UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Repeal of Greenhouse Gas Emissions Standards for Fossil Fuel-Fired Electric Generating Units

Docket No. EPA-HQ-OAR-2025-0124

Via regulations.gov

August 7, 2025

We submit these comments on behalf of Clean Air Task Force and Natural Resources Defense Council (together, "Commenters"), in response to the U.S. Environmental Protection Agency's June 17, 2025 proposed rulemaking in the above-caption docket, 90 Fed. Reg. 25752. Commenters are nonprofit organizations with decades of legal, technical and policy expertise on energy, environmental, and public health issues. This comment addresses aspects of the proposed repeal's alternative proposal.

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I. The Alternative Proposal's conclusions regarding 90 percent carbon capture and storage are unfounded, contrary to its earlier findings, and arbitrary.

EPA correctly determined in the Carbon Pollution Standards that 90 percent carbon capture and sequestration was the best system of emission reduction for long-term coal-fired power plants and the most frequently operated new gas-fired plants, and that standards based on it were achievable. *See* 89 Fed. Reg. 39798, 39801–02 (May 9, 2024) (hereinafter "Carbon Pollution Standards").[1] As part of those determinations, EPA correctly found these pollution control systems were adequately demonstrated and cost-reasonable. EPA also determined standards based on that system were achievable by the rule's compliance dates. Those determinations were supported by a strong and detailed technical record and were consistent with the Clean Air Act and Supreme Court precedent. The Carbon Pollution Standards are important to protect from the impacts of climate pollution to public health and welfare, and these standards should not be repealed.

The proposed repeal's reversal on those three previous determinations – adequate demonstration of the 90 percent capture rate, cost-reasonableness of 90 percent carbon capture and storage on a per metric ton or per megawatt-hour (MWh) basis, and achievability of the standards by January 1, 2032, compliance dates – in the alternative proposal are unreasonable, arbitrary and capricious, and contrary to the evidence before the agency and the agency's statutory responsibilities. *See* 90 Fed. Reg. 25752, 25768 (June 17, 2025) (hereinafter "proposed repeal"). EPA cannot remedy the proposal's many legal and technical deficiencies in this rulemaking, and the proposal must be withdrawn.

EPA's Office of the Administrator has stated that the purpose of the proposed repeal is "to Protect Beautiful, Clean Coal."[2] That unlawful motivating purpose is in stark contrast to the pollution reduction obligation Congress placed on EPA in the Clean Air Act. Section 111 requires EPA to "identify the emission levels that are 'achievable' with 'adequately demonstrated technology.' After EPA makes this determination, it must exercise its discretion to choose an achievable emission level which represents the best balance of economic, environmental, and energy considerations." *Sierra Club v. Costle*, 657 F.2d 298, 330 (D.C. Cir. 1981). Under this analysis, "the amount of air pollution [is] a relevant factor to be weighed when determining the optimal standard." *Id.* at 326. The system chosen must reduce emissions the best considering the relevant factors. But the proposed repeal completely fails to perform those statutory obligations and instead attempts to bend reality toward its stated motivating factor of protecting the coal industry.

Importantly, EPA is not here writing on a blank slate. When reversing a policy, as EPA proposes to do so here, it must provide a "more detailed justification than would suffice for a

[1] There are many types of fossil fuel-fired electricity generating units (EGUs). Because steam-generating EGUs are most frequently coal-fired power plants, this comment refers to these units as "coal-fired powered plants," and because stationary combustion turbine EGUs are most commonly gas-fired power plants, this comment commonly refers to these units as "gas-fired power plants." *See* 89 Fed. Reg. at 39811 (explaining types of power plants).

[2] EPA, Office of the Administrator, *Administrator Zeldin Proposes 2 Deregulatory Actions to Protect Beautiful, Clean Coal*, EPA's "Call it a Comeback" Newsletter (June 13, 2025), https://perma.cc/M7AM-4Y6R.

new policy written on a blank slate" if the "new policy rests upon factual findings that contradict those which underlay its prior policy." *FCC v. Fox Television Stations, Inc.*, 556 U.S. 503, 515 (2009). As the Supreme Court has held, it "would be arbitrary and capricious to ignore such matters." *Id.* That is why a "reasoned explanation is needed for disregarding facts and circumstances that underlay … the prior policy." *Id.* at 516. The proposed repeal falls woefully short of this legal requirement. It lacks new analysis, studies, or factual findings, and it does not provide any reasonable or more detailed explanations for why EPA is departing from its earlier determination, nor does it consider any alternatives other than simply discarding the Carbon Pollution Standards.

Among its many deficiencies, the proposal utterly fails to consider any alternative to complete repeal, instead treating the question before it as a binary choice – a 90 percent carbon capture and storage based standard with a compliance date of January 1, 2032, or no regulation at all. *See, e.g.*, 90 Fed. Reg. at 25773 ("Whether CCS with other, lower rates of capture could be the BSER is outside the scope of this repeal action.") That fundamental flaw in the analysis is contrary to EPA's obligation to "consider the alternatives that are within the ambit of the existing policy." *Dep't of Homeland Sec. v. Regents of the Univ. of Cal.*, 591 U.S. 1, 30 (2020) (cleaned up). This requirement is a part of the bedrock administrative law principle that it is arbitrary and capricious to ignore an "important aspect of the problem." *See id.* (quoting *Motor Vehicle Mfrs. Ass'n v. State Farm Mut. Auto. Ins. Co.*, 463 U.S. 29, 43 (1983)). But while the proposed repeal attacks the 90 percent capture rate and compliance date, it does not – and cannot – disrupt the finding that carbon capture and storage is an adequately demonstrated system of emission reduction, including at high rates of capture. In fact, as of the promulgation of the Carbon Pollution Standards, there were at least fifteen carbon capture and storage projects operating in the U.S., with another 121 in construction or advanced stages of development. *See* 89 Fed. Reg. at 39813–14. There have been successful deployments across both industrial applications and commercial-scale power plants. 89 Fed. Reg. at 39813. But the proposed repeal never considers other rates of capture, which it does not dispute have been demonstrated, or later compliance dates, among other alternatives within the ambit of the existing policy, and that failure cannot be corrected without, at a minimum, first withdrawing the proposal.

The proposed repeal also fails to perform EPA's obligation under Section 111(d) to regulate carbon emissions from existing coal-fired power plants. *See* 42 U.S.C. § 7411(d) ("The Administrator shall prescribe regulations … for any air pollutant … to which a standard of performance under this section would apply if such existing source were a new source"). EPA retains this obligation because it issued standards for new coal-fired sources in 2015, which remain in place as of the proposal and which the alternative proposal leaves intact. *See* 90 Fed. Reg. at 25768 ("under the alternative proposal, the EPA is not reopening the 2015 NSPS"). EPA's statutory responsibility is to "decide[] the amount of pollution reduction that must ultimately be achieved. It does so by again determining, as when setting the new source rules, the best system of emission reduction that has been adequately demonstrated for existing covered facilities." *West Virginia v. EPA*, 597 U.S. 697, 710 (2022) (cleaned up). But the proposed repeal does no such thing, and instead of determining achievable amounts of pollution reduction, unsuccessfully attempts through manipulation of capture rates and other unfounded assertions to discredit its earlier determinations.

Not only does the proposed repeal fail to grapple with the strong and detailed technical record supporting the Carbon Pollution Standards, but it also ignores the ways that carbon capture and storage has continued to improve since those standards were promulgated. Carbon capture and storage projects are continuing to operate successfully, with several large-scale projects consistently meeting high levels of technical performance. These include the commercial-scale Boundary Dam project, the data from which EPA previously – and correctly – concluded was "enough, by itself, to support the EPA's adequate demonstration finding for a 90 percent standard," *id.* at 39889, and which recently celebrated ten years of successful operation during which it has captured over 6,833,000 metric tons of carbon dioxide and provided valuable insight on successful carbon capture.[3] It also includes Petra Nova, which "successfully captured 92.4 percent" from its processed emissions stream during its initial three-year period of operation, 89 Fed. Reg. at 39850, and has now been back online for over a year since it was restarted in September 2023.

Taking a broader lens, the year 2024 saw growth in carbon capture and storage projects globally, with 50 projects in operation, 44 under construction, and 628 projects in the pipeline – representing a 60 percent year-on-year increase.[4] One of these projects is the gas-powered Ravenna CCS project in Italy, which began operating in September 2024 and, for its first eight months of operations, has seen monthly average capture rates "constantly greater than 91.8%, with a peak of 96.1%."[5] These developments, which are nowhere considered in the proposed repeal, bolster EPA's prior conclusions about the adequate demonstration of 90 percent carbon capture and storage and that standards based on this system are achievable.

Crucially, the proposed repeal also completely fails to consider one of the most important aspects of the problem of carbon pollution: the emissions themselves, and their impacts on public health and welfare. These emissions and their impact are covered more fully in a separate comment letter on the proposed repeal's primary proposal, which commenters join in full and incorporate here by cross reference.[6] The U.S. power sector alone emits more carbon dioxide than all but five national economies.[7] The standards that EPA is proposing to repeal would reduce

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[3] Zuri Epp & Laurent Thomas, *Learnings from a decade of carbon capture at Boundary Dam,* Shell Catalysts & Technologies, at 3 (June 25, 2025), https://catalysts.shell.com/hubfs/Learnings%20from%20a%20decade%20of%20carbon%20capture%20at%20Boundary%20Dam%20June%202025.pdf?hsCtaAttrib=191820288026 [hereinafter "Shell, Learnings from a decade"].

[4] Global CCS Institute, *Global Status of CCS 2024: Collaborating for a Net-Zero Future,* at 12 (2024), [Attachment A].

[5] Robert Ferrario et al., *Ravenna CCS - Phase 1: Early Insights from the First 8 Months of CO_2 Capture, Transport and Storage Operations*, 17th OMC Med Energy Conference and Exhibition in Ravenna - Italy 08-10, at 4 (April 2025) [hereinafter *Ravenna Phase I CCS Report*] [Attachment B].

[6] *See* Comments of Environmental NGOs on Repeal of Greenhouse Gas Emissions Standards for Fossil Fuel-Fired Electric Generating Units, Primary Proposal (filed to this docket Aug. 7, 2025); *See* Comments of Environmental NGOs on Repeal of Greenhouse Gas Emissions Standards for Fossil Fuel-Fired Electric Generating Units, Primary Proposal (filed to this docket Aug. 7, 2025).

[7] *See* Peter H. Howard & Jason A. Schwartz, Institute for Policy Integrity, *The Scale of Significance: The U.S. Power Sector's Annual Climate Pollution Causes Thousands of Deaths and Massive Economic Damage,* at 4 (May 2025), https://policyintegrity.org/files/publications/Power_Sector_GHG_Contribution_Issue_Brief_vF.pdf.

those CO_2 emissions by 1.38 billion metric tons over roughly two decades, equivalent to a year's worth of emissions from 328 million gasoline cars.[8]

These emissions are undisputedly warming the planet. As EPA correctly noted last year, "[e]very additional increment of temperature comes with consequences." 89 Fed. Reg. at 39809. Those consequences include exposure to air pollution, including from dust and wildfire smoke, more intense heat waves, and damages to infrastructure and property. *See id.* at 39807–10.[9] The standards EPA now proposes to repeal would also result in reductions of tens of thousands of tons of particulate matter, sulfur dioxide, and nitrogen oxide emissions. *See* 89 Fed. Reg. at 40008.[10] These pollution reductions are critical in a warming planet, where other sources of such pollution are on the rise.

It is imperative that the U.S. acts in a timely manner to address this problem. Last year saw the greatest increase in atmospheric carbon dioxide on record – barreling toward a new global average of 422.8 parts per million, a level last seen about three million years ago.[11] This proposed repeal completely – and unlawfully – ignores that problem, the significant contribution of U.S. fossil-fueled power plants to it, and the benefits of addressing it.

That failure to consider the possible emissions reductions from power plants is at the core of the proposed repeal's failings. Reducing emissions of harmful air pollutants is central to EPA's obligations under Section 111. *See* 42 U.S.C. § 7411(a)(1); *Sierra Club*, 657 F.2d at 326; *West Virginia*, 597 U.S. at 710. Moreover, the failure to consider emission reductions and their impacts renders specific aspects of the proposed repeal, such as the consideration of cost reasonableness, arbitrary by failing to consider the benefits of carbon emission reductions when analyzing costs of pollution control. *See* 90 Fed. Reg. at 25772 (considering costs of 90 percent carbon capture and storage on a per megawatt-hour and per ton without evaluating amount of or benefits from emission reductions); *Entergy Corp. v. Riverkeeper, Inc.*, 556 U.S. 208, 225–26 (2009). *See also Michigan v. EPA,* 576 U.S. 743, 753 (2015) ("reasonable regulation ordinarily requires paying attention to the advantages *and* the disadvantages of agency decisions"). Commenters here incorporate by reference the analysis of the expected emissions reductions from implementation of the Carbon Pollution Standards, and associated benefits that the proposed repeal would

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[8] *See* EPA, Press Release, *Biden-Harris Administration Finalizes Suite of Standards to Reduce Pollution from Fossil Fuel-Fired Power Plants* (Apr. 25, 2024), https://perma.cc/YCJ8-UEB3.

[9] US Global Change Research Program, *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* [Reidmiller, D.R. et al (eds.)]. U.S. National Climate Assessment, National Oceanic and Atmospheric Administration & National Aeronautics and Space Administration at 1515 (2018), doi:10.7930/NCA4.2018; IPCC, *Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [Masson-Delmotte, V., et al. (eds.)]. Cambridge University Press (2021) at 3–32, doi:10.1017/9781009157896.001.

[10] *See* EPA, Regulatory Impact Analysis for the NSPS for GHG Emissions from New, Modified, and Reconstructed Fossil Fuel-Fired EGUs; Emission Guidelines for GHG Emissions from Existing Fossil Fuel-Fired EGUs and Repeal of the Affordable Clean Energy Rule, EPA-HQ-OAR-2023-007208913 (2024), https://www.regulations.gov/document/EPA-HQ-OAR-2023-0072-8913.

[11] *See* Rebecca Lindsey, *Climate Change: Atmospheric Carbon Dioxide*, NOAA (May 21, 2025), https://perma.cc/5N4G-XJLY.

eliminate, that are described in a separate letter.[12] If finalized, the proposed repeal would eliminate these benefits.

In summary, each of EPA's three proposed determinations on 90 percent carbon capture and storage – (1) on adequate demonstration; (2) on cost reasonableness; or (3) on achievability of standards – are arbitrary and capricious, counter to the evidence before the agency, and unreasonable. 90 Fed. Reg. at 25768–69; *see State Farm*, 463 U.S. at 43. Further, the failure to even consider alternative standards alone renders the proposal unlawful. *See Regents*, 591 U.S. at 30. Due to the complete absence of much required analysis, the proposed repeal's failures cannot be remedied in this rulemaking. As a result, if finalized, the proposal would be arbitrary and capricious, an abuse of discretion, or otherwise not in accordance with law. EPA must withdraw the alternative proposal and enforce the Carbon Pollution Standards currently in effect.

II. EPA is required to set standards for existing coal-fired power plants under Section 111(d).

EPA has the legal obligation under Section 111(d) to issue emission guidelines covering existing coal-fired power plants. *See* 42 U.S.C. § 7411(d) ("The Administrator shall prescribe regulations … for any air pollutant … to which a standard of performance under this section would apply if such existing source were a new source"). In 2015, EPA finalized new source performance standards (NSPS) for coal-fired power plants based on what can be achieved through partial carbon capture and storage. *See* 80 Fed. Reg. 64510, 64513 (Oct. 23, 2015). Under the alternative proposal in the proposed repeal, EPA "is not reopening the 2015 NSPS or substantive elements of 40 CFR part 60, subpart TTTT." 90 Fed. Reg. at 25768. Because that rule would remain in effect under the alternative proposal, EPA's obligation to regulate existing coal-fired power plants under Section 111(d) would also remain.

Under Section 111(d), EPA "decides the amount of pollution reduction that must ultimately be achieved. It does so by again determining, as when setting the new source rules, the best system of emission reduction that has been adequately demonstrated for existing covered facilities." *West Virginia*, 142 S. Ct. at 2601–02 (2022) (cleaned up). In addition to adequate demonstration, EPA must "tak[e] into account the cost of achieving such reduction and any nonair quality health and environmental impact and energy requirements" when determining the "best system of emission reduction." 42 U.S.C. § 7411(a)(1). Once EPA has set the level of pollution reduction, states "then submit plans containing the emissions restrictions that they intend to adopt and enforce in order not to exceed the permissible level of pollution established by EPA." *West Virginia*, 142 S. Ct. at 2601, 2602.

The alternative proposal would completely repeal the guidelines for existing coal-fired power plants. By repealing these guidelines in their entirety, EPA would fail to comply with Congress's statutory command that it "shall prescribe regulations" under Section 111(d) for

[12] *See* Comments of Environmental NGOs on Repeal of Greenhouse Gas Emissions Standards for Fossil Fuel-Fired Electric Generating Units, Primary Proposal (filed to this docket Aug. 7, 2025).

pollutants from sources "to which a standard of performance under this section would apply if such existing source were a new source." 42 U.S.C. § 7411(d).

The repeal also violates Section 135 of the Clean Air Act, a recently added section of that law, which addresses "domestic electricity generation and use." 42 U.S.C. § 7435. This provision reinforces EPA's existing authority to regulate carbon dioxide emissions from existing power plants under Section 111(d). Subsection (a) provides funding to EPA, among other things, "to ensure that reductions in greenhouse gas emissions are achieved through the use of the existing authorities of this Act." *Id.* § 7435(a)(6). That subsection also directed EPA to incorporate anticipated changes in generation, which are influenced by incentives established by Congress, when regulating.[13] Congress enacted this provision shortly after the Supreme Court interpreted Section 111 as allowing standards that "improve the pollution performance of individual sources" and "caus[e] plants to operate more cleanly." *West Virginia*, 597 U.S. at 734, 706. *See* Inflation Reduction Act, Pub. L. No. 117-169, § 60107 (2022) (Low Emissions Electricity Program). Importantly, Section 135 of the Clean Air Act directs EPA to achieve greenhouse gas emissions reductions under its existing authorities, which include Section 111. However, by eliminating emissions guidelines for existing coal-fired power plants, EPA would ensure the opposite – that emissions increases will occur through the failure to use existing authorities of the Clean Air Act. Congress directed EPA to reduce greenhouse gas emissions through Clean Air Act authorities, and this proposed repeal is flatly contrary to that requirement.[14]

III. Basics of Carbon Capture and Storage

The proposed repeal fundamentally misrepresents several aspects of the pollution control system, carbon capture and storage, that EPA determined was the best system of emission reduction at a 90 percent capture rate for long-term existing coal-fired power plants and new baseload gas-fired power plants. This section explains carbon capture and storage, including carbon capture system design and operational principles.

Carbon capture and storage (CCS) is a pollution control technology that can be used to prevent the emission of CO_2 to the atmosphere, permanently storing it deep below the Earth's surface. This system encompasses the processes by which CO_2 is separated from emissions sources, transported, and injected deep below the earth's surface for permanent storage.[15]

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[13] See 42 U.S.C. § 7435(a)(5)-(6) (instructing EPA to "assess" the projected emission reductions from anticipated changes in electricity generation following enactment of the Inflation Reduction Act and to issue new standards that "ensure" reductions); *see also* EPA, *Electricity Sector Emissions Impacts of the Inflation Reduction Act: Assessment of Projected CO_2 Emission Reductions From Changes in Electricity Generation and Use*, EPA 430-R-23-004 (September 2023), https://perma.cc/RA8S-Z3J9 (EPA's report prepared in response to the Inflation Reduction Act).

[14] *See also* 89 Fed. Reg. at 39901 (describing legislative history of this provision); Greg Dotson & Dustin J. Maghamfar, *The Clean Air Act Amendments of 2022: Clean Air, Climate Change, and the Inflation Reduction Act*, 53 Env't L. Rep. 10,017, 10,033-34 (2023) (describing how section 135 "affirms EPA's responsibility for decreasing GHG emissions from the domestic power sector").

[15] *See generally* 89 Fed. Reg. at 89813; EIA, *CCUS in Clean Energy Transitions* (2020), https://www.iea.org/reports/ccus-in-clean-energy-transitions.

The fundamental technologies that comprise carbon capture and storage have been available for decades:

- **Capture –** The first patents for CO_2 separation or 'carbon capture' were issued in the 1930s. By the 1960s, industries could choose from diverse commercial capture processes.[16] At least 160 million metric tons of CO_2 are captured every year for use in industries such as food, drink, and fertilizers.[17]

- **Transport –** Over 8,500 kilometers of pipelines carry CO_2 in the United States. Over the last 50 years, they have transported over 500 million metric tons of CO_2.[18]

- **Storage** – Injecting CO_2 deep underground is well understood. Over 20 million metric tons of CO_2 have been injected into dedicated geological storage sites for climate purposes in Norway since 1996. In the U.S., over 850 million metric tons have been injected safely since the 1970s for a process known as enhanced oil recovery.[19]

Carbon dioxide needs to be in a relatively pure state before it can be safely transported and permanently stored underground. Carbon capture refers to a wide range of processes that can be used to separate CO_2 from the other gases produced with during combustion and industrial processes – often this is mostly nitrogen from the air. The majority of large-scale CCS projects use a form of the capture process shown in Figure 1 (p. 12), based on organic molecules called amines that can react with and bind CO_2. The gas mixture is introduced to an absorber reactor in which the amine solution flows downwards and reacts with the CO_2. The amine solution, now containing the bound CO_2, is then pumped to another reactor (known as the stripper or regenerator) where it is heated to release pure CO_2. The purified gas has to be pressurized to a dense state using compressors, before it can be transported and pumped into underground storage sites.

The separation, transport, and geological storage of CO_2 has been undertaken for decades as part of commercial industries including natural gas processing, fertilizer production, and oil extraction. This includes the separation (capture) of CO_2 from combustion flue gas, often for commercial uses of CO_2 for urea fertilizer or the food and beverage industry. For example,

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[16] *See* U.S. Patent US1783901A, *Process for separating acidic gases*. https://patents.google.com/patent/US1834016A/en (last visited July 30, 2025).

[17] *See* International Energy Agency, *Putting CO2 to use,* at 3 (2019), https://perma.cc/WD3G-FN4V (subtracting the consumption of CO_2 for enhanced oil recovery from the total of 230 million Tonnes of CO_2 captured every year).

[18] PHMSA, *Annual Report Mileage for Hazardous Liquid or Carbon Dioxide Systems* (July 1, 2025), https://www.phmsa.dot.gov/data-and-statistics/pipeline/annual-report-mileage-hazardous-liquid-or-carbon-dioxide-systems (last updated July 7, 2025); 89 Fed. Reg. at 39860.

[19] Bruce Hill et al., *Geologic carbon storage through enhanced oil recovery*, at 4 Energy Procedia. (2013). https://perma.cc/FU27-728S.

Mitsubishi Heavy Industries CO_2 capture technology is used in over a dozen plants for separation of CO_2 from gas-fired flue gas, at the scale of 200–1200 metric tons of CO_2 per day.[20]

A. Capture System Design

CO_2 capture systems operate based on the same fundamental chemical engineering principles underlying numerous other pollution control systems using scrubbers that have been in widespread commercial operation for decades. Scrubbers can be built for a variety of pollutants, but the common systems all operate by routing contaminated gas through a cylindrical unit where it comes into contact with a solvent. The interaction of the solvent with the gas causes the solvent to dissolve or react with part of the gas. The solvent is then treated to dispose of the contaminant.

Although a variety of carbon capture systems exist, the most commercially developed systems are amine solvent-based scrubbers. Carbon dioxide capture using amine solutions has been used to separate CO_2 from natural gas and hydrogen since the 1930s. The technology works by bubbling gas through a liquid solvent where CO_2 dissolves and is chemically absorbed by the amine. The CO_2-rich amine solvent is then heated to release the captured CO_2, allowing the amine solvent to be regenerated and reused continuously.[21]

1. Designing Capture Systems to Scale

Capture systems can be made larger or smaller to process different volumes of gas and to achieve higher or lower capture rates. A CO_2 scrubber uses packing beds of specially shaped components that provide high surface area for gas-liquid contact. The scrubber can be made taller with more packing beds to increase the capture rate by providing more contact time and surface area between the gas and liquid. Each additional packing stage improves removal efficiency. Increasing the absorber diameter can enable larger volumes of flue gas to be processed. The larger cross-sectional area reduces gas flow rate and therefore the power needed to push the gas through the system, although flow rates must be kept high enough to ensure good capture rates. In some circumstances, two or more absorber towers will be the optimum design for processing large flue gas volumes.

[20] Mitsubishi Heavy Industries, *CO_2 Capture Technology: CO_2 Capture Technologies Achievements*, https://www.mhi.com/products/engineering/co2plants_projectrecords.html (last visited July 30, 2025).

[21] *See* National Petroleum Council, *Meeting the Dual Challenge: A Roadmap to At-Scale Deployment of Carbon Capture, Use, and Storage, Appendix E Mature CO_2 Technologies,* at E-6 (December 12, 2019), https://perma.cc/TZC3-XKFY.

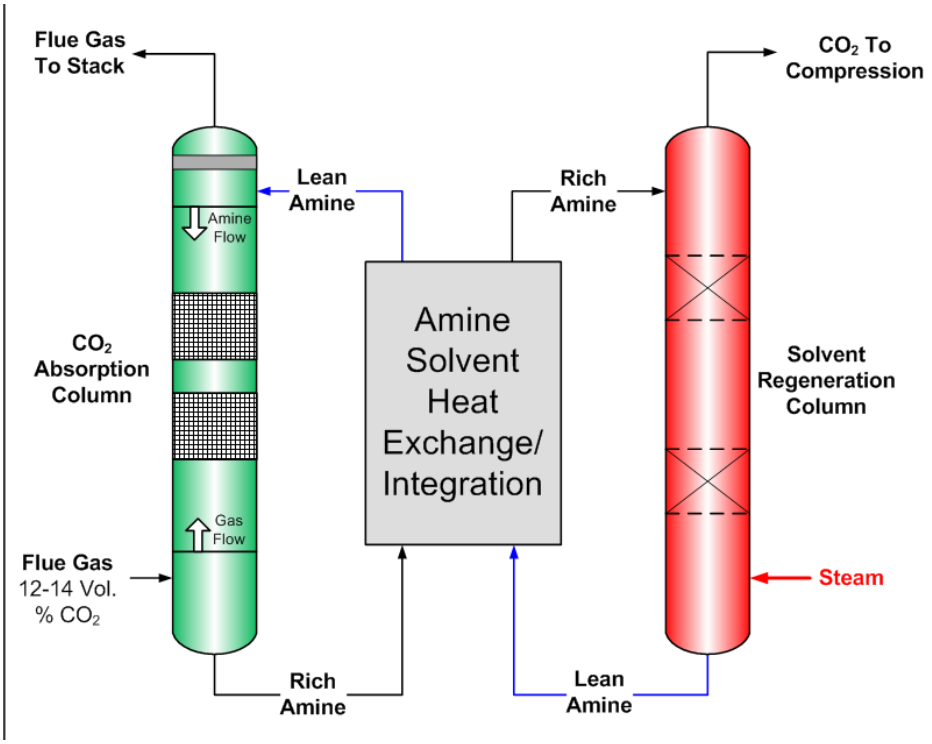

Figure 1. Schematic of Amine-Based Post-Combustion CO_2 Capture Process.[22]

A capture plant's efficiency depends on how an operator designs and operates the column. The design and operation of the system can adjust the ratio of amine to flue gas, the height of the absorber, and solvent loading to maximize capture rate of the system.[23] New retrofit projects designed to meet any particular standard would be built at sufficient size to meet that standard given current knowledge regarding the system's operational efficiency.

Capture systems using the most broadly available solvents, like Cansolv, can and do reach capture rates in excess of 95 percent, as demonstrated in at least six pilot projects[24] and at Boundary Dam.[25]

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[22] DOE NETL Carbon Dioxide Capture Handbook, at 18 (2015), https://perma.cc/5SDF-SVRS.

[23] *See* Stavros Michailos & Jon Gibbins, *A Modelling Study of Post-Combustion Capture Plant Process Conditions to Facilitate 95–99% CO2 Capture Levels From Gas Turbine Flue Gases*, 10 Front. Energy Res. 2022 (examining multiple variations in these parameters that can achieve 95–99 percent capture), *available at* https://www.frontiersin.org/journals/energy-research/articles/10.3389/fenrg.2022.866838/full.

[24] *See* David Mullen & Mathieu Lucquiaud, *On the cost of zero carbon electricity: A techno-economic analysis of combined cycle gas turbines with post-combustion CO2 capture*, 11 Energy Reports 5104 (2024) (describing 95%+ capture projects at 3 coal and 3 combined heat and power); *see also* Appendix A.

