Columbia Law School | COLUMBIA CLIMATE SCHOOL
SABIN CENTER FOR CLIMATE CHANGE LAW

August 7, 2025

U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460

Via *regulations.gov*

RE: EPA's Proposed Repeal of Greenhouse Gas Emissions Standards for Fossil Fuel-Fired Power Plants (Docket ID No. EPA–HQ–OAR–2025–0124)

Dear Administrator Zeldin,

Columbia Law School's Sabin Center for Climate Change Law ("Sabin Center") and the undersigned scientists and engineers, all of whom are experts in carbon capture and storage ("CCS") technologies, submit these comments in response to the Environmental Protection Agency's ("EPA") request for comments on the proposed rule titled "Repeal of Greenhouse Gas Emissions Standards for Fossil Fuel-Fired Electric Generating Units,"[1] which would repeal the 2024 performance standards for greenhouse gas ("GHG") emissions from new and existing fossil fuel-fired power plants.[2]

The Sabin Center and undersigned experts focus specifically on EPA's proposal to "revise the [best system of emission reduction or] BSER determinations" from the 2024 Rule which rely on CCS technology.[3] The Sabin Center is also submitting separate comments (1) on EPA's primary proposal to repeal all GHG emissions standards for fossil fuel-fired power plants based on EPA's determination that "GHG emissions from fossil fuel-fired power plants do not contribute significantly to dangerous air pollution within the meaning" of the Clean Air Act[4] and (2) on the harmful impacts that cities would experience were EPA to adopt its proposal.

In this letter, we focus on EPA's erroneous finding that CCS with a ninety percent carbon dioxide (CO_2) capture rate is not "adequately demonstrated" and, therefore, cannot form the BSER for (1) existing coal-fired power plants which intend to operate after January 1, 2039 and (2) new,

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[1] Repeal of Greenhouse Gas Emissions Standards for Fossil Fuel-Fired Electric Generating Units, 90 Fed. Reg. 25,752 (June 17, 2025) [hereinafter "Proposed Rule"].
[2] The performance standards were established by EPA in May 2024. New Source Performance Standards for Greenhouse Gas Emissions From New, Modified, and Reconstructed Fossil Fuel-Fired Electric Generating Units; Emission Guidelines for Greenhouse Gas Emissions From Existing Fossil Fuel-Fired Electric Generating Units; and Repeal of the Affordable Clean Energy Rule, 89 Fed. Reg. 39,798 (May 9, 2024) [hereinafter "2024 Rule"].
[3] 90 Fed. Reg. at 25,755.
[4] *Id*.

base load natural gas-fired combustion turbines.[5] Just a year ago, in its 2024 final decision, EPA appropriately concluded that the technologies required to implement CCS with a ninety percent capture rate are adequately demonstrated and achievable, as required by the Clean Air Act. The Sabin Center and undersigned experts in CCS science and technology strongly agree with that prior finding and urge EPA not to reverse course. To summarize:

- The Proposed Rule articulates a new legal standard for establishing that an emissions control system has been "adequately demonstrated" that is wholly unsupported by the text and purpose of the Clean Air Act and case law interpreting it. EPA's new claim that technologies that require further "enhancements and development that would take significant time" are not adequately demonstrated is inconsistent with its own prior findings and those of the courts. The case law is clear that, given the "technology forcing" nature of the Clean Air Act, EPA can determine that a technology is adequately demonstrated even if it is not already routinely used in an industry and would require design improvements or operational advances before being widely implemented. The courts have further recognized that EPA can factor in the lead time afforded to regulated parties in deciding that the technology will be adequately available by the compliance date and have not imposed any limits on the amount of time EPA may allow.
- In any event, even applying EPA's new, flawed standard, CCS with a ninety percent capture rate is adequately demonstrated. CCS technologies have been successfully implemented at scores of facilities worldwide, including multiple power plants, such as the Petra Nova facility in Texas and Boundary Dam facility in Canada. These and other at scale commercial projects establish that CCS with ninety percent capture is feasible. While EPA is correct that CCS is not currently in routine use within the power sector, it is "ready to go" and can be implemented without further technological "enhancements and development." Commercial guarantees for such systems are available from reputable technology vendors.
- CCS technology is readily scalable. The projects mentioned above were intended to, and did, validate capture technology at scale. While EPA is correct that the projects did not consistently capture ninety percent of CO_2 on a facility-wide basis, that was by design and not due to any flaw in the technology. Now that it has been proven effective and reliable, the technology is being deployed on a larger scale, with several new projects in development, as discussed below.
- The claim in the Proposed Rule that the BSER from the 2024 Rule is not cost reasonable is based on flawed cost analysis. As found in the 2024 Rule, the current deployment of CCS technology has proven to be cost effective in achieving ninety percent reductions in CO_2 emissions. The experience gained from Boundary Dam, Petra Nova, and other projects has already enabled further CCS cost reductions.

[5] *Id.* at 25,755–56. EPA established CCS with a ninety percent capture rate as the BSER for these two categories of power plants in the 2024 Rule. 89 Fed. Reg. at 39,801, 39,902–03, 39,947–48.

I. EPA's New Interpretation of "Adequately Demonstrated" is Inconsistent with Case Law and, Regardless, Does Not Justify Repeal of the 2024 BSER Determination

Under section 111 of the Clean Air Act, EPA is required to adopt standards of performance for stationary sources of air pollution that "reflect[] the degree of emission limitation achievable through the application of the best system of emission reduction which (taking into account . . . cost . . . and any nonair quality health and environmental impact and energy requirements) the Administrator determines has been adequately demonstrated."[6] In the 2024 Rule, EPA rightly concluded that the "adequately demonstrated" standard requires a "record-based finding that sufficient evidence exists to reasonably determine that the affected sources in the source category can adopt a specific system of emission reduction" even if it is "not yet in widespread use" so long as "it may be more broadly deployed with adequate lead time."[7] Now, just a year later, EPA is proposing to adopt a completely different interpretation of the statutory term "adequately demonstrated."

In the Proposed Rule, EPA states that it previously relied on the wrong legal standard for "adequately demonstrated" because, in the 2024 Rule, it took "the position that [its] discretion [under the Clean Air Act] includes a degree of forward-looking prediction on whether a technology has been 'adequately demonstrated' such that it could be the BSER for a given source category."[8] EPA now asserts, without any justification, that "technologies requiring enhancements and development that would take significant time, and certainly that would take an entire review cycle or longer, cannot be considered 'adequately demonstrated.'"[9] There is no legal basis for this new approach, which runs directly counter to longstanding EPA practice, as well as court decisions interpreting the "adequately demonstrated" standard.

