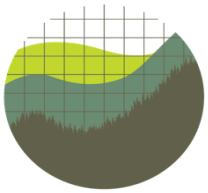


Institute *for*
Policy Integrity
NEW YORK UNIVERSITY SCHOOL OF LAW

August 8, 2023

To: Environmental Protection Agency

Subject: 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, 88 Fed. Reg. 33,240 (proposed May 23, 2023)

The Institute for Policy Integrity at New York University School of Law[1] respectfully submits this comment letter to the Environmental Protection Agency (EPA) regarding its proposal to strengthen its regulations governing greenhouse gas (GHG) emissions from power plants (Proposed Rule).[2] Policy Integrity is a nonpartisan think tank dedicated to improving the quality of government decisionmaking through advocacy and scholarship in the fields of administrative law, economics, and public policy.

EPA leverages its technical expertise to design a rule that fulfills its obligations under Section 111 of the Clean Air Act (CAA) to reduce GHG emissions, which endanger public health and welfare. The "best systems of emission reduction" (BSERs) identified in the Proposed Rule are traditional in scope, consistent with the Supreme Court's decision in *West Virginia v. EPA*, and adequately demonstrated. Although EPA already provides robust legal and economic support for the Proposed Rule, the agency could improve its proposal by conducting additional analysis and clarifying certain assumptions.

We make the following observations and suggestions with regard to the design of the Proposed Rule and its underlying legal authority:

- **EPA's proposed emissions limits are derived from traditional emissions-reduction techniques that can be applied at and by individual sources.** This approach is consistent with the legal pathway left intact by the Supreme Court in *West Virginia v. EPA* and reflects consideration of the relevant statutory factors.
    - If larger economic trends, independently or in conjunction with the regulations, drive sources to retire or meet these emissions limits through compliance pathways different from the BSER, that is consistent with a cost-reasonable BSER.

[1] This document does not purport to represent the views, if any, of New York University School of Law.
[2] 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, 88 Fed. Reg. 33,240 (proposed May 23, 2023) [hereinafter Proposed Rule].

- Reflective of these trends, EPA appropriately exercises its authority to subcategorize regulated sources in a manner informed by their costs to the regulated entities.
- EPA also appropriately considers the *effects* of a BSER at the local, regional, and national levels, as it has long done for the consideration of energy requirements and other environmental effects.

- **EPA should (1) specify that the hydrogen co-firing BSERs require units to fire low-GHG hydrogen and (2) define low-GHG hydrogen to mean hydrogen that was specifically produced via electrolysis powered by zero-emissions resources (e.g., solar, wind, nuclear, and hydro).**
  - EPA should further consider refining its proposed definition of "low-GHG hydrogen" to impose limitations on hydrogen leakage. In explaining whether it intends for the definition of low-GHG hydrogen to be legally severable from the remainder of the hydrogen co-firing BSERs, EPA should address whether and under what circumstances the BSERs would, absent the definition, aggravate climate change instead of mitigating it.
  - EPA should also develop its own compliance protocols for measuring the emissions intensity of hydrogen production if Treasury's relevant protocols underestimate associated emissions.
- **EPA should expand the coverage of its proposed emissions limits to more of the existing gas fleet so as to better fulfill its statutory obligations to reduce public harm from air pollution.**
  - Leaving most of the source category unregulated at this time could create perverse incentives to shift generation to smaller, less-frequently operated plants, which can be less efficient and emit GHGs and other air pollutants, including nitrogen oxides (NO_x) at higher rates.
  - By regulating existing sources at the same time as new sources, EPA can reduce the "old plant effect," which occurs when the imposition of differentially stringent standards for new and existing sources inadvertently extends the existing sources' economically useful life.

EPA has prepared a robust Regulatory Impact Analysis (RIA) for the Proposed Rule, but could supplement it. We recommend EPA take the following steps to strengthen its regulatory analysis:

- EPA should conduct additional sensitivity analysis using climate-damage valuations and social discount rates from draft guidance documents that reflect the best available science and economics.
- EPA should consider separately identifying and quantifying any increases or decreases in federal subsidy payments that will result from the Proposed Rule and contextualizing those amounts within the size of the relevant government subsidy programs.

- EPA should update the data underlying its baseline analysis and explain how its choices around modeling Inflation Reduction Act (IRA) implementation best reflect its projections about the anticipated state of the world.
- EPA should continue to refine its SAGE modeling of social costs and conduct additional sensitivity analysis to provide a more comprehensive accounting of the Proposed Rule's social costs. Where such modeling is not possible, EPA should explain why and highlight what those limitations mean for its estimated social cost figures.
- EPA should further update and strengthen the environmental justice analysis and provide guidance to states regarding opportunities to conduct distributional analysis and mitigate negative impacts on environmental justice communities.

We expand upon these suggestions in the following comments.

Table of Contents

I. Background

The Proposed Rule, which EPA published in May 2023, would reduce GHG emissions from coal- and natural gas-fired electric generating units (EGUs). This Proposed Rule includes five separate actions to be taken under Section 111 of the CAA that affect both new and existing sources. For new and modified sources, EPA sets emissions limits through New Source Performance Standards (NSPS).[3] For existing sources, EPA sets them through emissions guidelines, and then states submit State Implementation Plans that include performance standards of equivalent stringency.[4]

For GHG emissions, EPA now proposes to (1) revise standards for new gas-fired EGUs, (2) revise standards for modified fossil fuel-fired steam EGUs, (3) set emissions guidelines for existing fossil fuel-fired steam EGUs (including coal- and oil/gas-fired), (4) set emissions guidelines for the largest and most frequently operated existing gas-fired EGUs, and (5) repeal the Affordable Clean Energy (ACE) Rule issued by the Trump Administration.

Under Section 111, EPA must set air pollution limits for new and existing sources that reflect "the degree of emission limitation achievable through the application of the *best system of emission reduction* which (taking into account the cost of achieving such reduction and any nonair quality health and environmental impact and energy requirements) the Administrator determines has been adequately demonstrated."[5] A BSER is not a mandate to install a particular technology. Instead, it determines the stringency of the performance standards for new sources or the emissions guidelines for existing sources.

In *West Virginia v. EPA*, the Supreme Court continued to recognize that EPA has the authority under the CAA to reduce GHG emissions that cause climate change.[6] However, the Court found that the 2015 Clean Power Plan's inclusion of "generation shifting"— shifting electricity generation from coal-fired plants to natural gas-fired plants, and from fossil fuel-fired plants to renewables—as part of the BSER was unlawful.[7] The Court recognized that EPA has historically issued regulations that include emissions limits based on measures that individual regulated sources can take, such as "fuel-switching" and "add-on controls."[8]

The Proposed Rule applies the approach that the Court endorsed in *West Virginia*: setting emissions limits focused on reducing the pollution from individual sources. Specifically, the BSERs recognized in the Proposed Rule include technology that captures and stores carbon emissions, a process known as carbon capture and sequestration/storage (CCS); improvements to

[3] 42 U.S.C. § 7211(b).
[4] *Id.* § 7211(d). Even though EPA is not, in the case of existing sources, charged with implementing existing-source standards, it is responsible for determining their minimum stringency through emissions guidelines.
[5] *Id.* § 7411(a)(1) (emphasis added).
[6] West Virginia v. EPA, 142 S. Ct. 2587 (2022).
[7] *Id.*
[8] *Id.* at 2611.

plant efficiency; and increased co-firing with cleaner fuels, which involves using natural gas at coal-fired plants or low-GHG hydrogen[9] at natural gas-fired plants.

In the Proposed Rule, EPA weighs the relevant statutory factors and applies its technical expertise to identify GHG BSERs for various categories of new and existing coal- and gas-fired EGUs. To inform its decision, EPA discusses the Proposed Rule's impacts in the RIA[10] and several technical support documents (TSDs). EPA has long relied on the Integrated Planning Model (IPM), a peer-reviewed model developed and maintained by the consulting firm ICF International,[11] to inform its analysis of power sector regulations. IPM integrates key operational elements of electric power generation and assesses the sectoral costs and emissions impacts of proposed policies to limit air pollution emissions. EPA additionally uses SAGE, a computable general equilibrium (CGE) model, to better understand the potential economy-wide impacts of the Proposed Rule.[12]

As EPA acknowledges, the RIA for the Proposed Rule includes an IPM run for the regulations affecting existing coal-fired EGUs and the first two phases of regulations affecting new gas-fired EGUs. During the comment period, EPA released a memo with updated modeling reflecting an IPM run for the full integrated proposal, which includes the regulations affecting existing coal-fired EGUs, new gas-fired EGUs (all three phases), and existing gas-fired EGUs.[13] The memo also integrates updated assumptions regarding liquefied natural gas (LNG) exports from the Energy Information Administration's (EIA) Annual Energy Outlook 2023 (AEO 2023) into the baseline.[14]

II. EPA Has Set Emissions Limits Based on the Appropriate Statutory Factors and Consistent with *West Virginia v. EPA*

As explained above, under Section 111 of the CAA, EPA sets performance standards for new sources and emissions guidelines for existing sources (and then states set performance standards of equivalent stringency for those existing sources). When identifying the BSER for different source categories, EPA must consider not only the associated emissions reductions, but also the cost of achieving such reductions, any nonair quality health and environmental impacts, energy requirements, and whether the system has been "adequately demonstrated."[15] In the Proposed Rule, EPA considers the relevant factors and identifies BSERs consistent with the Supreme

[9] This refers to the emissions intensity of hydrogen production. For example, hydrogen produced via electrolysis powered by zero-emissions resources (e.g., solar, wind, nuclear, and hydro) would be described as low-GHG hydrogen. EPA is accepting comment on how it should define low-GHG hydrogen.
[10] EPA, EPA-452/R-23-006, REGULATORY IMPACT ANALYSIS FOR THE 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 3-13 (2023), https://perma.cc/FGY5-JQ4U [hereinafter RIA].
[11] *Post-IRA 2022 Reference Case: EPA's Power Sector Modeling Platform v6 Using IPM*, EPA (Apr. 5, 2023), https://perma.cc/E6LU-NAWX.
[12] *CGE Modeling for Regulatory Analysis*, EPA (May 2, 2023), https://perma.cc/X2N7-MMBA.
[13] EPA, Integrated Proposal Modeling and Updated Baseline Analysis Memo (July 7, 2023), https://perma.cc/VE7T-H4TC [hereinafter Integrated Proposal Modeling Update].
[14] *Id*.
[15] 42 U.S.C. § 7411(a)(1).

Court's interpretation of Section 111 in *West Virginia v. EPA*, including CCS, co-firing with cleaner fuels, and optimizing plant efficiency.

This section provides relevant legal and economic context for EPA's selection of BSERs. First, the selection of a BSER is distinct from an analysis of regulated entities' most likely compliance choices. Second, EPA subcategorizes existing coal-fired EGUs by operating horizon to reflect the different costs borne by units near retirement. Third, EPA considers the upstream emissions effects of hydrogen co-firing BSERs. Fourth, unlike the Clean Power Plan, the Proposed Rule does not implicate the major questions doctrine because it applies a traditional suite of controls that reduce the emissions of individual sources.

A. Projected Coal Retirements Are Consistent with an Appropriate BSER

CCS is the single identified BSER for existing coal-fired steam EGUs and one of two BSERs identified for both new and existing base load gas-fired turbines in the Proposed Rule. EPA's modeling projects that a limited amount of generation will come from facilities installing CCS over the next two decades.[16] Instead, many coal-fired EGUs will retire. Most of these retirements, however, would happen even without the Proposed Rule as a result of broader economic trends and the plants' advanced age. And the small number of retirements that *are* attributed to the Proposed Rule do not indicate an inappropriately stringent BSER. Even an extremely low-cost BSER could cause some retirements if applied to plants that are already economically marginal.

Coal-fired power plants are increasingly retiring due to several economic trends. Retirements are a rational economic choice "when the cost of operating a plant exceeds expected revenue or when operating costs exceed the plant's value to the power system, such as its value in providing reliability to the electric grid."[17] As coal-fired generators age and become less efficient, they "face higher operating and maintenance costs, which make them less competitive and more likely to retire,"[18] especially as they compete with newer, more efficient power generators. These pressures, combined with other economic trends, have already driven retirements and a large degree of generation shifting.[19] For example, low natural gas prices, shocks to electricity demand, and increased generation from renewables were found to be primary drivers of coal plant retirements in a study analyzing retirements between 2005 and 2015.[20] The passage of the IRA is expected to further strengthen trends driving coal plant retirements, even without finalization of the Proposed Rule.[21]

---

[16] Integrated Proposal Modeling Updated, *supra* note 13, at 15–16, tbl.11.
[17] David Fritsch, *Of the Operating U.S. Coal-Fired Power Plants, 28% Plan to Retire by 2035*, U.S. ENERGY INFO. ADMIN. (Dec. 15, 2021), https://perma.cc/L5KX-8HSJ.
[18] M. Tyson Brown, *Nearly a Quarter of the Operating U.S. Coal-Fired Fleet Scheduled to Retire by 2029*, U.S. ENERGY INFO. ADMIN. (Nov. 7, 2022), https://perma.cc/E8SG-XRK9.
[19] *See* EPA, POWER SECTOR TRENDS TECHNICAL SUPPORT DOCUMENT 7-13 (2023), https://perma.cc/QC8K-7E5R [hereinafter Power Sector Trends TSD].
[20] Joshua Linn & Kristen McCormack, *The Roles of Energy Markets and Environmental Regulation in Reducing Coal-Fired Plant Profits and Electricity Sector Emissions*, 50 RAND J. ECON. 733, 735 (2019).
[21] Power Sector Trends TSD, *supra* note 19, at 11–13.

Furthermore, many coal plants are now reaching the end of their anticipated lives: the capacity-weighted average retirement age for a coal plant retiring between 2000 and 2021 was 50 years, and in 2021, the average age of a coal-fired EGU was 43.[22] Approximately half of all operating coal-fired plants will be within seven years of the average age of retirement by 2030.[23] So while EPA is currently proposing that existing coal-fired plants retiring before 2032 do not need to co-fire or install CCS, it is not necessarily the rule that will cause them to retire by that year.

The baseline scenario in EPA's updated modeling for the integrated proposal and analysis show that it considers these broader economic trends. Under the updated baseline analysis, EPA estimates total coal retirements between 2023 and 2035 of 104 GW (or 15 GW annually).[24] Under updated modeling of the Proposed Rule, EPA estimates total coal retirements between 2023 and 2035 of 126 GW (or 18 GW annually).[25] EPA further contextualizes these projected trends by comparing them to an average historical retirement rate of 11 GW per year from 2015–2020.[26]

EPA does not need to regulate less stringently simply because the oldest and highest-emitting coal plants already have plans to retire or particularly tight economic margins. In fact, such a practice would run contrary to the CAA's objectives of forcing technological advancements.[27] The D.C. Circuit has long recognized that EPA can set standards at a level that not all regulated units *can* meet[28] or would choose to meet when less expensive ways of doing business exist.

Even for the marginal units that will choose to shut down due to a combination of the Proposed Rule and other economic factors, such effects are consistent with an appropriately identified on-site technology BSER. To determine the "best" system of emissions reduction, EPA has wide discretion to weigh the relevant factors, including cost.[29] The D.C. Circuit has confirmed that when EPA weighs a system's costs against other factors, the agency can adopt standards to protect public health as long as costs are not "exorbitant,"[30] "unreasonable,"[31] or "excessive."[32] This cost-reasonableness test does not mean that a BSER must be the cheapest compliance option or economically feasible for units close to retirement that are already economically marginal.

---

[22] *Id*. at 8.
[23] *Id*.
[24] Integrated Proposal Modeling Update, *supra* note 13, at 16.
[25] *Id*.
[26] *Id*.
[27] Sierra Club v. Costle, 657 F.2d 298, 364 (D.C. Cir. 1981) ("Recognizing that the Clean Air Act is a technology-forcing statute . . . ."); Portland Cement Ass'n v. Ruckelshaus, 486 F.2d 375, 391 (D.C.Cir.1973) ("Section 111 looks toward what may fairly be projected for the regulated future, rather than the state of the art at present . . . .The essential question [is] . . . whether the technology would be available for installation in new plants."); *see also* Union Elec. Co. v. EPA, 427 U.S. 246, 256–57 (1976); Train v. Nat. Res. Def. Council, Inc., 421 U.S. 60, 75 (1975); Note, *Forcing Technology: The Clean Air Act Experience*, 88 YALE L.J. 1713 (1979); Brief of Amicus Curiae Thomas C. Jorling in Support of Respondents at 15–16, West Virginia v. EPA, 142 S. Ct. 2587 (2022) (Nos. 20-1530, 20-1531, 20-1778, 20-1780), https://perma.cc/K6C8-MBUF.
[28] *See Portland Cement*, 486 F.2d at 391 ("We begin by rejecting the suggestion . . . that 'adequately demonstrated' necessarily implies that any cement plant now in existence be able to meet the proposed standards.").
[29] *See Sierra Club*, 657 F.2d at 330 (recognizing that CAA section 111 gives EPA authority "when determining the best technological system to weigh cost, energy, and environmental impacts").
[30] Lignite Energy Council v. EPA, 198 F.3d 930, 933 (D.C. Cir. 1999).
[31] *Sierra Club*, 657 F.2d at 343.
[32] *Id*.