[25] Brent Jacobs et al. *Reducing the CO2 Emission Intensity of Boundary Dam Unit 3 Through Optimization of Operating Parameters of the Power Plant and Carbon Capture Facilities*, Proceedings of the 16th Greenhouse Gas Control Technologies Conference (GHGT-16) 23–24 Oct 2022 (November 29, 2022) at Table 2, https://dx.doi.org/10.2139/ssrn.4286430.

2. Auxiliary and Integrated System Designs

There are two basic system designs that have been implemented for capture systems. In the first, an integrated design, the system captures waste heat from the power plant itself to drive solvent regeneration, which is the approach taken by the Boundary Dam capture plant.

The second, an auxiliary generation design, implements CCS with auxiliary heat generation specifically for solvent regeneration. This approach uses additional energy sources (such as natural gas boilers) to provide the temperatures needed to strip CO_2 from the amine solution and regenerate the solvent. Such heat can be provided by, for example, an auxiliary gas cogeneration unit, as in the case of the Petra Nova facility.

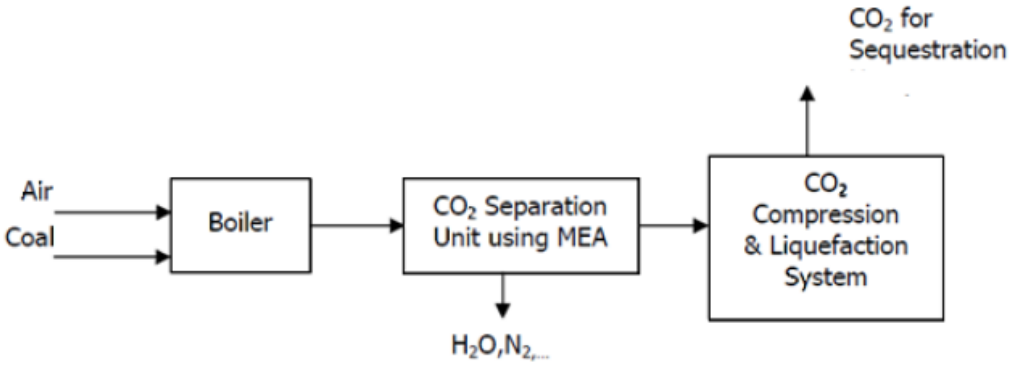

Figure 2. Simplified Diagram of Post-Combustion Capture of CO_2 using monoethanolamine (MEA) Solvent.[26]

[26] Sarah O. Bashadi & Howard J. Herzog, *Using auxiliary gas power for CCS energy needs in retrofitted coal power plants*, 4 Energy Procedia 1828 (2011), https://doi.org/10.1016/j.egypro.2011.02.060.

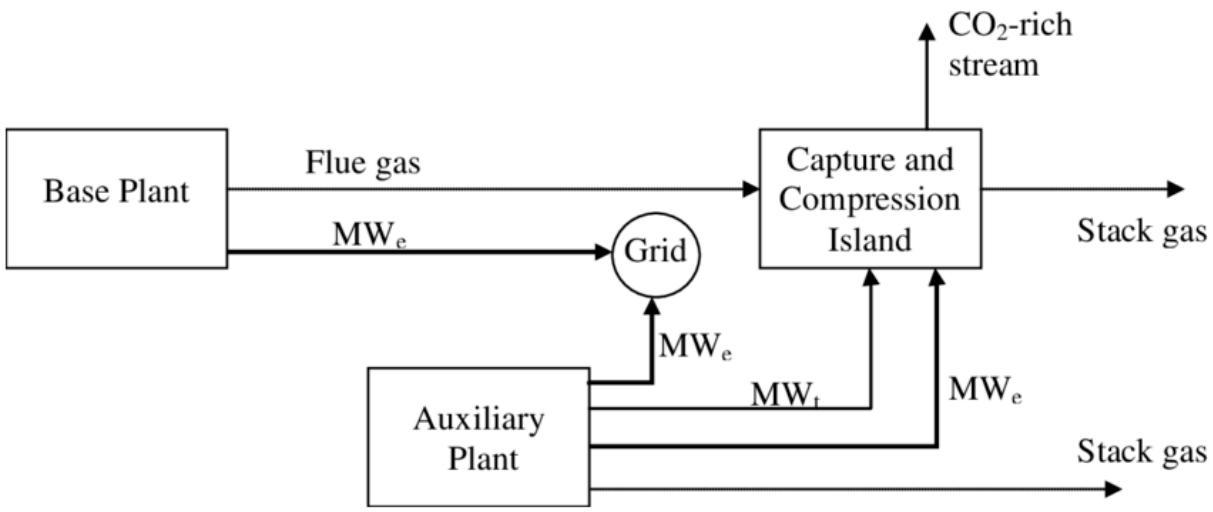

Figure 3.[27]

To lower the emissions rate of such systems, auxiliary plant stack gas may also be captured by the same or a parallel capture system.

B. Capture System Operational Metrics

Operators may use multiple metrics to track the performance of carbon capture systems. Such measures might include:

- *Capture rate* or *capture efficiency* generally refers to the percentage of CO_2 removed from the flue gas that is processed by the capture system. For example, the first commercial-scale CCS project on a coal-fired power plant at Boundary Dam Unit 3 averaged 89 percent from 2015–2022. It was 90, 94 and 91 percent in 2020, 2021, and 2022, respectively. This metric is what EPA referred to as the "capture rate" throughout the Carbon Pollution Standards when describing the adequate demonstration of 90 percent carbon capture and storage. *See, e.g.*, 89 Fed. Reg. at 39888–89 (describing capture rates for Boundary Dam and Petra Nova as capture percentages of treated flue gas).
- *Availability* refers to the amount of time a plant or other system is operational over a given timeframe. This includes planned downtime for maintenance. It is normal and expected that the availability of any system is less than 100 percent, including fossil generation without CCS. *See infra* Comment IV.D.2.
- *Capture amount* is the mass of carbon dioxide the system captures, usually in tons per year.
- *Emissions intensity* or *emission rate* refers to the mass of CO_2 emitted per unit of energy output, typically in terms of tons or pounds of CO_2 per megawatt-hour. It depends on

[27] Sarah O. Bashadi & Howard J. Herzog, *Using auxiliary gas power for CCS energy needs in retrofitted coal power plants*, 4 Energy Procedia 1828–1834 (2011). https://doi.org/10.1016/j.egypro.2011.02.060.

both the capture amount and the base unit's electrical output, both of which may vary over time. The standards and guidelines for long-term coal-fired power plants and new baseload gas-fired power plants in the Carbon Pollution Standards are based on the emission rate of the applicable unit. *See, e.g.*, 89 Fed. Reg. at 39801–39802 (describing emission rates).

C. Operational flexibilities in operating a power plant and capture system

Both capture systems and power plants are typically assumed to have 85 to 90 percent availability, accounting for 10 to 15 percent downtime from both scheduled maintenance and unexpected outages. Currently operating coal plants without CCS often have more than 15 percent downtime. *See infra* Comment IV.D.2. Operators can minimize the impact of planned equipment maintenance by coordinating maintenance schedules for the emissions source and the capture system. Where the capture system or other pollution control equipment faces unplanned downtime, an operator may cease operation of the source power plant in order to maintain compliance with pollution control standards. Measures such as equipment redundancy, isolations, and improved flue gas cleaning can also reduce the amount of downtime for capture systems and allow them to continue to operate while being maintained. *See infra* Comment V.D.

IV. EPA mischaracterizes its prior determination in the Carbon Pollution Standards on adequate demonstration and misstates Section 111's standard for adequate demonstration.

Throughout the proposal's discussion of 90 percent CCS, EPA misstates its prior conclusions and analysis. As a result, EPA has not provided a reasoned explanation for the alternative proposal. On many aspects of the Carbon Pollution Standards, EPA fails even to demonstrate an awareness that it is changing position. *See Fox TV*, 556 U.S. at 515 (explaining that "the requirement that an agency provide reasoned explanation for its action would ordinarily demand that it display awareness that it *is* changing position"). An agency "may not depart from a prior policy *sub silento*," as EPA does here. *Id.* For these and other reasons, the proposal is arbitrary and capricious.

A. The proposed repeal does not question the adequate demonstration of either the transport or storage components of CCS.

As explained above, carbon capture and storage systems consist of three components – capture, transport, and storage. The proposed repeal does not question the adequate demonstration of either transport or storage, nor could it.

Carbon dioxide pipelines have been in use for more than half a century, and thousands of miles of pipelines are currently in operation. 89 Fed. Reg. at 39855. Similarly, tens of millions of tons of carbon dioxide have already been permanently stored underground, and dozens of sequestration projects are ongoing. *Id.* at 39847, 39864. The Carbon Pollution Standards analyzed various and its conclusions – that the needed transport and storage will be available – are manifestly reasonable. *See id.* at 39855–56. The Carbon Pollution Standards also

acknowledged that, if existing sources have particular difficulties with transportation or storage, they may be eligible for variances. *See id*. at 39860.

The proposed repeal only discusses the achievability of standards with regards to transportation and storage and not those components' adequate demonstration. *See* 90 Fed. Reg. at 25733, 25769. Because the proposal could not be finalized based on new findings related to adequate demonstration of these components, Commenters do not discuss the adequate demonstration of the transportation or storage or storage components of the 90 percent CCS system beyond what is already included in the Carbon Pollution Standards and supporting materials for that rule,which we incorporate in full by reference here.[28]

B. EPA correctly found that 90 percent CCS was currently adequately demonstrated.

In 2024, EPA determined that 90 percent CCS was adequately demonstrated *at that time*. *See, e.g.*, 89 Fed. Reg. at 39939 ("CCS is clearly adequately demonstrated, and ripe for wider implementation. Nevertheless, the EPA acknowledged in the proposed rule, and reaffirms now, that the power sector will require some amount of lead time before individual plants can install CCS as necessary."). The proposed repeal instead suggests EPA based its prior determination that 90 percent CCS "would develop further." 90 Fed. Reg. at 25769. The proposed repeal is fundamentally flawed because it is based on this misstatement.

The Carbon Pollution Standards provided an eight-year lead time to allow sources to "design, acquire, install, test, and begin to operate" already demonstrated pollution control systems. 89 Fed. Reg. at 39832. This is a reasonable timeframe. *See, e.g.*, *id.* at 39802 ("the time that is needed to deploy the associated infrastructure"); *id.* at 39878 ("[I]t is reasonable for the EPA to determine that CCS can be deployed at the necessary scale in the compliance timeframe."). As EPA previously recognized, "[i]nstalling CCS requires the building of capture facilities and pipelines to transport captured CO_2 to sequestration sites, and the development of sequestration sites." *Id.* at 39878.

Allowing lead time for compliance so that pollution controls are more generally available is consistent with Section 111, consistent with long-standing agency practice in implementing Section 111, and eminently reasonable. In enacting the Clean Air Act, Congress contemplated that the agency would not require immediate conformity to standards but instead match compliance deadlines to the pace at which widespread accessibility of the best system can reasonably be implemented. *See* S. Rep. No. 91-1196, at 16 (1970) ("[T]he technology must be available at a cost and at a time which [EPA] determines to be reasonable."). In this vein, the D.C. Circuit has observed that "the question of availability [of pollution control technology] is partially dependent on 'lead time,' the time in which the technology will have to be available." *Portland Cement Ass'n v. Ruckelshaus*, 486 F.2d 375, 391–92 (1973). Accordingly, EPA has issued several new source rules under Section 111 in which it has set future compliance deadlines

[28] *See also* Comment submitted by Clean Air Task Force (CATF), Natural Resources Defense Council (NRDC) and The Nature Conservancy, EPA-HQ-OAR-2023-0072-0893 (Aug. 9, 2023), https://perma.cc/9DM8-PGYB (comment on Carbon Pollution Standards).

to allow time for the "best system" to be deployed across an industry.[29] And EPA's longstanding regulations, which have been in place since 1971, specifically authorize a minimum period for lead time for new source performance standards under Section 111. *See* 89 Fed. Reg. at 39832; 40 C.F.R. § 60.11; 36 Fed. Reg. 24877 (Dec. 23, 1971). This approach is reasonable – as EPA explained to the D.C. Circuit, it "may take a decade to build a highway; that does not make highways an emerging technology."[30]

The proposed repeal misstates the relevance of lead time for deployment and instead asserts EPA "erred" by failing to "demonstrate that CCS technology would develop further." *See* 90 Fed. Reg. at 25769 (arguing EPA relied on future technological development to determine adequate demonstration). However, EPA explicitly stated that it was "not relying" on "projection" about future technological development of CCS to determine that it was adequately demonstrated. 89 Fed. Reg. at 39832 n.223; *see also id.* at 39830 n.202 (describing EPA's ability to make a projection about development of a system to allow for greater emissions reductions in the future as "not relevant here, because CCS is already in existence"). CCS has "been proven." *Id.* at 39851. The proposed repeal's reference to the eight-year review period for new source standards in Section 111, which is based on the premise that the Carbon Pollution Standards depended on technological developments for development of CCS, is therefore inapposite. *Contra* 90 Fed. Reg. at 25769.

The conclusion that 90 percent capture has been adequately demonstrated is supported by decades of experience with each component of the system, as established in the record for the Carbon Pollution Standards. Carbon capture was first patented in the 1930s, and since then it has been applied across industries, demonstrated at power plants, tested for thousands of hours, and analyzed in dozens of engineering studies on a variety of designs. *See* 89 Fed. Reg. at 39846–54. Currently, commercial vendors offer guarantees that their solvents and equipment will remove more than 90 percent of the carbon dioxide from a power plant's exhaust.[31] *Id.* at 39851–52. The proposed repeal disregards these facts that underlay the previous adequate demonstration determination, and that failure renders it arbitrary.

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[29] *See, e.g.*, 77 Fed. Reg. 56422, 56450 (Sept. 12, 2012) (deferring standards for modifications to certain refinery equipment by three years both to allow controls and monitors to be installed and to prevent excess emissions from unplanned startups and shutdowns); 77 Fed. Reg. 49490, 49525–26 (Aug. 16, 2012) (concluding that there was "no BSER" for storage vessels in the oil and gas subcategory during a one-year "adjustment period" "for manufacturers to be ready to supply the operators with the correct equipment they need"); 70 Fed. Reg. 39870, 39887 (July 11, 2005) (proposed rule; finalized at 71 Fed. Reg. 39154, 39158 (July 11, 2006)) (allowing three years to manufacture and certify fire pump engines); 56 Fed. Reg. 24468 (May 30, 1990) (proposed rule; finalized at 61 Fed. Reg. 9905, 9919 (Mar. 12, 1996)) (allowing three years for testing, control system design, and installation at new and existing landfills); 44 Fed. Reg. 29828, 29829 (May 22, 1979) (emission guidelines contemplating up to six years for retrofits of equipment at kraft pulp mills); 60 Fed. Reg. 10654, 10689 (Feb. 27, 1995) (proposed rule; finalized at 62 Fed. Reg. 48348, 48381 (Sept. 15, 1997)) (standard under Sections 111 and 129 providing up to five-and-a-half years for commercial waste disposal to scale up to receive wastes diverted from the regulated medical waste generators).

[30] Respondent Brief at 27, Westmoreland Mining Holdings LLC v. EPA, No. 2083166 (D.C. Cir. Oct. 11, 2024), Dkt. No. 14.

[31] 89 Fed. Reg. at 39851–52.

C. The proposal unlawfully introduces a new standard for adequate demonstration into Section 111 that is contrary to the statutory text, decades of implementation, and caselaw.

EPA arbitrarily and unlawfully limits its consideration of evidence of the adequate demonstration of 90 percent CCS by disregarding pilot tests, vendor statements, and projects and technologies in development. EPA does so by stating without further explanation that even where these sources adequately demonstrate a 90 percent capture rate that those "capture rates have not been demonstrated at commercial scale over the course of a calendar year." 90 Fed. Reg. at 25772; *see also id.* ("There are no new post-combustion CCS applications in operation that are achieving 90 percent capture over the course of a calendar year at commercial scale."). This casual dismissal of these types of evidence either constitutes an unlawful, newly-invented interpretation of adequate demonstration, or EPA arbitrarily disregarding such evidence. Either way, it is a silent departure from the agency's long-standing consideration of pilot tests, vendor statements, and projects and technologies in development to determine if a pollution control system is adequately demonstrated. It is unlawful because it is based on extra-statutory terms and concepts, and is otherwise arbitrary. This new and unexplained interpretation lacks a thoroughness of consideration, validity of reasoning, consistency with longstanding implementation and earlier court precedents, or other persuasive factors. *See Loper Bright Enters. v. Raimondo*, 603 U.S. 369, 370 (2024) (citing *Skidmore v. Swift & Co.*, 323 U.S. 134, 140 (1944)).

Congress set a statutory mandate for EPA under Section 111 to determine the "best system of emission reduction which … has been adequately demonstrated."[32] As EPA has previously explained, the term "'demonstrated' in common usage at the time of enactment meant to 'explain or make clear by using examples, experiments, *etc.*'" 89 Fed. Reg. at 39830 (quoting Webster's New World Dictionary: Second College Edition (David B. Guralnik, ed., 1972)). And as EPA told the D.C. Circuit last year, that demonstration must be "adequate[]," which that same dictionary defines as "1. enough or good enough for what is required or needed; sufficient; suitable. 2. barely satisfactory; acceptable but not remarkable."[33]

As the D.C. Circuit has explained, Section 111 does not require that there is a plant "currently in operation which can at all times and under all circumstances meet the standards." *Essex Chem. Corp.*, 486 F.2d at 433–34; *see also Sierra Club*, 657 F.2d at 377, 380–82. Nowhere does Section 111 require commercial adoption or application. Nor does Section 111 include a phrase such as "readily available" (although Congress clearly knew how to do so, having included that modifier in section 119 of the Clean Air Act), that might place a higher standard on demonstration of a pollution control system. *See* 89 Fed. Reg. at 39831 (providing this comparison); 42 U.S.C. § 7419(b)(3). By setting a higher evidentiary bar than provided in the plain text of the statute, EPA in the proposed repeal is violating the "core administrative-law principle that an agency may not rewrite clear statutory terms to suit its own sense of how the

[32] 42 U.S.C. § 7411(a)(1).

[33] *See* Initial Brief for Respondents at 23, West Virginia v. EPA, No. 24-1120 (D.C. Cir. Oct. 11, 2024), Dkt. No. 2079658 (quoting Webster's New World Dictionary: Second College Edition (David B. Guralnik, ed., 1972)).

statute should operate." *UARG v. EPA*, 573 U.S. 302, 328 (2014). Because EPA's approach in the proposed repeal is counter to the plain statutory text, it is unlawful and arbitrary. It is also counter to EPA's longstanding practice.

EPA has long considered, and the courts have upheld, evidence of the adequate demonstration of pollution control systems from other industries, pilot projects, vendor statements, and studies. Section 111, like many other Clean Air Act provisions, is technology-forcing.[34] The statute "looks toward what may fairly be projected for the regulatory future, rather than the state of the art at present." *Portland Cement Ass'n v. Ruckelshaus*, 486 F.2d 375, 391 (D.C. Cir. 1973). Following this approach, for the purposes of Section 111, the D.C. Circuit has held:

> An adequately demonstrated system is one which has been shown to be reasonably reliable, reasonably efficient, and which can reasonably be expected to serve the interests of pollution control without becoming exorbitantly costly in an economic or environmental way. An achievable standard is one which is within the realm of the adequately demonstrated system's efficiency and which, while not at a level that is purely theoretical or experimental, need not necessarily be routinely achieved within the industry prior to its adoption.

Essex Chem. Corp. v. Ruckelshaus, 486 F.2d 427, 433–34 (D.C. Cir. 1973).

Considering this aspect of the Clean Air Act, reviewing courts have upheld EPA standards on the basis of (1) "literature review and operation of one plant in the U.S," *id.* at 434, (2) "various test programs," *Nat'l Petrochemical & Refiners Ass'n v. EPA*, 287 F.3d 1130, 1137 (D.C. Cir. 2002) (upholding Clean Air Act Section 202(a)(3) standards for new motor vehicles, which have a similar basis as Section 111 standards), (3) "pilot plant technology,"[35] and (4) "testimony from experts and vendors." *Portland Cement Ass'n,* 486 F.2d at 402. EPA may also also base standards upon "the reasonable extrapolation of a technology's performance in other industries," *Lignite Energy Council v. EPA*, 198 F.3d 930, 934 (D.C. Cir. 1978), and project "technological improvements" based on "known elements" of existing pollution control systems, including where EPA has concluded "manufacturers could 'improve, test, and apply' technology during the lead time period" for compliance. *Int'l Harvester Co. v. Ruckelshaus*, 478 F.2d 615, 629 (D.C. Cir. 1973) (quoting EPA decision under section 202 on technology availability for congressionally-set 90 percent emission reduction standard).

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[34] *See Union Electric Co. v. EPA*, 427 U.S. 246, 256–57 (1976) (describing Clean Air Act requirements as having a "'technology-forcing character,' and are expressly designed to force regulated sources to develop pollution control devices that might at the time appear to be economically or technologically infeasible" (citation omitted) (quoting *Train v. NRDC*, 421 U.S. 60, 91 (1975)); *Whitman v. Am. Trucking Ass'ns*, 531 U.S. 457, 592 (2001) (Breyer, J., concurring) ("Subsequent legislative history confirms that the technology-forcing goals of the 1970 amendments are still paramount to today's Act.").

[35] *Am. Iron & Steel Inst. v. EPA*, 526 F.2d 1027, 1061 (3rd Cir. 1975) (upholding Clean Water Act standards and guidelines, which are based on the best practicable technology currently available); *cf. FMC Corp. v. Train*, 539 F.2d 973, 983–84 (4th Cir. 1976) (upholding EPA's decision to set Clean Water Act guidelines based on data from a single pilot plant).

A standard of performance is "achievable" if it is "within the realm of the adequately demonstrated system's efficiency," although it "need not necessarily be routinely achieved within the industry prior to its adoption." *Essex Chem. Corp.*, 486 F.2d at 433–34. Data supporting the achievability of proposed standards can be "sparse, primarily because few plants had any need to attempt to achieve" them. *Sierra Club*, 657 F.2d at 362. The proposed repeal, however, unlawfully departs from this longstanding agency approach that is consistent with the statutory text and has been long upheld by the courts.

Furthermore, EPA is not writing on a blank slate – the Carbon Pollution Standards considered these types of evidence. *See* 89 Fed. Reg. at 39851–85; *Fox TV*, 556 U.S. at 515–16. EPA cannot now disregard those factual findings, certainly not based on the introduction of counter-textual, extra-statutory factors. The countertextual requirement in the proposed repeal – that performance must be at commercial scale for a full calendar year – would be contrary to historical agency practice and leave the Clean Air Act largely unworkable. As EPA has previously explained when rejecting such a heightened threshold, this "would require that at least one power plant *volunteer* to comply with regulatory standards before any such standard has even issued. But there is no evidence Congress intended to narrow EPA's consideration under [Section 111] to such rare circumstance."[36] And even if EPA were writing on a blank slate, the agency "cannot ignore evidence that undercuts its judgment." *See Inteliquent, Inc. v. FCC*, 35 F.4th 797, 802 (D.C. Cir. 2022); *see also Comcast Corp. v. FCC*, 579 F.3d 1, 8 (D.C. Cir. 2009) (explaining the court has "not hesitated to vacate a rule when the agency has not responded to empirical data or to an argument inconsistent with its conclusion"); *State Farm*, 463 U.S. at 43 (holding an agency action is arbitrary and capricioius if the agency has "offered an explanation for its decision that runs counter to the evidence before the agency").

The historical example of flue gas desulfurization (FGD) post-combustion sulfur scrubbers that EPA has based SO_2 emission standards on since the 1970s provides an illustration why the evidence threshold in the proposed repeal is counter to Section 111.[37] Even though there were only three scrubbers in operation at the time EPA proposed the rule, the D.C. Circuit upheld EPA's SO_2 standards as adequately demonstrated, achievable, and "the result of reasoned decision-making." *Essex Chem. Corp.*, 486 F.2d at 440. The court held EPA was justified in concluding that the systems were adequately based on "tests of prototype and full-scale control systems, considerations of available fuel supplies, literature sources, and documentation of manufacturer guarantees and expectations." *Id.* Due to that standard and subsequent EPA regulations, 93 percent of the SO_2 produced by combustion of fuels in power plants today never reaches the atmosphere. [38] In *West Virginia v. EPA,* the Supreme Court described "add-on

[36] Final Brief for Respondents at 40, West Virginia v. EPA, No. 24-1120 (D.C. Cir. Nov. 1, 2024) (emphasis in original), Dkt. No. 2083166; *see also* 89 Fed. Reg. at 39831–32 (explaining caselaw).

[37] *See generally* Brief for Prof. Rachel Rothschild as Amicus Curiae, West Virginia v. EPA, No. 24-1120 (D.C. Cir. Oct. 18, 2024), Dkt. No. 2080598. For further discussion of the regulatory drivers of the development and adoption of SO_2 and NO_x controls, *see infra* Comment IV.C.

[38] *See* EPA, *Acid Rain Program Results*, https://perma.cc/YXC8-G4B4 (last updated January 16, 2025). Congress in 1990 responded to the need for additional pollution reductions, and to the state of technology then in place enacting Title IV of the Act. With IRA, Congress also has recognized both the need for and promise of carbon-reducing demonstrated technologies.

controls" such as sulfur scrubbers and "fuel-switching" as "more traditional air pollution control measures" that EPA has time and again used in prior Section 111 rules "that devised the enforceable emissions limit by determining the best control mechanisms available for the source." 597 U.S. at 726–27 (quoting 80 Fed. Reg. at 64784).[39] The record supporting the feasibility of CO_2 scrubbers today compares favorably to that for SO_2 scrubbers when those regulations were adopted in 1971, and EPA's novel reinterpretation of "adequately demonstrated" would impermissibly constrain the agency from adopting either standard, or virtually any other pollution control standard under Section 111. That cannot be what Congress intended.

In sum, the proposed repeal is unlawful for setting a requirement for a system of emission reduction that is counter to the plain text of Section 111's "adequately demonstrated" standard, contrary to decades of agency practice, and inconsistent with relevant caselaw.

D. The proposal repeatedly and misleadingly confuses the adequate demonstration of a 90 percent capture rate with the per-megawatt emission rate based on application of that system.

Under Section 111, it is the the system of pollution control that must be adequately demonstrated. *See* 42 U.S.C. § 7411(a)(1). As EPA correctly concluded in the Carbon Pollution Standards, that system is CCS, and it is adequately demonstrated. Each of the components – capture, transport, and storage – has been successfully deployed for decades. When that rule was finalized, there were at least fifteen projects operating in the U.S., and dozens more in construction or late stages of development. 89 Fed. Reg. at 39813–14.

In the Carbon Pollution Standards, EPA determined the adequate demonstration of carbon capture rates by using "capture rate" to refer to a measure of how much carbon is removed from treated flue gas.[40] The Carbon Pollution Standards defined the "full capture" in the best system of emission reduction as "90 percent capture of the CO_2 in the flue gas." 89 Fed. Reg. at 39896.

The standard based on the application of the best system of emission reduction must be achievable. *See* 42 U.S.C. § 7411(a)(1). In the Carbon Pollution Standards, the standard for long-term coal-fired steam generating units is an 88.4 percent reduction in *emission rate*. *See* 89 Fed. Reg. at 39841–42 tbl.1. That *emission* rate is what can be achieved through application of a 90 percent *capture* rate. New base load gas plants have presumptive standards for 12-operating-month averages based on what is achievable by applying CCS at a 90 percent capture rate. *See id.* at 40046 tbl.1, Subpart TTTTa of Part 60.

Importantly, and ignored in the proposed rule, capture rates and emission rates are calculated differently and have different units of measurement. As used in the Carbon Pollution

[39] The 2005 rule was vacated without a court ruling on its legality under Section 111, and the Court used the wet scrubbers as an example only after assuming the rule was valid.

[40] *See, e.g.*, 89 Fed. Reg. at 39888–89 (describing capture rates at Boundary Dam and Petra Nova as percents of treated flue gas); *see also* DOE & NETL, *Understanding Scales and Capture Rates for Point-Source Carbon Capture Technology Development,* R-D 239, at 3 (May 2024), https://perma.cc/CB2N-Q4LB [hereinafter "DOE/NETL, Understanding Scales and Capture Rates"].

Standards, capture rate is a percentage calculated as how much carbon is captured divided by how much carbon is in the treated flue gas.[41] The rule's emission rate standards, however, are measured in pounds of CO_2 per megawatt-hour. Because compliance with the standards is an average measured in terms of emissions per unit energy, the percent capture of treated flue gas is only one variable that goes into compliance. An operator can maintain compliance with the mass-per-unit-energy standard by, for instance, both running a plant less (less energy) and emitting less CO_2. Similarly, a plant operator that runs a plant more (more energy) may emit more CO_2, as long as the average over the compliance period remains below the mass-per-unit-energy standard. As a result, decisions about operations, such as synchronizing maintenance schedules for capture plants with power plants, can help an operator achieve the standard.

