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

---

[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

---

[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

---

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

---

[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]

---

[36] *Id.* at 3-7, 3-9 – 3-10; NRC (2011) at 209-210; NRC (2010) at 55-56, 59-60.

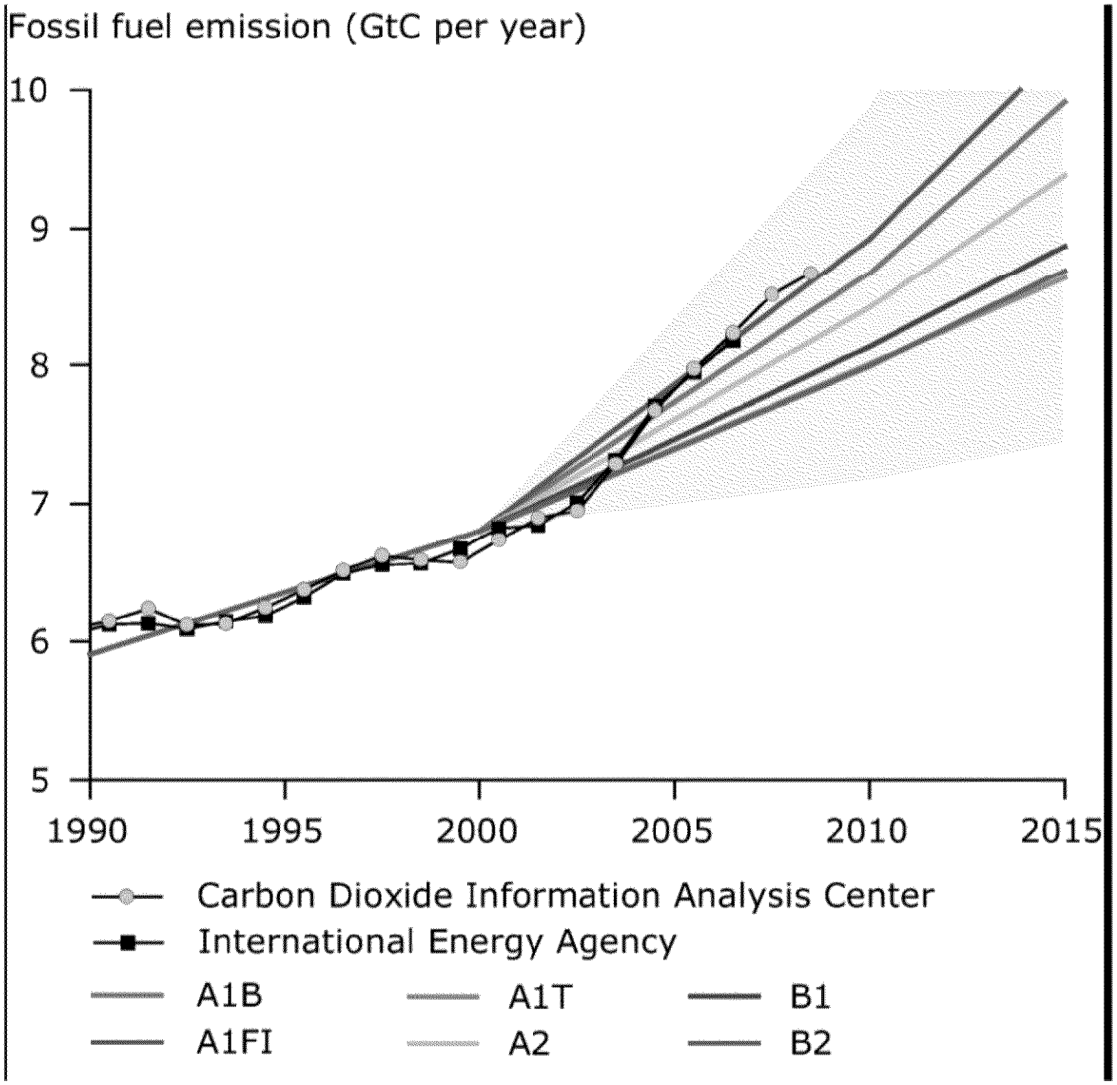
[37] Barbel Honsich *et al.*, *The Geological Record of Ocean Acidification*, 335 Science 1058, doi: 10.1126/science/1208277 (Mar. 16, 2012), attached as **Ex. 32.**

[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.

