Nos. 23A349, 23A350, & 23A351

In the Supreme Court of the United States

OHIO, ET AL.,
Applicants,

v.

ENVIRONMENTAL PROTECTION AGENCY, *et al.*,
Respondents.

KINDER MORGAN, INC., ET AL.,
Applicants,

v.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY, *et al.*,
Respondents.

AMERICAN FOREST & PAPER ASSOCIATION, ET AL.,
Applicants,

v.

ENVIRONMENTAL PROTECTION AGENCY, *et al.*,
Respondents.

ON EMERGENCY APPLICATIONS FOR STAY OF FINAL AGENCY ACTION TO THE HONORABLE JOHN G. ROBERTS, JR., CHIEF JUSTICE AND CIRCUIT JUSTICE FOR THE DISTRICT OF COLUMBIA CIRCUIT

PUBLIC INTEREST RESPONDENTS' RESPONSE IN OPPOSITION TO EMERGENCY APPLICATIONS FOR STAY OF FINAL AGENCY ACTION DURING PENDENCY OF PETITIONS FOR REVIEW

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PARTIES TO THE PROCEEDINGS

In addition to the parties and related cases identified in the applications, Air Alliance Houston, Appalachian Mountain Club, Center for Biological Diversity, Chesapeake Bay Foundation, Citizens for Pennsylvania's Future, Clean Air Council, Clean Wisconsin, Downwinders at Risk, Environmental Defense Fund, Louisiana Environmental Action Network, Sierra Club, Southern Utah Wilderness Alliance, and Utah Physicians for a Healthy Environment are Intervenors for Respondents in Case Nos. 23-1157, 23-1181, 23-1183, 23-1190, 23-1191, 23-1193, 23-1195, 23-1199, 23-1200, 23-1202, 23-1203, 23-1205, 23-1206, 23-1207, 23-1208, 23-1209, and 23-1211. Sierra Club is also Intervenor for Petitioner State of Wisconsin in Case No. 23-1201.

RULE 29.6 STATEMENT

Air Alliance Houston, Appalachian Mountain Club, Center for Biological Diversity, Chesapeake Bay Foundation, Citizens for Pennsylvania's Future, Clean Air Council, Clean Wisconsin, Downwinders at Risk, Environmental Defense Fund, Louisiana Environmental Action Network, Sierra Club, Southern Utah Wilderness Alliance, and Utah Physicians for a Healthy Environment are non-profit environmental and public health organizations. None of the organizations has any parent corporation or any publicly held corporation that owns 10% or more of its stock.

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TO THE HONORABLE JOHN G. ROBERTS, JR., CHIEF JUSTICE OF THE UNITED STATES, AS CIRCUIT JUSTICE FOR THE DISTRICT OF COLUMBIA CIRCUIT:

The Public Interest Respondents, intervenor parties in the court of appeals, respectfully submit this combined response in opposition to three emergency applications for a stay or partial stay of EPA's Good Neighbor Rule, 88 Fed. Reg. 36,654 (June 5, 2023).

INTRODUCTION

Applicants identify no legal issue worthy of this Court's review. Instead, they attempt to manufacture a sense of crisis from preliminary and partial judicial stays of a related but distinct agency action. There is no such crisis, and no stay is warranted.

The Rule under review effectuates Congress's directive to ensure upwind power plants and other large industrial facilities take reasonable measures to eliminate dangerous ozone emissions that significantly contribute to air quality problems in other States. *See* 42 U.S.C. § 7410(a)(2)(D)(i)(I). Congress tasked EPA with reviewing States' plans to address interstate ozone pollution; and when EPA finds a State has failed in its duty to its neighbors, EPA is statutorily required to step in to protect downwind States and their residents. *See id.* § 7410(c)(1). After EPA finalized a separate action disapproving multiple noncompliant State plans, EPA adopted the Rule. The Rule will help downwind States meet their

statutory duties to expeditiously restore healthy air, save thousands of lives, make it easier for millions of Americans to breathe, and provide near-immediate relief to smog-choked communities across much of the country, with health benefits far exceeding costs.

As the D.C. Circuit correctly decided after reviewing thousands of pages of evidence, Applicants are not entitled to a stay of the Rule. Public Interest Respondents supplement the arguments in EPA's and State Respondents' responses with critical facts and context, including declarations by independent experts in economics, engineering, and pollution control, relevant to three specific points: *First*, EPA contemplated potential shifts in the States the Rule covers, and the Rule remains workable, lawful, and effective, notwithstanding preliminary stays as to certain States of EPA's earlier action disapproving State plans. Applicants' primary merits argument—that later partial stays of a separate agency action can render an otherwise lawful rule arbitrary, thus obligating agencies to anticipate and analyze in advance, as if with a crystal ball, an infinitude of hypotheticals—is novel and untenable. And Applicants' claims of unworkability are demonstrably untrue.

Second, the Rule imposes modest obligations, if any, on Applicants while their challenges will be pending, so they will not suffer irreparable harm. Most of the Rule's requirements do not phase in until 2026 or later; in particular, sources

other than power plants face *no* emissions-reduction obligations before that time. Near-term requirements even for power plants are minimal, mostly entailing better use of pollution controls that plants *have already installed*. The Rule's compliance pathways are flexible and familiar.

And *third*, the balance of equities weighs overwhelmingly against a stay because no Applicant is irreparably harmed by optimizing their existing technology or planning for later upgrades, while the Rule has significant air quality benefits for downwind States and millions of Americans breathing dangerous ozone pollution, even as currently limited by partial stays.

Every consideration supports denying the extraordinary relief Applicants seek.

STATEMENT

A. Statutory and Regulatory Background

To protect public health and welfare, Congress directed EPA to establish national standards limiting ozone pollution. 42 U.S.C. §§ 7408(a), 7409(b)(l). Ozone, or smog, is a dangerous air pollutant that can cause acute breathing problems, disease, other serious health harms, and premature death. *See infra* III. Tens of millions of Americans are forced to breathe unhealthy air in communities across the country. *See id.*

Congress required quick action to address the serious problem of ozone pollution. When EPA sets (or revises) an ozone standard, States must develop and submit to EPA plans that will achieve and maintain the standard "as expeditiously as practicable and not later than" statutory deadlines, which are based on the severity of States' ozone pollution levels. *Id.* §§ 7410(a), 7511(a)(1). Congress "carefully designed" those attainment deadlines. *Whitman v. Am. Trucking Ass'ns*, 531 U.S. 457, 484 (2001). They are "central to ... the regulatory scheme," *Union Elec. Co. v. EPA*, 427 U.S. 246, 258 (1976), and constitute the "heart" of the Clean Air Act. *Train v. Nat. Res. Def. Council, Inc.*, 421 U.S. 60, 66 (1975).

Many States struggle to attain and maintain the ozone standard due in part to harmful pollution emitted elsewhere that blows across State borders. *EPA v. EME Homer City Generation, L.P.*, 572 U.S. 489, 496 (2014) ("*EME Homer II*"). Interstate pollution imposes an unfair burden on "downwind" States, harming their residents' health and forcing them to incur additional control costs. *See id.* at 496–97. To remedy this problem, Congress enacted the "Good Neighbor Provision," which requires States to adopt "adequate provisions ... prohibiting ... any source or other type of emissions activity within the State from emitting any air pollutant in amounts which will ... contribute significantly to nonattainment or interfere with maintenance" of standards downwind. 42 U.S.C. § 7410(a)(2)(D)(i)(I); *see also EME Homer II*, 572 U.S. at 496–500 (providing

statutory and regulatory background of the Good Neighbor Provision). "EPA must review each State's implementation plan and ensure its compliance with … the Good Neighbor provision." *New York v. EPA*, 964 F.3d 1214, 1218 (D.C. Cir. 2020) (citing 42 U.S.C. § 7410(k)(1)–(4)).

Congress again opted for prompt implementation of these added requirements by requiring EPA, when it determines a State has not submitted a compliant plan, to adopt within two years a federal plan for the State. 42 U.S.C. § 7410(c)(1), (k)(1)–(4). "EPA is not obliged to wait two years or postpone its [federal plan] even a single day." *EME Homer II*, 572 U.S. at 509. And EPA must ensure that pollution reductions required under the Good Neighbor Provision occur in time to enable downwind States to meet the Act's attainment deadlines. *See Wisconsin v. EPA*, 938 F.3d 303, 318–19 (D.C. Cir. 2019) (citing *North Carolina v. EPA*, 531 F.3d 896, 911–13 (D.C. Cir. 2008)); 42 U.S.C. §§ 7410(a)(2)(D), 7511(a)(1).

States have sometimes submitted non-compliant plans, requiring EPA to issue federal plans under the Good Neighbor Provision.[1] All of EPA's prior rules

[1] *See, e.g.*, 76 Fed. Reg. 48,208 (Aug. 8, 2011); 81 Fed. Reg. 74,504 (Oct. 26, 2016); 83 Fed. Reg. 65,878 (Dec. 21, 2018); 86 Fed. Reg. 23,054 (Apr. 30, 2021). EPA also adopted two early rules that required States to submit compliant interstate ozone plans, with federal plans as a backstop if the States did not comply. *See* 63 Fed. Reg. 57,356 (Oct. 27, 1998) (so-called "NO_X SIP Call"); 63

addressed emissions from power plants, and some also included non-power-plant industrial sources. *See, e.g.*, 63 Fed. Reg. at 57,417–18 (cement plants, industrial boilers and turbines, and stationary internal combustion engines); 69 Fed. Reg. 21,604, 21,618 (Apr. 21, 2004) (stationary internal combustion engines, including those used in gas pipelines). Prior interstate ozone federal plans typically have applied to numerous States. *See, e.g.*, *EME Homer II*, 572 U.S. at 489–90 (considering rule that applied to 27 States).

B. The Good Neighbor Rule

EPA strengthened the ozone standard in 2015 to protect the public from health harms associated with exposure, especially for those most vulnerable—children, older adults, and people with asthma. *See* 80 Fed. Reg. 65,292, 65,294 (Oct. 26, 2015). This triggered States' obligation to develop plans to satisfy the Good Neighbor Provision. 42 U.S.C. § 7410(a). EPA found that some States had failed to submit complete plans by the statutory deadline. 84 Fed. Reg. 66,612 (Dec. 5, 2019). And many of the State plans submitted to EPA—including those by State Applicants here—failed to adequately analyze their contributions to interstate pollution or to require *any* reductions in ongoing interstate pollution. *See*

Fed. Reg. 56,394 (Oct. 21, 1998) (proposed federal plans for any State not complying with the NO_X SIP Call); 70 Fed. Reg. 25,162 (May 12, 2005); 71 Fed. Reg. 25,328 (Apr. 28, 2006) (federal plans for any State not complying with 2005 rule).

88 Fed. Reg. 9,336, 9,354–61 (Feb. 13, 2023). After evaluating each plan on its own terms, and as required by statute, 42 U.S.C. § 7410(c)(1); *EME Homer II*, 572 U.S. at 507, EPA finalized its "Disapproval Action" disapproving those plans as inconsistent with the Good Neighbor Provision's requirements. *See* 88 Fed. Reg. 9,336.

Because those States failed to submit compliant plans, EPA had to issue federal plans. 42 U.S.C. § 7410(c)(1). EPA's action finalizing federal plan requirements, known as "the Good Neighbor Rule," identifies 23 upwind States that significantly contribute to violations of the ozone standard in downwind States and limits ozone-forming emissions from large power plants and other high-polluting industrial sources (such as gas pipeline engines and industrial boilers) in those States. *See* 88 Fed. Reg. at 36,656–57. Mindful of Congress's mandate of expeditious ozone standard attainment and the impending statutory deadlines faced by downwind States, *id*. at 36,654, 36,690, and pursuant to court order, Consent Decree, *Sierra Club v. Regan*, No. 3:22-cv-01992-JD (N.D. Cal. Jan. 24, 2023), EPA signed the Rule on March 15, 2023.

