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CHANGING CLIMATE CHANGE, 2009-2016

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Changing Climate Change, 2009-2016

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Abstract

In 2009, the Obama Administration entered office in the midst of a serious economic recession. Nonetheless, one of its priorities was to address the problem of climate change. It ultimately did a great deal -- producing, with the aid of market forces, significant reductions in greenhouse gas emissions, which ultimately helped make an international agreement possible. This essay offers an account of some of the central domestic reforms, including the "endangerment finding"; the selection of a social cost of carbon; fuel economy regulations for motor vehicles; controls on new and existing power plants; and energy efficiency regulations. At various points, potentially challenging issues of law and policy are identified, and different imaginable paths are specified. The various reforms show the extraordinary extent to which the executive branch, relying on pre-existing regulatory authorities, can reorient national policy in an area in which the national legislature is blocked. To that extent, the climate change initiatives offer an illuminating case study in the contemporary operation of the system of separation of powers. There is a brief discussion of whether the reforms are likely to prove enduring. Appendices offer an assortment of tables on relevant costs and benefits.

I. Article II, Not Article I

From 2009 to late 2016, the United States did a great deal to combat climate change.[1] It reduced greenhouse gas emissions from motor vehicles. It imposed severe restrictions on greenhouse gas emissions from power plants. It dramatically increased the energy efficiency of appliances (over forty of them). The result of the various initiatives is closely akin to what might have been done through aggressive congressional action.

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[1] For one catalogue, see EXECUTIVE OFFICE OF THE PRESIDENT OF THE UNITED STATES, THE ECONOMIC RECORD OF THE OBAMA ADMINISTRATION: ADDRESSING CLIMATE CHANGE (Sept. 2016), https://www.whitehouse.gov/sites/default/files/page/files/20160921_record_climate_energy_cea.pdf.

And yet it all happened through the executive branch. Congress did essentially nothing. Its only serious efforts, initiated in 2009, were blocked in 2010,[2] by which time it became clear that if greenhouse gas emissions were to be reduced, it would be a result of the use of pre-existing legal authorities, which were not enacted with the climate change problem in mind.

The principal goal of this Article is to catalogue the major developments.[3] The discussion is not meant to be exhaustive, and it leaves some significant gaps, but it does include the largest initiatives, along with an accounting of both costs and benefits.[4] The initiatives raise a host of political, legal,[5] and economic[6] questions. I will offer some discussion of those questions here, but I do not explore them in detail. My main purpose is attempt to provide the background against which they must be both asked and answered. One of the central points involves the Obama administration's insistent focus on ensuring that the benefits of regulation justify the costs[7] – though it must be acknowledged that some of the important calculations are contentious.[8]

In cataloguing the relevant initiatives, I hope also to provide a sense of paths not taken -- in a sense, of counterfactual histories – in part because it is valuable to explore that issue for its own sake, and in part because an understanding of those paths bears directly on the future. In the same period, we could easily imagine a minimalist path from

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[2] *See infra* notes 56–57 and accompanying text.

[3] For the Obama Administration's own account, see EXECUTIVE OFFICE OF THE PRESIDENT OF THE UNITED STATES, THE ECONOMIC RECORD OF THE OBAMA ADMINISTRATION: ADDRESSING CLIMATE CHANGE (Sept. 2016), https://www.whitehouse.gov/sites/default/files/page/files/20160921_record_climate_energy_cea.pdf. Relevant steps, not discussed here, include EPA Methane Rule, 81 Fed. Reg. 35824 (June 3, 2016) (NSPS cutting methane emissions from oil and gas sector); EPA Methane Landfill Rule, NSPS 80 Fed. Reg. 59332 (Aug. 29, 2016); FERC Order 745 (Demand Response) upheld in FERC v. Electric Power Supply Assn (US Sup. Ct January 25, 2016).

[4] *See* Appendix 2.

[5] In general, the legal track record has been exceptionally good, with partial defeats not bearing major consequences for aggregate reductions. *See, e.g.*, Coalition for Responsible Regulation, Inc. v. EPA, 684 F.3d 102 (D.C. Cir. 2012), *aff'd in part, rev'd in part*, Utility Air Regulatory Grp. v. EPA, 134 S. Ct. 2427 (2014).

[6] *See, e.g.*, Matthew J. Kotchen, *Which Social Cost of Carbon? A Theoretical Perspective* (Nat'l Bureau of Econ. Research, Working Paper No. 22246, 2016); Ted Gayer & W. Kip Viscusi, *Overriding Consumer Preferences with Energy Regulations* (Mercatus Ctr., George Mason U., Working Paper No. 12-21, 2012), https://www.mercatus.org/publication/overriding-consumer-preferences-energy-regulations; Robert S. Pindyck, *Climate Change Policy: What Do the Models Tell Us?* (Nat'l Bureau of Econ. Research, Working Paper No. 19244, 2013), http://www.nber.org/papers/w19244.

[7] *See* Executive Order 13,563, 76 Fed. Reg. 3821 (Jan. 21, 2011).

[8] *See* Gayer & Viscusi, *supra* note 6; Pindyck, *supra* note 6.

an administration unconcerned about climate change, or from one that focused exclusively on economic challenges, with the belief that climate change would be best handled after those challenges had been overcome, or that an international agreement should precede rather than follow domestic regulation. Such an administration could have chosen inaction and delays, which would have resulted in exceedingly little emissions reductions as compared to "business as usual." As we shall see, it is highly likely that an effort to proceed in this way would have succeeded.

The principal obstacle to such a path would have been legal: Litigants would predictably invoke federal courts to require regulatory initiatives, and for reasons that we will explore, they would have had a chance, for a large number of the initiatives were legally compelled, at least in some form. But litigation moves exceedingly slowly, and an executive branch that seeks not to act can usually find many ways to do so.[9] A minimalist administration might well have suffered some losses in court, but in general, it would have succeeded in producing minimal results. In the end, domestic minimalism would of course have produced international minimalism, which would mean that there would have been nothing like the Paris agreement.[10] The largest lesson, with implications both for the system and separation of powers and for the future, is that if an executive branch wants to forestall action in certain areas, it will probably succeed in doing so, even if it faces serious legal challenges. This is a defining feature of the modern of checks and balances, and it helps explain the massive differences in national regulatory policy across administrations, holding Congress constant.hh

We could also imagine a more maximalist path, in the form of an administration that moved significantly more quickly, and significantly more aggressively, to reduce greenhouse gas emissions. Many environmentalists were disappointed by the pace and the aggressiveness of some of the initiatives.[11] To take one example, a more aggressive administration might have chosen a much higher social cost of carbon,[12] which would have justified far more stringent regulations. To take another example, restrictions on greenhouse gas emissions from both mobile and stationary sources could have been more aggrressive than they ultimately were. Here as well, a major obstacle could have been legal, and it is certainly imaginable that more stringent regulations would have been invalidated. But in view of the general caution of federal courts in assessing difficult

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[9] *See* Cass R. Sunstein and Adrian Vermeule, *The Law of "Not Now,"* 103 GEORGETOWN L.J. 157 (2014). On the doctrinal framework, see Heckler v. Cheney, 470 US 821 (1985).

[10] *Paris Agreement*, U.N. FRAMEWORK CONVENTION OF CLIMATE CHANGE, http://unfccc.int/paris_agreement/items/9485.php (last visited Jan. 27, 2017).

[11] *See, e.g.*, Kent Garber, *Obama Is Slow on Global Warming Legislation*, U.S. NEWS (July 8, 2010, 11:15 AM), http://www.usnews.com/opinion/articles/2010/07/08/obama-is-slow-on-global-warming-legislation.

[12] Frances C. Moore & Delavane B. Diaz, *Temperature Impacts on Economic Growth Warrant Stringent Mitigation Policy*, NATURE CLIMATE CHANGE (Jan. 12, 2015), http://www.nature.com/nclimate/journal/v5/n2/full/nclimate2481.html.

questions of both policy and fact,[13] there is a good chance that a more aggressive administration would have been largely successful in court.

A general conclusion here is that for better or for worse, climate change policy is executive branch policy. During the Bush administration, very little was done to reduce greenhouse gas emissions, because the administration made no serious effort in such reductions notwithstanding the opportunities. It is important to emphasize that the absence of such an effort resulted from judgments of policy and principle, involving the administration's beliefs about proper priority-setting for the nation at the time.[14] During the Obama administration, by contrast, a great deal was achieved, with its magnitude and pace set almost entirely by the White House. Congress was a bystander, with members approving or disapproving from the sidelines. For the most part, the same was true of the federal courts (with one important exception[15]). In some ways, the case of climate change might be extreme on these counts, but it is more plausibly taken as exemplary: In the United States, modern government is, to a substantial extent, executive branch government, and executive branch government is, to a substantial extent, White House go government.

Now for some details.

II. The Clean Air Act: Three Programs

The central elements of the tale begin in 1977, when Congress enacted the Clean Air Act ("CAA") in its modern form. The CAA consists of hundreds of pages, and much of it is detailed and highly prescriptive. But its central provisions are defined by three large programs, each of which grants a great deal of discretion to the executive branch, and two of which are pivotal to the basic story here.

A. Air Quality Standards: An Evident Misfit

The first program requires the EPA to establish "national ambient air quality standards"[16] – that is, standards that set maximum levels of pollution in the ambient air. National standards must be established on a pollutant-by-pollutant basis: ozone,

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[13] *See* Jacob Gersen & Adrian Vermeule, *Thin Rationality Review*, 114 MICH. L. REV. 1355 (2016).

[14] For a relatively objective description, see *Analysis of President Bush's Climate Change Plan*, CTR. FOR CLIMATE & ENERGY SOLUTIONS, https://www.c2es.org/federal/executive/george-w-bush-climate-change-strategy (last visited Jan. 27, 2017).

[15] *Massachusetts v. EPA*, 549 U.S. 497 (2007), which was decided during the Bush administration, but which provided an important background for its successor. Also relevant, though practically not very important, was *Utility Air Regulatory Grp. v. EPA*, 134 S. Ct. 2427 (2014).

[16] 42 U.S.C. § 7408 (2012).

particulate matter, lead, nitrogen oxide, sulfur dioxide. The standards must be set at the level "requisite to protect the public health," along with "an adequate margin of safety."[17]

What does that mean? As the law has evolved, the EPA is not allowed to consider costs. It has to make a science-based, health-based judgment[18]: *What is requisite to protect the public health*? Above all, that question imposes an immense knowledge-gathering burden on the EPA, and it reflects a kind of trust, too, in its knowledge-gathering capacities. But it simultaneously grants the EPA discretion on questions that are not entirely technical. To know what is "requisite" to protect the public health, and to know what margin of safety is "adequate," the EPA has to decide what levels of harms are unacceptable. If, for example, fifty people will die each year as a result of levels of particulate matter that exceed 8 parts per billion, is more regulation required? What about two hundred people? A thousand? A regulator can stare at the word "requisite" all it wants, but by itself, that word will not provide an answer.

For obvious reasons, the idea of national ambient air quality standards is a singularly poor fit with the problem of greenhouse gas emissions. For climate change, the question is the total amount of such gases in the atmosphere; it is not the level in the ambient air in (say) Boston, New York, or Los Angeles. It would seem to make no sense to say that the EPA should issue national ambient air quality standards for greenhouse gas and then charge states with the task of producing implementation plans to ensure that the national ceilings are not exceeded. In this light, there is a strong argument that it would be *unlawful* for the EPA to issue national ambient air quality standards for greenhouse gases[19] – and after some internal discussion, the Obama administration did not even try, largely because of a judgment that any such standard would indeed make no sense.

B. Mobile Sources

The second program, and a far more relevant one, governs mobile sources of air pollution. The EPA is directed to issue standards for any pollutant that, in the judgment of its administrator, "causes or contributes to air pollution reasonably anticipated to endanger public health or welfare."[20] Here again, the CAA seems to ask the EPA to make a highly technical judgment: *Does the pollutant endanger public health or welfare*? If certain scientific findings have been made, the answer might be clear and definitive, and the EPA will have essentially no discretion.

But here as well, the judgment is not always resolved by science. The EPA has to decide what kinds of adverse effects "endanger public health or welfare." That is not the

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[17] *Id.*

[18] *See* Whitman v. Am. Trucking Ass'ns, Inc., 531 U.S. 457 (2001).

[19] *Cf. Utility Air Regulatory Grp.*, 134 S. Ct. at 2247 (concluding that the "EPA overstepped its statutory authority [under the Clean Air Act] when it decided that a source could become subject to PSD or Title V permitting by reason of its greenhouse-gas emissions" alone).

[20] 42 U.S.C. § 7408 (2012).

most open-ended question, and it mostly involves science, but at least in hard cases, it is not only one of fact. Some evaluative judgment has to be made about what kinds of adverse effects are serious enough to be counted as endangerment. To be sure, the CAA limits the boundaries of that judgment: If the science takes a particular form, the EPA could not lawfully find endangerment, and if some scientific findings would require it to do so. Of course the EPA has authority to evaluate the science, but here as elsewhere, it must not act arbitrarily.[21]

If the EPA does decide that a pollutant endangers public welfare, and if it comes from mobile sources, it must regulate it; on that count, it does not have discretion. At the same time, the CAA leaves considerable authority to the agency to determine both the nature and the degree of regulation. The EPA is required by the CAA to set standards that "reflect the greatest degree of emission reduction achievable," considering technological feasibility, costs of compliance, and necessary lead-time of such a standard.[22] The EPA also has the authority to consider other relevant factors, including safety,[23] impacts on consumers, and energy impacts related to the use of the technology.[24] Because the CAA does not specify how much weight to attribute to each of these factors, courts have understood the act to give the EPA significant room to maneuver in its analysis.[25] It follows that with respect to stringency, the agency has a great deal of discretion.