The Court of Appeals for the D.C. Circuit has described an "adequately demonstrated" system as 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."[10] The Court of Appeals has made clear that, given the "technology-forcing" nature of the Clean Air Act, EPA may set a performance standard "at a level that is higher than has actually been demonstrated over the long term by currently operating" facilities.[11] EPA has "authority to hold the industry to a standard of improved design and operational advances, so long as there is substantial evidence that such improvements are feasible."[12] Importantly, the system "need not necessarily be routinely [used] within the industry prior to its adoption."[13] EPA can also determine that a system is "adequately demonstrated" for the regulated industry based on "the

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[6] 42 U.S.C. § 7411(a)(1).
[7] 80 Fed. Reg. at 39,830, 39,832.
[8] 90 Fed. Reg. at 25,769.
[9] *Id*.
[10] *Essex Chem. Corp. v. Ruckelshaus*, 486 F.2d 427, 433 (D.C. Cir. 1973).
[11] *Sierra Club v. Costle*, 657 F.2d 298, 364 (D.C. Cir. 1981).
[12] *Id.* at 364.
[13] *Essex Chem. Corp.*, 486 F.2d at 433–34.

reasonable extrapolation of a technology's performance in other industries."[14] As explained further below, CCS systems with a ninety percent capture rate have been widely deployed in the industrial sector for several years, and are increasingly being used at power plants. While not yet in "routine" use throughout the power sector, the systems have been shown to be technically feasible and reliable and can be (and have been) deployed without exorbitant cost.

The Court of Appeals has repeatedly upheld EPA determinations of BSERs involving a technology that is not in routine use.[15] The court has made clear that, when setting a performance standard based on such technology, EPA can factor in the "lead time" afforded to regulated parties in deciding that the technology will be adequately available by the compliance date.[16] The court has not imposed any limits on the "lead time" that EPA may allow.

Unmoored from the principles articulated by the Court of Appeals, EPA now claims that the Clean Air Act's eight-year review cycle dictates that any technology that requires "enhancements or development that would take significant time, and certainly that would take an entire review cycle or longer, cannot be considered adequately demonstrated."[17] EPA cites no case law to support this new interpretation of the Clean Air Act; nor could it because there is no judicial support for its new position. EPA's new interpretation runs directly counter to the text and purposes of the Clean Air Act which, as noted above, was intended to be "technology forcing."

In any event, the fact that the 2024 Rule set a compliance deadline of 2032 does not indicate that the BSER identified there would fail to meet EPA's new "adequately demonstrated" standard, as the Proposed Rule seems to suggest. This reflects EPA's mistaken conflation of two separate issues: (1) the "development" of new technology and (2) the "deployment" of existing technology. As detailed in Section II below, and contrary to EPA's suggestion in the Proposed Rule, CCS technology does not require further technical "enhancements" or "development" before it can be used. On the contrary, as EPA itself previously found, the technology already exists and is in active use at power plants and industrial facilities in the U.S. and elsewhere. The 2032 compliance deadline merely reflects the fact that it will necessarily take time for regulated entities to install available capture equipment at their facilities and arrange for the transport and storage of CO_2 from those facilities. This involves permitting, contracting, and other activities that commonly take months or years to complete.[18] Recognizing this, in the 2024 Rule, EPA appropriately set a compliance date that would allow regulated entities seven years to deploy the technology. As explained further below, and contrary to the claims in the Proposed Rule, this was likely more time than required for the technology to be deployed.

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[14] *Lignite Energy Council v. U.S. EPA*, 198 F.3d 930, 934 (D.C. Cir. 1999) (upholding EPA's determination that a BSER for coal-fired industrial boilers was adequately demonstrated based on studies of the technology at utility boilers).

[15] *See, e.g.*, *Essex Chem. Corp.*, 486 F.2d at 440 (upholding a BSER that had only "approache[d] rather than achieve[d] the . . . standard."); *Sierra Club*, 657 F.2d at 364 (upholding an new source performance standard that assumed higher pollutant removal rates than had actually been achieved in practice).

[16] *See Portland Cement Ass'n v. Ruckelshaus*, 486 F.2d 375, 391 (D.C. Cir. 1973).

[17] 90 Fed. Reg. at 25,769.

[18] The Proposed Rule recognizes this, noting "[t]he equipment for the capture of CO2 takes time to design, permit and install." *Id.* at 25,773.

II. CCS Systems that Capture Ninety Percent of CO_2 Are Available and Being Deployed

In the Proposed Rule, EPA asserts that the record underlying the 2024 Rule "did not demonstrate that CCS technology would develop further so that 90 percent capture is achievable, did not demonstrate the period of time over which the technology would develop, and, by the same token, did not demonstrate that any such development would occur, at minimum, within the next eight years."[19] This is wholly inaccurate. The 2024 Rule included extensive evidence to establish that ninety percent capture technology already exists and has proven to be effective in use. In short, and contrary to EPA's new claims, no further technological development is needed before the technology can be implemented.

This section details the development of CCS component technologies, from the 1930s to now, and their successful combination in large-scale integrated systems. The section then explains, consistent with EPA's initial determination in the 2024 Rule, that the technology required to achieve CCS with a ninety percent capture rate is available and already being deployed. Finally, the section explains the process by which the technology can be scaled, such that it is in widespread use before the 2024 Rule's compliance date of January 2032.

A. CCS Technologies Have Existed for Decades and Been Successfully Deployed and Scaled Up

There are three components to CCS technology: CO_2 capture, CO_2 transport, and CO_2 storage. The specific technologies comprising the BSER in the 2024 Rule are (1) post-combustion capture using a chemical absorption process; (2) transportation via short (approximately sixty-two miles or less), lateral CO_2 pipelines; and (3) permanent geologic storage, especially in deep saline reservoirs.[20] All three components have a long history of use, both individually and in combination. CCS components are highly modular and easily linked, as demonstrated by at least thirty-four commercial-scale integrated CCS projects currently in operation.[21]

CCS has been most commonly deployed at industrial facilities, but the same technologies that have been proven there can also be used at power plants.[22] This has already occurred at several power plants including, but not limited to, Petra Nova, Boundary Dam, Plant Barry, and Bellingham, all of which have demonstrated that a ninety percent capture rate is reliably achievable.

