August 5, 2023

ELECTRONIC SUBMISSION

Attn: EPA-HQ-OAR-2023-0072

U.S. Environmental Protection Agency
1200 Pennsylvania Avenue N.W.
Washington, DC 20004

Re: New Source Performance Standards for Greenhouse Gas Emissions from New, Modified, and Reconstructed Fossil Fuel-Fired Electric Generating Units; Emission Guidelines for Greenhouse Gas Emissions from Existing Fossil Fuel Fired Electric Generating Units; and Repeal of the Affordable Clean Energy Rule. Docket No. EPA-HQ-OAR-2023-0072

To Whom It May Concern:

On May 23, 2023, the U.S. Environmental Protection Agency (EPA) published proposed "New Source Performance Standards for Greenhouse Gas Emissions from New, Modified, and Reconstructed Fossil Fuel-Fired Electric Generating Units; Emission Guidelines for Greenhouse Gas Emissions from Existing Fossil Fuel Fired Electric Generating Units; and Repeal of the Affordable Clean Energy Rule"[1] (Proposed Rule) under Section 111 of the Clean Air Act[2] (CAA). The Proposed Rule addresses greenhouse gas (GHG) emissions from fossil fuel-fired electric generating units (EGUs). Because we believe that the Proposed Rule is not in accordance with law and exceeds EPA's statutory authority, we respectfully submit these comments for EPA's consideration.

The Proposed Rule is EPA's second attempt to reorganize the U.S. power sector by invoking an expansive "beyond the fence line" view of its authorities under Section 111 of the CAA. Its first attempt, the 2015 Clean Power Plan,[3] was struck down by the Supreme Court in *West Virginia v.*

---

[1] *Federal Register*, Vol. 88 (May 23, 2023) p. 33240 (to be codified at 40 C.F.R. pt. 60).
[2] 42 U.S.C. §§ 7401–7671(q) (1970), as amended.
[3] "Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units; Final Rule," *Federal Register*, Vol. 80 (October 23, 2015), p. 64661.

EPA.[4] Like the Clean Power Plan, the Proposed Rule would force a "disorderly transition"[5] away from coal and natural gas plants to renewable sources in a manner incompatible with the goal of reliable and affordable electricity. The Proposed Rule would set emission limits on the basis of technologies that, contrary to EPA's claims, are not technically feasible, have not been adequately demonstrated, and would have exorbitant costs and grave impacts on health, environment, and energy requirements.

As with the Clean Power Plan, the compliance of regulated entities would depend mostly on the development of policies and infrastructure well outside the fence line of the regulated plants, by parties other than the regulated entities, including state governments with respect to areas within their traditional domain. As with the Clean Power Plan, the Proposed Rule's expansion of best system of emissions reduction (BSER) well beyond the fence line of regulated entities allows EPA to set the emission standards at whatever level it wants. EPA now proposes to eliminate virtually all carbon emissions from the most efficient and least carbon-intensive baseload power plants except for nuclear, notwithstanding that the far more limited goals of the Clean Power Plan raised the "major question" that led to its being struck down in *West Virginia v. EPA*.[6] Further, there is no environmental endpoint against which to calibrate the appropriateness and necessity of EPA's choice of standards, and EPA has not explained what the ideal planetary temperature is or how the Proposed Rule would measurably help to achieve it.

We urge EPA to reconsider its Proposed Rule in light of the Supreme Court's holding in *West Virginia v. EPA* and limit the BSER for GHG emissions to technologies that have been adequately demonstrated at utility scale and can actually be implemented by the regulated entities at reasonable cost and with reasonable impacts on health, environment, and energy requirements. Together with EPA's proposed rules on vehicle emissions (Tailpipe Rules),[7] which will significantly increase demand for electricity, the Proposed Rule will create serious grid-reliability issues. If fully implemented its main impact would be to constrict the supply of electricity and send electricity prices soaring, dramatically increasing the political difficulties of any clean-energy transition. As with Germany,[8] the effects could include greater carbon and other emissions per unit of economic output and the flight of capital and industry to other countries with more lax environmental regulations. By constricting energy supply, driving up electricity prices and endangering public safety, the Proposed Plan is far more likely to impede a

---

4 *West Virginia v. EPA*, 142 S. Ct. 2587 (2022).
5 "The Economic Transformation: What Would Change in the Net-Zero Transition," McKinsey & Co., January 25, 2022), https://www.mckinsey.com/capabilities/sustainability/our-insights/the-economic-transformation-what-would-change-in-the-net-zero-transition (accessed August 4, 2023).
6 142 S. Ct. 2587.
7 "Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles," *Federal Register*, Vol. 88 (May 5, 2023), p. 29184 (to be codified at 40 C.F.R. pts. 85, 86, 600, 1036, 1037, and 1066), and "Control of Air Pollution From New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards," *Federal Register*, Vol. 88 (January 24, 2023), p. 4296.
8 Claire Lehman, "Achtung Aussies: Learn from Germany's Energy Blunders: Rather than Transforming the Country into a Renewable Energy Superpower, Germany's *Energiewende* Has Created a Rust Belt," *The Australian*, July 21, 2023.

transition to a low-carbon power sector than to facilitate it and carries a high risk that federal courts will further curtail the authority of EPA.

Summary of Proposed Rule Requirements

The Proposed Rule has two main sets of emissions standards. The first is a set of New Source Performance Standards (NSPS) under Section 111(b) of the CAA that apply to three categories of combustion-driven natural gas plants. The second is a set of emission standards that apply mainly to existing coal-fired plants under Section 111(d) of the CAA. Both sets of emissions standards are based on multiple EPA determinations of BSER. These are divided into multiple components for each source subcategory, similar to the "blocks" of the original Clean Power Plan, which will apply in multiple phases over time.

With respect to the NSPS, the Proposed Rule divides natural gas plants into three categories: low-load (peaking units), intermediate-load, and baseload EGUs.[9] For all three categories, the first phase is simply highly efficient generation. These standards will apply immediately upon promulgation of the rule to all natural gas-fired plants that commenced construction (or reconstruction) after the publication date of the Proposed Rule.[10] For phase two, for the intermediate-load subcategory, EPA is proposing a BSER that includes cofiring 30 percent by volume low-GHG hydrogen with an associated standard of 1,000-lb carbon dioxide/megawatt-hour (CO_2/MWh)-gross, with compliance to start in 2032. This emissions rate is only slightly lower than the current performance of intermediate-load plants today, and well above the current performance of typical combined-cycle base load EGUs.[11] Hence, the Proposed Rule largely gives a pass to "peaker" and intermediate-load EGUs.

The burdens of the NSPS fall mainly on the most efficient gas plants, namely combined-cycle plants, which use the exhaust from the combustion turbines to power steam turbines. Under the combination of the second- and third-phase BSERs these plants—the cleanest, most efficient, and least carbon-intensive dispatchable power sources we have other than nuclear—would be required to achieve close to zero carbon emissions either by using carbon capture and storage (CCS) to capture 90 percent of emissions by 2035 or by switching from natural gas to 30 percent (by volume) low-GHG hydrogen by 2032 and ramping up to 96 percent by volume low-GHG hydrogen by 2038.[12]

In addition to the NSPS for natural gas plants, EPA proposes to promulgate guidelines for existing coal-fired steam generating units under Section 111(d).[13] It is accordingly proposing to repeal and replace the Affordable Clean Energy (ACE) Rule that was reinstated by the Supreme

---

[9] *Federal Register*, Vol. 88, p. 33244.
[10] Ibid. The application of NSPS immediately on publication of the final rule to plants that commenced construction or reconstruction after the publication of the proposed rule is specifically authorized under Section 111 of the CAA.
[11] Ibid.
[12] *Federal Register*, Vol. 88, p. 33245.
[13] *Federal Register*, Vol. 88, p. 33245.

Court in *West Virginia v. EPA*.[14] EPA is also dividing coal plants into various categories: those expecting to operate long term (long-term coal plants), those expecting to shutter by 2040 (medium-term coal plants), and those expecting to shutter by 2035 (near-term coal plants). For long-term coal plants, EPA proposes the use of CCS with 90 percent CO_2 capture; for medium-term coal plants, EPA is proposing 40 percent co-firing with natural gas; and for short-term coal plants, EPA is proposing routine maintenance and no increase in the CO_2 emissions rate.

EPA is not proposing NSPS for coal plants "because EPA does not anticipate that any such units will construct or reconstruct and is unaware of plans by any companies to construct or reconstruct a new coal-fired EGU."[15]

Discussion

I. Section 111: Statutory Requirements and Case Law

Under Section 111 of the Clean Air Act, EPA can mandate "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."[16]

Once it determines the BSER, EPA must determine the ''degree of emission limitation'' that is "achievable" by application of the BSER. For new sources, EPA establishes the standard of performance under Section 111(b) as New Source Performance Standards (NSPS) for the relevant source category. For existing sources, EPA publishes emission guidelines under Section 111(d) and directs the states to adopt state plans that contain enforceable standards of performance, which, once approved by EPA, become federally enforceable under the CAA.

A. The BSER Must Be "Adequately Demonstrated."

EPA's discussion of the statutory requirement that the BSER be "adequately demonstrated" cites four D.C. Circuit cases: *Portland Cement Ass'n v. Ruckelshaus*,[17] *Essex Chem. Corp. v. Ruckelshaus*,[18] *Sierra Club v. Costle*,[19] and *Lignite Energy Council v. EPA*.[20] EPA cherry-picks among those opinions' explications of the statutory text, and in at least one instance mischaracterizes the court's holdings. A close examination shows that, unlike the Proposed Rule, all four cases involved technologies that were either already in use for the purpose and at the scale at which they were claimed to be adequately demonstrated, or their availability for such use

[14] Ibid.
[15] Ibid.
[16] 42 US.C. § 7411(a).
[17] 486 F.2d 375 (D.C. Cir. 1973).
[18] 486 F.2d 427 (D.C. Cir. 1973).
[19] 657 F.2d 298 (D.C. Cir. 1973).
[20] 198 F.3d 930 (D.C. Cir. 1999).

could be readily extrapolated from existing prototypes or pilot plants, such that implementation by the regulated entities was feasible and reasonably within their control. That is a far cry from the technology-forcing standard that EPA now seeks to impose.

The linchpin of Section 111 is the phrase "adequately demonstrated." In *Portland Cement Ass'n v. Ruckelshaus*, the D.C. Circuit Court of Appeals wrote that in determining whether a technology is adequately demonstrated, "[t]he Administrator may make a projection based on existing technology, though that projection is subject to the restraints of reasonableness and cannot be based on 'crystal ball' inquiry."[21]

Portland Cement's characterization of Section 111 has been refined by subsequent decisions of the D.C. Circuit, particularly after Congress amended Section 111 to further restrict EPA's discretion in setting emissions standards, as explained below. In *Essex Chemical*, the D.C. Circuit vacated EPA's standards under Section 111, questioning the significance of tests conducted for purposes of standard development under conditions different from those to which the proposed standards would apply.[22] And *Sierra Club v. Costle* cuts against EPA's expansive view of its power to determine the BSER on the basis of emerging technologies, as explained in detail below.

The one case EPA discusses in some detail is the per curiam opinion in *Lignite Energy Council*, in which the D.C. Circuit upheld a BSER of selective catalytic reduction (SCR) to reduce nitrogen oxides (NOx) emissions from coal-fired industrial boilers, even though it was a ''new technology.'' The court in that case explained that ''Section 111 'looks toward what may fairly be projected for the regulated future, rather than the state of the art at present.''' As EPA points out, "The Court added that EPA may determine that control measures are 'adequately demonstrated' through a 'reasonable extrapolation of [the control measures'] performance in other industries.''[23]

However, EPA conveniently fails to mention *why* the D.C. Circuit found that it was reasonable for EPA to extrapolate from the control measure's performance in "other industries," namely that the sources were similar in design, scale, and emissions profile. In *Lignite Energy Council*, EPA had promulgated NSPS for coal-fired industrial boilers based on a BSER that had been demonstrated for utility (i.e., power plant) boilers. The D.C. Circuit upheld EPA's extrapolation because, as it explained, "[u]tility and industrial boilers are similar in design and both categories of boilers can attain similar levels of NOx emissions reduction through combustion controls, which means that SCR will be required to capture comparable quantities of NOx for both boiler types."[24]

---

[21] 486 F.2d 375, 391 (D.C. Cir. 1973) (quoting *International Harvester Co. v. Ruckelshaus*, 478 F.2d 615, 629 (D.C. Cir. 1973)).
[22] 486 F.2d at 436.
[23] *Federal Register*, Vol. 88, p. 33272 (quoting *Lignite Energy Council*, 198 F.3d at 934).
[24] 198 F.3d at 934.

EPA claims that "[t]he D.C. Circuit's view that EPA may determine a system of emission reduction to be adequately demonstrated if EPA reasonably projects that it will be available by a future date certain, is well-grounded in the purposes of CAA Section 111 to reduce dangerous air pollutants."[25] However, that is not the D.C. Circuit's view, as shown by a close reading of *Sierra Club v. Costle*. In *Sierra Club v. Costle*, the D.C. Circuit said of the current version of Section 111(a), "[I]t is clear that this language is far different from the words Congress would have chosen to mandate that EPA set standards at the maximum level of pollution control technologically achievable."[26]

In that case, the D.C. Circuit upheld coal plant emissions standards that EPA had based on "wet scrubbing" as the BSER. The standards were crafted to encourage the use of a potentially more cost-effective emerging technology, "dry scrubbing."[27] EPA apparently recognized that dry scrubbing was not yet "adequately demonstrated," and carefully avoided basing the emissions standards on the new technology. It nonetheless included extensive analysis of dry scrubbing at a pilot facility because it assessed that industry might start adopting the new technology.

Nevertheless, as the court noted, "At times EPA's discussion comes close to suggesting that dry scrubbing may be adequately demonstrated."[28] The court felt compelled to draw a clear line. Noting the "inherent tension" between the concepts of "emerging technology" and "adequately demonstrated technology," the D.C. Circuit wrote, "We feel compelled to state, so that there is no suggestion that the standard has been relaxed, that we do not hold that dry scrubbing is adequately demonstrated technology. Indeed, the record in this case would indicate the contrary."[29]

The court detailed the reasons why it thought that "it would be premature to conclude that dry scrubbing is adequately demonstrated technology."[30] As EPA had previously conceded, "no full-scale dry scrubbers are presently in operation at utility plants" and therefore "crucial issues such as … demonstration of commercial-scale systems, which may continue to limit the overall acceptability of this technology, remain to be answered."[31]

EPA's extrapolations were based on data from prototype units. Moreover, the court noted, "EPA does not attempt to explain how these results may be used to predict performance in full scale plants throughout the industry. The data standing alone is insufficient to establish that dry

---

[25] *Federal Register*, Vol. 88, p. 33273.
[26] 657 F.2d 298 (D.C. Cir. 1981).
[27] As the court explained, "Scrubbing…involves the maintenance of a large scale chemical reaction to clean the smoke produced by coal combustion. Typically, as exhaust gases flow up a power plant smokestack, they are exposed to an absorbent medium that is sprayed in their path." 657 F.2d at 323-24. In "wet scrubbing," the medium is a slurry composed of water and reagent. By contrast "dry scrubbing" involves a two-stage process using minimal water and a baghouse to collect the precipitated pollutants.
[28] 657 F.2d at 341 n. 157.
[29] Ibid.
[30] Ibid.
[31] Ibid. (internal citations and quotations omitted).

scrubbing is adequately demonstrated."[32] Indeed, EPA had admitted that "major uncertainty" existed with the technology "in the absence of experience at large-scale facilities."[33] Notwithstanding the fact that "three full scale dry scrubbing systems were being installed on utility boilers and were scheduled to start operation" in the next two to three years, with bids sought for five more dry control systems for utility-scale operations,[34] the D.C. Circuit concluded, "We see no basis on this record which would justify extrapolating from the pilot scale data to the conclusion that dry scrubbing is adequately demonstrated for full scale plants throughout the industry."[35]

Reviewing the legislative history of Section 111 as originally enacted the D.C. Circuit noted in *Portland Cement Ass'n v. Ruckelshaus*, "The essential question was rather whether the technology would be available for installation in new plants…. [I]t must be 'adequately demonstrated' that there will be 'available technology.'"[36] In the years since then, the D.C. has made clear (and EPA has acknowledged, as seen in the long quote immediately below) that the CAA distinguishes between technology-forcing provisions and ones that require adequately demonstrated technologies. In *Natural Resources Defense Council v. Thomas*, the D.C. Circuit stated:

> [A] standard cannot both require adequately demonstrated technology and also be technology-forcing. The agency describes technology-forcing standards as those that "are to be based upon that technology which the Administrator determines will be available, and not necessarily that technology which is already available. The adoption of such standards helps to encourage and hasten the development of new technology." 49 Fed. Reg. 40,258, 40,258 (1984) (emphasis in original). On the other hand, an adequately demonstrated technology "is one which has been shown to be reasonably reliable, reasonably efficient, and which can reasonably be expected to serve the interests of pollution control without becoming exorbitantly costly in an economic or environmental way." Essex Chemical Corp. v. Ruckelshaus, 486 F.2d 427, 433 (D.C. Cir. 1973).[37]

The distinction between an adequately demonstrated legal standard and one designed to be technology-forcing was affirmed most recently in *American Lung Ass'n v. EPA*,[38] which struck down the 2019 Affordable Clean Energy rule (ACE)[39] and was in turn reversed (on other grounds) in *West Virginia v. EPA*.