1. *The proposed repeal confuses "total capture efficiency" with "capture rate" to reach unsupported conclusions about adequate demonstration.*

The proposed repeal does not dispute the facts of demonstrated capture rates above 90 percent as measured by percent of treated flue gas that EPA evaluated in the Carbon Pollution Standards.[42] Instead, it repeatedly references a different term, "total capture efficiency," that also considers untreated flue gas. *See* 90 Fed. Reg. at 25769–72. The proposed repeal rule's misleading focus on – and completely unexplained switch to – this dubious metric is a red herring and does nothing to disturb the Carbon Pollution Standards' correct determination of the adequate demonstration of a 90 percent capture rate.

Capture rate, as used in the Carbon Pollution Standards to determine adequate demonstration, is a measure of how much carbon is removed from treated flue gas.[43] The Carbon Pollution Standards defined the "full capture" in the best system of emission reduction as "90 percent capture of the CO_2 in the flue gas." 89 Fed. Reg. at 39896. The proposed repeal's use of "total capture efficiency" is a different number that appears to compare how much carbon is captured to that of an entire unit's exhaust, including emissions that capture systems were never designed to treat, in order to generate lower percentages. This number arbitrarily inflates the denominator to include untreated flue gas in a naked attempt to generate numbers below 90 percent, even though this misleading calculation is divorced from the reality of what each project was trying to do and does nothing to discredit actual capture rates in treated flue gas. As DOE has explained, "[c]onfusing [different] measures of carbon capture efficiency can lead to misunderstandings. For example, if a capture system processes only a fraction of a facility's emissions, one may erroneously conclude that the capture system is underperforming if they mistake the facility-wide carbon capture efficiency for the capture system carbon capture

[41] *See supra* Comment III.B.

[42] *See, e.g.*, 90 Fed. Reg. at 25769 ("While Boundary Dam Unit 3 achieved 89.7 percent capture over a 3-day test…"); *id.* at 25770 (acknowledging capture rates at AES's Warrior Run (Cumberland, Maryland) and Shady Point (Panama, Oklahoma) plants were greater than 90 percent); *id.* at 25771 ("While Petra Nova captured 92.4 percent of the CO_2 from the 240 MWe flue gas it processed over a 3-year period…"); *id.* at 25776 (omitting the capture rate at Bellingham, which the Carbon Pollution Standards indicated "from 1991-2005 [was] 85-95 percent CO_2 capture." 89 Fed. Reg. at 39925).

[43] *See* DOE/NETL, Understanding Scales and Capture Rates, at 3.

efficiency."[44] The proposed repeal suffers from exactly this problem, which results in misleadingly portrayals of successful demonstrations of 90 percent capture as achieving much lower percentages than they actually do – for instance, by lowering a 95 percent capture rate at Boundary Dam to 83 percent by comparing it to emissions that were never treated. 90 Fed. Reg. at 25770. Similarly, and as explored in more detail below, EPA erroneously describes capture plant availability as a factor that can contribute to "lower total capture efficiencies," when availability is unlikely to affect capture rates at all assuming regular best practice of system maintenance and downtime. 90 Fed. Reg. at 25770.

The unexplained inconsistencies in EPA's logic between the Carbon Pollution Standards and the proposed repeal are indicative of the latter's failure to consider an important aspect of the problem, its failure to address the facts that underlay the prior policy, and its conclusions that are counter to the evidence before the agencies. *See State Farm*, 463 U.S. at 43; *Fox TV*, 556 U.S. at 515–16. Intentionally manipulating calculations by changing the denominator to include untreated flue gas in the calculation of a different metric does not overcome EPA's previous conclusions that 90 percent capture is adequately demonstrated. This new calculation is arbitrary, capricious, and an abuse of discretion.

2. The Carbon Pollution Standards properly considered unit availability.

Contrary to the proposed repeal's assertion, the Carbon Pollution Standards did not depend on an assumption that capture plants would be available 100 percent of the time. *Contra* 90 Fed. Reg. at 25776 (asserting incorrectly that "EPA assumed in the CPS that capture equipment has 100 percent availability"). Power plants with carbon capture, like power plants without capture, pollution control processes, and any other industrial processes, are expected to have downtime. Prior to the proposed repeal, EPA was well aware of this basic engineering fact, *see, e.g.*, 89 Fed. Reg. at 39850 (noting "planned and unplanned outages are normal for industrial processes" and explaining why such outages at Petra Nova were consistent with its BSER determination); *id.* at 39811 (EGUs are unavailable "during both routine and unanticipated outages"). Yet now, EPA concludes that "less than 100 percent" availability is a reason to discount the record of capture system performance. 90 Fed. Reg. at 25769 (briefly arguing "new solvents" to "capture CO2 at higher rates" would be necessary to address the "less than 100 percent" availability of capture systems); *id.* at 25570 ("EPA is proposing to conclude that the experience at Boundary Dam Unit 3 does not support 90 percent CCS as adequately demonstrated" in part because the availability of its capture system is "less than 100 percent."). This unexplained change in position renders the proposed repeal unlawful. *See Fox TV*, 556 U.S. at 515.

Contrary to the proposed repeal's inaccurate assertion, the Carbon Pollution Standards explicitly considered capture plant outages, and explained how Petra Nova and Boundary Dam had addressed issues and improved availability over time.[45] Those trends have continued, and the

[44] *Id* at 3.

[45] *See* 89 Fed. Reg. at 39849–50 (finding technical challenges at both facilities were addressed with outages at Petra Nova decreasing from 41 days in 2017 to 29 days in 2019, and explaining that "improvements already employed and

capture plant at Boundary Dam had a 98.4 percent availability over its most recent quarter and availabilities of 98 and 97 percent over each of the last two fiscal years.[46] Capture plant operators can take, and have taken, steps such as introducing isolations and redundancies that allow for maintenance and cleaning without shutting down the capture plant or reducing capacity.[47] These steps, such as those taken at Boundary Dam, improve capture plant reliability and availability.

Even assuming for the sake of argument EPA's caricature of capture system availability issues, EPA simply ignores how any such availability problems could be managed. The Carbon Pollution Standard for long-term coal plants is expressed as a reduction from a unit's baseline emissions, measured per unit of energy the plant produces.[48] Large new base load gas plants are similarly subject to a per-MWh standard. 40 C.F.R. § 60.5520a; Table 1 to Subpart TTTTa of Part 60. This form of standard means that operators can manage both planned and unplanned capture system outages, just as with any other pollution control equipment. Appropriate preventative maintenance in fossil power generation is a complex, well-developed practice that takes a systems approach that incorporates the identification and scheduling of preventative maintenance for all equipment, including pollution control equipment.[49] For planned maintenance periods, the impact of capture plant downtime can be minimized by synchronizing planned maintenance downtime between the capture and other system components. For instance, Boundary Dam developed a schedule for "14-day outages every 6 to 8 months, which are coordinated where possible with outage plans for the power plant of Unit 3 which usually occur every 6 months."[50]

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identified at Boundary Dam can be readily applied during the initial construction of a new CO_2 capture plant today").

[46] *See* Saskpower, *BD3 Status Update: Q1 2025*, (May 2, 2025), https://saskpower.com/about-us/our-company/blog/2025/bd3-status-update-q1-2025; Shell, *Learnings from a Decade.*

[47] Patit Pradoo et al., *Improving the Operability of the Boundary Dam Unit 3 Carbon Capture Facility*, Proceedings of the 16 Greenhouse Gas Technologies Conference (GHGT-16) 23–24 Oct 2022 (November 29, 2022), https://dx.doi.org/10.2139/ssrn.4286503; Stavroula Giannaris, et al., *SaskPower's Boundary Dam Unit 3 Carbon Capture Facility - The Journey to Achieving Reliability,* Proceedings of the 15th Greenhouse Gas Control Technologies Conference 15 - 18 March 2021 (April 6, 2021), https://dx.doi.org/10.2139/ssrn.3820191.

[48] 89 Fed. Reg. at 39896 ("an 88.4 percent reduction in emission rate on a lb CO_2/MWh-gross basis over an extended period (*e.g.*, an annual calendar-year basis)"; 40 C.F.R. § 60.5775b (requirement to apply this degree of emission limitation in state plans). States may also adopt mass-based limits for additional flexibilities. *See* 89 Fed. Reg. at 39982 (permitting states to translate rate-based standards to mass-based limits or budgets accompanied by a backstop rate of 80% reduction).

[49] *See, e.g.*, Electric Power Research Institute, *Guidelines for Developing a Preventive Maintenance (PM) Program: Identifying, Prioritizing, and Implementing PM Tasks* (Dec. 2012); Power Magazine, *Reduce Plant Fuel Use, Emissions, and Operating Cost with Performance Models and Predictive Maintenance* (Dec. 1, 2022), https://www.powermag.com/reduce-plant-fuel-use-emissions-and-operating-cost-with-performance-models-and-predictive-maintenance/.

[50] Patit Pradoo et al., *Improving the Operability of the Boundary Dam Unit 3 Carbon Capture Facility*, Proceedings of the 16 Greenhouse Gas Technologies Conference (GHGT-16) 23–24 Oct 2022 (November 29, 2022), https://dx.doi.org/10.2139/ssrn.4286503; *see also Lessons learnt from a decade of carbon capture innovation at SaskPower*, Carbon Capture J. 20 (July – Aug. 2025), https://catalysts.shell.com/hubfs/SaskPower%20from%20CCJ106web.pdf (explaining how "by synchronising maintenance across the power and capture units, SaskPower was able to increase maintenance efficiency and reduce downtime") [hereinafter "Lessons Learnt"].

For both planned and unplanned capture system downtime, operators may reduce energy output and/or compensate with higher capture rates at other times to meet the pollution control standard. These actions maintain operational flexibility while complying with the standards.[51]

Currently operating coal plants without CCS already manage downtime schedules in planning their operations, as illustrated by data from 12 existing coal-fired powered units across five plants.[52] These plants were selected to chosen to reflect a variety of ages, locations, ownership types, fuel types, sizes, and existing control equipment and show downtime schedules under a wide array of operating conditions. *See* Appendix A, Table 11. Based on the last five years of available data (2019–2024),[53] these units had median downtime of 27 percent, with some units down as much as 47 percent of the period. Only four units had downtime of less than 15 percent – two from the same plant experienced 12 percent downtime, while another two from a different plant experienced 14 percent downtime during this time frame. Should any of these units install CCS, it is clear that there is sufficient flexibility in existing operational schedules to schedule CCS equipment's downtime within this existing planned downtime in most if not all cases, and to therefore synchronize maintenance in a way that would not affect the unit's ability to achieve a standard measured in emissions-per-unit-energy averaged over a 12 month period.

These strategies for minimizing the impact of all plant equipment downtime – including pollution control equipment downtime – are standard practice, and the fact that operators can and do adopt these strategies means that reduced availability of a capture system does not necessarily impact the ability of a plant to meet the standard.[54] But instead, the proposed repeal treats operators as mindless automatons unable to take basic measures to deal with any potential issues. The proposed repeal's treatment of capture plant availability disregards EPA's prior analysis, is counter to the evidence before the agency, and fails to grapple with the basic operation of capture facilities.

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[51] To the extent that operational flexibility is a further concern for achievability of the standards, the Carbon Pollution Standards also found that rate-based emissions averaging was permissible in state plans as a way to allow for operational flexibility for certain units. *See* 89 Fed. Reg. at 39983–84. The proposed repeal completely disregards this aspect of the Carbon Pollution Standards.

[52] *See* EPA, *Clean Air Markets Program Data*, https://campd.epa.gov/ (last visited July 30, 2025).

[53] *Id.*

[54] *See, e.g.*, EPRI, Outage Management Guidelines for Fossil-Fueled Power Plants, at v (2006) https://www.epri.com/research/products/1012281 (providing the best practices necessary to minimize the cost and duration of planned outages by utilizing the downtime most efficiently and effectively); Brian Beatty, NAES, *Outage Planning: Are You Sure You're Ready to Execute?* (describing outage period as opportunity to do maintenance for the year), https://www.naes.com/outage-planning-are-you-sure-youre-ready-to-execute/; Rob Broglio & Henry Scheck, *Outage Management 101: Identify, Plan, Execute, Review*, Power Eng'ring (Dec. 2, 2015) (describing preventative maintenance as key outage task), https://www.power-eng.com/operations-maintenance/outage-management/outage-management-101-identify-plan-execute-review/.

V. The proposal is counter to the evidence before the agency and disregards the facts and circumstances underlying the Carbon Pollution Standards.

As explained above, the proposed repeal's conclusions run consistently counter to the evidence before the agency, rendering the proposed repeal arbitrary and capricious, unreasonable decisionmaking. *State Farm*, 463 U.S. at 43. EPA cannot simply disregard facts it does not like, including the facts and circumstances that underlay the Carbon Pollution Standards. *Id.*; *Fox TV*, 556 U.S. at 516. EPA fails to overcome the record supporting its earlier determinations that a 90 percent CCS-based standard was adequately demonstrated and cost reasonable, and achievable by January 1, 2032. The proposed repeal's paltry analysis contains myriad errors and runs counter to or overlooks much of the extensive record in support of the Carbon Pollution Standards. These errors are pervasive and cannot be cured in this rulemaking.

The proposed repeal fails to overcome the technical record on specific projects, on slipstreams, on the ability of CCS to scale, on variations in performance, on projects and technologies in development, and on other sources of supporting information in the original record. EPA furthermore ignored the numerous positive developments in CCS and its deployment at the power plants in the past two years that bolster its earlier findings. Additional technical information in support of this section of the comment is included at Appendix A.

A. The proposed repeal fails to overcome the technical record on specific projects

1. Boundary Dam continues to demonstrate CCS's effectiveness.

As EPA previously concluded, the data regarding the performance of Boundary Dam Unit 3, "a commercial-scale plant, is enough, by itself, to support the EPA's adequate demonstration finding for a 90 percent standard." 89 Fed. Reg. at 39889. The proposed repeal's discussion of Boundary Dam in no way disturbs that conclusion, which still stands. To quote the Vice President of Decarbonization and Emerging Technologies at Shell Catalysts and Technology, Boundary Dam "proves that post-combustion carbon capture works, not just in theory but in the most technically demanding conditions."[55]

The proposed repeal fails to overcome the existing technical record on Boundary Dam's performance and resolution of issues, ignores recent project performance, and unreasonably equates the project's capture amount to a standard that the project is not trying to meet. In fact, the proposed repeal even acknowledges that improvements to Boundary Dam reported to EPA in a meeting in 2024 improved performance, but instead of considering the relevance of those improvements, it arbitrarily disregards them by claiming that results of those improvements have not been reported, despite SaskPower's quarterly public updates and even a recent presentation on the plant's ten years of performance.[56]

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[55] Shell, *Lessons learnt from a decade of carbon capture innovation at SaskPower*, Carbon Capture J. 20 (July – Aug. 2025), https://catalysts.shell.com/hubfs/SaskPower%20from%20CCJ106web.pdf.

[56] *See* 90 Fed. Reg. at 25770 & n.138 (citing January 2024 meeting); *see also, e.g.*, Saskpower, *BD3 Status Update: Q1 2025*, (May 2, 2025), https://saskpower.com/about-us/our-company/blog/2025/bd3-status-update-q1-2025; Shell

Boundary Dam is a commercial-scale, coal-fired power plant that "consistently captured 90 percent or more" of the carbon dioxide in the processed emissions stream over a three-year period. 89 Fed. Reg. at 39888–89; *see also id.* at 39888 (the plant captures 83 percent of the total unit's emissions). That plant has also captured 89.7 percent of the full 110-MW unit's exhaust over a three-day test period. *Id.* at 39848; *see also* 90 Fed. Reg. at 25769. Although it has faced some technical challenges, after modifications to "stabilize operations, improve reliability and maximize capacity," "[r]ecent performance has shown that the CCS facility can capture at least 90% of the CO_2 from the partial flue gas stream it processes."[57] The plant's operators have already incorporated these design improvements – at a lower overall cost – into their next project. 89 Fed. Reg. at 39849 (describing Shand plant design study). Although the proposed repeal acknowledges the 89.7 percent capture rate from the early test, it disregards the three-year performance with capture rates over 90 percent of treated flue gas.

Boundary Dam's operators have calibrated the total amount of carbon captured to meet the relevant financial and regulatory incentives in Canada. When it faced "increases in Canadian regulatory CO_2 emission requirements," the operators "optimiz[ed] Boundary Dam Unit 3 so that the facility now captures 83 percent of its total CO_2."[58] As EPA previously concluded, operators have targeted capture rates based on "economic incentives and regulatory requirements of the project[s]." 89 Fed. Reg. at 39848.[59] The Carbon Pollution Standards record evaluated these factors as they related specifically to Boundary Dam.[60] For Boundary Dam, the main financial incentive is to stay below the Canadian carbon tax threshold of 549 tonnes/MWh, and by that metric it has been a resounding success with emissions of 376 tonnes/MWh in the most recent quarter for which data is available.[61] During a recent presentation, Boundary Dam's operators explained that the capture rate is optimized based on business needs and operational

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Catalysts & Technologies, *Learnings from a decade of carbon capture at Boundary Dam*, https://catalysts.shell.com/learning-from-decade-of-carbon-capture-webinar-lp (last visited July 30, 2025).

[57] *See* SaskPower Comment, EPA-HQ-OAR-2023-0072-0687 (email dated Aug. 4, 2023), https://www.regulations.gov/document/EPA-HQ-OAR-2025-0124-0030; *see also* 89 Fed. Reg. at 39848 (describing EPA's review of capture at Boundary Dam, including technical issues and resolutions).

[58] 89 Fed. Reg. at 39889; *see also* International CCS Knowledge Centre, *Carbon capture on B3 – successful by design* (May 11, 2023), https://ccsknowledge.com/insight/carbon-capture-on-bd3-successful-by-design/ (explaining how changing regulatory incentives have influenced operation of Boundary Dam and providing capture rates of treated flue gas of 94 percent in 2021 and 91 percent in 2022).

[59] *See also* Shell, *Lessons learnt from a decade of carbon capture innovation at SaskPower*, Carbon Capture J., 20 (July – Aug. 2025), https://catalysts.shell.com/hubfs/SaskPower%20from%20CCJ106web.pdf (noting Boundary Dam's operators "focus on capture rates that align with operational and business needs, such as CO2 offtake agreements").

[60] *See* EPA, *Greenhouse Gas Mitigation Measures for Steam Generating Units (Technical Support Document)*, EPA-HQ-OAR-2023-0072-9095 (Apr. 2024) at 25–26, https://www.regulations.gov/document/EPA-HQ-OAR-2023-0072-9095 [hereinafter "Coal TSD"].

[61] Saskpower, *BD3 Status Update: Q1 2025*, (May 2, 2025), https://saskpower.com/about-us/our-company/blog/2025/bd3-status-update-q1-2025 [hereinafter Saskpower, *BD3 Status Update*].

considerations, and that the capture plant toggles between a maximum capture mode and a lowest emissions intensity mode with a target capture rate of 2,800 to 2,900 tons per day.[62]

Other portions of the proposed repeal's description of Boundary Dam are speculative and counter to the evidence in the technical record supporting the Carbon Pollution Standards. For instance, the proposed repeal states incorrectly that EPA did not account for solvent degradation and fouling of the equipment at Boundary Dam. *See* 90 Fed. Reg. at 25771. However, EPA accounted for those in multiple ways in the Carbon Pollution Standards.

First, the Carbon Pollution Standards noted that "additional wash systems were added, including 'demister wash systems, a pre-scrubber flue gas inlet curtain spray wash system, flue gas cooler throat sprays, and a booster fan wash system,'" to address those issues.[63] And although the proposed repeal does not dispute the effectiveness of these maintenance procedures, it suggests that capture rates may decrease in between maintenance cycles. *See* 90 Fed. Reg. at 25771. But this claim has no support provided for it, and even if it were accurate, EPA does not explain why more frequent maintenance cycles would not address the issue. To the contrary, the evidence before the agency includes a study describing efforts undertaken by Boundary Dam's operators "to allow on-line cleaning and maintenance of the capture system equipment," such as redundant heat exchangers with double block and bleed valves, so that "maintenance and cleaning can be done without reducing capacity or having to shut down the plant, thus maintaining the capture plant availability."[64]

Second, the Carbon Pollution Standards explained that the fouling issues by Boundary Dam were caused by a "SO_2 removal system that is upstream of the CO_2 capture system." 89 Fed. Reg. at 39848. In the Carbon Pollution Standards, EPA explained that such issues "will definitively not occur in a different type of SO_2 removal system (*e.g.,* wet lime scrubber flue gas desulfurization, wet-FGD)," explained that "SO_2 scrubbers have been successfully operated for decades across a large number of U.S. coal-fired sources. Of the coal-fired sources with planned operation after 2039, 60 percent have wet FGD and 23 percent have a dry FGD," and accounted for "the cost of adding a wet-FGD for those sources that do not have an FGD." *Id.* at 39849. The proposed repeal completely ignores these factual findings.

The proposed repeal similarly completely ignores the facts in the existing technical record about solutions to other issues at Boundary Dam and how those compare to U.S. coal-fired power plants that would be subject to the 90 percent capture standard. These include the

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[62] *See* Shell Catalysts & Technologies, *Learnings from a decade of carbon capture at Boundary Dam*, https://catalysts.shell.com/learning-from-decade-of-carbon-capture-webinar-lp (last visited July 30, 2025); https://catalysts.shell.com/en/learning-from-decade-of-carbon-capture-webinar-thank-you?submissionGuid=0a97f910-dd0c-47fb-8359-4f934cb419c1&wvideo=d4ccxbpw05 (direct link to webinar) (Statement of Zuri Epp, Saskpower, at 27:24–28:05) (submitted to docket via email) [Attachment 1].

[63] *See* 89 Fed. Reg. at 39849 (quoting Stavroula Giannaris, et al., *SaskPower's Boundary Dam Unit 3 Carbon Capture Facility - The Journey to Achieving Reliability,* Proceedings of the 15th Greenhouse Gas Control Technologies Conference, 15 - 18 March 2021 (April 6, 2021), https://dx.doi.org/10.2139/ssrn.3820191.

[64] Patit Pradoo et al., *Improving the Operability of the Boundary Dam Unit 3 Carbon Capture Facility*, Proceedings of the 16 Greenhouse Gas Technologies Conference (GHGT-16) 23–24 Oct 2022 (November 29, 2022), https://dx.doi.org/10.2139/ssrn.4286503 (cited at 89 Fed. Reg. 39849 n.298 and 90 Fed. Reg. 25771 n.151).

upgrades to particulate matter controls installed in 2015/2016 to mitigate fouling due to fly ash and the fact that of "the coal-fired sources with planned operation after 2039, 31 percent have baghouses and 67 percent have electrostatic precipitators. Sources with baghouses have greater or more consistent degrees of emission control, and wet FGD also provides additional PM control." *Id.* Furthermore, Boundary Dam uses lignite coal. *See* 89 Fed. Reg. at 39,848. When burned, this type of coal "produces significantly more contaminants than typical coal, including high quantities of fly ash."[65] Lignite-powered coal generation accounts for just over 5 percent of coal generation and roughly 0.85 percent of total U.S. power generation.[66]

Another issue addressed at Boundary Dam involved "the heat exchangers in both the SO_2 removal system and the CO_2 capture system. Additional redundancies and isolations to those key components were added in 2017 to allow for online maintenance." 89 Fed. Reg. at 39849. And while the proposed repeal cites a 2022 report about Boundary Dam to list technical challenges there, it completely ignores the part of that report that explained all the measures taken to successfully address those challenges, and which were explained in the Carbon Pollution Standards in support of EPA's factual findings. *Compare* 90 Fed. Reg. at 25771, *with* 89 Fed. Reg. at 39849 (both citing Pradoo, 2022).

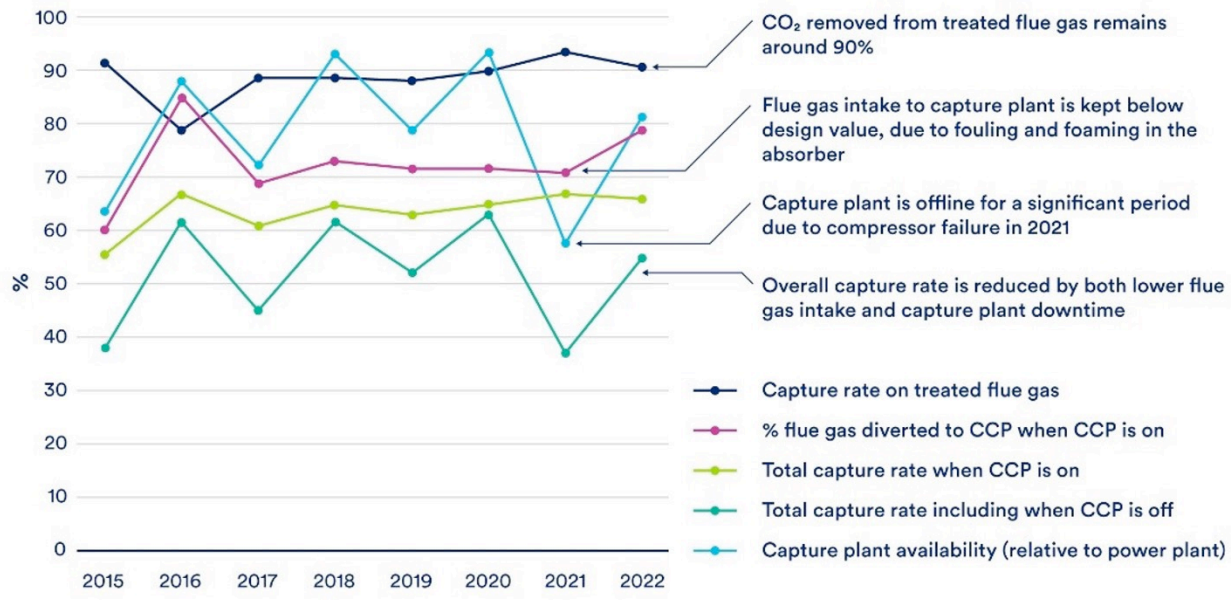

Figure 4. Performance data from Boundary Dam from 2015 to 2022.[67]

[65] Shell, *Lessons learnt from a decade of carbon capture innovation at SaskPower*, Carbon Capture J. 20 (July – Aug. 2025), https://catalysts.shell.com/hubfs/SaskPower%20from%20CCJ106web.pdf at 19.

[66] *See* EIA, 2023 Form EIA-923, https://perma.cc/WQ75-36R4 (calculated based on fuel type on Schedule 3A).

[67] Clean Air Task Force, *Carbon capture and storage: What can we learn from the project track record?* (July 31, 2024),https://www.catf.us/resource/carbon-capture-storage-what-can-learn-from-project-track-record/.

The proposed repeal's discussion of the availability of Boundary Dam's capture plant also does nothing to disturb the Carbon Pollution Standards' factual findings. As discussed above, EPA considered the availability of capture plants when determining the best system of emission reduction and did not actually depend on an assumption of 100 percent availability.[68] In any event, the proposed repeal's description of Boundary Dam's availability is misleading because it gives a high- and low-end range for availability, *see* 90 Fed. Reg. at 25770, while ignoring that the low-end availability year was due to an equipment failure that was remedied, a point that was covered in the Carbon Pollution Standards. *See* 89 Fed. Reg. at 39849 ("Damage to the capture plant's CO_2 compressor resulted in an unplanned outage in 2021, and the issue was corrected."). Since that issue was corrected, the capture plant availability was 98 percent and 97 percent over consecutive fiscal years.[69] In Q1 2025, the most recent quarter for which data is available, the capture system's availability was 98.4 percent.[70] This evidence illustrates that the technical issues at Boundary Dam can and have been overcome, and that some of these issues would definitively not occur at plants with other types of pollution control systems for issues such as fouling due to SO_2.

Furthermore, the proposed repeal suggests, without evidence, that it is "unclear" how Boundary Dam performs at lower loads of the host power plant. *See* 90 Fed. Reg. at 25770. Boundary Dam uses uncontrolled steam extraction, so the plant operators cannot control the amount of steam they have available, potentially leading to insufficient steam flow to maintain high capture rates at lower loads. However, it is perfectly possible to control steam extraction with a valve between the extraction point and the turbine inlet that avoids this problem. The International CCS Knowledge Centre has evaluated this approach in the feasibility study for a future project that "would be designed for seamless and continuous capture operation at 90% capture during decreased power plant output as dictated by a reduction in grid load demand."[71] The design would accomplish this rate through use of a "buttefly valve" that would "enable over-capture (beyond the 90% capture design parameter) at reduced loads by increasing extraction steam pressure. From a CO_2 supply point of view this would mean more consistent volumes of CO_2 would be delivered while enabling load variation of the" power plant.[72] EPA failed entirely to consider this evidence, which is in a study in the aron Pollution Standards, and how this design makes high capture rates achievable even at lower loads and while following grid demand reductions.