1. CCS Component Technologies Are Available

CO_2 Capture. Carbon capture technologies were first developed in the 1930s to remove CO_2 from raw natural gas using a process called chemical absorption. The process uses chemical

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[19] *Id.* at 25,769.
[20] 89 Fed. Reg. at 39,846, 39,855.
[21] *See* Table 1, *infra* page 10.
[22] Berend Smit et al., *The Grand Challenges in Carbon Capture, Utilization, and Storage*, 2 FRONT. ENERGY RES. 1 (2014).

solvents, most commonly amines, to separate CO_2 from other gases.[23] Industrial facilities began implementing this process in the 1970s to separate CO_2 from flue gas streams for sale to enhanced oil recovery ("EOR") operations and for other industrial applications.[24] Since then, the chemical absorption process has been refined and other carbon capture methods have been developed, including physical absorption, membrane separation, adsorption, and cryogenic separation.[25] These processes can be implemented in three types of capture systems at power plants: post-combustion, pre-combustion, or oxy-combustion systems.[26]

The BSER adopted in the 2024 Rule incorporated post-combustion capture with chemical absorption. The basic process of post-combustion CO_2 capture is straightforward and akin to the process for removing other pollutants from the exhaust, or "flue gas," produced by fossil fuel power plants. To capture the CO_2, the flue gas is pumped through a duct into a carbon scrubber rather than being released directly into the air. Most commonly, the carbon scrubber uses a chemical solution to separate the CO_2 from the rest of the flue gas. From there, the CO_2-depleted flue gas is vented into the air and the captured CO_2 is moved to a compressor, where it is compressed to a supercritical (liquid-like) fluid for transportation and then delivered to a storage site or utilization facility.[27] The process is essentially the same regardless of whether the flue gas is generated by an industrial plant or a power plant. It is also similar to the process of removing other noxious gases, such as sulfur dioxide, from power plant emissions. For example, sulfur dioxide scrubbers are installed at emitting units within power plants to process flue gas.

Post-combustion capture with chemical absorption is a mature technology, having been used for fifty-plus years.[28] It cannot, by any stretch of the imagination, be described as "purely theoretical or experimental."[29] On the contrary, amine-based absorption systems designed specifically for large-scale post-combustion capture at power plants are commercially available,[30] and already in use at operating plants.[31] Suppliers continue to refine their amine-based capture systems to enhance performance and reduce costs.[32]

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[23] Anand Rao & Edward Rubin, *A Technical, Economic, and Environmental Assessment of Amine-Based CO_2 Capture Technology for Power Plant GHG Control*, 36 ENV'T SCI. TECH. 4,467, 4,468 (2002).
[24] *Id.*
[25] *See id.*
[26] Heleen de Coninck & Sally Benson, *Carbon Dioxide Capture and Storage: Issues and Prospects*, 39 ANN. REV. ENV'T RES. 243, 248 (2014); Jennifer Wilcox, *Carbon Capture* (2012).
[27] *See generally Carbon Capture*, MIT, https://climate.mit.edu/explainers/carbon-capture.
[28] Cong Chao et al., *Post-Combustion Carbon Capture*, 138 RENEWABLE AND SUSTAINABLE ENERGY REV. 1 (2021); Rao & Rubin, *supra* note 23; 89 Fed. Reg. at 39,846.
[29] 90 Fed. Reg. at 25,758.
[30] Products include: Fluor Econamine FG Plus, Mitsubishi Heavy Industries KM-CDR Process, BASF/Linde OASE Blue, and Shell CANSOLV. EPA, *Technical Support Document: Literature Survey of Carbon Capture Technology*, EPA-HQ-OAR-2013-0495-11773, at 10–11 (2015). *See also* Global CCS Institute, *State of the Art: CCS Technologies 2023* (2023), https://www.globalccsinstitute.com/wp-content/uploads/2023/08/State-of-the-Art-CCS-Technologies-2023-Global-CCS-Institute.pdf (listing additional CCS vendors).
[31] Eva Sanchez Fernandez et al., *Operational Flexibility Options in Power Plants with Integrated Post-Combustion Capture*, 48 INT'L J. GREENHOUSE GAS CONTROL 275, 275 (2016).
[32] Companies include Mitsubishi, General Electric, Babcock and Wilcox, Aker Clean Carbon, HTC, and Huaneng.

CO_2 Transport. Just as capture technology has a long history of use, CO_2 transport via pipeline has occurred at a large scale for decades. Accordingly, the U.S. already has CO_2 pipeline infrastructure that connects entire regions via large, interstate systems.[33] As of 2024, there were approximately 5,124 miles of operational CO_2 pipelines in the U.S.[34]

Pipelines are a cost-effective, reliable means of transporting CO_2 and can be expanded relatively quickly. Between 2011 and 2022, the number of pipeline miles increased by fourteen percent.[35] Additional CO_2 pipeline projects are currently under development, including the Midwest Carbon Express line, which will extend approximately 2,000 miles across five states.[36] There are also plans to convert part of the existing 300,000 mile long natural gas transmission system to carry CO_2.[37]

Importantly, though, the BSER in the 2024 Rule did not require the expansion of interstate CO_2 pipelines. Rather, it was based on the use of short, lateral pipelines connecting emitting facilities to the nearest CO_2 storage reservoir.[38] This is viable because of the widespread availability of permanent CO_2 storage sites. Approximately eighty percent of emitting facilities in the U.S. are located within sixty-two miles of potential storage sites and seventy-five percent are within thirty-one miles.[39] Construction of short, lateral pipelines is thus a feasible near-term option. In the Proposed Rule, EPA speculates that pipeline development could "face delays due to factors including State permitting and the challenges associated with eminent domain authority and negotiating rights-of-way," but does not provide any evidence to support this claim.[40] In fact, in the 2024 Rule, EPA cited several examples of short lateral pipelines, some of which took only two years from project inception to pipeline operation.[41] EPA also fails to recognize that, even if this occurs, CO_2 can also be transported economically by truck, rail, or barge over the transportation distances anticipated in the 2024 Rule.[42]

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[33] Cong. Rsch. Serv., *Carbon Capture and Sequestration (CCS) in the United States* 8 (2022), https://sgp.fas.org/crs/misc/R44902.pdf.
[34] DOT, *Annual Report Mileage for Hazardous Liquid or Carbon Dioxide Systems*, https://www.phmsa.dot.gov/data-and-statistics/pipeline/annual-report-mileage-hazardous-liquid-or-carbon-dioxide-systems.
[35] 89 Fed. Reg. at 39,855, n.381.
[36] Cong. Rsch. Serv., *Carbon Dioxide (CO_2) Pipeline Development: Federal Initiatives* 1 (2023), https://crsreports.congress.gov/product/pdf/IN/IN12169.
[37] Cong. Rsch. Serv., *Siting Challenges for Carbon Dioxide (CO_2) Pipelines* 2 (2023), https://crsreports.congress.gov/product/pdf/IN/IN12269.
[38] 89 Fed. Reg. at 39,855.
[39] IEA, *Special Report on Carbon Capture Utilisation and Storage: CCUS in Clean Energy Transitions* 131–32 (2020), https://iea.blob.core.windows.net/assets/181b48b4-323f-454d-96fb-0bb1889d96a9/CCUS_in_clean_energy_transitions.pdf; 89 Fed. Reg. at 39,855–62.
[40] 90 Fed. Reg. at 25,773.
[41] *See, e.g.*, 89 Fed. Reg. at 39,856–57 ("Chaparral Energy entered a long-term CO_2 purchase and sale agreement with a subsidiary of CVR Energy for the capture of CO_2 from CVR's nitrogen fertilizer plant in 2011. The pipeline was then constructed, and operations started in 2013.")
[42] 89 Fed. Reg. at 39,880; Corey Myers et al., *The Cost of CO_2 Transport by Truck and Rail in the United States*, 134 INT'L J. GREENHOUSE GAS CONTROL 1 (2024).