As in prior interstate ozone rules, EPA grounded this Rule in national air quality modeling and uniform analytical and policy judgments designed to ensure an "efficient and equitable" solution to interstate pollution. *See* 88 Fed. Reg. at 36,673 (citing *EME Homer II*, 572 U.S. at 519). To identify cost-effective

emission controls and define each upwind State's obligations, EPA used the same four-step framework applied in prior interstate ozone rulemakings. *See* 88 Fed. Reg. at 36,659–62.

The Rule's emission limits apply only during the sunniest months of May to September—known as the "ozone season"—when ozone levels typically peak. *See* 88 Fed. Reg. at 36,817. The Rule's requirements are also phased. Certain minimal requirements—including participation in the latest iteration of EPA's decades-old allowance-trading program for power plants—began on August 4, 2023. *Id.* at 36,654. But most of the Rule's requirements—including tighter emissions limits for power plants and *all* emissions limits for other sources—will begin in May 2026 or later. *See id.* This phasing reflects a feasible schedule for compliance and, EPA found, aligns with the Clean Air Act deadlines that downwind States face. *Id.* at 36,754–55; 40 C.F.R. § 51.1303(a) tbl.1.[2]

C. Procedural Background

Various States and industry parties challenged the Rule in the D.C. Circuit and other courts of appeals. Some of the D.C. Circuit petitioners (including all of the Applicants) moved to stay the Rule, in whole or in part, pending review. The

[2] Pollution reductions in 2023 and 2026 are crucial because those are the last years of air quality data that can be used to assess downwind States' compliance with the standard by the attainment deadlines, which fall in 2024 and 2027. 88 Fed. Reg. at 36,659 & n.11.

D.C. Circuit, by a 2-1 vote, denied the motions, finding that "Petitioners have not satisfied the stringent requirements for a stay." Order, Sept. 25, 2023, ECF No. 2018645 (denying Applicants' stay motions); *see also* Order, Oct. 11, 2023, ECF No. 2021268 (unanimously denying separate stay motion by Petitioner U.S. Steel Corporation). On October 13, the States of Ohio, Indiana, and West Virginia ("State Applicants"); Kinder Morgan, Inc. and other gas pipeline industry entities ("Pipeline Applicants"); and American Forest and Paper Association ("AF&PA") and other industrial entities applied to this Court for an emergency stay of the Rule pending judicial review.[3]

Separate challenges to the Disapproval Action are pending in multiple courts of appeals. No court has reached a final determination of either the lawfulness of the Disapproval Action or the proper venue for challenges to it, but courts have preliminarily stayed the Disapproval Action as to 12 States.[4] All partial judicial

[3] On October 26, U.S. Steel Corporation separately applied for an emergency stay of the Rule pending judicial review. Public Interest Respondents intend to respond to that application separately.

[4] Order, *Texas v. EPA*, No. 23-60069 (5th Cir. May 1, 2023) (stay as to Texas and Louisiana); Order, *Arkansas v. EPA*, No. 23-1320 (8th Cir. May 25, 2023) (stay as to Arkansas); Order, *Missouri v. EPA*, No. 23-1719 (8th Cir. May 26, 2023) and Order, *Ameren Missouri v. EPA*, No. 23-1751 (8th Cir. May 26, 2023) (stay as to Missouri); Order, *Texas v. EPA*, No. 23-60069 (5th Cir. June 8, 2023) (stay as to Mississippi); Order, *Kentucky v. EPA*, No. 23-3216 (6th Cir. July 25, 2023) (stay as to Kentucky); Order, *Allete, Inc. v. EPA*, No. 23-1776 (8th Cir. July 5, 2023) (stay as to Minnesota); Order, *Nevada Cement Co. v. EPA*, No. 23-682

stays of EPA's Disapproval Action post-dated the Administrator's March 15, 2023, signature of the Good Neighbor Rule.

Those challenges are proceeding to merits consideration. The Fifth Circuit, for example, has scheduled for December 4 oral argument before a merits panel that may dismiss or transfer for improper venue and dissolve the temporary stay of EPA's Disapproval Action as to some States. *See Veasey v. Abbott*, 870 F.3d 387, 392 (5th Cir. 2017) (decisions on stay motions "do not bind the merits panel").

EPA has taken administrative action to stay the Rule in those States for which a court has stayed the Disapproval Action. Before the Rule was published in the Federal Register, EPA clarified that its requirements would not take effect in States then affected by partial judicial stays.[5] EPA then issued its stay of the Rule for those States promptly, after publication but before the Rule's effective date of August 4. 88 Fed. Reg. 49,295 (July 31, 2023); *see also* 88 Fed. Reg. 67,102

(9th Cir. July 3, 2023) (stay as to Nevada); Order, *Utah v. EPA*, No. 23-9509 (10th Cir. July 31, 2023) (stay as to Oklahoma and Utah); Order, *West Virginia v. EPA*, No. 23-1418 (4th Cir. Aug. 10, 2023) (administrative stay as to West Virginia pending an October 27 oral argument on West Virginia's motion to stay and EPA's motion to dismiss or transfer for improper venue); Order, *Alabama, ex rel. v. EPA*, No. 23-11173 (11th Cir. Aug. 17, 2023) (stay as to Alabama).

[5] *See* EPA, *Notice of Forthcoming EPA Action to Address Judicial Stay Orders* (June 1, 2023), Doc. ID No. EPA-HQ-OAR-2021-0668-1184.

(Sept. 29, 2023) (response to later-entered partial judicial stays). The Rule's requirements remain in effect for sources in 11 States unaffected by judicial stays.

ARGUMENT

A stay is "rarely" justified. *Heckler v. Lopez*, 463 U.S. 1328, 1330 (1983) (Rehnquist, J., in chambers). Further, because the court of appeals denied Applicants' stay motions, Applicants bear "an especially heavy burden" to justify this Court's awarding extraordinary relief. *Packwood v. Senate Select Comm. on Ethics*, 510 U.S. 1319, 1319–20 (1994) (Rehnquist, C.J., in chambers). Applicants have failed to meet their "heavy burden." *Id.* All four factors this Court examines in considering whether to grant a stay—(1) likelihood of success on the merits, (2) irreparable injury absent a stay, (3) injury to other parties from a stay, and (4) the public interest—weigh strongly against issuance here. *See Nken v. Holder*, 556 U.S. 418, 434 (2009). Applicants' primary merits argument, which seeks to leverage partial judicial stays of the Disapproval Action into nationwide relief against a different rule, crumbles under even casual scrutiny. And Applicants patently face no irreparable harm from the Rule during the pendency of litigation—let alone harm so great as to outweigh the significant health and welfare interests of the millions of people suffering from dangerous ozone emitted by Applicants' sources. No stay is warranted.

I. Contrary to Applicants' Claims, the Rule Is Designed to Accommodate Changes in State Coverage and Is Workable and Lawful Notwithstanding Temporary Partial Stays.

Applicants have not met their burden to show likely success on the merits of their core argument: that the Good Neighbor Rule was *rendered* arbitrary and capricious after its promulgation, when courts of appeals temporarily stayed the separate Disapproval Action as to some States. *See* Ohio Appl. 21; AF&PA Appl. 14, 19; Kinder Morgan Appl. 11–13.

Applicants cite no authority for the remarkable proposition that post-hoc, inherently provisional judicial stay orders (or an agency's compliance therewith) could render a well-supported, otherwise lawful agency action arbitrary. And it cannot be that the standard for reasoned decision-making requires EPA to anticipate and analyze in advance the infinitude of outcomes that may be produced by partial judicial stays of a separate agency action. *Contra* AF&PA Appl. 19. Such a requirement would encourage parties to pursue piecemeal, disorderly litigation in hopes of manufacturing grounds for claims of arbitrariness—and in defiance of Congress's intent that the D.C. Circuit be the exclusive forum for review of actions, like this one, of national scope. *See* 42 U.S.C. § 7607(b)(1). It would also upset foundational administrative law principles regarding record-based

review, as well as Congress's specific directions regarding the process for raising post-comment-period objections to Clean Air Act rules like this one.[6]

Even if Applicants' novel legal theory were tenable, they are wrong on the basic facts about this Rule and its record. EPA did not justify the Rule only as applied "to all 23 upwind states," as Applicants contend. Ohio Appl. 20; *see also* Kinder Morgan Appl. 2; AF&PA Appl. 15. The record shows that EPA designed the Rule, like prior interstate ozone rules, to address individual States' contributions to interstate pollution.[7]

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[6] *See, e.g.*, 42 U.S.C. § 7607(d)(7) (defining the record for judicial review and exhaustion requirements); *EME Homer City Generation, L.P. v. EPA*, 795 F.3d 118, 137 (D.C. Cir. 2015) (parties "must [first] petition EPA" regarding objections that arise after the public comment but within the judicial review period). *Cf.* 42 U.S.C. § 7607(b) (any petition for reconsideration "shall not postpone the effectiveness" of the Rule).

[7] *See, e.g.*, *EME Homer II*, 572 U.S. at 501 (explaining that EPA's four-step approach involves "calculat[ing], *for each upwind State*, the quantity of emissions the State could [cost-effectively] eliminate," "estimat[ing] … the amount *each upwind State's* NO_X emissions would fall if all pollution sources within each State employed" the cost-effective measures, and "[f]or *each regulated upwind State* … creat[ing] an annual emissions 'budget'" reflecting "the quantity of pollution an upwind State would produce in a given year if *its in-state sources* implemented" those measures (emphases added)); 88 Fed. Reg. at 36,659–63, 36,678 (affirming that EPA used the same approach as approved in *EME Homer II*); *id.* at 36,777 (describing State-specific budgets as based on the latest data regarding power-plant fleets in each State); *id.* at 36,785, tbl.VI.B.4.c–1 (State-specific emissions budgets); *id.* at 36,748 (analyzing whether "for any given state" sources should be subject to less-stringent control measures).

EPA also structured the Rule, like prior interstate ozone rules, to accommodate shifts in the scope of State coverage. In the Rule's preamble, EPA explained that it was deferring action on seven States (Arizona, Iowa, Kansas, New Mexico, Oregon, Tennessee, and Wyoming), thus recognizing that those States might join the regulatory program later. 88 Fed. Reg. at 36,656, 36,658. And consistent with statutory requirements, EPA expressly provided that any covered State could exit the Rule by adopting its own approvable plan. *See id.* at 36,658, 36,839–42.[8] Clearly, EPA did not design the Rule to fall apart under conditions that EPA itself provided.