The proposed repeal's conclusions on these points are counter to the evidence before the agency, unsupported, speculative, and unreasonable. Boundary Dam continues to provide enough evidence on its own to support EPA's prior conclusion that 90 percent CCS is adequately demonstrated.

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[68] *See supra* Comment IV.D.2.

[69] *See* Shell Catalysts & Technologies, *Learnings from a decade of carbon capture at Boundary Dam*, https://catalysts.shell.com/learning-from-decade-of-carbon-capture-webinar-lp (last visited July 30, 2025)

[70] *See* Saskpower, *BD3 Status Update*.

[71] Shand FEED Study at 17.

[72] *Id.*; *see also id.* (diagram of buttefly valve).

2. Petra Nova has demonstrated 90 percent capture at a 240-MWe scale.

The proposed repeal's discussion of 240-MWe Petra Nova CCS project at the coal-fired W.A. Parish plant does nothing to disturb EPA's previous determination that data from that plant corroborates the finding that 90 percent CCS is adequately demonstrated.[73] It is beyond dispute that this plant successfully captured 92.4 percent of the CO_2 in processed flue gas over a three-year period. 90 Fed. Reg. at 25771. This performance of Mitsubishi Heavy Industry's proprietary KM-CDR Process at a commercial scale over a sustained time period provides strong corroborating evidence that a 90 percent capture rate is adequately demonstrated. *See* 89 Fed. Reg. at 39850.

The proposed repeal provides three specious reasons to discount Petra Nova's performance: facility outages; the use of a slipstream; and accounting for auxiliary emissions from the gas-fired combustion turbine. 90 Fed. Reg. at 25771. None of these reasons overcome the technical record of Petra Nova's performance or provide a justification for departing from EPA's prior conclusions.

First, as the Carbon Pollution Standards noted, Petra Nova's outages attributable to the capture facility decreased year over year, and both planned "and unplanned outages are normal for industrial processes, including steam generating units." 89 Fed. Reg. at 39850. And as previously explained, the Carbon Pollution Standards properly considered unit availability generally.[74] In other words, there is nothing unusual about the outages that occurred at Petra Nova, and, in any event, those outages decreased over time as Petra Nova successfully addressed issues, such as leaks associated with gasket materials and vibration from slurry build-up, through maintenance, equipment upgrades, and installation of additional components. *See id.* Future projects can learn from Petra Nova's experience and the solutions it implemented, which are well documented in a public DOE report.[75] The proposed repeal completely ignores Petra Nova's measures to address its technical challenges and how those demonstrate that past issues can be and already have been overcome. Furthermore, as already explained, those outages did not change the plant's capture rate for treated flue gas and do not call into question a plant's ability to comply with a standard measured per megawatt-hour, as in the Carbon Pollution Standards.[76] Although it faced technical challenges, Petra Nova was "never restricted in reaching its maximum capture rate of 5,200 tons of CO_2 per day." 89 Fed. Reg. at 39850.

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[73] As EPA explained in the Carbon Pollution Standards, because Petra Nova received assistance under the Energy Policy Act of 2005, it may not be "the sole basis for a determination of adequate demonstration, but the EPA may rely on those projects to support or corroborate other information that supports such a determination." 89 Fed. Reg. at 39855; *see also* 42 U.S.C. § 15962(i); 89 Fed. Reg. at 39849 n.304 (explaining interpretation of that provision). The proposed repeal does not discuss this statutory provision.

[74] *Supra* Comment IV.D.2.

[75] *See* Greg Kennedy, *W.A. Parish Post-Combustion CO_2 Capture and Sequestration Demonstration Project (Final Scientific/Technical Report)*, US Department of Energy Office of Fossil Energy (March 2020). https://www.osti.gov/servlets/purl/1608572 [hereinafter "Petra Nova DOE Report"].

[76] *See supra* Comment IV.D.2; 89 Fed. Reg. at 39850.

Second, Petra Nova's performance of a 92.4 capture rate over three years on a 240-MWe stream is evidence of 90 percent capture's performance at a commercial scale. In fact, over the three initial years of operation, the project steadily increased the percentage of CO_2 it captured as technical issues were addressed – reaching 95 percent of the target volume in 2019.[77] The proposed repeal's description of lower (and uncalculated) capture rates has led the agency to "erroneously conclude that the capture system is underperforming [by] mistak[ing] the facility-wide carbon capture efficiency for the capture system carbon capture efficiency."[78] And as explained in a subsequent section, performance of capture systems on slipstreams are strong evidence of adequate demonstration and the proposed repeal's unsupported and vague assertions related to them do not disrupt EPA's previous factual findings. *See infra* Comment V.B. The relevant metric for capture rates is a comparison to the treated flue gas, not a comparison to untreated gas, and Petra Nova undisputedly captured 92.4 percent of the former over a three year period. Furthermore, the capture system was able to operate over a range of conditions as tests at Petra Nova demonstrated "the [carbon capture f]acility achieved stable, reliable and safe operation over its entire designed operating range."[79]

Third, the use of an auxiliary cogeneration unit at Petra Nova is irrelevant to the best system of emission reduction determination. In the Carbon Pollution Standards, EPA explained that "the final BSER is not premised on the CO_2 capture system using an auxiliary combined cycle plant for steam and power." 89 Fed. Reg. at 39850. As a result, outages at that facility were not relevant. *Id.* The proposed repeal does not mention that conclusion or explain why it no longer applies, and EPA cannot "depart from a prior policy *sub silentio*." *Fox TV*, 556 U.S. at 515. The proposed repeal's reference to auxiliary emissions reducing Petra Nova's capture rate is irrelevant because (1) as with EPA's treatment of partial capture, this uses a mistaken and misleading calculation of total capture efficiency instead of capture rate of treated flue gas; and (2) EPA considered those emissions as part of its analysis of energy requirements and explained that "any CO_2 emissions from the connected auxiliary equipment need to be captured or they will increase the facility's emission rate." 89 Fed. Reg. at 39883. The remainder of the proposed repeal's description of Petra Nova's auxiliary cogeneration unit is pure speculation about an aspect of performance that was "unclear" and provides no meaningful analysis. 90 Fed. Reg. at 25771.

The proposed repeal also completely ignores Petra Nova's performance since it restarted operations in September 2023. That capture plant successfully restarted and is fully operating at its design capacity.[80] In February 2025, ENEOS Xplora, Inc., announced that Petra Nova had

[77] *See* Petra Nova DOE Report at 47.

[78] *See* DOE/NETL, *Understanding scale and capture rates*.

[79] Petra Nova DOE Report at 22.

[80] *See* NRG, *Petra Nova Carbon Capture Facility*, https://www.nrg.com/case-studies/petra-nova.html (last visited July 30, 2025).

reached the milestone of having captured, transported, and stored five million metric tons of carbon dioxide, noting that the plant captures 90 percent of the treated flue gas.[81]

3. Other CCS projects support EPA's original conclusion that 90 percent CCS is adequately demonstrated.

The proposed repeal fails to provide a more detailed explanation for disregarding other factual findings that underlay the Carbon Pollution Standards. Without sufficient justification, the proposed repeal disregards the Argus Cogeneration Plant (Trona, California); AES's Warrior Run (Cumberland, Maryland) and Shady Point (Panama, Oklahoma) plants; eleven EPAct05-assisted projects related to natural gas-fired combined cycle turbines, *see* 89 Fed. Reg. at 39928; DOE Carbon Storage Assurance Facility Enterprise (CarbonSAFE) projects*, see id.* at 39864; and the studies and projects summarized in the technical support document underpinning the Carbon Pollution Standards, *see id.* at 39851.[82] For some, the proposed repeal gives cursory and flimsy reasons that do not explain why the evidence from these projects is not meaningful. *See, e.g.*, 90 Fed. Reg. at 25770 ("In general, these projects were not of an equivalent size to commercial scale or, in the case of the Argus Cogeneration Plant, captured far less than 90 percent of CO_2."). For others, the proposed repeal completely ignores these aspects of the technical record underlying the Carbon Pollution Standards. Neither approach is sufficient for EPA's legal obligations when rescinding a policy or considering evidence before the agency. It is arbitrary for EPA to completely disregard this evidence and to reach conclusions that run counter to this evidence. *See State Farm*, 463 U.S. at 43.

4. EPA unlawfully disregards other upcoming projects from the original record that demonstrate 90 percent CCS.

The proposed repeal unlawfully disregards many of the sources that EPA used to bolster its conclusion that 90 percent CCS was adequately demonstrated, including pilot projects, FEED studies, state policies, funding announcements, and vendor and industry statements.[83] These sources provide strong evidence of 90 percent CCS's adequate demonstration, as EPA previously concluded. To the extent EPA provides any reason for ignoring some of these sources, it bases it on the extra-statutory, counter-textual standard that "those capture rates have not been demonstrated at the commercial scale over the course of a calendar year." *See* 90 Fed. Reg. at 25772. EPA utterly fails to show that commercial scale demonstration or applications over the course of a calendar year are anywhere part of the standard for setting a performance standard for new or existing sources of air pollution. As explained *supra* Comment IV.C, such a new

[81] ENEOS Xplora, *Petra Nova Captures More Than 5 Million Tons of Carbon Dioxide*, News Release, at 1 (February 17, 2025), https://www.eneos-xplora.com/english/newsrelease/upload_files/Xplora20250217EN.pdf.

[82] EPA, *Greenhouse Gas Mitigation Measures for Steam Generating Units, Technical Support Document*, Docket No. EPA-HQ-OAR-2023-0072, https://www.epa.gov/system/files/documents/2023-05/TSD - GHG Mitigation Measures for Steam EGUs.pdf [Attachment C].

[83] *See, e.g.*, International CCS Knowledge Centre, *The Shand CCS Feasibility Study Public Report,* atx (November 2018), https://perma.cc/8L3G-T47K (FEED study cited at 89 Fed. Reg. at 39853 n.298, 363, 366, 655); 89 Fed. Reg. at 39820–22 (listing state policies); 89 Fed. Reg. at 39927–28 (listing projects' with awarded funding); 89 Fed. Reg. at 39852 n. 345–47 (industry statements); 89 Fed. Reg. at 39851–52 (vendor statements).

approach runs counter to the text, caselaw, and longstanding implementation of Section 111, and EPA provides no support for or even awareness of this change in policy. It is arbitrary for EPA to completely disregard this evidence and to reach conclusions that run counter to this evidence. *See State Farm*, 463 U.S. at 43.

B. The use of slipstreams is routine and does not undermine demonstration of capture performance.

The proposed repeal's rejection of evidence of 90 percent CCS based on slipstreams is completely unfounded, contrary to its existing factual findings, and arbitrary. The proposed repeal's woefully inadequate justification consists entirely of quotations from a legal brief in a case challenging the Carbon Pollution Standards. 90 Fed. Reg. at 25770 (quoting Opening Brief of Petitioners at 46–47, *West Virginia v. EPA*, No. 24-1120 (D.C. Cir. Nov. 1, 2024) Dkt. No. 2083273). In fact, when pressed by the Office of Management and Budget to provide literature in support of this argument, EPA was unable to do so.[84] To the contrary, slipstream evidence in the Carbon Pollution Standards provided strong evidence that carbon capture with a 90 percent capture rate is adequately demonstrated.

The use of slipstreams for purposes such as demonstration of control devices or measurement purposes is routine. As EPA previously explained in 2015, in a rulemaking that is undisturbed by the proposed repeal:

> A ''slip-stream'' is a portion of the flue gas stream that can be treated separately from the bulk exhaust gas. It is not an uncommon configuration for the flue gas from a coal-fired boiler to be separated into two or more streams and treated separately in different control equipment before being recombined to exit from a common stack. A slip-stream configuration is often used to treat a smaller portion of the bulk flue gas stream as a way of testing or demonstrating a control device or measurement technology.

80 Fed. Reg. at 64550 (citation omitted). Slipstreams, as EPA previously explained based on DOE/NETL reports, may be

> the most economical for carbon capture of less than 90 percent of the total CO_2. The advantage of the slip-stream approach is that the capture system will be sized to treat a lower volume of flue gas flow, which reduces the size of the CO_2 absorption columns, induced draft fans, and other equipment, leading to lower capital and operating costs.[85]

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[84] *See* 2025-05-30 2060-AW55 NPRM RLSO, EPA-HQ-OAR-2025-0124-0074_attachment_16, at 71 (OMB comment: "Is there any literature to support or refute this point of view?"; "EPA Response: There was no literature provided.")

[85] *Id.* (citing "Cost and Performance of PC and IGCC for a Range of Carbon Capture'', Rev 1 (2013), DOE/ NETL–2011/1498 p. 2 (''A literature search was conducted to verify that <90 percent CO2 capture is most economical using a 'slip-stream' (or bypass) approach. Indeed, the slip-stream approach is more cost-effective for <90 percent CO2 capture than removing reduced CO2 fractions from the entire flue gas stream, according to multiple peer-

For CCS, like other control devices, slipstreams have been used to demonstrate the technology, and it also has economic advantages when processing smaller quantities of carbon dioxide. As a result, it should be unsurprising that projects designed to capture less than 90 percent of total carbon dioxide emissions have opted for a slipstream approach.

Pilot-scale and demonstration plants for carbon capture technologies have frequently been applied to a slipstream of flue gas from a commercial power plant or industrial facility. This is simply to allow the testing of capture equipment on real flue gas conditions and composition while limiting the size and cost of the equipment deployed. In the absence of a strong economic or regulatory incentive to deploy carbon capture and storage at full scale, slipstream-based demonstrations are therefore sized appropriately to achieve specific technical deliverables, including operation at large scales. The size of deployed capture systems has largely been determined by demand for CO_2 from the targeted commercial application. *See, e.g.*, 89 Fed. Reg. at 39848 (explaining "amount of flue gas captured [at Boundary Dam] is based in part on economic reasons (*i.e.,* to meet related contract requirements"); *id.* at 39849 (noting Warrior Run's captured emissions have been "sold to the food and beverage industry"); *id.* at 39902 ("CO_2 that is captured from fossil-fuel fired sources is currently beneficially used, including, for example, for enhanced oil recovery and in the food and beverage industry."); 80 Fed. Reg. at 64613 (noting Bellingham Energy Center captured carbon "for use in the food and beverage industry").

The Plant Barry project used a slipstream, as its purpose was to test MHI's capture technology,[86] and provided the basis for scaling the same technology to Petra Nova and Project Tundra.[87] The slipstream for WA Parish plant's Unit 8 for Petra Nova is extracted from the stack breeching duct, using new ducting and flue gas dampers and flow straighteners. The extracted flue gas passes through the capture system quencher (cooling and SO_2 removal) before entering a flue gas blower which provides the force needed to pull the slipstream through the capture process.

Slipstreams provide strong evidence of control device performance, and EPA has relied on evidence from slipstreams in previous rulemakings.[88] Although the proposed repeal suggests, without support, that gas pressures and volumes are static and controllable in slipstreams, that is not always the case and slipstreams provide evidence of carbon capture with dynamic pressure and volume. *Contra* 90 Fed. Reg. at 25770. For instance, Petra Nova's 240 MWe slipstream contends with dynamic pressure and volume. Tests for ramping systems up and down on a slipstream at Petra Nova demonstrated that "the [carbon capture f]acility achieved stable, reliable and safe operation over its entire designed operating range."[89] And parametric tests by Linde-

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reviewed studies." *See also id.* at 19, 21, 77, and 478 (documenting further that treating a slip-stream is the most economical approach)).

[86] Mass. Inst. Tech. CCS Project Database, https://sequestration.mit.edu/tools/projects/plant_barry.html (last visited Aug. 5, 2025).

[87] *Infra* Comment V.C.

[88] *See, e.g.*, 71 Fed. Reg. 9866, 9870 (Feb. 27, 2006) (revised PM, NOx, and SO_2 standards) (citing testing of a control device "in a slipstream").

[89] Petra Nova DOE Report at 22.

BASF demonstrated an average capture rates of 89 percent at differing flue gas flow rates, including ramping, with varying pressures and volumes.[90]

EPA asserts without justification that slipstreams have historically been used because they reduce the impact of variable loading on the capture system. 90 Fed. Reg. at 25770. But CCS projects have been designed to deal with variable loads. While use of a slipstream may reduce variability in flue gas flow rate experienced by the capture system, this is not the reason for using slipstreams, and managing flow rate variability is not expected to be a major challenge for capture units processing an entire flue gas stream. Indeed, lower flue gas flow through the absorber will tend to lead to higher capture rates, as can be observed in data from Boundary Dam.[91] Operators can adjust the solvent flow rate through the absorber to respond to variable load, with higher solvent flow rates during high load and lower solvent flow rates during low load, to maintain optimum levels of energy consumption.

Performance of post-combustion capture at the Technology Centre Mongstad (TCM) facility in Norway, for instance, has shown that during "dynamic operation, 90% capture rate is feasible with load following regimes (e.g., ramp up/down) and hot start-up and shut down."[92] The Shand Front-End Engineering and Design (FEED study) reviewed by EPA in the Carbon Pollution Standards was designed to "follow the normal power output variation" of the plant.[93] Tests conducted as part of the study found operations of capture rates *exceeding* 90 percent at different flow rates.[94] That study found "a typical loading pattern for Shand would result in an aggregate CO_2 capture rate that would exceed 95%."[95] And as EPA observed previously, Shell designed its solvent for "reliability through its highly flexible turn-up and turndown capacity." 89 Fed Reg. at 39851–52. The evidence shows that plants can operate under variable loads, including for turn-up and turndown, and achieve a standard based on 90 percent CCS. The proposed repeal's conclusions, which are based entirely on an unsupported claim from a legal brief, are counter to this evidence and arbitrary.

In any event, the proposed repeal does not indicate that power plants that install CCS are even likely to regularly experience dynamic pressure and volume, and in fact the opposite is true.

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[90] Krish R. Krishnamurthy, *Slipstream Pilot-Scale Demonstration, Final Scientifc/Techmical Report,* Linde LLX, submitted to DOE & NETL, at 15–16 (February 3, 2017) https://perma.cc/PZ9Y-87Q6.

[91] 90 Fed. Reg. at 25570 n.136 (citing Brent Jacobs et al. *Reducing the CO2 Emission Intensity of Boundary Dam Unit 3 Through Optimization of Operating Parameters of the Power Plant and Carbon Capture Facilities*, Proceedings of the 16th Greenhouse Gas Control Technologies Conference (GHGT-16) 23-24 Oct 2022 (November 29, 2022), https://dx.doi.org/10.2139/ssrn.4286430.

[92] Mai Bui et al., *The prospects of flexible natural gas-fired CCGT within a green taxonomy*, Imperial London College Centre for Environmental Policy & Centre for Process Systems Engineering, at 11 (June 6, 2024), https://perma.cc/V59T-EMPR.

[93] International CCS Knowledge Centre. *The Shand CCS Feasibility Study Public Report,* at x (November 2018), https://perma.cc/S9V3-3UZZ [hereinafter "Shand FEED Study"]; *See* 89 Fed. Reg. at 39853 n.298, 363, 366, 655 (citing the report).

[94] Shand FEED Study at 63–67.

[95] *Id.* at 67.

As EPA previously found, variability of load at plants that install carbon capture is less likely because a federal tax credit provides a "strong economic incentive to increase utilization and run at higher capacity factors" of 80 percent or more. 89 Fed. Reg. at 39879. As EPA has explained elsewhere, base load plants "operate without much interruption throughout the year" whereas "load-following power plants, adjust their electricity output as demand for electricity fluctuates throughout the day."[96] And the proposed repeal even acknowledges this is the case for the examples of coal plants that have installed CCS, describing Boundary Dam as "a base load unit, typically operating at high capacity factors such that the unit experiences less variation in operation than a load-following unit." 90 Fed. Reg. at 25770. The proposed repeal is therefore arbitrary for its inconsistent reasoning. Even if dynamic pressure and volume may have some impact on capture rates – and EPA has not indicated that they would, or what the amount of that effect would be – the agency has not shown that dynamic pressure and volume are even likely for plants that install CCS.

In short, the proposed repeal's discussion of slipstreams is arbitrary, counter to the evidence before the agency, implausible, and does not disturb EPA's prior factual findings. Slipstreams are a routine approach for testing, may be deployed when targeting partial capture rates due to economic advantages, and have demonstrated high capture rates even with varying and dynamic conditions.

C. The history and current trends in scaling-up demonstrate that 90 percent CCS-based standard can be achieved at large coal-fired power plants.

Contrary to the proposed repeal's claims about project scale, CCS has already been scaled up and can continue to scale up to larger plants. *Contra* 90 Fed. Reg. at 25770. As EPA previously determined, CCS technology "providers have decades of experience and have done the work to responsibly scale up the technology over that time across a range of flue gas compositions." 89 Fed. Reg. at 39847.

Scaling up carbon capture simply requires more or larger carbon capture units holding more of the same solvent. For instance, a capture unit that demonstrated 90 percent reduction at the 25-megawatt project at Plant Barry in 2011 was scaled up tenfold, six years later, to capture 90 percent of emissions from the 240-megawatt project at Petra Nova, using the same solvent – Mitsubishi Heavy Industry's KM-CDR Process. *See* 89 Fed. Reg. 39849–50, 39852. That same vendor is now planning for 95 percent removal from a 530-megawatt project at Project Tundra – double the size of Petra Nova – and is performing an engineering design study for the full exhaust of two units totaling approximately 1,500 megawatts at Four Corners – nearly triple the size of Project Tundra.[97] The Four Corners FEED study is expected to be completed in 2025 and

[96] EPA, *Electric Power Sector Basics*, https://perma.cc/HB45-V2UD (last updated March 24, 2025).

[97] *See id.* at 39850–51; EPA, *Greenhouse Gas Mitigation Measures for Steam Generating Units (Technical Support Document)*, EPA-HQ-OAR-2023-0072-9095, at 30–31 (Apr. 2024), https://www.regulations.gov/document/EPA-HQ-OAR-2023-0072-9095; Navajo Transitional Energy Company Comments at 10 n.39, EPA-HQ-OAR-2023-0072-0819 (August 8, 2023), https://www.regulations.gov/comment/EPA-HQ-OAR-2023-0072-0819 (citing front end engineering design study announcement).

is for a plan to remove 95 percent of the power plant's carbon dioxide emissions.[98] There has been no technical impediment to this continuous scaling up, and the proposed repeal does not identify one.

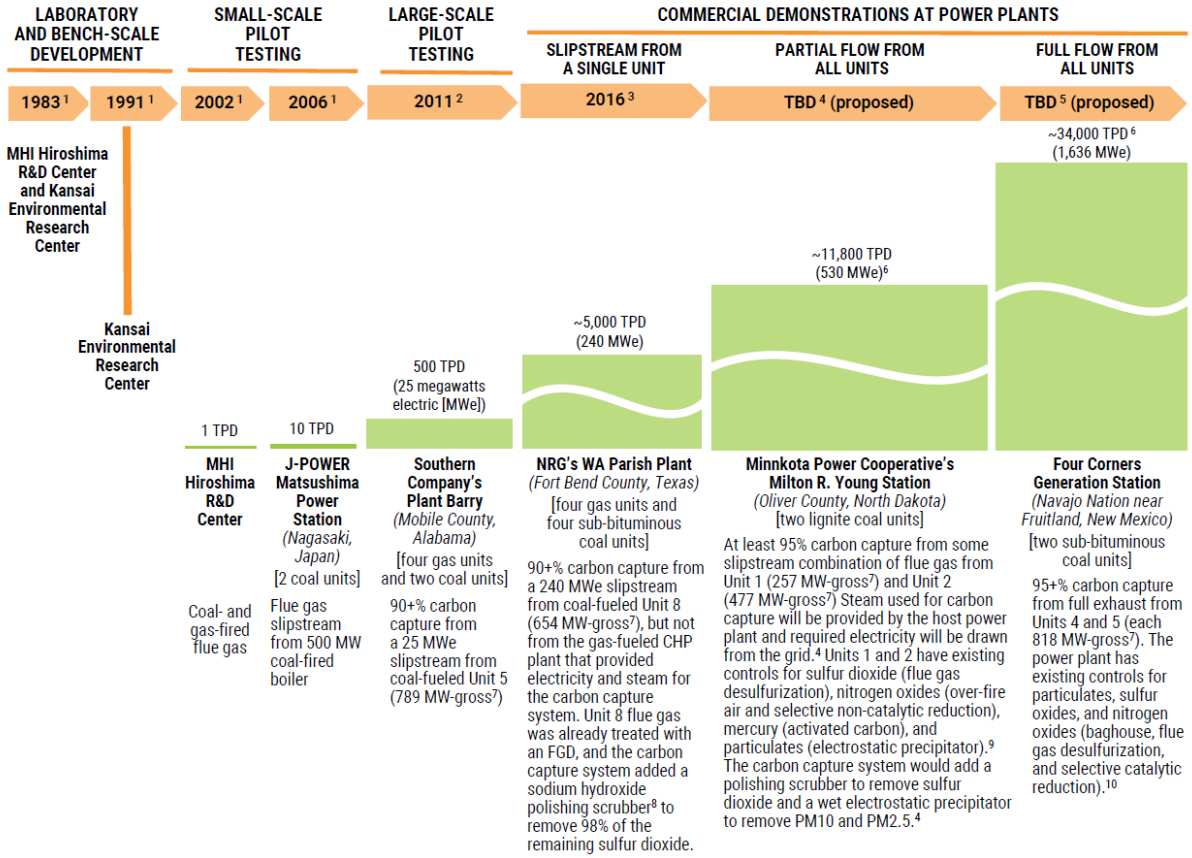

Figure 5. Development of the Kansai Mitsubishi Carbon Dioxide Recovery (KM-CDR) Process for Coal-Fueled Power Plants.[99]

There is also a reason why companies and utilities have been reticent to build commercial scale CCS plants – that companies would be unable to gain regulatory approval to recover their costs "without federal requirements to reduce greenhouse gas emissions already in place."[100]

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[98] *See* Navajo Transitional Energy Company, *NTEC Awarded $6.55M By DOE For Carbon Capture Study At Four Corners Power Plant,* Carbon Capture Magazine (September 18, 2024), https://carboncapturemagazine.com/articles/ntec-awarded-655m-by-doe-for-carbon-capture-study-at-four-corners-power-plant; https://netl.doe.gov/sites/default/files/netl-file/24CM/24CM_CTS1_9_Ampomah2.pdf.

[99] DOE/NETL, *Understanding Scales and Capture Rates*, *supra* note 40.

[100] American Electric Power, *News Release: AEP Places Carbon Capture Commercialization On Hold, Citing Uncertain Status Of Climate Policy, Weak Economy* (July 14, 2011), https://www.aep.com/news/stories/view/1206/AEP-Places-Carbon-Capture-Commercialization-On-Hold-Citing-Uncertain-Status-Of-Climate-Policy-Weak-Economy/; *accord* American Electric Power Comments at 9, EPA-HQ-OAR-2023-0072-0823 (August 7, 2023) https://www.regulations.gov/comment/EPA-HQ-OAR-2023-0072-0823.

That has been the case even as utilities such as American Electric Power (AEP) have acknowledged that demonstration projects have proven CCS. For instance, AEP acknowledged that a demonstration project it operated from 2009 to 2011 "successfully proved" the technology "could capture CO2 at a coal-fired power plant."[101] But AEP did not move forward with a full-unit, commercial scale project due to the lack of federal regulations. Considering these realities, the proposed repeal's insistance on commercial scale examples thus creates a catch-22: only federal regulation would justify a full-unit, commercial scale deployment of carbon capture, but a full-unit, commercial scale deployment is also required before the agency can regulate. That is counter to the purpose and text of Section 111, which requires only that demonstration be "adequate[]."42 U.S.C. § 7411(a)(1).

Furthermore, EPA does not explain why it now considers 25 MW to not be "reflective of commercial scale operation" when discounting the results from Plant Barry. *See* 90 Fed. Reg. at 25770. Considering that the process at Plant Barry was successfully scaled up to Petra Nova, and that EPA previously considered Plant Barry's performance as evidence of adequate demonstration, *see* 89 Fed. Reg. at 39850, the proposed repeal's failure to explain its new position makes it arbitrary and capricious and an abuse of discretion. *Fox TV*, 556 U.S. at 515. And the proposed repeal's conclusions about scaling up CCS are arbitrary because they run counter to the evidence before the agency. *See State Farm*, 463 U.S. at 43.