CO_2 Storage. Just like CO_2 capture and transport, permanent geologic CO_2 storage has also been occurring in the U.S. for decades. The technology was first developed in the 1970s for the purposes of EOR, which is now widespread within the oil industry. While EOR storage is an option for meeting the performance standards, the BSER in the 2024 Rule also accounted for storage in deep saline reservoirs, which are found throughout the U.S. and have enormous storage capacity.[43] The International Energy Agency ("IEA") has concluded that deep saline storage is a proven method for permanent CO_2 sequestration.[44]

The longest-running deep saline storage operation globally is the Sleipner project in Norway, which began in 1996 and injects CO_2 at a rate of 1 million metric tons ("MMT") per year.[45] Other large deep saline storage operations include the Snøhvit project, also in Norway, which injects CO_2 at a rate of 0.7 MMT per year and Quest CCS in Canada which began operating in 2015 and stored 5 MMT of CO_2 within its first five years at a cost thirty-five percent lower than anticipated.[46] These Norwegian and Canadian projects were put in place in response to governmental policies to reduce industrial carbon emissions.

In addition to deep saline reservoirs, there are a number of alternative storage options, including in basalt rock formations.[47] Basalt storage relies on the process of carbon mineralization, whereby CO_2 injected into basalt and certain other rock formations is rapidly converted into solid minerals. While not as prevalent as deep saline formations, basalt deposits can be found throughout the U.S., and could store significant CO_2.[48] Basalt storage has been demonstrated in the Wallula Project in the U.S. and at the Carbfix facility in Iceland, which has operated for a decade, and stored over 100,000 tons of CO_2 during that time.[49]

In the Proposed Rule, EPA acknowledges that "the U.S. has broad availability of the geologic formations that may potentially be suitable for CO_2 sequestration," but argues that CO_2 storage technology is not adequately demonstrated because currently operating projects cannot accommodate the amount of CO_2 that will need to be stored.[50] However, there are multiple new, large-scale sequestration facilities currently under development. Examples include the River Bend CCS project in Louisiana, which has storage capacity of over 620 MMT of CO_2 and is expected to make its first injection in 2026, and the Bayou Bend CCS project in Texas, which has over 1

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[43] 89 Fed. Reg. at 39,855; *see also* Michael Szulczewski et al., *Lifetime of Carbon Capture and Storage as a Climate-Change Mitigation Technology*, 109 PNAS 5185 (2012).
[44] IEA, *CO_2 Capture and Storage: A Key Carbon Abatement Option* 81 (2008), https://iea.blob.core.windows.net/assets/7a2e4c6f-6cb3-4e40-9623-e1d61843c8ba/CCS_2008.pdf.
[45] Kai Zhang et al., *Extension of CO_2 Storage Life in the Sleipner CCS Project by Reservoir Pressure Management*, 108 J. NAT. GAS SCI. & ENG'G 1 (2022).
[46] 89 Fed. Reg. at 39,865; *Quest CCS Facility Captures and Stores Five Million Tonnes of CO2 Ahead of Fifth Anniversary*, Shell (July 9, 2020), https://www.shell.ca/en_ca/media/news-and-media-releases/news-releases-2020/quest-ccs-facility-captures-and-stores-five-million-tonnes.html.
[47] 89 Fed. Reg. at 39,855.
[48] Arshad Raza et al., *Carbon Mineralization and Geological Storage of CO_2 in Basalt: Mechanisms and Technical Challenges*, 229 EARTH-SCI. REV. 1 (2022).
[49] *Wallula Basalt Project*, Pac. Nw. Nat'l Lab'y, https://www.pnnl.gov/projects/carbon-storage/wallula-basalt-project; Carbfix, *Turning CO_2 into Stone* 3 (2022), https://usea.org/sites/default/files/event-/Carbfix_Intro_US_DOE_2022_OJ.pdf.
[50] 90 Fed. Reg. at 25,773.

billion tons of CO_2 storage capacity and is expected to make its first injection in early 2027. Additional projects are planned for the near future; indeed, EPA is currently reviewing hundreds of applications for permits for geologic carbon sequestration wells under its Underground Injection Control (UIC) program.[51] The Proposed Rule suggests that, given the time required to permit new sequestration operations, it is "unlikely that infrastructure necessary for CCS can be deployed by the January 1, 2032." But EPA is committed to speeding up the permitting process and has recently advanced multiple states' applications for primacy under the UIC program,[52] which will build permitting capacity and allow states to issue new permits more quickly.[53] Since being awarded primacy in 2018, North Dakota has already issued permits for nine storage facilities,[54] whereas EPA has only issued eleven permits since the program's inception in 2010.[55]

Between the success of existing operations, the numerous projects in development, and the U.S.'s ample storage capacity, it is clear that CCS is a demonstrated, effective, and reliable technology for reducing CO_2 emissions.

2. Integrated CCS Systems Are in Operation at Power Plants and Industrial Facilities Around the World

Further proof that CCS is "adequately demonstrated" comes from the dozens of commercial-scale integrated CCS projects operating around the world (see Table 1). At least thirteen projects have come online within the last five years alone. A number of older projects have undergone upgrades to increase their capture capacity.[56] These projects demonstrate that the three CCS components can be successfully integrated at scale.

Generally speaking, existing CCS projects have been undertaken for one of two main reasons: (1) because there is a strong policy incentive (such as the section 45Q tax credit) or regulatory requirement (as is the case in Canada); or (2) because there is a research and development program providing funds to demonstrate CCS at scale. In the absence of either, many facilities still undertake CO_2 capture projects without the permanent storage component as part of industrial operations that sell or vent captured CO_2 (such as with the Bellingham facility discussed below). This context is critical to understanding why the scope of existing CCS systems is independent and not indicative of technical capacity for capture and permanent storage.

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[51] *Underground Injection Control (UIC) Class VI Permit Tracker*, EPA (Sept. 27, 2024), https://awsedap.epa.gov/public/single/?appid=8c074297-7f9e-4217-82f0-fb05f54f28e7&sheet=51312158-636f-48d5-8fe6-a21703ca33a9&theme=horizon&bookmark=6218ffed-bb6e-42e4-a4f1-52d87e036a1b&opt=ctxmenu.

[52] EPA, *Primary Enforcement Authority for the Underground Injection Control Program*, https://www.epa.gov/uic/primary-enforcement-authority-underground-injection-control-program-0.

[53] 89 Fed. Reg. at 39,863.

[54] *Class VI - Geologic Sequestration Wells*, N.D. Dep't of Mineral Res., https://www.dmr.nd.gov/dmr/oilgas/ClassVI.