That cleaner forms of generation replace the retiring units as an *effect* of the regulation is distinct from including "generation shifting" as part of the BSER. In *West Virginia*, the Supreme Court distinguished between selecting generation shifting as a BSER and selecting a traditional, on-site BSER that yields a performance standard that will result in some generation shifting upon implementation.[33] All regulations naturally affect the relative costs and benefits of different compliance pathways and therefore can cause generation-shifting effects.[34]

Corroborating the point that an appropriately selected on-site BSER will have generation-shifting effects, EPA has set numerous regulations under Section 111 that encourage adoption of less emissions-intensive fuels as a means of compliance, even when that is not the primary technology used to determine the stringency of the standard.[35] For example, in 1998, EPA revised its NO_x NSPS for fossil fuel-fired steam generating units.[36] The agency determined the BSER by calculating how much NO_x sources could reduce through implementation of the best demonstrated technology, selective catalytic reduction.[37] EPA emphasized that this rule was fuel-neutral, applying uniformly across units regardless of fuel type despite the fact that natural gas-burning units could achieve compliance more easily than coal-fired units.[38] Promulgating a fuel-neutral rule, the agency explained, would "encourage[] the use of clean fuels without limiting the control options available for compliance."[39] This rule was later upheld by the D.C. Circuit.[40]

[33] *See West Virginia*, 142 S. Ct. at 2613 n.4 (distinguishing between incidental shifting and setting allowable levels of generation for different fuel sources).
[34] Regulated entities explained this basic cause and effect of regulation in litigation over the Clean Power Plan: "[e]lectricity providers have been shifting generation among affected units and to zero-emitting sources as a means of achieving emission reductions for decades." Brief of Intervenors Calpine Corp. et al. at 2–3, West Virginia v. EPA, No. 15-1363 (D.C. Cir. Apr. 22, 2016), https://perma.cc/CWV2-RM5A.
[35] *See, e.g.*, Standards of Performance for Electric Utility Steam Generating Units for Which Construction Is Commenced After September 18, 1978; Standards of Performance for Industrial-Commercial-Institutional Steam Generating Units; and Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units, 71 Fed. Reg. 9866, 9873 (Feb. 27, 2006) (explaining that the standards might be more expensive depending on the type of fuel a source used and that the standards would "allow units with difficulty in achieving high levels of SO_2 control to overcome compliance demonstrations problems by burning low sulfur fuels"); Standards of Performance for New Stationary Sources; Industrial-Commercial-Institutional Steam Generating Units, 52 Fed. Reg. 47,826, 47,826–31 (Dec. 16, 1987) (allowing compliance and providing incentives for "'fuel switching' from coal or oil to natural gas" despite basing standards on flue gas desulfurization and fluidized bed combustion).
[36] Revision of Standards of Performance for Nitrogen Oxide Emissions from New Fossil-Fuel Fired Steam Generating Units; Revisions to Reporting Requirements for Standards of Performance for New Fossil-Fuel Fired Steam Generating Units, 63 Fed. Reg. 49,442 (Sept. 16, 1998).
[37] *Id.* at 49,444.
[38] *Id.* at 49,433, 49,446.
[39] *Id.* at 49,433. EPA rejected a commenter's assertion that the rule violated the CAA "by providing an overwhelming incentive for new and modified electric generating units to burn natural gas to the exclusion of coal," writing that the rule was "designed to allow the continued use of coal as a fuel in those cases where it is desirable" but "also not discourage conversion to natural gas where it makes sense in the individual application." *Id.* at 49,446.
[40] *Lignite Energy Council*, 198 F.3d at 933 (finding it "within EPA's discretion to issue uniform standards for all utility boilers, rather than adhering to its past practice of setting a range of standards based on boiler and fuel type").

B. EPA Subcategorizes Based on Appropriate Consideration of the Relevant Factors

As EPA recognizes, CAA Section 111(b)(2) grants the EPA discretion to "distinguish among classes, types, and sizes within categories of new sources for the purpose of establishing [new source] standards," an authority which EPA describes as "subcategorizing."[41] EPA has the same breath of authority in designating emission reductions from existing sources,[42] and as EPA explains in the Proposed Rule, its implementing regulations promulgated in 1975 provide that the Administrator will specify different emissions guidelines, compliance times, or both "for different sizes, types, and classes of designated facilities when costs of control, physical limitations, geographical location, and similar factors make subcategorization appropriate."[43]

EPA has appropriately contextualized its discussion of subcategorization with examples from the numerous Section 111 rulemakings it has issued since the 1970's that rely on a wide variety of factors to subcategorize,[44] including the levels of utilization of the sources.[45] As noted in EPA's implementing regulations, different "costs of control" are also a relevant ground upon which to differentiate treatment. Further, many of the other ways of differentiating between differently situated sources reflect differences in cost of achieving emissions reductions. When explaining its choice to subcategorize the BSER for existing coal-fired units, EPA "recognizes that the cost reasonableness of GHG control technology options differ depending on a coal-fired steam generating unit's expected operating time horizon" and that it "[a]ccordingly…is proposing to divide the subcategory for coal-fired units into additional subcategories based on operating horizon (*i.e.*, dates for electing to permanently cease operation) and, for one of those subcategories, load level (*i.e.*, annual capacity factor), with a separate BSER and degree of emission limitation corresponding to each subcategory."[46]

EPA's subcategories representing operating horizons can thus be understood as a choice to subcategorize which reflects the costs of control. In fact, EPA explains that industry stakeholders specifically requested that "EPA should provide a subcategory pathway for units to decommission/repower into the early 2030s, which would include enforceable shutdown obligations, as part of an approach to existing unit guidelines," due to the different costs these units would bare.[47]

---

[41] Proposed Rule, 88 Fed. Reg. at 33,270.
[42] *West Virginia*, 142 S. Ct. at 2601–02 (citations omitted) (recognizing that "EPA itself still retains the primary regulatory role in Section 111(d)" and "[t]he Agency, not the States, decides the amount of pollution reduction that must ultimately be achieved" by applying the same BSER analysis as for new sources).
[43] 40 C.F.R. §§ 60.22(b)(5), 60.22a(b)(5); State Plans for the Control of Certain Pollutants from Existing Sources, 40 Fed. Reg. 53,340, 53,341 (Nov. 17, 1975).
[44] Proposed Rule, 88 Fed. Reg. at 33,271.
[45] *See* Standards of Performance for Greenhouse Gas Emissions from New, Modified, and Reconstructed Stationary Sources: Electric Utility Generating Units, 80 Fed. Reg. 64,510, 64,602 tbl.15 (Oct. 23, 2015) (dividing new natural gas-fired combustion turbines into the subcategories of base load and non-base load).
[46] Proposed Rule, 88 Fed. Reg. at 33,341.
[47] *Id.* at 33,343.

C. EPA's Hydrogen Co-firing BSERs Can Reflect the Full Scope of Related GHG Emission Reductions

The amount of GHG emissions reduction achieved by a hydrogen co-firing BSER depends in large part on the type of hydrogen that is burned.[48] As EPA notes "[c]o-firing hydrogen at combustion turbines when that hydrogen is produced with large amounts of GHG emissions would ultimately result in increasing overall GHG emissions, compared to combusting solely natural gas at the combustion turbine."[49] EPA explains, such an anomalous outcome would be inconsistent with the purpose of CAA section 111 to reduce pollution that endangers human health and welfare through promulgation of standards of performance that reflect the ''best'' system of emission reduction. The D.C. Circuit has long recognized that EPA "must consider whether byproducts of pollution control equipment could cause environmental damage in determining whether the pollution control equipment qualified as the best system of emission reduction."[50]

EPA's consideration of the emissions associated with hydrogen production is consistent with its longstanding practice to consider the effects of the BSER broadly. Several of the statutory factors that EPA weighs in determining the BSER (such as cost, energy requirements, and nonair quality environmental effects) involve a regional or national scope of review that extends beyond the effects at an individual source. For example, EPA has assessed whether broad application of a BSER will interfere with energy demands at the regional or national level.[51] The D.C. Circuit recognizes EPA's authority to take cost, energy requirements, and environmental impacts into account "in the broadest sense at the national and regional levels and over time as opposed to simply at the plant level in the immediate present" and has upheld standards consistent with that finding.[52] Thus, in selecting the Proposed Rule's BSERs, it is appropriate for EPA to consider the production-related emissions of the hydrogen that a plant selects as its fuel.

This scope of consideration for the effects of the BSER is also consistent with *West Virginia*. In *West Virginia,* the Supreme Court emphasized that a BSER should be based on actions that an individual source can take, but it preserved the authority to consider the *effects* of the BSER more broadly. Co-firing hydrogen in a combustion turbine instead of natural gas is a system of emissions reduction undertaken at the source. EPA has long relied on lower-emitting fuels as a

[48] *Infra* Section III.
[49] Proposed Rule, 88. Fed. Reg. at 33,315.
[50] *Id*. at 33,315 (citing *Portland Cement Ass'n*, 486 F.2d at 385 n.42).
[51] *See, e.g., Sierra Club*, 657 F.2d at 330 (describing EPA's modeling as accounting for various factors in setting emissions standards for coal-burning power plants); EPA, PRIMARY ALUMINUM: GUIDELINES FOR CONTROL OF FLUORIDE EMISSIONS FROM EXISTING PRIMARY ALUMINUM PLANTS 9-34 (1980), https://perma.cc/VC4H-FA4F (discussing whether the United States could meet energy demands of aluminum industry, after increased demand due to control requirements).
[52] *See, e.g., Sierra Club*, 657 F.2d at 330 (concluding "that EPA was justified in relying on long term analysis of national and regional cost, environmental, and energy impacts of alternative percentage reduction standards in order to select the 'best technological system' upon which to base the NSPS")

BSER that an individual source can control[53] and the Court in *West Virginia* even noted the history of past practice to include "fuel-switching" with apparent approval.[54]

D. The Proposed Rule Does Not Trigger the Major Questions Doctrine

In finding that the Clean Power Plan's use of generation shifting exceeded EPA's Section 111 authority, the Supreme Court relied on the major questions doctrine, which provides that under rare circumstances that would transform the underlying statute, the Court may depart from its normal approach to agency deference and look more skeptically on agency authority in the absence of clear congressional authorization. Mindful of that decision, EPA has designed the Proposed Rule to avoid raising similar concerns. To provide legal context, this section describes how the Supreme Court has articulated the major questions doctrine and explains why the doctrine fits poorly with the Proposed Rule.

In *West Virginia*, the Supreme Court stressed that only "extraordinary cases" trigger the major questions doctrine—"cases in which the 'history and the breadth of the authority that the agency has asserted,' and the 'economic and political significance' of that assertion, provide a 'reason to hesitate before concluding that Congress' meant to confer such authority."[55] The bulk of the Court's analysis of the doctrine's triggers examined whether EPA had "'claim[ed] to discover in a long-extant statute [1] an unheralded power' [2] representing a 'transformative expansion in [its] regulatory authority.'"[56] In other words, the Supreme Court focused on (1) regulatory history and (2) the transformative nature of the agency's asserted authority.

In *Biden v. Nebraska*, the Supreme Court again reiterated the importance of "the 'history and the breadth of the authority that the agency had asserted,'" in addition to "the 'economic and political significance' of that assertion."[57] For example, the Court stressed that "[t]he Secretary [of Education] has never previously claimed powers of this magnitude under" the statute at issue in *Nebraska* and, "[u]nder the Government's reading of [that statute], the Secretary would enjoy virtually unlimited power to rewrite" it.[58] Both *West Virginia* and *Nebraska* reveal that an agency action does not trigger the major questions doctrine unless its history *and* breadth *and* economic and political significance provide a reason for a court to be skeptical of the agency's action.

To trigger the major questions doctrine, regulatory history must reveal that an agency action is unlike anything the agency has ever done. The agency need not identify an identical regulatory antecedent, because new regulations will rarely, if ever, be identical to previous ones as they would then be unnecessary. Rather, *West Virginia*'s and *Nebraska*'s analyses suggest that the relevant regulatory antecedent must be an analogous exercise of authority. The cases cited in

---

[53] Proposed Rule, 88. Fed. Reg. at 33,315 ("The EPA has relied on lower-emitting fuels as the BSER in several CAA section 111 rules."). EPA cites several examples of such rulemakings spanning from 1979 through 2015. *See id.*

[54] *West Virginia*, 142 S. Ct. at 2611 (recognizing EPA's history of selecting "systems of emission reduction" based on "efficiency improvements, fuel-switching," and "add-on controls"—as "more traditional air pollution control measures").

[55] *Id.* at 2608 (quoting FDA v. Brown & Williamson Tobacco Corp., 529 U.S. 120, 159–60 (2000)).

[56] *Id.* at 2610 (quoting Util. Air Regul. Grp. v. EPA (UARG), 573 U.S. 302, 324 (2014)).

[57] Biden v. Nebraska, 143 S. Ct. 2355, 2372 (2023) (quoting *West Virginia*, 142 S. Ct. at 2608) (alterations omitted).

[58] *Id.* at 2372–73.

West Virginia similarly focus on the unprecedented nature of the agency's action.[59] And the Court reaffirmed the centrality of "past practice under the statute" in *Nebraska*.[60]

In the Proposed Rule, EPA identifies BSERs that rely on a traditional approach of reducing emissions from individual sources, consistent with longstanding practice recognized by the Court in *West Virginia*. As EPA emphasizes, the Court noted with approval the use of "more traditional air pollution control measures," including the examples of "fuel switching" and "add-on controls."[61] Avoiding the selection of generation shifting as part of the BSER, the Proposed Rule instead identifies BSERs that include CCS, co-firing with cleaner fuels, and efficiency improvements to align with the "history" of prior controls noted by the Court.[62]

To trigger the major questions doctrine, the breadth of the agency action must also suggest the agency is dramatically changing its authority. In *West Virginia*, the Supreme Court explained that the challenged Clean Power Plan represented a "transformative expansion [of EPA's] regulatory authority."[63] In other words, the Supreme Court concluded that the Clean Power Plan "effected a 'fundamental revision of the statute, changing it from [one sort of] scheme of . . . regulation' into an entirely different kind."[64] In discussing this factor, the Court focused on whether the challenged action transformed the role of the regulator (i.e., EPA), not the regulated sector.[65] *Nebraska*[66] and the major questions cases cited in *West Virginia*[67] contain similar analyses of whether the agency action represented a transformation of the agency's authority.

Again, the Proposed Rule applies a traditional regulatory structure that sets emissions limits based on at-the-source controls, efficiency improvements, and co-firing cleaner fuels. Such regulations have long had significant effects on regulated sectors—as would be expected from a regulatory regime under a statute meant to be "technology forcing." For example, when EPA first set standards requiring sulfur scrubbers for power plants, scrubbers were used by only a few plants, but the regulation lead to the widespread installation and construction of scrubbers over

---

[59] For example, *UARG* notes that EPA's newfound statutory interpretation would have "swept" many sources under the agency's control that it had "not previously regulated." 573 U.S. at 310. *Alabama Association of Realtors v. Department of Health and Human Services* (*Alabama Realtors*) also highlights that the "expansive authority" asserted was "unprecedented." 141 S. Ct. 2485, 2489 (2021) (per curiam). And *National Federation of Independent Business v. Occupational Safety & Health Administration* likewise focused on the "lack of historical precedent" for the agency's action. 142 S. Ct. 661, 666 (2022) (per curiam) (cleaned up). In contrast, the Supreme Court rejected a challenge to a healthcare worker vaccine mandate from the Department of Health and Human Services because "the Secretary routinely imposes conditions of participation that relate to the qualifications and duties of healthcare workers." Biden v. Missouri, 142 S. Ct. 647, 653 (2022) (per curiam).

[60] *Nebraska*, 143 S. Ct. at 2372; *see also id.* at 2374 (describing the action as "unprecedented").

[61] *West Virginia*, 142 S. Ct. at 2610.

[62] *Id.*

[63] *Id.*

[64] *Id.* at 2612 (citation omitted).

[65] *See id.*; *see also* Mayes v. Biden, 67 F.4th 921, 934–35 (9th Cir. 2023) (focusing not on whether the government sought "to regulate a significant portion of the American economy," but on whether its action "*represent[ed]* an 'enormous and transformative expansion in [its] regulatory authority'" (quoting *UARG*, 573 U.S. at 324)).

[66] *Nebraska*, 143 S. Ct., at 2612.

[67] *See, e.g.*, *UARG*, 573 U.S. at 312, 325 (noting that EPA's action "would radically expand" the programs at issue, "making them both unadministrable and 'unrecognizable to the Congress that designed' them" (citation omitted)); MCI Telecomms. Corp. v. Am. Tel. & Tel. Co., 512 U.S. 218, 225, 229, 234 (1994) (finding that the agency action had effected a "basic and fundamental" change that went to the "heart" of the statute and constituted "effectively the introduction of a whole new regime of regulation").

the next decade.[68] Such influence on a regulated sector is fundamentally different from a transformation of a regulatory program. Additionally, as the D.C. Circuit has long confirmed, the requirement that the BSER be "adequately demonstrated" does not mean that a technology "must be in actual routine use somewhere" and does authorize EPA to rely on reasonable projections about future conditions.[69] EPA's determination that CCS and hydrogen co-firing are adequately demonstrated is consistent with that authority and is a technical matter within EPA's expertise and for which EPA should receive deferential review.[70]

The economic and political significance of an agency's action is necessary but insufficient to trigger the major questions doctrine. Although the Supreme Court often references economic and political significance in its major questions cases, these indicators alone have never sufficed to trigger the doctrine. *West Virginia*'s legal analysis avoids reference to economic significance, such as regulatory costs or the number of persons or entities affected. Moreover, the Supreme Court has decided numerous recent cases under sizable government programs without resort to the major questions doctrine, including cases involving large programs like Medicare[71] and myriad other agency actions implicating the energy, utility, and telecommunications industries.[72] And although *Nebraska* discusses economic and political significance, it does so only after reviewing regulatory antecedents and the transformation of the regulatory scheme.[73] Much of *Nebraska*'s economic discussion also focused on the relative costs of the challenged action compared to prior agency actions under the same statute, highlighting how this aspect of the regulatory history demonstrated the action was unlike anything the Secretary of Education had done before.[74]

EPA has designed an incremental proposal with costs that are modest compared to prior CAA rules[75] and dwarfed by the costs considered in *Nebraska*. The updated modeling for the integrated proposal, which updates assumptions like those regarding LNG exports from the EIA AEO 2023, estimates the costs of the combined rules at $6.2 billion ($2019) over 2024–2042 (net present value).[76] Moreover, the costs are best understood broken out individually for regulation pertaining to each source category rather than assessed cumulatively. In contrast, *Nebraska* concerned a program with hundreds of billions of dollars at stake.[77]

---

[68] Frank Sturges & Jay Duffy, *Unleashing Technological Potential Through Regulation: Scrubbing Away Pollution*, CLEAN AIR TASK FORCE (May 5, 2023), https://perma.cc/S6R7-5DZP.
[69] *Portland Cement Ass'n*, 486 F.2d at 391.
[70] *See* Motor Vehicle Mfrs. Ass'n v. State Farm Mut. Auto. Ins. Co., 463 U.S. 29, 43 (1983).
[71] *See, e.g.*, Becerra v. Empire Health Found., 142 S. Ct. 2354 (2022); Am. Hosp. Ass'n v. Becerra, 142 S. Ct. 1896 (2022); Azar v. Allina Health Servs., 139 S. Ct. 1804 (2019).
[72] *See, e.g.*, EPA v. EME Homer City Generation, L.P., 572 U.S. 489 (2014); Nat'l Cable & Telecomms. Ass'n v. Brand X Internet Servs., 545 U.S. 967 (2005); New York v. FERC, 535 U.S. 1 (2002).
[73] *Nebraska*, 143 S. Ct. at 2372–73.
[74] *Id.* at 2372 (noting that "past waivers and modifications issued under the Act have been extremely modest and narrow in scope").
[75] For example, EPA's 1979 NSPS for coal-burning power plants, which the D.C. Circuit upheld, were projected to cost utilities "tens of billions of dollars" by 1995, resulting in higher energy costs and consumer prices. *Sierra Club*, 657 F.2d at 314. And the 2012 fuel-efficiency and greenhouse gas emissions standards for motor vehicles, which were not challenged in court, were projected to cost industry $150 billion, at an annualized rate of at least $6.5 billion. 2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards, 77 Fed. Reg. 62,624, 62,663 tbl.I-19 (Oct. 15, 2012).
[76] Integrated Proposal Modeling Update, *supra* note 13, at 23.
[77] *Nebraska*, 143 S. Ct. at 2373.