D. Capture projects can handle various conditions and still achieve the Carbon Pollution Standards.

When EPA determined that 90 percent carbon capture and storage was adequately demonstrated in the Carbon Pollution Standards, it accounted for variations in performance. Even if these variations resulted in periodic lower capture efficiencies, plants can still achieve what the Carbon Pollution Standards require: an 88.4 percent reduction in emission rate on a lb. CO_2/MWh-gross basis over an extended period. The proposed repeal is simply wrong to state that high heat and humidity, periodic decreases in the performance of the CO_2 capture system due to solvent degradation and fouling of components between maintenance cycles, and periods of startup would prevent sources from achieving the Carbon Pollution Standards. *See* 90 Fed. Reg. 25771. EPA explained in the Carbon Pollution Standards,

> To be achievable, a standard "must be capable of being met under most adverse conditions which can reasonably be expected to recur and which are not or cannot be taken into account in determining the 'costs' of compliance." To show a standard is achievable, the EPA must "(1) identify variable conditions that might contribute to the amount of expected emissions, and (2) establish that the test data relied on

("[A]fter being unable to obtain the necessary cost-recovery approval from state regulators, the [commercial-scale] project was cancelled.").

[101] American Electric Power Comments at 8–9.

by the agency are representative of potential industry-wide performance, given the range of variables that affect the achievability of the standard."[102]

EPA thus has an obligation to consider "routine variations in conditions" when determining achievability for new sources. 627 F.2d at 431 n.46. For existing sources, there is little need for EPA to address hypothetical worst-case variations or outlier sources because Section 111(d) allows states, with EPA's review, to issue variances if merited by circumstances specific to an individual source. *See* 42 U.S.C. § 7411(d); 89 Fed. Reg. at 39835; 40 C.F.R. § 60.24a(e). EPA either considered the variations in conditions raised in the proposed rule or those variations, if merited by specific circumstances, may be grounds for a variance based on "remaining useful life and other factors" (RULOF).

In the proposed repeal, EPA raises three supposed issues: challenges related to high heat and humidity, periodic decreases in capture performance due to solvent degradation and fouling of components between maintenance cycles, and accounting for periods of startup and availability. *See* 90 Fed. Reg. at 25771. None of these assertions disturb EPA's previous determinations, and the proposed repeal's conclusions based on these points are counter to the evidence before the agency and implausible.

1. Heat and humidity.

The proposed repeal takes a single sentence from a blog post out of context to speculate that heat and humidity reduced the capture efficiency at Boundary Dam by a meaningful amount.[103] But EPA's reasoning confuses two separate performance metrics and fails to assess how, or if, they relate to one another. The Carbon Pollution Standards are, as discussed above, based on an *emissions intensity* – i.e., the mass of CO_2 emitted per unit of energy output. *See* 89 Fed. Reg. at 39841–42 tbl.1 The blog post discusses *capture amount* – i.e., the mass of CO_2 captured, regardless of energy output, which is important in Boundary Dam's Canadian regulatory context but is not directly relevant to a source's ability to comply with the Carbon Pollution Standards. Unhelpfully, the proposed repeal refers to both these distinct metrics as a "capture rate" in an apparent attempt to conflate them. As measured by emissions intensity, Boundary Dam's performance remained well below the Canadian carbon tax threshold of 549 tonnes CO_2/GWh every quarter.[104] Moreover, unlike the Carbon Pollution Standards, the proposed repeal nowhere considers how Boundary Dam's operations are optimized for the plant's particular incentives and policy environment, specifically to stay under the Canadian carbon tax emissions intensity threshold, rather than the limits in the Carbon Pollution

[102] 89 Fed. Reg. at 39835 (quoting *Nat'l Lime Ass'n v. EPA,* 627 F.2d 416, 433, n.46 (D.C. Cir. 1980); *Sierra Club* v. *Costle,* 657 F.2d 298, 377 (D.C. Cir. 1981) (citing *Nat'l Lime Ass'n v. EPA,* 627 F.2d 416 (D.C. Cir. 1980)).

[103] *See* 90 Fed. Reg. at 25771 (quoting SaskPower*, BD3 Status Update: Q3 2024* (November 13, 2024) https://www.saskpower.com/about-us/our-company/blog/2024/bd3-status-update-q3-2024).

[104] *See* SaskPower*, BD3 Status Update: Q3 2024* (November 13, 2024) https://www.saskpower.com/about-us/our-company/blog/2024/bd3-status-update-q3-2024.

Standards.[105] This disconnect fails to establish a "rational connection between the facts found and the choice made." *State Farm*, 463 U.S. at 52 .

The only other supposed evidence EPA musters in support of its baseless conclusion that carbon capture systems cannot handle heat and humidity is an out of context quote about the performance of Petra Nova. First, the observation has no relevance because, as the proposed repeal acknowledges, Petra Nova maintained its target capture rate during the period described. 90 Fed. Reg. at 25771. Because the target capture rate was maintained, there is no basis in fact for the proposed repeal's observation. Second, the quote on summer ambient conditions from the report on Petra Nova that follows has been removed from its context. The proposed repeal omits an important contributing factor, "the premature replacement of key cooling components" – and omits that what was difficult to maintain was 100 percent of the target capture rate, not "capture" itself as the altered quote suggests.[106] EPA alters the original quote in order to distract from the topic sentence of the referenced paragraph, which states: "Throughout Phase 3, Petra Nova continued to demonstrate that the technology worked at commercial scale."[107]

2. Performance between maintenance cycles.

This portion of the proposed repeal is based entirely on imprecise descriptions of challenges faced at Boundary Dam (related to solvent degradation and component fouling), but it leaves out any discussion of how those issues were successfully mitigated. It also fails to examine whether such issues would be expected for a coal retrofit project that would commence today. The track record at Boundary Dam, including how those issues were mitigated and why some of those issues are unlikely to occur at U.S. plants, are discussed in an earlier section on that project.[108] Additionally, evidence indicates that these problems are unlikely to meaningfully decrease capture rates such that the emissions limits in the Carbon Pollution Standard would be unachievable.[109] Studies have also concluded that solvent degradation in coal-fired applications of CCS are predictable and can be managed through process such as reducing the temperature

[105] *See supra* Comment V.A.1 (explaining optimization of Boundary Dam's operations).

[106] *Compare* Petra Nova DOE Report at 45 ("However, the combination of the scale-up, Houston's summer ambient conditions, the premature replacement of key cooling components (i.e., the CO_2 compressor intercoolers and eight process plate and frame heat exchangers discussed above) resulted in the loss of excess margin in the cooling system stressing the ability to maintain 100% capture, especially during periods when the host coal unit ramps during off-peak hours."); with 90 Fed. Reg. at 25771 ("summer ambient conditions [. . .] resulted in the loss of excess margin in the cooling system stressing the ability to maintain [. . .] capture [. . .]." (alterations in original)).

[107] Petra Nova DOE Report at 45.

[108] *See supra* Comment V.A.1.

[109] *See infra* Comment V.F. (discussing that routine maintenance has been sufficient to address anticipated solvent degradation at the Ravenna plant in Italy).

management practices,[110] even when targeting a 100 percent capture rate.[111] Stable operation at high capture rates can also be achieved through higher solvent flow rates.[112] Furthermore, as already explained, building in redundancies and isolations can allow for cleaning and maintenance of capture systems without shutting down or reducing capacity of a power plant.[113]

3. Periods of startup.

The proposed repeal is incorrect in stating that the Carbon Pollution Standards did not adequately account for periods of startup. 90 Fed. Reg. at 25771 (citing 89 Fed. Reg. 39854). EPA explained in that rule that in recent years "the number of startups per year has been relatively stable" for coal-fired power plants, with an average in 2011 of 10 startups and an average in 2023 of 12 startups. 89 Fed. Reg. at 39854. That portion of the rule's preamble also cited the Technical Support Document on coal-fired plants, which provides additional analysis, including a histogram of coal plant startups.[114] Considering these factual findings, EPA concluded previously that "emissions during startup and shutdown are therefore small relative to emissions during normal operation, so that any impact is averaged out over the course of a year." 89 Fed. Reg. at 39854.

Furthermore, the proposed repeal's assertion that the Carbon Pollution Standards relied on unspecified process improvements is unsupported by the citation to the response to comments, which says no such thing.[115] The proposed repeal also depends on an unsupported assumption that capture rates cannot exceed 90 percent, despite record evidence that those rates have been achieved not only in test facilities but also at Boundary Dam and Petra Nova.[116] EPA previously concluded "[t]here are no technical barriers to increasing capture rates beyond 90% for the most mature capture technologies (amine-based systems),"[117] and the proposed repeal offers no evidence to disrupt that previous conclusion. The proposed repeal fails to grapple with

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[110] Lucas Braakhuis & Hanna K. Knuutila, *Predicting solvent degradation in absorption–based CO_2 capture from industrial flue gases*, 279 Chemical Engineering Science 118940 (September 5, 2023), https://doi.org/10.1016/j.ces.2023.118940.

[111] *See* Daniel Mullen et al., *Monoethanolmine Degradation Rates in Post-combustion CO_2 Capture Plants with the Capture of 100% of the Added CO_2,* 63 Industrial & Engineering Chemistry Research 31 (July 29, 2024), https://pubs.acs.org/doi/10.1021/acs.iecr.4c01525.

[112] *See* Jasper Ros, *CESAR1 Carbon Capture Pilot Campaigns at an Industrial Metal Recycling Site aand Analyis of Solent Degradation Behavior*, 64 Industrial & Engineering Chemistry Research 10 (February 26, 2025), https://pubs.acs.org/doi/10.1021/acs.iecr.4c03998.

[113] *See* Comment at V.A.1, discussing Patit Pradoo et al., *Improving the Operability of the Boundary Dam Unit 3 Carbon Capture Facility*, Proceedings of the 16 Greenhouse Gas Technologies Conference (GHGT-16) 23–24 Oct 2022 (November 29, 2022), https://dx.doi.org/10.2139/ssrn.4286503).

[114] *See* Coal TSD at 49–50.

[115] *See* 90 Fed. Reg. at 25771 (citing EPA, U.S. EPA Response to Comments Document. April 2024. Document ID No. EPA-HQ-OAR-2023-0072-891 (April 2024) at Chapter 4.1.5, page 33, https://www.regulations.gov/document/EPA-HQ-OAR-2025-0124-0041).

[116] *See id.* (citing 89 Fed. Reg. at 39852); *see also* 89 Fed. Reg. at 39850 (citing 92.4 percent capture rate at Petra Nova).

[117] Coal TSD at 57.

EPA's previous factual conclusions regarding startup, which were based on quantitative analysis of the number of startups and technical conclusions or the performance of carbon capture at higher rates in certain circumstances, and it offers no new quantitative analysis about average capture rates over the course of a year. A recent study also bolsters the conclusion in the Carbon Pollution Standards that units can achieve the standards when considering startup and shutdown. This study "successfully demonstrated that the use of solvent storage in a post-combustion capture process can maintain a net CO_2 capture fraction of greater than 95% during simulated startup and shutdown (SUSD) events."[118] This study's approach "ensures greater than 95% CO2 capture fractions are maintained at all times while maximizing energy efficiency and minimizing capital expenditure."[119]

Additionally, the section on variations of performance of capture in the proposed repeal is devoid of any quantitative analysis. At no point does the section provide any evidence indicating that any of the supposed problems would necessarily result in average capture rates below the emission limits in the Carbon Pollution Standards. The proposed repeal's suppositions are implausible considering that the standard is based on an average capture rate of 90 percent. As described in this section, project performance, tests, vendor statements, and studies all indicate that capture rates of greater than 90 percent are feasible, including during startup and shutdown. Most recently opened plants or plants in development, for instance, target capture rates of 95 percent or higher.[120] If capture rates are greater than 90 percent, then periodic dips below a 90 percent capture rate would not result in an average rate below the standard. Although the proposed repeal characterizes capture rates greater than 90 percent as "overperform[ing]," 90 Fed. Reg. at 25771, what the record actually demonstrates is that achieving capture rates greater than 90 percent may simply be plants meeting their target expectations.

4. The proposed repeal ignores the availability of project-specific variances.

Lastly, the proposed repeal completely ignores the possibility of addressing source-specific circumstances through RULOF. *See* 42 U.S.C. § 7411(d); 89 Fed. Reg. at 39835. Under this provision of Section 111(d), states may provide project-specific variances for emissions standards where justified by the "remaining useful life" or other source-specific factors of a plant. The Carbon Pollution Standards explained how states could consider these factors when setting source-specific standards in their state plans. *See* 89 Fed. Reg. at 39891, 39963–64.

Even if the potential issues identified in this section of the proposed repeal were relevant, which they are not, EPA entirely fails to consider whether RULOF may be appropriate for sources impacted by these concerns. If, for instance, a source is likely to experience particularly high heat and humidity that it can demonstrate will impact its capture rate to the extent that the source cannot achieve a 90 percent capture rate, that source may be a candidate for RULOF. A source that faces unique challenges that require more frequent startups may also be a candidate

[118] Daniel Mullen et al., *Flexibly Operated Capture Using Solvent Storage (FOCUSS) – Results*, Proceedings of the 17th Greenhouse Gas Control Technologies Conference (GHGT-17) 20 -24 October 2024, at 1(December 2024), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5062762.

[119] *Id.* at 1.

[120] *See, e.g.*, *infra* Comment section V.F. (describing projects)

for RULOF. Although these sources would require individualized analysis, the proposed repeal has "entirely failed to consider an important aspect of the problem," namely whether RULOF could address the supposed variations in performance described here. *See State Farm*, 463 U.S. at 43.

E. Projects and technologies in development continue to show improvement in CCS.

As explained in a subsequent section, there are new post-combustion CCS applications in operation since the Carbon Pollution Standards were finalized in May 2024.[121] And neither of the proposed repeal's other observations on challenges facing projects or other capture technologies in development are relevant to, or disturb, EPA's prior determination about adequate demonstration of 90 percent post-combustion capture.

The proposed repeal references challenges to individual projects that were "supportive" of, but not essential to, EPA's determination that 90 percent capture was adequately demonstrated. *See* 89 Fed. Reg. at 39851. For Project Tundra, the proposed repeal notes that one sponsor backed out but acknowledged the project still intends to move forward. 90 Fed. Reg. at 25772. Indeed, as a spokesperson for Minntoka quoted in one of the cited articles on this explained, "We are continuing to move forward with development efforts and remain optimistic about Project Tundra's future."[122] And in March of 2025, Minnkota CEO Mac McLennan said that funding from the U.S. Department of Agriculture would help projects like Tundra "strengthen U.S. energy security, create jobs and fuel economic growth in energy-producing regions" in a statement by the National Rural Electric Cooperative Association (NRECA) that hailed Project Tundra as a "world-leading" carbon capture and storage project.[123] Loss of a financial backer may present a challenge, but it says nothing about the adequate demonstration of 90 percent capture. For Project Diamond Vault, although the FEED study was abandoned in late 2024, the source cited by the proposed repeal indicates the owners would still "evaluate other potential carbon capture sequestration technologies."[124]

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[121] Although the proposed repeal adds the qualifier for requiring performance over a calendar year, *see* 90 Fed. Reg. 25772, the agency cannot rely on that countertextual requirement, *see infra* Comment IV.C..

[122] Dan Gearino, *A Carbon Capture Project Faces a New Delay in a Year of Slow Progress for Coal Power Plants Looking for Retrofits*, Inside Climate News (December 10, 2024), https://insideclimatenews.org/news/10122024/north-dakota-coal-plant-carbon-capture-project-faces-new-delay/.

[123] Molly Christian, *USDA Takes Steps to Release Co-op Funding That Will 'Unleash American Energy'*, NRECA (March 31, 2025), https://www.electric.coop/usda-takes-steps-to-release-co-op-funding-that-will-unleash-american-energy; *see also* NRECA, Letter to USDA, at 44 (March 20, 2025) https://www.electric.coop/wp-content/uploads/2025/03/Secretary-Rollins-USDA-Letters-03_20_25.pdf ("Project Tundra is a world-leading carbon capture and storage initiative that strengthens coal's role in America's energy future and unleashes U.S. energy dominance. With up to $400 million in essential funding from the New ERA program, this project will deploy cutting-edge technology to capture and permanently store 4 million tons of CO2 annually – ensuring America's vast coal resources remain a powerful force in the energy sector.").

[124] Cleco Corporate Holdings, LLC, SEC Form 10Q, at 51 (August 18, 2024), https://www.sec.gov/Archives/edgar/data/18672/000108981924000026/cnl-20240630.htm.

In any event, the cancellation of some infrastructure projects, such as Project Diamond Vault, does not call into question EPA's determination on adequate demonstration in the Carbon Pollution Standards. Cancellation of announced infrastructure projects is a normal part of business decisionmaking. For example, data on electric transmission infrastructure projects across North America obtained during the reliability supplemental comment period on the Carbon Pollution Standards from the C Three Group, which is now Yes Energy and is an energy infrastructure and utility market research and consulting firm, suggests that over 15 percent of transmission projects since the early 2000s have been canceled or withdrawn.[125] Of the projects in that dataset, 60 percent of projects are operating, and 64 percent are labeled as either operating or under construction. Most of the remaining 20 percent are in some form of development pre-construction. Those cancellations do not cast the adequate demonstration of transmission technologies into doubt. Infrastructure build out of all kinds is often accompanied by cancellation of individual projects.

The proposed repeal's discussion of other capture technologies is even less relevant. As the proposed repeal notes, EPA's determination was "based … on the assessment of CO_2 capture technology using an amine solvent." 90 Fed. Reg. at 25772. The performance of capture technologies that EPA did not identify as the best system of emission reduction is not relevant to EPA's prior determination that amine-based post-combustion capture is adequately demonstrated. *See, e.g.*, 89 Fed. Reg. at 39814 ("the amine-based CCS technology that the EPA is finalizing as BSER "); *id.* ("90 percent capture amine based BSER"); *id.* at 39926 ("amine-based CO_2 capture has been shown to be effective at removal of CO_2 from the flue gas of natural gas-fired combined cycle EGUs") . The Carbon Pollution Standards included a discussion of these other technologies to explain "that as CCS infrastructure increases, technologies from each of these categories will become more economically competitive," 89 Fed. Reg. at 39932–33, and as part of a presumptively approvable backstop rate that "could provide flexibility for sources to employ other technologies," 89 Fed. Reg. at 39885–86. At no point were these other technologies essential to EPA's determinations. Instead, they were described as a part of compliance flexibility that underscores that the Carbon Pollution Standards are achievable. The other discussion of these technologies and their development was consistent with the Clean Air Act's provisions, which are "expressly designed to force regulated sources to develop pollution control devices that might at the time appear to be economically or technologically infeasible." *Union Elec. Co. v. E.P.A.*, 427 U.S. 246, 257 (1976).[126] Congress understood that protecting public health "may mean that people and industries will be asked to do what seems impossible at the present time." *Id*. at 258–59 (quoting Remarks of Sen. Muskie, 116 Cong. Rec. 32901–02 (1970)). Although

[125] This dataset provides a comprehensive catalog of nearly 38,000 electricity transmission projects since the early 2000s with information on their ownership, location, development status, voltage, project drivers, and other technical information. This information was compiled and submitted during the reliability supplemental comment period on the Carbon Pollution Standards. *See* Comment Submitted by Clean Air Task Force and Natural Resources Defense Council, EPA-HQ-OAR-2023-0072-8188 (Dec. 20, 2023). For a description of the C Three Group, which is now Yes Energy, see https://www.yesenergy.com/c-three-energy-infrastructure-data.

[126] As EPA explained previously, the Carbon Pollution Standards were explicitly not based on EPA's ability to base standards based on projections of technologies still in development. 89 Fed. Reg. at 39832 n.223.

EPA did not rely on this part of its statutory authority, in setting the Carbon Pollution Standards, it was still prudent to discuss these advances.

Furthermore, the proposed repeal does not itself analyze any technological developments in CCS since May 2024. Many of these developments have been collected and described by DOE's National Energy Technology Laboratory (NETL),[127] DOE's Office of Fossil Energy and Carbon Management,[128] and the Global CCS Institute.[129] These sources indicate that capture rates of 95 percent or 99 percent are technically feasible with various capture methods, and further bolster EPA's prior finding that the Carbon Pollution Standards are achievable. EPA must consider these sources of evidence on technological improvements of CCS.

F. Recent project updates and announcements continue to bolster EPA's original determination that 90 percent CCS is adequately demonstrated and standards based on its application are achievable.

Developments since the close of the Carbon Pollution Standards' comment period in August 2023 provide further support for EPA's 2024 final determination that 90 percent CCS is adequately demonstrated and that standards based on its application are achievable. There has been a significant increase in global CCS infrastructure, with 50 facilities in operation, 44 under construction, and over 600 projects in the pipeline as of July 2024.[130] In the United States, there are over 270 projects at various stages of development.[131] Mitsubishi Heavy Industries alone has 18 commercial plants operating worldwide using their KM-CDR process.[132]

Texas has recently issued permits for multiple carbon capture projects for gas-fired power plants. These include the 550-MW Quail Run Energy Center, 1,116-MW Deer Park plant, and 810-MW Baytown plant.[133] The proposed repeal failed to consider these plants, all of which

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[127] *See* DOE & NETL, *Carbon Capture Program R&D Conpendium of Carbon Capture Technology* (2024), at 2–6, https://perma.cc/F3YY-LZUT.

[128] *See* Sarah Hamilton, *Net-zero Flexible Power Project Reciew, Meeting – Summary and Key Findings*, DOE Ofice of Fossil Energy and Carbon Management, at 10–11, (August 7, 2024), https://perma.cc/FKD5-K6ZV.

[129] Hugh Barlow et al., *Advancements in CCS Technologies and Costs*, Global CCS Institute (January 30, 2025), https://www.globalccsinstitute.com/resources/publications-reports-research/advancements-in-ccs-technologies-and-costs/.

[130] Global CCS Institute, *Global Status of CCS 2024: Collaborating For A Net-Zero Future*, at 12 (2024), https://www.globalccsinstitute.com/wp-content/uploads/2024/11/Global-Status-Report-6-November.pdf.

[131] *See id.*

[132] *See* Mitsubishi Heavy Industries, *CO_2 Capture Technology: Plants, Systems and Services,* https://www.mhi.com/products/engineering/co2plants_service.html (last visited July 31, 2025).

[133] *See* Appendix A at II.C; *see also, e.g.*, ExxonMobil, *Calpine, ExxonMobil sign CO_2 transportation and storage agreement for power generation project* (April 23, 2025) https://corporate.exxonmobil.com/news/news-releases/2025/0423_calpine-exxonmobil-sign-co2-transportation-and-storage-agreement-for-power-generation-project (Baytown update); Calpine, *News: Calpine Announces Execution of Full-Scale Demonstration Project Cost Sharing Agreement With DOE for Baytown Decarbonization Project* (July 3, 2024), https://www.calpine.com/calpine-announces-execution-of-full-scale-demonstration-project-cost-sharing-agreement-with-doe-for-baytown-decarbonization-project/ (Baytown update); Office of Clean Energy Demonstrations, *Carbon*

were mentioned in the Carbon Pollution Standards, *see* 89 Fed. Reg. at 39866, and to consider the updates to their status.

There are more new plans to build carbon capture for power plants in the United States. Exxon plans to build 1.5-GW gas-fired power plants equipped with greater than 90 percent carbon capture.[134] Meta has committed to funding carbon capture for power plants, and is building gas plants with planned ability to upgrade to CCS in the future, in Louisiana.[135] Entergy is performing an engineering study for CCS at the Lake Charles Power Station in Louisiana.[136] Duke Energy is performing a CCS FEED study at the Edwardsport facility in Indiana.[137] The Competitive Power Ventures (CPV) Shay facility in West Virginia, a planned 2-GW CCS-controlled gas plant, is continuing to move forward.[138] There is a newly announced data center in Cheyenne, Wyoming, that will be powered by renewable energy and by natural gas with carbon capture.[139] And, despite the recent loss of Department of Energy funding, Louisville Gas and Electric is looking for ways to push forward with a carbon capture plant at the Cane Run Generating Station in Kentucky.[140]

There have been several notable deployments of CCS in other countries, including specifically for power, that bolster EPA's prior determinations and undercut the statements in the proposed repeal. For example, the Taizhou coal-fired power plant in China has operated a 500,000 tons/year capture system since 2023, and achieves capture rates of over 90 percent.[141] Nearly 50 other Chinese capture projects are operational or underway as detailed in Appendix A.

Capture Demonstration Projects Program – Baytown Carbon Capture and Storage Project, DOE, at 1, https://perma.cc/5RWY-9AK4 (last visited July 31, 2025).

[134] Rebecca F. Elliott, *Exxon Plans to Sell Electricity to Data Centers*, The New York Times (December 11, 2024), https://www.nytimes.com/2024/12/11/business/energy-environment/exxon-mobil-data-centers-power-plant.html ; ExxonMobil, *Steel, ammonia and AI? Oh my! What can't our CCS help decarbonize?* (December 11, 2024), https://corporate.exxonmobil.com/what-we-do/delivering-industrial-solutions/carbon-capture-and-storage/steel-ammonia-ai-what-cant-ccs-help-decarbonize.

[135] *See* Jeffrey Tomich, *Meta goes all in on gas to power a mega data center*, E&E News (November 21, 2024), https://subscriber.politicopro.com/article/eenews/2024/11/21/meta-goes-all-in-on-gas-to-power-a-mega-data-center-00190720.

[136] Carlos Anchondo, *Did Trump's assault on regs just knock out CCS?*, E&E News by Politico, EnergyWire (June 18, 2025), https://www.eenews.net/articles/did-trumps-assault-on-regs-just-knock-out-ccs-2/.

[137] *See id.*

[138] *Id.*

[139] *See* Renée Jean, *Cheyenne to Get Massive AI Data Center Powered by Gas and Carbon Cpature*, Cowboy State Daily (July 29, 2025), https://cowboystatedaily.com/2025/07/29/cheyenne-to-get-massive-ai-data-center-powered-by-gas-and-carbon-capture/.

[140] Liam Niemeyer, *Trump administration terminates award for Kentucky carbon capture projects*, Kentucky Lantern (June 2, 2025), https://kentuckylantern.com/2025/06/02/trump-administration-terminates-award-for-kentucky-carbon-capture-project/.

[141] Nathan Bongers, *China's impressive strides towards carbon capture, utilization, and storage (CCUS): Illustrated through two case studies*, Low Emission Technology Australia at 42–43 (May 2025), [Attachment D].

In September 2024, Eni and Snam launched the first power plant to use CCS in Italy, Ravenna CCS.[142] Soon after it came online, the project at a gas-fired power plant was "already delivering a reduction of over 90% in CO_2 emissions from the Casalborsetti plant's chimney, rising to peaks of 96%."[143] That successful operation has continued, and over the first eight months of its operation "the monthly average of the capture efficiency was constantly greater than 91.8%, with a peak of 96.1%."[144] This project uses Mitsubishi Heavy Industry's KS-1 solvent,[145] a solvent which EPA evaluated as evidence of 90 percent CCS's adequate demonstration in the Carbon Pollution Standards but which is not discussed in the proposed repeal. *See* 89 Fed. Reg. at 39852. This plant's performance also demonstrates how routine maintenance can address any issues related to solvent degradation, as the "degradation of the amine solvent required cyclic solvent make-ups of approximately 1–2% of the circulating volume every 30 days. This value is in line with the expected performance declared by the manufacturer and could be subject to further optimization due to the learning curve of plant operation."[146] And it illustrates how, at least in certain configurations, CCS can be run using "thermal energy which is entirely produced from the recovery of flue gas waste heat and renewable electric energy" so that "no new CO2 emissions are due to the capture process."[147] This plant's performance is powerful evidence that 90 percent CCS is adequately demonstrated for gas-fired power plants, that solvent degradation can be addressed through routine maintenance, and that the capture process can be run without adding carbon dioxide emissions from auxiliary load.

In the United Kingdom, the Net Zero Teeside project, a 742-MW gas-fired power plant designed for 95 percent capture, continues to move forward with a planned startup date of 2028.[148] The project will capture up to two million metric tons of carbon dioxide per year and generate enough flexible power to meet the electricity needs of one million homes.[149] The plant will use Shell's CANSOLV CO_2 amine based, post-combustion carbon capture solvent.[150] This is the same solvent in use at Boundary Dam and planned for use at Deer Park Energy Center and

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[142] Eni, *Eni and Snam launch Ravenna CCS, Italy's first Carbon Capture and Storage project* (September 3, 2024), https://www.eni.com/en-IT/media/press-release/2024/09/eni-snam-launch-ravenna-css-italy-s-first-carbon-capture-storage-project.html.

[143] *Id.*; *see also* Ravenna CCS, *Our activities in Ravenna*, https://ravennaccs.com/en-IT/project/ravenna-hub (last visited July 31, 2025).

[144] Ravenna Phase I CCS Report at 4, Attachment B.

[145] Mitsubishi Heavy Industries, *Europe's First Post-Combustion Carbon Capture Plants Starts Operation with MHI Technology as part of the Ravenna CCS Projects, Phase 1* (September 18, 2024), https://www.mhi.com/news/24091802.html.

[146] Ravenna Phase I CCS Report at 4, Attachment B.

[147] *Id.*at 9.

[148] Net Zero Teesside & NZT Power, *Net Zero Teesside Power,* https://www.netzeroteesside.co.uk/project/ (last visited July 31, 2025).