Applicants argue that "[n]ow," because of partial stays, and contrary to EPA's supporting rationale, "the Rule … imposes inconsistent requirements among states." Kinder Morgan Appl. 12. But the Rule as promulgated *already* exempted some covered States from certain requirements. For example, the Rule's

[8] In the long history of States' joining and exiting prior analogous interstate ozone rules, no one has seized on changes in the scope of coverage to seek to overturn the program nationwide. *See, e.g.*, *Michigan v. EPA*, 213 F.3d. 663, 681–85 (D.C. Cir. 2000) (remanding and vacating the inclusion of Wisconsin, Georgia, and Missouri in an interstate ozone rule); 69 Fed. Reg. at 21,608–09 (excluding Wisconsin and certain regions of Georgia, Missouri, Alabama, and Michigan from an interstate ozone rule); 73 Fed. Reg. 21,528 (Apr. 22, 2008) (removing Georgia from an interstate ozone rule); 74 Fed. Reg. 56,721 (Nov. 3, 2009) (staying an interstate ozone rule as to Minnesota); 82 Fed. Reg. 45,481, 45,484 (Sept. 29, 2017) (withdrawing federal plan provisions requiring Texas power plants to participate in certain multistate allowance-trading programs); 76 Fed. Reg. 80,760 (Dec. 27, 2011) (adding five States to an existing allowance-trading program).

provisions regarding non-power-plant industrial sources do not apply to Alabama, Minnesota, or Wisconsin. 88 Fed. Reg. at 36,657, 36,660. And the Rule's provisions regarding power plants do not apply to California. *Id*. at 36,657. Nor did EPA justify the allowance-trading program only on the participation of power plants in all covered States. *Contra* AF&PA Appl. 11. In fact, the Rule added new States to and amended an existing allowance-trading program, established by a prior interstate ozone rule, which has covered different numbers of States over time. *See* 88 Fed. Reg. at 36,657. One would be hard-pressed to identify a regulatory program *more* patently designed to accommodate shifts in State participation.

Severability principles also undercut Applicants' theory that the Rule must rise or fall on its application to all covered States. *See, e.g.*, AF&PA Appl. 20. A regulation is severable when an agency so intends and when the remainder can "function sensibly without the stricken provision." *Nasdaq Stock Mkt. LLC v. SEC*, 38 F.4th 1126, 1144 (D.C. Cir. 2022) (cleaned up); *see also K Mart Corp. v. Cartier, Inc.*, 486 U.S. 281, 294 (1988). The Rule easily satisfies both parts of the severability test—EPA intended it to be severable, and the Rule is in fact workable, efficient, and equitable notwithstanding temporary stays of its requirements as to sources in certain States.

First, contrary to Applicants' assertions (*e.g.*, Ohio Appl. 20–21), EPA directly considered severability and explained in detail that the Rule may be implemented both as a whole or, if necessary, in segmented fashion—by State, by industry, or by emissions-control requirement. *See* 88 Fed. Reg. at 36,693. With regard to the inclusion or exclusion of individual States in particular, EPA stated that it "views this rule as severable along … state and/or tribal jurisdictional lines, such that the rule can continue to be implemented as to any remaining jurisdictions." *Id.* EPA's intent is clear. *See MD/DC/DE Broads. Ass'n v. FCC*, 236 F.3d 13, 22 (D.C. Cir. 2001) (finding that the agency "clearly intends that the regulation be treated as severable … for it said so in adopting the regulation").

Second, the Rule not only can "function sensibly" notwithstanding partial judicial stays, *Nasdaq Stock Mkt. LLC*, 38 F.4th at 1144, but remains an efficient and effective program to reduce dangerous emissions from sources in upwind States that continue to be covered by its requirements. Some Applicants allege, without support, that partial stays will increase allowance costs and impact the viability of trading markets so as to render the Rule unworkable. AF&PA Appl. 25–26. But actual experience contradicts those speculations. Crucially, "allowance prices did not increase" as a result of the partial stays. Celebi Decl. ¶ 6

(App. 4a).[9] Allowance prices have "in fact decreased sharply," and have continued to fall to multiyear lows as court orders have temporarily removed additional States from the program. *Id.* ¶ 6 (App. 4a); *see also* Silva Decl. ¶ 26 (App. 53a) (allowance prices at the close of the 2023 ozone season were "far below" 2022 prices).[10] Allowance prices plummeted after judicial orders disrupted a prior interstate ozone rule too, which "suggests that [any] regulatory uncertainty … may in fact depress allowance prices, which would lower the cost of compliance." Celebi Decl. ¶ 7 (App. 5a). As to alleged "higher demand" for allowances, AF&PA Appl. 26, market analysis shows that there will be sufficient allowances in the near-term (2023 through 2026) and very likely in the longer term, regardless of the partial stay orders. Silva Decl. ¶ 8 (App. 40a); *see also id.* ¶¶ 16–17 (App. 46a–47a).

[9] Declarant Metin Celebi is a Ph.D. economist and consultant at The Brattle Group with decades of experience in the U.S. power sector. Celebi Decl. ¶ 1 (App. 1a). Paragraphs 2, 5, 6, 8, and 9 have been updated since Dr. Celebi's D.C. Circuit declaration to reflect the current factual context, including recent allowance prices and partial judicial stays as to 12 States. Paragraphs 1 and 3 incorporate minor changes that do not affect Dr. Celebi's prior conclusions.

[10] Declarant Patricio Silva is a Principal Associate at Synapse Energy Economics with considerable expertise in the U.S. power sector. Silva Decl. ¶¶ 1–3 (App. 38a). As compared to Mr. Silva's declaration filed in the D.C. Circuit, the appended declaration includes substantive updates reflecting the current factual context, including partial judicial stays as to 12 States, as well as other minor clarifications throughout.

In any event, even if the partial stays did result in a marginal increase in allowance costs, Applicants fail to show that this could upset the workability of the Rule and constitute an emergency warranting this Court's intervention. "[E]ven if states were unable to trade with one another, each likely has enough allowances to meet its compliance obligations." *Id.* ¶ 8 (App. 40a). Moreover, power plants have a variety of compliance pathways available even if they opt to rely on little or no allowance trading. *See id.* ¶ 21 (App. 49a); Celebi Decl. ¶ 8 (App. 5a–6a). Nor did EPA's adoption of the Rule rely on expectations of interstate trading or maximum trading market liquidity, as Applicants suggest. *See* AF&PA Appl. 15–16. Emissions budgets reflect implementation of the cost-effective pollution-control strategies EPA identified, while the allowance-trading program merely facilitates compliance. *See* 88 Fed. Reg. at 36,777. Overall, despite partial judicial stays, "the Final Rule's emissions trading program is still reasonable and workable" for covered power plants.[11] Silva Decl. ¶ 7 (App. 40a).

Applicants allege too that the Rule is no longer "equitable" due to the partial stays. Ohio Appl. 18–19; Kinder Morgan Appl. 12. But their argument that the

[11] Unlike power plants, covered industrial sources do not participate in any interstate allowance-trading program to meet their obligations under the Rule. Applicants' arguments about allowance trading are therefore irrelevant to industrial sources, and Applicants fail to identify any concrete way in which partial judicial stays could adversely affect industrial-source compliance.

obligation to reduce dangerous pollution is not fair because some other States' sources do not yet have to clean up *their* mess fares no better in the courtroom than in the playroom. "Each State must eliminate its own significant contribution to downwind pollution." *North Carolina*, 531 F.3d at 921; *see also* 42 U.S.C. § 7410(a)(2)(D)(i) ("prohibiting … any source" from violating Good Neighbor requirements). Applicants would seek to cure an alleged inequity with a far graver one: removing overdue protections for pollution-burdened States and their residents.

In sum, temporary stays issued in separate litigation challenging a separate EPA action do not justify a stay here. The courts that issued those temporary stays could dissolve them by upholding the Disapproval Action, and thus permit EPA to implement the Rule for the States in question, well before a final merits decision on the Rule. Meanwhile, no lower court has ruled on the merits of challenges to EPA's Disapproval Action in those complex record-review cases, and no review-worthy question has been distilled and presented to this Court.[12] The Court should

[12] Arguments for dismissal or transfer are also still live in every regional court of appeals hearing challenges to the Disapproval Action. That the logical consequence of Applicants' argument is that a partial stay of the Disapproval Action as to some States is to force the stay of the nationally applicable Rule as to all States underscores what all Respondents have maintained: that review of *both* EPA actions belongs only in the D.C. Circuit. Applicants' efforts to deploy partial stays of the Disapproval Action to obtain a nationwide stay of the Rule only

reject Applicants' speculations and permit the courts of appeals to proceed uninterrupted with review of EPA's actions.

II. Applicants Have Not Shown They Will Suffer Irreparable Harm Without a Stay.

Applicants fail to show that they "will be irreparably injured absent a stay" pending review. *Nken*, 556 U.S. at 434. Mere "possibility of irreparable injury" does not suffice. *Id.* (cleaned up). Applicants must demonstrate injury that is "certain," "great," and "directly result[ing] from" the Rule. *Wis. Gas Co. v. FERC*, 758 F.2d 669, 674 (D.C. Cir. 1985). Applicants do not, and cannot, demonstrate such irreparable injury from the Rule's modest near-term requirements.

A. The Rule Does Not Threaten Power Reliability—Most Plants Can Meet Minimal Near-Term Requirements by Operating Existing Pollution Controls and Will Not Face Large Costs to Plan for Later Compliance.

Applicants fail to show the Rule threatens power reliability, let alone that it will do so before a decision on the Rule's merits. *See Chaplaincy of Full Gospel Churches v. England*, 454 F.3d 290, 298 (D.C. Cir. 2006) (stay applicants must show "that equitable relief is urgently necessary"). Requirements for power plants phase in gradually and are minimal in the near term. *See* 88 Fed. Reg. at 36,657.

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highlights how challengers' multi-circuit campaign defies Congress's intent that the D.C. Circuit be the exclusive forum for reviewing such actions. *See* 42 U.S.C. § 7607(b)(1).

Emissions budgets for the 2023 and 2024 control periods reflect plants' fully operating their existing post-combustion controls (which some plants otherwise will idle or only partially operate) and, in some cases, taking "very modest" steps to install or update combustion controls, at costs typically less than $1 per megawatt-hour for coal plants. Celebi Decl. ¶ 8 (App. 5a); *see also* 88 Fed. Reg. at 36,720, 36,724. The Rule does not assume that any power plant will have retrofitted with new post-combustion controls until three or four years from now—and most plants have already installed such controls anyway. 88 Fed. Reg. at 36,657, 36,726 (noting that over 66% of coal plants have already installed selective catalytic reduction technology, including "[n]early every [large coal plant] built in the last 30 years"); Sahu Decl. ¶¶ 9–10, 15, 24 (App. 75a–76a, 78a, 81a–82a).[13] Plants "have substantial flexibility in choosing among various low-cost options to comply." Celebi Decl. ¶ 4 (App. 2a).

State Applicants' claims that the Rule's very modest near-term requirements will "severely undermine" power generation capacity strain credulity. Ohio Appl. 25. Recent emissions data show that the vast majority of power plants likely can meet the Rule's near-term requirements with *no changes*, and others can feasibly

[13] Declarant Dr. Ranajit (Ron) Sahu is an independent expert with over three decades of experience in air pollution control and engineering. Sahu Decl. Att. A (App. 88a).

comply through purchasing allowances, optimizing existing controls, and/or making modest upgrades that "are not likely to adversely affect the [plant's] overall economics." Sahu Decl. ¶¶ 17–37 (App. 79a–86a); *see also* Silva Decl. ¶¶ 8–18 (App. 40a–47a). State Applicants' claims that people "could" be "unable to heat or cool their homes" are pure fear-mongering, unsupported even by Applicants' own declarations. Ohio Appl. 26. No Applicant offers a credible claim of imminent power reliability harm from the Rule because there is none.

