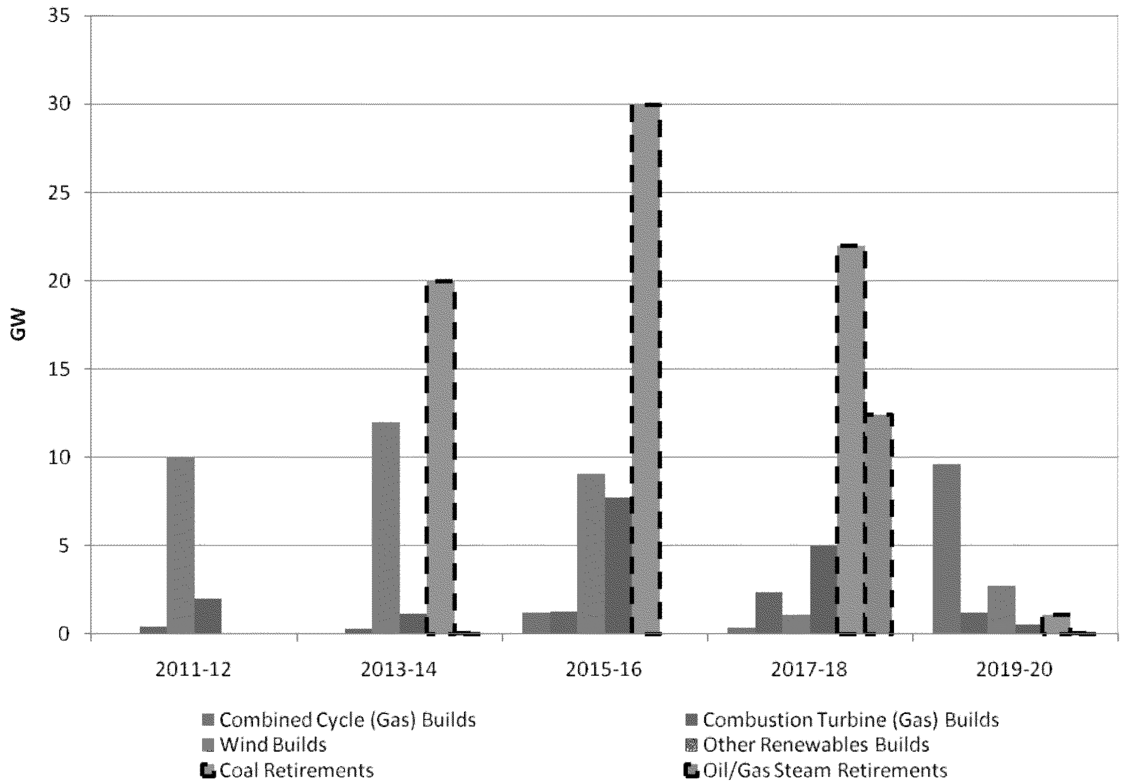
Results of Core Case Model Run
U.S. Retirements and New Builds