If the EPA gave no weight to cost, it would of course be acting unlawfully. If a standard had far higher costs than a less stringent standard, the EPA would have to give some explanation to its decision to proceed; perhaps it could show that the more costly approach also has far greater benefits. But the CAA does not specify whether EPA must give costs a little weight or instead a great deal. If the agency wants to press right up against the point where further regulation is not feasible, there is a plausible argument that it is allowed to do that, at least if the benefits are not disproportionately low as compared to the costs.[26] If it wants to engage in something more like standard cost-

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[21] 5 U.S.C. § 706 (2012).

[22] 42 U.S.C. § 7521(a)(2) (2012) ("Any regulation . . . shall take effect after such period as the Administrator finds necessary to permit the development and application of the requisite technology, giving appropriate consideration to the cost of compliance within such period.")

[23] *See* Nat'l Resources Defense Council, Inc. v. EPA, 655 F.2d 318, 336 n.31 (D.C. Cir. 1981).

[24] *See* George E. Warren Corp. v. EPA, 159 F.3d 616, 623–24 (D.C. Cir. 1998) (concluding that the EPA may generally consider factors other than those listed in the CAA).

[25] *See* Sierra Club v. EPA, 325 F.3d 374, 378 (D.C. Cir. 2003); Husqvarna AB v. EPA, 254 F.3d 184, 200 (D.C. Cir. 2001); *Nat'l Resources Defense Council*, 655 F.2d at 336.

[26] *See* Michigan v. EPA, 135 S. Ct. 2699 (2015); Cass R. Sunstein, *Cost-Benefit Analysis and Arbitrariness Review* (Harvard Law Sch. Pub. Law & Legal Theory Working Grp., Working Paper No. 16-12, 2016), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2752068.

benefit analysis, it is probably allowed to do that as well. These points of course bear on the permissible stringency of regulation of greenhouse gas emissions.

C. Stationary Sources

The third program involves stationary sources, of which the most important are power plants.[27] The EPA is required to publish and revise a list of such sources.[28] It must include a source in that list if, in the EPA's judgment, "it causes, or contributes significantly to, air pollution which may reasonably be anticipated to endanger public health or welfare."[29] (Note the words "is required to" and "must.") The substantive standard of courses uses the same language as for mobile sources.

But the list is not merely a matter of bookkeeping. Whenever a source is listed, the EPA must produce a "standard of performance," which means a regulation. (Yet again, we are not speaking of discretion.) The CAA requires standards that reflect

> the degree of emission limitation achievable through the application of the best system of emission reduction which (taking into account the cost of achieving such reduction and any nonair quality health and environmental impact and energy requirements) the Administrator determines has been adequately demonstrated.[30]

That is a complex sentence, but it is similar to what we saw for mobile sources. The EPA cannot do beyond what is achievable, but it is required to consider a range of factors, including cost and adverse effects on the energy supply. As before, the weight that it places on those factors appears to be within its discretion, subject to the limits of reasonableness. Once endangerment is found, there is an obligation to act, but the extent of the resulting regulation depends on judgments of science, economics, and policy.

III. Agency-Forcing? The Supreme Court Intervenes

Under President George W. Bush, the EPA declined to exercise whatever authority it might have to regulate greenhouse gases.[31] In its view (which undoubtedly followed considerable interagency discussion at the highest levels), the CAA was not well-adapted to the problem of climate change. This conclusion was widely shared at the time, and it remains shared today (even if the CAA is the principal available route, and even if a poorly adapted statute is believed to be better than nothing). For present purposes, it is important to keep in mind a background fact, one that bears on my central thesis here: For eight years, the Bush administration decided to do essentially nothing to

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[27] *See* 42 U.S.C. § 7411 (2012).
[28] *Id.* § 7411(b)(1)(A).
[29] *Id.*
[30] *Id.* § 7411(a)(1).
[31] A description is offered in *Massachusetts v. EPA*, 549 U.S. 497 (2007).

reduce greenhouse gas emissions under the CAA, and its decision was unimpeded until the Supreme Court's decision in 2007 – and it also did nothing after that judgment.

A. Two Plausible Arguments

In explaining itself, the EPA made two distinct arguments. First, it contended that greenhouse gases are not air pollutants within the meaning of the CAA. In its view, the statute was not meant to address the climate change problem at all; the whole idea of "air pollution" was altogether separate from that problem. If this argument were correct, the EPA could not lawfully address greenhouse gases through the Clean Air Act.[32]

Second, and in the alternative, the EPA pointed to scientific uncertainty and explained that the administration was using other means to address the problem of climate change, that some kind of international agreement was crucial, and that the CAA was not at all the right tool. The agency objected that any EPA regulation of motor-vehicle emissions as a "piecemeal approach" to climate change, in conflict with the President's "comprehensive approach" to the problem. That approach involved not domestic regulation, but support for technological innovation, creation of nonregulatory programs to encourage voluntary private-sector reductions in greenhouse gas emissions, and further research on rather than regulation.[33] The EPA added that unilateral regulation might undermine the President's ability to persuade key developing countries to reduce greenhouse gas emissions.[34]

As a matter of policy, that was hardly an implausible position. It could reasonably be contended that any solution to the climate change problem required international cooperation and that unilateral action by the United States would compromise negotiations. Whether or not that argument was correct – and as history has unfolded, it probably was not[35] – it was certainly reasonable.

B. Literalism Triumphant

In a massively important ruling, one that has come to constitute the legal foundation of climate change policy in the United States, the Supreme Court held by a vote of five to four that greenhouse gases must be counted as pollutants under the CAA, which strongly suggests that the EPA is legally obliged to use the CAA to regulate them.[36] At the very least, the EPA cannot simply conclude that greenhouse gases are not CAA-encompassed air pollutants. After all, an air pollutant is explicitly defined as "any air pollution agent of combination of such agents . . . which is emitted into or otherwise

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[32] *Id.* at 511–13.

[33] *Id.* at 513.

[34] *Id.* at 513–14.

[35] The successful Paris negotiation was made possible in part by unilateral action by the United States, which persuaded other nations, including India and China, that the United States was serious about the problem.

[36] *Mass. v. EPA*, 549 U.S. at 532; *see also id.* at 528–29.

enters the ambient air."[37] Greenhouse gases, and carbon dioxide in particular, seem to fit the statutory definition.

The Court seemed to ask: *What part of "any air pollution agent" did the Bush administration fail to understand*? While the Court asked the EPA to consider exactly what to do, the clear implication of its ruling was that greenhouse gases must be treated as pollutants, at least for purposes of the CAA's mobile source program, and hence that the EPA was legally obliged to regulate them accordingly. In fact, however, the legal question was far more complicated than that, and hence the 5-4 division within the Court was fully understandable. When the CAA was originally enacted, the climate change problem was barely on the horizon, and Congress was hardly focused on or even contemplating the consequences of greenhouse gas emissions. With the term "air pollutant agent," the national legislature was specifically focused on pollutants that have adverse effects on health – particulate matter, ozone, sulfur dioxide.[38] Carbon dioxide produces adverse effects because of its effect on the climate – which is not the *kind* of adverse effect that Congress had in mind.

That argument raises many questions. The Court's response was simple: Whatever the specific understandings of the Congress that enacted the CAA, the EPA was in violation the unambiguous language of the CAA.[39] But according to accepted principles, the Court was probably wrong. In the *Chevron* case,[40] the Court ruled that whenever a statutory provision is ambiguous, agencies charged by Congress with implementing statutory provisions are entitled to interpret them as they see fit, subject only to the constraints of reasonableness. In its context, the term "air pollutant agent" was ambiguous, and its interpretation was not unreasonable. For that reason, the EPA should have been allowed to choose to use the CAA to regulate greenhouse gases, or to choose not to do so.[41] Surprisingly, the Court rejected that argument.

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[37] 42 U.S.C. § 7602(g) (2012).

[38] *Criteria Air Pollutants*, U.S. ENVTL. PROT. AGENCY, https://www.epa.gov/criteria-air-pollutants (last visited Jan. 27, 2017).

[39] According to the Court, "[t]he Clean Air Act's sweeping definition of 'air pollutant' includes 'any air pollution agent or combination of such agents, including any physical, chemical . . . substance or matter which is emitted into or otherwise enters the ambient air . . . .' On its face, the definition embraces all airborne compounds of whatever stripe, and underscores that intent through the repeated use of the word 'any.' Carbon dioxide, methane, nitrous oxide, and hydrofluorocarbons are without a doubt 'physical [and] chemical . . . substance [s] which [are] emitted into . . . the ambient air.' The statute is unambiguous." *Mass. v. EPA*, 549 U.S. at 528–59 (internal citations omitted) (alterations in original).

[40] Chevron U.S.A., Inc. v. Nat'l Resources Defense Council, Inc., 467 U.S. 837 (1984).

[41] In fact, there was a plausible argument that in view of either the context or the "major questions" exception to *Chevron*, the EPA lacked authority to regulate greenhouse gas emissions under the CAA. *See* Utility Air Regulatory Grp. v. EPA, 134 S. Ct. 2427 (2014) (noting the exception). In my view, the exception is hard to justify, and so should

One reason might be a perception that in the relevant period, political intransigence had overcome technical expertise – that the Bush administration was refusing to bring its own agencies' knowledge to bear on the greenhouse gas problem.[42] If so, the Court's unusually aggressive decision could be seen as this instruction to the EPA: *Use your knowledge*. As we shall soon see, that is exactly what the EPA did.

C. Counterfactual Worlds

Did the Court's decision matter? How much? It should be plain that if the Court had ruled that EPA lacked the legal authority to regulate greenhouse gases, its ruling would have proved massively important: In view of its internal divisions, Congress would not have been willing to grant EPA that authority, which means that all EPA action, under the Clean Air Act, would have been foreclosed. Notably, however, not a single member of the Court believed that EPA lacked such authority; the dissenters claimed instead that the EPA could interpret the statutory ambiguity as it (reasonably) saw fit. If the Court had agreed with the Bush administration, and if Justice Scalia's dissenting opinion had gathered five votes, the consequences would have been modest, even trivial, at least until 2017: Authorized to act, the Obama administration would have proceeded exactly as it ultimately did.

At the same time, the Court's decision could have been important if a Republican had been elected president in 2008 or 2012. An administration unconcerned about climate change would have faced a serious legal challenge if it decided to do nothing at all about greenhouse gases. But the Court's opinion could be read to have left some room for EPA not to act, and even if it had to do *something*, there is a good argument that it could have done very little – resting content, for example, with a modest increase in fuel economy standards. The point suggests the judiciary's relative powerlessness in dealing with an executive branch that is determined not to undertake action in specified domains. Indeed, it is very difficult to think of areas of regulation in which federal courts prompted agencies to address regulatory problems in which agencies (and the White House) had no interest.[43]

In 2017 and 2018, of course, the Trump administration will reconsider a host of existing regulatory requirements and in light of *Mass. v. EPA*, it has limited room to maneuver. It is too early to specify the extent of that limitation, but the principal source is

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not be invoked here. *See* Cass R. Sunstein, Chevron *Step Zero*, 92 VA. L. REV. 187 (2006). But if the exception is in place, there is a strong argument for using it in the context of such emissions.

[42] Jody Freeman & Adrian Vermeule, Massachusetts v. EPA*: From Politics to Expertise*, 2007 S. CT. REV. 51, http://www.law.harvard.edu/faculty/freeman/SCR.pdf.

[43] The most plausible example is the installation of airbags in automobiles, which was prompted by *Motor Vehicles Mfrs. Ass'n of the United States, Inc. v. State Farm, Inc.*, 463 U.S. 29 (1983).

likely to be the difficulty of repealing existing rules under the Administration Procedure Act,[44] not the Supreme Court of the United States.

IV. Plan A, and God Laughs

There is a saying: "If you make a plan, God laughs. If you make two plans, God smiles."

The Obama administration came into power in 2009. Even in January of that year, with the Great Recession in full force, climate change was a major priority – not on the level of preventing a depression or enacting health care reform, but nonetheless toward the top of the list. For the administration, the principal vehicle – and the preferred one by far – was legislation.[45] Most important, a statutory program would be likely to be far more efficient and far more effective than executive action.[46] Because a cap-and-trade program could be national, and include a wide range of sources, it could produce significant emissions reductions at the lowest possible cost.[47] It would also stand on firm legal ground; any executive action would inevitably be subject to challenge in court as beyond EPA authority, and a statute would avoid that trouble.[48] At the same time, legislative action could well have stronger public legitimacy than action that relied on the CAA, whose original focus was hardly greenhouse gas emissions.