---

[32] Ibid.
[33] Ibid.
[34] 657 F.2d at 324 n. 75.
[35] 657 F.2d at 341 n. 157.
[36] 486 F.2d at 391.
[37] *Natural Resources Defense Council v. Thomas*, 805 F.2d 410, 429 n. 30 (D.C. Cir. 1986) (some internal citations omitted; others included for reference).
[38] 985 F.3d 914, 962 (2021) (quoting *Essex Chemical Corp. v. Ruckelshaus*, 486 F.2d 427, 433 (D.C. Cir. 1973)).
[39] "Repeal of the Clean Power Plan; Emission Guidelines for Greenhouse Gas Emissions From Existing Electric Utility Generating Units; Revisions to Emission Guidelines Implementing Regulations," *Federal Register*, Vol. 84 (2019), p. 32521.

EPA's claim that a currently unavailable technology may be considered "adequately demonstrated" as long as it is available "by a date certain"[40] and that in some circumstances "the infrastructure needed to support the system so that it will cover sources across the category…may require a predictable amount of time to build out or develop in sufficient quantity to achieve such coverage."[41] EPA appears to imply that this is the D.C. Circuit's view, but cites no decisions to that effect, and there are none in the D.C. Circuit.

B. The Standard of Performance Must Be "Achievable."

Once EPA has determined the BSER that is "adequately demonstrated," it must determine the degree of emission limitation that is "achievable" by application of the BSER. The analysis of what constitutes achievability is similar to the standard for "adequately demonstrated."

In *National Lime Association v. EPA*, the D.C. Circuit struck down EPA's NSPS for particulate matter (PM) emissions from commercial producers of lime and lime hydrate. The emissions standards were based on test data from the best performing rotary kilns in the industry. The D.C. Circuit vacated the rule in part because EPA had not considered "the representativeness for the industry as a whole of the tested plants on which it relies, at least where its central argument is that the standard is achievable because it has been achieved (at the tested plants)…. [W]e think that by failing to explain how the standard proposed is achievable under the range of relevant conditions which may affect the emissions to be regulated, the Agency has not satisfied this initial burden."[42]

Hence the standard for "achievability" reinforces the standard for "adequately demonstrated" in requiring EPA to show that both the BSER and the standards based on it have been shown to be technically feasible at the scale and for the purpose for which EPA expects the BSER to be used by the regulated entities.

C. EPA Must Take into Account Costs and Impacts on Health, Environment, and Energy Requirements.

Under CAA Section 111(a)(1), in determining the BSER, EPA is required to take into account "the cost of achieving [the emission] reduction." Thus the D.C. Circuit has held that the costs cannot be "exorbitant,"[43] "greater than the industry could bear and survive,"[44] "excessive,"[45] or "unreasonable."[46]

---

[40] *Federal Register*, Vol. 88, p. 33273.
[41] Ibid.
[42] 627 F.2d 416, 434 (D.C. Cir. 1980).
[43] *Lignite Energy Council v. EPA*, 198 F.3d 930, 933 (D.C. Cir. 1999) (per curiam).
[44] *Portland Cement Ass'n v. EPA*, 513 F.2d 506, 508 (D.C. Cir. 1975).
[45] *Sierra Club v. Costle*, 657 F.2d 298, 343 (D.C. Cir. 1981).
[46] Ibid.

In its original version, Section 111 required the Administrator to take only those costs into account in determining the BSER that is adequately demonstrated.[47] In the Clean Air Act Amendments Act of 1977 Congress further constrained the Administrator's discretion by adding the additional requirement that he take into account "any nonair quality health and environmental impact and energy requirements."[48] The provision has remained unamended since.

Unless the law specifies a narrower definition, an agency official that is directed by statute to consider the "costs" of a proposed action must include reasonably foreseeable costs to society as a whole. In the case of Section 111, the D.C. Circuit in *Sierra Club v. Costle* took an expansive view of the costs that must be considered, stating, "[c]onsumers will ultimately bear these costs, both directly in the form of residential utility bills, and indirectly in the form of higher consumer prices due to increased energy costs."[49] Similarly, the health, environment, and energy requirements factors that EPA must consider encompassing the whole society and are not limited to the regulated entities.

Relatedly, while Section 111 does not require a formal cost-benefit analysis, any EPA determination that the costs of achieving the required emission reduction are reasonable requires that the BSER have some benefit in terms of reducing underlying danger of the relevant pollutant. EPA alludes to endangerment findings and estimates of social cost of carbon, but nowhere in the Proposed Rule does EPA establish how its proposed standards of performance could have any measurable impact on the danger that the Proposed Rule is claimed to be responding to. If the benefits of a standard of performance are none (or so trivial as to be impossible to measure), then any significant cost involved in complying with the rule must be considered unreasonable.

II. The Technologies Supporting the Proposed Emissions Standards Have Not Been Adequately Demonstrated.

As discussed in the preceding section, the cases EPA relies on to establish Section 111's threshold of "adequately demonstrated" clearly show that Section 111 is not a technology-forcing provision. Rather the pollution control used as the BSER must be demonstrated at the scale and for the purpose for which it will be used to comply with the standard at facilities that are either substantially the same or similar in design, such that the control will produce similar levels of emissions reductions. Furthermore, in all the cases relied on by EPA, the regulated utilities' compliance with the BSER was feasible and reasonably under their control.

By contrast, EPA's claims that both CCS and low-GHG hydrogen have been adequately demonstrated rely on demonstrations at facilities that are materially different in both scale and design. EPA also relies on proprietary technology for BSER, without any explanation of how

[47] Clean Air Act of 1970, Public Law 91–604, 84 Stat. 1676 (1970).
[48] Public Law 95–95, 91 Stat. 685 (1977).
[49] *Sierra Club v. Costle*, 657 F.2d 298 (D.C. Cir. 1981), quoting "New Stationary Sources Performance Standards; Electric Utility Steam Generating Units," Federal Register, Vol. 44 (June 11, 1979), pp. 33580 and 33606.

regulated entities could acquire the propriety technology or of how or why they should be expected to develop such technology independently.

Furthermore, the BSERs for both CCS and low-GHG hydrogen explicitly include components that can only be implemented by entities (including states and third parties) that are not subject to the Proposed Rule. These "beyond the fence line" components of the BSERs in the Proposed Rule include those related to transportation and sequestration of captured CO_2 and the production and transportation of low-GHG hydrogen.

EPA's claim that a currently unavailable technology may be considered "adequately demonstrated" as long as it is available "by a date certain"[50] fails where, as here, the extrapolated availability of the BSER depends upon circumstances that are totally beyond the control of the regulated entities and beyond the jurisdiction and expertise of EPA. EPA claims that in some circumstances "the infrastructure needed to support the system so that it will cover sources across the category…may require a predictable amount of time to build out or develop in sufficient quantity to achieve such coverage."[51] Even if that were the legal standard, which it is not as explained above,[52] the time required for such a buildout depends on far too many factors to be reasonably predictable. EPA's confidence in predicting how long such a buildout will take is particularly unwarranted where the factors on which the buildout depends are not even within its jurisdiction or expertise. Simply put, EPA has no reasonable basis for predicting how long it would take, or how much it would cost, to deploy the vast infrastructure that would be required for the regulated entities to comply with the Proposed Rule.

A. CCS Has Not Been Adequately Demonstrated.

As EPA explains, "CCS has three major components: CO_2 capture, transportation, and sequestration/storage."[53] With respect to carbon capture, EPA cites many examples of projects which are planned or under development, and which are not operational. Among the demonstrations at facilities that are already operational, none are similar in design, scale, or purpose to the regulated sources in the Proposed Rule. None of these satisfy the legal standard of an "adequately demonstrated" BSER under Section 111.

EPA relies on CCS at coal-fired steam-generating EGUs to claim adequate demonstration of CCS for natural gas EGUs. Even if its justification that "[t]he function, design, and operation of post-combustion CO_2 capture equipment is similar, although not identical, for both steam generating units and combustion turbines" can be credited, there are major problems with every example cited.

---

[50] *Federal Register*, Vol. 88, p. 33273.
[51] Ibid.
[52] See nn. 40 and 41 and accompanying text.
[53] *Federal Register*, Vol. 88, p. 33290.

For example, EPA proposes SaskPower's Boundary Dam Unit 3, a 110 MW lignite-fired unit in Canada, as an example of adequate demonstration. But by EPA's own admission, "[a]s a first-of-a-kind commercial-scale project, Boundary Dam Unit 3 experienced [multiple] challenges" and was not entirely successful. EPA points to a "feasibility study" on possible design improvements as pointing the way to adequate demonstration, but is a feasibility study is not sufficient to establish that any technology has been adequately demonstrated.

EPA's examples of operational demonstrations at coal plants are little better:

> Amine-based carbon capture has been demonstrated at AES's Warrior Run (Cumberland, Maryland) and Shady Point (Panama, Oklahoma) coal-fired power plants, with the captured CO_2 being sold for use in the food processing industry. At the 180– MW Warrior Run plant, approximately 10 percent of the plant's CO_2 emissions (about 110,000 metric tons of CO_2 per year) has been captured since 2000 and sold to the food and beverage industry. AES's 320–MW coal-fired Shady Point plant captured CO_2 from an approximate 5 percent slipstream (about 66,000 metric tons of CO_2 per year) from 2001 through around 2019.[54]

As noted in EPA's own description, these facilities have succeeded in capturing only a small volume, and small percentage, of their CO_2 emissions. Their inclusion as the best examples of "adequate demonstration" is a further indication that CCS at any meaningful scale has not been adequately demonstrated.

EPA gives only two examples of demonstrations of CCS at natural gas EGUs like those that would be subject to the CCS-based NSPS in the Proposed Rule. One, the Bellingham Energy Center in central Massachusetts, was a small-scale (40 MW) slipstream capture facility which sold the captured CO_2 for use in the food industry, used a proprietary technology (Fuor's Econamine FG Plus capture system) and shuttered in 2005, presumably because the operation was not economical. The other, Scotland's "proposed 900-MW Peterhead Power Station combined cycle EGU with CCS is in the planning stages of development…[and] is anticipated that the power plant will be operational by the end of the 2020s." Neither can be used as basis for adequate demonstration under the D.C. Circuit cases that EPA relies on.

Similarly, the examples cited as adequate demonstration of transport and storage fall far short of the scale that would be required to comply with the Proposed Rule and are not even theoretically feasible for the regulated entities to implement on their own. EPA's extrapolations from small demonstrations are not reasonable where the political, social, and other challenges to building out transport and storage would be exponentially greater at a large scale than at a small scale, another factor that EPA fails to consider. As previously noted, those challenges are also outside of EPA's jurisdiction and expertise, making it particularly unreasonable for EPA to make confident predictions about them, one of the many reasons that BSER should consist of measures that can actually be implemented within the fence line of regulated facilities.

[54] Ibid.

In the original Clean Power Plan, EPA considered and rejected CCS because it was not adequately demonstrated and was too costly.[55] In particular, EPA noted that the cost to implement CCS for existing source standards is not reasonable and that "CCS is not an appropriate component of the [BSER]."[56] The issues raised in the original Clean Power Plan remain valid reasons to reject CCS as an adequately demonstrated control technology.

B. Low-GHG Hydrogen as Utility Fuel Has Not Been Adequately Demonstrated.

While CCS fails to meet the statutory requirements of Section 111 for the BSER, it comes much closer than hydrogen co-firing, which has not been remotely adequately demonstrated. This is particularly the case because the Proposed Rule's hydrogen BSER is based on "low-GHG" hydrogen gas, which is to say, hydrogen gas produced by means that do not produce more GHG than would be reduced by co-firing with the hydrogen. As EPA admits, there is a major problem there: "[A]t present, nearly all industrial hydrogen is produced via methods that are GHG-intensive."[57] "Only small-scale facilities are currently producing hydrogen through electrolysis with renewable or nuclear energy."[58] EPA provides no estimate of how much renewable and nuclear power would be required to produce enough low-GHG hydrogen gas to power half the U.S. electricity grid.

That is only the start of the problems. Only a few combustion turbines currently are able to co-fire "relatively high percentages" of hydrogen "up to 75 percent hydrogen by volume."[59] As EPA explains, there are major challenges relating to physical properties of the gas, such that new natural gas EGUs capable of co-firing 96 percent hydrogen will need to be designed differently than any EGUs currently in operation. No EGU currently in operation is able to co-fire anywhere near the volume of hydrogen that EPA calls for in its BSER. Hence, EPA's phase-three BSER of co-firing 96 percent hydrogen has not been adequately demonstrated by EPA's own admission.

Even EPA's phase-two proposed BSER of co-firing 30 percent for new base-load and intermediate-load EGUs has not been demonstrated at scale. The demonstrations that EPA relies on for high percentages of hydrogen co-firing are small industrial combustion turbines that, in addition to being smaller than utility combined-cycle EGUs, have a substantially different design.[60]

EPA's claims of adequate demonstration are explicitly aspirational:

---

[55] Technical Support Document (TSD) for Carbon Pollution Guidelines for Existing Power Plants: Emission Guidelines for Greenhouse Gas Emissions from Existing Stationary Sources: Electric Utility Generating Units; chapters 6–7, June 10, 2014, Docket Item No. EPA-HQ-OAR-2013-0602-36852.
[56] Ibid., chapter 6.
[57] *Federal Register*, Vol. 88, p. 33306.
[58] *Federal Register*, Vol. 88, p. 33312.
[59] *Federal Register*, Vol. 88, p. 33308.
[60] *Federal Register*, Vol. 88, p. 33311–33312.

> The goals of equipment manufacturers and the fact that existing combined cycle combustion turbines have successfully demonstrated the ability to co-fire various percentages of hydrogen supports EPA's proposal to determine that co-firing 30 percent hydrogen is technically feasible for new base load stationary combustion turbine EGUs by 2032 and that co-firing 96 percent hydrogen is technically feasible.[61]

The fact that a technology is theoretically feasible is not sufficient to meet the standard of "adequately demonstrated" under Section 111.

EPA helpfully points out other ways in which hydrogen co-firing has not been adequately demonstrated: "Midstream infrastructure limitations and the adequacy and availability of hydrogen storage facilities currently present obstacles and increase prices for delivered low-GHG hydrogen."[62] It is crucial to note that these obstacles are entirely outside the control of regulated entities.

Furthermore, EPA admits that it is treating Section 111 as a technology-forcing provision, despite the D.C. Circuit's admonitions to the contrary. EPA states,

> Developing new configurations for flame dimensions and turbine modifications to adjust for the characteristics unique to hydrogen combustion are technology forcing advancements that industry appears to be already leaning into based on the project announcements. Thus, co-firing low-GHG hydrogen fulfills the requirements of BSER to generally advance technology development.[63]

As the D.C. Circuit has made clear, Section 111's requirement that the BSER be "adequately demonstrated" is not satisfied by aspirational goals, or demonstrations at facilities that are not similar in scale and design, or by treating the provision as technology-forcing. By ignoring or minimizing these caveats, EPA is jeopardizing the entire effort to regulate GHG from power plants.

III. EPA Has Not Sufficiently Considered the Proposed Rule's Costs, Environmental Impact, or Impact on Energy Requirement.

As explained in Section VI below, EPA can point to no measure environmental benefit in the Proposed Rule. This is a function of EPA's legal error in failing to undertake an endangerment finding specific to EGUs and its failure to demonstrate, as part of that finding, that the regulated source makes a significant contribution to ameliorating a condition of air pollution. EPA has not even defined the condition of air pollution. GHGs are a component of ambient air, and should be regulated, if at all, under National Ambient Air Quality Standards (NAAQS). But EPA has

[61] *Federal Register*, Vol. 88, p. 33312.
[62] Ibid.
[63] *Federal Register*, Vol. 88, p. 33314.

proposed no NAAQS, nor has it defined any planetary temperatures as ideal. In short, EPA has failed to define an environmental baseline against which any condition of air pollution that endangers health or welfare under Section 111 could be defined.