Economic significance and political significance are sometimes relevant, but have never been sufficient by themselves to trigger the major questions doctrine, and are of limited relevance for this incremental Proposed Rule. Moreover, the major questions doctrine also requires examining whether the agency action at issue is of sufficient novelty and breadth to counsel skepticism. Only when the doctrine is triggered must an agency point to "clear congressional authorization" for the its approach.[78] But this is not the same as a "clear statement rule"—a phrase found nowhere in the majority opinions in either *West Virginia* or *Nebraska* (or any the Court's other major question precedents).[79] Or, as Justice Barrett explained in her concurrence in *Nebraska*, the necessary clear congressional authorization should not be equated with "'an "unequivocal declaration"' from Congress authorizing the *precise* agency action under review, as [the Court's] clear-statement cases do in their respective domains."[80] This explanation of "clear Congressional authorization" reflects the Court's interpretive approach in *West Virginia*.[81]

III. EPA Should Select the Hydrogen Co-Firing BSERs to Maximize Emissions Reductions, While Accounting for the Other Statutory Factors

The Proposed Rule identifies different levels of hydrogen co-firing as the BSERs for new intermediate load and base load natural gas-fired combustion turbines, as well as for existing base load natural gas-fired combustion turbines bigger than 300 MW.[82] For new intermediate load turbines, EPA proposes 30% hydrogen co-firing by 2032.[83] For both new and existing base load turbines, EPA proposes 30% hydrogen co-firing by 2032 and 96% hydrogen co-firing by 2038 as one of two BSER pathways.[84] The Proposed Rule specifies that, to comply with the hydrogen co-firing BSERs, the co-fired hydrogen must be "low-GHG hydrogen."[85]

EPA proposes to define "low-GHG hydrogen" as hydrogen with an emissions intensity of less than 0.45 kilograms of CO_2 equivalent (CO_2e) per kilogram of hydrogen on a well-to-gate basis (i.e., counting life-cycle emissions only from feedstock production and delivery and from the hydrogen-production process).[86] EPA adopts this emissions-intensity threshold and the well-to-gate system boundary from the IRA's hydrogen production tax credit, which provides the highest tier of tax credits to hydrogen produced with that same emissions intensity.[87] EPA further proposes to adopt the Department of the Treasury (Treasury's) guidance for determining

[78] *West Virginia*, 142 S. Ct. at 2614 (quoting *UARG*, 573 U.S. at 324).
[79] Natasha Brunstein & Donald L.R. Goodson, *Unheralded and Transformative: The Test for Major Questions After West Virginia*, 47 WM. & MARY ENV'T L. & POL'Y REV. 47, 95–100 (2022).
[80] *Nebraska*, 143 S. Ct. at 2378 (Barrett, J., concurring) (quoting Fin. Oversight & Mgmt. Bd. for P.R. v. Centro De Periodismo Investigativo, Inc., 143 S. Ct. 1176, 1183 (2023)).
[81] Brunstein & Goodson, *supra* note 79, at 99–100 ("[A]lthough a court must approach an agency's assertion of authority with 'skepticism' after having determined it is 'unheralded' and represents a 'transformative' change, if the most natural reading of the statute would permit the agency action, the agency has 'clear congressional authorization' for the action.").
[82] Proposed Rule, 88 Fed. Reg. at 33,284 tbl.1, 33,363.
[83] *Id.* at 33,284 tbl.1.
[84] *Id.* at 33,284 tbl.1, 33363.
[85] *Id.* at 33,304.
[86] *Id.* at 33,304, 33,328 n.499.
[87] *Id.* at 33,310; *see* 26 U.S.C. § 45V(b)(2)(D), (c)(1)(B).

compliance with this <0.45 kg CO_2e/kg H_2 threshold.[88] EPA indicates, however, that it would have certain program-design preferences if the agency were to instead adopt its own compliance protocols;[89] namely, hourly-matching within the same balancing authority.[90]

These comments make five recommendations for the Proposed Rule's selection of hydrogen co-firing as a BSER for different source categories. First, EPA should finalize its proposal to require that only low-GHG hydrogen is co-fired under each BSER because, without any restrictions, EPA's efforts to reduce GHG emissions may backfire. Second, EPA should consider defining "low-GHG hydrogen" to mean hydrogen with a well-to-gate emissions intensity of 0 kg CO_2e/kg H_2 (i.e., hydrogen produced via electrolysis powered by zero-emissions resources). Third, EPA should consider refining its proposed definition of "low-GHG hydrogen" to impose limitations on hydrogen leakage. Leaked hydrogen acts as an indirect GHG that contributes to climate change and thereby undermines the climate benefits of burning hydrogen instead of natural gas. Fourth, as EPA evaluates whether the requirement to co-fire with low-GHG hydrogen should be legally severable from the remainder of the hydrogen co-firing BSERs, EPA should consider multiple important questions, including the likelihood that severability would cause this rule to aggravate climate change instead of mitigating it. Fifth, if Treasury adopts guidance that will underestimate the emissions intensity of hydrogen produced using grid electricity, EPA should develop its own compliance protocols.

A. EPA Should Require Generators to Co-Fire with Only "Low-GHG Hydrogen"

EPA proposes BSERs based on co-firing with "low-GHG hydrogen" and takes comment on this choice and the proposed definition of the phrase.[91] The Proposed Rule correctly recognizes that some methods of hydrogen production create significant GHG emissions and, therefore, "co-firing hydrogen at combustion turbines when that hydrogen is produced with large amounts of GHG emissions would ultimately result in increasing overall GHG emissions, compared to combusting solely natural gas at the combustion turbine."[92] In other words, under these conditions, the hydrogen co-firing BSERs would cause a net increase in the pollution they are designed to reduce. Despite EPA's recognition of this risk, EPA asks whether requiring the use of low-GHG hydrogen would be unnecessary by 2032 (the first year the generators would need to comply with the hydrogen co-firing BSERs) because federal incentives and industry trends may themselves be sufficient to ensure that low-GHG hydrogen dominates the market.[93]

EPA's proposal to base BSERs on low-GHG hydrogen at co-firing generators better ensures the rule's climate benefits because, without this safeguard, it is likely that generators would co-fire with high-GHG hydrogen. Of the multiple ways to produce hydrogen, only electrolysis powered by zero-emissions electricity has a carbon intensity less than EPA's proposed definition of <0.45

[88] Proposed Rule, 88 Fed. Reg. at 33,328.
[89] *Id.* at 33,329.
[90] *Id.* at 33,331.
[91] *Id.* at 33,304, 33,310.
[92] *Id.* at 33,315.
[93] *Id.* at 33,310–11.

kg CO_2e/kg H_2 from well to gate.[94] The next cleanest production method—steam methane reforming/auto-thermal reforming (SMR/ATR) with greater than 90% CCS—has a carbon intensity of approximately 2.5–6 kg CO_2e/kg H_2, which represents a combination of CO_2 directly released during SMR/ATR and upstream emissions[95] of the methane feedstock.[96] Without CCS, SMR/ATR has a carbon intensity of at least 10 CO_2e/kg H_2.[97] Using fossil fuels to power electrolysis is even more emissions-intensive: 22–24 kg CO_2e/kg H_2 for natural gas (without even accounting for upstream methane emissions) and 51–56 CO_2e/kg H_2 for coal.[98] In 2022, less than 1% of hydrogen was produced via electrolysis powered by zero-emission resources; less than 5% was produced through SMR/ATR with greater than 90% CCS; and approximately 95% was produced with SMR/ATR without CCS.[99]

Modeling from the Department of Energy (DOE) further supports specifying, as part of the hydrogen co-firing BSERs, the types of hydrogen that generators can use for co-firing, notwithstanding federal incentives and industry trends. Although the IRA incentivizes investment in electrolytic zero-emissions hydrogen, DOE's modeling indicates that EPA should not assume that this cleanest category of hydrogen will dominate the market.[100] While DOE predicts that electrolytic zero-emissions hydrogen will largely outcompete SMR/ATR hydrogen with CCS in 2030 and comprise 70–95% of the market, DOE also predicts increasing penetration of SMR/ATR hydrogen with CCS in the 2030s and 2040s.[101] In 2040, DOE expects SMR/ATR hydrogen with CCS to comprise 50–70% of total U.S. hydrogen production, with electrolytic zero-emissions hydrogen being the other 30–50%.[102] For 2050, DOE predicts a similar breakdown,[103] and EPA cites this result in the Proposed Rule.[104] Given that SMR/ATR hydrogen with CCS can have a GHG intensity of more than 13-times the emissions of EPA's proposed threshold of <0.45 kg CO_2e/kg H_2,[105] these trends suggest the usefulness of a low-GHG requirement to ensure emissions reductions.

EPA is correct that the emissions intensity of SMR/ATR hydrogen may decrease in the future as EPA limits upstream methane emissions (because methane is a feedstock for these processes) through proposed regulation of, among other sources, leaks at wells and natural gas processing,

---

[94] U.S. DEP'T OF ENERGY, PATHWAYS TO COMMERCIAL LIFTOFF: CLEAN HYDROGEN 10 fig.2 (2023), https://perma.cc/7U99-J28P [hereinafter DOE HYDROGEN LIFTOFF REPORT].
[95] "Upstream emissions" refer to the release of methane, which is a GHG, before it reaches the hydrogen-production facility. These emissions include fugitive emissions during extraction, transportation, and storage.
[96] DOE HYDROGEN LIFTOFF REPORT, *supra* note 94, at 10 fig.2.
[97] *Id.*
[98] *See* THOMAS KOCH BLANK & PATRICK MOLLY, RMI, HYDROGEN'S DECARBONIZATION IMPACT FOR INDUSTRY 5 (2020), https://perma.cc/T3XH-9DSQ ("Producing one kilogram of hydrogen with electrolysis requires 50–55 kWh of electricity. This power consumption leads to indirect CO_2 emissions, the level of which varies according to the sources of electricity used."); *Frequently Asked Questions*, U.S. ENERGY INFO. ADMIN., https://perma.cc/6DJ6-2C77 (providing the CO_2 intensity per kWh for natural gas and coal plants).
[99] DOE HYDROGEN LIFTOFF REPORT, *supra* note 94, at 10 fig.2.
[100] *See id.* at 37 fig.15.
[101] *Id.*
[102] *Id.*
[103] *Id.*
[104] Proposed Rule, 88 Fed. Reg. at 33,329.
[105] *See* DOE HYDROGEN LIFTOFF REPORT, *supra* note 94, at 10 fig.2.

transportation, and storage infrastructure.[106] But EPA should carefully consider the likelihood that SMR/ATR hydrogen would satisfy the <0.45 kg CO_2e/kg H_2 standard during the years when the hydrogen co-firing BSER would apply. According to EPA, emissions from the oil and gas sector (which include leakage from wells and other sources) amounted to 187 million metric tons CO_2e in 2019,[107] and EPA expects that its proposed rulemaking for that sector to lead to a reduction in 2032 of 80 million metric tons CO_2e.[108] Thus, even with EPA's proposed regulation of upstream methane emissions, SMR/ATR hydrogen with CCS may be associated with unacceptably high production-related emissions in 2032.

For the above reasons, EPA should define the type of hydrogen that generators can use when co-firing. Without such a definition, the climate impact of this rule may be blunted, or the hydrogen co-firing BSERs may even have the perverse effect of causing a net increase in GHG emissions relative to the status quo.

B. EPA Should Consider Whether to Define "Low-GHG Hydrogen" as Hydrogen with a Well-to-Gate Emissions Intensity of 0 kg CO_2e/kg H_2

In addition to soliciting comment on whether to require co-firing with "low-GHG hydrogen," EPA seeks comment on its proposed definition for the term.[109] EPA should consider decoupling its definition from the IRA's <0.45 kg CO_2e/kg H_2 well-to-gate standard for the highest tier of hydrogen production tax credits. More specifically, EPA should consider whether to define "low-GHG hydrogen" to mean hydrogen with a well-to-gate emissions intensity of 0 kg CO_2e/kg H_2. That is the emissions intensity of hydrogen produced via electrolysis and powered by a zero-emission resource such as wind, solar, nuclear, or hydropower.

In the CAA, Congress directed EPA to identify "the best system of emission reduction . . . adequately demonstrated" taking into account costs, nonair health and environmental effects, and energy requirements.[110] Congress's decision to provide the greatest tax subsidy to hydrogen produced with an emissions intensity of <0.45 kg CO_2e/kg H_2 does not necessarily bear on what hydrogen should be burned as part of a co-firing BSER for natural gas combustion turbines. Instead, that element of the BSER turns on how, in EPA's assessment, different definitions of "low-GHG hydrogen" would affect emissions reductions, costs, nonair health and environmental effects, and energy requirements.

As EPA considers whether it is appropriate to adopt the IRA's <0.45 kg CO_2e/kg H_2 standard, EPA should consider lead time because the proposed hydrogen co-firing BSER would not begin to apply until 2032. In contrast, hydrogen producers became eligible this year to earn hydrogen

---

[106] Proposed Rule, 88 Fed. Reg. at 33,329; *see* Standards of Performance for New, Reconstructed, and Modified Sources and Emissions Guidelines for Existing Sources: Oil and Natural Gas Sector Climate Review, 87 Fed. Reg. 74,702, 74,708–13 tbls.2 & 3 (proposed Dec. 6, 2022) (to be codified at 40 C.F.R. pt. 60).

[107] EPA, REGULATORY IMPACT ANALYSIS OF THE SUPPLEMENTAL PROPOSAL FOR THE STANDARDS OF PERFORMANCE FOR NEW, RECONSTRUCTED, AND MODIFIED SOURCES AND EMISSIONS GUIDELINES FOR EXISTING SOURCES: OIL AND NATURAL GAS SECTOR CLIMATE REVIEW 65 (2022), https://perma.cc/5GBL-VK9S.

[108] *Id.* at 64 tbl.3-2.

[109] Proposed Rule, 88 Fed. Reg. at 33,310.

[110] 42 U.S.C. § 7411(a)(1).

production tax credits for hydrogen with an emissions intensity of <0.45 kg CO_2e/kg.[111] Because generators will have almost a decade of lead time to prepare for the hydrogen co-firing BSERs, a stricter threshold than Congress established for 2023 may be justified for Section 111 purposes.

Specifically, EPA should consider whether to strengthen the proposed definition to require generators to burn electrolytic zero-emissions hydrogen. The Proposed Rule contains numerous examples of already-announced projects that would produce hydrogen through renewable or nuclear energy.[112] Further, DOE predicts that this type of hydrogen will comprise 70–95% of total U.S. hydrogen production in 2030, two years before the hydrogen co-firing BSER would apply.[113] This forecast reinforces the feasibility of a low-GHG co-firing requirement.[114] And requiring this cleanest category of hydrogen, rather than hydrogen produced with as much as 0.45 kg CO_2e/kg H_2, would result in greater emissions reductions. Under a <0.45 kg CO_2e/kg H_2 standard, a generator might burn electrolytic zero-emissions hydrogen blended with SMR/ATR hydrogen, or with electrolytic hydrogen partially powered by fossil fuels.

In short, EPA should use its expertise to evaluate whether the evidence supports defining "low-GHG hydrogen" as hydrogen with a well-to-gate emissions intensity of 0 kg CO_2e/kg H_2. In effect, this would mean requiring co-firing with electrolytic hydrogen powered by zero-emissions resources.