Within the Obama Administration, a great deal of time and effort was devoted to substantive issues: What exactly should federal legislation look like[49]? Within the White House, officials from the Office of Management and Budget, the Council of Economic Advisers, the National Economic Council, and the (important but short-lived) Office of Energy and Climate Change Policy[50] worked closely to offer answers to these questions. For everyone, the preferred design involved a system of "cap and trade," which would involve a national "cap" on greenhouse gas emissions, accompanied by authority, on the part of polluters, to trade with one another. From the standpoint of economic theory, this approach made a great deal of sense.[51] A national cap could achieve the desired

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[44] 5 U.S.C. § 553 *et seq.* (2012).

[45] *See* Evan Lehmann, *Obama Calls Carbon Price Better Than Regulations*, SCI. AM. (Dec. 2, 2015), https://www.scientificamerican.com/article/obama-calls-carbon-price-better-than-regulations/.

[46] As President Obama stated: "I have long believed that the most elegant way to drive innovation and to reduce carbon emissions is to put a price on it." *Id.*

[47] *See* A. DENNY ELLERMAN ET AL., MARKETS FOR CLEAN AIR: THE U.S. ACID RAIN PROGRAM (2005).

[48] It could of course be subject to constitutional challenge, but any such challenge would be unlikely to succeed unless the statute were drafted with indifference with constitutional restrictions.

[49] I report here from personal experience.

[50] The office existed from 2009 until 2011.

[51] In *The Climate Casino*, William Nordhaus makes a strong argument that a carbon tax would be preferable to cap-and-trade. *See* WILLIAM D. NORDHAUS, THE CLIMATE

reductions, and a trading system could ensure that the system would be as efficient (in other words, as inexpensive, given as specified goal) as possible. Such a system would produce reductions far more cheaply than regulatory mandates, which would inevitably be at least somewhat clumsy.

Within that broad design, however, there were many open questions for both the executive branch and Congress. Should the national greenhouse gas program also contain energy efficiency requirements? Some people favored them as useful supplements to the cap-and-trade idea, but others believed that if the cap-and-trade program was properly designed, there was no need for them. (In my view, that belief was and remains correct.[52]) Should the national program specifically mandate renewable fuels? Some people thought so, but other people that the cap-and-trade program would automatically produce the right level of renewable fuels. (Correct again, in my view.) As a matter of substance, these issues were intensely debated within the Executive Office of the President, and they were disputed in Congress too.

What is noteworthy, for present purposes, is the highly technical nature of the executive branch debates. Some outstanding environmentalist economists were participating in those debates on a regular basis.[53] In addition, officials in the EPA and elsewhere within the executive branch had extraordinary expertise and experience on the underlying questions. At the same time, these intensely substantive debates had a highly artificial quality, because in Congress, everything depended not only on the substance but also on the politics. If important members of Congress wanted energy efficiency mandates, then the bill would contain energy efficiency mandates. (It did.[54]) If important members of Congress would support a bill only if it contained a renewable fuel mandate, then the bill would contain a renewable fuel mandate. (It did.[55]) Political feasibility imposed sharp constraints on ideal theory.

Over 1200 pages, the bill that eventually obtained a vote in the House of Representatives – the American Clean Energy Security Act[56] – did not constitute what anyone would consider ideal legislation. Within the White House, some prominent

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CASINO: RISK, UNCERTAINTY, AND ECONOMICS FOR A WARMING WORLD (2013). A carbon tax had essentially no prospect of enactment. Whatever the choice between them, the two instruments are of course preferred to command-and-control on economic grounds.

[52] The reason is that if the cap is set at the right level, any energy efficiency mandate is unnecessary; the cap would create the proper incentives for energy efficiency. A mandate would add economic costs without providing environmental benefits. Admittedly, behavioral economics does introduce some complexities. *See* Hunt Allcott & Cass R. Sunstein, *Regulating Internalities*, 34 J. PUB. POL'Y & MGMT. 698 (2015).

[53] They included Michael Greenstone, who worked at the Council of Economic Advisers, and Joseph Aldy, who worked at the National Economic Council.

[54] *See* American Clean Energy and Security Act of 2009, H.R. 2454, 111th Cong., https://www.congress.gov/bill/111th-congress/house-bill/2454.

[55] *Id.*

[56] *Id.*

officials thought that it was so confusing and complex, and so full of favors to special interests, that it should not be embraced at all; perhaps the whole project should be abandoned. But most people believed that it was an important step in the right direction. There was no real question that the Obama Administration would strongly support it. With the help of furious lobbying from the White House, it passed the House by the slimmest of margins: 219 votes for, 212 votes against.

Within the White House, passage was a cause for celebration. I remember congratulating Carol Browner, the White House official in charge of climate change and energy policy, who was pleased but (to my surprise) quite cautious, adding, "It's going to be even tougher in the Senate." As on so many things, Browner was right. Republicans intensely opposed the bill, and in the midst of a difficult economic situation, Democrats could not muster the votes to override their opposition.[57]

V. Plan B, and God Smiles: Pricing Carbon

It turned out that while the legislative efforts were proceeding, Browner was leading the interagency effort to address climate change through executive action. (In fact serious thinking on the effort started in the transition period.) Although the Obama administration was eager to engage in that effort as a matter of policy, one motivation for that effort was strictly legal: The EPA appeared to be obliged to respond to the Supreme Court's decision involving greenhouse gases as a pollutant under the CAA. It is true that if the administration had absolutely no interest in regulating greenhouse gases, it might have been able to find a lawful way to avoid doing that. The executive branch can be extraordinarily agile in figuring out how not to do things.[58]

A. Regulation As Incentive

But as a matter of law, that would have been difficult. After the Court's decision, the legal obstacles to declining to act were serious. The Court had essentially foreclosed the most natural argument, which was that the Clean Air Act was not the appropriate or preferred vehicle for regulating greenhouse gas emissions, and that the executive branch would use other methods, including international negotiations, to try to come to terms with the climate change problem.[59] As a simple matter of law, it would be impossible, in the abstract, for regulators to conclude that greenhouse gases did not "endanger" public health or welfare – but in light of the science, that conclusion would be challenging and probably impossible to justify. (It could have been interesting for the EPA to try; the

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[57] Evan Lehmann, *Senate Abandons Climate Effort, Dealing Blow to President*, N.Y. TIMES (July 23, 2010), http://www.nytimes.com/cwire/2010/07/23/23climatewire-senate-abandons-climate-effort-dealing-blow-88864.html?pagewanted=all.

[58] Cass R. Sunstein & Adrian Vermeule, *The Law of "Not Now": When Agencies Defer Decisions*, 103 HARV. L. REV. 157 (2014).

[59] For a discussion that seems to forbid use of that argument, see *Massachusetts v. EPA*, 549 U.S. 497 (2007).

focus would have to be on an absence of demonstrable adverse effects on the United States, but that would not have been promising.[60])

After the Court's decision, then, the executive branch was essentially obliged to make a finding of endangerment and then to regulate greenhouse gas emissions from motor vehicles, though the stages and the timing was not clear, and the extent of the resulting regulation would involve the exercise of discretion. As we shall see, the administration made the intriguing decision to proceed in two independent stages, first with an endangerment finding, and second with fuel economy regulation.[61]

As noted, both the White House and the EPA were enthusiastic about proceeding. They *wanted* to act immediately. Most people thought that if the EPA showed a willingness to act, reluctant members of Congress would take notice and be more willing to support legislation, which could impose lower costs (and explicitly preempt threatened EPA action). Unilateral executive action would create an incentive to enact cap-and-trade; if the EPA acted, relevant interest groups would have a strong motivation to press for legislation that they might otherwise oppose. In a sense, such legislation might even seem deregulatory.

B. The SCC

But the more fundamental point was that success in Congress was not foreordained, and it was sensible to have a Plan B. A pivotal early step, beginning in early 2009, was to produce an interagency working group on the social cost of carbon (SCC) – the damage from a ton of carbon emissions.[62] The primary reason for this initiative was simple: regulators would be producing regulatory impact analyses for regulations that would reduce carbon emissions, and it made sense for those in the executive branch to work together to produce a unitary number, rather than to have diverse numbers from different agencies (some of which might turn out to be arbitrary or indefensible). An additional reason involved the law: A lower court had struck down a decision of the Bush administration because of its failure to specify a defensible SCC.[63] Without some kind of figure, and a supporting analysis, regulatory decisions might be

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[60] *See Global Climate Change Impacts in the United States*, U.S. GLOBAL CHANGE RES. PROGRAM, http://www.globalchange.gov/browse/reports/global-climate-change-impacts-united-states (last visited Jan. 27, 2017).

[61] For valuable discussion, see Jody Freeman & Jim Rossi, *Agency Coordination in Shared Regulatory Space*, 125 HARV. L. REV. 1131 (2012).

[62] For a valuable discussion, see Michael Greenstone et al., *Developing a Social Cost of Carbon for US Regulatory Analysis: A Methodology and Interpretation*, 7 REV. ENVTL. ECON. & POL'Y 23 (2013), http://isites.harvard.edu/fs/docs/icb.topic1186096.files/Session%206/Greenstone%20Developing%20a%20Social%20Cost%20of%20Carbon.pdf.

[63] Ctr. for Biological Diversity v. NHTSA, 538 F.3d 1172 (2008); High Country Conservation Advocates v. U.S. Forest Serv., 52 F. Supp. 3d 1174 (D. Colo. 2014).

vulnerable in court. But in terms of both policy and law, the executive branch had a range of reasonable options.

The Interagency Working Group, which I helped to convene, included representatives of the Council of Economic Advisers, the Council on Environmental Quality, the Department of Agriculture, the Department of Commerce, the Department of Energy, the Department of Transportation, the Environmental Protection Agency, the National Economic Council, the Office of Energy and Climate Change, the Office of Management and Budget, the Office of Science and Technology Policy, and the Department of the Treasury. The discussion was unfailingly substantive and entirely technical. The meetings were long and complex, and people explored the technical merits, above all the science and the economics.

Many agencies were active participants; the discussion was not dominated by just a few of them. Notably, there was no political interference with the deliberations of the working group. In fact, the standard political issues – the reactions of interest groups, the concerns of legislators with strong views, electoral considerations, and so forth – came up not at all. The resulting document describes the monetary value of reductions in carbon emissions, in a way that bears on a large number of regulatory judgments.[64] In that sense, the United States did in fact "put a price on carbon."

There of the most important decisions should be underlined, with an emphasis on the fact that all of them might have been otherwise. *First*: For its fundamental judgments, the working group builds on the three leading integrated assessment models (from the United States, the United Kingdom, and Germany), rather than choosing among them, or attempting to make novel scientific assessments of its own.[65] Reliance on the three models, whatever their defects, was believed to reflect a degree of neutrality and to avoid some of the difficult technical judgments, and the risk of selectivity, that might come from having to pick and choose. Because of its reliance on those models, the SCC does not reflect "new science" on the part of the working group. Instead it is based on what the working group took to be the best available science (and economics) in the international arena – with an acknowledgement that some of the best available science (and economics) might not be close to correct, and that it is being continually updated.[66]

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[64] *See* INTERAGENCY WORKING GROUP ON SOCIAL COST OF CARBON,TECHNICAL SUPPORT DOCUMENT: SOCIAL COST OF CARBON FOR REGULATORY IMPACT ANALYSIS UNDER EXECUTIVE ORDER 12866 (Feb. 2010), https://www.epa.gov/sites/production/files/2016-12/documents/scc_tsd_2010.pdf. For subsequent updates, see *The Social Cost of Carbon*, U.S. ENVTL. PROT. AGENCY, https://www.epa.gov/climatechange/social-cost-carbon (last visited Jan. 27, 2016).

[65] INTERAGENCY WORKING GROUP, *supra* note 64, at 5.

[66] *Id.* at 1 ("The estimates are presented with an acknowledgement of the many uncertainties involved and with a clear understanding that they should be updated over time to reflect increasing knowledge of the science and economics of climate impacts.").

The working group could of course have done something different. It might have selected one of the three models and abandoned the other two. It might have chosen a preferred model, but made significant adjustments whenever the group concluded that the model was wrong. It could have ventured an assortment of judgments of its own. It could have abandoned all of the three models and conducted some kind of survey of experts.[67] Imaginable approaches might have moved the SCC significantly up or down. These various alternatives would have given rise to a variety of objections and might have proved vulnerable in court. But in view of the deference likely to be accorded to the executive branch on technical questions, these alternative approaches would probably have survived.

Second: The working group adopted a global, rather than merely domestic, measure of damages; harms to people, from emissions in the United States, to China, Europe, Africa, and India are fully counted.[68] In fact they are counted every bit as much as harms to people in the United States. This was a highly consequential decision, and it was not an inevitable one; it reflected a contestable judgment of policy (and we could imagine legal challenges to either the global or the domestic measure). If a purely domestic measure had been chosen, the SCC would have been some fraction of the original figure of $21.40 (2010 dollars) – probably $5 or less.

By way of explanation, the TSD notes that climate change involves "a global externality," that it "presents a problem that the United States alone cannot solve," and that "the United States has been actively involved in seeking international agreements to reduce emissions and in encouraging other nations, including emerging major economies, to take significant steps to reduce emissions."[69] Every member of the interagency group found these arguments convincing; they did not prove controversial internally. But it is hardly difficult to imagine a decision to choose the domestic measure,[70] which would have resulted in a significantly lower SCC.