Even looking ahead to compliance in 2026 and 2027—long after Applicants' challenges to the Rule would be resolved—Applicants have not shown nonspeculative reliability threats. Applicants claim that the Rule's longer-term requirements will be so burdensome that some plants may opt to retire instead of installing controls, that these hypothetical premature retirements will be disruptive, and that replacement resources will be less reliable. *See, e.g.*, Ohio Appl. 25–26; AF&PA Appl. 25–26; Alban Decl. ¶ 27 (AF&PA Appl. 416); Lane Decl. ¶¶ 9–18 (Ohio Appl. D-5–D-10). But Applicants' chain of "hypotheticals are just that—speculation that [they] '*may* suffer irreparable harm at some point in the future,' not concrete proof." *Murthy v. Missouri*, 601 U.S. __, __ (2023) (Alito, J., dissenting from grant of stay) (slip op. at 3–4) (quoting *White v. Florida*, 458 U.S. 1301, 1302 (1982) (Powell, J., in chambers)). In fact, EPA thoroughly analyzed reliability impacts, 88 Fed. Reg. at 36,770–75; "worked extensively with affected

regional transmission organizations," Silva Decl. ¶ 19 (App. 47a–48a); consulted with the Department of Energy, *id.* ¶ 22 (App. 49a–50a); and implemented changes to "ensure[] that [the Rule] will not create electric reliability concerns," 88 Fed. Reg. at 36,679. The Rule is not expected to cause significant plant retirements; indeed, the few coal plants that EPA assumed would retire likely will do so regardless of the Rule for economic reasons. Silva Decl. ¶¶ 21, 23 (App. 49a, 50a–51a). And while highly unlikely, if a reliability emergency is truly imminent, appropriate federal and regional mechanisms are in place to ensure that emissions limits do not impede plants' operation. *Id.* ¶ 22 (App. 49a–50a).

State Applicants attempt to bolster their claims with reference to challenges associated with the industry's broader transition away from coal-fired power, *see* Lane Decl. ¶¶ 13–15 (Ohio Appl. D-8–D-9), but fail to show that such phenomena "will directly result from the action which the movant seeks to enjoin." *Wis. Gas*, 758 F.2d at 674.[14] Applicants' invocation of a recent reliability emergency is equally irrelevant. *See* Ohio Appl. 26. Applicants' own evidence shows the cited emergency was principally due to fossil-fuel plants' "operating difficulties due to

[14] Some of the Applicants quote a report by the mid-Atlantic regional grid operator, PJM Interconnection, discussing possible low-reliability scenarios between now and 2030. *See* Ohio Appl. 25; AF&PA Appl. 28. PJM's analysis predates the Rule and is otherwise flawed. *See* James F. Wilson, Wilson Energy Econ., *Maintaining the PJM Region's Robust Reserve Margins* (2023), https://bit.ly/40eqCkq.

cold weather or fuel limitations"—not pollution-control requirements. Hodanbosi Decl., Ex. A at 1 (Ohio Appl. B-15).

B. The Rule Does Not Threaten Gas Reliability—Most Pipeline Engines Do Not Need Upgrades, and the 2026 Compliance Deadline Provides Ample Time to Coordinate Any Outages.

Applicants claim that pipeline engines cannot meet the Rule's 2026 emissions limits without taking many engines offline for technology retrofits, thereby disrupting gas supply. Kinder Morgan Appl. 23–27; Ohio Appl. 25–27; AF&PA Appl. 24. But parties should not be permitted to delay and evade regulation simply by incanting the word "reliability" without supporting facts. *See Wis. Gas*, 758 F.2d at 674. EPA's robust record, independent expert analysis, and even Pipeline Applicants' own filings rebut their rhetoric and show that compliance is both highly feasible and "very unlikely to result in disruptions in gas supply." Stamper Decl. ¶ 27 (App. 201a).[15]

First, should the Rule's compliance deadline turn out to be infeasible in particular circumstances, operators can request extensions (potentially until 2029), 40 C.F.R. § 52.40(d), and/or a less-stringent emissions limit, *id.* § 52.40(e). *See*

[15] Declarant Victoria Stamper is an independent expert with more than three decades of experience in air pollution control. Stamper Decl. ¶ 1 (App. 185a).

Staudt Decl. ¶¶ 22–33 (App. 158a–164a);[16] Stamper Decl. ¶ 13 (App. 188a–189a). Applicants speculate that extensions might be needed for a large number of engines and that EPA might unreasonably deny extension requests that parties have yet to file. *See* Kinder Morgan Appl. 27. But Applicants cannot base claims of imminent harm on speculations about how EPA might resolve hypothetical extension requests years in the future.

Second, most of the engines covered by the Rule will not require a retrofit, either because they already have the technology needed to comply[17] or because they can rely on the Rule's flexible facility-wide averaging. Stamper Decl. ¶ 21 (App. 196a); *see also id.* ¶¶ 18–20 (App. 192a–196a). Pipeline Applicants carefully suggest—without precisely saying—that the Rule requires retrofitting of all covered engines, or "over three thousand pipeline engines across the country." Kinder Morgan Appl. 17. The inference they seek to encourage is seriously wrong. Applicants' own declarant estimates that "approximately 1,220 pipeline engines will require controls." Yager Decl. ¶ 9 (Kinder Morgan Appl. 711a).

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[16] Declarant James Staudt is a Ph.D. engineer and independent expert with decades of experience in air pollution control technologies and finance. Staudt Decl. ¶¶ 1–2 (App. 147a–148a).

[17] Many State and local air agencies already enforce more stringent or comparable emissions standards for pipeline engines. *See* Stamper Decl. ¶ 13 (App. 188a–189a); *see also, e.g.*, N.Y. Comp. Codes R. & Regs. tit. 6, § 227-2.4(f); N.J. Admin. Code 7:27-19.8.

Even that figure is high—EPA found that only about 900 engines would need retrofits. *See* Stamper Decl. ¶ 17 (App. 192a–193a) (citing 88 Fed. Reg. at 36,824). EPA's estimate is well supported and, if anything, conservatively high. *See id.*

Third, because the compressor stations that house covered pipeline engines are typically designed with "significant over-capacity," Kinder Morgan Appl. 476a n.32, operators can take individual engines offline to complete retrofits without disrupting compressor operations. Stamper Decl. ¶ 25 (App. 200a). EPA's record confirms capacity utilization is low, about 40%. *See id.* ¶ 26 (App. 201a). In arguing to EPA and the D.C. Circuit that the Rule's pollution controls are not cost-effective, Pipeline Applicants have repeatedly emphasized the industry's excess capacity and underutilized engines.[18] Applicants now attempt to walk back their prior statements by speculating, without citing evidence, that no engine could be

[18] *See, e.g.*, Kinder Morgan Appl. 476a n.32 (stating in comments to EPA that "transmission compressor stations are designed to meet peak demand days and typically include significant over-capacity" and "units [must] be available to operate at capacities well-above typical operating conditions"); *id.* at 476a (Engines often operate "much less than 25 percent of the year," and ozone season operation "may be very low"; for "most" compressor stations, average annual utilization is around 40 to 45%, "with some units … operating … only when needed during peak demand during cold winter weather events."); Yager Decl. ¶ 14 (Kinder Morgan Appl. 713a) ("many" covered engines "operate as backup units and are not needed to operate," with utilization rates "lower than 20% annually"); *see also* Stamper Decl. ¶¶ 25–27 (App 200a–201a).

taken offline without compromising reliability. *See* Kinder Morgan Appl. 26. But those conclusory hypotheticals are contradicted by Applicants' own evidence, as well as EPA's well-considered findings, and are not credible. *See* Stamper Decl. ¶¶ 25–27 (App. 200a–201a).

Fourth, pipeline operators have ample time to plan, schedule, and coordinate retrofits by May 2026. *Cf.* Kinder Morgan Appl. 24 (retrofitting requires an engine to be offline for "between three to six months"). The Rule's compliance deadline, which is still years away, is well supported by EPA's extensive review—including interviews with State permitting authorities and technology vendors—demonstrating the feasibility of completing necessary retrofits on time. Stamper Decl. ¶ 22 (App. 197a–198a). Experience in Colorado and other States further shows that operators can retrofit a substantial percentage of their engines over several years. *See id.* ¶ 23 (App. 198a–199a). Pipeline Applicants' assertion that "retrofits [will] require taking hundreds of engines offline during peak-demand seasons," Kinder Morgan Appl. 25, assumes an imminent compliance deadline that does not exist.

Finally, alleged vendor and logistical challenges are vastly overstated. *See* Kinder Morgan Appl. 17 n.9. "Experience has shown that, while industry commonly claims that resources will not be available, it is consistently the case that they are." Staudt Decl. ¶ 22 (App. 158a); *see also id.* ¶ 27 (App. 159a–160a).

If anything, actual installation timelines will be much shorter than reflected in EPA's ultra-conservative estimates, which include pandemic-related assumptions. *Id*.

In sum, "there is absolutely no reason why any operator should have trouble complying with the Rule." Stamper Decl. ¶ 24 (App. 199a–200a).

C. Applicants Have Not Shown Significant Costs Pending Judicial Review from Mere Planning Activities for Industrial Sources and Minimal Requirements for Power Plants.

Demonstrating irreparable harm from regulatory compliance costs is an especially heavy burden.[19] *See Wis. Gas*, 758 F.2d at 674 (injury must be "great"). Crucially, the Rule's emissions-reduction requirements for industrial sources do not phase in for several years—and even then, sources facing hardship may obtain appropriate extensions. *See* 40 C.F.R. § 52.40(d) (providing for potential extension until 2029). Applicants allege that pipeline engines will need to incur costs in the next 12 to 18 months, *see* Kinder Morgan Appl. 27–28, and that other industrial sources will incur significant costs, *see, e.g.*, AF&PA Appl. 25–27. Pipeline

[19] State Applicants assert flawed claims about potential costs to in-State sources. *See* Hodanbosi Decl. ¶¶ 12, 23 (Ohio Appl. B-5, B-9–B-10); Farah Decl. ¶¶ 12, 15 (Ohio Appl. E-5, E-6); Lane Decl. ¶ 9 (Ohio Appl. D-5). In any event, States cannot rely on costs to private businesses as a basis for their harm. *Cf. Haaland v. Brackeen*, 599 U.S. 255, 143 S. Ct. 1609, 1640 (2023) ("[a] State does not have standing as *parens patriae* to bring an action against the Federal Government" (cleaned up)).

Applicants' cost claims depend, like their theorized supply disruptions, on the erroneous assumption that facility-wide averaging will be unavailable. Wooden Decl. ¶ 17 (Kinder Morgan Appl. 704a); Yeager Decl. ¶ 27 (Kinder Morgan Appl. 730a). In reality, far fewer engines require retrofits than in Applicants' self-serving projections. *See infra* II-B. Industrial sources simply "will not experience significant expenses in the first year after promulgation of the [R]ule." Staudt Decl. ¶ 21 (App. 157a–158a).