C. EPA Should Consider the Climate Impacts of Leaked Hydrogen When Defining "Low-GHG Hydrogen"

EPA should additionally consider whether to define "low-GHG hydrogen" to require that hydrogen be sourced via low-hydrogen-leakage pathways. According to DOE, hydrogen "losses . . . throughout the supply chain . . . impact . . . [the] environmental benefits" of transitioning to hydrogen.[115]

Although hydrogen is not technically a GHG, the Proposed Rule recognizes that leaked hydrogen indirectly contributes to climate change by increasing the atmospheric lifetime of methane and ozone.[116] One recent study estimated the GWP20 of hydrogen at 37.3, indicating that hydrogen causes 37.3 times as much warming over a 20-year period as an equal mass of CO_2.[117] Accordingly, if co-fired hydrogen were associated with a leakage rate of 1.2%, the leakage by

---

[111] U.S. Dep't of the Treasury & Internal Revenue Serv., *Request for Comments on Credits for Clean Hydrogen & Clean Fuel Production*, 2022-47 I.R.B. 483 (2022) ("The § 45V credit is allowable for qualified clean hydrogen produced after 2022 at a qualified clean hydrogen production facility during the 10-year period beginning on the date the facility is originally placed in service.").
[112] Proposed Rule, 88 Fed. Reg. at 33,312–13.
[113] DOE HYDROGEN LIFTOFF REPORT, *supra* note 94, at 37 fig.15.
[114] As discussed in Section III.A, DOE predicts that SMR/ATR hydrogen with CCS will gain market share through the 2030s and 2040s. *Id*. The low-GHG hydrogen requirement could help preserve the dominance of zero-emissions electrolytic hydrogen. As the Proposed Rule recognizes, this requirement "creates market demand for, and advances the development of, low-GHG hydrogen, a fuel that is useful for reducing emissions in the power sector and other industries, [which] provides further support for this proposal." Proposed Rule, 88 Fed. Reg. at 33,311.
[115] DOE HYDROGEN LIFTOFF REPORT, *supra* note 94, at 17.
[116] Proposed Rule, 88 Fed. Reg. at 33,306.
[117] Maria Sand et al., *A Multi-Model Assessment of the Global Warming Potential of Hydrogen*, 4 COMMC'NS EARTH & ENV'T 1, 5 (2023).

itself would be the equivalent of 0.45 kg CO_2/kg H_2 for a 20-year period.[118] There are relatively few empirical studies of leakage rates, especially for emerging hydrogen technologies and end uses, but one survey of the literature concludes that 4% of electrolytic hydrogen may escape during production, another 2% could escape during transportation and storage, and another 3% may leak during end-use at the turbine.[119] These leaks are driven in part by hydrogen's small molecular size.[120]

EPA's proposed definition of "low-GHG hydrogen" places no restrictions on hydrogen leakage, but these hydrogen emissions are arguably as significant for EPA's selection of the BSERs as GHG emissions from hydrogen production. Just as EPA recognizes that "[p]ermitting EGUs to burn high-GHG hydrogen to meet the standard of performance here would ignore an important aspect of the problem being addressed, contrary to reasoned decisionmaking," the same could be said for ignoring hydrogen leakage that could diminish or negate this rule's climate benefits.[121]

In part, the Proposed Rule's failure to consider hydrogen leakage was dictated by the proposed alignment with the <0.45 kg CO_2e/kg H_2 well-to-gate standard. By definition, a well-to-gate system boundary excludes any emissions during the transportation, distribution, and use of hydrogen.[122] Thus, inattention to leakage is another reason why EPA should consider decoupling its definition of "low-GHG hydrogen" from the IRA's <0.45 kg CO_2e/kg H_2 well-to-gate standard.[123]

Given the issue of leakage, EPA should consider adopting a definition of "low-GHG hydrogen" that contains two criteria. First, there should be a limit on well-to-gate emissions, which, as discussed above, could take the form of a requirement to use hydrogen with a well-to-gate emissions intensity of 0 kg CO_2e/kg H_2 (instead of the proposed <0.45 kg CO_2e/kg H_2 threshold).[124] Second, the definition of "low-GHG hydrogen" should include a limit on hydrogen leakage. Both components of the definition would need to be satisfied for the hydrogen to qualify as "low-GHG."[125]

There are multiple ways that EPA could define a leakage limit. EPA might develop estimates of hydrogen leakage for different types of equipment, establish a maximum leakage percentage, and require generators to verify that the hydrogen they co-fire does not exceed that threshold based on the hydrogen's path to the generator and EPA's equipment estimates. If EPA does not incorporate a leakage limit into the definition of "low-GHG hydrogen," it should work expeditiously toward a Section 111 rulemaking to regulate hydrogen emissions from hydrogen infrastructure.

---

[118] Using a GWP100 of 11.6, *see id.* at 1, a leakage rate of 3.9% would be the equivalent of 0.45 kg CO_2/kg H_2.
[119] ZHIYUAN FAN ET AL., CTR. ON GLOB. ENERGY POL'Y, HYDROGEN LEAKAGE: A POTENTIAL RISK FOR THE HYDROGEN ECONOMY (2022), https://perma.cc/L77T-TYKG.
[120] DOE HYDROGEN LIFTOFF REPORT, *supra* note 94, at 17.
[121] Proposed Rule, 88 Fed. Reg. at 33,316.
[122] *Id.* at 33,304, 33,328 n.499.
[123] *See* Section III.B.
[124] *See id.*
[125] Because hydrogen is not a GHG, if EPA were to impose a limitation on hydrogen leakage, EPA might describe compliant hydrogen as "low-emissions hydrogen" or "low CO_2e hydrogen," rather than "low-GHG hydrogen."

D. EPA Should Consider Climate Impacts When Deciding Whether the Requirement to Co-Fire with Low-GHG Hydrogen Should Be Severable from the Hydrogen Co-Firing BSERs

EPA also solicits comment on whether the final rule should state that the hydrogen co-firing BSERs are legally severable from any requirement to co-fire with low-GHG hydrogen.[126] This choice should be informed by the discussion above explaining why EPA should mandate low-GHG hydrogen: The hydrogen co-firing BSERs' climate impact is highly sensitive to the emissions profile of the co-fired hydrogen, and EPA should not expect electrolytic zero-emissions hydrogen to dominate all other production methods.[127] Given these conditions, EPA should specify that the low-GHG requirement is inseverable or carefully explain why the hydrogen co-firing BSERs could continue to fill EPA's regulatory goals even without specifying the use of low-GHG hydrogen.

To inform its decision on severability, EPA should focus on the risk that the hydrogen co-firing BSERs would cause a net climate harm if there were no restrictions on the emissions intensity of co-fired hydrogen. The Proposed Rule correctly recognizes that such a result would be contrary to Section 111 because "creat[ing] more damage (in the form of GHG emissions) than [a rule] prevented" would, ironically, cause "the precise problem CAA Section 111 is intended to address."[128] An important dimension of this calculation is how the climate implications of severability would play out differently for different turbines. For new base load turbines and existing base load turbines bigger than 300 MW, the Proposed Rule provides a CCS BSER in addition to the hydrogen co-firing BSER.[129] But the hydrogen co-firing BSER is the sole proposed BSER for new intermediate load turbines.[130]

In the case of a *dual BSER subcategory*, inseverability of the low-GHG definition from the hydrogen co-firing BSER could be more effective for achieving emissions reductions, as these sources would still be subject to an alternative CCS BSER.[131] (EPA would need to clarify that the CCS-based BSER was severable from the hydrogen co-firing alternative BSER in this scenario.) Whereas, if the dual BSER subcategories allowed the definition of "low-GHG hydrogen" to be severable, and it was subsequently severed, this would potentially create a loophole for emissions increases under the hydrogen co-firing pathway relative to the CCS pathway.

In the case of a subcategory for which hydrogen co-firing is the *sole BSER pathway*, if the definition of low-GHG hydrogen were inseverable, and the hydrogen co-firing BSER were

[126] Proposed Rule, 88 Fed. Reg. at 33,248 ("[T]he EPA also solicits comment as to whether the low-GHG hydrogen requirement could be treated as severable from the remainder of the standard such that the standard could function without this requirement.").
[127] *See supra* Section III.A.
[128] Proposed Rule, 88 Fed. Reg. at 33,315.
[129] *Id.* at 33,284 tbl.1, 33,362.
[130] *Id.* at 33,284 tbl.1.
[131] According to the Proposed Rule, the CCS BSER's requirements for 2035 and the hydrogen co-firing BSER's requirements in 2038 are comparably stringent. *Id.* at 33,314 ("A source co-firing 96 percent by volume hydrogen (approximately 89 percent by heat input) would achieve an approximate 90 percent CO_2 emission reduction, which is roughly equivalent to the emission reduction achieved by sources utilizing 90 percent CCS.").

struck down for phases 2 and 3, it could result in these sources needing to comply with only the phase 1 standards, which are best practices for operating and maintenance.[132] However, if the definition were severed, plants could comply by co-firing any hydrogen. Thus, for the sole-BSER subcategory, EPA should carefully consider the likelihood that severability would result in more GHGs than inseverability, based on EPA's expectations about the emissions intensity of the hydrogen that generators would co-fire.

Accordingly, EPA should weigh whether to describe the hydrogen co-firing BSER as severable for some turbines but not others. Relatedly, EPA should consider the feasibility and desirability of a CCS BSER for new intermediate turbines, as the existence of such a standard would significantly affect the severability calculus for these units. If a CCS standard existed for these plants, that failsafe would largely maintain the stringency of the rule if the entire hydrogen co-firing BSER were to be set aside.

EPA should also recognize that boilerplate language labeling an aspect of a rule as severable does not necessarily make it so in the eyes of a court.[133] For a court to find a regulation severable, there cannot be "substantial doubt" that the agency would have promulgated the remainder of the regulation by itself, and the surviving regulation must "function sensibly" on its own.[134] Accordingly, after EPA makes a decision regarding severability—a decision that, again, might vary across subcategories of turbines—EPA should be careful to explain how the agency arrived at that result through consideration of the statutory factors (emissions reductions, costs, etc.). For example, if EPA were to conclude that the first-best system of emission reduction for a turbine is hydrogen co-firing with a requirement to use low-GHG hydrogen but that—if that option were legally unavailable—the next-best system of emission reduction would be hydrogen co-firing using any hydrogen, then EPA should explain this and classify the low-GHG requirement as severable. If EPA were to reach a contrary conclusion—that the BSER for a turbine would not be hydrogen co-firing if the low-GHG hydrogen requirement were set aside—then EPA should say this instead and classify the requirement as inseverable.

To summarize, EPA's overriding concern should be avoiding an increase in GHG emissions compared to the baseline. Ultimately, severability should depend on whether allowing a generator to co-fire hydrogen would be the BSER for a particular turbine if the low-GHG requirement were set aside.

E. EPA Should Adopt Its Own Compliance Protocols for Measuring the Emissions Intensity of Hydrogen if Treasury's Forthcoming Guidance Would Underestimate Emissions from Hydrogen Production

Lastly, EPA solicits comment on whether to adopt Treasury's forthcoming guidance for measuring compliance with the <0.45 kg CO_2e/kg H_2 standard and, if not, how EPA should

[132] *Id.* at 33,288.
[133] Nasdaq Stock Mkt. LLC v. Sec. & Exch. Comm'n, 38 F.4th 1126, 1145 (D.C. Cir. 2022) ("'[T]he ultimate determination of severability will rarely turn on the presence or absence' of a severability clause." (quoting Cmty. for Creative Non-Violence v. Turner, 893 F.2d 1387, 1394 (D.C. Cir. 1990))).
[134] *Id.* (first quoting Epsilon Elecs., Inc. v. U.S. Dep't of Treasury, 857 F.3d 913, 929 (D.C. Cir. 2017); and then quoting Carlson v. Postal Regul. Comm'n, 938 F.3d 337, 351 (D.C. Cir. 2019)).

structure its own compliance protocols.[135] As EPA explains, "[t]he purpose of these strategies would be to ensure that EGUs are using only low-GHG hydrogen."[136] Different compliance protocols would affect how (and possibly whether) this rule would reduce emissions, as well as costs.

As Policy Integrity explained in prior comments to Treasury,[137] there is significant risk that a poorly designed compliance regime would substantially underestimate the production-related emissions. (The same risk does not exist for the much simpler case of an off-grid electrolyzer powered by dedicated zero-emissions resources.) If Treasury releases guidance that mishandles estimating emissions—and thus would misclassify high-emissions hydrogen as low-GHG hydrogen—then adopting the guidance for this rule could undermine EPA's emissions-reduction goals and choice of BSERs. In contrast, the compliance protocols outlined by EPA in the Proposed Rule would avoid several of the pitfalls that Treasury faces. Nevertheless, EPA's proposed protocols could be further improved in the final rule by more careful attention to the critical issue of additionality.

1. EPA Should Reject Treasury's Guidance If It Adheres to a Regional-Annual-Average Approach

The IRA instructs Treasury to measure the well-to-gate emissions intensity of hydrogen using (1) the most recent Greenhouse Gases, Regulated Emissions, and Energy Use in Technologies Model (GREET) or (2) a successor model determined by the Secretary of the Treasury.[138] But the current version of GREET cannot accurately measure the emissions intensity of grid electricity because it lacks geographic and temporal granularity. As a result, if Treasury fails to update or replace GREET, adopting Treasury's guidance would cause this rule to undercount grid emissions and possibly cause more warming than it prevents.

GREET divides the United States into large regions and assigns each an emissions intensity for regional electricity consumption.[139] These regional averages are also *annual* averages because they are calculated using the average emissions intensity of the regional grid over an entire year.[140] In contrast, the true emissions intensity of using grid electricity depends on the emissions intensity of the additional—or "marginal"—generating resource used to meet the electrolyzer's additional consumption of electricity.

Given the realities of grid operation, the marginal resource is typically dirtier than the average electricity mix, meaning that GREET will usually underestimate the grid emissions from an electrolyzer. Grid operators generally dispatch generation resources according to their operating costs: The first resources that a grid operator will rely on to meet demand are those that generate cheap electricity after they have been built, like solar, wind, and hydropower. Only when the

[135] Proposed Rule, 88 Fed. Reg. at 33,329.
[136] *Id*.
[137] Inst. for Pol'y Integrity & WattTime, Comments to U.S. Department of Treasury and Internal Revenue Service on Credits for Clean Hydrogen and Clean Fuel Production (Dec. 2, 2022), https://perma.cc/74SS-5SVM [hereinafter Policy Integrity & WattTime Comments to Treasury].
[138] 26 U.S.C. § 45V(c)(1)(B).
[139] J. KELLY ET AL., ARGONNE NAT'L LAB'Y, UPDATING ELECTRIC GRID EMISSIONS FACTORS 2–3 (2016).
[140] *Id.* at 1.

output of these resources is not enough to satisfy demand will the grid operator call on resources with higher operating costs like coal and oil that also tend to release more emissions. Accordingly, whenever an electrolyzer begins to draw power from the local grid and the low-operating-cost, zero-emissions resources are already committed, the electrolyzer will be powered entirely by fossil fuels. As discussed above, producing hydrogen via fossil-fuel-powered electrolysis is currently the most-emitting production method, worse than SMR/ATR.[141]

In short, GREET underestimates the emissions from using grid electricity to power an electrolyzer because it treats electrolyzers as if they were using an imaginary regional-annual-average mix of electricity, instead of electricity from the marginal resource that actually ramped up to meet the electrolyzer's demand. EPA should reject Treasury's guidance if it retains this regional-annual-average approach because this would lead to the misclassification of high-emissions hydrogen as low-GHG.

If EPA were to develop its own guidance, it should require regulated sources to co-fire hydrogen from grid-connected electrolyzers that have demonstrated compliance with the definition of "low-GHG hydrogen" based on the emissions rates of the marginal resources when and where the electrolyzer was operating.[142] These marginal emissions rates (or marginal fuel sources, from which marginal emissions rates can be extrapolated) are increasingly available from grid operators[143] and private vendors,[144] and the Energy Information Administration is in the process of releasing real-time or near-real-time marginal emissions data for balancing authorities and pricing nodes.[145] Accordingly, if EPA were to require these data in 2032, there would be more than enough lead time for market participants to stand up the necessary systems. Alternatively, it may be desirable to use electricity prices that fall below a low threshold (e.g., $10/MWh) as a proxy for when the marginal generator is zero-emissions.[146]

---

[141] *Supra* Section III.A.

[142] Policy Integrity & WattTime Comments to Treasury, *supra* note 137, at 3–7.

[143] *Five Minute Marginal Emission Rates*, PJM INTERCONNECTION, https://perma.cc/5V2F-HAGN; *Dispatch Fuel Mix*, ISO NEW ENG., https://perma.cc/5249-GD3E (see "marginal flag string"); *California Self-Generation Incentive Program*, CAL. PUB. UTIL. COMMI'N & WATTTIME, https://perma.cc/T5D7-VEPP; *Fuel on Margin*, SPP, https://perma.cc/U3TK-V9TM; *Real-Time Fuel on the Margin*, MIDCONTINENT INDEP. SYS. OPERATOR, https://perma.cc/WYN6-HM9U; *Integrating Public Policy Task Force*, N.Y. INDEP. SYS. OPERATOR, https://perma.cc/VDA9-UC7G (releasing marginal emissions data that were not publicly available; select meeting materials from meeting on Mar. 19, 2018).

[144] Karen Palmer et al., RES. FOR THE FUTURE, OPTIONS FOR EIA TO PUBLISH CO_2 EMISSIONS RATES FOR ELECTRICITY 22–25 (2022), https://perma.cc/6VAA-JEQX.

[145] 42 U.S.C. § 18772(a)(2)(B) (instructing the Energy Information Administration to establish an online database that may include, where available, the estimated marginal GHG emissions per megawatt hour of electricity generated).

[146] TESSA WEISS ET AL., RMI, CALIBRATING US TAX CREDITS FOR GRID-CONNECTED HYDROGEN PRODUCTION: A RECOMMENDATION, A FLEXIBILITY, AND A RED LINE (2023), https://perma.cc/6477-ES22 [hereinafter RMI POLICY BRIEF].

2. EPA Should Reject Treasury's Guidance If It Omits Safeguards Relating to Temporal Matching, Deliverability, or Additionality

Whereas the previous section addressed measuring emissions when an electrolyzer buys electricity without a long-term contract (e.g., on the spot market), electrolyzers might instead opt to enter into power purchase agreements (PPAs) with specific zero-emissions generators.[147] Alternatively, as the Proposed Rule discusses, an electrolyzer might contract solely for the unbundled zero-emissions attribute of the electricity that a generator injects into the grid (e.g., an energy attribute certificate (EAC)).[148] Although neither of these possibilities are accommodated by the current version of GREET,[149] EPA notes that there has been significant debate about how Treasury might structure its forthcoming guidance to allow for these options.[150] EPA should not adopt Treasury's guidance if it accommodates PPAs and EACs without also establishing the necessary safeguards to prevent a net increase in emissions: hourly matching, deliverability, and additionality.[151]

a. Hourly Matching

Hourly matching refers to the requirement that, to satisfy an emissions-intensity standard (e.g., <0.45 kg CO_2e/kg H_2 or 0 kg CO_2e/kg H_2), an electrolyzer must align its purchases of clean electricity or EACs with its consumption of grid electricity on an hourly basis. The advantage of using this granular unit of time is that it helps ensure that an electrolyzer pays for a generator to inject clean electricity into the grid at the same moments when the electrolyzer consumes grid electricity. Without hourly alignment, electrolyzers could have a PPA with a zero-emissions generator (or buy EACs) and use the PPA/EACs to cover electricity consumption that happened during a different hour of the day—perhaps in the middle of the night—when the marginal resource might be natural gas.