[149] Technip Energies, *Net Zero Teesside Power*, at 2 (2025), https://www.ten.com/sites/energies/files/2025-05/net-zero-teesside-case-study.pdf.

[150] *Id.* at 4.

Baytown Energy Center. *See* 89 Fed. Reg. at 39928. As EPA previously observed, Shell developed this solvent for "highly flexible turn-up and turndown capacity" and Shell provides that systems "can be guaranteed for bulk CO_2 removal of over 90%." *Id.* at 39851–52. In fact, the plant's permit requires a 95 percent capture rate of the total flue gas of the plant during normal operating conditions,[151] and the publicly available contract for the project indicates a design capture rate of 96 percent.[152] The government of the United Kingdom referred to carbon capture as a "proven technology" when announcing the signing of contracts for this plant in December 2024.[153]

In May 2025, Mitsubishi Heavy Industries began operation of a new carbon capture system at the Himeji No. 2 gas-fired power plant in Japan.[154] This plant is part of an end-to-end carbon capture and storage solution partnership between Mitsubishi Heavy Industries and ExxonMobil.[155] According to Mitsubishi Heavy Indutries, the company's Advanced KM CDR Process and KS-21 solvent have been able to achieve capture rates of 99.8 percent in testing.[156] And in July 2025, Mitsubishi Heavy Industries announced a contract for a front end engineering design (FEED) study for a capture plant at the coal-fired Tomato-Atusma Power Station in Japan.[157]

VI. The alternative proposal uses unfounded and unreasonable assumptions to calculate costs, but even still shows 90 percent CCS to be cost reasonable.

The proposed repeal's cost analysis suffers from multiple flaws that render it arbitrary and the conclusions based on the analysis unreasonable. *See* 90 Fed. Reg. at 25772–73. These errors include an arbitrary capacity factor assumption that runs counter to the evidence, an incorrect suggestion on whether the Agency should consider tax credits in analyzing cost, the complete disregard of the benefits of climate change, and an arbitrary comparison to past determinations of cost reasonableness. Any one of these failures on its own would render the

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[151] Environment Agency, *Guidance: Post-combustion carbon dioxide capture: emerging techniques*, GOV.UK (March 27, 2024), https://perma.cc/LYM2-KFU5.

[152] *See* Net Zero Teesside Power Limited & Low Carbon Contracts Company LTD, *Agreement Relating to Net Zero Teesside Power, Final Version*, 5 (November 19, 2024) ("The 'CO_2 Capture Rate Estimate' applicable to this [agreement] is: 96%"), https://perma.cc/4DMZ-6XTT.

[153] Department for Energy Security and Net Zero & The Rt Hon Ed Miliband MP, *Press Release: Contracts signed for UK's first carbon capture projects in Teesside*, GOV.UK (December 10, 2024), https://perma.cc/GG4K-TFUM.

[154] *See* Mitsubishi Heavy Industries, *Press Information: MHI Starts Operation of New CO_2 Capture Pilot Plant at KEPCO's Himeji No.2 Power Station* (May 14, 2025), https://www.mhi.com/news/250514.html.

[155] *See id.*; *see also* Mitsubishi Heavy Industries & Exxon Mobil, *Press Information: ExxonMobil, Mitsubishi Heavy Industries Form Carbon Capture Technology Alliance* (November 30, 2022), https://www.mhi.com/news/22113001.html.

[156] *See* Sasha Ranevska, *MHI And KEPCO To Test New CO2 Capture Pilot Plant At Japan Power Station*, Carbon Herald (Jan. 18, 2024), https://carbonherald.com/mhi-and-kepco-to-test-new-co2-capture-pilot-plant-at-japan-power-station/; *see also* 89 Fed. Reg. at 39852 (citing 99.8 percent capture rate for KS-21).

[157] Mitsubishi Heavy Industries, *Press Information: MHI Awarded Contract for Basic Design of Japan's Largest CO_2 Capture Plant at Hokkaido* (July 7, 2025), https://www.mhi.com/news/25070701.html.

entire cost analysis arbitrary and capricious, *see State Farm*, 463 U.S. at 43; collectively, these errors magnify each other to create a wholly unsubstantiated and wildly inaccurate analysis.

A. The proposed repeal's assumptions for calculating costs are unreasonable and counter to the evidence before the agency.

The proposed repeal's 40-percent capacity factor assumption in the cost calculations lacks any foundation, is counter to the evidence before the agency, and is implausible. It is unreasonable to assume that power plants with and without CCS will behave similarly, and the proposed repeal also ignores historical evidence on capacity factors.[158]

First, it is implausible to assume that coal-fired power plants with and without CCS will behave similarly. As EPA determined previously, "because the IRC section 45Q tax credit provides a significant economic benefit, sources that apply CCS will have a strong economic incentive to increase utilization and run at higher capacity factors than occurred historically." 89 Fed. Reg. at 39879. That conclusion was based on a study by NETL and the historical practice of other forms of generation that receive section 45 tax credits and continue to produce even when power prices are negative.[159] Modeling runs for the Carbon Pollution Standards also showed capacity factors for coal-fired power plants with CCS over 80 percent.[160] The proposed repeal offers no new analysis or modeling to undercut these earlier findings or the facts underlying them. In fact, the proposed repeal includes an example of how a coal plant with CCS operates – Boundary Dam, which the proposed repeal describes as a "a base load unit, typically operating at high capacity factors." 90 Fed. Reg. at 25770. Furthermore, additional sources bolster the finding that plants with CCS will operate at higher capacity factors than those without CCS have historically, including a DOE report on gas-powered power plants[161] and an analysis led by a Southern Company researcher that concluded "45Q Incentivizes Higher Capacity Factor" because while "available—for the 12 years following the retrofit—the 45Q tax credit makes the net dispatch cost of the units negative. Power companies would be incentivized to operate at availability."[162]

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[158] *See* EPA, *U.S. EPA. Memorandum. Updated Evaluation of BSER Costs of Carbon Capture and Sequestration*, Document ID EPA-HQ-OAR-2025-0124-0076 (June 18, 2025), https://www.regulations.gov/document/EPA-HQ-OAR-2025-0124-0076.

[159] *See* 89 Fed. Reg. at 39879 (citing National Energy Technology Laboratory, *Cost and Performance Baseline for Fossil Energy Plants Volume 1: Bituminous Coal and Natural Gas to Electricity*, DOE & NETL (October 14, 2022), https://perma.cc/WW7W-HK57.

[160] *See id.*

[161] *See* Eli Bashevkin et al., *Portfolio Insights: Carbon Capture in the Power Sector* at 12, Department of Energy Office of Clean Energy Demonstrations (April 2024), https://perma.cc/CRE4-2WRZ ("For example, this analysis depicts an illustrative NGCC with a CCUS retrofit at an 85% capacity factor enabled by structure of the 45Q tax credit, whereas average capacity factor for existing NGCCs was 57% in 2022.").

[162] Esposito et al., *An Updated Look at the Costs, Economics, and Business Case for CO2 Capture from Retrofit of Natural Gas Combined-Cycle and Coal-Fueled Power Plants: Two New Case Studies*, Proceedings of the 17th Greenhouse Gas Control Technologies Conference (GHGT-17) 20-24 October 2024, at 7 (November 6, 2024), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5010874.

Second, the proposed repeal bases its capacity factor on a snapshot of only one year – 2023 – when the average capacity factor for coal was 43 percent. 90 Fed. Reg. at 25772. Historical capacity factors were higher.[163] In fact, before "2010, coal capacity factors routinely averaged 70% or more," and capacity factors dropped due to lower prices of natural gas.[164] Even if EPA were to use historical data, it has not explained why 2023 is a representative year for projecting future capacity factors, or why the proposed repeal's analysis uses an even *lower* capacity factor of 40 percent.

Third, the proposed repeal's reasoning is internally inconsistent. Whereas it projects a lower capacity factor when considering the cost of CCS, EPA elsewhere asserted it "believes that coal-fired steam generating unit capacity and generation will continue to comprise a substantial portion of the nation's electricity supply." 90 Fed. Reg. at 25774. As courts have held, "EPA's actions must also be consistent; an internally inconsistent analysis is arbitrary and capricious." *Nat'l Parks Conservation Ass'n v. EPA*, 788 F.3d 1134, 1141 (9th Cir. 2015) (citing *Gen. Chem. Corp. v. United States*, 817 F.2d 844, 857 (D.C. Cir. 1987) (per curiam)). EPA has made no attempt to reconcile that internal inconsistency. See *ANR Storage Co. v. FERC*, 904 F.3d 1020, 1026–28 (D.C. Cir. 2018) (agency action arbitrary and capricious where its "analysis . . . was internally inconsistent").

Fourth, the proposed repeal's conclusions cannot be rationally drawn from the information EPA puts forward. As already explained, the incentives of plants with carbon capture units are to run more to maximize revenue, including from the 45Q tax credit. While a unit is eligible for the 45Q tax credit, its net variable operating and maintenance cost (VOM) is significantly decreased because of the tax credit revenue associated with capturing and storing CO_2. Based on the Sargent and Lundy spreadsheet that EPA cites,[165] the marginal operating cost of carbon capture (including net variable and operating costs, transport and storage costs, 45Q tax credits) is -$41/MWh (in 2019 $) over the 12-year period when the credit is available, even using the proposed repeal's unsupported assumption that the effective capture rate is only 75 percent.[166] This negative variable operating cost would incentivize units to run at substantially higher capacity factors to maximize profit. As EPA explained in the Carbon Pollution Standards,

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[163] *See, e.g.*, EIA, *Electric Power Monthly, Table 6.07.A Capacity Factors for Utility Scale Generators Primarily Using Fossil Fuels*, https://perma.cc/Y2M8-2EF7 (last visited July 31, 2025).

[164] *See* Today in Energy, *Annual U.S. coal-fired electricity generation will increase for the first time since 2014*, EIA (October 18, 2021), https://perma.cc/3BTQ-JX3A.

[165] EPA, "*Coal CCS Cost Calculations – Updated Assumptions.xlsx",* Document ID EPA-HQ-OAR-2025-0124-0076 (June 18, 2025), available at https://www.regulations.gov/document/EPA-HQ-OAR-2025-0124-0076.

[166] To reach this calculation, total variable costs for each unit in the EPA spreadsheet were tallied (in $) and then divided by the generation of the unit in megawatt hour (MWh) to generate the variable costs of carbon capture (in $/MWh) for each unit. A weighted average was then calculated across all of the units in EPA's spreadsheet that were expected to be online on January 1, 2039, and therefore subject to the long-term subcategory's standards. To calculate a weighted average, the variable costs for each unit were multipled by the capacity of each unit in megawatts, summed across all units, and then divided across the total capacity in megawatts for all plants to create the weighted average in $/MWh. *See* attached spreadsheet "Variable Operating Cost Analysis," Attachment E, which is a copy of the EPA Coal CCS Cost Calculations with headers for fields showing new analysis building on EPA's spreadsheet highlighted in yellow.

this economic reality – the ability of these coal plants to produce electricity cheaper than other grid resources – would actually result in higher capacity factors, as demonstrated both by modeling and empirical evidence from other generating units receiving analogous tax credits. . 89 Fed. Reg. at 39879 (coal plants); *id.* at 39934 (gas plants).

Without the proposed repeal's baseless assumption of a 40 percent capacity factor, the argument that CCS's cost is out of step with other cost-reasonable pollution controls evaporates. Even with the longer operating horizon assumed in the proposed repeal, the average costs of CCS would be $2 per short ton or $2 per MWh.[167] Using an 80 percent capacity factor rather than a 40 percent capacity factor, while using the same range of input assumptions that EPA uses in the proposed repeal, results in CCS costs ranging from -$4 to $11/MWh.[168] EPA's new cost calculations are based on an unreasonable assumption that lacks any analytical foundation and deviates from the agency's previous conclusions without explanation, leading to conclusions that are arbitrary and capricious, and unreasonable.

Beyond the flaws related to capacity factors, EPA's proposed repeal deliberately manipulates capture rate assumptions in a way that distorts cost estimates. The proposed repeal assumes that all cost components – including capital costs, fixed operating and maintenance (O&M) costs, and variable O&M costs – are based on a plant designed to achieve 90 percent carbon capture, while modeling performance and tax revenues based on only a 75 percent actual capture rate.[169] It is patently unreasonable to consider the costs of a standard based on 90 percent capture by determining the cost of a plant that fails to meet the standard by 15 percentage points. This mismatch artificially inflates the estimated costs of CCS, as higher design capture rates with lower actual capture rates drive up per-ton costs.[170] If a facility is designed to achieve 90 percent capture-based standard, it is both technically and economically reasonable to assume it will

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[167] *See* EPA, *U.S. EPA. Memorandum. Updated Evaluation of BSER Costs of Carbon Capture and Sequestration/Storage at Existing Coal-Fired Electric Generating Units. June 2025*, Document ID EPA-HQ-OAR-2025-0124-0076 at 4, tbl.2. (June 18, 2025), https://www.regulations.gov/document/EPA-HQ-OAR-2025-0124-0076.

[168] *See id.* at tbl.2 (-$4/MWh); *Coal CCS Cost Calculations - Updated Operating Assumptions*, EPA-HQ-OAR-2025-0124-0076_attachment_1. Although EPA did not provide an output in its memo of a 15-year amortization, 80% capacity factor, 90% CCS percent design efficiency, 75% CCS operation scenario, that figure can be easily generated using EPA's cost spreadsheet cited here. The output in cell F18 (Capacity Weighted Average $/MWh) can be obtained by changing the capacity factor in cell C9 to 80%, which will generate a capacity weighted average of $11/MWh.

[169] *See* 90 Fed. Reg. at 25776 n.196 (citing EPA, *U.S. EPA. Memorandum. Updated Evaluation of Best System of Emission Reduction Costs of Carbon Capture and Sequestration/Storage at New and Reconstructed Natural Gas-Fired Combustion Turbine Electric Generating Units. May* 2025., Document ID EPA-HQ-OAR-2025-0124-0075 (June 18, 2025), https://www.regulations.gov/document/EPA-HQ-OAR-2025-0124-0075).

[170] Analysis using the Lundy spreadsheet that EPA cites shows that with a 75 percent actual capture rate, 80 percent capacity factor, and a 12-year amortization period, reducing the design capture rate from 95 percent to 90 percent decreases total costs by $4.5 per ton (in 2019 dollars); a drop from 80 percent to 75 percent lowers costs by $3.6 per ton. Assuming a 90 percent design capture rate, an 80 percent capacity factor, and a 12-year amortization period, reducing the actual capture rate from 90 percent to 85 percent increases total costs by $3.9 per ton; reducing it from 55 percent to 50 percent increases costs by $31.20 per ton.

operate to meet that standard, particularly given the structure of 45Q, which ties tax credits to the amount of CO_2 actually captured. Assuming, as EPA does in the proposed repeal, that a plant will bear the costs of a 90 percent design but receive 45Q credits for only 75 percent capture misrepresents real-world incentives and compliance behavior, and results in distorted cost estimates. The proposed repeal does not explain or justify its use of a 75-percent capture rate, and it is as if this "number was pulled from thin air." *See Mayor of Baltimore v. Azar*, 973 F.3d 258, 282 (4th Cir. 2020).

Along with the other deficiencies described in this section, this mismatch between the data before the agency and its cost calculations is a "serious flaw" rendering the proposed repeal's cost analysis arbitrary and capricious, and the proposed repeal has failed to examine the relevant data that "could reveal that the figures being used are erroneous." *Window Covering Mfrs. Ass'n v. Consumer Prod. Safety Comm'n*, 82 F.4th 1273, 1288 (D.C. Cir. 2023) (citations and quotations omitted).

B. EPA must consider the section 45Q incentive in examining costs.

EPA's assertion that industry cannot rely on the availability of 45Q due to introduced legislation is unsupported. 90 Fed. Reg. at 25772–73. EPA's job is to analyze costs based on policies as they actually exist, not on hypotheticals. Even so, Congress's actions on 45Q indicate that the tax credit enjoys considerable support and is likely to continue – it was established in 2008, reformed in 2018, and enhanced in 2022.[171] Commodity analysts considered the credit's future stable regardless of electoral outcomes in 2024.[172] And during the comment period on the proposed repeal, Congress not only retained 45Q but increased its value where captured CO_2 is used in enhanced oil recovery,[173] and did so even as it altered or phased out numerous other energy-related tax provisions.[174] In contrast to this durability across congresses, EPA provides the flimsiest of examples – a single bill that has only two co-sponsors and, as of five months after its introduction, has not even received a committee hearing. 90 Fed. Reg. at 25773 n.168 (citing 45Q Repeal Act, H.R. 1946, 119th Congress (2025)). The proposed repeal's suggestion that operators may not be able to depend on 45Q, *see* 90 Fed. Reg. at 25772–73, is also counter to Congress's intent in enacting that section of the Internal Revenue Code and outside of EPA's area

[171] Emergency Economic Stabilization Act of 2008, Pub. L. No. 110-343, §115(a) (2008) (establishing 45Q tax credit); Bipartisan Budget Act of 2018, Pub. L. No. 115-123, § 41119 (2018); Inflation Reduction Act of 2022, Pub. L. 117-169, § 13104 (2022).

[172] Markham Watson, *US carbon capture tax credits to persist no matter who wins elections: experts*, S&P Global (July 24, 2024), https://www.spglobal.com/commodity-insights/en/news-research/latest-news/electric-power/072424-us-carbon-capture-tax-credits-to-persist-no-matter-who-wins-elections-experts.

[173] *See* One Big Beautiful Bill Act of 2025, Pub. L. No. 119-21 § 70522 (2025). The Carbon Pollution Standards explain that sources can comply through EOR. *See* 89 Fed. Reg. at 39951 ("EGUs also have the compliance option to send CO_2 to EOR facilities that report under subpart RR or GHGRP subpart VV").

[174] *See, e.g.*, Sidley, *The "One Big Beautiful Bill" Act – Navigating the New Energy Landscape* (July 15, 2025) (describing various changes to energy tax credits), https://www.sidley.com/en/insights/newsupdates/2025/07/the-one-big-beautiful-bill-act-navigating-the-new-energy-landscape.

of expertise. As the Energy Information Administration has explained, for instance, the 45Q tax credit will drive carbon capture deployment, regardless of the Carbon Pollution Standards.[175]

As EPA previously explained in the Carbon Pollution Standards, recent congressional enactments "demonstrate an intent to support development and deployment of low-[greenhouse gas] emitting technologies in the power sector." 89 Fed. Reg. at 39818–20, 39881; see also I.R.C. § 45Q (tax credit for capture and sequestration); 42 U.S.C. § 7435(a) (grants for technical assistance to reduce greenhouse gas emissions from electricity generation). In 2022, shortly after the Supreme Court interpreted Section 111 as allowing standards that "improve the pollution performance of individual sources" and "caus[e] plants to operate more cleanly," *West Virginia*, 597 U.S. at 734, 706, Congress significantly expanded tax credits for carbon capture and storage to accomplish those goals. *See* Inflation Reduction Act, Pub. L. No. 117-169, § 13104 (2022). In the same enactment, Congress also amended the Clean Air Act, directing EPA to assess the effect of Congress's significant tax incentives, and to regulate with those incentives in mind.[176] Had Congress wanted to limit how EPA could consider those subsidies when developing standards under Section 111, it could have done so.[177] The proposed repeal's suggestion that EPA should not consider tax credits when determining the cost of pollution controls, *see* 90 Fed. Reg. at 25772, is also an unacknowledged departure from EPA's past position and therefore arbitrary and unlawful, *see Fox TV*, 556 U.S. at 515–16.

Furthermore, including the 45Q tax credit in the analysis of cost reasonableness is the only valid reading of the statutory factors of Section 111, which direct EPA to "tak[e] into account the cost *of achieving such reduction*" when determining the best system of emission reduction. 42 U.S.C. § 7411(a)(1) (emphasis added). Thus, the plain language of the statute indicates that EPA is to consider the cost of compliance, which would be offset by tax credits.[178] The legislative history of the Inflation Reduction Act underscores that Congress intended that EPA consider 45Q specifically when evaluating costs for regulation of greenhouse gases under Section 111. *See* 89 Fed. Reg. at 39881 (describing legislative history). Where the proposed

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[175] *See* EIA Today in Energy, *Tax credits drive carbon capture deployment in our Annual Energy Outlook* (July 18, 2025), https://perma.cc/AX53-G6EK.

[176] See 42 U.S.C. § 7435(a)(5)-(6) (instructing EPA to "assess" the projected emission reductions from anticipated changes in electricity generation following enactment of the Inflation Reduction Act and to issue new standards that "ensure" reductions); *see also* EPA, *Electricity Sector Emissions Impacts of the Inflation Reduction Act: Assessment of Projected CO_2 Emission Reductions From Changes in Electricity Generation and Use*, EPA 430-R-23-004 (September 2023), https://perma.cc/5MLM-4F7C (EPA's report prepared in response to the Inflation Reduction Act).

[177] *See, e.g.*, 42 U.S.C. § 15962(i)(1) (partly constraining how EPA can consider subsidized technology demonstrations when setting Section 111 standards); *see also Rotkiske v. Klemm*, 589 U.S. 8, 14 (2019) (it is "particularly inappropriate" to read atextual constraints into statutory language when, as here, "Congress has shown that it knows how to adopt the omitted language or provision").

[178] The legislative history of the Clean Air Act supports this reading. The House and Senate committees in 1970 required EPA to consider achievability and economic feasibility of the standards from the perspective of the regulated industry, which would be improved by tax credits to aid in compliance. H.R. Rep. No. 91-1146, at 35 (1970); *see also id.* at 10 (discussion of this provision using nearly identical terms); S. Rep. No. 91-1196, at 91 (1970). Similarly, the D.C. Circuit has suggested that EPA's consideration of costs is properly limited to the regulated industry itself, and potentially its suppliers and customers. *See, e.g.*, *Portland Cement Ass'n v. Train*, 513 F.2d 506, 508 (D.C. Cir. 1975); *Sierra Club v. Costle*, 657 F.2d 298, 330-31 (D.C. Cir. 1981).

repeal suggests that EPA should not consider tax credits when evaluating cost, it departs from the factors that Congress directed EPA to consider when evaluating costs, and is therefore arbitrary.

C. The proposed repeal wholly fails to consider the benefits of the Carbon Pollution Standards.

The proposed repeal also fails to weigh the benefits of the Carbon Pollution Standards against projected compliance costs when asserting that the Carbon Pollution Standards are not cost-reasonable. The Supreme Court has previously suggested, in different statutory contexts, that consideration of a rule's benefits is relevant to a determination of cost reasonableness. *See Entergy Corp. v. Riverkeeper, Inc.*, 556 U.S. 208, 225–26 (2009). *See also Michigan v. EPA,* 576 U.S. 743, 753 (2015) ("reasonable regulation ordinarily requires paying attention to the advantages *and* the disadvantages of agency decisions"). Comparing total climate benefits based on the tons of CO_2 emissions reduced and the total benefits of other air pollution reductions to costs, EPA projected net benefits of the Carbon Pollution Standards upwards of $12 or $15 billion (2019 $) in 2030[179] and cumulative net benefits with a present value of $370 billion (2019 $).[180] These assessments confirm the Carbon Pollution Standards' reasonable cost. However, the proposed repeal completely disregards those benefits of reducing carbon pollution emissions, and as a result its analysis is arbitrary. *See State Farm*, 463 U.S. at 43 ("entirely failed to consider an important aspect of the problem").

D. The proposed repeal's cost reasonableness comparison is unreasonable.

In any event, the artificially inflated calculations in the proposed repeal on a per megawatt-hour and per metric ton basis still show that 90 percent CCS is cost reasonable, including as compared to prior EPA rulemakings. Based on implausible and unreasonable changes to assumptions, the proposed repeal calculates costs of $53.70/MWh or $77/ton of CO_2 reduced. 90 Fed. Reg. at 25772. On a per ton basis, the $77 per ton of CO_2 reduced is *still lower* than the $98 per ton of CO_2 reduced that EPA has previously determined to be cost reasonable, a point which the proposed repeal completely disregards.[181]

The cost on a per-MWh basis cited by the proposed repeal is also not a bright line metric for cost reasonableness – as EPA has previously explained, $18.50/MWh is not a "bright line standard[] that distinguish[es] between levels of control costs that are reasonable and levels that are unreasonable" but rather can "usefully indicate that control costs that are generally consistent

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[179] As noted, compliance costs and benefits do not include impacts associated with the proposed emission guidelines for existing gas-fired EGUs, which were not modeled. *See* EPA, *Regulatory Impact Analysis for the New Source Performance Standards for Greenhouse Gas Emissions from New, Modified, and Reconstructed Fossil Fuel-Fired Electric Generating Units*, EPA-452/R-24-009 at 7-4, tbl. 7-1 (April 2024), https://perma.cc/4X7E-RBUA.

[180] *Id.* at ES-18, tbl. ES-5.

[181] *See, e.g.*, 89 Fed. Reg. at 39843; *id.* at 39880 (comparing to "costs in the 2016 NSPS regulating GHGs for the Crude Oil and Natural Gas source category of $98/ton of CO_2e reduced", citing 80 Fed. Reg. 56627 (September 18, 2015)).

with those levels of control costs should be considered reasonable." 89 Fed. Reg. at 39882. In other words, if costs as measured per MWh were at that level, they would be reasonable, but higher costs are not necessarily unreasonable, and the proposed rule gives no explanation as to why it is now arbitrarily treating that amount as a threshold. And even if costs under the proposed rule's artificially inflated calculations are higher on a per megawatt basis, that number is an average across the entire fleet and an insufficient analysis for cost reasonableness because costs may vary by plant. When EPA previously considered shorter amortization periods, the agency explained that higher costs on a per megawatt basis may still be cost reasonable because a "significant number of sources [could] cost reasonably install CCS" even under those alternative assumptions. 89 Fed. Reg. at 39879–80.The failure to do a similar analysis in the proposed repeal renders even the per megawatt-hour comparison incomplete and arbitrary.

Not only is the proposed repeal's cost calculation arbitrary based on assumptions and methodology that are counter to the evidence before the agency, but it also ignores the point that even the artificially inflated calculation would be cost reasonable on a per ton basis when compared to EPA's previous determinations. EPA has not even demonstrated an awareness that it is changing position on how to determine cost reasonableness, much less provided a detailed justification for this change in policy. *See Fox TV*, 556 U.S. at 515–16. And even with a more detailed explanation, it would be arbitrary to conclude the Carbon Pollution Standards are not cost reasonable when the standards cost less on a per-ton basis than other prior EPA determinations and when significant numbers of sources could still install CCS even under higher average costs.

VII. The Carbon Pollution Standards are achievable by January 1, 2032.

EPA correctly determined in the Carbon Pollution Standards that CCS-based standards were achievable by January 1, 2032. *See* 89 Fed. Reg. at 39874. EPA adopted this compliance date, which was two years later than the date in its initial proposal, in response to comments. *See id.* This compliance timeframe does not require substantial work to be done during the planning process, provides six years and seven months for both initial feasibility and more substantial work, and is consistent with the six year timeframe for Boundary Dam and Petra Nova. *See id.* The Carbon Pollution Standards also include a one-year compliance date extension for sources that face delays outside of their control. *See id.*

This section covers the reasonableness of the timeline in the Carbon Pollution Standards and the achievability of the storage and transport components of CCS by the compliance date. It also discusses compliance flexibilities in the Carbon Pollution Standards that the proposed repeal completely ignores. The proposed repeal is arbitrary because it runs counter to the evidence before the agency, completely ignores the important aspect of compliance flexibilities in the Carbon Pollution Standards, and is an unexplained departure from the the agency's prior policies. *See State Farm*, 463 U.S. at 43; *Fox TV*, 556 U.S. at 515–16.

A. The proposed repeal's conclusion that standards are not achievable by January 1, 2032, is vague, counter to the record, and baseless.

The proposed repeal's assertions that the Carbon Pollution Standards may not be achievable by January 1, 2032, are vague, counter to the record, and otherwise baseless. At most, the proposed repeal only suggests that the necessary infrastructure buildout would be "unlikely" by January 1, 2032. *See, e.g.*, 90 Fed. Reg. at 25755; 25768; 25773. Where EPA previously found the standards "achievable," which is the actual statutory standard, 42 U.S.C. § 7411(a)(1), the proposed repeal's unsupported and imprecise claim about likelihood is insufficient. Not only does the proposed repeal fail to undercut the factual findings that supported the Carbon Pollution Standards on infrastructure buildout, but it ignores critical aspects of the rule that would ensure compliance and allow for delays where those may impact timelines.

1. *Capture Equipment Deployment*

The proposed repeal concludes – entirely unsupported by evidence – that the assumptions EPA used regarding CCS equipment deployment to calculate the January 1, 2032 compliance date for the Carbon Pollution Standards "may not reflect what is achievable by the average source." 90 Fed. Reg. at 25773. In contrast, EPA's calculation of the 2032 compliance date in the Carbon Pollution Standards was based on an evaluation by Sargent and Lundy (S&L) as well as consideration of real schedules for completed and in-progress CCS projects.[182] The S&L report estimates a range of 6.25 years ("baseline duration") to 7 years ("extended duration") total for capture equipment deployment in a typical CCS project, from initial feasibility evaluation through engineering and design, construction, startup and testing, to the start of commercial operation.[183] Even the S&L extended duration estimate falls within the compliance deadline, 7.5 years after the Carbon Pollution Standards' effective date of July 8, 2024.