Applicants similarly fail to support their claims that power companies will incur substantial near-term costs absent a stay. *See* AF&PA Appl. 25–27. Power-plant obligations from the Rule during the likely pendency of this litigation are very modest. *See supra* II-A. And Applicants fail to show that costs associated with planning now for compliance several years down the road constitute severe and imminent harm justifying a stay. *See Wis. Gas*, 758 F.2d at 674. *Cf.* Farah Decl. ¶ 12 (Ohio Appl. E-5). While plants that choose to install controls will need to make some plans before 2026–2027, "every such unit has or should have, at one time or another, seriously evaluated the implementation of [those controls]" before choosing, likely for economic reasons, not to implement them. Sahu Decl. ¶ 12 (App. 77a). "[G]iven the pre-planning … and other basic evaluations that have likely already been conducted," implementation may be even easier than EPA projected—certainly not rising to the level of extreme harm. *Id.*

Even if *long-term* compliance costs were relevant to imminent harm, Applicants fail to show such costs are "certain," *Wis. Gas*, 758 F.2d at 673, and "very significant." *In re NTE Connecticut, LLC*, 26 F.4th 980, 991 (D.C. Cir. 2022).[20] Applicants allege that controls required by 2026–2027 are "prohibitively expensive." AF&PA Appl. 25. But notably, most covered power plants have already installed those controls. 88 Fed. Reg. at 36,744; *see also* Sahu Decl. ¶¶ 9–10, 15 (App. 75a–76a, 78a). As noted by EPA, selective catalytic reduction is a "well-established at-the-source NO_X control technology," 88 Fed. Reg. at 36,680, and "reflect[s] prevailing practice among [power plants]," *id.* at 36,744. For industrial sources, relevant control technologies "have been commercially available and … deployed in these applications for decades," Sahu Decl. ¶ 5 (App. 148a–149a), and the Rule provides ample compliance time and flexibility. *Id.* ¶¶ 10–12, 22–29 (App. 152a–153a, 158a–162a); Stamper Decl. ¶¶ 22–24 (App. 197a–200a); *see also supra* II-B. Overall, compliance costs are eminently

[20] Applicants muse that power-plant compliance costs "may" be passed onto ratepayers, AF&PA Appl. 28; but such costs will not necessarily translate to rate increases. *See* Silva Decl. ¶¶ 43–48 (App. 63a–65a). And the Court should give no weight to speculation that disadvantaged communities in particular may bear costs, especially as raised in an amicus brief by an industry association that does not represent those communities' interests. *See* Energy Infrastructure Council Amicus Br. 8–9. The Rule will have enormous benefits for low-income communities and communities of color, which are disproportionately harmed by ozone pollution. *See* Southerland Decl. ¶¶ 10, 22 (App. 213a, 218a–219a); 88 Fed. Reg. at 36,859.

manageable for the large companies covered by the Rule. Sahu Decl. ¶¶ 9–22 (App. 75a–81a); Prull Decl. ¶¶ 6–11 (App. 210a) (explaining that "costs are a very small fraction of overall revenues").

III. The Balance of Harms and the Public Interest Weigh Heavily Against a Stay That Would Delay Large, Time-Critical Air-Quality Benefits for Downwind States and Millions of Americans.

Applicants' blatantly wrong assertion that "a stay will not harm any other parties" (AF&PA Appl. 27; *see also* Ohio Appl. 27) ignores that Public Interest Respondents' members are harmed by ozone pollution. *See* Southerland Decl. ¶¶ 41–44 (App. 227a–228). Any stay of the Rule would result in more dangerous pollution in downwind communities and therefore would be contrary to the public interest and Public Interest Respondents' interests. *See Nken*, 556 U.S. at 434; Southerland Decl. ¶ 43 (App. 228a). Every American breathing air downwind of regulated polluters has a strong interest in continued implementation of this life-saving Rule.

Applicants argue that EPA's procedural delay—missing its statutory deadline for acting on States' proposed plans—somehow cancels out any health harms *to the public* from a stay of the Rule's pollution controls. *See* Ohio Appl. 27; Kinder Morgan Appl. 29; AF&PA App 27. That is a grave distortion of the public interest factor. EPA's delay should not be held against downwind States, Public Interest Respondents, their pollution-exposed members, or the American

people generally. Downwind States and Public Interest Respondents have been advocating for EPA to adopt ozone pollution protections for years, with several even filing lawsuits to compel EPA to take the overdue actions that Applicants cite here. *See, e.g.*, Compl., *Sierra Club v. Regan*, No. 3:22-cv-01992-JD (N.D. Cal. Mar. 29, 2022). If EPA's delay has any bearing on the Court's determination of where the public interest lies, it would weigh *against* a stay. *See Wisconsin*, 938 F.3d at 318–19 (EPA must ensure upwind States eliminate their significant contributions of pollution before downwind States' attainment deadlines).

Whatever delay has already occurred, *further* delay would irreparably harm human health. *See, e.g.*, Southerland Decl. ¶ 44 (App. 228a). The Rule's critical and time-sensitive health protections are already long overdue and should not be delayed even a single day. The pollution reductions the Rule will achieve in its first few years of implementation, simply by incentivizing upwind power plants to utilize already-existing controls and make modest updates, are hugely important for public health. *See* Southerland Decl. ¶¶ 41–44 (App. 227a–228a); Silva Decl. ¶ 34 (App. 58a–59a). Those benefits would be fully lost if a stay were granted.

Most importantly, the Rule will reduce ambient levels of ozone—a corrosive pollutant that irritates the lungs, constricts breathing, exacerbates asthma, causes a variety of serious respiratory and cardiovascular illnesses, and results in premature death. Southerland Decl. ¶¶ 9–25 (App. 213a–220a). Tens of millions of people

across the country are subjected to unhealthy levels of ozone. *Id*. ¶ 10 (App. 213a). Children, people with lung disease, and older people have heightened vulnerability. *Id*. ¶¶ 20–21, 24 (App. 217a–218a, 219a–220a).

In the first year of full implementation across all covered States, EPA estimated the Rule would prevent approximately 110,000 asthma attacks, 640 cases of asthma onset, 200 emergency room visits, and 80 premature deaths. Southerland Decl. ¶ 43 (App. 228a). When the Rule's 2026 requirements are phased in, annual health benefits will increase by an order of magnitude. *See id*. Applicants invoke compliance costs, *see* AF&PA Appl. 28, but do not impeach EPA's conclusion that the Rule's massive benefits, totaling an estimated $200 billion through 2042, dwarf compliance costs each year. *See* EPA, *Regulatory Impact Analysis for Final Federal Good Neighbor Plan* 214–17 (2023), Doc. ID No. EPA-HQ-OAR-2021-0668-1115; Silva Decl. ¶¶ 34–36 (App. 58a–60a).

Partial judicial stays that temporarily limit the scope of the Rule's implementation could be dissolved by the issuing courts within months, clearing the way for the Rule to deliver its full suite of air quality benefits. But even considering only partial implementation of the Rule in the 11 States currently unaffected by judicial stays, public health benefits are "enormous." Silva Decl. ¶ 35 (App. 59a). For example, a subset of the health benefits from regulating only the 10 States with covered power plants, and from 2023–2026 only, is valued

between $719 million and $1.6 billion. *Id.* Those massive health benefits could well be lost if the Rule were stayed.

Emissions reductions from the currently covered States are also particularly important for downwind regions that struggle to attain and maintain the ozone standard in part due to pollution from one or more of those States. For example, sources in the upwind States currently covered by the Rule contribute more than half of the allowable pollution under the ozone standard to a violating monitor in Fairfield, Connecticut, whereas sources in Connecticut itself contribute only a fraction of that.[21] For locales on the cusp of attaining or maintaining the ozone standard, even a single upwind State's contribution can matter a great deal. Indiana, for instance, contributes more than 10% of the standard to a monitor in Cook County, Illinois, that is barely maintaining the standard.[22]

Even a partial stay of the Rule's provisions for pipeline engines, as the Pipeline Applicants seek, would jeopardize important pollution-control benefits. If the Rule is ultimately upheld, as it should be, pipeline companies will claim the

[21] *See* EPA, Final GNP O3 DVs Contributions ("2023gf Ozone Contributions" tab, line 198, monitor 90010017). This spreadsheet is available at https://www.epa.gov/Cross-State-Air-Pollution/good-neighbor-plan-2015-ozone-naaqs, under entry for "Data File with Ozone Design Values and Contributions."

[22] *See id.* ("2023gf Ozone Contributions" tab, line 237, monitor 170310001).

need for tolled compliance deadlines based on a stay.[23] If tolling occurs here, as it has for some challenged interstate ozone rules in the past, Applicants will have had "the associated costs" of their pollution "borne instead by the downwind States" for additional months or years, as people breathing unhealthy air downwind continue to suffer. *EME Homer II*, 572 U.S. at 496. *Cf.* Order, *EME Homer City Generation, L.P. v. EPA*, No. 11-1302 (D.C. Cir. Oct. 23, 2014), ECF No. 1518738 (lifting stay of prior interstate ozone rule but tolling by three years most compliance deadlines). There is no equity in such an outcome.

CONCLUSION

The applications for a stay or partial stay of the Rule should be denied.

[23] Pipeline Applicants have admitted as much in judicial filings. Interstate Natural Gas Association of America and American Petroleum Institute have already argued below that compliance deadlines should be tolled for *years* (31 months) even after the stay they seek is lifted—despite not knowing, now, the duration or scope of any such stay or their members' compliance capacity on that unknown future date. *See* Mot. for Stay 25–26, July 27, 2023, ECF No. 2009932. And Kinder Morgan has explained that it is not investing resources to prepare for compliance in States covered by partial judicial stays while those stays are in effect. Grubb Decl. ¶ 6 (Kinder Morgan Appl. 653a–654a).

October 30, 2023

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APPENDIX

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DECLARATION of METIN CELEBI, PH.D.

I, Dr. Metin Celebi, declare:

1. I am a consultant at The Brattle Group with more than 20 years of experience in the US electric sector. I am a Principal at Brattle, and I hold a Ph.D. in Economics from Boston College. A copy of my resume is provided in Attachment A.

2. I provide the following opinions based on my review of the U.S. Environmental Protection Agency's ("EPA's") "Good Neighbor Plan" for the 2015 Ozone National Ambient Air Quality Standard, 88 Fed. Reg. 36,654 (June 5, 2023) ("Final GNP Rule"), as well as various supporting materials and public comments in the rulemaking docket, Docket ID No. EPA-HQ-OAR-2021-0668. I understand the Final Rule requires nitrogen oxide (NOx) emissions reductions from covered fossil fuel-fired electric generating units ("EGUs") in 22 states. However, in response to judicial orders partially staying the EPA's disapproval of state implementation plans to address states' obligations for the 2015 Ozone National Ambient Air Quality Standard, the EPA will not implement the Final GNP Rule in the affected states until those judicial proceedings are resolved, *see* 88 Fed. Reg. 49,295, 49,297 (July 31, 2023) ("July Interim Final Rule") and 88 Fed. Reg. 67,102, 67,103 (Sept. 29, 2023) ("September Interim Final Rule"). I further understand that some applicants in the present litigation have requested a stay of the implementation of the Final GNP Rule in the remaining states based on their allegation that, among other factors, the Final GNP Rule would cause significant economic harm to the owners of the EGUs, or the states in which they are located, in the absence of the requested stay. Among other things, applicants have asserted that EGUs in the states remaining in the program could face a choice to purchase

allowances at a "significantly higher premium" than the price they would pay with full implementation, specifically referring to the higher allowance prices observed in 2022.[1]

3. My opinions as expressed in this Declaration are informed by training as an economist and my experience in economic analysis of coal plant operations, environmental regulations, and wholesale power markets. I have testified in cases before the Federal Energy Regulatory Commission ("FERC"), the U.S. District Court for the Eastern District of Missouri, the Public Service Commission of Wisconsin, the Pennsylvania Public Utility Commission, the Kentucky Public Service Commission, the Public Utility Commission of Texas, and the Superior Court of the State of Arizona on topics including the economics of coal plant retirements and their impact on wholesale energy prices, economic damages in energy contract disputes, locational marginal price spikes in the Pennsylvania-New Jersey-Maryland (known as "PJM") Regional Transmission Organization, allocation of certain ancillary services costs among market participants in the Electric Reliability Council of Texas (known as "ERCOT"), and wholesale power prices in Arizona.