[55] *Underground Injection Control (UIC) Class VI Permit Tracker*, *supra* note 51.

[56] *See, e.g.*, Nat'l Petroleum Council, *Meeting the Dual Challenge* C-3–C-4 (2021), https://dualchallenge.npc.org/files/CCUS-Appendix_C-030521.pdf.

Table 1: Commercial-Scale Integrated CCS Systems Operating in 2023[57]

Project	Operation Date	CO_2 Source	Capture	Pipeline km	Storage	Rate MMT/year
Taizhou (China)	2023	Power generation	Chemical absorption	N/A (under construction)	EOR	0.5
Qilu-Shengli (China)	2022	Chemical	Chemical absorption	115	EOR	1
Yulin CO_2-EOR (China)	2022	Chemical	Chemical absorption	N/A (truck)	EOR	0.3
Glacier (Canada)	2022	Natural gas processing	Physical absorption	Not public	Geologic storage	0.2
Richardton (U.S.)	2022	Ethanol production	Compression	3	Deep saline	0.18
Jinjie (China)	2021	Power generation	Chemical absorption	N/A (truck)	Deep saline	0.15
Yan'an CO_2-EOR (China)	2021	Chemical	Physical absorption	25	EOR	0.1
Sturgeon Refinery (Canada)	2020	Bitumen refining	Physical separation	240	EOR	1.6
Nutrien (Canada)	2020	Hydrogen production	Chemical absorption	240	EOR	0.3
Gorgon (Australia)	2019	Natural gas processing	Chemical absorption	7	Deep saline	4
Jilin Oilfield (China)	2018	Natural gas processing	Chemical absorption	50	EOR	0.6
Petra Nova (U.S.)	2017	Power generation	Chemical absorption	129	EOR	1.4
ADM Decatur (U.S.)	2017	Ethanol production	Compression and drying	3	Deep saline	1.1
Abu Dhabi (U.A.E.)	2016	Iron and steel production	Chemical absorption	43	EOR	0.8
Quest (Canada)	2015	Hydrogen production	Chemical absorption	64	Deep saline	1.3
Uthmaniyah (Saudi Arabia)	2015	Natural gas processing	Chemical absorption	85	EOR	0.8

[57] Global CCS Institute, *Global Status of CCS 2023*, at 77–78 (2023), https://www.globalccsinstitute.com/wp-content/uploads/2024/01/Global-Status-of-CCS-Report-1.pdf; Nat'l Energy Tech. Lab'y, *Carbon Capture and Storage Database* (2023), https://netl.doe.gov/carbon-management/carbon-storage/worldwide-ccs-database; Nat'l Petroleum Council, *supra* note 56, at App. C; *SCCS Projects Home*, Scottish Carbon Capture & Storage, https://www.geos.ed.ac.uk/sccs/; *Geoengineering Map*, Geoengineering Monitor, https://map.geoengineeringmonitor.org/; *Facilities Database*, Global CCS Institute, https://co2re.co/FacilityData.

Project	Operation Date	CO_2 Source	Capture	Pipeline km	Storage	Rate MMT/year
Karamay Dunhua (China)	2015	Chemical	Chemical absorption	N/A (truck)	EOR	0.1
Boundary Dam (Canada)	2014	Power generation	Chemical absorption	66	EOR/ Deep saline	1
Petrobras Santos Basin (Brasil)	2013	Natural gas processing	Membrane separation	Not public	EOR	10.6
Coffeyville Fertilizer (U.S.)	2013	Fertilizer production	Adsorption	109	EOR	1
Air Products (U.S.)	2013	Hydrogen production	Adsorption	21	EOR	1
Lost Cabin Gas (U.S.)	2013	Natural gas processing	Physical absorption	373	EOR	0.9
Bonanza BioEnergy (U.S.)	2012	Ethanol production	Compression	23	EOR	0.1
Yanchang Demonstration (China)	2012	Chemical	Physical absorption	100	EOR	0.05
Century Plant (U.S.)	2010	Natural gas processing	Physical absorption	161	EOR	8.4
Shute Creek (U.S.)	2010	Natural gas processing	Cryogenic separation	229	EOR	7
Arkalon (U.S.)	2009	Ethanol production	Compression	50	EOR	0.5
Snøhvit (Norway)	2008	Natural gas processing	Chemical absorption	143	Deep saline	0.7
South Chester (U.S.)	2003	Natural gas processing	Chemical absorption	15	EOR	0.35
Great Plains Synfuels (U.S.)	2000	Coal gasification	Physical absorption	330	EOR	3
Sleipner (Norway)	1996	Natural gas processing	Chemical absorption	240	Deep saline	1
Szank Field (Hungary)	1992	Natural gas processing	Chemical absorption	Not public	EOR	0.16
Enid Fertilizer (U.S.)	1982	Fertilizer production	Chemical absorption	193	EOR	0.7
Terrell (U.S.)	1972	Natural gas processing	Physical absorption	354	EOR	0.5

Scores more CCS facilities are currently under development, with 105 integrated or component facilities scheduled to begin operation within the next two years.[58]

B. CCS Systems with Ninety Percent Capture Have Been Developed over Decades and Deployed at Scale

In the Proposed Rule, EPA specifically argues that "90 percent CCS is not adequately demonstrated," apparently because "capture rates [of ninety percent] have not been demonstrated at the commercial scale over the course of a calendar year."[59] But that is not the legal standard. There is nothing in the Clean Air Act, nor in court decisions interpreting it, that requires emissions control technology to have been in actual use for twelve months before it can be considered "adequately demonstrated." Such an approach is illogical; EPA's new test would effectively prevent it from requiring regulated entities to adopt new demonstrated and available emissions control technologies, unless they had first voluntarily implemented them for a year. But, as EPA clearly understands, it would be entirely unreasonable to expect such a long demonstration from unregulated parties. Indeed, just months ago, EPA wrote, "[c]arbon capture is not presently in widespread use at power plants, but that is because the industry has had little incentive to control emissions voluntarily, not for any lack of technology."[60]

The assertion, in the Proposed Rule, that CCS with ninety percent CO_2 capture is not adequately demonstrated ignores decades of experience with the technology and its deployment in real-world settings. Indeed, capture rates of ninety percent or more were observed in laboratory settings as far back as the 1970s and have been a continued focus of research since then.[61] After decades of technological advances, the achievability of a ninety percent capture rate on an annual basis is widely accepted in the scientific literature, and indeed is commonly assumed in CCS studies by the electric power industry and others.[62] In fact, as the technology has matured, "state of the art" applications of CCS at power plants and other industrial facilities have been designed to achieve emission reductions well in excess of ninety percent.[63]

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[58] Global CCS Institute, *Global Status of CCS 2023*, at 77–92 (2023), https://www.globalccsinstitute.com/wp-content/uploads/2024/01/Global-Status-of-CCS-Report-1.pdf.