EPA's estimate of costs and benefits are highly speculative. This is inevitable, given that EPA's estimates of costs and benefits are based on a number of assumptions that are themselves speculative, starting with how utilities will react to the rule. Because EPA cannot predict with any precision how utilities will react, it cannot reliably estimate how the rule will impact cost and any non-air-quality health and environmental factors or energy requirements. Indeed, EPA admits that over the next year it will have to "complete additional advanced modeling…considering real-world scenarios within the power sector to best understand how components of the rule impact each other."[64]

Uncertainties aside, EPA's assessment of the impacts of the Proposed Rule underestimates costs, impact of electricity availability on public health, and ignores significant costs and non-air-quality impacts of both the CCS and low-GHG hydrogen components of the BSER.

A. Contrary to EPA's Estimates, the Costs of the Rule Will Be Exorbitant.

Unless the law specifies a narrower definition, an agency official that is directed by statute to consider the "costs" of a proposed action must include reasonably foreseeable costs in the aggregate; that is, costs for society as a whole. In the case of Section 111, the D.C. Circuit has made clear that the costs that must be considered are those that are passed on to consumers, whether directly or indirectly: "Consumers will ultimately bear these costs, both directly in the form of residential utility bills, and indirectly in the form of higher consumer prices due to increased energy costs."[65]

Instead, however, EPA has been highly selective in those costs that it considered in establishing the proposed standards, ignoring several significant costs. These include (1) the cost of federal subsidies such as those in the Inflation Reduction Act, on which EPA relies in its analysis; (2) the potential for vastly higher electricity costs to end-use consumers if compliance with the rule does not occur on EPA's unrealistically rapid timetable and electricity production regularly falls short of demand, with the potential for scarcity pricing, and costly load-shedding; and (3) the possibility that wholesale electricity market prices will be set by very high marginal cost units using expensive low-GHG hydrogen as the primary fuel.

1. Federal Subsidies Do Not Reduce the Cost of CCS or Hydrogen Co-Firing.

---

[64] News release, "EPA Proposes New Carbon Pollution Standards for Fossil Fuel-Fired Power Plants to Tackle the Climate Crisis and Protect Public Health," U.S. Environmental Protection Agency, May 11, 2023.

[65] *Sierra Club v. Costle*, 657 F.2d 298 (D.C. Cir. 1981), quoting "New Stationary Sources Performance Standards; Electric Utility Steam Generating Units," *Federal Register*, Vol. 44 (June 11, 1979), pp. 33580 and 33606.

Explaining how CCS is "adequately demonstrated" taking into account the "cost" of achieving emissions reductions, EPA claims: "The use of CCS at this level can be implemented at reasonable cost because it allows affected sources to maximize the benefits of the [Internal Revenue Code] Section 45Q tax credit."[66] Section 45Q of the Internal Revenue Code provides enormous subsidies for CCS. Similarly for the low-GHG hydrogen BSERs: EPA's cost estimates depend explicitly on the "IIJA incentives and IRA tax subsidies for low-GHG hydrogen production, CCS, and generation from renewable sources."[67]

As noted, however, the costs of a Section 111 standard include costs directly and indirectly passed on to consumers. Accordingly, the Section 45Q does not reduce the cost of CCS, but rather only shifts the costs from consumers to taxpayers. The same analysis applies to the investment and production tax credits available for renewable generation technologies—several estimates indicate that the Congressional Budget Office's score of approximately $369 billion[68] for IRA subsidies underestimates their full costs by a factor of three to seven (and will ultimately cost the taxpayer between $1.2 trillion[69] and $2.7 trillion[70]).

EPA's practice of reducing cost estimates under Section 111 by the amount of federal subsidies amounts to an accounting trick that vitiates the purpose for which cost considerations were included in Section 111. To see why, suppose a Section 111 standard that costs 10 percent of gross domestic product to achieve every year. Congress could pass a law subsidizing the entire cost of achieving the standard. By the logic EPA uses in the Proposed Rule, the cost of the standard would then be "zero," even though the subsidy would actually cost more than $2 trillion every year, increasing the overall federal budget by half. To say that the costs of such a standard are "zero" would be misinformation on a massive scale, tantamount to a fraud on the public, in addition to violating Section 111.

EPA tries to get around this fatal flaw in its consideration of costs for both the CCS and hydrogen co-firing BSERs by repairing to the legislative history of the Inflation Reduction Act: "The legislative history of the IRA makes clear that Congress was well aware that EPA may promulgate rulemaking under CAA Section 111 based on CCS and explicitly stated that EPA should consider the tax credit to reduce the costs of CCUS (i.e., CCS)."[71] But the only "explicit statement" to that effect in the legislative history is a statement entered into the Congressional Record by a single Congressman, Representative Frank Pallone (D–NJ), who, as chairman of the House Energy and Commerce Committee, was unable to muster the rest of his committee behind putting such a statement in the committee report, much less into the law itself. EPA cites no legal

---

[66] *Federal Register*, Vol. 88, p. 33290.
[67] *Federal Register*, Vol. 88, p. 33314.
[68] Congressional Budget Office, "The Distributional Effects of the Build Back Better Act," February 14, 2023.
[69] Goldman Sachs, "The US Is Poised for an Energy Revolution," April 17, 2023, https://www.goldmansachs.com/intelligence/pages/the-us-is-poised-for-an-energy-revolution.html (accessed July 31, 2023).
[70] Wood Mackenzie, "IRA Tax Credits for Renewables," March 8, 2023, https://www.woodmac.com/news/opinion/IRA-tax-credits-for-renewables/ (accessed July 31, 2023).
[71] *Federal Register*, Vol. 88, p. 33300.

basis for reducing the cost estimates under Section 111 by the amount of federal subsidies, and there is none. EPA's claim that "Congress … explicitly stated that EPA should consider the tax credit to reduce the costs of CCUS" for purposes of Section 111 is demonstrably misleading and would deserve a shark rebuke from the federal judiciary if it appears in a final rule.

Finally, if EPA relies on federal subsidies in crafting the BSER, then the BSER itself is reliant on Congress's continuing to fund the subsidies, another element of the BSER that is entirely beyond the fence line and control of the regulated entities. If a future Congress declines to fund or simply eliminates the subsidies in the IRA and IIJA, or even shortens the period during which the subsidies are available, EPA's BSERs would instantly cease to be adequately demonstrated at reasonable cost.

2. EPA's Overly Optimistic Cost Estimates Are Not Reasonable.

As it has in the past, EPA estimates the additional capital and operating costs that CCS would impose on regulated entities, as well the decrease in power output and increase in emissions from the addition of CCS. There is a curious difference between how it renders the estimate in the Proposed Rule and how its prior practice, namely that this time, EPA avoids giving a bottom-line estimate of how much electricity prices would increase as a result of CCS. As a result, courts and the public are left with no way to assess the ultimate cost of CCS and no way to know whether or to what extent the Administrator really took costs into account in weighing whether CCS had been adequately demonstrated.

Estimating the additional costs of CCS for coal plants in the 2019 Ace Rule, EPA wrote:

> According to NETL [National Energy Technology Laboratory], the capital costs of a CCS system with 90 percent capture increases the cost of a new coal-fired power plant approximately 75 percent relative to the cost of constructing a new coal-fired power plant without post-combustion control technology. Furthermore, the additional auxiliary load required to support the CCS system consumes approximately 20 percent of the power plant's potential generation. The NETL Pulverized Coal Carbon Capture Retrofit Database tool (April 2019) estimates that the operating costs of existing coal-fired EGUs range from 22 to 44 $/MWh. The incremental increase in generating costs, including the recovery of capital costs over a 30-year period, due to CCS range from 56 to 77 $/MWh. *For reference, according to the EIA, the average electricity price for all sectors in March of 2019 was 103.8 $/MWh. About 60 percent of these latter costs (60 $/MWh) are associated with generation and 40 percent with transmission and distribution of the electricity. Thus, the incremental increase in generating costs due to CCS by itself would equal or exceed the average generation cost of electricity for all sectors*.[72]

The key data point in this description is the conclusion: CCS would at least double the cost of generating electricity for all sectors. In the Proposed Rule, however, EPA summarizes the same

[72] *Federal Register*, Vol. 84 (2019), pp. 32520 and 32545 (internal citations omitted and emphasis added).

components of the added cost of CCS for the combined-cycle plants subject to that BSER, but without any mention of how much electricity prices would increase once those costs are added up:

> According to the NETL Fossil Energy Baseline Report (October 2022 revision), before accounting for the IRC Section 45Q tax credit for sequestered CO_2, using a 90 percent capture amine-based post-combustion CO_2 capture system increases the capital costs of a new combined cycle EGU by 115 percent on a $/kW basis, increases the heat rate by 13 percent, increases incremental operating costs by 35 percent, and derates the unit (i.e., decreases the capacity available to generate useful output) by 11 percent. For a base load combustion turbine, carbon capture increases the LCOE [Levelized Cost of Energy] by 61 percent (an increase of 27 $/MWh) and has an estimated cost of $81/ton ($89/metric ton) of onsite CO_2 reduction.[73]

Given how closely its recital of these costs hews to previous iterations, EPA's refusal to estimate what the added costs would mean for the overall price of electricity is a material omission and should lead reviewing courts to conclude that either the Administrator totally ignored what the bottom line cost would be of achieving emissions reductions by application of CCS, or, knowing those costs to be exorbitant, decided that it was better not to mention it. Either way, it is another example of how EPA covers up its failure to meet the statutory requirements of Section 111.

Going beyond the fence line, the transportation system required could be quite expensive. A Department of Energy NETL report from 2021 stated: "For sizes ranging from 4 inches to 24 inches in diameter, estimated pipeline costs ranged from $51,000 per inch-mile to $119,000 per inch-mile (on a total project cost basis) where inch is the diameter of the pipeline."[74] Further, the U.S. Geological Survey (USGS) finds that many basins in the U.S. have been "evaluated by the assessment panel and found to contain no definitive evidence that there are reservoir and seal formations that satisfy the specific requirements of the USGS methodology for assessing CO_2 storage resources."[75] These areas include the Northern California Coast Basins, the Midcontinent Rift Basin, and others. If an individual source's compliance with the BSER requires the buildout of hundreds of miles of transportation to a geologic formation that can accommodate sequestration/storage, then the capital costs alone could reach into the tens or hundreds of millions of dollars, not to mention the extreme difficulty and cost in acquiring rights of way and permits for construction.[76]

---

[73] Federal Register, Vol. 88, p. 33298.

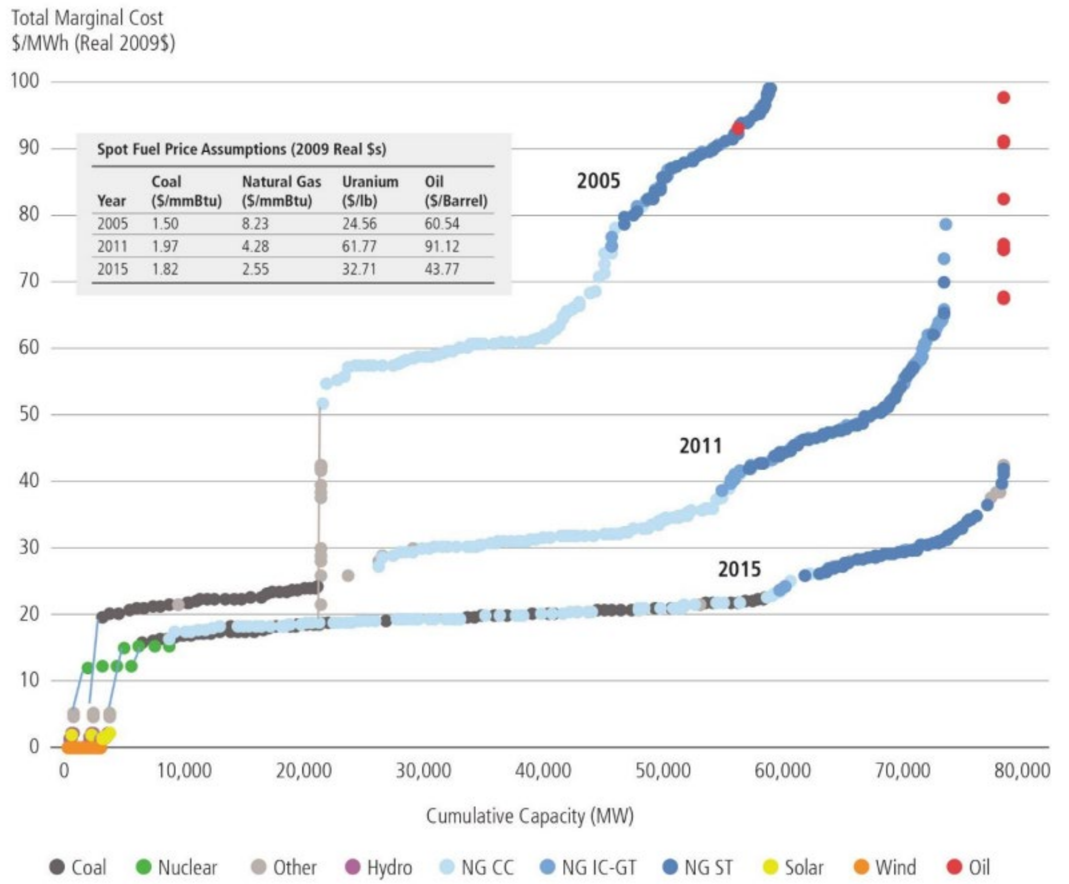
[74] Ray McKaskle, and Steve Whittaker, *Screening-Level Cost Estimates for CO2 Capture and Transportation: CarbonSAFE Illinois - Macon County (Task 10)*, https://doi.org/10.2172/1871212 (accessed August 2, 2023).

[75]U.S. Geological Survey, Geologic CO_2 Sequestration viewer, https://co2public.er.usgs.gov/viewer/ (accessed July 31, 2023).

[76] Regarding the cost and feasibility of building new pipelines for CO_2 transportation, EPA ignores opposition from environmentalist organizations to new pipelines, in general, and new CO_2 pipelines, in particular. The Oakland Institute, "The Midwest Carbon Express: A False Solution to the Carbon Crisis," 2022, https://www.oaklandinstitute.org/sites/oaklandinstitute.org/files/midwest-carbon-express.pdf (accessed July 31, 2023).

The power plant rule would also increase the cost of electricity substantially. Unfortunately, EPA's modeling of the cost of electricity does not follow the real-world mechanics of the electricity system, which enables EPA to claim that electricity prices will remain nearly unchanged. Nonetheless, it is possible to estimate changes to the wholesale cost of electricity under the Proposed Rule using a simple electricity supply-and-demand framework. The graph below illustrates a representative electricity supply curve in the Electric Reliability Council of Texas (ERCOT) market using different historical prices of natural gas.

Figure 5.5. Simulated ERCOT Dispatch Curves[xxx]



What would the electricity supply curve look like if power plants used green hydrogen instead of natural gas? The International Energy Agency (IEA) states that green hydrogen costs between $3 and $8 per kilogram, which works out to between $24 and $64 per Metric Million British Thermal Unit (MMBtu).[77] Under optimistic assumptions, the IEA believes the cost of green

[77] "Hydrogen vs. Natural Gas for Electric Power," Seeking Alpha, December 2, 2020, https://seekingalpha.com/article/4392471-hydrogen-vs-natural-gas-for-electric-power-generation (accessed July 31, 2023).

hydrogen could fall to a range of $1 to $3 per kg, or $8 to $24 per MMBtu.[78] In the graph above, $8/MMBtu is the price of natural gas in the steepest part of the supply curve, meaning the supply curve would be much steeper if the cost of green hydrogen doesn't fall as fast as the IEA expects. Compare green hydrogen costs to market prices for natural gas in 2023, which have hovered around $2 to $3 per MMBtu.[79]

Wholesale electricity markets pay all resources the marginal cost of the highest-cost resource needed in a given interval. At a demand of 40,000 MW, the market price for electricity would be about $20/MWh (using the 2015 curve based on a natural gas commodity price of $2.55 per MMBtu). If low-GHG hydrogen achieved the lower end of the IEA price estimate, the market price at a demand of 40,000 MW would be over $60/MWh (using the 2005 curve based on a low-GHG hydrogen cost of about $8 per MMBtu). In this illustrative example, even when using the most optimistic path for low-GHG hydrogen, EPA rule would increase the cost of electricity generation by at least 300 percent. And if the cost of green hydrogen does not fall as EPA hopes, the Proposed Rule would increase the cost of electricity generation by far more than that.

3. The Proposed Rule Will Disproportionately Impact Low-Income and Vulnerable Communities.

Poor and middle-class people would pay a steep price for the increase in electricity prices that would occur under the Proposed Rule. They would suffer a decline in inflation-adjusted income, safety and security, for no measurable benefit in terms of climate change. With increases in electricity prices, manufacturing jobs would be sacrificed to other countries, including China, where forced labor is often used in manufacturing.