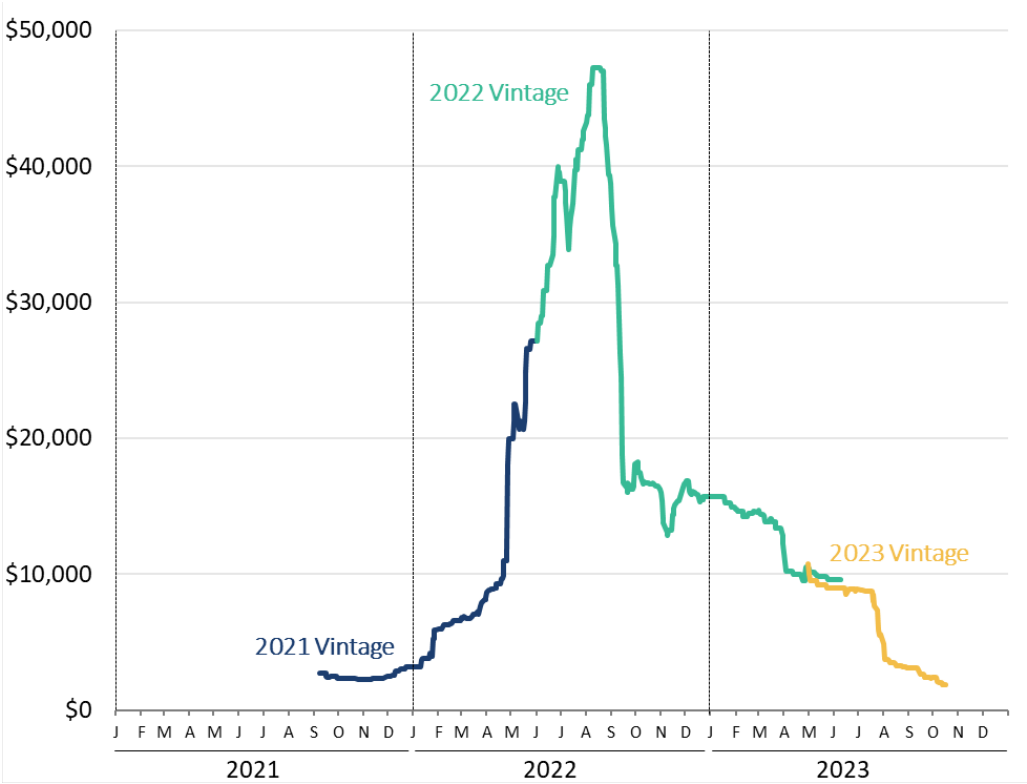
4. I opine that the near-term compliance requirements in the Final GNP Rule are very modest and feasible, and EGU owners have substantial flexibility in choosing among various low-cost options to comply with those near-term requirements. Therefore, implementation of the Final GNP Rule for the remaining states in the program during the pendency of this litigation would not cause significant economic harm to owners or operators of the affected EGUs or the states in which they are located. My opinion is based on the following observations:

5. First, market prices of seasonal NOx allowances, purchase of which is one of the instruments that EGU owners may select to comply with the Final GNP Rule, have not increased

[1] Am. Forest & Paper Ass'n *et al.*, Emergency Application for Immediate Stay of Final Agency Action Pending Disposition of Petition for Review, No. 23A____, at 26 (submitted Oct. 13, 2023).

after the issuance of the Final GNP Rule earlier this year. Specifically, Group 3 seasonal NOx allowance prices for the 2023 ozone season (May through September 2023) for the sources in states that are currently participating in the GNP EGU trading program have been lower this year than the market prices of allowances for the 2022 ozone season. Figure 1 below shows that compared to the 2022 ozone season allowance prices, the 2023 prices for Group 3 seasonal NOx allowances are significantly lower. Prices in the early 2023 season were several times as low as the 2022 peak prices. Since the beginning of the 2023 season, prices have decreased further by more than four fifths to a level below the lowest price of the 2021 vintage allowances. Therefore, the Final GNP Rule did not appear to result in any increase in seasonal NOx allowance prices.

Figure 1: 2021-2023 Group 3 NOx Allowance Price



Source: S&P Global Market Intelligence LLC. Data as of October 16, 2023.[2]

[2] S&P Global Market Intelligence requires the following disclaimer to accompany presentations reflecting its services: "Reproduction of any information, data or material, including ratings ('Content') in any form is prohibited

6. Second, NOx allowance prices did not increase after EPA's removal of six states at the end of July 2023 and another six states at the end of September 2023 from the Group 3 allowance trading program to comply with stay orders from courts. As shown in the figure above, Group 3 seasonal NOx allowance prices for the 2023 ozone season have in fact decreased sharply from about $9,000/ton on June 14 to $8,775/ton on July 14, and further to $5,125/ton at the end of July, after the stays of the EPA's SIP disapproval rule and the issuance of EPA's July Interim Final Rule on June 29. The market prices for summer 2023 NOx allowances were even lower at $3,125/ton as of September 1, 2023, after EPA's July Interim Final Rule became effective on August 4, 2023. After the effective date of September 29, 2023, for EPA's September Interim Final Rule that removed six more states from the trading program, the market prices decreased to $1,900/ton as of October 16, 2023. The $1,900/ton price translates to about $2.1/MWh compliance cost.[3]

7. Third, if past trends in allowance prices following reinstatement of trading programs hold true, then the potential return of the states for which EPA's SIP disapproval rule has been stayed to the Group 3 allowance trading program will not necessarily increase allowance prices substantially. For example, annual NOx allowance spot market prices fell dramatically

[3] Assuming an average plant with NOx emissions rate of 0.2 lb/MMBtu and an average heat rate of 11,000 Btu/kWh.

immediately following the D.C. Circuit's vacatur of the Clean Air Interstate Rule,[4] from roughly $5,000/ton around May 2008 to just about $1,000/ton in September 2008.[5] Prices rebounded to $4,000/ton in January 2009 following the D.C. Circuit's ruling reconsidering vacatur and instead remanding the rule to EPA without vacatur,[6] but still lost significant value.[7] While market prices of allowances depend also on expectations for market fundamentals (such as fuel prices and load conditions) and installation and operation of emissions control equipment, this history suggests that regulatory uncertainty surrounding the fate of a trading program may in fact depress allowance prices, which would lower the cost of compliance with this rule during the pendency of the present litigation.

8. Fourth, the multiple options for EGUs to comply with the Final GNP Rule and the EPA's method of setting the emissions budgets for 2023, 2024, and 2025 based largely on assumed use of existing pollution controls would make the cost impacts of the rule very modest in the near term. EGUs can comply with the 2023, 2024, and 2025 requirements by choosing among various options including running their existing NOx emissions control equipment (which typically adds less than $1/MWh to costs for existing coal units[8]), shifting the generation output from some of the EGUs during summer off-peak or shoulder hours to non-summer hours or from higher-emitting EGUs to lower-emitting generation resources, or simply buying allowances from the market. In its Regulatory Impact Analysis, the EPA assumes that most EGUs can comply with the emissions

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4 *North Carolina v. EPA*, 531 F.3d 896 (D.C. Cir. 2008).

5 *See* Arthur G. Fraas and Nathan Richardson, *Banking on Allowances: The EPA's Mixed Record in Managing Emissions-Market Transitions*, Figure 8 (Sept. 2010).

6 *North Carolina v. EPA*, 550 F.3d 1176 (D.C. Cir. 2008).

7 *See* Arthur G. Fraas and Nathan Richardson, *Banking on Allowances: The EPA's Mixed Record in Managing Emissions-Market Transitions*, Figure 8 (Sept. 2010).

8 Using the $900/ton average cost of running existing selective catalytic reduction (SCR) emissions control equipment at coal units from the EPA's Regulatory Impact Analysis (page 143) for an average plant with NOx emissions rate of 0.2 lb/MMBtu and an average heat rate of 11,000 Btu/kWh.

limits reflected in the NOx budgets for 2023, 2024, and 2025 by fully operating their existing control equipment during the ozone season, with a limited number (9 units) assumed to install state-of-the-art combustion controls.[9] Therefore, even with a smaller number of states remaining in the Group 3 allowance trading program after the stays as to some states, the costs of complying with the rule likely would not significantly harm the business of any power company.

9. Fifth, while the Final GNP Rule's state-level NOx emissions budgets reflect deployment of cost-effective control techniques at fossil fuel-fired EGUs,[10] they do not assume shifts in generation away from those units.[11] Furthermore, any changes in generation output from covered units (as a result of change in heat input) could only *increase* (but cannot decrease) a state's budget during the period 2026-2029 relative to the preset budget levels as a result of EPA's use of the preset budget values as a floor.[12] In the near term (i.e., 2024-2029), banked (unused) allowances from earlier years will provide additional compliance flexibility because EGUs will be able to use allowances reflecting early emission reductions in lieu of pursuing other compliance strategies, such as installing emissions control equipment. The recalibrated target bank of 21% of the sum of remaining state budgets[13] during each year of 2024-2029 far exceeds the 12.5% historical upper bound on variability[14] for the 10-state region where the Final GNP Rule is currently being implemented.[15] Therefore, even with partial stays of EPA's disapproval of state

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[9] U.S. EPA, Regulatory Impact Analysis for the Final Federal Good Neighbor Plan Addressing Regional Ozone Transport for the 2015 Ozone National Ambient Air Quality Standard, 138-40 (Mar. 2023), https://www.epa.gov/system/files/documents/2023-03/SAN%208670%20Federal%20Good%20Neighbor%20Plan%2020230315%20RIA_Final.pdf.

[10] 88 Fed. Reg. at 36,777-86.

[11] *Id.* at 36,731.

[12] *Id.* at 36,777-78 and 36,783.

[13] *See id.* at 36,788-89.

[14] This upper bound is measured as the top of the 95% confidence interval for the annual variability in total heat input (expressed as a fraction of average heat input during the period 2000-2021).

[15] *See* Ozone Season Heat Input Variability 2000 to 2021 updated, EPA-HQ-OAR-2021-0668-1165 (spreadsheet showing calculation of 95% confidence level variability in heat input as a percentage of average heat input for the covered region, from which states affected by judicial stays can be removed); Power Sector Variability

implementation plans, the Final GNP Rule's enhancements to the EGU trading program would not present compliance difficulties while challenges to the rule are adjudicated.

10. Based on the reasons I provided above, I conclude that implementation of the Final GNP Rule for the remaining states in the program during the pendency of this litigation would not cause significant economic harm to owners or operators of the affected EGUs or the states in which they are located.

I declare that the above is true and accurate under the penalty of perjury.

Executed in Boston, Massachusetts on October 26, 2023.

Metin Celebi

Final Rule TSD, EPA-HQ-OAR-2009-0491-4454 (July 2011) (describing methodology); *see also* 88 Fed. Reg. at 36,789 (setting forth the rationale for a regional approach to setting the target bank level).

Attachment A - Resume

Metin Celebi

PRINCIPAL

Practice Leader: Electricity Litigation & Regulatory Disputes

Boston +1.617.864.7900 Metin.Celebi@brattle.com

Dr. Celebi provides expertise in electricity markets, resource planning, and analysis of environmental and climate policy.

He has consulted primarily in the areas of electricity litigation and regulatory disputes, including on the economic viability of coal-fired and nuclear power plants, wholesale power pricing, and market design. Dr. Celebi has experience in developing and analyzing federal and state climate policies, environmental regulations, role of hydrogen to reduce economy-wide GHG emissions, LMP modeling, generation plant valuation, and transmission cost allocation.