---

[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/m^2)	CO_2 concentration[a] (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

---

[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]

---

[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

---

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]

[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

---

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.

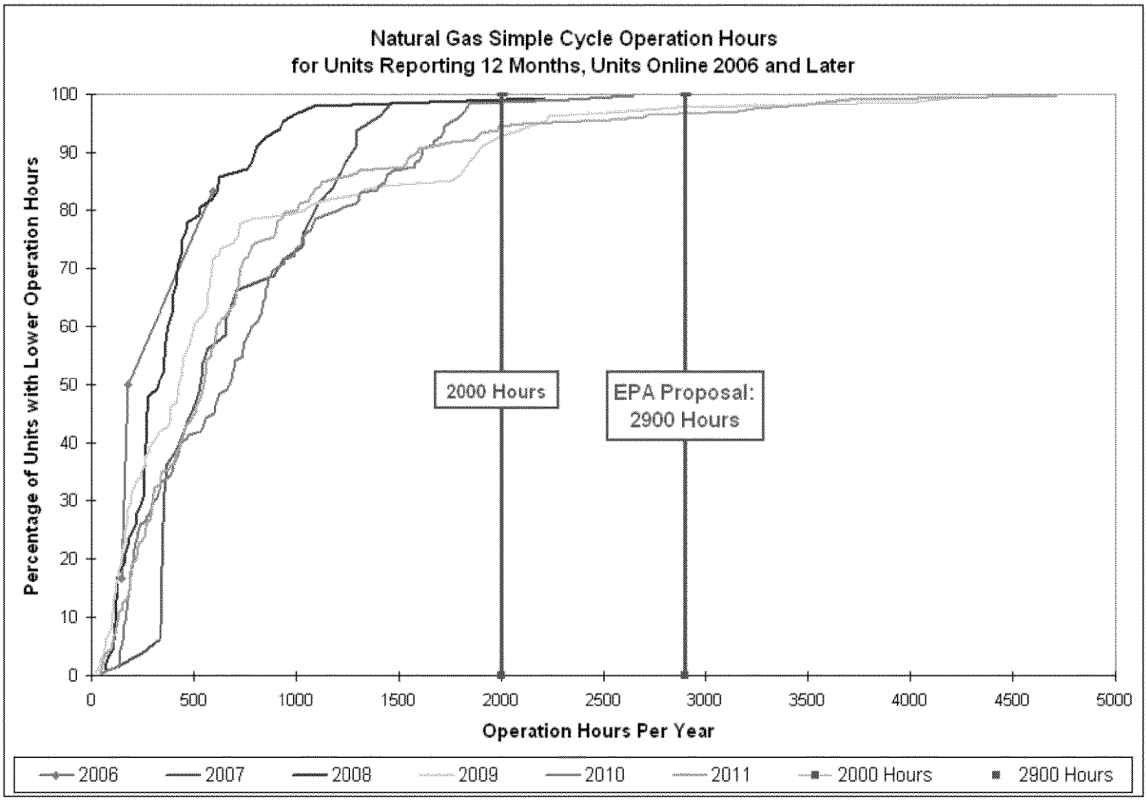
c. The Data Suggest that Simple Cycle Units Are Not Only Used to Serve Peak Power and that Peaking Units Are Those that Operate No More than 2000 Hours per Year.