Higher costs of electricity disproportionately affect the poor and middle class because they spend a higher share of their income on electricity. President Biden's plan to push forward EPA regulations to raise electricity prices is making the United States weaker and China stronger. This is taking place without noticeable effects on global temperatures, using the Model for the Assessment of Greenhouse Gas Induced Climate Change developed by researchers at EPA, as discussed in Section VI below. In order to comply with recent EPA proposals to regulate tailpipe emissions, 60 percent of vehicle sales would have to be battery-powered electric vehicles in 2030, and 67 percent in 2032.[80] This would be impractical, costly, and less safe for drivers. The Department of Energy also wants to regulate a variety of other appliances, depriving Americans of the ability to have a simple gas stove[81]—an appliance that goes back almost 200 years. Poor

[78] *Global Hydrogen Review 2021 Executive Summary*, International Energy Agency, October 2021, https://www.iea.org/reports/global-hydrogen-review-2021/executive-summary (accessed July 31, 2023).
[79] "Natural Gas: Data," U.S. Energy Information Administration Independent Statistics and Analysis (July 12, 2023), https://www.eia.gov/dnav/ng/hist/rngwhhdm.htm (accessed July 31, 2023).
[80] News Release, "Biden-Harris Administration Proposes Strongest-Ever Pollution Standards for Cars and Trucks to Accelerate Transition to a Clean-Transportation Future," U.S. Environmental Protection Agency, April 12, 2023, https://www.epa.gov/newsreleases/biden-harris-administration-proposes-strongest-ever-pollution-standards-cars-and (accessed April 28, 2023).
[81] *Federal Register*, Vol. 88 (February 1, 2023).

and middle-class people will be paying the price for these rules, both proposed and enacted. And these proposed rules will add significantly to the burdens on the electricity grid, just as the Proposed Rule constricts electricity supply.

Low-cost electricity is also essential for agriculture. Reliable energy availability creates cheap food, jobs, and more productive economic growth. This contributes to lower greenhouse gas emissions in the long run. If America gives up its energy and agricultural security, people will be left with the insecurity of higher food and transportation costs, higher electricity costs, and lost jobs, with decreased food access, and with the poor paying most of the price. High food and energy costs in emerging economies reduce economic growth, leading to pressures to migrate to countries with job opportunities, particularly in Europe and North America.

B. EPA Has Not Fully Considered Non-Air Health and Environmental Impacts or Energy Requirements.

1. The Proposed Rule Will Force Generation-Shifting to More Emissions-Intensive (and Carbon-Intensive) Power Plants.

As explained above, the principal burden of EPA's proposed NSPS standards falls on the most efficient natural gas EGUs, namely combined-cycle baseload generators that have significantly lower carbon emissions than intermediate-load or low-load ("peaker") plants. The chief reason for this is that CCS is incompatible with intermediate-load and low-load configurations. This leads to an absurd result, particularly given EPA's ultimate purpose of reducing carbon emissions: By imposing only light regulations on less efficient intermediate and peaker generators while punishing the most efficient plants, the Proposed Rule will actually force generation-shifting to more emission-intensive sources, including sources that are more carbon-intensive.

The most efficient "combined-cycle" plants take a long time to ramp up and down. That is partly because in a combined-cycle plant, a heat recovery steam generator (HSRG) is added as a secondary cycle to capture heat generated by the primary (combustion-turbine) cycle. Because the boiler in the HSRG takes a long time to heat up, combined-cycle plants are not suited to tasks that require rapid ramp-up and ramp-down (such as stabilizing a grid with a substantial component of intermittent renewable power) for which intermediate and peaker generators are ideally suited.

CCS is incompatible with intermediate and peaker generation. EPA explains why:

> Currently available post-combustion amine-based carbon capture systems require that the flue gas be cooled prior to entering the carbon capture equipment. This holds true for the exhaust from a combustion turbine. The most energy efficient way to do this is to use a HSRG—which…is an integral component of a combined cycle turbine system—to generate additional useful output. Because simple cycle combustion turbines do not

> incorporate a HRSG, the Agency is not considering the use of CCS as a potential component of the BSER for them.[82]

Combined-cycle plants are ideally suited for "base-load generation," in which power plants ae generally running around the clock and do not need to ramp up and ramp down quickly. Because CCS technologies currently depend upon HSRG, CCS is incompatible with the less efficient simple-cycle plants that are used to provide intermediate and peaker generation quickly when the grid might be overwhelmed, as in the evenings when demand soars and solar power wanes or during sudden peaks in demand caused by severe weather. As EPA explains, "Intermediate load combustion turbines tend to start and stop frequently and have relatively short periods of continuous operation. CCS systems could have difficulty starting fast enough to get significant levels of CO_2 capture."[83]

EPA is therefore proposing to apply the new standards mostly to combined-cycle plants, essentially punishing the most efficient and least carbon-intensive source of base-load generation except for nuclear. The Proposed Rule would divert much of the power from the second cycle of CCS away from electricity production to carbon-capture. That would dramatically increase the amount of fuel that needs to be burned per kilowatt-hour (kWh), while increasing such plants emission intensity per kWh prior to the CCS cycle. As Robert Bryce pointed out when the first carbon-capture incentives were introduced in 2010, the immediate impact would be to reduce the electricity produced by such power plants by about 28 percent, making them much less efficient and requiring them to burn far more natural gas to produce the same amount of electricity.[84]

In a concession to reality, EPA is proposing less stringent standards for the less efficient simple-cycle plants, and it would in effect exempt peaker plants from the rule altogether. Ironically, renewable-energy mandates are making such plants more important because the more solar and wind power is added to a grid, the more intermediate and peaker power is required to maintain grid stability, as Californians learned in August 2020 when the lack of sufficient peak capacity led to rolling blackouts for 800,000 customers.

That crisis, and a near-repeat in 2022 when Californians were asked not to charge their electric vehicles and to conserve power for several weeks, were purely the results of too much solar power thrown onto the grid without enough "dispatchable" gas capacity to back it up. Hence, EPA rule will reinforce a broader unintended consequence of the renewables push, which is to force utilities to switch to less efficient, more expensive, more emissions-intensive (including carbon-intensive) EGUs.

2. Non-Cost Impacts of CCS and Hydrogen Infrastructure Buildout

---

[82] *Federal Register*, Vol. 88, p. 33292.
[83] *Federal Register*, Vol. 88, p. 33305.
[84] Robert Bryce, "A Bad Bet on Carbon," *New York Times,* May 12, 2010.

As Robert Bryce wrote in a recent newsletter, sequestering 600 million tons of CO_2 per year, "would require creating an industry capable of handling a mass of CO_2 that's equal to about 12 million barrels of oil per day."[85] The prominent "Net-Zero America" study led by Princeton University estimates that sequestering between 900 million and 1.7 billion tons of CO_2 per year (its estimated requirement to achieve net zero) would require 21,000 to 25,000 kilometers of new interstate CO_2 trunk pipelines and 85,000 kilometers of spur pipelines delivering CO_2 to trunk lines, along with thousands of injection wells.[86] And the Congressional Research Service has explained how safety concerns have created major problems for the roughly 4,000 miles of pipeline projects currently being developed to transport CO_2 from ethanol plants in the Midwest to injection wells in the region.[87] Local opposition has been both fierce and effective, given that CO_2 pipeline permits and the relevant landowner rights and eminent-domain laws are all subject to state jurisdiction.

3. Risk to Health

The reliability of the electric grid is a matter of public health and safety. The connection between access to reliable electric power and public health and safety is well established: blackouts are a safety hazard worthy of the Administrator's consideration.[88] As one recent example, hundreds of lives were lost during Winter Storm Uri in February 2021 due to a lack of reliable electricity supplies during a long-lasting extreme cold weather event.[89] EPA should avoid contributing to such losses in the future. Unfortunately, because EPA unreasonably assumed the Proposed Rule will have no reliability impacts, it failed to consider the risks to human health stemming from unreliable electricity among the health and welfare impacts it considered.

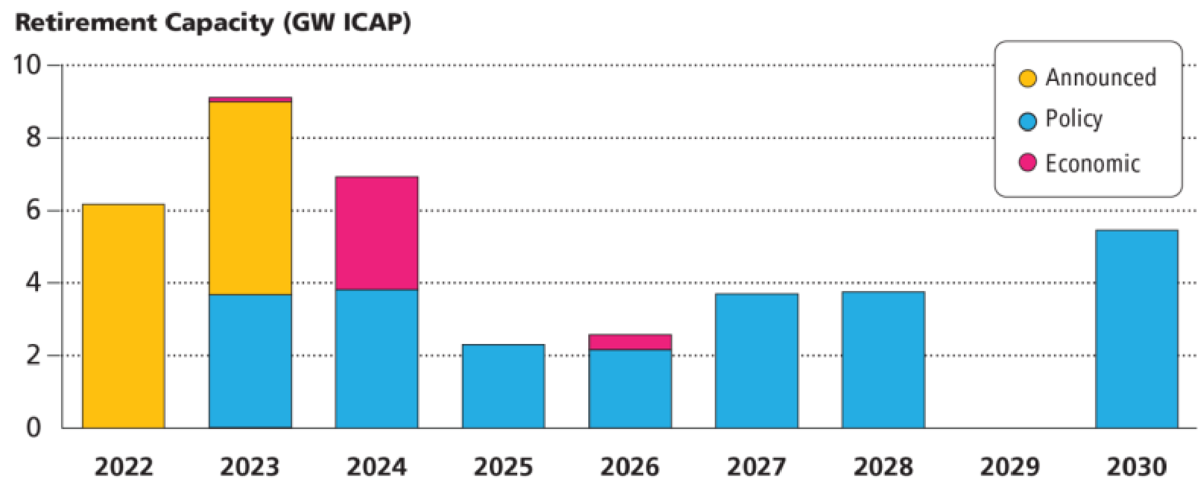
The Proposed Rule was issued after many serious warnings of supply shortfalls in the U.S. electricity system. PJM Interconnection, Inc. (PJM), the largest regional transmission organization in the U.S., has warned federal policymakers about the rapid retirement of generation resources. PJM notes:

---

[85] Robert Bryce, "EPA v. The Grid," Substack, May 13, 2023, https://robertbryce.substack.com/p/epa-v-the-grid (accessed August 2, 2023).
[86] Princeton University, "Net Zero America Final Report Summary," October 29, 2021, p. 17, https://netzeroamerica.princeton.edu/img/Princeton%20NZA%20FINAL%20REPORT%20SUMMARY%20(29Oct2021).pdf (accessed August 2, 2023).
[87] Congressional Research Service, "Carbon Dioxide Pipelines: Safety Issues," June 3, 2022, p. 2, https://crsreports.congress.gov/product/pdf/IN/IN11944 (accessed August 2, 2023).
[88] Joan A. Casey et al., "Power Outages and Community Health: A Narrative Review," Curr Environ. Health Rep., Vol. 4, No. 2 (December 2020), pp. 371–383, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7749027/ (accessed July 31, 2023) ("The existing literature suggests that power outages have important health consequences ranging from carbon monoxide poisoning, temperature-related illness, gastrointestinal illness, and mortality to all-cause, cardiovascular, respiratory, and renal disease hospitalizations, especially for individuals relying on electricity-dependent medical equipment.").
[89] See Jess Donald, "Winter Storm Uri 2021: The Economic Impact of the Storm," *Fiscal Notes: The Review of the Texas Economy*, October 2021, https://comptroller.texas.gov/economy/fiscal-notes/2021/oct/winter-storm-impact.php (accessed July 2, 2023).

> Historically, thermal resources have provided the majority of the reliability services in PJM. Today, a confluence of conditions, including state and federal policy requirements, industry and corporate goals requiring clean energy, reduced costs and/or subsidies for clean resources, stringent environmental standards, age-related maintenance costs, and diminished energy revenues are hastening the decline in thermal resources.[90]

The following figure illustrates forecast retirements in PJM, of which policy-driven retirements comprise the majority. The total expected closures—40 gigawatts (GW)—represent 21 percent of PJM's installed generating capacity. Taken together, the suite of EPA regulations already impacting the supply side of the electricity sector poses a significant threat to the reliable operation of the nation's bulk power system. The Proposed Rule would exacerbate risks to human health from electricity outages by forcing more closures of reliable power plants.



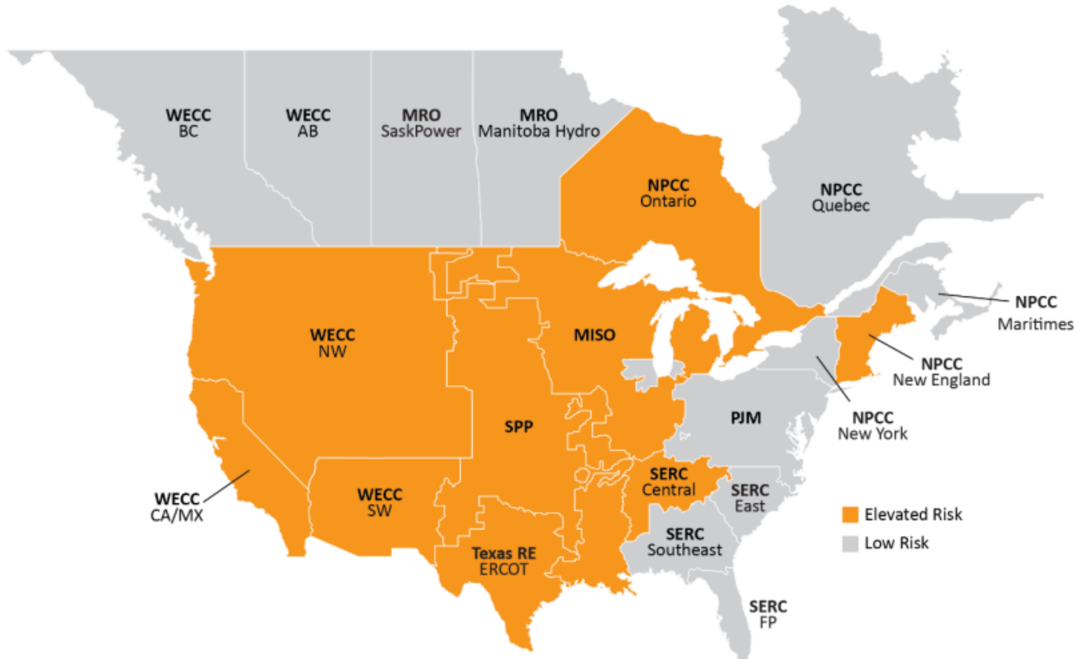
The North American Electric Reliability Corporation (NERC), which is the organization responsible for establishing mandatory reliability standards, is also sounding alarms. In its most recent Long Term Reliability Assessment (LTRA), NERC highlighted the significant grid reliability problems facing the United States in the near term. The LTRA states that "[w]ithin the 10-year horizon, over 88 GW of generating capacity is confirmed for retirement."[91] Speaking to the press about the report, John Moura, NERC's director of reliability assessment and

---

[90] PJM, "Energy Transition in PJM: Resource Retirements, Replacements, and Risks," February 24, 2023, https://www.pjm.com/-/media/library/reports-notices/special-reports/2023/energy-transition-in-pjm-resource-retirements-replacements-and-risks.ashx (accessed July 2, 2023) (emphases added).

[91] North American Electric Reliability Corporation, *2022 Long-Term Reliability Assessment*, December 2022, https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC_LTRA_2022.pdf (accessed July 2, 2023).

performance analysis, said, "[w]e are living in extraordinary times, from an electric industry perspective. There are extraordinary reliability challenges and opportunities in front of us."[92] In May of this year, NERC released its Summer Reliability Assessment, which warned that "two-thirds of North America is at risk of energy shortfalls this summer during periods of extreme demand." Figure 1 from NERC's 2023 Summer Reliability Assessment shows the regions of the country that face an elevated risk of supply shortfalls this year.



Seasonal Risk Assessment Summary	
High	Potential for insufficient operating reserves in normal peak conditions
Elevated	Potential for insufficient operating reserves in above-normal conditions
Low	Sufficient operating reserves expected

Figure 1: Summer Reliability Risk Area Summary

These risks are well known. NERC has been warning about the speed of the energy transition for years, largely from the perspective of the changing supply resource mix.

EPA should be involved in NERC working groups in order to base its rulemakings in sound science and to fully consider the health impacts of its rules. Given the requirement in Section 111 of the CAA that the Administrator consider non-air environmental impacts, EPA should not move

[92] Robert Walton, "Most of US Electric Grid Faces Risk of Resource Shortfall Through 2027, NERC Finds," Utility Dive, December 16, 2022, https://www.utilitydive.com/news/nerc-grid-resource-adequacy-shortfall-reliability-assessment/638949/ (accessed July 2, 2023).

forward with a final rule (or a new proposed rule) until it reaches a better understanding of NERC's warnings regarding the pace of the forced energy transition.