Third: The TSD offers a detailed discussion of discount rates and climate change.[71] Noting the differences between prescriptive and descriptive approaches to the problem, it relies "primarily on the descriptive approach to inform the choice of discount rate. With recognition of its limitations, we find this approach to be the most defensible and transparent given its consistency with the standard contemporary theoretical

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[67] Robert S. Pindyck, *The Social Cost of Carbon Revisited* (Nat'l Bureau of Econ. Research, Working Paper No. 22807, 2016), http://web.mit.edu/rpindyck/www/Papers/SCCRevisitedNov2016.pdf

[68] *See* INTERAGENCY WORKING GROUP, *supra* note 64, at 3 (defining "global SCC value" as "the value of damages worldwide").

[69] *Id.* at 10–11.

[70] *See* Ted Gayer & W. Kip Viscusi, *Determining the Proper Scope of Climate Change Policy Benefits in U.S. Regulatory Analyses: Domestic Versus Global Approaches*, BROOKINGS (Aug. 24, 2016), https://www.brookings.edu/wp-content/uploads/2016/08/rev-environ-econ-policy-2016-gayer-reep-rew002.pdf.

[71] INTERAGENCY WORKING GROUP, *supra* note 64, at

foundations of benefit- cost analysis and with the approach required by OMB's existing guidance."[72] At the same time, the TSD states that "the interagency group has been keenly aware of the deeply normative dimensions of both the debate over discounting in the intergenerational context and the consequences of selecting one discount rate over another."[73]

The TSD opts for three discount rates, designed to span a plausible range of certainty-equivalent rates: 2.5, 3, and 5 percent.[74] Importantly, it selects 3 percent as the basis for the "central value," which has come to dominate regulatory analysis.[75] The TSD explains that 3 percent corresponds to the after-tax riskless interest rate and that 5 percent reflects "the possibility that climate damages are positively correlated with market returns" and "may be justified by the high interest rates that many consumers use to smooth consumption across periods."[76] The low value of 2.5 percent is used to reflect the uncertainty of interest rates over time, and also to acknowledge "ethical objections that have been raised about rates of 3 percent or higher."[77]

It should be noted that the choice of 3 percent, as the basis for the central value, was hardly inevitable. In the academic literature, there is some support for 5 percent, which would have resulted in a significantly lower SCC.[78] There is also support for a lower figure – even below 2 percent[79] - which would of course produce a much higher figure.[80] Within the executive branch itself, there was significant discussion of both of these possibilities, producing lively debates. Here again, a wide range of choices would likely have survived judicial review.[81]

The guidance was updated in 2013, maintaining the three discount rates and with changes that are not especially relevant here.[82] In 2013, the Obama Administration

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[72] *See id.* at 17–23.

[73] *Id.* at 19.

[74] *See id.* at 1.

[75] *Id.* at 3.

[76] *Id.* at 23.

[77] *Id.*

[78] *See* WILLIAM D. NORDHAUS, *supra* note 51.

[79] *See* NICHOLAS STERN, THE ECONOMICS OF CLIMATE CHANGE: THE STERN REVIEW (2007).

[80] For the last word from the Obama Administration on the discount rate issue, see Council of Economic Advisors, Discounting for Public Policy: Theory and Recent Evidence on the Merits of Updating the Discount Rate (Jan. 2017), https://obamawhitehouse.archives.gov/sites/default/files/page/files/201701_cea_discounting_issue_brief.pdf.

[81] For a decision upholding the social cost of carbon without extended discussion, see Zero Zone, Inc. v. U.S. Dep't of Energy, 832 F.3d 654 (2016).

[82] INTERAGENCY WORKING GROUP ON SOCIAL COST OF GREENHOUSE GASES, TECHNICAL SUPPORT DOCUMENT: TECHNICAL UPDATE ON THE SOCIAL COST OF CARBON FOR REGULATORY IMPACT ANALYSIS UNDER EXECUTIVE ORDER 12866 3 (Aug. 2016),

announced that it would seek public comments on the social cost of carbon.[83] Revisions were produced in various years, most recently in 2016, and while the numbers were updated (and significantly increased), mostly in response to changes in the integrated assessment models, the basic approach was not altered.[84]

VI. Plan B, and God Smiles: DOT and (Mostly) EPA

With the social cost of carbon as background, Plan B focused on the Clean Air Act. It included numerous and diverse initiatives. The agency lead was the EPA, sometimes working with DOT. Importantly, both agencies worked closely with other parts of the federal government, including of course various offices within the White House, which has the policymaking lead.

A. The First Week: Fuel Economy

On January 26, 2009, President Obama issued a memorandum to DOT, directing it to issue fuel economy regulations under the Energy Independence and Security Act (EISA) of 2007, beginning with the year 2011.[85] Everyone understood that this memorandum, which specifically mandated coordination with EPA, would start a process for eventually reducing greenhouse gas emissions. At the same time, compliance with EISA is not optional. President Obama was indicating his direction, which involved compliance with statutory deadlines.[86]

B. The Endangerment Finding

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https://www.whitehouse.gov/sites/default/files/omb/inforeg/scc_tsd_final_clean_8_26_16.pdf ("In May of 2013, the [Interagency Working Group (IWG)] provided an update of the SC-CO2 estimates based on new versions of each [integrated assessment model] . . . . The 2013 update did not revisit other IWG modeling decisions (e.g., the discount rate, reference case socioeconomic and emission scenarios, or equilibrium climate sensitivity).").

[83] *See* Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order No. 12866, 78 Fed. Reg. 70,586 (Nov. 26, 2013).

[84] *See* INTERAGENCY WORKING GROUP, *supra* note 82.

[85] Memorandum from the President of the United States to the Secretary of Transportation and the Administrator of the National Highway Traffic Safety Administration (Jan. 26, 2009), https://www.whitehouse.gov/the-press-office/2009/01/26/presidential-memorandum-fuel-economy.

[86] *See id.* ("[I]n order to comply with the EISA requirement that fuel economy increases begin with model year 2011, [I request that] you take all measures consistent with law, and in coordination with the Environmental Protection Agency, to publish in the Federal Register by March 30, 2009, a final rule prescribing increased fuel economy for model year 2011.").

Facing the Supreme Court's ruling, the EPA began the process of regulating greenhouse gas emissions from motor vehicles with an "endangerment finding" – a technical finding that greenhouse gases threaten public health and welfare. The EPA initially proposed such a finding to the public on April 24, 2009, invited public comments over a 60-day period (ending June 23, 2009). It is worth emphasizing that the proposal was issued just a few months after the Obama administration took office, which attests to the priority given to climate change even at the earliest stages. The EPA finalized the rule in light of those comments, with the finding approved by the EPA Administrator on December 7, 2009 and published on December 15, 2009.[87] The finding went into effect on January 14, 2010.[88] By itself, it imposed no regulation. But it was a predicate for much of what followed, and given the finding, regulation was not optional.[89]

The endangerment finding was long and detailed, and it was packed with information.[90] Its contents were discussed and debated at great length in the interagency process overseen by the Office of Information and Regulatory Affairs. Focusing on the "combined mix of six key directly-emitted, long-lived and well-mixed greenhouse gases"[91] – carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride – the EPA observed, among other things, that "current atmospheric greenhouse gas concentrations are now at elevated and essentially unprecedented levels," causing "increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level."[92] As a result, "[c]old days, cold nights, and frost have become less frequent, while hot days, hot nights, and heat waves have become more frequent."[93] Heat is "the leading cause of weather-related deaths in the United States," and "the net impact on mortality is more likely [than not] to be adverse."[94] Considering "observed and projected effects of greenhouse gases in the atmosphere, their effect on climate, and the public health and welfare risks and impacts associated with such climate change," the EPA concluded that greenhouse gases

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

[88] *See id.* at 66496.

[89] Massachusetts v. EPA, 549 U.S. 497, 533 (2007) ("If EPA makes a finding of endangerment, the Clean Air Act requires the Agency to regulate emissions of the deleterious pollutant from new motor vehicles"); 42 U.S.C. § 7521(a)(1) (2012) (providing that the EPA "shall by regulation prescribe . . . standards applicable to the emission of any air pollutant from any class or classes of new motor vehicles . . . , which in [its] judgment cause, or contribute to, air pollution which may reasonably be anticipated to endanger public health or welfare").

[90] The Endangerment Finding was 52 pages. *See* Endangerment, *supra* note 87.

[91] *Id.* at 66516.

[92] *Id.* at 66517.

[93] *Id.* at 66518.

[94] *Id.* at 66497.

"may reasonably be anticipated both to endanger public health and to endanger public welfare."[95] [can we add a little more concrete detail about the particular adverse effects?]

This was a pivotal moment, in which the United States formally and officially recognized the existence of climate change, and the adverse effects – for the United States and the world – that it was creating and would continue to create. The EPA's endangerment finding was the legal precondition for everything that followed. The precise content of the finding involved a range of judgments, principally scientific in character; some of them had a policy dimension. In view of the scientific background, any administration was almost certainly required to make some kind of endangerment finding, though its precise content could vary considerably from one administration to another.

For example, it would not have transgressed legal boundaries for the administration to have been far more equivocal about both health and welfare effects. In counterfactual worlds, we could imagine many different versions of the endangerment finding, consistent with the emerging science. One implication is that while a softer version would have been consistent with that science, any effort to find "no endangerment" would almost certainly be invalidated.

C. Light-Duty Vehicles: Round One

Having made the endangerment finding, the EPA was under a statutory obligation to propose greenhouse gas standards for light-duty vehicles.[96] It is worth emphasizing that the CAA did not make such standards discretionary. In carrying out its obligation, the EPA worked closely with the DOT, which has authority over fuel economy;[97] it would not make much sense for two federal agencies to impose inconsistent or redundant requirements on the automobile industry.[98] In addition, the United States had to work closely with state governments, above all California, which was planning to impose greenhouse gas standards of its own that could end up driving the national market.[99] The prospect of regulations from California played a significant role in encouraging the automobile companies to work cooperatively and constructively with the federal government.[100]

Under Browner's leadership, the United States produced a "new national policy aimed at both increasing fuel economy and reducing greenhouse gas pollution for all new cars and trucks sold in the United States."[101] President Obama announced what became

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[95] *Id.*

[96] 42 U.S.C. § 7521(a)(1) (2012).

[97] *See* 49 U.S.C. § 32902 (2012).

[98] For an instructive discussion of this point, see Freeman & Rossi, *supra* note 61.

[99] *Id.*

[100] *See id.*

[101] Press Release, White House, Office of the Press Sec'y, President Obama Announces National Fuel Efficiency Policy (May 19, 2009),

known as the "national program," in the form of proposed average fuel economy standards covering cars and trucks with model years 2012–2016, on May 19, 2009.[102] This first set of standards were jointly finalized by the EPA and DOT on April 1, 2010,[103] and published on May 7, 2010.[104]

The joint final rule issued by the EPA and DOT in fact contained two separate though largely consistent sets of standards: national CO_2 emissions standards (EPA) and fuel economy standards (DOT).[105] The EPA's national CO_2 emissions standards required a slightly higher combined average fuel economy level by 2016 (35.5 mpg) than the DOT's fuel economy standard (34.1 mpg),[106] and therefore became the focus in the media and the market.[107] The EPA and DOT estimated that their 2012–2016 standards would reduce total CO_2 emissions by 960 million metric tons over the lifetimes of covered cars and trucks, and at the same time produce 1.8 billion barrels of oil savings. In total, the agencies projected that their standards would reduce greenhouse gas emissions from U.S. cars and trucks by about 21 percent by 2030. According to the agencies, their standards also provided "important energy security benefits, as light-duty vehicles are about 95 percent dependent on oil-based fuels." The EPA and DOT concluded that total benefits from their joint final rule would likely exceed $240 billion.[108] When factoring in lifetime costs — estimated at $51.5 billion — net benefits could end up being as high as $189 billion, a 350-plus percent return on investment.[109]

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https://www.whitehouse.gov/the-press-office/president-obama-announces-national-fuel-efficiency-policy.

[102] *Id.*

[103] Press Release, U.S. Envtl. Prot. Agency, DOT, EPA Set Aggressive National Standards for Fuel Economy and First Ever Greenhouse Gas Emission Levels for Passenger Cars and Light Trucks (Apr. 1, 2010), https://yosemite.epa.gov/opa/admpress.nsf/d0cf6618525a9efb85257359003fb69d/562b44f2588b871a852576f800544e01!OpenDocument.

[104] Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards, 75 Fed. Reg. 25,323, 25,324 (May 7, 2010) (codified at 40 C.F.R. pts. 85, 86, 600; 49 C.F.R. pts. 531, 533, 536–38).

[105] *Id.* at 25,329–30.

[106] *Id.* at 25,330.

[107] *See, e.g.*, Bill Vlasic, *U.S. Sets Higher Fuel Efficiency Standards*, N.Y. TIMES (Aug. 28, 2012), http://www.nytimes.com/2012/08/29/business/energy-environment/obama-unveils-tighter-fuel-efficiency-standards.html.

[108] Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards, *supra* note 104, at 25,328. The $240 billion figure is based on a three percent discount rate. *Id.* At a seven percent discount rate, total benefits are expected to exceed $190 billion. *Id.* Both the $240 billion and $190 billion estimates were derived by the EPA. *See id.* at 25,346, Table I.C.2–1.