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

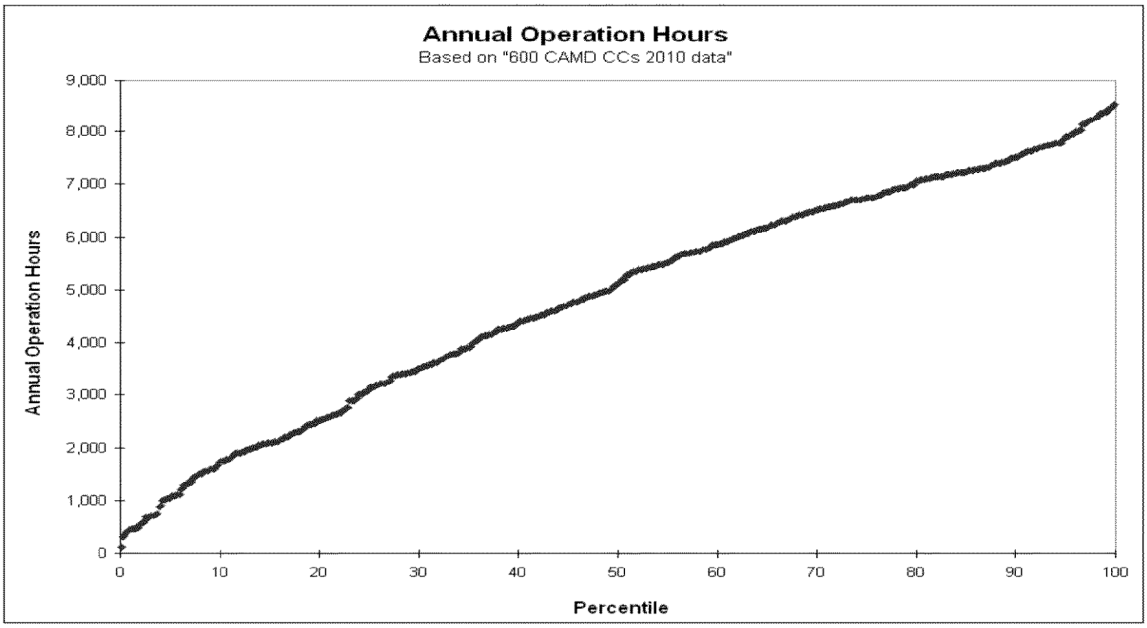


We note that even 2000 hours of operation may represent CTs that are in intermediate load rather than peaking operation, especially if such use is seasonal. We also note that there are a substantial number of combined cycle units that are designed for intermediate load applications but that may have 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

[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

---

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]

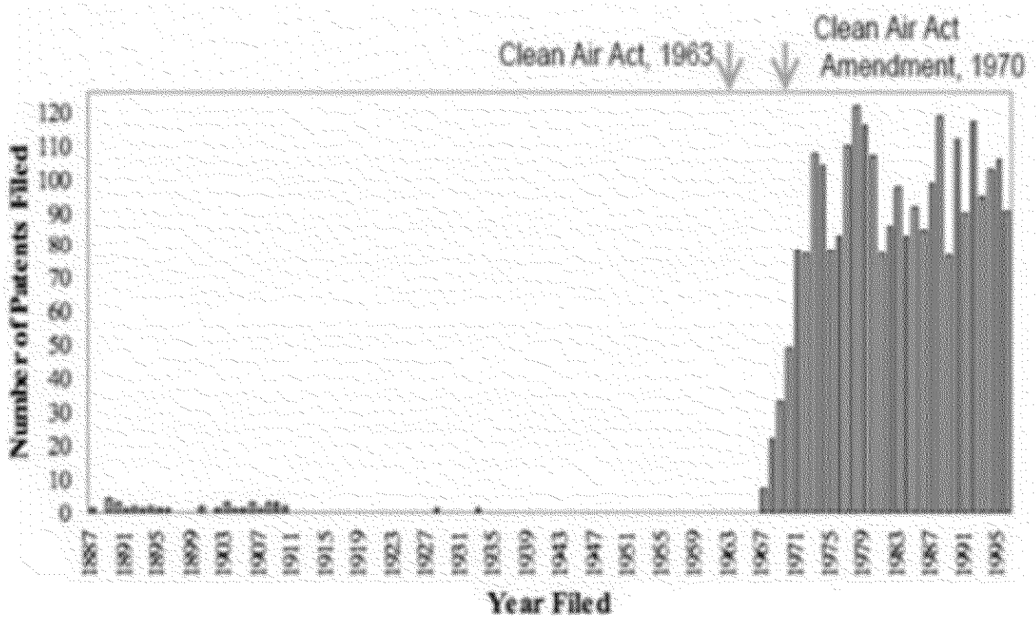
As can be seen in Figure 3, analysis of patenting activity further demonstrates the dramatic rise in control technology innovation in the U.S. that followed the 1971 SO_2 NSPS promulgation.[100]

---

[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.**

[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

---

[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

---

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

---

[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

[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

---

[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.