The proposed repeal disregards those overall timelines and instead focuses on the "slight adjustments" EPA made to the S&L timeline "upon an examination of actual project timelines." 89 Fed. Reg. at 39874. Without any supporting evidence, the proposal objects to EPA's use of a 12-month duration for a Front-End Engineering and Design (FEED) study – the baseline duration assumed by Sargent & Lundy – instead of the 18 months allowed by Sargent & Lundy's "extended duration" schedule. 90 Fed. Reg. at 25773. The proposal also objects to minor amendments condensing the overall representative timeline by three months, the feasibility of which EPA explained in the Carbon Pollution Standards preamble and technical support

[182] EPA, *Greenhouse Gas Mitigation Measures for Steam Generating Units: Technical Support Document* at 45–46, Docket ID No. EPA-HQ-OAR-2023-0072-9095 (April 2024), https://www.regulations.gov/document/EPA-HQ-OAR-2023-0072-9095.

[183] Sargent & Lundy, *CO_2 Capture Project Schedule and Operations*, Docket ID No. EPA-HQ-OAR-2023-0072-9095 at A-1 (April 2024), available for download at: https://www.regulations.gov/document/EPA-HQ-OAR-2023-0072-9095.

documents, and which are consistent with actual completed projects and ongoing project schedules.[184]

Each of the proposed repeal's timeline adjustments are counter to the evidence before the agency and arbitrary. The proposed repeal also completely disregards other evidence supporting the timeline in the Carbon Pollution Standard, including DOE assessments of workforce and commodity materials needs for CCS.[185] As EPA previously concluded, the workforce and material needs for deploying CCS can be met by the compliance date in the Carbon Pollution Standards, and the standard is therefore achievable. EPA cannot now disregard those factual findings, as it does in the proposed repeal.

2. Storage

The proposal's vague assertions about the availability of geologic storage are counter to the evidence before the agency and do not provide a reasoned explanation to depart from EPA's prior conclusions regarding achievability. 90 Fed. Reg. at 25773. The proposed repeal cannot refute the factual foundation of the Carbon Pollution Standards that the U.S. has "broad availability" of suitable sites for geologic storage, 90 Fed. Reg. at 25573; *see also* 89 Fed. Reg. 39862 ("Sequestration is broadly available in the United States…"), and does not dispute the adequate demonstration of geologic storage. Instead, the proposed repeal states that EPA inappropriately based its conclusion on "potential" storage sites because (1) it takes an unspecified amount of time to characterize those sites, and the nearest site may not be available; and (2) permitting delays and unspecified other issues may delay storage. Neither claim has support in the proposed repeal, and each claim is counter to the record supporting the Carbon Pollution Standards and other material on this component of the CCS pollution control system.

As EPA previously concluded based on analyses by the Department of Energy and U.S. Geological Survey, sequestration potential is broadly available and more than sufficient for compliance with the Carbon Pollution Standards.[186] The volume of sequestered carbon to comply with these standards would be less than a tenth of the available amount estimated by DOE.[187] And coal-fired power plant capacity that would be subject to the 90 percent CCS based standard

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[184] 89 Fed. Reg. at 39875; *see* EPA, *TSD Greenhouse Gas Mitigation Measures for Steam Generating Units 2024*, Document ID EPA-HQ-OAR-2023-0072-9095 at 45 (2024), https://www.regulations.gov/document/EPA-HQ-OAR-2023-0072-9095.

[185] *See* 89 Fed. Reg. at 39877–78 & nn.600 & 608 (citing DOE, *Material Requirements for Carbon Capture and Storage Retrofits on Existing Coal-Fueled Electric Generating Units* (April 19, 2024) & DOE. *Workforce Analysis of Existing Coal Carbon Capture Retrofits* (April 19, 2024) *both available for download at:* https://www.energy.gov/policy/articles/2024-workforce-analysis-existing-coal-carbon-capture-retrofits-2024-commodity (last accessed July 30, 2025)).

[186] *See* 89 Fed. Reg. at 39862–64; *id* at 39863 nn. 462–63 (citing DOE NETL, *Carbon Storage Atlas*, Fifth Edition (September 2015), https://www.netl.doe.gov/coal/carbon-storage/strategic-program-support/natcarb-atlas; U.S. Geological Survey Geologic Carbon Dioxide Storage Resources Assessment Team. *National Assessment Of Geologic Carbon Dioxide Storage Resources—Summary: U.S. Geological Survey Factsheet 2013–3020*, https://perma.cc/B8ES-D7RT (last modified November 29, 2016).

[187] DOE NETL, *Carbon Storage Atlas*, Fifth Edition (September 2015), https://www.netl.doe.gov/coal/carbon-storage/strategic-program-support/natcarb-atlas.

are relatively close to these sites, with calculations showing "more than 50 percent is less than 32 km (20 miles) from potential deep saline sequestration sites, 73 percent is located within 50 km (31 miles), 80 percent is located within 100 km (62 miles), and 91 percent is within 160 km (100 miles)." 89 Fed. Reg. at 39864. The proposed repeal does not and cannot refute these findings.

Failing completely to undermine those facts, the proposed repeal offers only obscure and unsupported claims about delays due to site characterization and permitting. The Carbon Pollution Standards, however, were based on an examination of actual past CCS project timelines and an ICF sequestration schedule built on relevant project timelines.[188] These timelines were realistic. The typical process for storage site selection includes reviewing the existing basin-scale potentially amenable formations to identify one or more sites that are likely to be suitable for the project, screening them to remove sites that will not work for the project and investing further in those that are most favorable. The first step of the process involves feasibility analysis of basin-scale formations, which can be done using the DOE and USGS studies cited by EPA in the Carbon Pollution Standards.[189] The next step is site selection, where developers select one or more candidate sites to screen. This step may take one to three years depending on the quality of available data.[190] Where there is poor data, the core and seismic data to be collected as part of the site selection process would overlap with the site characterization stage. The next step is site characterization, which involves collecting data needed to model the site response to CO_2 injection, engineer a suitable injection, risk reduction, monitoring, and closure program. Based on a survey of previous U.S. site characterization, this may take three years.[191] The last year of this characterization program will include data collection and writing for permit preparation. Well construction then takes one year. Collectively, these processes may take up to six years: one to three years for site selection, which overlaps with site characterization where there is poor data; up to three years for site characterization, including permit development; and one year for well construction. That timeline is consistent with the Carbon Pollution Standards, which estimated a representative four-year timeline for construction of storage but allowed for one additional year in all cases, and another additional year for variances for sources with unusual difficulties meeting the requirements in time—for six years total in such cases. *See* 89 Fed. Reg. at 39875 (describing four-year estimate and additional 12 month allowance); 39952 (one-year compliance date extension for gas-fired turbines); 39960 (states may incorporate one-year compliance date extensions for coal-fired EGUs, not including RULOF variances, for factors beyond the owner or operator's control). The proposed repeal, however, includes no timeline analysis or support for its unsupported assertion that it is

[188] *See* 89 Fed. Reg. at 39856 n.386; citing ICF, *Transport and Storage Timeline Summary*, Document ID EPA-HQ-OAR-2023-0072-9095 (2024), *available at* https://www.regulations.gov/document/EPA-HQ-OAR-2023-0072-9095.

[189] *See* 89 Fed. Reg. at 39862–64; *id* at 39863 nn. 462–63 (citing DOE NETL, *Carbon Storage Atlas*, Fifth Edition (September 2015), https://www.netl.doe.gov/coal/carbon-storage/strategic-program-support/natcarb-atlas; U.S. Geological Survey Geologic Carbon Dioxide Storage Resources Assessment Team. *National Assessment Of Geologic Carbon Dioxide Storage Resources—Summary: U.S. Geological Survey Factsheet 2013–3020*. https://pubs.usgs.gov/fs/2013/3020/ (last modified November 29, 2016).

[190] *See* Susan Hovorka, Taylor Barhart et al., *Early stage cost of storage characterization*, Proceedings of the 16th Greenhouse Gas Control Technologies Conference (GHGT-16) 23-24 Oct 2022, at 1 (November 23, 2022), https://ssrn.com/abstract=4284960.

[191] *See id.* at 2.

"unlikely" that infrastructure can be deployed in time for the January 1, 2032, compliance deadline. *See* 90 Fed. Reg. at 25773.

The proposed repeal avers that there may be potential permitting delays, but fails to note that the Carbon Pollution Standards incorporated consideration of permitting delays and even included a mechanism to address them through a one-year compliance date extension. *See* 89 Fed. Reg. 39805 ("a mechanism to extend compliance timelines by up to 1 year in the case of unforeseen circumstances, outside of an owner/operator's control, that delay the ability to apply controls (*e.g.,* supply chain challenges or permitting delays)"). The proposed repeal completely ignores this compliance flexibility. The proposed repeal also completely ignores that the Carbon Pollution Standards require enforceable increments of progress for sources that would comply by applying CCS. *See* 89 Fed. Reg. at 39973. As EPA previously concluded, this "approach will provide states and EGUs with flexibility to account for idiosyncrasies in planning processes, tailor compliance timelines to individual facilities, allow simultaneous work toward separate increments, and ensure full performance by the compliance date." *Id.* Furthermore, if necessary, states can extend compliance deadlines further through the plan revision process.[192] The proposed rule similarly completely ignores this possibility, and thereby has "entirely failed to consider an important aspect of the problem." *State Farm*, 463 U.S. at 43. These mechanisms from the Carbon Pollution Standards will help ensure that sources are on track for timely compliance and, where there are difficulties, provide sufficient information and time for any compliance flexibilities that may be necessary.

The proposed repeal also ignores EPA's commitment to permit underground injection control (UIC) class VI wells, the category for carbon sequestration, expeditiously. As EPA Regional Administrator Scott Mason recently stated when approving three geologic storage wells in Texas in April, 2025, "EPA is committed to approving permits as quickly as possible and ensuring they meet requirements to protect drinking water sources."[193] EPA's most recent draft permit issuance for ExxonMobil's Rose Carbon Capture and Storage Project in Region 6, for instance, took sixteen months from application submission to draft permit issuance, approximately twelve months faster than the previous permit issuance in Region 6 for Oxy's Brown Pelican Project and five months faster than EPA's own guidance of twenty-one months. This approval demonstrates EPA's ability to expeditiously permit Class VI wells. EPA also recently permitted its first Class VI wells in California.[194] And EPA has approved or proposed granting primacy to permit Class VI wells to West Virginia, Texas, and California.[195] According

[192] *See* 89 Fed. Reg. at 39803 ("Any extensions exceeding 1 year must be addressed through a state plan revision."); *id.* at 39961 ("If the delay is anticipated to be longer than 1 year, states can provide for the use of this mechanism for up to 1 year but should also initiate a state plan revision if necessary to provide an updated compliance date through consideration of RULOF, subject to EPA approval of the plan revision.").

[193] EPA, *EPA Issues Final Permits for Geologic Sequestration of Carbon Dioxide In Texas* (April 7, 2025), https://perma.cc/9DPB-7N22.

[194] EPA, *EPA issues first ever underground injection permits for carbon sequestration in California* (December 31, 2024), https://perma.cc/AFR4-NJY5.

[195] EPA, *EPA Proposes to Approve Texas' Application to Administer Class VI Underground Injection Well Program* (June 9, 2025), https://perma.cc/J67T-S232; EPA, *Administrator Zeldin Proposes to Approve Arizona's Primacy*

to EPA press releases, these grants of primacy are part of an agency "promise to fast track UIC permitting" and will "speed up" permitting. These statements illustrate how arbitrary EPA's position is in this repeal proposal – the Agency speaks Janus-like with two contradictory voices, one touting its commitment to increasing the speed of permitting, and the other, where it is inconvenient to its agenda, saying the opposite in this rulemaking.

3. Transport

The proposed repeal's discussion of purported issues with transport infrastructure for compliance with the standards is similarly arbitrary. EPA has changed its position on the achievability of emission standards without explanation. *See Fox TV*, 556 U.S. at 515–16. It now faults the Carbon Pollution Standards on the basis that most coal-fired power plants are not presently connected to the 5,000 miles of CO_2 pipelines in the country. *See* 90 Fed. Reg. 25773. But that fact is of limited relevance for the achievability of standards with compliance dates in January 1, 2032. Instead, what matters is the infrastructure that will be available in time to allow plant owners choosing to comply using CCS technology to connect with that infrastructure by 2032. Indeed, as EPA previously explained, "section 111's allowance for lead time recognizes that existing pollution control systems may be complex and may require a predictable amount of time for sources across the source category to be able to design, acquire, install, test, and begin to operate them," and as a result "EPA has typically allowed for some amount of time before sources must demonstrate compliance with the standards." 89 Fed. Reg. at 39832; *see also* EPA Br. at 62 ("the present state of infrastructure does not determine what is achievable"). The current proposal fails to acknowledge or justify this change in position.

EPA's earlier determination – that covered sources could meet emission limitations by, *inter alia*, constructing pipelines by the January 1, 2032 compliance date – was supported by hundreds of pages of scientific and technical analysis, including reports by the Department of Energy and expert engineering firms. As EPA previously explained, a "standard of performance is 'achievable' if a technology can reasonably be projected to be available to an individual source at the time it is constructed that will allow it to meet the standard." 89 Fed. Reg. at 38835 (citing *Sierra Club* v. *Costle,* 657 F.2d 298, 364, n.276 (D.C. Cir. 1981)). Infrastructure is generally not built until a regulatory requirement compels it, so the fact that most coal-fired power plants are not currently connected to CO_2 pipelines is irrelevant to the question of whether the current standard is achievable.

In the Carbon Pollution Standards, EPA found that more than 90 percent of existing coal-fired power plants expected to operate after 2038 are within 100 miles of potential sequestration sites, and more than 50 percent are within 20 miles.[196] Additionally, the pipeline industry is fully

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Application for All Underground Injection Wells (May 15, 2025), https://perma.cc/F79D-H9LA; EPA, *Administrator Zeldin Approves West Virginia's Class VI Primacy Application* (February 18, 2025), https://perma.cc/M6P6-25YP.

[196] *See* 89 Fed. Reg. at 39863–64 nn. 462, 463, 467 (citing DOE/NETL studies and IPM documentation); *see also* EPA, *TSD - Greenhouse Gas Mitigation Measures for Steam Generating Units* TSD at 33–35 (Apr. 2024) [Attachment C]; B. Chen et al., *CO_2 Pipeline Analysis for Existing Coal-fired Power Plants*, EPA-HQ-OAR-2023-0072-8831 (March 11, 2024), available for download at: https://www.regulations.gov/document/EPA-HQ-OAR-2023-0072-8831 (confirming results).

capable of constructing pipelines over much longer distances. *See* 89 Fed. Reg. at 39857 (citing, *e.g.*, carbon pipelines of 500 and 232 miles). The proposed repeal does not analyze either this variety in distances to sequestration site or this history of pipeline construction.

The Carbon Pollution Standards included a careful assessment of the pipeline buildout that could be required under the standards using multiple conservative assumptions. First, EPA included all coal plants that have not announced retirement before 2039, even though half of those plants are expected to reach typical retirement age by then. *Id.* at 39856, 39876. Second, EPA assumed that each plant would construct its own pipeline, despite the common practice of pipelines serving multiple customers. *Id.* Third, EPA assumed no plant would use existing or proposed pipeline infrastructure, even though 5,385 miles of carbon pipelines already exist in the U.S. *Id.*

Even under these conservative assumptions, EPA concluded that a maximum of 5,000 miles of pipeline would need to be constructed by 2032 – equating to an average buildout of 1,000 miles per year over five years. This is well within recent build rates for natural gas pipelines, which ranged from 1,000 to 2,500 miles annually between 2017 and 2021. *Id.* Moreover, EPA found that an additional 3,300 miles of CO_2 pipeline would be built even without the rule in place, and modeling suggests a more likely compliance scenario would require only 1,400 additional miles. 89 Fed. Reg. at 39856.

EPA performed a similar analysis for new gas-fired power plants, finding:

> The vast majority of the continental U.S. is within 100 km of a potential geologic sequestration site. The areas of the U.S. that do not have conditions suitable for geologic sequestration are limited; these areas are connected to potential geologic sequestration sites via a system of CO_2 pipelines and/or transmission lines. If an area does not have a suitable geologic sequestration site, owners/operators may locate their units closer to such sites and deliver power through transmission lines, or choose alternative forms of generation.[197]

Because most plants are located near deep saline formations, EPA determined that it would be feasible for existing sources to build smaller, shorter source-to-sink lateral pipelines, rather than depending on a large-scale trunkline network. 89 Fed. Reg. at 39889. Specifically, EPA used a DOE analysis that found over 70 percent of pipelines in each case it analyzed would be less than 100 miles, with more than half the pipeline segments being less than 25 miles in scenarios where pipeline length is minimized.[198] EPA also determined that CO_2 can be transported by vessel, highway, or rail. 89 Fed. Reg. at 39889. The proposed repeal completely fails to consider any of these facts and arbitrarily disregards EPA's prior analysis.

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[197] EPA, *Technical Memorandum: Geographic Availability of CCS for New NGCC Baseload Units* (Apr. 24, 2024), available for download here: https://www.regulations.gov/document/EPA-HQ-OAR-2023-0072-9133.

[198] Bailen Chen, et al., DOE, Los Alamos Nat'l Lab., *CO_2 Pipeline Analysis for Existing Coal Fired Power Plants*, at 5 (Apr. 11, 2024), https://www.osti.gov/biblio/2337631; *see* 89 Fed. Reg. at 39856 n.385 (citing this analysis).

As discussed above, to the extent that a particular plant faces unique challenges, such as "delays due to factors including State permitting and the challenges associated with eminent domain authority and negotiating rights-of-way," *see* 90 Fed. Reg. 25773, the relevant state may account for those circumstances in its plan by adjusting the compliance timeline for that plant, 89 Fed. Reg. at 39860, an important aspect of the problem that the proposed repeal entirely fails to consider. *See* 463 U.S. at 43.

The Repeal's reference to the Summit Carbon Solutions pipeline provides no new relevant information. EPA already addressed these concerns in the Carbon Pollution Standards. *See* 89 Fed. Reg. at 39861. That project involves a 2,500-mile pipeline network spanning five states and connecting 57 ethanol plants to sequestration sites in North Dakota. As the Carbon Pollution Standards emphasized, EPA "did not base its analysis of CCS on the projected existence of a large-scale interstate pipeline network." *Id.* at 39855. The 5,000 miles potentially required for *all* coal-fired power plants is only twice the length of the *single* Summit project. Ninety percent of these plants would require pipelines at least 96 percent shorter than Summit's.

Moreover, on August 28, 2024, Summit Carbon Solutions was granted a permit to construct the 688.01-mile segment of the pipeline in Iowa.[199] On November 15, 2024, they received a permit to construct 333 miles in North Dakota.[200] And on December 12, 2024, Summit received a permit for 28 miles in Minnesota.[201] While South Dakota passed legislation prohibiting CO_2 pipeline developers from using eminent domain to acquire private property, that law has not altered Summit's plans in other states.[202] It is also highly unlikely that eminent domain would be necessary for the shorter, less complex pipelines envisioned by the current standards. A similar bill referenced in the proposal failed in Iowa in June.[203]

B. The proposal fails to account for the possibility of one-year compliance extensions in the Carbon Pollution Standards

As with the unit-specific RULOF variances that the proposed repeal ignores, *supra* Comment V.D.4, EPA fails to even acknowledge the opportunity for sources to receive unit-specific timing variances. For both coal- and gas-fired power plants subject to CCS-based standards, the Carbon Polution Standards allow for one-year extensions for operators facing

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[199] Iowa Utilities Commission, *Summit Carbon Solutions and SCS Carbon Transport: Applications to Construct Hazardous Liquid Pipelines* (June 19, 2025), https://perma.cc/87V8-NE6D.

[200] Jeff Beach, *North Dakota approves Summit carbon pipeline route,* North Dakota Monitor (November 15, 2024), https://northdakotamonitor.com/2024/11/15/north-dakota-approves-summit-carbon-pipeline-route/.

[201] Peter Cox, *Minnesota Public Utilities Commission approves state's first carbon capture pipeline*, MPR News (December 12, 2024), https://www.mprnews.org/story/2024/12/12/minnesota-public-utilities-commission-approves-states-first-carbon-capture-pipeline.

[202] Lee Blank, *The Path Forward: Strengthening the Future of Biofuels and Agriculture*, Summit Carbon Solutions (March 14, 2025), https://summitcarbonsolutions.com/the-path-forward-strengthening-the-future-of-biofuels-and-agriculture/.

[203] Katarina Sostaric, *Reynolds vetoes Iowa bill aimed at limiting eminent domain for carbon pipelines*, Iowa Public Radio (June 11, 2025), https://www.iowapublicradio.org/state-government-news/2025-06-11/iowa-governor-kim-reynolds-veto-eminent-domain-carbon-capture-pipeline-bill.

unavoidable delays in the startup of their CCS operations. 89 Fed. Reg. at 39952 (gas); 39960–62 (coal). The Carbon Pollution Standards provided that such extensions could be available for circumstances such as "delays related to permitting, delays in delivery or construction of parts necessary for installation or implementation of the control technology, or development of necessary infrastructure (*e.g.,* CO_2 pipelines)." 89 Fed. Reg. at 39952. Thus, even if the potential issues identified in this section of the proposed repeal were relevant, which they are not, EPA entirely fails to consider whether these compliance extensions may be sufficient to address these concerns. Although these sources would require individualized analysis, the proposed repeal has "entirely failed to consider an important aspect of the problem," namely whether these extensions could address the alleged problems with the timing of capture system, transport, and storage deployment. *See State Farm*, 463 U.S. at 43.

VIII. EPA failed to consider alternatives to repeal.

As the Supreme Court has held, "when an agency rescinds a prior policy its reasoned analysis must consider the 'alternative[s]' that are 'within the ambit of the existing [policy].'" *Dep't of Homeland Sec. v. Regents of the Univ. of Cal.*, 591 U.S. 1, 30 (2020) (quoting *State Farm*, 463 U.S. at 51). When an agency fails to do so, as EPA has in the proposed repeal, it has "entirely failed to consider [that] important aspect of the problem." *Id.* (quoting *State Farm*, 463 U.S. at 43). Here, EPA states "Whether CCS with other, lower rates of capture could be the BSER is outside the scope of this repeal action." 90 Fed. Reg. at 25773. That statement is contrary to EPA's legal obligation, unreasonable, and renders the entire alternative proposal unlawful, arbitrary, and capricious.

As described throughout, Commenters contest the proposed repeal's assertions that the Carbon Pollution Standards are not sound. However, even assuming the Agency's concerns were valid, EPA repeatedly fails to consider the obvious alternatives presented by its own characterization of the supposed problems with CCS. EPA did not evaluate any other rate of capture, any alternative compliance timelines, any alternative subcategories, or any additional variances that might be allowed under state plans. These alternatives are all within the ambit of the Carbon Pollution Standards and compelled by the statutory requirement to determine the "best" system, *see* 42 U.S.C. § 7411(a)(1), and must be analyzed. That is especially the case where, as here, EPA is facing a long-overdue legal obligation to regulate greenhouse gases from the power sector[204] and such alternatives would directly address the agency's own stated concerns about the Carbon Pollution Standards.

The proposed repeal even fails to consider several alternatives for CCS capture rates that it does not dispute are adequately demonstrated, such as:

- An 83 percent capture rate, which the proposed repeal presents as the capture rate (by including untreated flue gas) for the total unit of Boundary Dam. *See* 90 Fed. Reg. at 25770.

[204] *Supra* Comment II.

- The proposed repeal's uncalculated capture rate at Petra Nova that would deduct periods of unavailability from the 92.4 percent demonstrated capture rate. *See id*. at 25771.
- A slipstream-based capture standard at a 90 percent capture rate for treated flue gas that is only some portion of a total unit's emissions. *See id*. at 25770.
- The 16 to 24 percent capture rate that is still in effect for new coal-fired power plants. 80 Fed. Reg. 64510.

Each of these capture rates are clearly adequately demonstrated, and not even disputed in the proposed repeal, but EPA failed to consider *any* of them as a potential best system of emission reduction as an alternative to full repeal.

EPA also failed to consider any alternatives with later compliance dates based on revised timelines that would address the supposed concerns about delay and the achievability of the standards. For instance, EPA could have considered postponing the compliance date by 8 months to reflect the alleged timeline shortenings described in the proposed repeal and set a compliance date of September 1, 2032, or even of January 1, 2033, to give additional cushion for any unexpected delays. *See id*. at 25773.

There are also subcategory-based alternatives that EPA could have considered based on purported concerns in the proposed repeal. Based on EPA's stated concerns with existing pipelines being "not located near existing coal-fired sources," 90 Fed. Reg. at 25573, EPA has the obligation to consider options that would directly address the alleged problem. For instance, EPA could have subcategorized coal-fired power plants based on distance to potential geologic storage, limiting the maximum distance sources would need to transport their captured CO_2. As EPA previously determined, of "existing coal-fired steam generating capacity with planned operation during or after 2039, more than 50 percent is located less than 32 km (20 miles) from potential deep saline sequestration sites, 73 percent is located within 50 km (31 miles), 80 percent is located within 100 km (62 miles), and 91 percent is within 160 km (100 miles)." 89 Fed. Reg. at 39855. EPA could have analyzed – but failed to –subcategory alternatives based on any of these distances, which would have reduced infrastructure needs and cost while still providing substantial emission reductions.

Another possible alternative would have been to change the operating horizon for the subcategory of coal-fired power plants subject to the most stringent limits to January 1, 2040. That alternative would have tracked the proposed version of the Carbon Pollution Standards, *see* 89 Fed. Reg. at 39845, and therefore is clearly an alternative within the ambit of the current policy. That alternative would likely have reduced the total capacity of coal-fired power plants subject to the 90 percent CCS based standard by about 8 GW. *See id.* at 39,877 n.602 (comparing 81 GW of capacity anticipated to still be operating on January 1, 2039, with 73 GW of capacity anticipated to still be operating on January 1, 2040).

EPA's new higher cost numbers for the long-term coal subcategory are driven in large part by unreasonable assumptions regarding these plants' capacity factors.[205] But even if some long-term coal plants equipped with capture could really be expected not to run much, the

[205] *See supra* Comment VI.

supposed problem would be clearly addressed by subcategorizing coal plants, as EPA subcategorized gas plants, by their capacity factors. Although the Carbon Pollution Standards presented good reasons for the chosen subcategorization approach, *see* 89 Fed. Reg. at 39908-39915, applying a similar capacity-factor subcategory would address the supposed problems with low capacity factor, long-term coal plants.

Considering EPA's conclusions in the Carbon Pollution Standards on the adequate demonstration and cost reasonableness of 40 percent co-firing, the failure to consider that as an alternative for long-term coal-fired power plants is particularly glaring. As EPA previously determined,

> 40 percent co-firing is adequately demonstrated for the long-term subcategory, and has reasonable energy requirements and reasonable non-air quality environmental impacts. It would also be of reasonable cost for the long-term subcategory. Although the capital expenditure for natural gas co-firing is lower than CCS, the variable costs are higher. As a result, the total costs of natural gas co-firing, in general, are higher on a $/ton basis and not substantially lower on a $/MWh basis, than for CCS. Were co-firing the BSER for long-term units, the cost that industry would bear might then be considered similar to the cost for CCS. In addition, the GHG Mitigation Measures TSD shows that all coal-fired units would be able to achieve the requisite infrastructure build-out and obtain sufficient quantities of natural gas to comply with standards of performance based on 40 percent co-firing by January 1, 2030.

89 Fed. Reg. at 39887.

Although the proposed repeal also would eliminate standards based on 40-percent co-firing for the medium-term subcategory, as explained in a separate comment letter that commenters join in full, that portion of the proposed repeal is arbitrary and capricious, unreasonable, and without merit.[206] Because there are no grounds for the rejection of that subcategory, EPA should have considered 40-percent co-firing as an alternative system of emission for long-term plants.

The failure to consider at least these alternatives is counter to EPA's obligations when rescinding a rule and to determine the "best" system of emission reduction under Section 111 of the Clean Air Act. The proposed repeal is therefore is arbitrary and capricious, and this failure is one reason why the proposed repeal must be withdrawn.