[109] *Id.* at 25,346, Table I.C.2–1. The $189 billion estimate assumes a three percent discount rate. *Id.* For more information on the rule's expected costs and benefits, see Appendix 1, Tables 1–4.

It is important to see that because of the complexity of some of the factual issues and the relatively open-ended nature of the statutory standard, the agencies made a number of discretionary choices here – not merely in the calculation of relevant numbers, on which reasonable people might differ, but also in choosing the relevant level of stringency. A less aggressive approach would not have been difficult to defend. For example, the agencies might have discounted, to a modest or not-so-modest degree, the consumer savings that accounted for the bulk of the monetized benefits.[110] The central reason is that consumers can of course purchase fuel-efficient cars if they wish; if they fail to do, it might be because they do not want those cars, which would mean that the consumer benefits are illusory. If so, the benefits from the regulation would be dramatically lower, thus suggesting, on cost-benefit grounds, that a weaker standard would be better. Without such high consumer savings, it would have been possible to read the underlying statutes to permit and perhaps to require such a weaker standard. The

[110] Gayer & Viscusi, *supra* note 6.

agencies offered a behavioral justification for counting the consumer savings,[111] but the justification is controversial.[112]

More modestly, the agencies might have offered different numbers for the "rebound effect"[113] (which measures the increase in driving from higher fuel economy, offsetting environmental gains). The agencies might have made different judgments about the adverse safety effects of the standards.[114] The agencies might have made different projections about the likely sales of more fuel-efficient (and expensive) cars.

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[111] *See* Light-Duty Vehicle Greenhouse Gas Emission Standards, 75 Fed. Reg. at 25,510–13. As stated in the preamble to this rule,

> The central conundrum has been referred to as the Energy Paradox in this setting (and in several others). In short, the problem is that consumers appear not to purchase products that are in their economic self-interest. There are strong theoretical reasons why this might be so:
>
> - Consumers might be myopic and hence undervalue the long-term.
> - Consumers might lack information or a full appreciation of information even when it is presented.
> - Consumers might be especially averse to the short-term losses associated with the higher prices of energy efficient products relative to the uncertain future fuel savings, even if the expected present value of those fuel savings exceeds the cost (the behavioral phenomenon of "loss aversion").
> - Even if consumers have relevant knowledge, the benefits of energy-efficient vehicles might not be sufficiently salient to them at the time of purchase, and the lack of salience might lead consumers to neglect an attribute that it would be in their economic interest to consider.
> - In the case of vehicle fuel efficiency and perhaps as a result of one or more of the foregoing factors, consumers may have relatively few choices to purchase vehicles with greater fuel economy once other characteristics, such as vehicle class, are chosen.
>
> A great deal of work in behavioral economics identifies and elaborates factors of this sort, which help account for the Energy Paradox. This point holds in the context of fuel savings (the main focus here), but it applies equally to the other private benefits, including reductions in refueling time and additional driving. For example, it might well be questioned whether significant reductions in refueling time, and corresponding private savings, are fully internalized when consumers are making purchasing decisions. (citations omitted).

[112] *See* Hunt Allcott & Christopher Knittel, *Are Consumers Poorly-Informed about Fuel Economy? Evidence from Two Experiments* (Nat'l Bureau of Econ. Research, Working Paper No. 23076, 2016), http://www.nber.org/papers/w23076.

[113] Joshua Linn, The Rebound Effect of Passenger Vehicles (Resources for the Future, Discussion Paper No 13-19, 2013), http://www.rff.org/files/sharepoint/WorkImages/Download/RFF-DP-13-19.pdf

[114] *See* Mark R. Jacobson, *Fuel Economy and Safety: The Influences of Vehicle Class and Driver Behavior* (Nat'l Bureau of Econ. Research, Working Paper No. 18012, 2012), http://www.nber.org/papers/w18012.

With lower projections, the anticipated benefits would be reduced as well – and hence the argument for less stringency would be strengthened.

Consistent with the statutory standard, and emphasizing the consumer benefits, the agencies might also have chosen a *higher* level of stringency. Feasibility would have restricted the agencies' judgments here,[115] but more ambition would not have exceeded the bounds. A variety of judgments would almost certainly have survived judicial review.

D. Permitting and Tailoring

At least at first glance, the EPA's endangerment finding seemed to trigger an obligation to issue permit requirements for greenhouse gas emissions from numerous stationary sources in various parts of the country.[116] So the EPA thought, and within the executive branch, no one seriously disagreed with it. If the CAA were interpreted literally, the resulting requirements would apply to about 6.2 million sources – an intolerable administrative burden for the EPA, and also a case of regulatory overkill in light of the modest greenhouse gas reductions that would follow.[117]

Understanding itself as obliged to proceed, the EPA therefore issued what it called "the tailoring rule," which dramatically increased the threshold of emissions that would trigger the permit requirement.[118] At the same time, the rule imposed regulatory restrictions on covered sources, including sources already subject to regulation for non-greenhouse gas pollutants, and other new and existing sources that emit at least 100,000 tons of CO_2 equivalent emissions per year.[119] The rule was proposed on September 30, 2009,[120] finalized on May 13, 2010,[121] and published on June 3, 2010.[122]

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[115] *See* 42 U.S.C. § 7521(a)(2) (2012); *id.* § 7521(c); 49 U.S.C. § 32902(a) (2012).

[116] *See* Utility Air Regulatory Grp. v. EPA, 134 S. Ct. 2427, 2436 (2014) (Under EPA's view, once greenhouse gases became regulated under any part of the [CAA], the [Prevention of Significant Deterioration (PSD)] and Title V permitting requirements [of the CAA] would apply to all stationary sources with the potential to emit greenhouse gases in excess of the statutory thresholds: 100 tons per year under Title V, and 100 or 250 tons per year under the PSD program depending on the type of source."); 42 U.S.C. §§ 7470–7479, 7491–7492 (2012) (PSD); *id.* § 7661 (Title V).

[117] *Utility Air Regulatory Grp.*, 134 S. Ct. at 2442–43.

[118] *See* Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule, 75 Fed. Reg. 31,514 (June 3, 2010) (codified at 40 C.F.R. pts. 51, 52, 70, 71) [hereinafter Tailoring Rule].

[119] *Id.* at 31,516.

[120] U.S. Envtl. Prot. Agency, Fact Sheet — Proposed Rule: Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule, https://www.epa.gov/sites/production/files/2015-12/documents/20090930fs.pdf.

[121] U.S. Envtl. Prot. Agency, Fact Sheet: Proposed Rules on Clean Air Act Permits for Sources of Greenhouse Gas Emissions under the Prevention of Significant Deterioration Program 4, https://www.epa.gov/sites/production/files/2015-12/documents/20100810sipfipfactsheet.pdf.

In 2014, a sharply divided Supreme Court struck down the tailoring rule, holding that the EPA cannot use the CAA to regulate new and existing sources on the basis solely of greenhouse gas emissions.[123] The Court's conclusion – reminiscent of the view rejected in *Mass. v. EPA* – was that the very fact that the tailoring rule was necessary in order to avoid the clear statutory requirement, demonstrated that the provision did not apply to greenhouse gases.[124] So far as I am aware, the argument that prevailed in the Court was never even ventured within the executive branch – a fact that might attest to an absence of imagination there or to real creativity on the part of the lawyers challenging the regulation. But the practical consequence of the Court's ruling was relatively modest. The Court simultaneously held that where a source is otherwise regulated for a non-greenhouse gas pollutant, then the EPA may regulate those sources' emissions of greenhouse gases as well – which ensured achievement of the vast majority of the reductions required by the original rule.[125]

E. Light Duty Vehicles: Round Two

A second set of light-duty fuel economy standards, covering model years 2017-2025, was proposed by the EPA and DOT on December 1, 2011.[126] In terms of aggregate impact, this was the most important fuel economy rule for emissions reductions. The agencies finalized their joint rule on August 28, 2012,[127] and published it on October 15, 2012.[128] As with the final rule setting standards for model years 2012-2016, this rule established both national CO_2 emissions standards and fuel economy standards, ultimately resulting in an average fuel economy level of 54.5 mpg.[129]

In total, the 2017-2025 standards are expected to reduce greenhouse gas emissions by about 2 billion metric tons, reducing oil consumption by about 4 billion barrels in the process. According to the agencies, fuel savings and other benefits from the standards will far outweigh higher vehicle costs, with annualized net benefits ranging between $19.5 billion and $24.4 billion — and net benefits totaling between $326 billion and $451

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[122] Tailoring Rule, *supra* note 118.

[123] Utility Air Regulatory Grp. v. EPA, 134 S. Ct. 2427, 2449 (2014).

[124] *Id.* at 2444.

[125] *Id.* at 2449.

[126] 2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards, 76 Fed. Reg. 74,854 (proposed Dec. 11, 2011).

[127] Press Release, White House Office of the Press Sec'y, Obama Administration Finalizes Historic 54.5 MPG Fuel Efficiency Standards (Aug. 28, 2012), https://www.whitehouse.gov/the-press-office/2012/08/28/obama-administration-finalizes-historic-545-mpg-fuel-efficiency-standard.

[128] *See* 2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards, 77 Fed. Reg. 62,624 (Oct. 15, 2012) (codified 49 C.F.R. pts. 523, 531, 533, 536, 537).

[129] *Id.* at 62,627.

billion over the covered vehicles' lifetimes.[130] (It is worth pausing over those numbers.) Here as well, the rule depended on a range of contestable judgments of policy and fact, which might have been different, consistent with legal requirements. And here as well, higher or lower levels of stringency would not be difficult to justify. On those counts, the analysis is the same as for the earlier version of the same basic program.

An important note: This rule was accompanied by a commitment to a mid-term review, calling for a reassessment on the basis of how matters proceed in the initial years.[131] Many people, inside as well as outside of government, believed that this review was exceedingly important. Markets can be unpredictable, and so too for technological change. For good Hayekian reasons,[132] planners should build a degree of flexibility into their programs, so as to allow adjustments in case of surprises, which are essentially inevitable. In 2017, the EPA made certain findings based on its mid-term review, essentially concluding that the plan set out in the original rule was the right one.[133] This proposal has proved controversial, and the Trump Administration is highly likely to revisit it.[134]

F. Heavy-Duty Vehicles: Round One

Greenhouse gases are emitted by heavy-duty vehicles as well as light-duty ones. In 2010, the EPA and DOT proposed the first-ever rule to regulate the resulting emissions.[135] The rule, which was legally optional, was finalized in 2011.[136] The rule covered model years 2014-2018, and was estimated to reduce CO_2 emissions by about 270 million metric tons and reduce oil consumption by about 530 million barrels over the

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[130] *Id.* at 62,663, Table I–19. For more information on the rule's expected costs and benefits, see Appendix 1, Tables 5–6.

[131] *See* 2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions, *supra* note 128, at 62,652.

[132] *See* Friedrich Hayek, *The Use of Knowledge in Society*, 4 AM. ECON. REV. 519 (1945).

[133] U.S. Envtl. Prot. Agency, Final Determination on the Appropriateness of the Model Year 2022-2025 Light-Duty Vehicle Greenhouse Gas Emissions Standards under the Midterm Evaluation (Jan.2017), https://www.epa.gov/sites/production/files/2017-01/documents/420r17001.pdf .

[134] *See, e.g.*, Ryan Beene & John Lippert, *EPA Defies Automakers by Keeping Efficiency Standards Intact*, BLOOMBERG (Jan. 13, 2017, 9:29 AM), https://www.bloomberg.com/news/articles/2017-01-13/epa-defies-automakers-by-keeping-efficiency-standards-intact .

[135] *See* Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles, 75 Fed. Reg. 74,151 (proposed Nov. 30, 2010).

[136] Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles, 76 Fed. Reg. 57,106 (Sept. 15, 2011) (codified at 40 C.F.R. pts. 85, 86, 600, 1033, 1036, 1037, 1039, 1065, 1066, 1068; 49 C.F.R. pts. 523, 534, 535).

covered vehicles' lifetimes.[137] These standards are projected to provide annual net benefits totaling $2.2 billion to $2.5 billion, with aggregate lifetime benefits reaching as high as $49 billion.[138] Essentially the same kinds of discretionary judgments were made here as with prior fuel economy standards.

G. New Stationary Sources

Some of the most important provisions of the CAA govern new sources.[139] After the endangerment finding and associated developments, it seemed fairly clear that *the EPA was under a legal obligation to regulate new sources*, though the timing was not specified, and a lengthy delay would probably have been possible. With a proposed rule in 2014[140] and a final rule in 2015,[141] the EPA imposed strict requirements for greenhouse gas emissions from new power plants.

The irony is that while these requirements received a great deal of attention, their likely impact is modest, and so too their costs and benefits. The government's analysis found (and on this count there was no serious dispute) that because of the economic situation, in which natural gas is less expensive than coal, new coal-fired power plants are unlikely to be built in the United States.[142] For this reason, even strict regulatory requirements would have essentially no impact, because no coal plants would have to meet them. This point suggests a more general one, which is that the economics of the energy market are playing a large role in moving away from coal and hence reducing greenhouse gas emissions.