[59] 90 Fed. Reg. at 25,769, 25,772.

[60] Respondents' Brief at 1, *West Virginia v. EPA*, No. 24-1120 (D.C. Cir., filed May 9, 2024).

[61] *See, e.g.*, C. Mustacchi et al., *Carbon Dioxide Disposal in the Ocean*, *in Carbon Dioxide, Climate and Society* 286 (Jill Williams ed., 1978); Angelo Basile et al., *Membrane Technology for Carbon Dioxide (CO_2) Capture in Power Plants*, *in Advanced Membrane Science and Technology for Sustainable Energy and Environmental Applications* 121 (Angelo Basile & Suzana Pereira Nunes eds., 2011).

[62] *See, e.g.*, Desmond Dillon et al., *A Summary of EPRI's Engineering and Economic Studies of Post Combustion Capture Retrofit Applied at Various North American Host Sites*, 37 ENERGY PROCEDIA 2349, 2357 (2013); Patrick Brandl et al., *Beyond 90% Capture: Possible, But at What Cost?*, 105 INT'L J. GREENHOUSE GAS CONTROL 1, 1 (2021) ("a 90% CO_2 capture rate has become ubiquitous in the literature").

[63] Yang Du et al., *Zero- and Negative-Emissions Fossil-Fired Power Plants UsingCO₂ Capture by Conventional Aqueous Amines*, 111 INT'L J. GREENHOUSE GAS CONTROL 1 (2021); Haibo Zhai & Edward Rubin, *It Is Time to Invest in 99% CO_2 Capture*, 56 ENV'T SCI. TECH. 9829 (2022).

The feasibility of CCS with a ninety percent capture rate has also been proven through deployment of the technology at multiple large-scale power plants, including the coal-fired Boundary Dam, Petra Nova, and Plant Barry projects and the natural gas-fired Bellingham Cogeneration Facility.

SaskPower's Boundary Dam in Canada was the first coal-fired power plant globally to be retrofitted with CCS using an amine-based post-combustion capture system designed to achieve ninety percent CO_2 capture at a commercial scale.[64] The integrated system includes a fifty kilometer pipeline which delivers a portion of the CO_2 to nearby oil fields for use in EOR and a second two kilometer pipeline which delivers CO_2 to the Aquistore Storage Project where it is injected for deep saline storage. The capture system at Boundary Dam was installed at the 115 megawatt ("MW") Power Unit 3, came online in 2014, and "completed a 72-hour demonstration nameplate test of its design capacity [where] the plant was able to capture . . . 99.7% of the design capacity [89.7% CO_2 capture]."[65] In total, since coming online, the system has captured over 5.7 MMT of CO_2.[66] Since the project was designed to demonstrate the technology and tailored to capture an amount of CO_2 in demand by the plant's EOR off-takers, SaskPower has not consistently run all flue gas from the unit through the capture system.[67] Nevertheless, the project clearly establishes that ninety percent capture is achievable and feasible at scale.

This has also been demonstrated at several other facilities. For example, the Petra Nova facility in Texas was the first CCS retrofit project to a coal-fired plant in the U.S. This at-scale demonstration employed a post-combustion system using a proprietary, amine solvent from Mitsubishi Heavy Industries.[68] The project aimed to demonstrate a ninety percent capture rate at a scale of up to 250 MW-electric and successfully captured 92.4% of CO_2 from the processed slipstream.[69]

The same technology has also been implemented at smaller scale at coal plants. Plant Barry is a coal-fired power plant in Alabama, which launched an integrated CCS demonstration project in 2011 treating a 25 MW portion of the plant's flue gas stream. It operated stably, capturing ninety percent CO_2 under full load conditions.[70]

The Bellingham Cogeneration Facility in Massachusetts demonstrated ninety percent CO_2 capture at a combined cycle natural gas-plant. An amine-based post-combustion capture system

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[64] EPA, *Technical Support Document: Greenhouse Gas Mitigation Measures for Steam Generating Units*, EPA-HQ-OAR-2023-0072, at 25 (2024).
[65] SaskPower, *SaskPower 2015–16 Annual Report* 59 (2016), https://www.saskpower.com/about-us/our-company/~/link.aspx?_id=29E795C8C20D48398EAB5E3273C256AD&_z=z.
[66] *BD3 Status Update: Q4 2023*, SaskPower (Jan. 16, 2024), https://www.saskpower.com/about-us/our-company/blog/2024/bd3-status-update-q4-2023.
[67] 89 Fed. Reg. at 39,848.
[68] EPA, EPA-HQ-OAR-2023-0072, *supra* note 64, at 28.
[69] Nat'l Energy Tech. Lab'y, *W.A. Parish Post-Combustion CO_2 Capture and Sequestration Demonstration Project* 6 (2020), https://www.osti.gov/servlets/purl/1608572.
[70] Mitsubishi Heavy Industries, *Plant Barry CO_2 Capture Project* 11 (2015), https://fossil.energy.gov/archives/cslf/sites/default/files/documents/tokyo2016/Kamijo-PlantBarryProject-Workshop-Session2-Tokyo1016.pdf.

operated on a 40 MW slipstream from 1991 to 2006.[71] It consistently captured eighty-five to ninety-five percent of CO_2 emissions.[72] CCS technologies are the same for coal- and natural gas-fired plants. In the 2024 Rule, EPA correctly concluded that the technology used at coal plants will actually be easier to implement at natural gas plants because natural gas lacks impurities that naturally occur in coal and affect the efficiency of capture systems.[73]

EPA's claim in the Proposed Rule that these are "experimental projects aiming to achieve 90 percent CCS"[74] is a gross mischaracterization of the state of the technology. The projects are, in fact, full-scale deployments of the technology that *have achieved* ninety percent capture. Indeed, mere months ago, EPA itself said: "Carbon-capture technology is not projected futuristic technology; it is available and can be applied today. Indeed, power plants have employed carbon-capture technology for decades; the technology was patented nearly a century ago."[75]

C. Ninety Percent CO_2 Capture Technology Is Readily Scalable

In reality, the commercial-scale CCS projects discussed above have accomplished exactly what is necessary to adequately demonstrate that the CCS technology can be scaled up to meet the 2024 Rule's performance standards by the 2032 compliance date. This is true for two reasons: (1) the same technologies that have been proven to capture ninety percent or more of CO_2 at individual slipstreams can be deployed on a facility-wide basis; and (2) the previous projects reflect a phased approach to implementing CCS in which capture systems were intentionally installed on single slipstreams. This is not due to any flaw in the technology but, rather, to demonstrate that they work before incurring the costs of full deployment and to tailor capture systems to the amount of CO_2 the facilities have agreed to sell. Now that the systems' efficacy has been established, additional, larger projects are being implemented.