NERC's elevated risk scenario is for this summer, meaning reliability challenges are already here. Hence any EPA proposal—including the Proposed Rule—to force more reductions in supply will further weaken an already fragile grid. The Proposed Rule thus creates a new non-air health risk by forcing a rapid decrease in electricity supply from coal and natural gas EGUs amid a deepening reliability crisis.

4. Interactions with EPA's Tailpipe Rules

The Proposed Rule and its Regulatory Impact Analysis (RIA) should address the interactions between the Proposed Rule and other EPA rules, including the recently proposed rules under Section 202 of the CAA regarding tailpipe emissions.[93] Under Section 111 of the CAA, the Administrator must take into account cost, non-air-quality health and environmental impacts, and energy requirements. By ignoring interactions between the Proposed Rule and the Tailpipe Rules, EPA's impact assessments in this docket fail to provide the information the Administrator is statutorily required to consider under the CAA.

Specifically, the Tailpipe Rules would significantly increase electricity demand by forcing a shift from a transportation system built on liquid fuels and internal combustion engines to one increasingly reliant on the power grid and plug-in electric vehicles (EVs). Although the RIAs for the Tailpipe Rules claim reliability issues from the increased use of EVs will be minimal, the RIAs rest on the inaccurate assumption that American families and businesses will only charge their EVs when it is convenient for the power grid. That assumption is not reflective of real-world experience and is completely disconnected from reality.[94]

The magnitude of EPA's error is large. The U.S. Chamber of Commerce highlighted EPA's omission in terms of terawatt-hours (TWh), stating:

> EPA has proposed vehicles rules projected to result in a 263 TWh increase in electricity demand in 2040 and is now proposing hydrogen co-firing requirements that would add another 108 TWh in 2035. Assuming hydrogen production does not decline in 2040, this totals 371 TWh of electricity demand that EPA's modeling completely ignores—an amount equivalent to an 8.7% increase in nationwide

[93] "Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles," Federal Register, Vol. 88 (May 5, 2023), p. 29184, and "Greenhouse Gas Emissions Standards for Heavy-Duty Vehicles—Phase 3" Federal Register, Vol. 88 (April 27, 2023), p. 25926.

[94] Travis Fisher, "EPA's Power Grid Assumptions Are Disconnected from Reality," RealClearEnergy, July 23, 2023, https://www.realclearenergy.org/articles/2023/07/23/epas_power_grid_assumptions_are_disconnected_from_reality_967803.html (accessed August 2, 2023).

> electricity use compared to 2022 levels, or 1.5 times the electricity used each year in the State of California.[95]

EPA's modeling is deficient by hundreds of millions of megawatt-hours because EPA did not follow the regulatory principles established in Executive Order 12866.[96] EPA's omission of the impacts of its own Tailpipe Rules is arbitrary and capricious. Although a minor conflict with a rule from a different agency might not be material, the Tailpipe Rules were published by the same agency and in the same month as the Proposed Rule and would have reinforcing impacts that EPA has made no attempt to estimate. This omission is particularly egregious given the worsening grid-reliability crisis. Accordingly, EPA should not move forward with a final rule without first correcting the record and accounting for the interactions between its simultaneous rules impacting the power grid.

IV. As with the Original Clean Power Plan, EPA's Interpretation of Section 111 Would Give It Sweeping Powers to Reorganize the American Economy.

The Supreme Court recently struck down another EPA rule under Section 111 of the CAA, namely the 2015 Clean Power Plan, in *West Virginia v. EPA*.[97] The key issue there was whether EPA's expansive definition of the (BSER) could be squared with the statute. For reasons substantially similar to those raised by the Proposed Rule, the Court held that EPA's interpretation raised a "major question," and that, in the absence of clear congressional authorization for the expansive powers claimed by EPA, authorization similarly absent with respect to the Proposed Rule, EPA's interpretation could not survive scrutiny.

The key problem with EPA's interpretation of the BSER was its expansion of the terms far beyond the original intent of the statute. The BSER had always been interpreted to refer to technologies, such as scrubbers, that the source categories subject to regulation under Section 111 could feasibly install within the facility to reduce emissions. But in the 2015 Clean Power Plan, EPA decided that the BSER could extend beyond the fence line to the whole economy, encompassing utilities' choice of power sources for generating electricity—a matter that the Federal Power Act specifically leaves to the states and, in certain situations, to the Federal Energy Regulatory Commission.[98]

Under this novel "outside the fence line" definition of the BSER, EPA was claiming the power to reorganize a significant portion of the American economy, raising a major question. Similarly, the Proposed Rule relies on an expansive definition of the BSER to establish standards that can only be met by utilities shifting generation away from fossil sources, and by states and utilities

---

[95] U.S. Chamber of Commerce Global Energy Institute, "A Closer Look at EPA's Powerplant Rule," June 2023, p. 9, https://www.globalenergyinstitute.org/sites/default/files/2023-06/USCC_EPA%20Powerplant%20Rule%20Analysis_2023.FINAL_.pdf (accessed August 2, 2023).
[96] Executive Order 12866, "Regulatory Planning and Review," October 4, 1993.
[97] 142 S. Ct. 2587 (2022).
[98] 16 U.S.C. §§ 791–828c (1940), as amended.

building whole CCS and hydrogen production-and-transport infrastructure which do not currently exist and which (as explained above) have not even been adequately demonstrated.

In *West Virginia*, the Supreme Court explained that once EPA expanded the concept of the BSER from power plants to utilities' choice of power sources, it could set the emission standard at whatever level it liked:

> The Agency recognized that—given the nature of generation shifting—it could choose from "a wide range of potential stringencies for the BSER." Put differently, in translating the BSER into an operational emissions limit, EPA could choose whether to require anything from a little generation shifting to a great deal.[99]

The standards in the Clean Power Plan "resulted in numerical emissions ceilings so strict that no existing coal plant would have been able to achieve them without engaging in [generation-shifting]."[100] The Court went on to note,

> Rather than focus on improving the performance of individual sources, it would improve the overall power system by lowering the carbon intensity of power generation. And it would do that by forcing a shift throughout the power grid from one type of energy source to another….[101]
>
> On EPA's view of Section 111(d), Congress implicitly tasked it, and it alone, with balancing the many vital considerations of national policy implicated in deciding how Americans will get their energy. EPA decides, for instance, how much of a switch from coal to natural gas is practically feasible by 2020, 2025, and 2030 before the grid collapses, and how high energy prices can go as a result before they become unreasonably "exorbitant." There is little reason to think Congress assigned such decisions to the Agency….[102]
>
> We presume that Congress intends to make major policy decisions itself, not leave those decisions to agencies.[103]

The same may be said of the Proposed Rule. Its emissions limits are so strict that regulated utilities will most likely comply by shuttering or switching to a completely different type of power source. The only way that regulated sources could comply with the rule is if states or utilities (or other developers) build a major interstate infrastructure for CCS including tens of thousands of miles of specialized pipelines to transport carbon and hydrogen co-firing, including large-scale production and transport of hydrogen gas. Whether or not to develop such

---

[99] 142 S. Ct. at 2603 (citations omitted).
[100] 142 S. Ct. at 2604.
[101] 142 S. Ct. at 2611 (quotations and citations omitted).
[102] 142 S. Ct. at 2612.
[103] 142 S. Ct. at 2609 (quotations and citations omitted).

infrastructure is a decision for private investors, not any regulated entity. And the decision to permit and fund those facilities are typically the domain of state authorities, also beyond the control of the regulated entity.

Indeed, the Proposed Rule is even worse than the 2015 Clean Power Plan in at least one respect: It would force utilities to switch from the highly efficient combined-cycle baseload generation to the significantly more carbon-intensive intermediate and peaker configurations, in order to escape the worst of its crushing emissions standards. Hence, the Proposed Rule not only in effect requires generation-shifting, but it also requires generation-shifting that would actually increase the carbon intensity of power generation in the United States.

"In arguing that Section 111(d) empowers it to substantially restructure the American energy market," the Supreme Court held, "EPA claimed to discover in a long-extant statute an unheralded power representing a transformative expansion in its regulatory authority."[104] That is virtually indistinguishable from what EPA is trying to do in the Proposed Rule: It is claiming to have found in a long-extant statute the power to substantially restructure not just the U.S. electricity sector, but also the production and pipeline transportation of nation-scale quantities of gases for fuel (clean hydrogen) and sequestration (CO_2), and with these incursions, the rest the American economy.

In *West Virginia v. EPA*, the Court held that the EPA's sudden discovery of a "transformative expansion" in its regulatory authority based on an obscure provision of "a long-extant statute" raised a "major question" about the agency's authority, requiring Congress to speak with far greater clarity than it had in the statute. EPA's expansive definition of the BSER entailed impacts of great political significance and sought to regulate a significant portion of the American economy.

Just so, EPA's new interpretation of its authority under Section 111 of the CAA, departing from an almost infinitely elastic concept of both the BSER and "adequately demonstrated," presents a major question. The claimed power would regulate a significant portion of the American economy, entails political impact of great significance, and (as explained in the following section), intrudes on matters that are the traditional domain of the states.

V. The Proposed Rule Is Unconstitutionally Coercive of State Governments.

The Proposed Rule seeks to force states to adopt policies that EPA could not itself require under its existing statutory authorities. This is true for both the Proposed Rule's NSPS and its standards for existing plants under Section 111(d). Unlike the Clean Power Plan, in which federal coercion of state governments was virtually explicit in the requirements for approvable state plans, the federal coercion of state governments in the Proposed Rule is less obvious. Like the Clean Power

[104] 142 S. Ct. at 2610 (quotations and citations omitted).

Plan, however, that coercion inheres in a BSER that goes well beyond the fence line of the regulated facilities.

The coercion in the Proposed Rule becomes clear when considering the significant efforts that states would have to undertake in order to make compliance by regulated entities at all possible. Both CCS and hydrogen would require extensive buildout of pipeline and (in the case of hydrogen) production facilities that do not exist today, and which would face significant permitting hurdles under both federal and state law, potentially requiring changes in state law. Hence the Proposed Rule applies to regulations and entities outside EPA's purview, which does not extend to dispatch decisions in the operation of a state's electrical grid nor to the buildout of pipeline infrastructure or any other infrastructure outside the fence line of entities regulated under the CAA. The Section 111(d) component of the Proposed Rule, moreover, would, in effect, require states to shut down most of the coal plants in their jurisdiction and manage generation-switching to renewable sources of electricity, as in the Clean Power Plan.

The Supreme Court's federalism jurisprudence has travelled "an unsteady path."[105] This has been particularly so since the Court's New Deal–era cases, which expanded the federal commerce power to the ends of the earth and created major coordination problems in the overlap of state and federal jurisdiction.[106] Still, certain principles have remained consistent throughout.

In *Hodel v. Virginia Surface Mining & Reclamation Assn., Inc.*, the U.S. Supreme Court has held that Congress cannot "commandeer the legislative processes of the States by directly compelling them to enact and enforce a federal regulatory program."[107] The Court has warned that "[a]ccountability is…diminished when, due to federal coercion, elected state officials cannot regulate in accordance with the views of the local electorate in matters not pre-empted by federal regulation."[108] Likewise, in *South Dakota v. Dole*, a Spending Clause case, the Court noted, "Our decisions have recognized that in some circumstances the financial inducement offered by Congress might be so coercive as to pass the point at which 'pressure turns into compulsion.'"[109] As the Court explained in *Printz v. United States*, federal and state governments occupy separate spheres in a "structural framework of dual sovereignty," and states must remain "independent and autonomous within their proper sphere of authority."[110] If a federal law offends "the structural framework of dual sovereignty," it is categorically unconstitutional.[111]

For years various forms of federal compulsion of state governments were allowed to stand because the Court considered them mere encouragement not crossing the line into compulsion. "[W]here Congress has the authority to regulate private activity under the Commerce Clause, we have recognized Congress' power to offer States the choice of regulating that activity according

[105] See, *New York v. United States*, 505 U.S. 144, 160 (1992).
[106] See generally, Richard A. Epstein and Mario Loyola, "Saving Federalism," *National Affairs* (Summer 2014).
[107] 452 U.S. 264, 288 (1981).
[108] *New York v. United States*, 505 U.S. at 169.
[109] 483 U.S. 203, 211 (1987) (quoting *Steward Machine Co. v. Davis*, 301 U.S. 548, 590 (1937)).
[110] 521 U.S. 898, 928 (1997).
[111] Id. at 932.

to federal standards or having state law pre-empted by federal regulation."[112] In *Printz*, the Court pointed to *Hodel* and *FERC v. Mississippi*[113] as cases in which the Court "sustained statutes against constitutional challenge only after assuring ourselves that they did not require the States to enforce federal law."[114]

The "traditional government functions" test applied in *Hodel* and *FERC* somewhat misstated the rule of *National League of Cities v Usery*, the most essential element of which was that the Tenth Amendment protects "States' ability to function effectively in a federal system" and their "separate and independent existence" within that system.[115]

Hodel and *FERC* were steps on the road to the Court's decision in *Garcia v. San Antonio Metropolitan Transit Authority*, 469 U.S. 528 (1985). *Garcia*, which overruled *National League of Cities*, replaced the "traditional government functions" test with the "process federalism" standard, which, as theorized by Professor Herbert Wechsler, posited that states are protected by the national political process.[116] The theory of process federalism has been roundly rejected in the academic literature,[117] and was substantially undermined by the Court's subsequent rulings in *New York* and *Printz*. Those cases arguably revived the *National League Cities*' concern for the "separate and independent existence" of the states, a principle reinforced by the more recent *NFIB v. Sebelius*, in which the Court demonstrated a heightened sensitivity to the vulnerability of states in the face of federal coercion and their ability to function effectively in a federal system.

However shaky the precedents in *Hodel* and *FERC* may be after the Court's more recent federalism rulings, the challenged statute in those cases merely created "preconditions to continued state regulation in an otherwise pre-empted field."[118] The Proposed Rule can be readily distinguished from the statutes in *Hodel* and *FERC*: It uses EPA's power to regulate power plant emissions as a cudgel to shape state policies in areas not subject to federal preemption under EPA's regulatory authority. As noted, the binding emission goals of the Proposed Rules are so stringent that regulated entities will be unable to meet them unless states enact a series of policies outside the traditional, inside-the-fence-line modifications and significantly alter their energy policies and infrastructure. Hence, the Proposed Rule would punish state officials who are faithful to their local electorates in matters that not only are not preempted by federal regulation, but which EPA could not preempt under the authorities that it claims under the CAA. Simply put, the Proposed Rule forces upon states policy choices that are not EPA's to make.

---

[112] *New York*, 505 U.S. at 167 (quoting *Hodel*, 456 U.S. at 288).
[113] 456 U.S. 742 (1982).
[114] 521 U.S. at 925.
[115] See *National League of Cities*, 426 U.S. 833, 851–52 (1976).
[116] *Garcia*, 469 U.S. at 552 (quoting "The Political Safeguards of Federalism: The Role of the States in the Composition and Selection of the National Government," *Columbia Law Review*, Vol. 54, No. 543 (1954)).
[117] See, Jessica Bulman-Pozen, "From Sovereignty and Process to Administration and Politics: The Afterlife of American Federalism," *Yale Law Review*, Vol. 123, No.1920 (2014).
[118] *Printz*, 521 U.S. at 926.

Moreover, by using its power under one program (Section 111 of the CAA) in order to enforce state compliance with a set of policy goals that do not fall within EPA authority, the Proposed Plan would constitute commandeering in a sense the Supreme Court has never upheld: The states would be faced with a Hobson's choice between accepting the loss of a large fraction of their electrical generating capacity, or transforming their energy regulation and infrastructure in accordance with EPA's BSER. It bears repeating that this is true for both the NSPS and Section 111(d) rules under the Proposed Rule.

In the Spending Clause context, the Court recently rejected a similar scheme of leveraging federal power under one program to force state compliance with another program. In *NFIB v. Sebelius*, the Court held that where the conditions attached to one program "take the form of threats to terminate other significant independent grants, the conditions are properly viewed as a means of pressuring the States to accept policy changes…. The threatened loss of over 10 percent of a State's overall budget…is economic dragooning that leaves the States with no real option to but to acquiesce in the Medicaid expansion."[119]

The states face a similar "economic dragooning" under the Proposed Rule. Their choice ultimately boils down to either accepting a catastrophic loss of electricity supply or transforming their electricity sector in the ways envisioned by EPA as the BSER, a transformation which, under EPA's interpretation of its own power, it would not be able to impose upon the states.