H. Existing Stationary Sources

The endangerment finding and associated developments had another implication: The CAA seemed to require the EPA to regulate *existing* sources, though here again the timing was not specified. Everyone was aware that regulatory restrictions on existing power plants would raise far more complex questions of economics and policy than similar restrictions on new ones. If the restrictions called for significant reductions, they would not be cheap. And indeed, they are not. The rule known as the Clean Power Plan,

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[137] *Id.* at 57,106.

[138] *Id.* at 57,125, Table I–5. For more information on the rule's expected costs and benefits, see Appendix 1, Tables 7–8.

[139] *See supra*.

[140] *See* U.S. Envtl. Prot. Agency, Fact Sheet: Clean Power Plan & Carbon Pollution Standards Key Dates, https://www.epa.gov/cleanpowerplan/fact-sheet-clean-power-plan-carbon-pollution-standards-key-dates.

[141] *See* Standards of Performance for Greenhouse Gas Emissions From New, Modified, and Reconstructed Stationary Sources: Electric Utility Generating Units, 80 Fed. Reg. 64,509 (Oct. 23, 2015) (codified at 40 C.F.R. pts. 60, 70, 71, 98) [hereinafter Clean Power Plan].

[142] *Id.* at 64,526.

originally proposed in 2014[143] and finalized in 2015,[144] will require states to meet restrictions that are anticipated to reduce national CO_2 emission from existing power plants by about 32 percent compared with 2005 levels by 2030.[145] Importantly, the Clean Power Plan will also achieve emission reductions of other air pollutants, including sulfur dioxide, nitrogen oxide, and fine particulate matter.[146] For that reason, it is expected to produce significant public health benefits, comparable (in monetary terms) to the benefits of greenhouse gas reductions

The EPA estimated that, by 2030, the Clean Power Plan's annual compliance costs would be between $5.1 billion and $8.4 billion.[147] Nonetheless, the EPA concluded that the annual climate and health benefits of the rule, ranging from $32 billion to $54 billion by 2030, easily justified the regulatory imposition.[148] Moreover, the EPA noted that some additional benefits — such as the climate benefits of reducing non- CO_2 greenhouse gases — could not be quantified.[149]

The Clean Power Plan raised a host of economic, scientific, and legal questions. The legal objections are numerous and complex.[150] As of this writing, implementation of the Clean Power Plan has been stayed by the Supreme Court.[151] In terms of economics and science, the calculation of benefits raises familiar challenges; it depends on judgments about the social cost of carbon and about the adverse effects of more standard pollutants (above all particulate matter), and also about how to monetize those adverse effects. It would not be difficult to defend different judgments, which could have moved the benefits figures up (for example, with a higher social cost of carbon) or down (for example, with a lower social cost of carbon or a less optimistic projection of monetized health benefits).

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[143] *See* Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, 79 Fed. Reg. 34,830 (proposed June 18, 2014).

[144] *See* Clean Power Plan, *supra* note 141.

[145] *See id.* at 64,665.

[146] *Id.* at 64,679.

[147] *Id.*

[148] *Id.* These figures all assume a three percent discount rate. *Id.* Moreover, these ranges include figures drawn from both the rate-based approach and the mass-based approach. *Id.* For an explanation of the two approaches, see U.S. Envtl. Prot. Agency, Clean Power Plan — Technical Summary for States, https://www3.epa.gov/airquality/cpptoolbox/technical-summary-for-states.pdf.

[149] Clean Power Plan, *supra* note 141, at 64,682. For more information on the rule's expected costs and benefits, see Appendix 1, Tables 9–10.

[150] *See* Coral Davenport, *Appeals Court Hears Challenge to Obama's Climate Change Rules*, N.Y. TIMES (Sept. 27, 2016), https://www.nytimes.com/2016/09/28/us/politics/appeals-court-hears-challenge-to-obamas-climate-change-rules.html .

[151] *See* West Virginia v. EPA, 136 S. Ct. 1000 (2016).

Recall, however, that under the CAA, it would have been challenging to defend a decision *not* to issue some kind of regulation of greenhouse gas emissions from existing sources. I do not explore the legal technicalities here, but any such decision would encounter serious legal objections – a point that has important implications for the Trump administration.

I. Heavy-Duty Vehicles: Round Two

In 2016, the EPA and DOT produced a second round of regulations on heavy-duty vehicles. The rule, which does not appear to be compelled by the CAA, was finalized in August 16, 2016,[152] and published on October 25, 2016.[153] According to the EPA and DOT, the final standards — covering model years 2018-2027 — will lower CO_2 emissions by up to 1.1 billion metric tons, reduce individual fuel costs by up to $170 billion, and decrease fuel consumption by upwards of 82 billion gallons over the lifetimes of the vehicles sold under the standards.[154]

In total, the EPA and DOT estimate that the standards could result in $230 billion in total net benefits, with benefits outweighing costs by about an eight-to-one margin.[155] Here yet again, some highly discretionary judgments were made both about analytic questions and about levels of stringency – the same questions that we have seen (how to assess fuel savings, the rebound effect, safety effects, and so forth).

VI. Energy Efficiency

More quietly, and less glamorously, the Department of Energy issued a series of rules governing energy efficiency. Under the statute, standards must be "technologically feasible and economically justified"[156] – a phrase that leaves DOE with considerable discretion. For example, it could issue standards that would end up close to the limits of what is technologically feasible, at least if there was a plausible argument that the resulting requirements did not fail some form of cost-benefit analysis ("economically justified"). On the other hand, it could almost certainly understand the statute to require a form of strict cost-benefit balancing, allowing standards to fall far short of the technologically feasible.

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[152] Press Release, U.S. Envtl. Prot. Agency, EPA and DOT Finalize Greenhouse Gas and Fuel Efficiency Standards for Heavy-Duty Trucks (Aug. 16, 2016), https://www.epa.gov/newsreleases/heavydutyaug162016.

[153] *See* Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles-Phase 2, 81 Fed. Reg. 73,478 (Oct. 25, 2016) (codified in 40 C.F.R. 40 CFR pts. 9, 22, 85, 86, 600, 1033, 1036, 1037, 1039, 1042, 1043, 1065, 1066, 1068; 49 C.F.R. pts. 523, 534, 535, 538).

[154] *See id.* at 73,508–09, Table I-11.

[155] *See id.* For more information on the rule's expected costs and benefits, see Appendix 1, Tables 11–13.

[156] 42 U.S.C. § 6295(o)(2)(A).

In light of Executive Order 13563, mandating cost-benefit balancing,[157] the Obama administration required a demonstration, for energy efficiency regulations, that the benefits justified the costs and in general, a demonstration that the particular standard that was chosen ended up maximizing net benefits. At the same time, the technical assessment on these counts – central to review by the Office of Information and Regulatory Affairs – was at least complicated by the fact that many energy efficiency standards emerged from a consensus process, akin to a negotiated rulemaking, among stakeholders. There were, and are, the familiar questions about valuation – the social cost of carbon yet again, but also how to handle consumer savings. After all, and as in the context of vehicular choice, consumers can purchase energy-saving products if they wish. If they decline to do so, is there a problem with counting the regulatory savings as benefits? Might that turn out to be unacceptably paternalistic, or miss some kind of welfare loss that consumers must be experiencing?

However these questions might answered, the basic idea of energy efficiency standards was, and remains, extremely promising, certainly in principle. If a rule can increase the energy efficiency of refrigerators, greenhouse gas emissions should be reduced, and so too air pollution of other kinds, thus reducing illness and even death. At the same time, energy efficiency rules do save consumers a great deal of money over the lifetime of refrigerators. An energy efficient refrigerator is far less expensive to operate – and while individual consumers are unlikely to get rich as a result, they will save significant sums of money in the aggregate. It is at least plausible to say that as a result of behavioral biases, such as present bias, some significant part of these savings are real in the sense that theyare not counteracted by consumer losses (in the form, for example, of refrigerators that do not cool as well or look as nice).[158]

The Obama administration finalized over forty energy efficiency regulations under its Appliance and Equipment Standards Program,[159] including new standards for microwave ovens,[160] dishwaters[161] and refrigerators.[162] Among the most important of

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[157] Executive Order 13,563, *supra* note 7, at 3821 ("[E]ach agency must . . . propose or adopt a regulation only upon a reasoned determination that its benefits justify its costs (recognizing that some benefits and costs are difficult to quantify) . . . .").

[158] *See* Hunt Allcott & Cass R. Sunstein, *Regulating Internalities*, 34 J. POL'Y ANALYSIS & MGMT. 698 (2015).

[159] *See* U.S. Dep't of Energy, Saving Energy and Money with Appliance and Equipment Standards in the United States (Oct. 2016), http://energy.gov/sites/prod/files/2016/10/f33/Appliance%20and%20Equipment%20Standards%20Fact%20Sheet-101416.pdf (noting that the Department of Energy had "issued 44 new or updated appliance standards across more than 50 products" under the Obama Administration).

[160] *See* Energy Conservation Program: Energy Conservation Standards for Standby Mode and Off Mode for Microwave Ovens 78 Fed. Reg. 36,316 (June 17, 2013) (codified at 10 C.F.R. pts. 429, 430).

[161] *See* Energy Conservation Program: Energy Conservation Standards for Dishwashers, 77 Fed. Reg. 59,712 (Oct. 1, 2012) (codified at 10 C.F.R. pts. 429, 430).

these established energy conservation standards for certain classes of air conditioning and heating equipment, and commercial warm air furnaces.[163] Issued on December 17, 2015,[164] and published on January 15, 2016, the rule is expected to "yield the biggest energy and pollution savings of any standard issued since [the] Appliance and Equipment Standards Program began" in 1987.[165] DOE estimated that, by 2048, energy consumption would be 24 percent lower as a result of the rule.[166] It added that the rule would produce cumulative CO_2 savings of up to 885 million metric tons.

To be sure, the rule was expensive; manufacturers would incur about $711 million per year in increased equipment expenses. At the same time, DOE concluded that the rule's annual benefits — about $2.1 billion in reduced equipment operating costs, about $1.3 billion in reduced CO_2 emissions, and about $135 million in reduced nitrogen oxide emissions — easily offset the costs.[167] In total, the Administration projected that these regulations would save consumers $550 billion dollars in their first two decades, and produce energy savings "roughly equivalent to the energy used by all U.S. buildings over one year."[168]

For other examples, consider standards for commercial refrigeration equipment[169] and commercial clothes washers.[170] The DOE estimated that the commercial refrigeration equipment standards would yield annual net benefits between $704 million and $888 million, including about $246 million in annual CO_2 emission reductions.[171] With commercial clothes washers, the DOE estimated annual net benefits at $32 and $38

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[162] *See* Energy Conservation Program: Energy Conservation Standards for Residential Refrigerators, Refrigerator-Freezers, and Freezers, 76 Fed. Reg. 57,516 (Sept. 15, 2011) (codified at 10 C.F.R. pt. 430).

[163] *See* Lauren Urbanek, *2015 Closes with New Energy Efficiency Standards That Will Save Consumers and Businesses Billions*, NAT'L RESOURCES DEF. COUNCIL (Jan. 5, 2016), https://www.nrdc.org/experts/lauren-urbanek/2015-closes-new-energy-efficiency-standards-will-save-consumers-and.

[164] Saving Energy and Money, *supra* note 159.

[165] Urbanek, *supra* note 163.

[166] *See* Energy Conservation Program for Certain Industrial Equipment: Energy Conservation Standards for Small, Large, and Very Large Air-Cooled Commercial Package Air Conditioning and Heating Equipment and Commercial Warm Air Furnaces, 81 Fed. Reg. 2420, 2428 (Jan. 15, 2016) (codified at 10 C.F.R. pt. 431).

[167] *See id.* at 2429.

[168] Saving Energy and Money, *supra* note 159.

[169] Energy Conservation Program: Energy Conservation Standards for Commercial Refrigeration Equipment, 79 Fed. Reg. 17,726 (Mar. 28, 2014) (codified at 10 C.F.R. pt. 431).

[170] Energy Conservation Program: Energy Conservation Standards for Commercial Clothes Washers, 79 Fed. Reg. 74,492 (Dec. 15, 2014) (codified at 10 C.F.R. pt. 431).

[171] Energy Conservation Standards for Commercial Refrigeration Equipment, *supra* note 169, at 17,730. For more information on the rule's expected costs and benefits, see Appendix 1, Tables 14.

million, including about $7 million in annual CO_2 emission reductions.[172] According to one estimate, these and other energy efficiency standards are expected to produce annual CO_2 savings of 345 million tons by 2020, with cumulative savings reaching 7.9 billion tons by 2030.[173] An account of the various standards is provided in the Appendix.

VI. Conclusions

With a paralyzed Congress, the executive branch proved able, between 2009 and 2016, to use regulatory authorities to take a remarkable variety of steps to reduce greenhouse gas emissions. The background was established by the social cost of carbon, which helped determine the monetary value of those reductions, as required by Executive Order 13563. The domestic measures were essential to the eventual leadership position of the United States and its central role in producing the Paris agreement in 2015.