To illustrate the value of truly considering alternatives, in the limited time available during this comment period, Commenters conducted modeling of a limited set of alternatives that would address some of the dubious criticisms outlined in the proposed repeal. To conduct this modeling, Commenters used FACETS (the Framework for Analysis of Climate-Energy-Technology Systems), a highly detailed, technologically realistic model of the U.S. energy

[206] Comments of Environmental NGOs on Repeal of Greenhouse Gas Emissions Standards for Fossil Fuel-Fired Electric Generating Units, Alternative Proposal (filed to this docket Aug. 7, 2025).

system.[207] Like IPM, the model used by EPA in the Carbon Pollution Standards, *see, e.g.*, 89 Fed. Reg. at 39899–39900 (describing comparsion between baseline and policy case in IPM), FACETS is a capacity deployment model that allows the user to assess the impact of different economic and policy conditions and constraints on the electric system to assess the energy, environmental, and economic impacts.[208] It is particularly adept at scenario analysis allowing for modification of multiple, multi-pronged assumptions to assess measures in the context of technology, market, and policy uncertainties. Although the FACETS model is similar to the IPM model used by EPA in the Carbon Pollution Standards and the Regulatory Impact Assessment for the proposed repeal, outputs are not perfectly comparable between the two. As a result, and to avoid confusion by comparing unlike outputs, Commenters present the alternatives that were run using this analysis and the Carbon Pollution Standards as percent comparisons to the existing rule rather in dollar figures. A memorandum presenting the results of this analysis is attached.[209]

One alternative assessed using FACETS was a modification of the timeline for coal plants in the long-term subcategory to meet the CCS-based standard by delaying compliance deadlines by up to two years. Commenters assessed the impact of this policy alternative, leaving the remainder of the Carbon Pollution Standards in place, under two baseline scenarios: one reflecting economic and energy system assumptions from 2023 (the same general baseline used by EPA in both the final Carbon Pollution Standards and the proposed repeal) and an updated baseline reflecting rough 2025 assumptions, such as changes in resource costs, estimated demand projections, and policy considerations. Under both scenarios, the delayed complince deadline alternative could reduce compliance costs significantly, by 27–32 percent, while maintaining 94–96 percent of the cumulative tons of emission reductions of the Carbon Pollution Standards.[210] Commenters also assessed a standard based on a lower capture rate – 63 percent – and found nearly identical emissions reducutions to the Carbon Pollution Standards (within one percentage point), at the same costs, were achieved under either baseline. The rough analysis of both of these potential standards illustrate that alternatives less than full repeal can generate meaningful – if fewer – emission reductions and lower compliance costs than the Carbon Pollution Standards. EPA has an obligation to consider these alternatives, including through detailed modeling and analysis, instead of full repeal of the Carbon Pollution Standards.

IX. The proposed repeal fails to disturb the determinations in the Carbon Pollution Standards on adequate demonstration, cost reasonableness, and achievability of the 90 percent CCS-based Phase 2 standards for new gas-fired power plants.

The proposed repeal's arbitrary and unsupported conclusions about new gas-fired power plants mirror those about coal fired power plants – proposing to find (1) that a 90 percent capture

[207] *See Framework for Analysis of Climate-Energy-Technology Systems,* https://facets-model.com/overview (last accessed Aug. 6, 2025).

[208] *See infra* Comment Section VIII (describing aspects of IPM capacity expansion model).

[209] *See* Memorandum, FACETS Energy System Modeling (Aug. 6, 2025) [Attachment F].

[210] Comparing cost per ton reductions under the existing Carbon Pollution Standards and a rule incorporating the alternative policy, calculated for each baseline and case as summation of discounted total system compliance costs (using a 3% discount rate) from 2025 to 2047 divided by total emission reductions over the same period.

rate is not adequately demonstrated; (2) that 90 percent carbon capture and storage is not cost reasonable; and (3) that the infrastructure buildout necessary to achieve the Phase 2 standards is "unlikely" by January 1, 2032. 90 Fed. Reg. 25775. Just as with the same proposed findings for existing coal-fired power plants, this portion of the proposed repeal is arbitrary and capricious, an abuse of discretion, and otherwise unlawful. EPA must therefore withdraw its proposal to repeal these standards.

Because the proposed repeal's assertions about coal-fired power plants are baseless, as covered in previous sections of this comment, the record on their performance continues to support EPA's previous determination that 90 percent carbon capture and storage is adequately demonstrated for base load gas-fired power plants and that standards based on what can be achieved by that system are achievable by the Phase 2 compliance date of January 1, 2032. *See* 89 Fed. Reg. at 39924–25. EPA's previous determination was also based on the use of CCS for combined cycle turbines, such as at the Bellingham Cogeneration Facility in Bellingham, Massachusetts, that "was able to continuously capture 85–95 percent of the CO_2 that would have otherwise been emitted from the flue gas of a 40 MW slip stream." 89 Fed. Reg. at 39926. EPA also considered evidence of tests at the Technology Centre Mongstad (TCM) in Norway and other planned or in development combustion turbine CCS projects. *See id.* Based on this evidence in the record, EPA correctly determined that 90 percent carbon capture and storage was adequately demonstrated. The proposal's failure to counter these plain facts renders it arbitrary and capricious. *See State Farm*, 463 U.S. at 43; *Fox TV*, 556 U.S. at 515–16.

A. The proposed repeal provides only unsupported and implausible reasons that are counter to the record to question the performance of carbon capture and storage on combustion turbines.

Beyond restating its supposed new findings on 90 percent carbon capture and storage for coal-fired power plants, the reasons given in the proposed repeal to change EPA's determination on adequate demonstration as applied to combustion turbines are (1) that the exhaust gas composition for natural gas-fired combustion turbines is different in "other ways" than for coal-fired that make CO_2 capture more challenging; (2) that combustion turbines are "able to change loads more rapidly and start and stop more frequently," and (3) that there have been limited examples of CCS to combustion turbines. *See* 90 Fed. Reg. at 25775–76. Each of these proposed findings is unsupported and counter to the evidence before EPA.

First, as the proposed repeal acknowledges, many of the differences between flue gas between gas- and coal-fired power plants make carbon capture *less* challenging for gas-fired units, most notably the presence of fewer contaminants. *See id.*; 89 Fed. Reg. at 39926 ("Where differences exist, due to differences in flue gas composition, CCS at natural gas-fired combined cycle combustion turbines will in general face fewer challenges than CCS at coal-fired steam generators."). For instance, as EPA previously explained,

> Many of the challenges faced by Boundary Dam Unit 3—which proved to be solvable—were caused by the impurities, including fly ash, SO_2, and trace contaminants in coal-fired post-combustion flue gas—which do not occur in the natural gas post-combustion flue gas. As a result, for CO_2 capture for natural gas combustion, flue gas handling is simpler, solvent degradation is easier to prevent,

> and fewer redundancies may be necessary for various components (*e.g.,* heat exchangers).

89 Fed. Reg. at 39926 n.761. That previous conclusion, which the proposed repeal does not address, undermines the offhanded comparison to Boundary Dam's performance in the proposed repeal's section on gas-fired power plants. *Contra* 90 Fed. Reg. at 25776.

The only "other" difference between flue gases that the proposed repeal identifies is that gas-fired flue gas has "lower CO_2 concentrations and higher oxygen concentrations" that supposedly make carbon capture "more challenging." *Id.* This statement is made without any supporting evidence and is contrary to the evidence in the Carbon Pollution Standards. As EPA previously determined, "flue gases with lower CO_2 concentrations can be readily addressed by the correct sizing and design of the capture equipment" and, in "fact, there is not a technical limit to removal of CO_2 from flue gases with low CO_2 concentrations—the EPA notes that amine solvents have been shown to be able to remove CO_2 to concentrations that are less than the concentration of CO_2 in the atmosphere." 89 Fed. Reg. at 39926. EPA also considered that for combustion turbines "the oxygen concentration is approximately 3 times that of a coal-fired EGU." *Id.* at 39932. As EPA explained previously,

> Exhaust gas recirculation (EGR), also referred to as flue gas recirculation (FGR), is a process that addresses all these issues. EGR diverts some of the combustion turbine exhaust gas back into the inlet stream for the combustion turbine. Doing so increases the CO_2 concentration and decreases the O_2 concentration in the exhaust stream and decreases the flow rate, producing more favorable conditions for CCS.

89 Fed. Reg. at 39932. The proposed repeal completely ignores how this process addresses those differences in flue gas composition. The successful performance of the capture plant at Bellingham, where the flue gas "contained 3.5 volume percent CO_2 and 13–14 volume percent oxygen," further supported EPA's previous conclusions that these differences in flue gas between coal-fired and gas-fired plants did not impede combustion turbines from achieving 90 percent capture rates. *See* 89 Fed. Reg. at 39926.

EPA's previous determinations are further bolstered by recent successful applications of carbon capture at gas-powered combustion turbines. At the gas-fired Ravenna plant in Italy described above,[211] the "CO_2 content in the flue gas is between 2.3% and 2.5% in volume at atmospheric pressure conditions."[212] And at that plant, during "the months from August 2024 (start of operations) to February 2025 the monthly average of the capture efficiency was constantly greater than 91.8%, with a peak of 96.1%."[213] This plant's performance further proves that high capture rates are adequately demonstrated at lower CO_2 concentrations. So does recent experience of GE Vernova in a two-year FEED study at natural gas-fired James M. Barry combined cycle power plant in Bucks, Alabama, which also demonstrated a 95 percent capture

[211] *See supra* Comment V.F.

[212] Ravenna Phase I CCS Report at 3 [Attachment B].

[213] *Id.* at 4.

rate through an analysis that "included installation of an exhaust gas recirculation (EGR) system which was evaluated to confirm expected technical and economic benefits with respect to plant design and performance."[214] These tests applied the approach, exhaust gas recirculation, identified by EPA in the Carbon Pollution Standards as a means to address CO_2 and O_2 concentration levels at a project that EPA considered for corroborating its determination in that rule. *See* 89 Fed. Reg. at 39928. This successful test bolsters the conclusions in the Carbon Pollution Standards.

Second, the ability of gas plants to follow loads and more rapidly ramp up and down does not undermine their ability to achieve a 90 percent capture rate-based standard. *Contra* 90 Fed. Reg. at 25776. As an initial matter, "intermediate or load following" combustion turbines are not subject to the 90 percent carbon capture based standard, making this argument of little relevance to begin with. 89 Fed. Reg. at 39903. Gas plants with capture systems, in order to maximize revenues from that capture, are also expected to operate at high capacity factors in excess of 80 percent.[215]

Even if load following was relevant to plants subject to the 90 percent CCS-based standard, the Carbon Pollution Standards also analyzed it. In that rule, EPA concluded "the capture rate would not be affected by load following operation, and the operation of the combustion turbine would not be limited by turndown capabilities of the capture equipment." 89 Fed. Reg. at 39928. EPA based this previous conclusion on several pieces of evidence, including that "single trains of CO_2 capture facilities have turndown capabilities of 50 percent," that effective "turndown to 25 percent of throughputs can be achieved by using 2 trains of capture equipment," that "capture rates have also been shown to be higher at lower throughputs," and that "during off-peak hours when electricity prices are lower, additional lean solvent can be produced and held in reserve, so that during high-demand hours, the auxiliary demands to the capture plant stripping column reboiler be reduced." *Id.* Furthermore, the 90 percent carbon capture and storage based standard would apply to combined cycle plants, and "combined cycle units cycle less frequently and have fewer startups and shutdowns per year" and those startups and shutdowns take less time than for coal-fired power plants. *Id.* EPA's previous determination considered this evidence and was reasonable; the proposed repeal ignores this evidence completely and reaches an implausible conclusion as a result.

Third, the reference to few examples of gas-fired applications of CCS and discounting the scale of Bellingham in the proposed repeal are of little relevance. 90 Fed. Reg. at 25776. That there are few examples is unsurprising, because, as already explained, without regulations forcing adoption of pollution control measures, data supporting the achievability of proposed standards can be "sparse, primarily because few plants had any need to attempt to achieve" them. *Sierra Club*, 657 F.2d at 362. The number of examples, however, has continued to grow since the

[214] Matt Davidsaver et al., *GE Vernova Advances Carbon Capture*, Gas Turbine World (December 31, 2024), https://gasturbineworld.com/ge-vernova-carbon-capture/.

[215] *See infra* Comment IX.B; *see also* Kirk LaBarbara, DOE NETL, Economics of Competing CCS plants, at 14 https://netl.doe.gov/sites/default/files/netl-file/23CM_PSCC28_Labarbara.pdf (showing NGCC plants going from 24.5 percent capacity factor, during mostly summer months, to 87.9 percent capacity factor after CCS is installed and running the whole year).

finalization of the Carbon Pollution Standards.[216] And on scale, as already explained, there has been no technical impediment to scaling up carbon capture plants, nor does the proposed repeal suggest any.[217] Furthermore, the proposed repeal's disregard of evidence in the technical record, such as pilot studies, is no more valid for gas-fired power plants than it is for coal-fired power plants.[218]

B. The costs of a 90 percent carbon capture and storage system are reasonable for combined cycle power plants.

The Carbon Pollution Standards properly determined a 90 percent carbon capture and storage system is cost reasonable for new base load gas-fired power plants. As EPA previously determined, assuming "continued operation of the capture equipment, the compliance costs are $15/MWh and $46/ton ($51/metric ton) for a 6,100 MMBtu/h H-Class turbine, which has a net output of approximately 990 MW; and $19/MWh and $57/ton ($63/metric ton) for a 4,600 MMBtu/h F-Class turbine, which has a net output of approximately 700 MW." 89 Fed. Reg. at 39934–35. Those figures are lower if the capture plant does not operate while the combustion turbine is categorized as an intermediate load combustion turbine, a point that the proposed rule disregards. *See id.* These costs are comparable to previous rulemaking on a per MWh and per tonne basis.

None of the supposed flaws described in the proposed repeal disturb that conclusion. First, the proposed repeal faults the Carbon Pollution Standards for only providing figures for large base load combustion turbines, and proposes to find that it did not establish the costs as reasonable for smaller base load turbines. 90 Fed. Reg. at 25776. However, as EPA previously determined, "smaller combined cycle turbines do not represent the typical new base load combustion turbine and are not a determining factor in the BSER analysis."[219] The proposed repeal completely ignores that earlier finding and does not provide any reason why the costs for smaller base load turbines, which are unlikely to be built, are relevant.

Second, the proposed repeal estimates that reducing the availability of capture equipment to 75 percent would increase compliance costs by $2 per megawatt-hour and $20 per tonne. 90 Fed. Reg. at 25776. EPA provides no justification for this number. In any event, for the turbines of a size likely to be built, increases of these amounts would still result in lower costs than EPA has previously concluded are reasonable for greenhouse gas reductions on a per metric ton basis and comparable to costs for other pollutants on a per megawatt-hour basis.[220]

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[216] *See supra* Comment section V.F.

[217] *See supra* Comment section V.C.

[218] *See supra* Comment section IV.C.

[219] Greenhouse Gas Mitigation Measures, Carbon Capture and Storage for Combustion Turbines Technical Support Document at 6 (Apr. 2024), Docket ID No. EPA-HQ-OAR-2023-0072, https://www.regulations.gov/document/EPA-HQ-OAR-2023-0072-9099.

[220] *See* 90 Fed. Reg. at 39882 (describing other EPA pollution control rules with costs of $14.80 to $18.50 per MWh, $10.80 to $11.80 per MWh, and $98 per ton CO_2 equivalent reduced); *see also supra* Comment VI.D.

Third, the proposed repeal's critique of EPA not using an energy market model to perform a dispatch analysis is a red herring. *See* 90 Fed. Reg. at 25776–77. In the proposed repeal, EPA claims that the Carbon Pollution Standards should have used such a model to evaluate the capacity factors for new gas-fired units for the final 18 years of an assumed 30-year asset life using a dispatch analysis. This assertion is unfounded because a dispatch model is not designed to make projections on this time scale.[221] Production cost dispatch modeling software is used primarily for grid operations and unit commitment and dispatch questions in the near term or within a limited multi-year timeframe. Dispatch modeling would be ineffective at projecting capacity factors for new gas-fired units, particularly in the long-term.[222] Its use would therefore be unreasonable and would generate implausible results.

Instead, it is appropriate to use long-term models and assessments, as EPA did in the Carbon Pollution Standards, to analyze long-term costs. *See* 89 Fed. Reg. at 39803 (explaining EPA "conducted capacity expansion modeling").[223] For example, EPA's modeling in the Carbon Pollution Standards showed that plants with carbon capture would operate at capacity factors greater than 80 percent.[224] The capacity factors in the Carbon Pollution Standards are also supported by DOE "NETL Baseline Reports [that] use an 85 percent capacity in the base case scenario when comparing the cost and performance of combined cycle turbine with and without CCS."[225] Another DOE report cited in the Carbon Pollution Standards on carbon capture retrofits for natural gas combined cycle units similarly used an 85 percent capacity factor. This report considered "real-world power market data" from ERCOT and determined "as long as a plant's marginal OpEx is below the market clearing settlement price 85% of the time, that plant can operate at an 85% capacity factor."[226] The Carbon Pollution Standards summarized this report by noting that a "DOE analysis of a representative NGCC plant using CCS in the ERCOT market

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[221] *See* Erin Boyd, DOE, *Power Sector Modeling 101* at 19 (explaining dispatch models "[s]imulate operation of a specified power system over a relatively short period compared to Capacity Expansion Model (1-week to 1-year)"), https://perma.cc/JG83-RDS3.

[222] The model used by EPA in the Carbon Pollution Standards does include analysis of energy markets and dispatch curves. *See* EPA, *Documentation for EPA's Power Sector Modeling Platform v6, Using the Integrated Planning Model*, at 2-1 (2018) ("The model represents economic activities in key components of energy markets – fuel markets, emission markets, and electricity markets."), https://perma.cc/H96L-R5GV; *id.* at 2-9 to 2-10 (describing dispatch modeling aspects). In the proposed repeal, EPA does not demonstrate an awareness of these aspects of its prior model, which render the proposal arbitrary. *See Fox TV*, 556 U.S. at 515–16. To the extent the proposed repeal does actually indicate a reversal of EPA on the type of modeling to use, the explanation is insufficient and arbitrary, as described in the body of this comment.

[223] *See also* EPA, *Documentation for EPA's Power Sector Modeling Platform v6, Using the Integrated Planning Model*, at 1-10 (2018) (describing advantages of the model including "ability to compute optimal capacity that combined short-term dispatch decisions with long-term investment decisions"); *id.* at 2-1 ("IPM is a long-term capacity expansion and production-costing model of the electric power sector.").

[224] 89 Fed. Reg. at 39934 (explaining 80 percent capacity factor used in Carbon Pollution Standards "is generally consistent with the IPM model projections of 87 percent (and, in fact, somewhat more conservative)").

[225] *Id.*; *see also* Kirk LaBabara, NETL, *Economics of Competing CCS Plants* at 14 (Oct. 2023), https://perma.cc/QZ28-VXGA.

[226] Eli Bashevkin, *Portfolio Insights: Carbon Capture in the Power Sector*, Office of Clean Energy Demonstrations, Department of Energy at 11-12 (April 2024), https://perma.cc/9QXF-W9QY.

indicates that operating at high operating capacity could be profitable today with the IRC 45Q tax credits." 89 Fed. Reg. at 39935 n.833. Similarly, the long-term capacity factor assumption of 31 percent in the Carbon Pollution Standards is supported by DOE/NETL in its study of the economics of multiple CCS configurations in ERCOT[227] using the dispatch model PROMOD to assess CCS plant performance, dispatch and economic results. This study found that in ERCOT, capacity factors of new natural gas combined cycle units without tax credit revenue would be about 24.5 percent (during mostly summer months). In another analysis conducted by Commenters, electric sector capacity expansion modeling conducted using IPM projects that capacity factors for essentially all new natural gas combined cycle facilities would exceed 50 percent through 2050 (Table 1). The NETL study and modeling support the estimation of future new natural gas combined cycle unit capacity factors in the Carbon Pollution Standards.

Table 1. Commenters' power sector modeling analysis regarding combined cycle (CC) and simple cycle combustion turbine (CT) capacity factor projections (2023 business-as-usual case).

New CC and CT- MW						
Type	**Min CF**	**Max CF**	**2030**	**2032**	**2035**	**2038**
New CC	0%	15%	-	-	-	-
New CC	15%	20%	-	-	-	-
New CC	20%	40%	-	-	-	-
New CC	40%	50%	-	-	-	426
New CC	50%	100%	26,901	28,918	29,531	29,105
New CT	0%	15%	15,562	18,509	23,321	24,636
New CT	15%	20%	-	-	-	-
New CT	20%	40%	-	-	-	-
New CT	40%	50%	-	-	-	-
New CT	50%	100%	-	-	-	-

The proposed repeal further alleges that all natural gas combined cycle power plants with CCS should operate at capacity factors lower than those of simple cycle combustion turbines (CTs) due to having higher incremental generating costs. *See* 90 Fed. Reg. at 25777. This argument represents a fundamental misstatement of energy market dispatch, and is thoroughly disproven by day-to-day operations of generators across the country. Dispatch order is not based exclusively on incremental generating costs. While variable operating costs play a role in dispatch decisions, there are other factors that often affect dispatch. These include unit startup times and ramp rates, air permit requirements or other environmental requirements, transmission system constraints and electric system reliability needs. For example, coal plants may have lower marginal costs compared with other resources, yet there has been a continuing trend of coal plants running at declining capacity factors over time. The proposed repeal's reliance on inaccuracies related to generating technology, capital investments and operating costs, and electricity markets leads it to misguided claims about the capacity factors of NGCC units.

[227] Kirk LaBarbara, DOE NETL, *Economics of Competing CCS plants* at 14, https://perma.cc/QZ28-VXGA.

The proposed repeal does not disturb any of these determinations on cost reasonableness from the Carbon Pollution Standards.

C. A 90 percent carbon capture and storage-based standard is achievable for base load gas plants by January 1, 2032.

Most of the infrastructure buildout arguments presented in this portion of the proposed repeal simply refer back to the section on coal-fired power plants, and those proposed findings are just as arbitrary and capricious, implausible, counter to the evidence, and otherwise unreasonable here as they are in the other portion of the proposed repeal.[228]

The only distinct argument EPA attempts in this section is that it claims new combustion turbines sited near potential storage, which the Carbon Pollution Standards referred to as "gas-by-wire," did not consider (1) the availability of sufficient quantities of natural gas; (2) the availability of sufficient transmission capacity; (3) associated line loss due to potentially longer transmission lines; or (4) requirements of siting electricity sources in locations necessary to meet local grid reliability considerations. *See* 90 Fed. Reg. at 25777.

As an initial point, the Carbon Pollution Standards presented "gas-by-wire" as a potential option that a utility or project developer might *choose* instead of using a longer carbon pipeline. 89 Fed. Reg. at 39931. Although EPA reasoned this option "may be preferred for projects where a CO_2 pipeline of substantial length would be required to reach the sequestration site," it was presented as a "flexibility" and not essential to the determination of achievability. *Id.*

Even setting aside that "gas-by-wire" is merely a compliance option, the proposed repeal's arguments about possible complications are counter to this evidence in the record that shows these issues are unlikely to occur. Furthermore, the proposed repeal does not explain how any of these possible factors would actually affect the feasibility of gas-by-wire as an option beyond conclusory statements. In contrast to these unsupported proposed findings, the Carbon Pollution Standards substantiated the feasibility of the "gas-by-wire" option by explaining the "electricity grid's extensive high voltage transmission networks that enable electricity to be transmitted over long distances," how regional transmission organizations (RTOs) operate, and providing specific examples of the analogous "coal-by-wire" approach that has already been in use for many years. 89 Fed. Reg. at 39931. The geographic availability TSD included an extensive analysis on a region-by-region basis of how gas-by-wire would be feasible.[229]

The discussion of achievability also completely ignores the compliance flexibilities in the Carbon Pollution Standards. That standard includes "a mechanism whereby baseload units may request a one-year extension of their CCS compliance deadline under certain circumstances." 89 Fed. Reg. at 39803. Under that provision, "EPA will grant a request for a Phase 2 compliance extension of up to one year only where a source demonstrates that it has taken all steps possible

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[228] *See supra* Comment VII.

[229] EPA, *Technical Memorandum: Geographic Availability of CCS for New NGCC Baseload Units* at 6-14 (Apr. 24, 2024), available at https://www.regulations.gov/document/EPA-HQ-OAR-2023-0072-9133.

to install and start up the necessary controls and still cannot comply with the Phase 2 standards of performance by the January 1, 2032 compliance date due to circumstances entirely beyond its control." 89 Fed. Reg. at 39952. Sources that cannot meet the standard even with a one-year extension would also have the option of operating at the intermediate load subcategory "until the necessary controls are installed and operational such that the source can comply with the Phase 2 standard of performance." *Id.* The Phase 2 standards are achievable, and these compliance flexibilities further address any issues that may arise on a case-by-case basis.

D. EPA unlawfully failed to consider alternatives to full repeal of the Phase 2 standards.

EPA failed to perform its obligation that "when an agency rescinds a prior policy its reasoned analysis must consider the 'alternative[s]' that are 'within the ambit of the existing [policy].'" *Dep't of Homeland Sec. v. Regents of the Univ. of Cal.*, 591 U.S. 1, 30 (2020) (quoting *State Farm*, 463 U.S. at 51). When an agency fails to do so, as the proposed repeal does for the Phase 2 standards for base load gas-fired power plants, it has "entirely failed to consider [that] important aspect of the problem." *Id.* (quoting *State Farm*, 463 U.S. at 43). Although this portion of the proposed repeal does not explicitly state that other rates of capture were outside the scope of the rulemaking, the failure to consider alternatives is no less unlawful here.

As with the analysis of coal-fired power plants, while Commenters contest the proposed repeal's assertions that the Carbon Pollution Standards are not sound, even assuming for the sake of argument that the Agency has reasonable concerns, its failure to consider alternatives is fatal. For gas-fired power plants, there are a number of alternatives that EPA must consider, but has not. Because the only aspect of the best system of emission reduction in dispute for adequate demonstration in the proposed repeal is the capture rate, *see* 90 Fed. Reg. at 25775–76, EPA should consider other rates of capture – or at least explain why it chose not to. It does neither.

Considering that supposed issues raised with costs were mostly related to plant size or capacity factor, EPA should have considered different subcategories. For example, EPA could have suggested a different electric sales threshold for the base load category, like the one considered in the proposed version of the Carbon Pollution Standards, *see* 88 Fed. Reg. at 33322, tbl. 2. Instead of a full repeal, EPA also could have proposed changes to the base load subcategory to exclude smaller combustion turbines that the proposed repeal references, perhaps making a cutoff at 4,600 MMBtu/h, *see* 90 Fed. Reg. at 25776; or specifying that the base load category only applies to combined cycle plants.

Considering that the supposed concerns on achievability primarily relate to timeframes for infrastructure buildout, EPA should have considered extending the compliance date for Phase 2, making additional accommodations for delays, more flexibility for sources toggling between the intermediate and base load subcategories, or combinations of those options. Another alternative within the ambit of the Carbon Pollution Standards is low-GHG hydrogen co-firing. *See* 89 Fed. Reg. at 39805 (explaining why low-GHG hydrogen co-firing was not selected as a component of the best system of emission reduction and how it could be used for compliance).

As with the coal-fired standards, to illustrate the value of truly considering alternatives, in the limited time available during this comment period, Commenters conducted modeling of

alternative scenarios that could analyze a subset of the supposed criticisms outlined by EPA utilizing FACETS.[230] A memorandum presenting the results of this analysis is attached.[231]

One alternative assessed using FACETS was a modified timeline for natural gas facilities in the base load category to adopt CCS by delaying compliance deadlines by up to two years. Commenters assessed the impact of this policy alternative, leaving the remainder of the Carbon Pollution Standards in place, under two baseline scenarios: one reflecting economic and energy system assumptions from 2023 (the same general baseline utilized by EPA in both the final Carbon Pollution Standards and the proposed repeal) and an updated baseline reflecting rough 2025 assumptions, such as changes in resource costs, estimated demand projections, and policy considerations. Under both scenarios, this alternative could reduce compliance costs by 2–20 percent while acheiving greater emission reductions than the Carbon Pollution Standadrs.[232]

EPA failed to discuss any of these alternatives in the proposed repeal. Such failure is contrary to EPA's obligations when reconsidering and rescinding a rule, as well as its mandate under Section 111 to determine the "best" system of emission reduction.

X. EPA must withdraw the alternative proposal.

The proposed repeal is fundamentally flawed. Its legal and technical deficiencies, including those explained in this comment, cannot be remedied in this rulemaking. For these reasons, EPA must withdraw the alternative repeal proposal. The Carbon Pollution Standards remain in effect, and EPA has an obligation to enforce them.

Respectfully Submitted,

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[230] *See supra* Comment Section VIII.

[231] *See* Memorandum, FACETS Energy System Modeling (Aug. 6, 2025) [Attachment F].

[232] Comparing cost per ton reductions under the existing Carbon Pollution Standards and an alternative with a delayed compliance date for new base load gas-fired plants, calculated for each baseline and case as summation of discounted total system compliance costs (using a 3% discount rate) from 2025 to 2047 divided by total emission reductions over the same period.

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