VI. The Proposed Rule Would Have No Measurable Environmental Benefit.

The Proposed Rule begins by saying:

> For the analysis of the proposed standards for new combustion turbines and for existing steam generating EGUs, which do not include the impact of the proposed standards for existing combustion turbines and the third phase of the proposed standards for new combustion turbines, total cumulative power sector CO_2 emissions between 2028 and 2042 are projected to be 617 million metric tons lower under the illustrative proposal scenario than under the baseline….
> For the analysis of the proposed standards for existing combustion turbines and for the third phase of the proposed standards for new natural gas fired EGUs, total cumulative power sector CO_2 emissions between 2028 and 2042 are estimated to be between 215–409 million metric tons lower than under the illustrative proposal scenario.[120]

As the policy is intended to avert climate change it is necessary to quantify the climate impact of the proposed rule. Estimating the reduction in carbon emissions is not enough. At The Heritage Foundation, we used the "Model for the Assessment of Greenhouse Gas Induced Climate Change version 6," developed by researchers at EPA to quantify the climate effect. We found that

[119] *Nat'l Fed'n of Indep. Bus. v. Sebelius*, 567 U.S. 519, 580 (2012).
[120] Federal Register, Vol. 88, p. 33409.

assuming a climate sensitivity of 5.0 degrees C (the upper bound of estimated climate sensitivities indicated by the Intergovernmental Panel on Climate Change) and that the upper limit of the above emissions reductions occurred immediately, there would be less than 0.0273 degrees C temperature mitigation by 2050 and less than 0.0575 by 2100.

EPA's RIA focuses on the Social Cost of Carbon (SCC) and bases the entire discussion of the Proposed Rule's environmental benefit on the reduction of CO_2 emissions. In the Proposed Rule's summary of RIA, EPA states:

> The following PV and EAV estimates reflect projected benefits over the 2024 to 2042 period, discounted to 2024 in 2019 dollars, for the analysis of the proposed standards for new natural gas fired EGUs and for existing coal-fired EGUs, which do not include the impact of the proposed standards for existing natural gas-fired EGUs and the third phase of the proposed standards for new natural gas-fired EGUs. We monetize benefits of the proposed standards and evaluate other costs in part to enable a comparison of costs and benefits pursuant to E.O. 12866, but we recognize there are substantial uncertainties and limitations in monetizing benefits, including benefits that have not been quantified. The projected PV of monetized climate benefits is about $30 billion, with an EAV of about $2.1 billion using the SC–CO_2 discounted at 3 percent. The projected PV of monetized health benefits is about $68 billion, with an EAV of about $4.8 billion discounted at 3 percent. Combining the projected monetized climate and health benefits yields a total PV estimate of about $98 billion and EAV estimate of $6.9 billion.
>
> At a 7 percent discount rate, these proposed rules are expected to generate projected PV of monetized health benefits of about $44 billion, with an EAV of about $4.3 billion discounted at 7 percent. EPA notes that while OMB Circular A–4, as published in 2003, recommends using 3 percent and 7 percent discount rates as "default" values, Circular A–4 also recognizes that "special ethical considerations arise when comparing benefits and costs across generations," and Circular A–4 acknowledges that analyses may appropriately "discount future costs and consumption benefits…at a lower rate than for intragenerational analysis." Therefore, climate benefits remain discounted at 3 percent in this benefits analysis. Thus, these proposed rules would generate a PV of total monetized benefits of $74 billion, with an EAV of $6.4 billion discounted at a percent rate.
>
> The projected PV of monetized climate benefits for the analysis of the impact of the proposed standards for existing combustion turbines and the third phase of the proposed standards for new natural gas-fired EGUs is between about $10 to 20

> billion, with an EAV of between about \$0.7 to 1.4 billion using the SC–CO_2 discounted at 3 percent.
>
> The results presented in this section provide an incomplete overview of the effects of the proposals. The monetized climate benefits estimates do not include important benefits that we are unable to fully monetize due to data and modeling limitations. In addition, important health, welfare, and water quality benefits anticipated under these proposed rules are not quantified. We anticipate that taking non-monetized effects into account would show the proposals to be more beneficial than the tables in this section reflect. Discussion of the non-monetized health, climate, welfare, and water quality benefits is found in section 4 of the RIA.[121]

In engaging in this type of cost-benefit analysis one must assess the robustness of the estimate of the SCC on which EPA is relying. The tremendous uncertainty associated with the SCC is relevant for this question.[122] The SCC is an estimate in dollars of the cumulative long-term damage caused by the CO_2 emitted in a specific year. That number also represents an estimate of the benefit of avoiding or reducing one ton of CO_2 emissions.

The SCC is estimated by Integrated Assessment Models (IAMs), which have been used in the past by the federal government as a basis for regulatory policy. For example, the Obama Administration's Interagency Working Group (IWG) had drawn upon three models—abbreviated as DICE, FUND, and PAGE—to estimate the SCC.[123] The Biden Administration appears to be using other models as well; however, the analysis presented in the Proposed Rule is said to be based on the 2021 Technical Support Document, which is based on the above models.[124]

---

[121] Federal Register, Vol. 88, p. 33412.

[122] See, e.g., Patrick Michaels, Kevin Dayaratna, and Marlo Lewis, "Comments Federal Energy Regulatory Commission, Notice Inviting Technical Conference Comments, 86 FR 66293," https://cei.org/wp-content/uploads/2022/04/CEI-Comments-Michaels-Dayaratna-Lewis-Docket-No-PL21-3-000-January-7-2022.pdf (accessed August 2, 2023).

[123] Interagency Working Group [IWG] on Social Cost of Greenhouse Gases, "Technical Support Document [TSD]: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866," August 2016, p. 4, https://www.epa.gov/sites/default/files/2016-12/documents/sc_co2_tsd_august_2016.pdf (accessed August 3, 2023) (hereafter, IWG, TSD 2016). For the Dynamic Integrated Climate and Economy (DICE) model, see William D. Nordhaus, "DICE/RICE Models," https://williamnordhaus.com/dicerice-models (accessed August 3, 2023). For the Framework for Uncertainty, Negotiation, and Distribution (FUND) model, see "FUND Model, http://fund-model.org (accessed September 15, 2021). For the Policy Analysis for the Greenhouse Effect (PAGE) model, see Climate CoLab, "PAGE," https://www.climatecolab.org/wiki/PAGE (accessed August 3, 2023).

[124] Interagency Working Group [IWG] on Social Cost of Greenhouse Gases, "Technical Support Document [TSD]: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990," February

As any model is as good as the assumptions from which it is composed, we tested their sensitivity to a variety of important and reasonable assumptions. We found that under reasonable assumptions they can offer a plethora of different estimates of the SCC, ranging from extreme damages to overall benefits. The vast range in potential estimates of the SCC suggests that quantifying the economic impact of GHG emissions is highly speculative.

Among others, SCC estimates are highly sensitive to:

- Discount rates chosen to calculate the present value of future emissions and reductions,
- Estimated climate sensitivities chosen to estimate the warming impact of projected increases in atmospheric GHG concentration,
- Time period chosen to estimate cumulative damages from rising GHG concentration, and
- Assumptions regarding agricultural benefits.

We find the economic impact of climate change (even if it exists) is quite uncertain depending on assumptions made and that EPA should take note accordingly.

A. How Discount Rates Affect the SCC[125]

Models used to estimate the SCC rely on the specification of a discount rate. Discounting is essential in cost-benefit analysis because compliance costs are best viewed as investments intended to yield benefits in the future. Applying discount rates enables agencies to compare the projected rate of return from CO_2-reduction expenditures to the rates of return from other potential investments in the economy.

Office of Management and Budget (OMB) guidance in Circular A-4 specifically stipulates that agencies discount the future costs and benefits of regulations using both 3.0 percent and 7.0 percent discount rates.[126] The Obama and Biden Administrations have suggested that a 7 percent discount rate is an affront to intergenerational equity, apparently on the theory that discount rates higher than 1 percent to 2 percent imply that people living today are more valuable than people living decades or centuries from now.[127]

2021, https://www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf (accessed August 2, 2023).
(hereafter, IWG, TSD 2021), and U.S. Environmental Protection Agency, "EPA External Review Draft of Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances," November 11, 2022, https://www.epa.gov/environmental-economics/scghg (accessed August 3, 2023).

[125] This discussion draws upon Kevin Dayaratna's testimony on "Climate Change, Part IV: Moving Toward a Sustainable Future," before the Subcommittee on Environment, Committee on Oversight and Reform, U.S. House of Representatives, September 24, 2020, https://docs.house.gov/meetings/GO/GO28/20200924/111042/HHRG-116-GO28-Wstate-DayaratnaPhDK-20200924.pdf (accessed August 4, 2023).

[126] Office of Management and Budget, "Circular A-4," Obama White House, February 22, 2017, https://obamawhitehouse.archives.gov/omb/circulars_a004_a-4/ (accessed September 27, 2021).

[127] IWG, TSD 2021, pp. 17–19.

We respectfully disagree. The point of discounting is not to rank the worth of different generations but to have a consistent basis for comparing alternate investments. Only then can policymakers determine which investments are most likely to transmit the most valuable capital stock to future generations. In other words, discounting clarifies the *opportunity cost* of investing in climate mitigation, for example, rather than medical research, national defense, or trade liberalization.

Not only is it reasonable to include a 7 percent discount rate in SCC estimation, but it is also arguably the best option because 7 percent is the rate of return of the New York Stock Exchange.[128] Only by using a 7 percent discount rate can policymakers assess the wealth foregone when government invests in GHG reduction rather than other policy objectives or simply allows companies and households to invest more of their dollars as they see fit.

Institute for Energy Research economist David Kreutzer illustrates the point as follows. Suppose an emission-reduction investment produces $100 in benefits by 2171 (150 years from now). That is equivalent to investing $5.13 today with a 2 percent annual return on investment. But if the same $5.13 is invested in stock that appreciates at 7 percent annually, the investment yields $131,081 in 2171. Clearly, that is a much larger bequest to future generations. How does that negatively affect "intergenerational equity"? It would confer much greater wealth on posterity, endowing them with far more productive capital stock.

Kreutzer also notes that all baseline scenarios assume future generations are richer than current generations. He comments:

> It is a terrible policy to make investments that return $100 instead of $131,081, but it is virtually brain-dead to argue the bad return is justified on equity grounds. Those alive centuries from now are almost certain to be much wealthier, healthier, and possessed of technology to better overcome any adversity—including climate change.[129]

It is hard to shake the suspicion that the IWG declines to use a 7 percent discount rate, even as a sensitivity case analysis, because doing so would spotlight the comparatively low rates of return of GHG-reduction policies.

At The Heritage Foundation, Dayaratna and colleagues ran DICE and FUND using a 7.0 percent discount rate to quantify how much the IWG's lower discount rates increases SCC estimates.

---

[128] D. W. Kreutzer, "Discounting Climate Costs," Heritage Foundation *Issue Brief* No. 4575, June 16, 2016, https://www.heritage.org/environment/report/discounting-climate-costs, and Kevin Dayaratna, Rachel Greszler, and Patrick Tyrrell, "Is Social Security Worth Its Cost?" Heritage Foundation *Backgrounder* No. 3324, July 10, 2018, https://www.heritage.org/budget-and-spending/report/social-security-worth-its-cost.

[129] David Kreutzer, IER Comments on Social Cost of Greenhouse Gas Estimates, Docket No. OMB-2021-0006, June 24, 2021, HTTPS://WWW.INSTITUTEFORENERGYRESEARCH.ORG/CLIMATE-CHANGE/IER-COMMENTS-ON-SOCIAL-COST-OF-CARBON-ESTIMATES/ (accessed August 2, 2023).

Below are the 2016 Technical Support Documents' SCC estimates[130] followed by the Heritage analysts' results published in the peer-reviewed journal *Climate Change Economics*:[131]

Table ES-1: Social Cost of CO_2, 2010 – 2050 (in 2007 dollars per metric ton of CO_2)

Year	5% Average	**3% Average**	2.5% Average	High Impact (95th Pct at 3%)
2010	10	**31**	50	86
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

	DICE Model Average SCC – Baseline, End Year 2300			
Year	**Discount Rate - 2.5%**	**Discount Rate – 3.0%**	**Discount Rate – 5.0%**	**Discount Rate – 7.0%**
2020	$56.92	$37.79	$12.10	$5.87
2030	$66.53	$45.15	$15.33	$7.70
2040	$76.96	$53.26	$19.02	$9.85
2050	$87.70	$61.72	$23.06	$12.25

	FUND Model Average SCC – Baseline, End Year 2300			
Year	**Discount Rate - 2.5%**	**Discount Rate – 3.0%**	**Discount Rate – 5.0%**	**Discount Rate – 7.0%**
2020	$32.90	$19.33	$2.54	–$0.37
2030	$36.16	$21.78	$3.31	–$0.13
2040	$39.53	$24.36	$4.21	$0.19
2050	$42.98	$27.06	$5.25	$0.63

If any government agency is going to use SCC analysis, it should include SCC discounted at 7 percent as part of its cost-benefit analysis, because only on that basis can the public compare

[130] IWG, TSD 2016, p. 4.
[131] K. Dayaratna, R. McKitrick, and D. Kreutzer, "Empirically Constrained Climate Sensitivity and the Social Cost of Carbon," *Climate Change Economics*, Vol. 8, No. 2 (2017), p. 1750006-1–1750006-12, https://www.worldscientific.com/doi/abs/10.1142/S2010007817500063 (accessed August 2, 2023).

climate policy "investments" to other capital expenditures. And only through such comparisons can policymakers reasonably assess which investments will best position future generations to inherit the most productive capital stock. Furthermore, as the above analysis illustrates, under a 7 percent discount rate, the SCC is essentially zero and might even be negative at times, suggesting overall net benefits to climate change.

B. How the Time Horizon Affects the SCC

Human beings use technology to adapt to environmental conditions. Consequently, the loss functions in IAMs depend on assumptions about how adaptive technologies will be developed and deployed as the world warms. It is essentially impossible to forecast technological change decades, let alone centuries, into the future.

Consider U.S. natural gas as an example. Around the turn of this century, it was accepted wisdom that our supplies were running so low that large net imports would be required. A mere 10 years later, thanks to the widespread use of hydraulic fracturing of shale, it was apparent there are literally hundreds of years of supply within rock layers under vast areas of the lower-48 states (as well as in Europe and China, as later discovered).

Substitution of gas-fired combustion for coal firing reduces net greenhouse gas emissions by nearly 60 percent. Supercritical natural gas–fired turbine technology can actually reduce net emissions to *zero* in an experimental plant,[132] though a much-anticipated commercial-grade upscaling has yet to be achieved. These developments only serve to emphasize how foolhardy it is to use, as the IWG does, a 300-year period (2000–2300). Dayaratna and his former Heritage Foundation colleague David Kreutzer ran the DICE model with a significantly shorter, albeit still unrealistic, time horizon of 150 years into the future.[133]

Following are the DICE-estimated SCC values with a baseline ending in 2300:

[132] See, for example, Sonia Patel, "Breakthrough: NET Power's Allam Cycle Test Facility Delivers First Power to ERCOT Grid," *Power*, November 18, 2021, https://www.powermag.com/breakthrough-net-powers-allam-cycle-test-facility-delivers-first-power-to-ercot-grid/ (accessed August 2, 2023).

[133] Kevin Dayaratna and David Kreutzer, *Loaded DICE: An EPA Model Not Ready for the Big Game*, Heritage Foundation *Backgrounder* No. 2860, November 21, 2013, https://www.heritage.org/environment/report/loaded-dice-epa-model-not-ready-the-big-game.

TABLE 1

Average SCC Baseline, End Year 2300

Year	Discount Rate: 2.5%	Discount Rate: 3%	Discount Rate: 5%	Discount Rate: 7%
2010	$46.57	$30.04	$8.81	$4.02
2015	$52.35	$34.32	$10.61	$5.03
2020	$56.92	$37.79	$12.10	$5.87
2025	$61.48	$41.26	$13.60	$6.70
2030	$66.52	$45.14	$15.33	$7.70
2035	$71.57	$49.03	$17.06	$8.70
2040	$76.95	$53.25	$19.02	$9.85
2045	$82.34	$57.48	$20.97	$11.00
2050	$87.69	$61.72	$23.06	$12.25

Source: Calculations based on Heritage Foundation Monte Carlo simulation results using the DICE model. B 2860 heritage.org

Following are the results with a baseline ending in 2150:

TABLE 3

Average SCC, End Year 2150

Year	Discount Rate: 2.5%	Discount Rate: 3%	Discount Rate: 5%	Discount Rate: 7%
2010	$36.78	$26.01	$8.66	$4.01
2015	$41.24	$29.65	$10.42	$5.02
2020	$44.41	$32.38	$11.85	$5.85
2025	$47.57	$35.11	$13.28	$6.68
2030	$50.82	$38.00	$14.92	$7.67
2035	$54.07	$40.89	$16.56	$8.66
2040	$57.17	$43.79	$18.36	$9.79
2045	$60.27	$46.68	$20.16	$10.92
2050	$62.81	$49.20	$22.00	$12.13

Source: Calculations based on Heritage Foundation Monte Carlo simulation results using the DICE model. B 2860 heritage.org

The SCC estimates drop substantially—in some cases by more than 25 percent—as a result of ending the SCC estimation period in 2150.