Dr. Celebi has provided expert testimony in a number of cases, including ones estimating economic damages in energy contract disputes, assessing the impact of mandates to install emission control equipment on economic viability of a coal plant; economic viability of coal plants and recovery of undepreciated past investments; transmission cost allocation; a long-term power contract dispute in California; the impact of coal plant retirements on wholesale energy prices in MISO; causes of locational marginal price (LMP) spikes in PJM; and the allocation of ancillary services costs among market participants in ERCOT.

AREAS OF EXPERTISE

- Electricity Litigation & Regulatory Disputes
- Electricity Wholesale Markets & Planning

PROFESSIONAL EXPERIENCE

- **The Brattle Group (2000–Present)**
  Principal (2011–Present)
  Senior Associate (2006–2011)
  Associate (2000–2006)

- **London Economics, Inc. (1999–2000)**
  Associate
- **Boston College (1998–1999)**
  Teaching Fellow, Microeconomics and Macroeconomics

EDUCATION

- **Boston College**
  PhD in Economics
- **Bilkent University (Ankara, Turkey)**
  MA in Economics
- **Middle East Technical University (Ankara, Turkey)**
  BS in Industrial Engineering
- **Hebrew University**
  Summer School in Economic Theory on Auctions and Market Design

EXPERT TESTIMONY

- Before the Iowa Utilities Board, direct testimony on behalf of Interstate Power and Light Company re: reasonableness of IPL continuing to fully recover the remaining net book value of Lansing Generating Station Unit 4, a coal-fired generating unit, after the unit's retirement (October 12, 2023).
- Before the US Court of Appeals for the Sixth Circuit, declaration on behalf of Conservation Groups re: compliance requirements and flexibility to choose among compliance options under the EPA's Good Neighbor Plan for the 2015 Ozone National Ambient Air Quality Standard (September 5, 2023).
- Before the US Court of Appeals for the District of Columbia Circuit, declaration on behalf of Environmental and Public Health Intervenors re: compliance requirements and flexibility to choose among compliance options under the EPA's Good Neighbor Plan for the 2015 Ozone National Ambient Air Quality Standard (August 18, 2023).
- Before the District Court 165th Judicial District, Harris County, Texas, prepared expert report on behalf of Peaker Power, LLC re: economic damages from the counterparty's violation of the Heat Rate Call Option contracts by exceeding the annual cap on exercise hours during Storm Uri in February 2021 (July 25, 2022).

- Before the Federal Energy Regulatory Commission, prepared answering testimony on behalf of Tri-State Generation and Transmission Association, Inc. re: the appropriate approach to determine the contract termination payment from a departing member (February 4, 2022, March 25, 2022).
- Before the US District Court for the Western District of North Carolina Charlotte Division, direct and rebuttal expert reports on behalf of NTE Energy re: discounts provided by Duke Energy Progress (DEP) to City of Fayetteville in its wholesale power supply contract and the impacts on competition as well as on rates being charged to DEP's other wholesale and retail customers (January 14, 2022, February 18, 2022).
- Before the Public Service Commission of Wisconsin, prepared direct testimony on behalf of Wisconsin Power and Light Company re: appropriateness of WPL continuing to recover as a regulatory asset the undepreciated past investments at the Edgewater 5 coal unit after its proposed retirement in 2022 (May 27, 2021).
- Before the Public Service Commission of Kentucky, prepared direct testimony on behalf of Big Rivers Electric Corporation re: economic viability of Station Two coal plant (May 1, 2018).
- Before the United States District Court Eastern District of Missouri Eastern Division, expert report on behalf of Ameren Missouri re: impacts of proposed mandates to install emission control equipment at Rush Island coal plant on revenue requirements and economic viability of the plant, Case No. 4:11 CV77 RWS (April 23, 2018 and April 27, 2018).
- Before the Superior Court of the State of Arizona, expert report on behalf of Vieste SPE, LLC and Vieste Energy LLC re: projected long-term wholesale power prices in Arizona (January 30, 2017 and February 21, 2017).
- Before Federal Energy Regulatory Commission, prepared direct testimony on behalf of the California parties re: economic burden imposed by the prices in two long-term contracts that California Department of Water Resources (CDWR) signed with Shell and Iberdrola during the California energy crisis (May 19, 2015 and October 6, 2015).
- Before the Public Service Commission of Wisconsin, pre-filed rebuttal and sursurrebuttal testimony on behalf of Wisconsin Public Service Corporation re: the impacts of pending coal plant retirements and environmental retrofits on energy and capacity prices in the MISO region (December 14, 2012 and January 11, 2013).

- Before the District of Columbia Office of Tax and Revenue, affidavit on behalf of Pepco Energy Services re: categorization of electricity as a tangible property versus a service for determining the eligibility of electricity sales for exemption from sales tax (July 15, 2011).
- Before the Pennsylvania Public Utilities Commission, Docket No. P 2008 2020257, rebuttal and surrebuttal testimony on behalf of Pennsylvania Electric Company re: causes and pricing of transmission congestion in Wellsboro area in PJM (January 16, 2009 and March 10, 2009) (with P. Hanser).
- Before the Public Utilities Commission of Texas, Docket 33416, affidavit supporting Constellation New Energy's request for expedited hearing re: allocation of replacement reserve costs in ERCOT (November 8, 2006).

SELECTED CONSULTING EXPERIENCE

ENERGY LITIGATION AND REGULATION

- For a coal producer, provided litigation support to estimate potential economic damages from an alleged breach in a long-term coal supply agreement.
- For the owner of two gas-fired peaking generation plants in Texas, provided expert testimony before the District Court 165th Judicial District, Harris County, Texas regarding a dispute in a Heat Rate Call Option (HRCO) contract with Shell Energy North America. Estimated economic damages from the counterparty's violation of the HRCO contracts by exceeding the annual cap on exercise hours during Storm Uri in February 2021, and assessed the economic value of the cancelation clause in the HRCOs.
- For Calpine, managed a team of consultants to support expert testimony in a bankruptcy court regarding the ERCOT wholesale power prices during the February 2021 storm when the extreme weather conditions caused nearly half of Texas to lose power for several days. The testimony from a Brattle expert explained why the high power prices were consistent with the scarcity pricing mechanism and market design in ERCOT, and such prices reflected, or even understated, the value of loss load during the scarcity conditions.
- For NTE Energy, provided expert testimony on discounts provided by Duke Energy Progress (DEP) to City of Fayetteville in North Carolina in its long-term wholesale power supply contract, and the resulting impacts on wholesale competition as well as on rates being charged to DEP's other wholesale and retail customers.
- For Tri-State Generation and Transmission Association, Inc. (Tri-State), provided expert testimony before Federal Energy Regulatory Commission (FERC) regarding the appropriate economic principles to determine the contract termination payment from a departing member.
- For a generation owner in ERCOT region, managed a team of consultants to prepare an expert testimony and to provide economic litigation support in a bankruptcy proceeding regarding the real-time energy prices during the winter storm Uri in February 2021.
- For owner of a paper mill in Minnesota, provided economic litigation support in an arbitration dispute regarding the pricing terms of a steam supply contract with an electric utility that operated a cogeneration facility.

- For a co-owner of a nuclear power plant project in the Southeast US, evaluated the prudency of past decisions to start and continue construction until the project was eventually terminated. These investment decisions by the co-owners of the project were subject to multiple lawsuits regarding the appropriateness of recovering the past investment costs from the utility's customers. Brattle team evaluated the ranges of long-term outlooks on major market fundamentals and project costs as of the past decision points to assess the projected economics of continuing the project against options involving termination and replacement by other new resources.
- For owner of a coal plant in the Eastern US, developed an expert testimony in an arbitration proceeding regarding a force majeure claim for non-performance in supplying a pre-determined volume of coal combustion byproducts under a long-term contract. Evaluated the drivers of the historical reductions in generation output and the accompanying byproducts, and the impacts of the drivers outside the control of the plant owner on the supply of byproducts under the contract.
- For Hydro-Québec Trans-Énergie (HQT), provided expert testimony before Québec Régie De l'énergie on the adequacy of the categories used by HQT to classify its transmission investments and HQT's treatment of transmission losses in transmission planning. Provided expert opinions before the regulator on the adequacy of HQT's investment categories in allocating the investment costs across different categories for multi-objective projects. Compared the HQT practices against those adopted by other system operators in the US and Canada.
- For investors in refined coal production facilities in the US, managed several consulting teams in supporting expert testimonies submitted before a US Tax Court on the economic rationale and requirements behind the refined coal production tax credit, and on the operational and environmental permitting risks for the investors of refined coal production facilities.
- In an international arbitration dispute involving a coal mine in South America, co-managed a team to support expert report on the economic damages associated with a change in royalty structure. The analysis included the impact of royalty terms on the incentives for increasing mine production and on royalty payments to the government, under base outlook and sensitivities for projected international coal prices, mine cost structure, and discount rates.

- In a coal bankruptcy case regarding the qualification of a coal supply contract under the safe harbor provisions in the US Bankruptcy Code, assisted an electric utility to evaluate the effectiveness of a long-term coal supply agreement as a hedge against regional fuel and power prices, including alternative coal prices and the more volatile prices of natural gas and wholesale power.
- In a large litigation case before FERC, provided testimony on the economic burden imposed by the prices in two long-term contracts that California Department of Water Resources (CDWR) signed with Shell and Iberdrola during the California energy crisis. Estimated the "down the line" economic burden by comparing the payments under the contracts to prices in comparable contracts and market prices after the end of the dysfunction. Assessed whether the contract prices could be explained by the expected future market fundamentals in the California power markets by using DAYZER market simulation software for the near-term and expected cost of installing and operating a new generation unit for the long-term.
- For estimating breach-of-contract damages, managed the team to support expert testimony in a high-profile international arbitration case. Brattle team built and ran simulation models to forecast power prices and GHG allowance prices in California and the rest of Western states through 2050, accounting for very short-term operational effects as well as long-term capacity expansion needs. The simulation models covered all of the states in the full Western Electricity Coordination Council (WECC) region to capture California's dependency on imports from other areas and changes in price and availability of these imports over time. The modeling team evaluated the impact of GHG policies, RPS policies, changes in load forecasts, changes in hydro conditions, and changes in natural gas prices over time on the power and GHG allowance prices. The simulation models were benchmarked against historical unit dispatch and near term power price forwards to replicate actual market operations and expectations. The Brattle team used the resulting range of power price forecasts under expected range of future market conditions to estimate damages, including an options framework to simulate plant operations and show the threshold conditions for economic shutdown.
- In a New Source Review (NSR) litigation case, analyzed whether the repairs conducted in several coal-fired generation plants should have been expected to result in significant increases in emissions of certain pollutants. The major disagreements were on the choice of baseline emissions and the level of expected impact from the repairs.

- In several NSR cases, estimated the amount of potential increases in emissions of SO_2 and NOx as a result of repairs and replacements of various equipment in coal-fired generation plants. The analyses focused on potential increases in emissions due to avoided outage hours or increased output due to improved relative efficiency of the plants compared to the rest of the generation facilities in the system.
- For a group of municipal electric utilities in Massachusetts buying energy from a generating facility under a long-term contract, assisted in evaluating their net benefits from requesting must-run operation of the facility relative to the operations chosen by the seller. The engagement also included a comparison of municipal utilities and investor-owned utilities with respect to their incentives under the Massachusetts Electric Restructuring Act to buy out their power purchase contracts.
- Helped a client in the western US in a litigation case involving allegations of market power and market dysfunction affecting the prices and other terms of various long-term electricity purchase and sale contracts.
- Managed multiple cases related to estimation of damages resulting from early termination of power contracts.