It would be inappropriate to adopt a blanket rule allowing the electrolyzer to use the agreement with the solar farm to cancel out its upstream emissions, because the emissions accounting depends on the identity of the marginal generator when the solar farm was generating. If the solar farm sold power/EACs when the marginal generator was natural gas, the power/EACs would be associated with a high quantity of avoided emissions. The same quantity of electricity generated by the solar farm would have been supplied by natural gas if the solar farm had not been operating. So, the electrolyzer could buy power/EACs from the solar farm and offset the carbon intensity of hydrogen produced with grid electricity from the natural gas plant. In contrast, imagine that the solar farm produced electricity when renewable resources were on the margin. In such a situation, some renewables would have been being curtailed, meaning the solar

[147] *See Physical PPA*, EPA (Feb. 25, 2022), https://perma.cc/8YA3-F9GE ("A physical PPA for renewable electricity is a contract for the purchase of power and associated renewable energy certificates (RECs) from a specific renewable energy generator (the seller) to a purchaser of renewable electricity (the buyer).").
[148] Proposed Rule, 88 Fed. Reg. at 33,330.
[149] *See* Memorandum from Clean Air Task Force & Nat. Res. Def. Council to U.S. Dep't of the Treasury & Internal Revenue Serv. 10 (Apr. 10, 2023), https://perma.cc/87TB-GV3C.
[150] Proposed Rule, 88 Fed. Reg. at 33,329.
[151] *See generally* Letter from Clean Air Task Force et al. to U.S. Dep't of the Treasury et al. (Feb. 23, 2023), https://perma.cc/9DDG-G6PL; RMI POLICY BRIEF, *supra* note 146.

farm displaced no emissions. In that case, the electrolyzer cannot validly contract with the solar farm for any offset.

Figures 1 and 2 show how quickly the marginal resource can change within a single regional grid.[152] As such, they reveal that allowing electrolyzers to match their electricity purchases and consumption over timescales longer than an hour (e.g., daily, monthly, or annual matching) would often result in a mismatch between the marginal resources during power consumption and production.

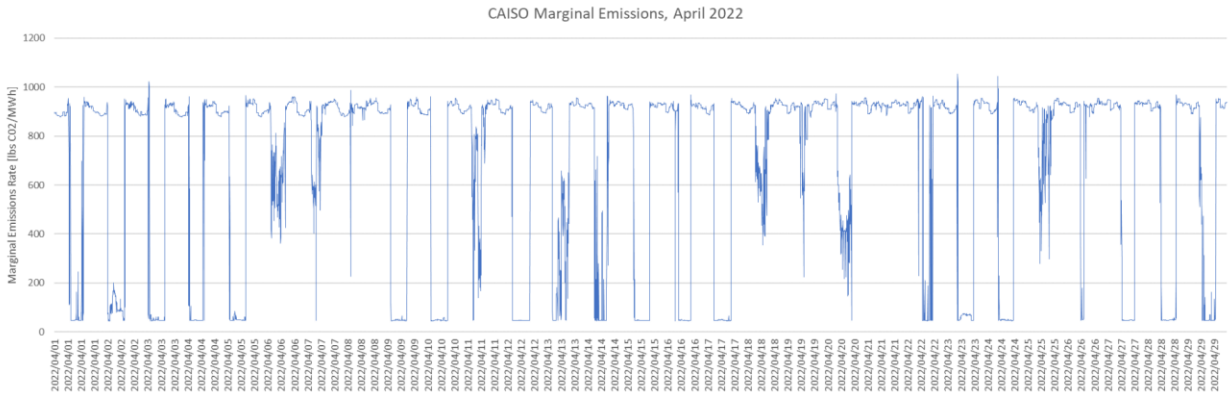


Figure 1: variability in CAISO marginal emissions rate

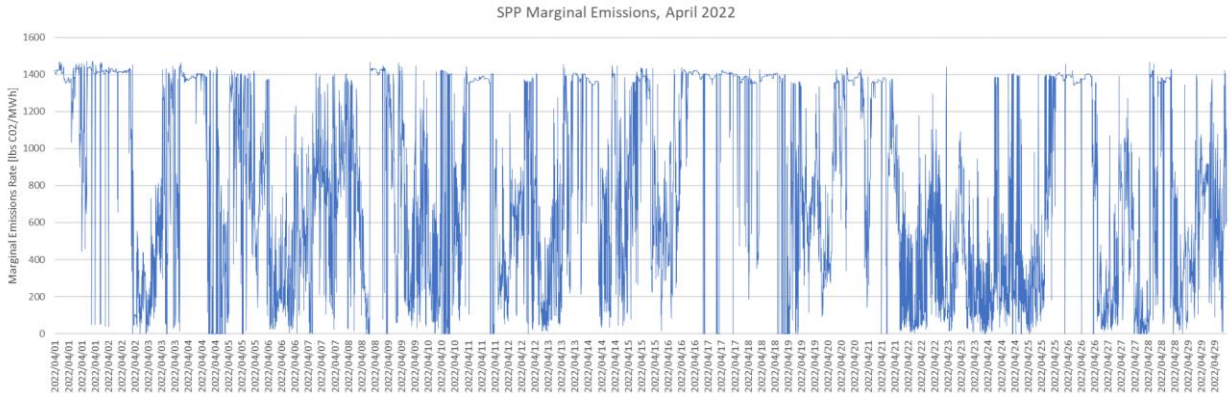


Figure 2: variability in SPP marginal emissions rate

Fortunately, EPA appears to favor an hourly-matching requirement for any EPA-developed compliance protocols.[153] On this point, the Proposed Rule appropriately focuses on the long lead time that generators would have before becoming accountable for co-firing hydrogen.[154]

---

[152] Each figure reflects marginal emissions rates as modeled by WattTime. *See Methodology: How Does WattTime Calculate Marginal Emissions?*, WATTTIME, https://perma.cc/NTD8-F88L; WATTTIME, MARGINAL EMISSIONS MODELING: WATTTIME'S APPROACH TO MODELING AND VALIDATION (2022), https://perma.cc/6DMQ-NX7P.

[153] Proposed Rule, 88 Fed. Reg. at 33,331 ("[T]he EPA is soliciting comments on the appropriateness of requiring hourly EAC alignment requirements at the onset of the compliance period for BSER in 2032. . . . Hourly tracking systems are evolving to meet this need in real time.").

[154] *Id.* at 33,329 ("EPA is taking comment on the need for (and design of) approaches and appropriate timeframes for allowing EGUs to meet requirements for geographic and temporal alignment requirements to verify that the hydrogen used by the EGU is compliant with this rulemaking, recognizing that EPA's low-GHG standard for compliance would not begin until 2032.").

If Treasury finalizes guidance that would not mandate hourly matching by the time the hydrogen co-firing BSERs go into effect, EPA should include this requirement in its protocols. Without granular temporal matching, generators would be able to use potentially meaningless PPAs/EACs while co-firing hydrogen produced via fossil-fuel-powered electrolysis.[155]

b. Deliverability

To be effective, compliance protocols that accommodate PPAs/EACs require not only temporal alignment but also geographic alignment. When an electrolyzer pays for a generator to inject clean electricity into the grid, the injection needs to happen at a location where the electrolyzer could receive the power, given the organization of balancing authorities and transmission constraints. Otherwise, an electrolyzer might be consuming power in a region where the marginal resource is a fossil-fuel-fired plant while contracting with a generation resource located somewhere where renewables are on the margin. The result would be electrolysis powered by fossil fuels, because the clean generation could not reach the electrolyzer and merely displaced other clean generation.

Figure 3 is a snapshot of the geographic variation in emissions rates of marginal resources at a moment in time.[156] It underscores how hourly matching without geographic alignment would be inadequate for measuring compliance with an emissions-intensity threshold, whether that be <0.45 kg CO_2e/kg H_2 or 0 kg CO_2e/kg H_2.

[155] This pitfall could also be avoided under a carbon-matching framework that required the PPA or EACs to cause an emissions reduction equal to the emissions that are induced by the electrolyzer. *See* Letter from Clean Incentive et al. to U.S. Dep't of the Treasury et al. (May 24, 2023), https://perma.cc/VUW2-8CE8. For both the electricity generator and the electrolyzer, emissions avoided or induced would be calculated by multiplying the amount of power generated or consumed by the emissions rate of the marginal generator at the time and location. Policy Integrity & WattTime Comments to Treasury, *supra* note 137, at 8–9; *see also* CARL OSTRIDGE & DEVON LUKAS, RESURETY, EMISSIONS IMPLICATIONS FOR CLEAN HYDROGEN ACCOUNTING METHODS (2023), https://perma.cc/QL53-C5D6. This framework would also obviate the need for deliverability, *see* Section III.E.2.b, but it would still be necessary to show additionality, *see* Section III.E.2.c.

[156] Figure 3 depicts the spatial variation in marginal emissions rates at a representative moment in time on the afternoon of July 25, 2023, as modeled by WattTime. *Grid Emissions Intensity by Electric Grid*, WATTTIME, https://perma.cc/F8K8-G9VF.

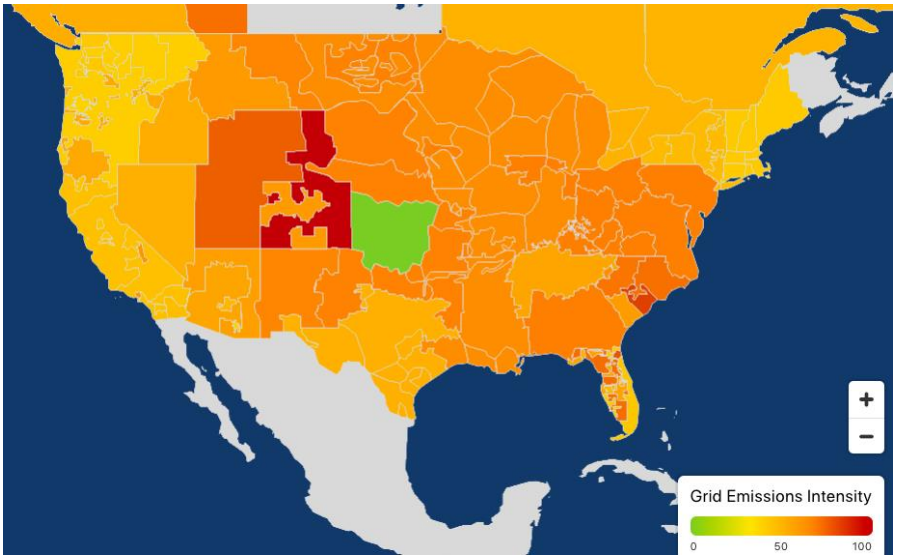


Figure 3: spatial variability in marginal emissions rates

For example, the differences in marginal emissions intensity between the green and red regions indicate the presence of transmission constraints that prevent clean power from flowing out of the green area and into the red one. If an electrolyzer were located in the red area and entered into a PPA with a wind farm in the green area, the power would not be deliverable. The electrolyzer would be causing significant grid emissions. The wind farm would be displacing none because the emissions intensity of zero indicates that renewables are on the marginal resource and thus are being curtailed.

In light of the foregoing, it is appropriate that the Proposed Rule expresses support for requiring alignment at the balancing authority level.[157] If Treasury's guidance does not impose such a mandate, EPA should craft its own compliance protocols with such a deliverability requirement. This would help ensure that co-fired hydrogen is truly satisfies EPA's final definition of "low-GHG hydrogen."

Moreover, EPA should consider whether, by 2032, it would be administrable to implement a heuristic for deliverability that is more precise than requiring co-location within the same balancing authority. Even within balancing authorities, transmission constraints prevent the free flow of electricity.[158] EPA should therefore consider using regions that are smaller than balancing authorities and that better reflect transmission constraints, such as the geographic regions from DOE's National Transmission Needs Study.[159] Alternatively, in wholesale electricity markets, the lack of transmission capacity causes divergences among locational marginal prices, because purchasers must pay for more expensive sources of generation when cheaper electricity is not deliverable to their area.[160] Accordingly, EPA should consider whether

[157] Proposed Rule, 88 Fed. Reg. at 33,331.
[158] DEV MILLSTEIN ET AL., LAWRENCE BERKELEY NAT'L LAB'Y, THE LATEST MARKET DATA SHOW THAT THE POTENTIAL SAVINGS OF NEW ELECTRIC TRANSMISSION WAS HIGHER LAST YEAR THAN AT ANY POINT IN THE LAST DECADE 1–2 (2023), https://perma.cc/MMF2-FDV6.
[159] *See* RMI POLICY BRIEF, *supra* note 146.
[160] PJM INTERCONNECTION, TRANSMISSION CONGESTION CAN INCREASE COSTS 1–2 (2023), https://perma.cc/8TNZ-ENZ8.

a difference in locational marginal prices between the node where an electrolyzer consumes power and the node where a generator produces power could be used to evaluate deliverability in the context of a PPA or EAC.[161]

c. Additionality

Finally, any compliance protocols for PPA/EACs must also require that the temporally- and geographically-matched generation be *additional*, as opposed to electricity that was always going to be generated and used by some other consumer.[162] Without this requirement, PPAs/EACs could merely reshuffle the allocation of electricity on paper and fail to genuinely offset any emissions resulting from the hydrogen production.[163] The electrolyzer would be adding load to the grid, which may be met with fossil-fuel resources, so allowing PPAs/EACs to offset electric load on a 1:1 basis regardless of additionality might lead to underestimating the life-cycle emissions of hydrogen.

Further, without an additionality requirement, EPA would potentially undermine resource adequacy. The generous federal subsidies for clean hydrogen production create an incentive for electricity generators, including nuclear power plants, to opt out of wholesale markets and dedicate their facilities to powering electrolyzers.[164] If EPA were to classify electrolytic hydrogen powered by existing generators as low-GHG hydrogen, this move would further enable their exit. In contrast, if EPA were to insist on additionality, there would be less demand for hydrogen produced using existing power plants, and they would be more likely to participate in wholesale markets.

EPA should not adopt Treasury's guidance unless Treasury requires that, before an electrolyzer can use a PPA/EACs to characterize the emissions intensity of hydrogen, the electrolyzer must demonstrate that the associated clean generation would not have been built but for the prospect that the clean generator could enter into a PPA with (or sell the EACs to) the electrolyzer.[165] And, if EPA develops its own compliance protocols, it should insist on additionality.

---

[161] Volts, *We're About to Give Billions of Dollars to Clean Hydrogen. How Should We Define It?*, at 29:03 (Mar. 29, 2023), https://perma.cc/87SE-ERN3 (statement of Rachel Fakhry) ("[T]he notion is that electrolyzers and the clean energy supply that is netting out their emissions need to be located within a region where the LMP differential is not bigger than X. . . . That is a very good proxy for . . . no congestion between the two . . . .").

[162] *See generally* Memorandum from Clean Air Task Force & Nat. Res. Def. Council to U.S. Dep't of the Treasury & Internal Revenue Serv. 10 (Apr. 10, 2023), https://perma.cc/87TB-GV3C.

[163] *See* GOV'T ACCOUNTABILITY OFF., GAO-11-345, OPTIONS FOR ADDRESSING CHALLENGES TO CARBON OFFSET QUALITY 8 (2011), https://perma.cc/6FUU-ZEG6 [hereinafter GAO OFFSET REPORT].

[164] *See* Will Wade, *Billion-Dollar 'Pink Hydrogen' Plan on Hold as US Weighs Rules*, BLOOMBERG (May 30, 2023), https://perma.cc/FE5T-P9JW (describing Constellation's plan to "add[] electrolyzers at several of its Midwest power plants").

[165] *See* GAO OFFSET REPORT, *supra* note 163, at 3 ("An offset is additional if it would not have occurred without the incentives provided by the offset program."). Additionality is not necessarily satisfied by contracting with a clean generator that has yet to be built. In the context of EACs, if the associated generation would have happened irrespective of any EAC sales, the EACs sold by that generator would not represent avoided emissions that could be claimed by an electrolyzer.

We do not take a stance on which of the multiple tests for assessing additionality would be most appropriate,[166] but an easy-to-administer heuristic would likely be most preferable given the potential future scale of the hydrogen industry. EPA should note that the European Union's heuristic requires the generation facility to have come into operation not earlier than 36 months before the electrolyzer.[167] As the Proposed Rule correctly notes, however, that rule exists in tandem with other European policies that help that ensure new demand is met by clean generation.[168] Thus, a more stringent heuristic may be more appropriate in the United States, where there is no such national policy.

IV. EPA Should Expand the Coverage of the Proposed Emissions Guidelines for Existing Gas Turbines to Encompass More of the Fleet to Mitigate the Risk of Creating Perverse Incentives

EPA takes comment on whether it should expand the coverage of its proposed emissions guidelines for existing gas-fired turbines to encompass more of the fleet.[169] The proposed guidelines regulate only existing units that are larger than 300 MW and run more than 50% of the time.[170] EPA "projects that 37 GW of capacity would meet these criteria in 2035, representing 14 percent of the projected existing combustion turbine capacity and 23 percent of the projected generation from existing combustion turbines in 2035."[171] Other analysis estimates this threshold may cover as little as 7% of natural gas units, responsible for less than 30% of the CO_2 emissions from gas-fired units in the power sector.[172] Leaving most of the source category unregulated at this time could create perverse incentives to shift generation to smaller, less-frequently operated plants. These plants can be less efficient and produce greater rates of GHG emissions and other air pollution, including NO_x emissions.[173] Such behavior could jeopardize delivery of the Proposed Rule's climate and public health benefits.