[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

---

[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.

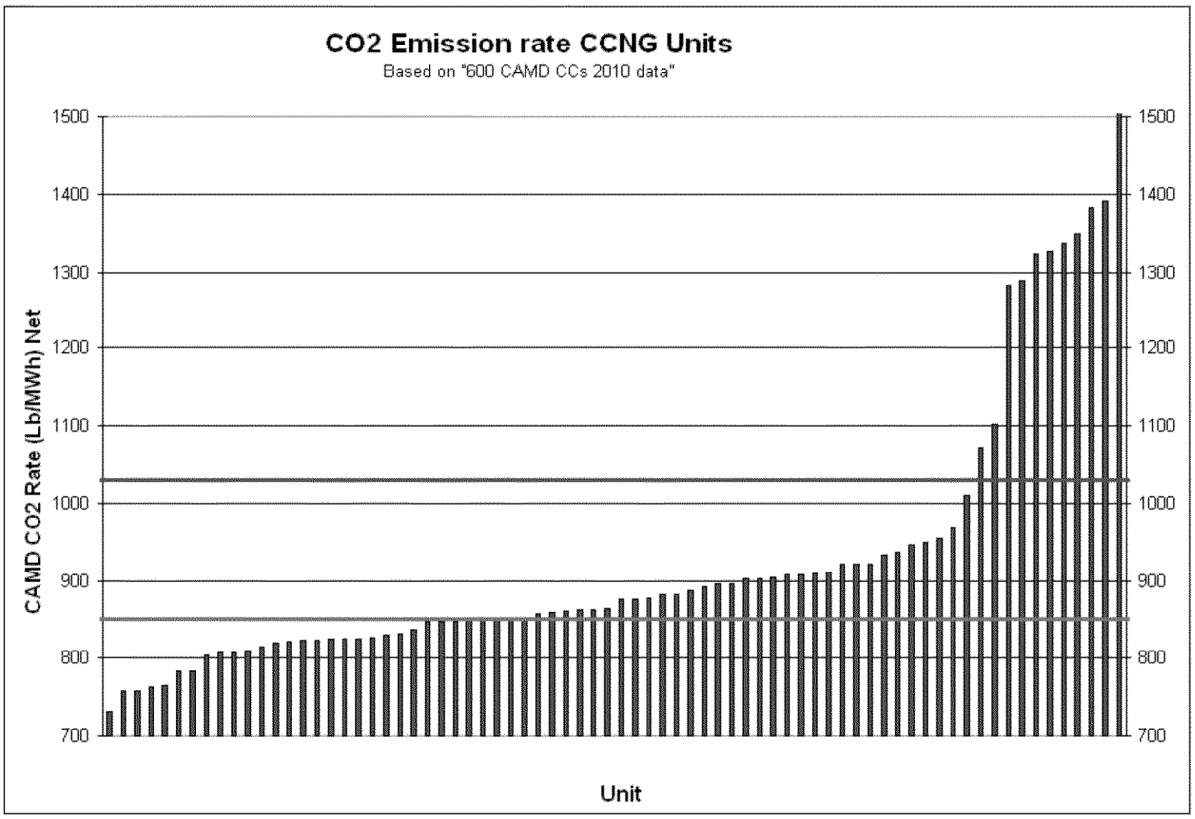
While Joint Environmental Commenters agree that EPA should consider the design information provided by the Gas Turbine World Handbook, the agency should also recognize that vendor performance guarantees are necessarily conservative, as the vendor may be liable for damages if the promised performance 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