With respect to point (1) above, the process of scaling CO_2 capture from slipstream capture to facility-wide capture does not require different technology. It requires expanding the technology's capacity, either by building bigger capture systems or by building multiple process trains. Capture projects performed on a single slipstream are foundational for commercial deployment and are viewed as an adequate demonstration of the technology to be implemented more widely.[76]

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[71] 89 Fed. Reg. at 39,926.
[72] DOE, *Carbon Capture Opportunities for Natural Gas Fired Power Systems* 2, https://www.energy.gov/fecm/articles/carbon-capture-opportunities-natural-gas-fired-power-systems.
[73] 89 Fed. Reg. at 39,927.
[74] 90 Fed. Reg. at 25,755.
[75] Respondents' Brief at 1, *West Virginia v. EPA*, No. 24-1120 (D.C. Cir., filed May 9, 2024).
[76] *See Illinois Utility Working with University of Illinois on DOE Funded Carbon Capture Research Project*, Mining Connection (May 21, 2021), https://miningconnection.com/news/article/illinois_utility_working_with_university_of_illinois_on_doe_funded_carbon_c ("The successful construction and operation of [a CCS project on a 10 MW slipstream of flue gas at a larger] plant will provide a means to demonstrate an economically attractive and transformational capture technology. The approach used to design, construct, and commission the design . . . will help enable the commercialization process").

For example, the Boundary Dam system can treat the flue gas from a single 115 MW unit.[77] Indeed, in a letter to EPA, SaskPower has confirmed that "the CCS facility can capture at least 90% of the CO_2 from the . . . flue gas stream it processes."[78] Although this is not facility-wide capture because Boundary Dam has other coal-fired units, it is consistent with how CCS systems are expected to be implemented at full facilities. That is on a unit-by-unit basis, which is feasible because CCS technologies are modular. For instance, if a new base load natural gas-fired unit was constructed at a multi-unit facility, a CCS system capable of ninety percent capture would be applied to the single new unit with its own stack. Therefore, Boundary Dam Unit 3 demonstrates the CCS technology on a full unit in the same manner that power plants will likely deploy CCS systems one unit at a time—at least initially—to meet facility-wide performance standards. (As with sulfur dioxide capture, the size of CO_2 capture units may increase with learning, which could accommodate multiple units and yield economies of scale.)

With respect to point (2) above, EPA's new finding in the Proposed Rule reflects a misunderstanding of the CCS research, development, and demonstration ("RD&D") process. When developing CCS technologies for point sources, "[t]o cost-effectively meet the research objectives of a pilot-scale test, a project is usually sized such that only a small fraction of the plant's gas stream emissions is used."[79] Thus, "at a fossil-fuel power plant with multiple combustion units, the volume of flue gas from a single unit will typically exceed what is needed by a pilot project to validate the technology's maximum steady-state gross carbon capture efficiency, typically 95+%."[80] In other words, the fact that ninety percent CO_2 capture systems have been deployed on only single slipstreams or single units within larger-scale facilities is not evidence that the technology is infeasible. Rather, projects like Petra Nova are sized to capture the amount of CO_2 that the facility contracts to sell for EOR applications and need not capture from full units in the absence of a regulatory requirement to do so. Still, having served an important purpose of validating the technologies in the RD&D process, their systems are now being scaled-up and implemented more broadly. The RD&D cycle for Petra Nova, shown in Figure 1 below, illustrates this process.

As described in Figure 1, Mitsubishi Heavy Industries' capture system has been though a number of development phases: laboratory- and bench-scale research in Japan, small-scale pilot testing in Japan, large-scale pilot testing at Plant Barry in the U.S., and commercial demonstration at Petra Nova using a single unit's slipstream. The technology is now ready to be deployed in commercial projects which involve all emitting units in a facility. And that is already happening.

Additional facilities are now deploying ninety percent capture technology based on the success of the prior demonstration projects. For example, two proposed projects have followed from Petra Nova and will deploy Mitsubishi's capture technology at all emitting units: (1) the

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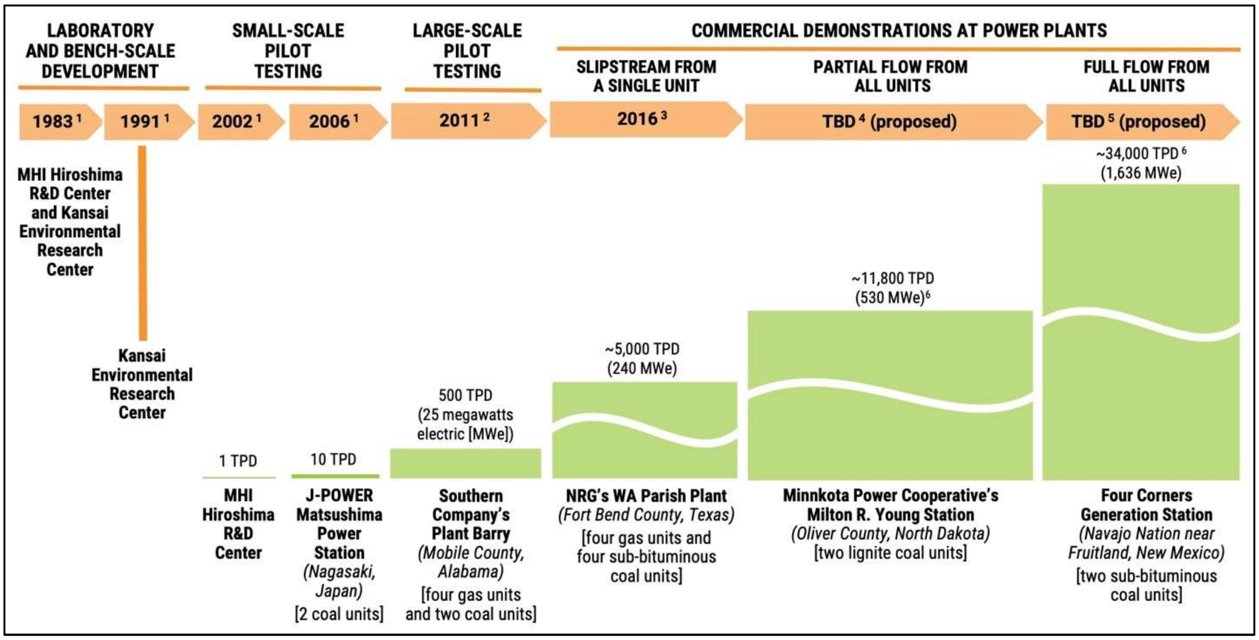
[77] SaskPower, *supra* note 62, at 59.
[78] EPA, EPA-HQ-OAR-2023-0072-0687 (Aug. 4, 2023), https://www.regulations.gov/document/EPA-HQ-OAR-2025-0124-0030.
[79] Nat'l Energy Tech. Lab'y, *Understanding Scales and Capture Rates for Point-Source Carbon Capture Technology Development* 1 (2024), https://netl.doe.gov/sites/default/files/publication/R-D239%20-%20Scales%20and%20Capture%20Rates%20for%20Point-Source.pdf.
[80] *Id*.