C. How the Equilibrium Climate Sensitivity (ECS) Distribution Affects the SCC

The key climate specification used in estimating the SCC is the equilibrium climate sensitivity (ECS) distribution. Such distributions probabilistically quantify the earth's temperature response to a doubling of CO_2 concentrations.

ECS distributions are derived from general circulation models (GCMs) or more comprehensive earth system models (ESMs), which attempt to represent physical processes in the atmosphere, ocean, cryosphere, and land surface. The IWG used the ECS distribution from a study by Gerard

Roe and Marcia Baker published over 15 years ago in the journal *Science*.[134] This non-empirical distribution, calibrated by the IWG based on assumptions it selected in conjunction with past Intergovernmental Panel on Climate Changes (IPCC) recommendations,[135] is no longer scientifically defensible.[136] In particular, over the past decade a variety of newer and empirically constrained distributions have been published in the peer-reviewed literature. Many of those distributions suggest lower probabilities of extreme global warming in response to CO_2 concentrations. Figure 1 includes several such distributions:[137]

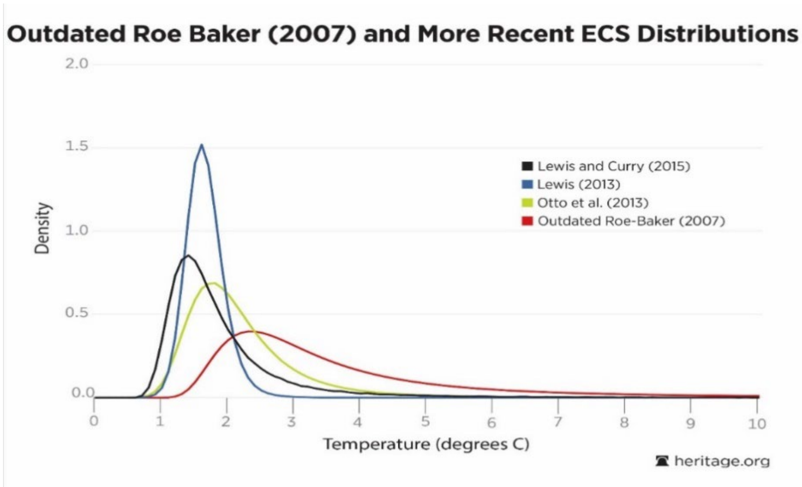


Figure 1: A variety of equilibrium climate sensitivity (ECS) distributions

[134] Gerard H. Roe and Marcia B. Baker, "Why Is Climate Sensitivity So Unpredictable?" *Science*, Vol. 318, No. 5850 (2007), pp. 629–632, https://science.sciencemag.org/content/318/5850/629 (accessed August 2, 2023).
[135] Interagency Working Group [IWG] on the Social Cost of Greenhouse Gases, "Technical Support Document [TSD]: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis - Under Executive Order 12866," revised November 2013, https://obamawhitehouse.archives.gov/sites/default/files/omb/assets/inforeg/technical-update-social-cost-of-carbon-for-regulator-impact-analysis.pdf (accessed August 4, 2023).
[136] Patrick J. Michaels, "An Analysis of the Obama Administration's Social Cost of Carbon," testimony before the Committee on Natural Resources, U.S. House of Representatives, July 22, 2015, https://www.cato.org/publications/testimony/analysis-obama-administrations-social-cost-carbon (accessed August 2, 2023).
[137] Nicholas Lewis, "An Objective Bayesian Improved Approach for Applying Optimal Fingerprint Techniques to Estimate Climate Sensitivity," *Journal of Climate*, Vol. 26, No. 19 (October 2013), pp. 7414–7429, https://journals.ametsoc.org/view/journals/clim/26/19/jcli-d-12-00473.1.xml (accessed August 2, 2023); Alexander Otto et al., "Energy Budget Constraints on Climate Response," *Nature Geoscience*, Vol. 6, No. 6 (June 2013), pp. 415–416, https://www.nature.com/articles/ngeo1836 (accessed August 2, 2023); and Nicholas Lewis and Judith A. Curry, "The Implications for Climate Sensitivity of AR5 Forcing and Heat Uptake Estimates," *Climate Dynamics*, Vol. 45, No. 3 (September 25, 2014), pp. 1009–1923, http://link.springer.com/article/10.1007/s00382-014-2342-y (accessed August 2, 2023).

The areas under the curves between two temperature points represent the probability that the earth's temperature will increase between those amounts in response to a doubling of CO_2 concentration. For example, the area under the curve from 4°C onwards (known as right-hand "tail probability") represents the probability that the earth's temperature will warm by more than 4°C in response to a doubling of CO_2 concentrations. Note that the more up-to-date ECS distributions (Otto et al., 2013; Lewis, 2013; Lewis and Curry, 2014) have significantly lower tail probabilities than the outdated Roe-Baker (2007) distribution used by the IWG.

Here, again, is the IWG's 2016 SCC estimates for 2020–2050:

Table ES-1: Social Cost of CO_2, 2010 – 2050 (in 2007 dollars per metric ton of CO_2)

Year	5% Average	**3% Average**	2.5% Average	High Impact (95th Pct at 3%)
2010	10	**31**	50	86
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

In *Climate Change Economics*, Dayaratna and colleagues re-estimated the DICE and FUND models' SCC values using the more up to date ECS distributions and obtained the following results:[138]

	DICE Model Average SCC – ECS Distribution Updated in Accordance with Lewis and Curry (2015), End Year 2300			
Year	**Discount Rate - 2.5%**	**Discount Rate – 3.0%**	**Discount Rate – 5.0%**	**Discount Rate – 7.0%**
2020	$28.92	$19.66	$6.86	$3.57
2030	$33.95	$23.56	$8.67	$4.65
2040	$39.47	$27.88	$10.74	$5.91
2050	$45.34	$32.51	$13.03	$7.32

[138]Dayaratna, McKitrick, and Kreutzer, "Empirically Constrained Climate Sensitivity and the Social Cost of Carbon."

	FUND Model Average SCC – ECS Distribution Updated in Accordance with Lewis and Curry (2015), End Year 2300			
Year	**Discount Rate - 2.5%**	**Discount Rate – 3.0%**	**Discount Rate – 5.0%**	**Discount Rate – 7.0%**
2020	$5.86	$3.33	–$0.47	–$1.10
2030	$6.45	$3.90	–$0.19	–$1.01
2040	$7.02	$4.49	–$0.18	–$0.82
2050	$7.53	$5.09	$0.64	–$0.53

Using the more up to date ECS distributions dramatically lowers SCC estimates. The IWG's outdated assumptions overstate the probabilities of extreme global warming, which artificially inflates their SCC estimates. In its Fifth Assessment Report (AR5), the IPCC used the Coupled Model Intercomparison Project Phase 5 (CMIP5) models to project future warming and the associated climate impacts.[139] Figure 2 compares predicted and observed average tropospheric temperature over the tropics.[140] The observations come from satellites, weather balloons, and re-analyses.[141] A careful analysis reveals that only one of the 102 model runs correctly simulates what has been observed. This is the Russian climate model INM-CM4, which also has the least prospective warming of all of them, with an ECS of 2.05°C, compared to the CMIP5 average of 3.2°C.

[139] Program for Climate Model Diagnosis and Intercomparison, CMIP5 – Coupled Model Intercomparison Project Phase 5 – Overview, https://pcmdi.llnl.gov/mips/cmip5/ (accessed August 2, 2023).
[140] The CMIP5 predictions are available at World Meteorological Organization, Climate Explorer, https://climexp.knmi.nl/start.cgi (accessed August 2, 2023).
[141] Climate re-analyses produces synthetic histories of recent climate and weather using all available observations, a consistent data-assimilation system, and mathematical modeling to fill in data gaps. See National Center for Atmospheric Research, Atmospheric Reanalysis: Overview & Comparison, https://climatedataguide.ucar.edu/climate-data/atmospheric-reanalysis-overview-comparison-tables (accessed August 2, 2023), and European Centre for Medium-Range Weather Forecasts, Climate Reanalysis, https://www.ecmwf.int/en/research/climate-reanalysis (accessed August 2, 2023).

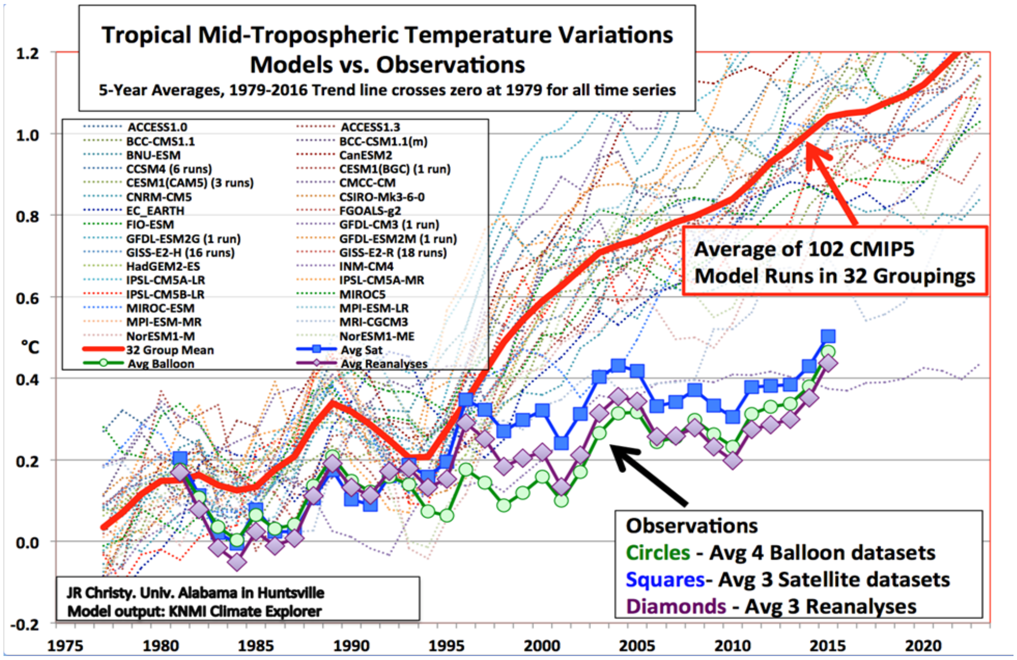


Figure 2. Solid red line—average of all the CMIP-5 climate models; thin colored lines—individual CMIP-5 models; solid figures—weather balloon, satellite, and re-analysis data for the tropical troposphere.[142]

Best scientific practice uses models that work and does not seriously consider those that do not. This is standard when formulating the daily weather forecast and should be the standard with regard to climate forecasts.

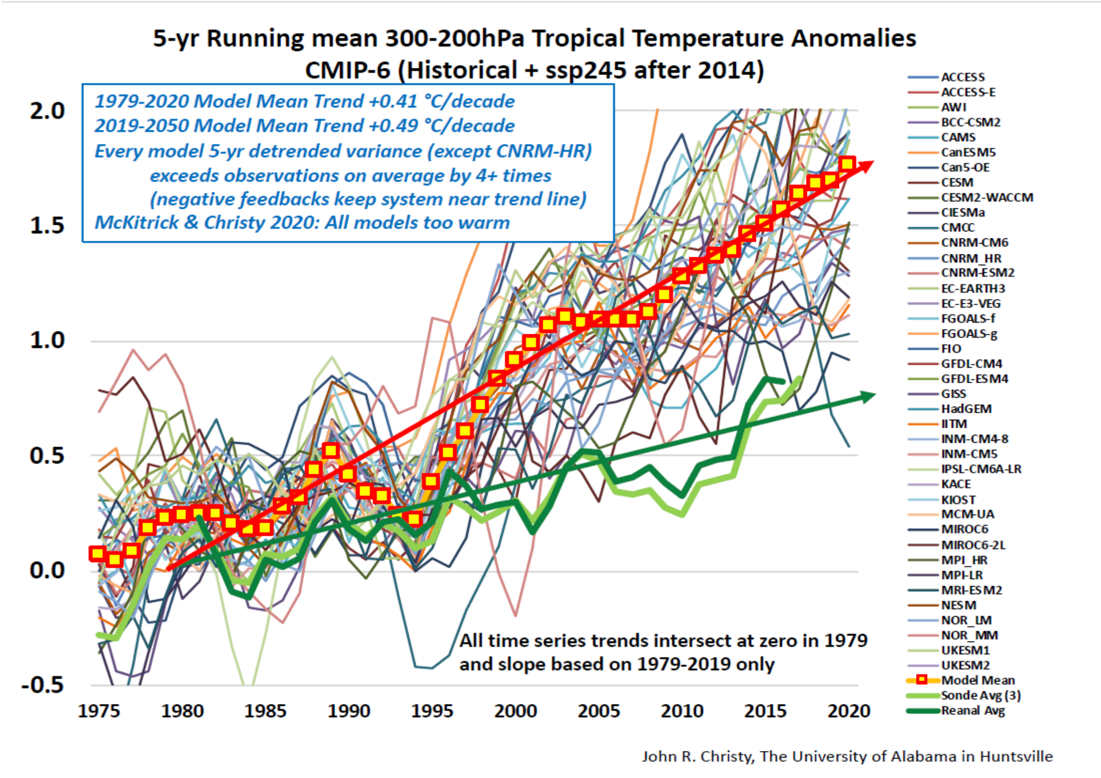
The IPCC's recently released Sixth Assessment Report (AR6) uses a new suite of models, designated CMIP6. As shown by McKitrick and Christy (2020), however, the CMIP6 models are even worse.[143] Of the two models that work, the Russian INM-CM4.8, has even less warming than its predecessor, with an ECS of 1.8°C, compared to the CMIP6 community value of around four degrees.[144] The other one is also a very low ECS model from the same group, INM-CM5. The model mean warming rate exceeds observation by more than two times at altitude in the tropics.

---

[142] J. R. Christy, "State of the Climate in 2016," *Bulletin of the American Meteorological Society*, Vol. 98, No. 8(2017), pp. S16–S17, https://journals.ametsoc.org/view/journals/bams/98/8/2017bamsstateoftheclimate.1.xml (accessed August 2, 2023).

[143] R. McKitrick and J. Christy, "Pervasive Warming Bias in CMIP6 Tropospheric Layers," *Earth and Space Science*, Vol. 7, No. 9 (2020), https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2020EA001281 (accessed August 2, 2023).

[144] Most (not all) of the CMIP-6 models were available for McKitrick and Christy (2020); this figure is the mean ECS of what was released through late 2020.



Quoting from McKitrick and Christy's conclusion:

> The literature drawing attention to an upward bias in climate model warming responses in the tropical troposphere extends back at least 15 years now…. Rather than being resolved, the problem has become worse, since now every member of the CMIP6 generation of climate models exhibits an upward bias in the entire global troposphere as well as in the tropics.[145]

Zeke Hausfather, hardly a climate skeptic, has noted that while the CMIP6 models are warmer than the previous generation, the warmer they are, the more they over-forecast warming in recent decades, confirming what McKitrick and Christy found.[146]

Zhu, Poulsen, and Otto-Bliesner (2020) used a CMIP6 model called CESM2 to project warming from an emission scenario that reaches 855 parts per million by 2100—roughly three times the pre-industrial concentration. Despite being tuned to match the behavior of 20th-century climate, CESM2 produced a global mean temperature "5.5°C greater than the upper end of proxy

---

[145] R. McKitrick and J. Christy, "Pervasive Warming Bias in CMIP6 Tropospheric Layers," *Earth and Space Science*, Vol. 7, No. 9 (2020), https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2020EA001281 (accessed August 2, 2023).

[146] Zeke Hausfather, "Cold Water on Hot Models," The Breakthrough Institute, February 11, 2020, https://thebreakthrough.org/issues/energy/cold-water-hot-models (accessed August 2, 2023).

temperature estimates for the Early Eocene Climate Optimum." That was a period when CO_2 concentrations of about 1,000 parts per million (ppm) persisted for millions of years.[147] Moreover, the modeled tropical land temperature exceeded 55°C, "which is much higher than the temperature tolerance of plant photosynthesis and is inconsistent with fossil evidence of an Eocene Neotropical rainforest."[148]

Altogether, faulty assumptions regarding climate sensitivity have been manifested in the SCC and associated regulatory policy, and more realistic assumptions inject significant uncertainty into the potential long-term impact of climate change.