Legal and economic scholars have long recognized that stringently regulating new sources of pollution while exempting existing sources—a regulatory practice commonly known as "grandfathering"—can perversely encourage those existing sources to stay in operation longer than they otherwise would and lead to adverse environmental consequences.[174] If EPA does not move forward to regulate a larger share of existing gas turbines, this "old plant effect" will be an

[166] *See id.* at 18–21 (comparing different approaches for testing additionality).
[167] Commission Delegated Regulation 2023/1184 of 10 February 2023 supplementing Directive (EU) 2018/2001 of the European Parliament and of the Council by establishing a Union methodology setting out detailed rules for the production of renewable liquid and gaseous transport fuels of non-biological origin, 2023 O.J. (L 157), https://perma.cc/5HFV-2F4Y.
[168] Proposed Rule, 88 Fed. Reg. at 33,331.
[169] *Id.* at 33,361.
[170] *Id.* at 33,362.
[171] *Id.* at 33,361.
[172] Amanda Levin & Sophia Ahmed, *Strengthen Power Plant Carbon Standards for Greater Climate Benefit*, NAT. RES. DEF. COUNCIL (May 22, 2023), https://perma.cc/G3SN-6FXW.
[173] *See, e.g.*, Appendix Figures A & B (comparing the GHG & NO_x emissions rates for existing gas-fired EGUs by size (nameplate capacity)). Many smaller units have higher emissions rates for GHGs and NO_x. *See Id*.
[174] SEE RICHARD L. REVESZ & JACK LIENKE, STRUGGLING FOR AIR: POWER PLANTS AND THE "WAR ON COAL" 30–35 (2016); see also Richard L. Revesz & Allison L. Westfahl Kong, *Regulatory Change and Optimal Transition Relief*, 105 NW. U. L. REV. 1581 (2011); Jonathan Remy Nash & Richard L. Revesz, *Grandfathering and Environmental Regulation: The Law and Economics of New Source Review*, 101 NW. U. L. REV. 1677 (2007).

additional perverse incentive that will potentially undermine delivery of the Proposed Rule's targeted climate and public health benefits. This could affect not only GHGs, but also co-pollutants. EPA is likely to tighten NOx standards for new gas-fired EGUs soon,[175] so incentivizing the operation of new plants by simultaneously regulating GHGs from new and existing plants would likely incentivize the use of new units with better control technologies for NO_x as well.

EPA is considering revised thresholds for the coverage of existing gas units that would be as low as 100 MW capacity and a 40% capacity factor. Analysis from Natural Resources Defense Council finds that adopting a capacity threshold between 100-150 MW and a 40% capacity factor would encompass over 80% of emissions and reduce the risk of shifting generation to older and dirtier units.[176] Expanding coverage would better fulfill EPA's legal obligation to reduce pollution that endangers public health and welfare[177] and avoid creating perverse incentives. EPA should assess whether the BSER identified for the units subject to the threshold in the Proposed Rule would also be the BSER for the additional units covered by the new threshold.

EPA should also consider applying the threshold at the plant level rather than the unit level and conduct the relevant BSER and cost-benefit analyses of applying the threshold to this group of sources. EPA cited smoothing out the burden on regulated entities over time and ensuring reliability as factors it needed to balance when proposing a more limited scope of coverage for existing gas. A plant-based approach could potentially help address these concerns because a plant-based approach could capture a greater percentage of emissions more efficiently by concentrating on groupings of turbines rather than isolated turbines.[178] Consequently, investments in CCS or hydrogen transportation infrastructure could then potentially be lower per unit of generation. If costs are much higher than average for a small number of geographically isolated plants that are far from CCS sequestration sites or hydrogen supplies, EPA could also consider subcategorizing these sources and addressing them in a future rule.

V. While EPA Robustly Analyzes the Proposed Rule's Benefits and Costs, It Should Conduct Additional Analysis Around Key Parameters, Provide Further Explanation of Certain Modeling Assumptions, and Update Baseline Data

Using IPM, EPA conducts a thorough analysis of benefits, costs, and net benefits[179] of the Proposed Rule and its alternatives. The original RIA did not model all components of the

---

[175] Ethan Howland, *EPA Could Set Tighter NOx Limits for New Gas-Fired Power Plants Under Proposed Consent Decree*, UTIL. DIVE (June 15, 2023), https://perma.cc/KF2E-7EHV (discussing EPA's consideration of tightening NO_x emissions limits for new gas-fired power plants under a proposed consent decree that would require a proposal by November 2024); *see also* Proposed Consent Decree, Clean Air Act Citizen Suit, 88 Fed. Reg. 38,507 (proposed June 13, 2023).

[176] Levin & Ahmed, *supra* note 172.

[177] *See* 42 U.S.C. § 7411(b)(1)(A).

[178] *See 111 Existing Gas Coverage*, CLEAN AIR TASK FORCE, https://perma.cc/5EXP-NFBG (showing that if EPA were to set a plant-based standard to cover the same number of units as the unit threshold in the Proposed Rule, it would increase emissions coverage by 60%).

[179] In the RIA for the Proposed Rule, the monetized net benefits for the more stringent alternatives are higher than those for the proposal, but it is not apparent whether this will remain the case when EPA updates its analysis to reflect all elements of the rule. If EPA's final analysis of all elements of the rule shows that an alternative has higher

Proposed Rule, but EPA released updating IPM modeling during the comment period that reflects the full proposal and incorporates some new assumptions regarding LNG exports from the EIA's AEO 2023.[180] In the final rule, EPA should similarly update other components of the RIA that rely on IPM inputs, including its SAGE modeling of social costs[181] and environmental justice analysis modeling.

EPA should also consider supplementing its analysis in the following ways. First, EPA should conduct additional analysis around some key analytical parameters—such as the discount rate and the social cost of carbon—for which additional valuations reflecting the state-of-the-art economic literature exist and would ensure a more complete presentation of benefits and costs. As demonstrated below with calculations using the preliminary RIA data, updating these parameters is likely to show that the net benefits of the proposed program and its alternatives are even greater than EPA's current projections. Second, EPA should consider separately identifying and quantifying any increases or decreases in federal subsidy payments that will result from the Proposed Rule. While these payments are not themselves net social costs, they are nevertheless relevant to an assessment of the Proposed Rule's distributional impacts. Third, EPA should update the information underlying its estimation of baseline emissions and provide further explanation of certain modeling assumptions regarding IRA implementation.

A. EPA Reasonably Relies on Climate-Damage Estimates from an Interagency Working Group, but Should Conduct Further Analysis with Its Own Estimates

To monetize the Proposed Rule's climate benefits, EPA appropriately relies on four valuations produced by the Interagency Working Group on the Social Cost of Greenhouse Gases (Working Group). Those values—though widely agreed to underestimate the full social costs of greenhouse gas emissions[182] —are appropriate to use for now as conservative estimates. They have been applied in dozens of previous rulemakings[183] and upheld in federal court.[184] Policy Integrity, along with six other non-profit organizations, has submitted separate comments to this docket in support of the Proposed Rule's use of the Working Group's climate-damage estimates.

As those joint comments further explain, however, EPA should conduct additional analysis using draft climate-damage valuations that EPA recently published.[185] Though the Working Group's

net benefits that the final rule, EPA should explain why it is not selecting the alternative with higher net benefits. Such a choice could reflect rule effects that are not reflected in the net benefits analysis, either because they cannot be monetized or because they are distributional in nature.

[180] Integrated Proposal Modeling Update, *supra* note 13.

[181] *See infra* Section VI.

[182] Interagency Working Group on the Social Cost of Greenhouse Gases, Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide – Interim Estimates Under Executive Order 13,990 at 4 (2021) [hereinafter 2021 TSD] (acknowledging that current social cost valuations "likely underestimate societal damages from [greenhouse gas] emissions"). Richard L. Revesz et al., *Global Warming: Improve Economic Models of Climate Change*, 508 NATURE 173 (2014) (co-authored with Nobel Prize-winning economist Kenneth Arrow).

[183] Peter Howard & Jason A. Schwartz, *Think Global: International Reciprocity as Justification for a Global Social Cost of Carbon*, 42 COLUM. J. ENV'T L. 203, 270–84 (2017) (listing all uses through mid-2016).

[184] Zero Zone v. Dept. of Energy, 832 F.3d 654, 679 (7th Cir. 2016).

[185] *See* Joint Comments on the Consideration of the Social Cost of Greenhouse Gases in "New Source Performance Standards for Greenhouse Gas Emissions from New, Modified, and Reconstructed Fossil Fuel-Fired Electric

valuations relied on the best science available at the time of their initial development in 2010, they are now widely recognized to understate the true costs of climate change. In November 2022, EPA released updated draft climate-damage estimates (SC-GHG Update).[186] EPA's draft valuations faithfully apply recent advances in science and economics on the costs of climate change and implement the roadmap laid out in 2017 by the National Academies of Sciences for updating the social cost of greenhouse gases.[187] And while EPA's draft valuations remain underestimates,[188] they more fully account for the costs of climate change by incorporating the latest available research on climate science, damages, and discount rates.[189]

Unsurprisingly, given the developing state of the science and economics around climate change, EPA's draft valuations find that the incremental cost of greenhouse gas emissions is substantially higher than the Working Group projected. Using these new valuations will provide a more complete picture of the climate damages from the Proposed Rule and its alternatives. If EPA finalizes the Draft SC-GHG Update prior to its finalization of the Proposed Rule, it should apply the updated valuations in its RIA for the final rule. If EPA has not finalized the Draft SC-GHG Update prior to its finalization of the Proposed Rule, it should apply the Draft SC-GHG Update in sensitivity analysis.

Table 1 shows the climate benefits of the Proposed Rule, the less stringent scenario, and the more stringent scenario using EPA's "central" certainty-equivalent near-term discount rate of 2%.[190] For comparison, the table presents those estimates alongside the four estimates from the Working Group. (Note: These calculations rely on emissions reductions projections from the RIA,[191] which do not reflect modeling for the full integrated proposal and so are meant to be illustrative. EPA should conduct any subsequent analysis to reflect the final integrated proposal and any updated assumptions including regarding LNG exports from the EIA's AEO 2023.)

Generating Units; Emission Guidelines for Greenhouse Gas Emissions from Existing Fossil Fuel-Fired Electric Generating Units, and Repeal of the Affordable Clean Energy Rule," 88 Fed. Reg. 33,240 (proposed May 23, 2023). *See also* EPA External Review Draft of Report on the Social Cost of Greenhouse Gases (2022) [Draft SC-GHG Update].

[186] *Id*.

[187] Nat'l Acads. Sci., Engineering & Med., Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide (2017).

[188] Draft SC-GHG Update, *supra* note 185, at 4 ("[B]ecause of data and modeling limitations . . . estimates of the SC-GHG are a partial accounting of climate change impacts and, as such, lead to underestimates[.]"); *id*. at 72.

[189] External Letter Peer Review of Technical Support Document: Social Cost of Greenhouse Gas (May 4, 2023), https://perma.cc/A9ZY-9RRS.

[190] Draft SC-GHG Update, *supra* note 185, at 9 (describing 2% as the "central" rate); Peter H. Howard et al., *U.S. Benefit-Cost Analysis Requires Revision*, 380 SCIENCE 803 (2023).

[191] RIA, *supra* note 10, at 4-15 tbl. 4-2.

Table 1: Climate Benefits Using Draft SC-GHG Update (2019$ Billion)

	Proposed Scenario	Less Stringent Scenario	More Stringent Scenario
Working Group 5% Average	8.2	7.7	9.1
Working Group 3% Average	30	28	34
Working Group 2.5% Average	45	43	51
Working Group 3% 95th percentile	92	86	100
Draft Update (2% discount)[192]	113	106	134

As Table 1 illustrates, the climate benefits of the Proposed Rule and its alternatives are higher under EPA's draft climate-damage valuations than using the four Working Group valuations that EPA now applies.

B. EPA Should Conduct Additional Analysis Using the Discounting Approach Laid Out in the Draft Update to Circular A-4

In economics, a discount rate translates impacts that occur at different times into a common present value—the higher the annual discount rate, the less impacts further into the future are valued relative to impacts closer to the present. In the Proposed Rule, EPA generally follows the default approach to discounting laid out in the Office of Management and Budget's Circular A-4 by applying annual discount rates of 3% and 7%.[193] While it is reasonable for EPA to rely on the discount rates provided by federal guidance, it is now widely recognized that Circular A-4's discount rates are outdated and too high.[194]

In April, the Office of Management and Budget published a draft update to Circular A-4 that, among other revisions, called for extensive changes in discounting to ensure that long-term benefits and costs receive proper consideration in regulatory impact analysis ("Draft Circular A-4 Update").[195] Specifically, the Draft Circular A-4 Update proposes to lower the default, risk-free consumption discount rate used in regulatory impact analysis from the current 3% to 1.7%, based on updated data and extensive economic scholarship.[196] Also reflecting current economic literature, the update would eliminate the use of the opportunity cost of capital discount rate (currently estimated at 7%) and replace it with the shadow price of capital approach.[197] These

[192] Emissions in future years are discounted back to present value using a 3% discount rate. This is consistent with EPA's approach to the climate-damage valuations using non-standard discount rates of 2.5% and 5%. In the Draft SC-GHG Update, EPA uses a Ramsey rate calibrated to 2% in the short-run for the risk-free rate and also calculates a certainty-equivalent SCC, which accounts for risk as well.

[193] OFF. OF MGMT. & BUDGET, CIRCULAR A-4: REGULATORY ANALYSIS 33–34 (2003), https://perma.cc/SF4S-5V2R [hereinafter CIRCULAR A-4].

[194] *See, e.g.*, Howard et al., *supra* note 190; COUNCIL OF ECON. ADVISERS, DISCOUNTING FOR PUBLIC POLICY: THEORY AND RECENT EVIDENCE ON THE MERITS OF UPDATING THE DISCOUNT RATE (2017), https://perma.cc/HKY9-DSDE.

[195] OFF. OF MGMT. & BUDGET, CIRCULAR A-4: DRAFT FOR PUBLIC REVIEW 9–11 (Apr. 6, 2023), https://perma.cc/4PEM-8CFL [hereinafter DRAFT CIRCULAR A-4 UPDATE].

[196] *Id.* at 75–76.

[197] *Id.* at 78–80.

updates are consistent with the best available evidence and widely supported by the field's leading experts.[198]

If OMB finalizes the Draft Circular A-4 Update before EPA finalizes the Proposed Rule, EPA should apply the discounting approach from the update in its primary analysis. If EPA finalizes the Proposed Rule before OMB finalizes the Draft Circular A-4 Update, EPA should apply the updated discounting approach in sensitivity analysis.

Table 2 shows the net benefits of the Proposed Rule and its two alternatives using the 1.7% discount rate from the Draft Circular A-4 Update. (Note: Once again, these calculations rely on emissions projections from the RIA,[199] which do not reflect modeling the full integrated proposal, and are so meant to be illustrative.)

Table 2: Net Benefits Using 1.7% Social Discount Rate (2019$ Billion)

	Proposal Scenario	Less Stringent Scenario	More Stringent Scenario
3% discount rate, 3% average SC-GHG from Interagency Working Group	85	73	89
3% discount rate, 2% average SC-GHG from EPA's 2022 Draft Update	167	151	189
1.7% discount rate, 2% SC-GHG from EPA's 2022 Draft Update	212	190	239

As Table 2 illustrates, the net benefits of the proposed program and its alternatives increase when a 1.7% social discount rate is applied.

C. EPA Should Explicitly Identify and Quantify Transfers Associated with the Proposed Rule

Circular A-4, the primary guidance document for federal agencies' economic analyses of regulations, defines "transfer payments" as "monetary payments from one group to another that do not affect total resources available to society."[200] Transfers include taxes (transfers from citizens to the government) and subsidies (transfers from the government to citizens). For decades, Circular A-4 has instructed agencies to leave transfers out of their estimates of a regulation's costs and benefits, but counsels agencies to identify any transfers associated with a given regulation and discuss them in the context of a regulation's distributional effects.[201] In

[198] Howard et al., *supra* note 190.
[199] For emissions reductions estimates affecting calculation of climate benefits see RIA, *supra* note 10, at 4-15 tbl.4-2. For estimates of PM2.5 and O3-related health benefits, see *id.* at 7-6 to -8 tbls.7-5, 7-6, 7-7.
[200] CIRCULAR A-4, *supra* note 193, at 8 (2003).
[201] *Id.*

April 2023, the Office of Management and Budget published a draft update to Circular A-4, which reinforces this guidance. [202]

Because some of the technologies affected by the Proposed Rule—carbon capture and storage,[203] for example—are eligible for federal subsidies, the rule will generate transfers between the federal government and the power sector. But EPA does not currently report the magnitude of these transfers. Its IPM results reflect the post-subsidy compliance costs that industry experiences.[204] And its SAGE modeling uses the IPM results to estimate the Proposed Rule's total social costs.

Per Circular A-4, EPA should consider separately identifying and quantifying any increases or decreases in federal subsidy payments that will result from the Proposed Rule. While these payments are not themselves social costs, they are nevertheless relevant to an assessment of the Proposed Rule's distributional impacts.[205] Quantifying these transfers would enhance transparency, and moreover, EPA has reported out transfers in past rulemakings.[206] EPA should contextualize the size of identified increases or decreases in subsidy payments within the size of the relevant government subsidy programs.

D. EPA Should Update IPM Baseline Parameters with the Latest Information and Explain Its Assumptions About IRA Implementation

Some baseline assumptions of IPM rely on outdated AEO projections, potentially introducing biases in estimating the costs and benefits of the Proposed Rule. For example, IPM's projections of electricity demand are derived from the total net energy for load from the AEO 2021 Reference Case.[207] Likewise, the projections for imports, exports, and non-electric sector coal

---

[202] DRAFT CIRCULAR A-4 UPDATE, *supra* note 195, at 57–59. The draft update also notes that, instead of omitting transfers from the cost-benefit analysis entirely, an agency may choose to deviate from this default and include one side of a transfer as a benefit and one side as an offsetting cost. *Id.* at 59–60.