It must be acknowledged that many of the underlying decisions were controversial. The social cost of carbon has been subject not only to legal challenge (which it has survived[174]) but also to a wide range of policy objections. For example, it chooses the global rather than domestic measure, and its use of the three integrated assessments models has hardly been met with universal approval.[175] The fuel economy and energy efficiency measures have not been subject to successful legal objections, but some people have (rightly) noted that the vast majority of the benefits come not from greenhouse gas reductions but from consumer savings, and have objected that if consumers would like to purchase fuel-efficient or energy-efficient products, they can do so – and hence that consumers savings should not be counted.[176] In my view, this objection is unconvincing, but it does raise difficult conceptual and empirical questions.[177]

The Trump Administration is in a position to reassess many of these initiatives, and as of this writing, it seems clear that it will seriously question several of them. But all of the initiatives have significant political support, and a repeal via Congress would be extremely challenging. To be sure, regulations can be rescinded through the ordinary

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[172] Energy Conservation Standards for Commercial Clothes Washers, *supra* note 170, at 74,495. For more information on the rule's expected costs and benefits, see Appendix 1, Tables 15.

[173] Saving Energy and Money, *supra* note 159.

[174] Zero Zone, Inc. v. U.S. Dep't of Energy, Nos. 14–2147, 14–2159, 14–2334 (7th Cir. Aug. 8, 2016), http://media.ca7.uscourts.gov/cgi-bin/rssExec.pl?Submit=Display&Path=Y2016/D08-08/C:14-2159:J:Ripple:aut:T:fnOp:N:1807496:S:0.

[175] Robert S. Pindyck, *Climate Change Policy: What Do the Models Tell Us?* (Nat'l Bureau of Econ. Research, Working Paper No. 19244, 2013).

[176] Gayer & Viscusi, *supra* note 6.

[177] Allcott & Sunstein, *supra* note 158.

regulatory process.[178] But that process usually proves time-consuming,[179] and for many of the relevant regulations, those who are apparently burdened (automobile manufacturers, refrigerator companies) participated directly in their creation and might well have an investment in their maintenance – and hence would strenuously resist their rescission. If so, rescission will be unlikely. And if the Trump administration undertakes repeal efforts, it will likely run into serious legal objections.[180] At the same time, it is true that the Clean Power Plan itself is currently under legal challenge,[181] which simplifies the route to its rescission – with the qualification that any such rescission would also face legal objections.

The efforts to reduce climate change between 2009 and 2016 raise a host of questions about law, politics, economics, science, and the system of separation of powers in its modern incarnation. For now, we may draw two conclusions. The first is that in the United States, climate change policy has long been executive branch policy; Congress has been a mere bystander. The second is that while the Clean Air Act and the various statutes governing energy efficiency were not enacted with the goal of reducing greenhouse gas emissions, the executive branch has been able to use them for precisely that purpose, generally without encountering significant legal objections.[182]

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[178] On the relevant standards, see Motor Vehicles Mfrs. Ass'n of the United States, Inc. v. State Farm, Inc., 463 U.S. 29 (1983); Fed. Commc'n Comm'n v. Fox Television Stations, Inc., 556 U.S. 502 (2009).

[179] *See* Richard J. Pierce, Jr., *Rulemaking Ossification Is Real: A Response to* Testing the Ossification Thesis, 80 GEO. WASH. L. REV. 1493 (2012).

[180] Motor Vehicles Mfrs. Ass'n of the United States, Inc. v. State Farm, Inc., 463 U.S. 29 (1983).

[181] Among the interesting legal issues being adjudicated in the Clean Power Plan litigation, one involves the constitutionality of the Plan under the Fifth Amendment Takings Clause. *Compare* Jody Freeman & Richard J. Lazarus, *Is the President's Climate Plan Unconstitutional?*, HARVARD LAW TODAY (Mar. 18, 2015), http://today.law.harvard.edu/is-the-presidents-climate-plan-unconstitutional/, *with* Laurence H. Tribe, *Why EPA's Climate Plan Is Unconstitutional*, HARVARD LAW TODAY (Mar. 20, 2015), http://today.law.harvard.edu/why-epa-climate-plan-is-unconstitutional/ .

[182] For an excellent discussion on this development, see Jody Freeman & David B. Spence, *Old Statutes, New Problems,* 163 U. PENN. L. REV. 1 (2014).

Appendix 1: Social Cost of Carbon, 2015–2050 (in 2007 dollars per metric ton of CO_2)[183]

	Discount Rate and Statistic			
Year	**5% Average**	**3% Average**	**2.5% Average**	**High Impact (95th pct at 3%)**
2015	$11	$36	$56	$105
2020	$12	$42	$62	$123
2025	$14	$46	$68	$138
2030	$16	$50	$73	$152
2035	$18	$55	$78	$168
2040	$21	$60	$84	$183
2045	$23	$64	$89	$197
2050	$26	$69	$95	$212

[183] INTERAGENCY WORKING GROUP, *supra* note 82, at 4.

Appendix 2: Selected Cost-Benefit Tables

Table 1—EPA's Estimated 2012-2016 Model Year Lifetime Discounted Costs, Benefits, and Net Benefits Assuming the $21/Ton SCC Value[184]

[2007 dollars]

3% Discount rate	**$Billions**
Costs	51.5
Benefits	240
Net Benefits	189
7% Discount rate	
Costs	51.5
Benefits	192
Net Benefits	140

[184] Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards, *supra* note 104, at 25,346.

Table 2—EPA's Estimated 2012-2016 Model Year Lifetime Fuel Saved and GHG Emissions Avoided[185]

		2012	**2013**	**2014**	**2015**	**2016**	**Total**
Cars	Fuel (billion gallons)	4.0	5.5	7.3	10.5	14.3	41.6
	Fuel (billion barrels)	0.10	0.13	0.17	0.25	0.34	0.99
	CO_2 EQ (mmt)[186]	49.3	68.5	92.7	134	177	521
Light Trucks	Fuel (billion gallons)	3.3	5.0	6.6	9.0	12.2	36.1
	Fuel (billion barrels)	0.08	0.12	0.16	0.21	0.29	0.86
	CO_2 EQ (mmt)	39.6	61.7	81.6	111	147	441
Combined	Fuel (billion gallons)	7.3	10.5	13.9	19.5	26.5	77.7
	Fuel (billion barrels)	0.17	0.25	0.33	0.46	0.63	1.85
	CO_2 EQ (mmt)	88.8	130	174	244	325	962

[185] *Id.* at 25346–47.

[186] The acronym "mmt" refers to "million metric tons."

Table 3—Estimated Societal Benefits Associated with the Lifetimes of 2012-2016 Model Year Vehicles[187]

[Millions of 2007 dollars; 3% discount rate]

Monetized values (millions)	**2012MY**	**2013MY**	**2014MY**	**2015MY**	**2016MY**	**Sum**
Cost of Noise, Accident, Congestion ($)	−$1,100	−$1,600	−$2,100	−$2,900	−$3,900	−$11,600
Pretax Fuel Savings ($)	16,100	23,900	32,200	46,000	63,500	181,800
Energy Security (price shock) ($)	900	1,400	1,800	2,500	3,500	10,100
Value of Reduced Refueling time ($)	1,100	1,600	2,100	3,000	4,000	11,900
Value of Additional Driving ($)	2,400	3,400	4,400	6,000	7,900	24,000
Value of $PM_{2.5}$-related Health Impacts ($)	700	900	1,300	1,800	2,400	7,000
Reduced CO_2 Emissions at each assumed SCC value						
Avg SCC at 5%	400	500	700	1,000	1,300	3,800
Avg SCC at 3%	1,700	2,400	3,100	4,400	5,900	17,000
Avg SCC at 2.5%	2,700	3,900	5,200	7,200	9,700	29,000
95th percentile SCC at 3%	5,100	7,300	9,600	13,000	18,000	53,000
Total Benefits at each assumed SCC value						
Avg SCC at 5%	20,500	30,100	40,400	57,400	78,700	227,000
Avg SCC at 3%	21,800	32,000	42,800	60,800	83,300	240,200
Avg SCC at 2.5%	22,800	33,500	44,900	63,600	87,100	252,200
95th percentile SCC at 3%	25,200	36,900	49,300	69,400	95,400	276,200

[187] Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards, *supra* note 104, at 25,537.

Table 4—Quantified Net Benefits Associated with the Lifetimes of 2012-2016 Model Year Vehicles[188]

[Millions of 2007 dollars; 3% discount rate]

Monetized Values (millions)	**2012MY**	**2013MY**	**2014MY**	**2015MY**	**2016MY**	**Sum**
Quantified Annual Costs (excluding fuel savings)	$4,900	$8,000	$10,300	$12,700	$15,600	$51,500
Quantified Annual Benefits at each assumed SCC value						
Avg SCC at 5%	20,500	30,100	40,400	57,400	78,700	227,000
Avg SCC at 3%	21,800	32,000	42,800	60,800	83,300	240,200
Avg SCC at 2.5%	22,800	33,500	44,900	63,600	87,100	252,200
95th percentile SCC at 3%	25,200	36,900	49,300	69,400	95,400	276,200
Quantified Net Benefits at each assumed SCC value						
Avg SCC at 5%	15,600	22,100	30,100	44,700	63,100	175,500
Avg SCC at 3%	16,900	24,000	32,500	48,100	67,700	188,700
Avg SCC at 2.5%	17,900	25,500	34,600	50,900	71,500	200,700
95th percentile SCC at 3%	20,300	28,900	39,000	56,700	79,800	224,700

[188] *Id.* at 25,538–39.

Table 5—EPA's Estimated 2017-2025 Model Year Lifetime Discounted Costs, Benefits, and Net Benefits Assuming the 3% Discount Rate SCC Value[189]

[Billions of 2010 dollars]

Lifetime Present Value d**—3% Discount Rate**	
Program Costs	−$150
Fuel Savings	475
Benefits	126
Net Benefits	451
Annualized Value f**—3% Discount Rate**	
Annualized costs	−6.49
Annualized fuel savings	20.5
Annualized benefits	5.46
Net benefits	19.5
Lifetime Present Value d**—7% Discount Rate**	
Program Costs	−144
Fuel Savings	364
Benefits	106
Net Benefits	326
Annualized Value f**—7% Discount Rate**	
Annualized costs	−10.8
Annualized fuel savings	27.3
Annualized benefits	7.96
Net benefits	24.4

Table 6—EPA's Estimated 2017-2025 Model Year Lifetime Fuel Saved and GHG Emissions Avoided (Primary Analysis)[190]

[189] 2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards, *supra* note 129, at 62,663.

	2017 MY	2018 MY	2019 MY	2020 MY	2021 MY	2022 MY
Cars:						
Fuel (billion gallons)	2.4	4.5	6.8	9.3	11.9	14.8
Fuel (billion barrels)	0.06	0.11	0.16	0.22	0.28	0.35
CO2 EQ (mmt)	29.7	55.7	83.0	113	146	178
Light Trucks:						
Fuel (billion gallons)	0.1	1.0	1.7	2.6	5.5	7.5
Fuel (billion barrels)	0.00	0.02	0.04	0.06	0.13	0.18
CO2 EQ (mmt)	0.8	13.9	24.6	36	70	92
Combined:						
Fuel (billion gallons)	2.5	5.5	8.5	11.9	17.4	22.3
Fuel (billion barrels)	0.06	0.13	0.20	0.28	0.41	0.53
CO2 EQ (mmt)	30.5	69.6	108	149	216	270

	2023 MY	2024 MY	2025 MY	Total
Cars:				
Fuel (billion gallons)	17.4	20.2	23.0	110.3
Fuel (billion barrels)	0.41	0.48	0.55	2.63
CO2 EQ (mmt)	207	238	269	1,319
Light Trucks:				
Fuel (billion gallons)	9.4	11.3	13.1	52.2
Fuel (billion barrels)	0.22	0.27	0.31	1.24
CO2 EQ (mmt)	113	134	154	638
Combined:				
Fuel (billion gallons)	26.8	31.5	36.2	162.5
Fuel (billion barrels)	0.64	0.75	0.86	3.87
CO2 EQ (mmt)	320	371	423	1,956

[190] *Id.* at 62,664.

Table 7—Estimated Lifetime Discounted Costs, Fuel Savings, Benefits, and Net Benefits for 2014-2018 Model Year Heavy-Duty Vehicles[191]

[Billions, 2009$]

Lifetime Present Value—3% Discount Rate	
Program Costs	$8.1
Fuel Savings	$50
Benefits	$7.3
Net Benefits	$49
Annualized Value—3% Discount Rate	
Annualized Costs	$0.4
Fuel Savings	$2.2
Annualized Benefits	$0.4
Net Benefits	$2.2
Lifetime Present Value—7% Discount Rate	
Program Costs	$8.1
Fuel Savings	$34
Benefits	$6.7
Net Benefits	$33
Annualized Value—7% Discount Rate	
Annualized Costs	$0.6
Fuel Savings	$2.6
Annualized Benefits	$0.5
Net Benefits	$2.5

Table 8—Estimated Lifetime Reductions in Fuel Consumption and CO_2Emissions for 2014-2018 Model Year HD Vehicles[192]

[191] Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles, *supra* note 136, at 57,125.

[192] *Id.* at 57,126.