D. Negative SCC Values

Policymakers and the media often assume CO_2 emissions have only harmful impacts on society. However, CO_2 emissions have enormous direct agricultural[149] and ecological benefits,[150] global warming lengthens growing seasons,[151] and warming potentially also alleviates cold-related mortality, which may exceed heat-related mortality by 20 to 1.[152]

Of the three IAMs used by the IWG, only the FUND model estimates CO_2 fertilization benefits. Dayaratna and colleagues investigated whether a model with CO_2 fertilization benefits could produce negative SCC estimates. A negative SCC means that each incremental ton of CO_2 emissions produces a net benefit.

---

[147] NOAA National Centers for Environmental Information, Early Eocene Period, 54 to 48 Million Years Ago, https://www.ncdc.noaa.gov/global-warming/early-eocene-period (accessed August 2, 2023).
[148] Jiang Zhu, Christopher J. Poulsen, and Bette L. Otto-Bliesner, "High Climate Sensitivity in CMIP6 Model Not Supported by Paleoclimate," *Nature Climate Change*, Vol. 10 (2020), pp. 378–379, https://www.nature.com/articles/s41558-020-0764-6 (accessed August 2, 2023).
[149] Literally hundreds of peer-reviewed studies document significant percentage increases in food-crop photosynthesis, dry-weight biomass, and water-use efficiency due to elevated CO_2 concentrations. See the Center for the Study of Carbon Dioxide and Global Change, Plant Growth Database, http://co2science.org/data/plant_growth/plantgrowth.php (accessed August 2, 2023).
[150] See, for example, Randall J. Donahue et al., "Impact of CO2 Fertilization on Maximum Foliage Cover Across the Globe's Warm, Arid Environments," *Geophysical Research Letters* Vol. 40 (2013), pp. 1–5, https://friendsofscience.org/assets/documents/CO2_Fertilization_grl_Donohue.pdf (accessed August 2, 2023); Zaichun Zhu et al., "The Greening of the Earth and Its Drivers," *Nature Climate Change*, Vol. 6 (2016), pp. 791–795, https://www.nature.com/articles/nclimate3004 (accessed August 2, 2023); and J. E. Campbell et al., 2017. "Large Historical Growth in Global Gross Primary Production," *Nature*, Vol. 544 (2017), pp. 84–87, https://www.nature.com/articles/nature22030 (accessed August 2, 2023).
[151] U.S. Environmental Protection Agency, Climate Change Indicators: Length of Growing Season, updated July 21, 2023, https://www.epa.gov/climate-indicators/climate-change-indicators-length-growing-season (accessed August 2, 2023).
[152] Antonio Gasparrini et al., "Mortality Risk Attributable to High and Low Ambient Temperature: A Multicountry Observational Study," *The Lancet*, Vol. 386, No. 9991 (2015), https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(14)62114-0/fulltext (accessed August 2, 2023).

The researchers calculated the probability of a negative SCC under a variety of assumptions. Below are some of the results published both at The Heritage Foundation as well as in the peer-reviewed journal *Climate Change Economics*:[153]

	FUND Model Probability of Negative SCC – ECS Distribution Based on Outdated Roe–Baker (2007) Distribution, End Year 2300			
Year	**Discount Rate - 2.5%**	**Discount Rate – 3.0%**	**Discount Rate – 5.0%**	**Discount Rate – 7.0%**
2020	0.084	0.115	0.344	0.601
2030	0.080	0.108	0.312	0.555
2040	0.075	0.101	0.282	0.507
2050	0.071	0.093	0.251	0.455

	FUND Model Probability of Negative SCC – ECS Distribution Updated in Accordance with Otto et al. (2013), End Year 2300			
Year	**Discount Rate - 2.5%**	**Discount Rate – 3.0%**	**Discount Rate – 5.0%**	**Discount Rate – 7.0%**
2020	0.268	0.306	0.496	0.661
2030	0.255	0.291	0.461	0.619
2040	0.244	0.274	0.425	0.571
2050	0.228	0.256	0.386	0.517

	FUND Model Probability of Negative SCC – ECS Distribution Updated in Accordance with Lewis (2013), End Year 2300			
Year	**Discount Rate - 2.5%**	**Discount Rate – 3.0%**	**Discount Rate – 5.0%**	**Discount Rate – 7.0%**
2020	0.375	0.411	0.565	0.685
2030	0.361	0.392	0.530	0.645
2040	0.344	0.371	0.491	0.598

[153] Kevin Dayaratna and David Kreutzer, "Unfounded FUND: Yet Another EPA Model Not Ready for the Big Game," Heritage Foundation *Backgrounder* No. 2897, April 29, 2014, http://thf_media.s3.amazonaws.com/2014/pdf/BG2897.pdf (accessed August 2, 2023), and Dayaratna et al., "Empirically Constrained Climate Sensitivity and the Social Cost of Carbon," 2017.

2050	0.326	0.349	0.449	0.545

	FUND Model Probability of Negative SCC – ECS Distribution Updated in Accordance with Lewis and Curry (2015), End Year 2300			
Year	**Discount Rate - 2.5%**	**Discount Rate – 3.0%**	**Discount Rate – 5.0%**	**Discount Rate – 7.0%**
2020	0.402	0.432	0.570	0.690
2030	0.388	0.414	0.536	0.646
2040	0.371	0.394	0.496	0.597
2050	0.354	0.372	0.456	0.542

As the above statistics illustrate, under a variety of reasonable assumptions, the SCC has a substantial probability of being negative. In fact, in some cases, the SCC is more likely to be negative than positive, which implies—if one adopts the perspective of a central planner—that EPA should, in fact, subsidize (not limit) CO_2 emissions. We, of course, oppose such interventionism. Our purpose here is to illustrate the extreme sensitivity of these models to reasonable changes in assumptions as well as to point out that the probabilities of negative SCC value are non-trivial and potentially quite substantial.

E. Updated Agricultural Benefits and Cost-Benefit Analysis

It is a well-established fact that increases in CO_2 concentration enhance plant growth by increasing their internal water use efficiency as well as raising the rate of net photosynthesis.[154] As discussed in the previous section, the FUND model attempts to incorporate those benefits; however, this aspect of the model is grounded on research that is one to two decades old. Even so, as discussed in the preceding section, Dayaratna et al. (2017) found substantial probabilities of negative SCC using the outdated assumptions in FUND. Dayaratna et al. (2020) summarized more recent CO_2 fertilization research in a peer-reviewed study published in *Environmental Economics and Policy Studies* and re-estimated the FUND model's SCC values upon updating

[154] K. E. Idso and S. B. Idso, "Plant Responses To Atmospheric CO2 Enrichment in the Face of Environmental Constraints: A Review of the Past 10 Years' Research," *Agricultural and Forest Meteorology*, Vol. 69 (1994), pp. 153–203, https://www.sciencedirect.com/science/article/abs/pii/0168192394900256 (accessed August 2, 2023), and Jennifer Cuniff et al., "Response of Wild C4 Crop Progenitors to Subambient CO_2 Highlights a Possible Role in the Origin Of Agriculture," *Global Change Biology*, Vol. 14 (2008), pp. 576–587, https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1365-2486.2007.01515.x (accessed August 2, 2023).

those assumptions.[155] To facilitate EPA's review of that research, we excerpt several paragraphs from Dayaratna et al. (2020):

> Three forms of evidence gained since then indicates that the CO_2 fertilization effects in FUND may be too low. First, rice yields have been shown to exhibit strong positive responses to enhanced ambient CO_2 levels. Kimball (2016) surveyed results from Free-Air CO_2 Enrichment (FACE) experiments, and drew particular attention to the large yield responses (about 34 percent) of hybrid rice in CO_2 doubling experiments, describing these as "the most exciting and important advances" in the field. FACE experiments in both Japan and China showed that available cultivars respond very favorably to elevated ambient CO_2. Furthermore, Challinor et al. (2014), Zhu et al. (2015) and Wu et al. (2018) all report evidence that hybrid rice varietals exist that are more heat-tolerant and therefore able to take advantage of CO_2 enrichment even under warming conditions. Collectively, this research thus indicates that the rice parameterization in FUND is overly pessimistic.
>
> Second, satellite-based studies have yielded compelling evidence of stronger general growth effects than were anticipated in the 1990s. Zhu et al. (2016) published a comprehensive study on greening and human activity from 1982 to 2009. The ratio of land areas that became greener, as opposed to browner, was approximately 9 to 1. The increase in atmospheric CO_2 was just under 15 percent over the interval but was found to be responsible for approximately 70 percent of the observed greening, followed by the deposition of airborne nitrogen compounds (9 percent) from the combustion of coal and deflation of nitrate-containing agricultural fertilizers, lengthening growing seasons (8 percent) and land cover changes (4 percent), mainly reforestation of regions such as southeastern North America….
>
> Munier et al. (2018) likewise found a remarkable increase in the yield of grasslands. In a 17-year (1999–2015) analysis of satellite-sensed LAI, during which time the atmospheric CO_2 level rose by about 10 percent, there was an average LAI increase of 85 percent. A full 31 percent of earth's continental land outside of Antarctica is covered by grassland, the largest of the three agricultural land types they classified. Also, for summer crops, such as maize (corn) and soybeans, greening increased an average of 52 percent, while for winter crops, whose area is relatively small compared to those for summer, the increase was 31 percent. If 70 percent of the yield gain is attributable to increased CO_2, the results from Zhu et al. (2016) imply gains of 60 percent, 36 percent and 22 percent over

---

[155] Kevin Dayaratna, Ross McKitrick, and Patrick Michaels, "Climate Sensitivity, Agricultural Productivity and the Social Cost of Carbon in FUND," *Environmental Economics and Policy Studies*, Vol. 22 (2020), pp. 433–448, https://link.springer.com/article/10.1007/s10018-020-00263-w (accessed August 2, 2023).

the 17-year period for, respectively, grasslands, summer crops and winter crops, associated with only a 10 percent increase in CO_2, compared to parameterized yield gains in the range of 20 to 30 percent for CO_2 doubling in FUND.

Third, there has been an extensive amount of research since Tsingas et al. (1997) on adaptive agricultural practices under simultaneous warming and CO_2 enrichment. Challinor et al. (2014) surveyed a large number of studies that examined responses to combinations of increased temperature, CO_2 and precipitation, with and without adaptation. In their metanalysis, average yield gains increased 0.06 percent per ppm increase in CO_2 and 0.5 percent per percentage point increase in precipitation, and adaptation added a further 7.2 percent yield gain, but warming decreased it by 4.9 percent per degree C. In FUND, 3°C warming negates the yield gains due to CO_2 enrichment. However, based on Challinor et al.'s (2014) regression analysis, doubling CO_2 from 400 to 800 pm, while allowing temperatures to rise by 3°C and precipitation to increase by 2 percent, would imply an average percent yield increase ranging from 2.1 to 12.1 percent increase, indicating the productivity increase in FUND is likely too small.[156]

Based on that literature, Dayaratna et al. (2020) updated the FUND model's coefficients to increase its agricultural benefits by 15 percent and 30 percent. In addition, the authors used an updated ECS distribution—that of Lewis and Curry (2018).[157] In the charts below, the last three columns show the mean SCC as well as the associated probability of negative SCC values under different discount rates.

	FUND Model Average SCC, agricultural component updated - Discount Rate – 2.5%			
	Roe Baker (2007)	**Lewis and Curry (2018)**	**Lewis and Curry (2018) + 15%**	**Lewis and Curry (2018) + 30%**
2020	$32.90	$3.78 / 0.46	$0.62 / 0.53	–$1.53 / 0.59
2030	$36.16	$4.69 / 0.44	$1.25 / 0.51	–$1.02 / 0.57
2040	$39.53	$5.76 / 0.42	$2.03 / 0.48	–$0.33 / 0.54

[156] Kevin Dayaratna, Ross McKitrick, and Patrick Michaels, "Climate Sensitivity, Agricultural Productivity and the Social Cost of Carbon in FUND," *Environmental Economics and Policy Studies*, Vol. 22 (2020), pp. 433–448, https://link.springer.com/article/10.1007/s10018-020-00263-w (accessed August 2, 2023).
[157] Nicolas Lewis and Judith A. Curry, "The Impact of Recent Forcing And Ocean Heat Uptake Data on Estimates of Climate Sensitivity," *Journal of Climate* Vol. 31 (2018), pp. 6051–6071, https://journals.ametsoc.org/view/journals/clim/31/15/jcli-d-17-0667.1.xml (accessed August 3, 2023).

2050	$42.98	$6.98 / 0.39	$2.96 / 0.46	–$0.55 / 0.51

	FUND Model Average SCC, agricultural component updated - Discount Rate – 3%			
	Roe Baker (2007)	**Lewis and Curry (2018)**	**Lewis and Curry (2018) + 15%**	**Lewis and Curry (2018) + 30%**
2020	$19.33	$1.61 / 0.49	–$0.82 / 0.57	–$2.74 / 0.63
2030	$21.78	$2.32 / 0.47	–$0.35 / 0.54	–$2.39 / 0.61
2040	$24.36	$3.18 / 0.44	$0.28 / 0.51	–$1.85 / 0.57
2050	$27.06	$4.21 / 0.42	$1.08 / 0.48	–$1.12 / 0.54

	FUND Model Average SCC, agricultural component updated - Discount Rate – 5%			
	Roe Baker (2007)	**Lewis and Curry (2018)**	**Lewis and Curry (2018) + 15%**	**Lewis and Curry (2018) + 30%**
2020	$2.54	–$1.02 / 0.62	–$2.25 / 0.71	–$3.41 / 0.78
2030	$3.31	–$0.77 / 0.58	–$2.14 / 0.67	–$3.41 / 0.74
2040	$4.21	–$0.39 / 0.54	–$1.89 / 0.63	–$3.24 / 0.70
2050	$5.25	$0.15 / 0.49	–$1.47 / 0.58	–$2.87 / 0.65

	FUND Model Average SCC, agricultural component updated - Discount Rate – 7%			
	Roe Baker (2007)	**Lewis and Curry (2018)**	**Lewis and Curry (2018) + 15%**	**Lewis and Curry (2018) + 30%**
2020	–$0.37	–$1.25 / 0.71	–$2.06 / 0.80	–$2.84 / 0.85
2030	–$0.13	–$1.18 / 0.67	–$2.08 / 0.76	–$2.94 / 0.82
2040	$0.19	–$0.98 / 0.62	–$1.98 / 0.71	–$2.91 / 0.77
2050	$0.63	–$0.66 / 0.56	–$1.74 / 0.65	–$2.71 / 0.72

As the results illustrate, under more realistic assumptions regarding agricultural productivity and climate sensitivity, the mean SCC essentially drops to zero and in many cases has a substantial probability of being negative. At a minimum, Dayaratna et al. (2020) further demonstrates that the SCC is highly sensitive to very reasonable changes in assumptions. The models can therefore suggest a variety of outcomes of climate change—ranging from catastrophic disaster or continued prosperity to climate change—all under very reasonable assumptions.

Given the uncertainty surrounding EPA's estimated SCC and its impact on climate, EPA simply cannot point to any measurable environmental benefit that could result from the Proposed Rule.

Conclusion

Like other global environmental challenges, climate change forces society to make difficult choices among competing priorities of great significance. In a democracy, those choices are for people to make through their elected representatives after debate and deliberation. They are not for unaccountable bureaucrats to make on the basis of legislative powers that Congress clearly did not intend to delegate. Simply put, the risk of climate change does not justify the risk of departing from constitutional democratic governance—especially where, as here, EPA can point to no measurable climate benefits at all.

Thank you for your consideration of these comments.

Respectfully submitted,

/s/

Mario Loyola[158]
Research Assistant Professor, Florida International University
Senior Research Fellow, Center for Energy, Climate, and Environment,
The Heritage Foundation

Kevin Dayaratna[159]
Chief Statistician, Data Scientist, and Senior Research Fellow
Center for Data Analysis
The Heritage Foundation

[158] Affiliation and title provided for identification purposes only. I submit this comment in my personal capacity only and not as an employee of The Heritage Foundation.
[159] Affiliation and title provided for identification purposes only. I submit this comment in my personal capacity only and not as an employee of The Heritage Foundation.

Travis Fisher[160]
Senior Research Fellow
Center for Energy, Climate, and Environment
The Heritage Foundation

Diana Furchtgott-Roth[161]
Director
Center for Energy, Climate, and Environment
The Heritage Foundation

[160] Affiliation and title provided for identification purposes only. I submit this comment in my personal capacity only and not as an employee of The Heritage Foundation.
[161] Affiliation and title provided for identification purposes only. I submit this comment in my personal capacity only and not as an employee of The Heritage Foundation.