[203] RIA, *supra* note 10, at 3-13. Tax credits also exist for the production of low-GHG hydrogen, another technology associated with the Proposed Rule. In its RIA, EPA takes low-GHG hydrogen as an exogenous input to its models. *Id.* In other words, EPA assumes that the Proposed Rule will not increase the production of low-GHG hydrogen, and thus, should not include the associated tax credits in an estimate of transfers associated with the rule. Should EPA later decide to model the Proposed Rule's potential impact on hydrogen production—something it indicates it plans to do, *id.* at 3-12—it should include the magnitude of the hydrogen tax credits in any analysis of transfers.

[204] Separately, EPA appropriately considers only the post-subsidy cost of carbon capture and storage when assessing its reasonableness as a system of emission reduction under Clean Air Act Section 111. Proposed Rule, 88 Fed. Reg. at 33,300. Whether the cost of a particular system of emission reduction is reasonable for purposes of Section 111 is a different inquiry than whether the costs of a rule are justified by its benefits for purposes of Executive Order 12,866.

[205] CIRCULAR A-4, *supra* note 193, at 8; EPA, GUIDELINES FOR PREPARING ECONOMIC ANALYSES 9-16 n.30 (2014), https://perma.cc/9JZH-FKK5.

[206] EPA, EPA-420-D-23-003, MULTI-POLLUTANT EMISSIONS STANDARDS FOR MODEL YEARS 2027 AND LATER LIGHT-DUTY AND MEDIUM-DUTY VEHICLES: DRAFT REGULATORY IMPACT ANALYSIS 10-34 to -35 (2023), https://perma.cc/Q8B8-X3UJ; EPA, EPA-420-D-23-004, GREENHOUSE GAS EMISSIONS STANDARDS FOR HEAVY-DUTY VEHICLES: PHASE 3: DRAFT REGULATORY IMPACT ANALYSIS 496 tb.8-7 (2023), https://perma.cc/49VN-V3KP.

[207] EPA, DOCUMENTATION FOR EPA'S POWER SECTOR MODELING PLATFORM V6 USING THE INTEGRATED PLANNING MODEL POST-IRA 2022 REFERENCE CASE 3-6 (2023), https://perma.cc/RVJ9-P7H7.

demand are based on the AEO 2020 Reference Case.[208] Moreover, both the fuel-oil and nuclear fuel prices are based on the same data source.[209] Additionally, the cost and performance assumptions for potential conventional units, renewable generating technologies, and non-conventional technologies are based on AEO 2021.[210] These obsolete baseline assumptions might partially explain the lower natural gas prices projected by IPM relative to other models.[211]. To address this issue, EPA should update these baseline parameters using the most current AEO 2023 projections. Alternatively, if EPA does not update these parameters, it should provide an explanation for its choice and explain its understanding of how that choice affects the projections.

EPA should also clarify its assumptions regarding IRA implementation in comparison to AEO 2023.[212] In AEO 2023, EIA explains that it incorporates to the extent possible laws and regulations adopted through mid-November 2022, but acknowledges that it does not reflect full implementation of the IRA package.[213] For example, it does not reflect the wind and solar bonus credits for low-income communities or budget-based government programs such as the Advanced Industrial Facilities program, government green procurements programs, the Greenhouse Gas Reduction Fund, and clean fleet investments.[214] To the extent that EPA projects greater emissions reductions in the baseline than EIA due to modeling implementation of a more complete suite of IRA tax credits and/or the effect of other IRA programs, EPA should explain that choice and how it affects its projections. A report from Energy Innovation provides further clarity on some of the key assumptions in the AEO 2023 that lead EIA to underestimate emissions reductions from the IRA, most notably assumptions about the scale of renewable energy deployment, relative to other models.[215]

EPA should continue to model a fuller picture of IRA implementation in its baseline, including missing aspects from the AEO 2023 analysis. EPA's efforts to capture a fuller picture of IRA implementation is appropriate and consistent with relevant guidance on economic analysis, which provides that agency baselines should reflect anticipated real-world conditions to the extent possible.[216] Given EIA's indication that it will not produce an AEO for 2024, it is

[208] *Id.* at 7-32.
[209] *Id.* at 9-1, 9-3.
[210] *Id.* at 4-18, 4-25.
[211] John Bistline et al. show that natural gas prices in IPM-NRDC are the lowest among nine independent peer-reviewed models employed to examine implications of key IRA provisions. John Bistline et al., *Emissions and Energy Impacts of the Inflation Reduction Act*, 380 SCIENCE 1324, at 16 of Supplementary Materials (2023).
[212] EPA does appropriately discuss assumptions regarding IRA implementation in the Proposed Rule. *See* RIA at 3-11 (explaining that the details of the approach can be found in the modeling documentation).
[213] *Issues in Focus: Inflation Reduction Act Cases in the AEO2023*, U.S. ENERGY INFO. ADMIN. (Mar. 16, 2023), https://perma.cc/4FA9-5PF6 ("Insights produced in this report should be tempered by the assumptions we made regarding IRA implementation as documented in the narrative to the AEO2023. We note in the text where simplifying assumptions may have a significant effect on our results. We excluded certain IRA provisions and programs if they lacked details regarding implementation or if we were unable to reflect the design of those provisions in our current model structure."); *see also* MEGAN MAHAJAN & ROBBIE ORVIS, ENERGY INNOVATION, COMPARING INFLATION REDUCTION ACT MODELING TO THE ANNUAL ENERGY OUTLOOK 5–6 (2023), https://perma.cc/GF4Q-AY5L (comparing which IRA tax credits are included in AEO 2023 and other models).
[214] *Id*. at 5–6.
[215] *See id.*
[216] CIRCULAR A-4, *supra* note 193, at 4 (instructing that the baseline should represent "the best assessment of the way the world would look absent the proposed action" and specifying it "should incorporate the agency's best

particularly helpful for EPA to explain these different assumptions, as an EIA analysis with more current IRA assumptions will likely not be available prior to EPA's finalization of the Proposed Rule.

VI. EPA Should Continue to Refine Its SAGE Model to More Accurately Assess Social Costs and Explain the Uncertainties and Limitations to Its Current Application

In its regulatory analysis, EPA analyzes the potential economy-wide impacts of the Proposed Rule using a CGE model called SAGE. EPA has "invested building capacity" in further development of the SAGE model to fulfill the Science Advisory Board's (SAB's) recommendation that EPA enhance its regulatory analysis with use of CGE models.[217] As recognized by the SAB and highlighted in the regulatory analysis, "the CGE modeling results are complements to, rather than substitutes for other types of detailed analysis EPA conducts for its rulemakings."[218] EPA solicits comments on the SAGE analysis presented in RIA Appendix B.[219]

EPA appropriately includes social costs (i.e., the consumer welfare changes resulting from changes in the mix of consumption goods) as part of its regulatory analysis because they inform EPA's understanding of the Proposed Rule's effects. EPA also appropriately considers these social costs separately from its primary calculation of net benefits, which, consistent with past practice, relies on results from IPM, a partial-equilibrium.[220] SAGE does not model emissions reductions and thus cannot, in its current form, be used to generate a net-benefits estimate.[221]

As detailed below, while it is reasonable for EPA to supplement its IPM-based cost and benefit estimates with SAGE-based social cost estimates, the agency should acknowledge relevant uncertainties and, where possible, perform sensitivity analysis to better understand how these uncertainties affect SAGE's cost estimates.

A. EPA Should Conduct Sensitivity Analyses Around SAGE Baseline Parameters to Capture the Effects of Potential Climate Policies

Certain baseline parameters of SAGE are calibrated using projections from external data sources, which are subject to high policy uncertainty. Accordingly, EPA should conduct sensitivity analyses to assess the degree to which changes in these parameters would affect the estimate of the social costs of the Proposed Rule.

---

forecast of how the world will change in the future, with particular attention to factors that affect the expected benefits and costs of the rule.")

[217] RIA, *supra* note 10, at B-1 to -2.

[218] *Id*. at B-1.

[219] Proposed Rule, 88 Fed. Reg. at 33,411.

[220] EPA could not use SAGE to calculate net benefits because SAGE models only social costs and not social benefits.

[221] As a long-term strategy, EPA can also continue to build its expertise to more fully model effects.

For instance, SAGE calibrates baseline energy use based on EIA's AEO forecast.[222] However, it is important to note that the AEO projections assume that current policies will remain unchanged, disregarding both U.S. and global efforts to mitigate the impacts of climate change.[223] Consequently, the baseline energy use calibrated in SAGE may not accurately reflect the most likely scenario in terms of future climate policies. A recent elicitation by Resources for the Future revealed that the surveyed experts assigned only a 5% probability to global emissions increasing in line with policy assumptions underlying AEO's reference case.[224]

Growth in labor productivity is another example of baseline parameters subject to climate policy uncertainty. SAGE calibrates aggregate economy-wide growth in labor productivity to match the estimates used in the U.S. Congressional Budget Office (CBO) Long Term Budget Projection. Although the CBO's baseline projection incorporates certain climate change effects, it represents a midpoint among various potential outcomes due to economic, scientific, and policy uncertainties.[225] In the future, while unexpected weather-related disasters could reduce labor force productivity and labor supply, more aggressive climate mitigation and adaptation policies might alleviate the adverse effects of climate change on labor productivity.[226] Conducting sensitivity analyses would better illuminate the potential impact of these uncertainties.

B. EPA Should Capture Emissions Changes That Will Occur Due to Shifts in Production Across Regions and Countries

EPA does not currently use SAGE—or any other CGE model—to estimate the CO_2, $PM_{2.5}$, NO_x, and SO_2 emissions reductions associated with the Proposed Rule. Instead, it uses the projections of the IPM to determine the emissions reductions that will result from the rule. However, as a partial equilibrium model that focuses on power sector emissions within the contiguous United States, IPM cannot account for the potential for production shifts across countries and regions,[227]

---

[222] SAGE calculates the unit energy consumption (UEC) based on the total energy consumption from the AEO and then calibrates the model to ensure the growth rates of UEC remain consistent between SAGE and the AEO forecast.
[223] PETER HOWARD ET AL., INST. FOR POL'Y INTEGRITY, THE REAL COSTS OF OFFSHORE OIL AND GAS LEASING at 5 (2022), https://perma.cc/BL55-6HG9.
[224] Kevin Rennert et al., *The Social Cost of Carbon: Advances in Long-Term Probabilistic Projections of Population, GDP, Emissions, and Discount Rates* 23–24 (Res. For the Future, Working Paper No. 21-28, 2021), https://perma.cc/8K2T-49G7 (finding that CO_2 emissions equal or greater to the amount in SSP3-7.0, which represents the current policy moving forward according to Intergovernmental Panel on Climate Change (IPCC)'s AR6 report, has only a 5% change of occurring); INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, WORKING GROUP III CONTRIBUTION TO THE IPCC SIXTH ASSESSMENT REPORT (A6R): TECHNICAL SUMMARY 77 box Ts.5 tbl.1 (2021), https://perma.cc/CMF2-JJLV. AEO's reference case is relatively consistent with SSP3-7.0, as it, too, represents a current policy scenario, which would only deviate from SSP3-7.0 with significantly more aggressive climate policy and action worldwide.
[225] CONG. BUDGET OFF., THE 2022 LONG-TERM BUDGET OUTLOOK 13–14 (2022), https://perma.cc/WR3H-GWC8.
[226] Michael Hübler et al., *Costs of Climate Change: The Effects of Rising Temperatures on Health and Productivity in Germany*, 68 ECOLOGICAL ECON. 381, 382–83 (2008); Arnaud Costinot et al., *Evolving Comparative Advantage and the Impact of Climate Change in Agricultural Markets: Evidence from 1.7 Million Fields Around the World*, 124 J. POL. ECON. 205, 207 (2016); Mengzhen Zhao, *Assessment of the Economic Impact of Heat-Related Labor Productivity Loss: A Systematic Review*, 167 CLIMATIC CHANGE 1, 2 (2021).
[227] Gunnar S. Eskeland & Ann E. Harrison, *Moving to Greener Pastures? Multinationals and the Pollution Haven Hypothesis*, 70 J. DEV. ECON. 1, 3 (2003); Ralf Martin et al., *Industry Compensation Under Relocation Risk: A Firm-Level Analysis of the EU Emissions Trading Scheme*, 104 AM. ECON. REV. 2482, 2483 (2014); J. Scott

each varying in combustion efficiency and fossil-fuel emissions factors.[228] On the demand side, price fluctuations in relevant sectors, influenced by price changes in the power sector, impact trade and consumer demand, further influencing foreign production and emissions.[229] In analyses for future power sector rules, EPA should consider expanding its CGE modeling capabilities to estimate emissions and their impacts. This approach would provide a more comprehensive analysis of the net emissions effect of new limits on U.S. power-sector emissions, considering the interconnectedness of global economies and the potential spillover effects of EPA regulation beyond U.S. borders.

C. EPA Should Describe How Social Costs Might Change if the Condition of Perfect Competition Does Not Hold

As the Proposed Rule increases compliance costs for regulated firms, these costs can be transferred to consumers through higher prices, thus affecting consumer welfare. The extent to which regulatory costs are passed on to product prices, known as the pass-through rate, depends on factors like supply and demand elasticities. Notably, market power also plays a role in the pass-through rate under specific conditions.[230] However, SAGE makes the simplifying assumption that households and firms interact in perfectly competitive markets,[231] which is not true of all 23 sectors covered by the model. For instance, in the healthcare sector, patients may have limited access to full information about healthcare services, while regional markets may exhibit disparities in the availability and quality of health services.[232] Similar complexities arise in sectors such as crude oil extraction,[233] natural gas distribution,[234] airline transport,[235] and water, sewage, and waste,[236] where certain providers may hold market power due to the efficiency advantage over other companies. Consequently, the estimated social costs associated

---

Holladay et al., *Emissions Leakage, Environmental Policy and Trade Frictions*, 88 J. ENV'T ECON. & MGMT. 95, 96 (2018).

[228] These variations can arise from differences in fuel composition, climate conditions, and extraction and combustion technologies, Charles J. Mueller et al., *Fuels and the Impact of Fuel Composition on Engine Performance*, *in* ENCYCLOPEDIA OF AUTOMOTIVE ENGINEERING (David Crolla et al. eds., 2012), as well as regulations and policies in place to control and mitigate GHG and air pollutant emissions, Ekaterina Rhodes et al., *Designing Flexible Regulations to Mitigate Climate Change: A Cross-Country Comparative Policy Analysis*, 156 ENERGY POL'Y. 112419, at 8 (2021).

[229] Holladay et al., *supra* note 227, at 96.

[230] E. Glen Weyl & Michal Fabinger, *Pass-Through as an Economic Tool: Principles of Incidence Under Imperfect Competition*, 121 J. POL. ECON. 528, 531–32 (2013); Jacquelyn Pless & Arthur A. Van Benthem, *Pass-Through as a Test for Market Power: An Application to Solar Subsidies*, 11 AM. ECON. J.: APPLIED ECON. 367, 367–68 (2019).

[231] In perfectly competitive markets, many buyers and sellers operate independently, and no single participant has the power to significantly influence market prices or conditions. Competitive markets allow for free entry and exit of businesses, and information is readily available to all participants.

[232] Livio Garattini & Anna Padula, *Competition in Health Markets: Is Something Rotten?*, 112 J. ROYAL SOC'Y MED. 6, 6–7 (2019).

[233] John Asker et al., *(Mis)Allocation, Market Power, and Global Oil Extraction*, 109 AM. ECON. REV. 1568, 1570 (2019).

[234] Jean-Michel Guldmann, *Economies of Scale and Natural Monopoly in Urban Utilities: The Case of Natural Gas Distribution*, 17 GEOGRAPHICAL ANALYSIS 302, 303 (1985).

[235] Severin Borenstein, *Airline Mergers, Airport Dominance, and Market Power*, 80 AM. ECON. REV. 400, 400–04 (1990); Jonathan E. Hughes, *The Higher Price of Cleaner Fuels: Market Power in the Rail Transport of Fuel Ethanol*, 62 J. ENV'T ECON. & MGMT. 123, 124 (2011).

[236] John K. Ashton, *Total Factor Productivity Growth and Technical Change in the Water and Sewerage Industry*, 20 SERV. INDUS. J. 121, 127 (2000).

with the Proposed Rule, based on the assumption of perfect competition, may not accurately reflect real-world outcomes. Considering these limitations, the agency should qualitatively discuss the constraints of its perfect competition assumption and interpret the resulting estimates with caution.

D. EPA Should Incorporate Frictions Resulting from Involuntary Unemployment

Like general frictionless CGE models, SAGE is designed to depict equilibrium outcomes in a well-functioning economy. As a result, it lacks the capacity to incorporate phenomena such as frictional, structural, or cyclical unemployment.[237] Instead, SAGE can only predict voluntary changes in labor supply as regulations affect the equilibrium wage and the labor-leisure choice of individuals. Thus, in times of involuntary unemployment, such as during the coronavirus pandemic, SAGE cannot accurately represent actual job outcomes. Additionally, it does not provide information about other employment-related conditions, such as the duration of unemployment spells, the reason behind the coexistence of unemployed workers and job vacancies within a certain market, and wage differentials among otherwise similar workers. To more accurately model the effects of the proposed regulation on the labor market, the agency should consider incorporating a search model with frictions, as suggested by peer-reviewed studies such as Hafstead & Williams,[238] in conjunction with SAGE. This augmented approach would enable the representation of unemployed workers searching and matching with job openings over time. In the absence of such augmentation, EPA and others should not rely on SAGE modeling to predict rule-related effects on employment. Beyond the labor market, additional rigidities may exist in both the U.S. and global markets.[239] In the long run, EPA should strongly consider real-world market frictions, including those in the labor market, to ensure realistic economic projections.