Milton R. Young Station in North Dakota and (2) the Four Corners Generation Station in Navajo Nation.[81] Both projects are designed to capture ninety-five percent or more CO_2.

Similarly, building on the success of Boundary Dam Unit 3, SaskPower is planning another CCS project at the coal-fired Shand Power Station.[82] Drawing on the lessons learned from Boundary Dam Unit 3, SaskPower has concluded that Shand can achieve a capture rate of *at least* ninety percent when the plant is at full load, or up to ninety-seven percent at a reduced load with integration of renewable energy sources.[83]

Figure 1: Development of the Kansai Mitsubishi Carbon Dioxide Recovery (KM-CDR) Process for Coal-Fired Power Plants[84]



Understanding how this scaling process will continue to unfold, EPA appropriately set a compliance date of January 1, 2032 in the 2024 Rule to allow power plants sufficient lead time to deploy the technology. EPA now claims the original compliance timeline is unrealistic.[85] However, 7.5 years is within the range of time required to develop CCS projects.[86] In fact, Petra Nova took only two and a half years to design, procure, construct, and commission the fully integrated CCS system.[87]

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[81] *See* Figure 1; 89 Fed. Reg. at 39,840.
[82] *See* Int'l CCS Knowledge Centre, *The Shand CCS Feasibility Study: Public Report* (2018), https://ccsknowledge.com/pub/Publications/Shand_CCS_Feasibility_Study_Public_Report_Nov2018_(2021-05-12).pdf.
[83] *Id.* at iii, x.
[84] *Id*.
[85] 90 Fed. Reg. at 25,771.
[86] *See, e.g.*, Emily J. Moore et al., *Expert Elicitation of the Timing and Uncertainty to Establish a Geologic Sequestration Well for CO_2 in the United States*, 121 PNAS 1 (2023).
[87] DOE, *Final Scientific/Technical Report: Petra Nova* 17 (2020), https://www.osti.gov/servlets/purl/1608572.

III. CCS Costs Are Reasonable and Have Already Declined with Operational Experience

In support of the BSER determinations in the 2024 Rule, EPA completed a detailed cost analysis with the assistance of a third-party engineering firm, and concluded that CCS with a ninety percent capture rate is cost-reasonable.[88] EPA now claims that its previous analysis was incorrect and arrives at a different cost estimate in the Proposed Rule based on a completely different set of assumptions. EPA's change in position is both unjustified and based on fundamentally flawed logic.

For example, in the Proposed Rule, EPA states, "even with a design capture efficiency of 90 percent, the effective annual capture efficiency [at existing facilities with CCS systems already installed] is lower, and under some circumstances significantly lower."[89] EPA bases its new cost estimates on these lower annual capture efficiencies. However, as explained in Section II above, annual capture rates at existing facilities are currently lower than ninety percent capture by design, not due to technology failures. Absent regulation, those facilities had no reason to consistently capture CO_2 at a rate of ninety percent—they are intended to validate the technology and capture enough CO_2 to meet the demand of buyers, which they have done. It is unreasonable for EPA, in the Proposed Rule, to estimate costs based on an assumption that regulated facilities will capture CO_2 at rates that would not comply with the performance standards it sets.

Further, even if relying on that and other flawed assumptions, EPA's new cost estimates are still cost-reasonable. In the Proposed Rule, EPA estimates the costs associated with the ninety percent capture BSER to be $53.7/megawatt hour ("MWh") or $77/ton of CO_2 reduced.[90] EPA then concludes that this is unreasonable, while conveniently neglecting to acknowledge that the agency has already determined in other rules that costs *higher* than $77/ton of CO_2 reduced are reasonable. For example, in EPA's 2016 new source performance standards for GHG emissions from the crude oil and natural gas industry, EPA determined that a cost of $98/ton of CO_2-equivalent reduced is reasonable.[91]

The costs of CCS systems have and will decline as the adoption of CCS becomes more widespread. Studies show "economies of scale [have] an observable effect on the cost of CO_2 capture."[92] Operational experience has a similar effect. EPA contends in the Proposed Rule that cost declines will "supposedly" occur[93] but we have already seen *actual* cost reductions associated with lessons learned from past projects. For example, SaskPower's feasibility study for the Shand Power Station found that the capital costs of retrofitting Shand with ninety percent capture

[88] *See* 89 Fed. Reg. at 39,880.
[89] 90 Fed. Reg. at 25,772.
[90] *Id*.
[91] *See* 80 Fed. Reg. 56,593, 56,627 (Sept. 18, 2015); 89 Fed. Reg. at 39,879.
[92] Brandl et al., *supra* note 62, at 9.
[93] 90 Fed. Reg. at 25,761.

technology would be sixty-seven percent less than they were for Boundary Dam Unit 3, in large part due to SaskPower's experience implementing the technology at Unit 3.[94]

The same trend has been observed in China: after China Energy began CCS operations at the Yulin Jinjie power plant in 2021, it quickly implemented CCS at a significantly larger power plant in Taizhou, Jiangsu province in 2023. Both plants' post-combustion systems have a ninety percent capture rate but the second project's total costs per ton of CO_2 were nearly thirty percent lower than the first project's.[95]

These expectations for significant and sustained cost reductions for CCS build on a rich and well-documented history of cost reductions for other power plant technologies and emissions control systems.[96] The history of other power plant emission control technologies, such as the flue gas desulfurization systems implemented in response to past performance standards, provides compelling evidence that "learning by doing" dramatically reduces costs over time. Sources that would be regulated under the 2024 Rule's performance standards would reap the cost benefits of economies of scale and the operational experience already gained by scores of facilities.

IV. Conclusion

CCS systems that capture ninety percent of CO_2 emissions are technically viable and capable of delivering the emissions reductions necessary to meet the 2024 Rule's performance standards for power plants. Large-scale demonstrations leave no question that these systems are ready to be implemented now and can be designed, permitted, and installed within the next seven years. Advances in existing and emerging technologies, plus lessons learned from past experience, will further drive down costs and improve the performance of CCS systems. For these reasons, the Sabin Center and undersigned experts oppose EPA's proposal to revise the BSER determinations it initially promulgated in the 2024 Rule.

Thank you for your consideration.

Sincerely,

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[94] Int'l CCS Knowledge Centre, *supra* note 82, at x.
[95] Tao Wang, Professor, Zhejiang University, Presentation at DOE Nat'l Energy Tech. Lab'y Carbon Management Research Project Review Meeting 9 (Aug. 30, 2023), https://netl.doe.gov/sites/default/files/netl-file/23CM_GP_Tao.pdf.
[96] Edward Rubin et al., *A Review of Learning Rates for Electricity Supply Technologies*, 86 ENERGY POL'Y 198 (2015).

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