All heavy-duty vehicles	**2014 MY**	**2015 MY**	**2016 MY**	**2017 MY**	**2018 MY**	**Total**
Fuel (billion gallons)	4.0	3.6	3.6	5.1	5.8	22.1
Fuel (billion barrels)	0.10	0.09	0.08	0.12	0.14	0.53
CO_2 (mmt)	50.2	44.8	44.0	62.8	71.7	273

Table 9—Summary of the Monetized Benefits, Compliance Costs, and Net Benefits for the Final Guidelines in 2020, 2025, and 2030 Under the Rate-Based Illustrative Plan Approach[193]

[Billions of 2011$]

Rate-based approach, 2020		
	3% Discount rate	**7% Discount rate**
Climate benefits	$2.8	
Air pollution health co-benefits	$0.70 to $1.8	$0.64 to $1.7.
Total Compliance Costs	$2.5	$2.5.
Net Monetized Benefits	$1.0 to $2.1	$1.0 to $2.0.
Non-monetized Benefits	Non-monetized climate benefits. Reductions in exposure to ambient NO_2 and SO_2. Reductions in mercury deposition. Ecosystem benefits associated with reductions in emissions of NO_X, SO_2, PM, and mercury. Visibility impairment.	
Rate-based approach, 2025		
Climate benefits	$10	
Air pollution health co-benefits	$7.4 to $18	$6.7 to $16.
Total Compliance Costs	$1.0	$1.0.
Net Monetized Benefits	$17 to $27	$16 to $25.
Non-monetized Benefits	Non-monetized climate benefits. Reductions in exposure to ambient NO_2 and SO_2.	

Rate-based approach, 2020		
	3% Discount rate	**7% Discount rate**
	Reductions in mercury deposition. Ecosystem benefits associated with reductions in emissions of NO_X, SO_2, PM, and mercury. Visibility impairment.	
Rate-based approach, 2030		
Climate benefits	$20	
Air pollution health co-benefits	$14 to $34	$13 to $31.
Total Compliance Costs	$8.4	$8.4.
Net Monetized Benefits	$26 to $45	$25 to $43.
Non-monetized Benefits	Non-monetized climate benefits. Reductions in exposure to ambient NO_2 and SO_2. Reductions in mercury deposition. Ecosystem benefits associated with reductions in emissions of NO_X, SO_2, PM, and mercury. Visibility impairment.	

Table 10—Summary of the Monetized Benefits, Compliance Costs, and Net Benefits for the Final Guidelines in 2020, 2025 and 2030 Under the Mass-Based Illustrative Plan Approach[194]

[Billions of 2011$]

Mass-based approach, 2020		
	3% Discount rate	**7% Discount rate**
Climate benefits	$3.3	
Air pollution health co-benefits	$2.0 to $4.8	$1.8 to $4.4.
Total Compliance Costs	$1.4	$1.4.
Net Monetized Benefits	$3.9 to $6.7	$3.7 to $6.3.
Non-monetized Benefits	Non-monetized climate benefits. Reductions in exposure to ambient NO_2 and SO_2. Reductions in mercury deposition. Ecosystem benefits associated with reductions in emissions of NO_X, SO_2, PM, and mercury. Visibility impairment.	
Mass-based approach, 2025		
Climate benefits	$12	
Air pollution health co-benefits	$7.1 to $17	$6.5 to $16.
Total Compliance Costs	$3.0	$3.0.
Net Monetized Benefits	$16 to $26	$15 to $24.
Non-monetized Benefits	Non-monetized climate benefits.	

[194] Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, *supra* note 141, at 64,681.

Mass-based approach, 2020		
	3% Discount rate	**7% Discount rate**
	Reductions in exposure to ambient NO_2 and SO_2. Reductions in mercury deposition. Ecosystem benefits associated with reductions in emissions of NO_X, SO_2, PM, and mercury. Visibility impairment.	
Mass-based approach, 2030		
Climate benefits	$20	
Air pollution health co-benefits	$12 to $28	$11 to $26.
Total Compliance Costs	$5.1	$5.1.
Net Monetized Benefits	$26 to $43	$25 to $40.
Non-monetized Benefits	Non-monetized climate benefits. Reductions in exposure to ambient NO_2 and SO_2. Reductions in mercury deposition. Ecosystem benefits associated with reductions in emissions of NO_X, SO_2, PM, and mercury. Visibility impairment.	

Table 11: Summary of the Phase 2 Medium- and Heavy-Duty Vehicle Rule Impacts to Fuel Consumption, GHG Emissions, Benefits and Costs Over the Lifetime of Model Years 2018-2029[195]

	3%	**7%**
Fuel Reductions (billion gallons)	71-82	
GHG Reductions (mmt, CO2eq[196])	959-1098	
Pre-Tax Fuel Savings ($billion)	149-169	80-87
Discounted Technology Costs ($billion)	24-27	16-18
Value of reduced emissions ($billion)	60-69	48-52
Total Costs ($billion)	29-31	19-20
Total Benefits ($billion)	225-260	136-151
Net Benefits ($billion)	197-229	117-131

[195] Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles-Phase 2, *supra* note 153, at 73,482..

[196] The acronym "C02eq" is a measurement of GHG emissions whereby GHGs are calculated in terms of CO_2.

Table 12: Summary of the Phase 2 Medium- and Heavy-Duty Vehicle Annual Fuel and GHG Reductions, Program Costs, Benefits and Net Benefits in Calendar Years 2040 and 2050[197]

	2040	**2050**
Fuel Reductions (Billion Gallons)	10.8	13.0
GHG Reduction (mmt, CO2eq)	166.8	199.3
Vehicle Program Costs (including Maintenance; Billions of 2013$)	−$6.5	−$7.5
Fuel Savings (Pre-Tax; Billions of 2013$)	$53.1	$63.4
Benefits (Billions of 2013$)	$24.8	$31.7
Net Benefits (Billions of 2013$)	$71.4	$87.6

[197] Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles-Phase 2, *supra* note 153, at 73,482.

Table 13—Lifetime Fuel Savings, GHG Reductions, Benefits, Costs and Net Benefits for Model Years 2018-2029 Vehicles Using Analysis Method B[198]

[Billions of 2012$]

Category	3% discount rate	7% discount rate
Fuel Reductions (Billion Gallons)	73-82	
GHG reductions (mmt, CO2eq)	976-1,098	
Vehicle Program (e.g., technology and indirect costs, normal profit on additional investments)	−$26.5 to −$26.2	−$17.6 to −$17.4
Additional Routine Maintenance	−$1.9 to −$1.9	−$1.0 to −$1.0
Fuel Savings (valued at pre-tax prices)	$149.3 to $169.1	$76.8 to $87.2
Energy Security	$6.9 to $7.8	$3.5 to $4.0
Congestion, Crashes, and Noise from Increased Vehicle Use	−$3.2 to −$3.2	−$1.8 to −$1.8
Savings from Less Frequent Refueling	$3.4 to $4.0	$1.8 to $2.1
Economic Benefits from Additional Vehicle Use	$10.4 to $10.5	$5.7 to $5.7
Benefits from Reduced Non-GHG Emissions	$28.3 to $31.9	$13.4 to $15.0
Reduced Climate Damages from GHG Emissions	$33.0 to $37.2	
Net Benefits	$200 to $229	$114 to $131

Table 14—Annualized Benefits and Costs of Amended Standards for Commercial Refrigeration Equipment[199]

[198] *Id.* at 73,508–09. "Table I-11 shows benefits and cost from the perspective of reducing GHG. As shown below in terms of MY lifetime GHG reductions, and in RIA Chapter 5 in terms of year-by-year GHG reductions, the final program is expected to reduce more GHGs over the long run than the proposed program. In general, the greater reductions can be attributed to increased market penetration and effectiveness of key technologies, based on new data and comments, leading to increases in stringency such as with the diesel engine standards (Section I.C.(2)(a) above)."

	Discount rate	million 2012$/year		
		Primary estimate	Low net benefits estimate	High net benefits estimate
Benefits				
Operating Cost Savings	7%	710	688	744.
	3%	900	865	947.
CO_2 Reduction at ($11.8/t case)	5%	73	73	73.
CO_2 Reduction at ($39.7/t case)	3%	246	246	246.
CO_2 Reduction at ($61.2/t case)	2.5%	361	361	361.
CO_2 Reduction at ($117.0/t case)	3%	760	760	760.
NO_X Reduction at ($2,591/ton)	7%	3.01	3.01	3.01.
	3%	5.64	5.64	5.64.
Total Benefits	7% plus CO_2 range	786 to 1,474	764 to 1,451	820 to 1,508.
	7%	960	937	994.
	3% plus CO_2 range	978 to 1,666	943 to 1,631	1,026 to 1,713.
	3%	1,152	1,117	1,200.
Costs				
Incremental Equipment Costs	7%	256	250	261.
	3%	264	258	271.
Net Benefits				

[199] Energy Conservation Standards for Commercial Refrigeration Equipment, *supra* note 169, at 17.

	Discount rate	million 2012$/year		
		Primary estimate	**Low net benefits estimate**	**High net benefits estimate**
Total	7% plus CO_2 range	530 to 1,218	513 to 1,201	559 to 1,246.
	7%	704	687	733.
	3% plus CO_2 range	714 to 1,402	685 to 1,373	755 to 1,442.
	3%	888	859	929.

Table 15—Annualized Benefits and Costs of Proposed Energy Conservation Standards for Commercial Clothes Washers[200]

	Discount rate	Primary estimate	Low net benefits estimate	High net benefits estimate
		million 2012$/year		
Benefits				
Operating Cost Savings	7%	31	27	38.
	3%	46	40	60.
CO_2 Reduction Monetized Value ($11.8/t case)	5%	2	2	3.
CO_2 Reduction Monetized Value ($39.7/t case)	3%	9	8	11.
CO_2 Reduction Monetized Value ($61.2/t case)	2.5%	13	12	17.
CO_2 Reduction Monetized Value ($117/t case)	3%	28	25	34.
NO_X Reduction Monetized Value (at $2,639/ton)	7%	0.37	0.33	0.45.
	3%	0.57	0.51	0.70.
Total Benefits	7% plus CO_2 range	33 to 58	29 to 52	42 to 73.
	7%	40	35	50.
	3% plus CO_2 range	49 to 75	43 to 66	64 to 95.
	3%	56	49	72.
Costs				
Incremental Product Costs	7%	0.02	0.02	0.02
	3%	0.02	0.03	0.02

[200] Energy Conservation Standards for Commercial Clothes Washers, *supra* note 170, at 14.

	Discount rate	Primary estimate	Low net benefits estimate	High net benefits estimate
Net Benefits				
Total	7% plus CO_2 range	33 to 58	29 to 52	42 to 73.
	7%	40	35	50.
	3% plus CO_2 range	49 to 75	43 to 66	64 to 95.
	3%	56	49	72.

Appendix 3: Energy Efficiency Regulations

Product(s)	Year efficiency standards finalized	Nat'l econ. net benefits (million $) (3% discount) (inc. emission reduction monetized value)	Cumulative CO2 savings (million metric tons)
Commercial boilers	2009	Not clearly provided	5.644
Fluorescent lamp ballasts	2011	18,500	27 to 106
Dishwashers	2012	545	4.06
Commercial heating, air-conditioning, and water-heating equipment	2012	Not clearly provided	2.29 to 35.05
Microwave ovens (standby mode and off mode)	2013	4,162 to 4,600	38.11
Distribution transformers (liquid-immersed; low-voltage dry-type; medium-voltage dry-type)	2013	17,600	264.7
External power supplies	2014	5,400	47
Residential furnace fans	2014	34,353	180.6
Commercial clothes washers	2014	677	4.1
Commercial refrigeration equipment	2014	16,400	142
Commercial and industrial electric motors	2014	41,900	395

Walk-in coolers and freezers	2014	15,600	159.2
General service fluorescent lamps and incandescent reflector lamps	2014	13,500	160
Metal halide lamp fixtures	2014	1,634	22.5 to 27.8
Automatic commercial ice makers	2015	1,326	3.9
Air-cooled commercial package air conditioning and heating equipment and commercial warm air furnaces	2015	79,200	873
Single package vertical air conditioners and single package vertical heat pumps	2015	710 to 1,520	8.9
Battery chargers	2016	1,600	10.79
Boilers	2016	1,789	9.3
Ceiling fan light kits	2016	820	3.4
Dehumidifiers	2016	3,400	18.6
Commercial prerinse spray valves	2016	1,724	5.87
Pumps	2016	1,700	17
Refrigerated bottled or canned	2016	780	7

beverage vending machines			
		Cumulative nat'l NPV of total consumer costs and savings (million $) (3% discount)	
Certain consumer products (dishwashers, dehumidifiers, microwave ovens, and electric and gas kitchen ranges and ovens) and certain commercial and industrial equipment (commercial clothes washers)	2009	706	13.7
Commercial ice cream freezers; self-contained commercial refrigerators, commercial freezers, and commercial refrigerator-freezers without doors; and remote condensing commercial refrigerators, commercial freezers, and commercial refrigerator-freezers	2009	3,930	52.6

General service fluorescent lamps and incandescent reflector lamps	2009	25,620 to 71,340	175 to 488
Residential water heaters, direct heating equipment, and pool heaters	2010	10,110	164
Small electric motors	2010	12,500	112
Residential furnaces, and residential central air conditions and heat pumps	2011	15,900 to 18,700	113 to 143
Residential clothes dryers and room air conditioners	2011	4,480	36.1
Residential refrigerators, refrigerator-freezers, and freezers	2011	37,500 to 45,500	344
Clothes washers	2012	31,290	113
General service fluorescent lamps and incandescent reflector lamps	2014	5,500	160