E. EPA Should Clarify How It Accounts for Transportation Costs and Trade Barriers

Transportation costs are a particularly critical component of the overall production costs of perishable goods,[240] influencing production decisions in industries like agriculture, food and beverage, and services, each of which SAGE incorporates. SAGE does not model transportation costs or trade tariffs directly, but it relies on IMPLAN data, i.e., an input-output modeling system that estimates the economic impact of activities in a specific region or economy, for business

---

[237] Marc A.C. Hafstead & Roberton C. Williams III, *Unemployment and Environmental Regulation in General Equilibrium*, 160 J. PUB. ECON. 50, 51 (2018); Kenneth Castellanos & Garth Heutel, *Unemployment, Labor Mobility, and Climate Policy*, J. ASS'N ENV'T & RES. ECONOMISTS (forthcoming 2023).

[238] Hafstead & Williams, *supra* note 237, at 51 (analyzing the effects of environmental policy on employment, using a general equilibrium two-sector search model). Hafstead and Williams's findings indicate that the implementation of a pollution tax results in significant employment reductions within the regulated industry. *Id.* However, these reductions are counterbalanced by heightened employment opportunities within the unregulated sector. As a result, the overall effect on employment is relatively minor. *Id.*

[239] Francesco Bosello & Ramiro Parrado, *Climate Change Impacts and Market-Driven Adaptation: The Costs of Inaction Including Market Rigidities*, CLIMATE & DEV. 137, 137 (2022) (modeling rigidities in market adjustments to climate change using a CGE model). These frictions include restricted substitution in production, limited substitutability of domestic and imported inputs, and constrained sectoral workforce mobility.

[240] David L. Hummels & Greg Schaur, *Time as a Trade Barrier*, 103 AM. ECON. REV. 2935, at 2957 (2013).

taxes and subsidies and interregional flow of goods data.[241] EPA should review and explain whether transportation costs and trade barriers are taken into account in the model through the use of the IMPLAN data, as it is currently unclear. If not, EPA should work to include them. Failing to address this issue might lead to lower equilibrium prices in the relevant sectors in SAGE, thus biasing its estimates of economy-wide social costs borne by consumers. Moreover, the level of trade friction in CGE models has an impact on emission leakage, which would bias estimates of global GHG and local non-GHG emissions if SAGE were utilized to quantify climate effects.[242]

F. EPA Should Conduct Sensitivity Analyses Using a Range of Methods to Simulate Abatement Requirements

SAGE has two built-in approaches for simulating abatement requirements on producers: a productivity shock and a nesting structure that explicitly represents the abatement activity. The two approaches differ in their underlying assumptions.[243] To assess the economy-wide effects of the Proposed Rule, EPA applies the productivity shock approach, which involves calibrating the value of a productivity parameter to reflect the compliance requirements.

Specifically, EPA aligns the incremental costs resulting from the Proposed Rule between IPM and a partial equilibrium sub-model of SAGE, known as SAGE-PE.[244] SAGE-PE captures the effects of the proposed regulation by adjusting the reference productivity indices associated with inputs such as materials, fuels, labor, and capital. Once calibrated, the productivity shock is incorporated into the full SAGE model to assess the economy-wide social costs, distributional impact, and indirect effects (e.g., GDP, production output, output price, and employment) of the Proposed Rule.

However, this productivity shock approach implicitly assumes that the capital inputs for compliance activities always already exist.[245] This assumption fails to account for the fact that the Proposed Rule limits emissions for production associated with both new and existing fossil fuel-fired electric generating units, which would influence not only old capital inputs but also new capital investment.

By contrast, the explicit abatement approach employs a nesting structure to represent the abatement activity explicitly.[246] Unlike the productivity approach, this alternative approach assumes that capital inputs for compliance activities are new capital investments.[247] As EPA

---

[241] ALEX MARTEN ET AL., EPA, SAGE MODEL DOCUMENTATION 8, 41, 86 (2023), https://perma.cc/FT8X-FMQ5.
[242] *Id*.
[243] *Id*.
[244] SAGE-PE represents the electric sector and related primary energy sectors like coal mining and natural gas, mirroring the partial equilibrium behavior of IPM.
[245] MARTEN ET AL., *supra* note 241, at 86.
[246] In the explicit abatement approach, the model extends the nesting structure of the production function to include a top-level Leontief nest that combines production of saleable goods and services with pollution abatement activities. With the extended production function that includes abatement activities, firms are assumed to maximize profits inclusive of the abatement inputs.
[247] MARTEN ET AL., *supra* note 241, at 86. The two approaches also differ in how the abatement requirements are met. The productivity shock approach implicitly assumes that compliance inputs have the same substitution

highlights in a scenario simulation of a hypothetical regulation, when a rule affects both existing and new sources of production, the productivity shock approach could lead to a slightly larger estimate of social costs than the abatement requirement approach.[248] However, the Proposed Rule's RIA does not provide clear insight into how the chosen approach would affect the estimates compared with alternative methods. To provide a more robust estimate, the agency should clarify the underlying assumptions and implications of using the productivity shock approach and incorporate the alternative explicit abatement approach as a sensitivity analysis.

VII. EPA Should Update and Strengthen Its Environmental Justice Analysis and Provide Guidance to States on Considering & Addressing Distributional Effects

EPA properly includes an environmental justice (EJ) analysis in the RIA. EPA should update and strengthen this analysis in the following five ways:

A. EPA Should Update the EJ Analysis to Reflect the Final Integrated Proposal

EPA appropriately structures the EJ analysis to assess the distributional effects of the Proposed Rule and its alternatives in addition to the baseline. However, in the current RIA, EPA analyzes the regulations for only existing coal-fired EGUs and the first two phases of new gas-fired EGUs.[249] During the comment period, EPA released additional modeling of the integrated proposal which included the proposed regulations for existing gas and the third phase of the new gas regulations, but the memo summarizing this modeling did not include an updated EJ analysis.[250] EPA should prepare an EJ analysis for the final rule that reflects all regulatory components, including any expansion of the coverage for the existing gas fleet.

B. EPA Should Provide Greater Clarity in the EJ Analysis Concerning its Expectations Regarding NOx and Other Non-GHG Air Emissions

In the integrated modeling update, EPA anticipates that the Proposed Rule will reduce NOx emissions relative to the baseline.[251] EPA also acknowledges that co-firing hydrogen can lead to increases in NO_x emissions,[252] discusses control technology to limit these emissions,[253] and concludes that the hydrogen co-firing BSERs for new[254] and existing[255] gas-fired units will not have adverse effects. In the EJ analysis, EPA should explain how it estimates and locates future NO_x emissions and why it concludes that technologies will be adopted to mitigate adverse local impacts. If EPA cannot fully locate some emissions, such as the emissions from new EGUs, it

---

elasticities as the underlying production technology for the regulated sector, whereas the explicit abatement approach does not allow that flexibility.

[248] *Id.* at 88.

[249] *See* RIA, *supra* note 10, at Ch. 6.

[250] Integrated Proposal Modeling Update, *supra* note 13.

[251] *Id*. at 22 tbl.14.

[252] Proposed Rule, 88 Fed. Reg. at 33,312.

[253] *Id*. at 33,312–13.

[254] *Id*. at 33,314 ("The co-firing of hydrogen in combustion turbines in the amounts that the EPA proposes as the BSER would not have adverse non-air quality health and environmental impacts. It would result in NOX emissions, but those emissions can be controlled, as described in section VII.F.3.c.vii.(A) of this preamble.").

[255] *Id*. at 33,366.

should explain so in the EJ analysis.[256] EPA also should further explain how existing regulations of NO_x and other non-GHG emissions will impact emissions from increased hydrogen use.

C. EPA Should Provide Further Explanation for Its Selection of a 10-Mile Radius for its Demographic Analysis for Existing Facilities with at Least One Coal-Fired EGU and Add Additional Gas-Fired EGUs to the Analysis[257]

EPA should explain why 10 miles is the most appropriate radius for assessing effects from noise, odors, traffic, and emissions, particularly in light of EPA's use of a 3-mile radius in other contexts.[258] EPA should also add existing gas plants subject to the final rule to its demographic analysis. EPA should also expand its demographic analysis to encompass effects from additional existing gas-fired EGUs that are subject to the final rule.

D. EPA Should Provide Guidance to States to Help Them Analyze and Mitigate Negative Impacts on Environmental Justice Communities During the State Plan Development Process for Existing EGUs, Including Advice on Performing Distributional Analysis

As a supplement to the rule, EPA should issue guidance to states to help them further analyze and mitigate pollution impacts on environmental justice communities to the extent feasible. For example, the agency can provide recommendations for conducting a robust, distributional analysis when determining whether to grant a variance to facilities seeking the application of less stringent standards on RULOF (Remaining Useful Life and Other Factors) grounds. EPA should instruct states on how to identify affected communities, how to decide who is vulnerable, and how to analyze impacts to vulnerable communities from adopting less stringent standards.[259] EPA should also offer guidance on how states can reduce non-GHG pollution in environmental justice communities as part of their state plans and suggest states apply the same principles for any underlying distributional analysis.

E. EPA Should Take Seriously Input from EJ Groups on How to Best Structure the Continuation of the Regulatory Process, State Planning, and Related Project and Permitting Activities to Achieve Meaningful Engagement

In light of possible impacts on environmental justice communities, EPA should take seriously their recommendations for how to improve engagement in the rulemaking and its implementation. In the Proposed Rule, EPA notes that "CCS projects undertaken pursuant to these emission guidelines will, if the EPA finalizes proposed revisions to the CAA [S]ection 111 implementing regulations, be subject to requirements for meaningful engagement as part of the State plan development process."[260] EPA should move forward to expeditiously finalize these revisions to the implementing regulations and ensure that they reflect input from EJ groups.

---

[256] See RIA, *supra* note 10, at 6-30.
[257] *See* RIA, *supra* note 10, at 6–7.
[258] *See Power Plants and Neighboring Communities*, EPA (May 11, 2023), https://perma.cc/C4X4-NJG9 (citing EPA, EJ SCREENING REPORT FOR THE CLEAN POWER PLAN (July 30, 2015), https://perma.cc/DL2F-9S4C).
[259] *See* Inst. for Pol'y Integrity, Comments on the EPA's Standards of Performance and Emissions Guidelines for Oil and Natural Gas Sector Climate Review" at 15–17 (Feb. 13, 2023), https://perma.cc/B2SK-4HQS.
[260] *See* Proposed Rule, 88 Fed. Reg. at 33,369.

Respectfully,

Dena Adler
Libby Dimenstein
Christopher Holt
Peter Howard
Matthew Lifson
Minhong Xu

dena.adler@nyu.edu

Appendix

Figure A: CO2 Emissions Rates (lbs. / MWh-gross) vs. Nameplate Capacity (MW), Natural Gas-Fired Units, 2021

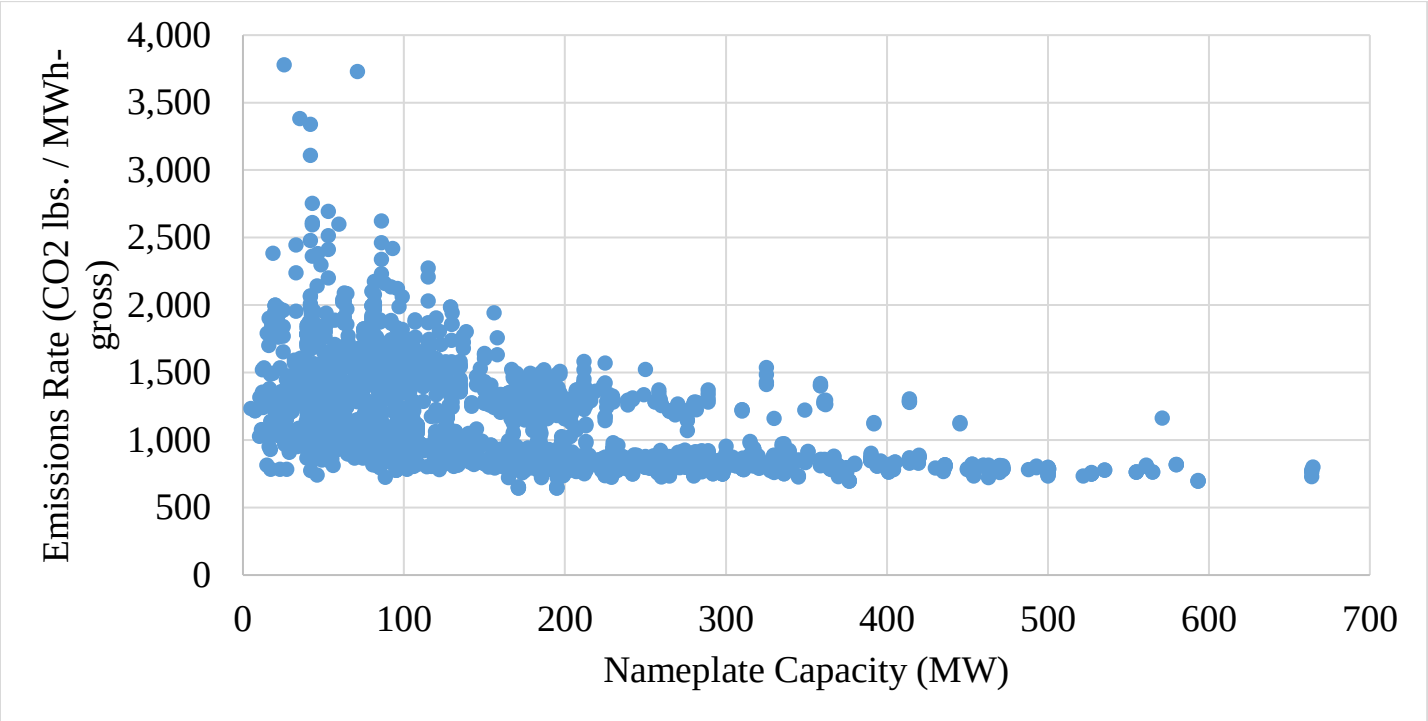
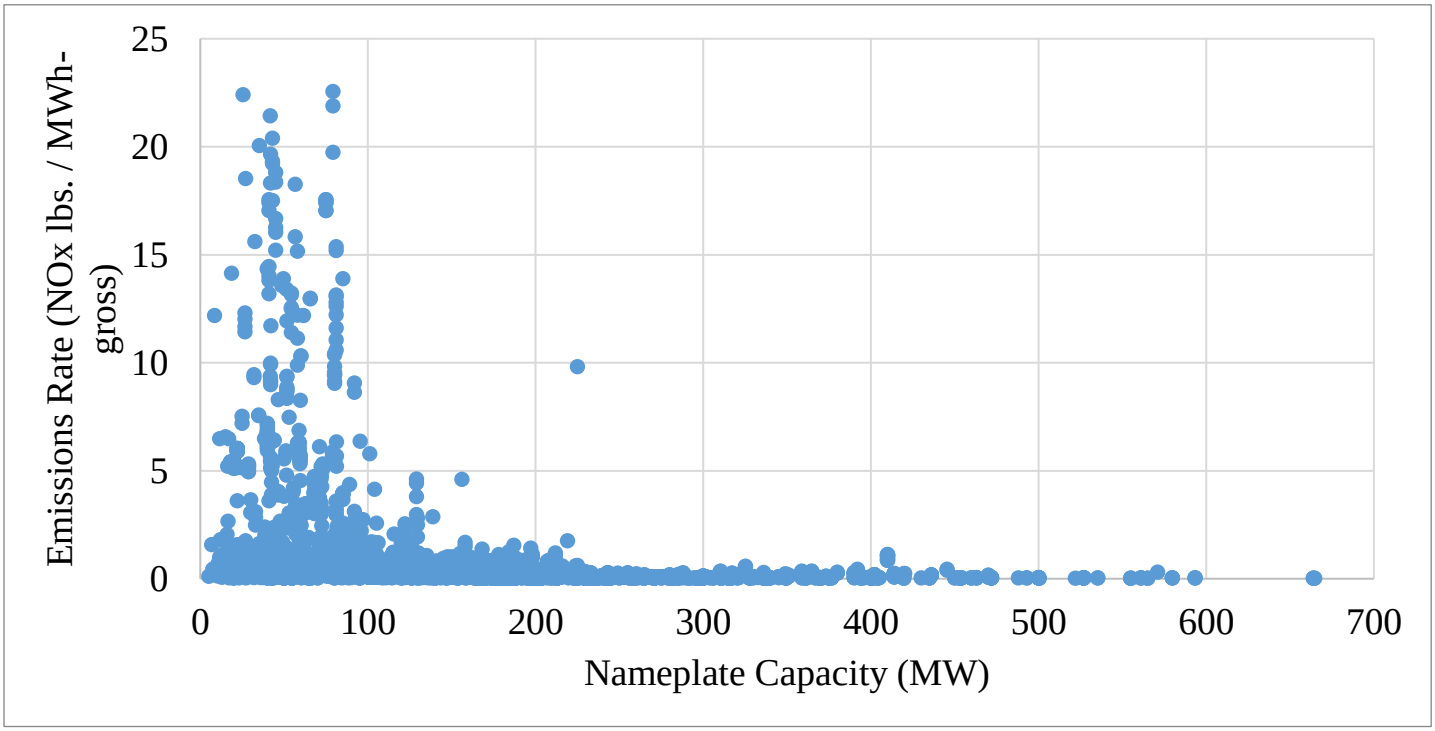


Figure B: NOx Emissions Rates (lbs. / MWh-gross) vs. Nameplate Capacity (MW), Natural Gas-Fired Units, 2021



Emissions rates were calculated using EPA's Clean Air Markets Program Data (CAMPD), available at https://campd.epa.gov/data/custom-data-download. We filter on units with natural gas or pipeline natural gas listed as the primary fuel type, and combustion turbine or combined cycle as the unit type. Consistent with the methodology employed by EPA in its technical support documentation (Natural Gas-and Oil-fired Steam Generating Unit Technical Support Document, Simple Cycle Stationary Combustion Turbine EGUs Technical Support Document, Docket ID No. EPA-HQ-OAR-2023-0072), we compute emissions rates as pounds of 2021 emissions divided by gross megawatt hours. Nameplate capacities for generators associated with each unit were determined using the CAMPD facility level data. Outliers with emissions rates greater than 4,000 lbs. CO2 per MWh-gross or 30 lbs. NO_x per MWh-gross are omitted from the plots.