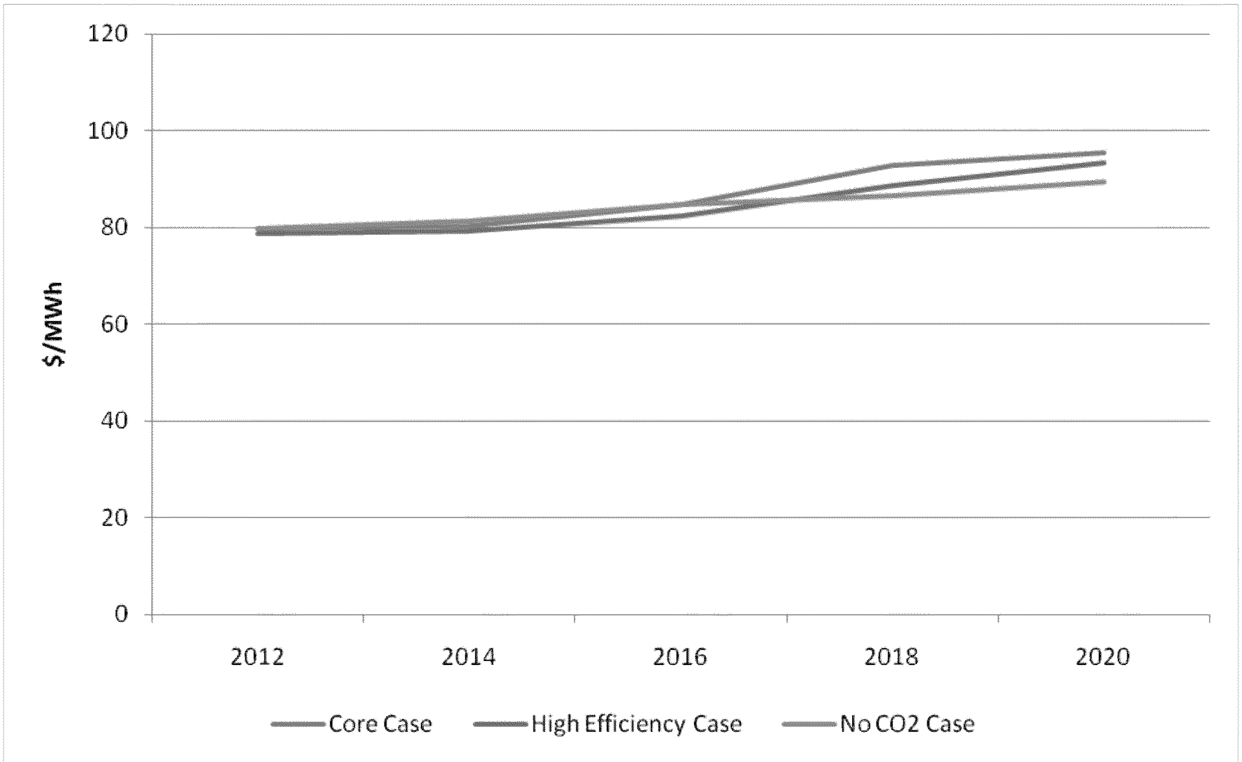
Results of High Efficiency Case Model Run

U.S. Retirements and New Builds

Power Plant Retirements and New Builds



U.S. Retail Electricity Price Impacts (National Average)



Note: National average based on generation-weighted average of PJM, Southeast, MISO, NYISO, ISONE, accounting for 60% of national generation

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To: Gina McCarthy/DC/USEPA/US@EPA[]
From: "Jared Snyder"
Sent: Mon 9/19/2011 6:28:55 PM
Subject: Accepted: Conference Call on 111(d) standards

To: Gina McCarthy/DC/USEPA/US@EPA[]
From: "Doig, Rebecca (DEP)"
Sent: Mon 9/19/2011 6:38:07 PM
Subject: Accepted: Conference Call on 111(d) standards

To: Gina McCarthy/DC/USEPA/US@EPA[]
From: "Kimberly Sarbo"
Sent: Mon 9/19/2011 7:40:58 PM
Subject: Accepted: Conference Call on 111(d) standards

To: Gina McCarthy/DC/USEPA/US@EPA[]
From: "Esty, Daniel"
Sent: Mon 9/19/2011 11:25:04 PM
Subject: Accepted: Conference Call on 111(d) standards

To: Gina McCarthy/DC/USEPA/US@EPA[]
From: Rosalynn.Grzywinski@ct.gov
Sent: Mon 9/19/2011 6:39:25 PM
Subject: Accepted: Conference Call on 111(d) standards

To: Gina McCarthy/DC/USEPA/US@EPA[]
From: Rebecca.Doig@MassMail.State.MA.US
Sent: Tue 9/20/2011 2:47:09 PM
Subject: Accepted: Conference Call on 111(d) standards

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Sent: Tue 9/20/2011 7:25:45 PM
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From: "Kimberly Sarbo"
Sent: Wed 9/21/2011 7:27:05 PM
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