COAL PLANT ECONOMICS – VIABILITY, RETIREMENTS, AND MARKET IMPACTS

- For environmental and clean energy groups, submitted declarations before the US Courts of Appeals for the District of Columbia Circuit and the Sixth Circuit regarding compliance requirements and flexibility to choose among compliance options under the EPA's Good Neighbor Plan (GNP Rule) for the 2015 Ozone National Ambient Air Quality Standard.
- For Center for Applied Environmental Law and Policy, co-authored a report on the recent history of changes in the US coal generation fleet and explain factors contributing to the decrease in coal-fired generation capacity over the past 20 years. The report also summarizes the state of market fundamentals and regulations as of 2023 affecting the economics of coal plants in the US as well as their near- and medium-term outlook. Notably, the report explains that provisions in the recently passed Inflation Reduction Act (IRA) that increase the economic attractiveness of clean energy resources have prompted some coal plant owners to re-examine the options for their coal fleet.
- For Alliant Energy, co-authored a report to describe rail service issues observed in the US in 2022 and the impacts on coal use in the electric sector. During this period, acute logistical and capacity challenges in rail transportation have limited many coal shippers' ability to deliver critical inputs to electric utilities. More generally, rail service delivery issues were widespread throughout the country across many industries with shippers experiencing

slower train speed, increased delays, poor on-time performance, and inability to satisfy demand for rail shipments.

- For Wisconsin Power and Light Company (WPL), provided expert testimony before the Public Service Commission of Wisconsin on the appropriateness of WPL continuing to recover as a regulatory asset the undepreciated past investments at the Edgewater 5 coal unit after its proposed retirement in 2022. Reviewed and analyzed the prudency of WPL's past decisions to make those investments its current proposal to retire the unit and replace it with new renewable resources. Explained that longstanding and economically well-justified principles and standards in the utility industry strongly indicate that prudent investments should be fully recoverable from customers, even if they eventually prove less economic than initially projected.
- For an electric utility operating in multiple states, reviewed the utility's draft internal planning studies for evaluating the future cost savings for its customers from early retirements of some coal units. Provided feedback on the reasonableness of the modeling approach and key assumptions of utility's internal modeling team, suggested potential improvements, and estimated the impacts of the suggested changes on the future cost savings from early retirements of the coal units.
- For Public Service Company of New Mexico (PNM), managed a team to evaluate the prudency of retiring San Juan Generation Station and replacing it with renewables and gas peakers, with securitization of remaining undepreciated and adjustment costs. Brattle helped PNM to demonstrate the prudency of PNM's proposed plan based on the findings that i) the expected cost savings and risk reductions of PNM's plan outweighed the option retrofitting the plant with carbon capture, utilization, and storage (CCUS); and ii) securitization was a beneficial approach for providing full cost recovery at low cost to customers, as the state moves to fully clean electricity. The New Mexico Public Regulation Commission ruled in favor of PNM, allowing the utility to abandon SJGS and to securitize up to $360.1 million of unrecovered investments and adjustment costs.
- For Big Rivers Electric Corporation, a municipal electric utility in the MISO market region, provided expert testimony before the Kentucky state regulatory commission to evaluate the economic viability of an existing coal plant against the projected wholesale power prices in MISO. By using an in-house plant dispatch and commitment modeling tool, estimated the future annual capacity factor and variable costs of operating the plant, and compared the plant's avoidable future costs against the projected market prices of energy and capacity for the plant. Developed scenarios for future market prices by considering the key uncertainties

such as natural gas prices and potential pricing of CO_2 emissions. Estimated the savings from a potential early retirement of the coal plant.

- For an investor-owned electric utility in the MISO market region, provided expert testimony before a US District Court to assess the potential for economic early retirement of a coal-fired plant under several scenarios including potential future requirements for retrofitting the plant with SO_2 emissions control equipment and future wholesale power market conditions. Estimated the likely impact of retrofits and early retirement on the utility's revenue requirements and retail rates.
- For an electric utility considering an early retirement for one of its coal plants, provided regulatory support to describe the changing economic viability of the existing coal plants in the US wholesale power markets over the last decade. Conducted research on regulatory decisions in various state jurisdictions on recovery of past investments at retiring generation plants, and explained the perverse incentives on retirement decisions that would be created by disallowing prudently incurred past investments.
- For a merchant generation company in PJM, assessed the potential impacts of coal plant retirements on future likely range of energy prices under key uncertainties for market fundamentals. In addition, the project team evaluated whether the recent price spikes under the extreme weather and system conditions can be repeated in the future with increasing reliance on gas-fired generation plants.
- For an electric utility in Wisconsin, provided expert testimony on the likely changes in energy and capacity prices as a result of projected coal plant retirements and environmental retrofits in the MISO region. The analysis included a transparent model to estimate the impacts of retirements and retrofits on the regional supply curve, and the impacts of nationwide coal retirements on natural gas prices. Reviewed the projected reserve margins in the MISO region with and without the coal retirements to evaluate the likely changes in capacity prices in the MISO region after 2016.
- Conducted a screening analysis of coal-fired units in the United States for a producer of biomass fuel that could be an alternative to burning coal in generating units in order to avoid or mitigate future compliance requirements with environmental regulations. The analysis compared the projected costs for each unit under the coal-fired operations (including the retrofit cost of environmental control equipment) against the costs under operations with the alternative fuel and the costs of replacement with a new gas-fired unit.
- For American Coal Ash Association, conducted annual surveys for the production and use of coal combustion residuals in the US. The Brattle team designed and implemented the

survey circulated to coal generation plant operators, and supplemented that information with Brattle's assessment of key market trends in the power industry. The results of the survey are published each year for consumption by energy and environmental agencies and industry analysts.

- For an investor, assessed the economic viability of selected merchant and regulated coal plants in the Midwest. The analysis focused on estimates of projected net revenues for merchant plants, and cost of continued operations of the regulated coal plants against replacement power costs. In addition, estimated the projected capacity factor and coal use by each plant under selected future gas and CO_2 price sensitivities.
- Managed a case regarding the estimation of cost and performance benchmarks for two coal-fired generation plants in the Eastern US. We assessed their performance and cost by comparing them with similar coal plants in the country with respect to various performance metrics (heat rate, availability, forced outage rate, etc.) and cost metrics (fuel cost, maintenance costs, capital expenditure). We identified strong and weak points, by using various definitions of total costs and key performance metrics, and we analyzed the tradeoff between good performance and high costs among peer group plants.

RESOURCE PLANNING FOR ELECTRIC UTILITIES

- For an industry association, prepared a report on the potential role of clean hydrogen and other clean dispatchable resources in the future in a decarbonized electric system with high penetration of variable renewable energy resources. The report summarized the key findings and gaps in recent industry studies regarding the key attributes needed from clean dispatchable resources in such a system, including fast and sustained flexibility and ability to store energy across seasons. The report compared the effectiveness, availability and cost of clean hydrogen technologies against other clean dispatchable resources such as gas with carbon capture, small modular reactors, and long-duration storage.
- For Clean Power Suppliers Association, performed a detailed review of the Carbon Plan, which is Duke Energy's recent integrated resource plan study on alternative resource portfolios to achieve 70% reduction in Duke Energy's North Carolina CO_2 emissions by 2030 relative to its 2005 emissions. The Brattle team identified a number of modeling assumptions that made the comparison of costs across the portfolios flawed. The team replicated the Carbon Plan modeling results through its GridSIM capacity expansion and production cost modeling software and simulated additional alternative portfolios that would result in lower future costs for Duke's customers.

- For Cypress Creek Renewables, prepared an economic study to analyze the generation costs and emissions impacts of a future resource mix for Duke Energy that achieves the requirements outlined in North Carolina's House Bill 951 (H951) and minimizes additional development of natural gas capacity. The study concluded that by shifting its resource mix from coal and gas resources to renewable energy and battery storage, Duke Energy could achieve over 70% GHG emissions reductions by 2030 (relative to 2005 emissions) while lowering generation costs. The study also found that use of securitization to finance the recovery of undepreciated past investment costs at some of the retiring coal plants is a major driver of the customer cost savings in addition to the avoided fixed operating and ongoing capital expenditures from early retirements.
- For a large Midwest utility serving electric and gas, assessed current and likely future industry developments with potential to create opportunities and risks for the regulated and nonregulated operations of the company. The key developments included emerging EPA air quality, water and ash regulations for power plants, potential climate policies, macroeconomic recovery, and smart grid technologies. In addition, conducted a thorough comparison of the risks and cost of capital associated with regulated and unregulated businesses, including behind-the-meter renewable generation. Presented the findings of these assessments to the board of directors.
- Assisted a municipal electric utility in developing a least-cost strategy to comply with environmental regulations. Developed a screening tool to compare the economics of environmental retrofits against alternatives such as replacement with a new gas-fired combined cycle or relying on market purchases of energy and capacity to meet the retail load obligations. Presented the results of the economic analysis and potential hedging strategies to the executive management.
- Co-authored a chapter of a recent EPRI report on decision-making complexities and factors in utility resource planning and environmental compliance investment decisions. The chapter described how various metrics of cost and performance are used by power industry planners and executive decision makers, what some of the limitations of those metrics and modeling techniques are, and how this problem and modeling complexity may alter the type and timing of technology preferences. Some of the complexities are illustrated with a couple of examples on retire/retrofit choices for coal plants to comply with the environmental regulations and on decision-making for Carbon Capture and Sequestration (CCS) investment under CO_2 price volatility.
- Assisted an electric utility in the Midwest in their resource planning. Developed environmental regulation scenarios with the executives and experts at the utility, and

assisted in modeling and reviewing the implications of regulatory and market scenarios on the least-cost strategy subject to meeting load, renewable energy standards, and capital constraints. The strategy options included retrofitting the coal-fired generation plants with necessary control equipment, retirement of coal-fired units and replacement with gas-fired units. Presented the results to the utility executives.

- Assisted an electric utility in developing an Integrated Resource Plan under potential climate policy scenarios. The plan was developed by reviewing and choosing the best mix of supply side alternatives and demand side programs that would achieve the joint objectives of minimizing cost and mitigating CO_2 footprint subject to meeting the utility's obligation to serve its customers. The supply side options included combinations of conventional generation technologies, renewables and low CO_2 fossil fired generation, and new transmission investment.
- For a large independent generation company, led a team to assess the reasonableness of the evaluation procedures and criteria used by an electric utility in the southern US in its RFP to acquire new generation assets and PPAs. The team reviewed the RFP requirements and the workpapers supporting the RFP results in a short period of time to identify the questionable assumptions and criteria used by the electric utility, and quantified the impacts of these on the relative costs of bids.
- For EPRI, analyzed and reviewed the major drivers of generation technology choice in various countries and regions around the world. Although the availability and degree of access to fuels is a common driver, other factors such as capital cost, attitude towards nuclear technology and renewables, constraints on carbon-intensive technologies, and degree of economic development play varying degrees of roles in the choice of generation fuels and technologies in each country.

ENVIRONMENTAL AND CLIMATE POLICIES – DESIGN AND IMPLICATIONS

- For a merchant generation owner in New England, managed a team to conduct an economic study on the potential cost and emission impacts of making the existing clean energy generators eligible under an expanded Clean Energy Standard (CES) program in Massachusetts. Under the existing CES program, commercial operating date requirements limit eligibility to clean energy generators commencing operation after 2010. The study concluded that retaining existing clean generation that came online prior to 2010 under the CES program would reduce GHG emissions in Massachusetts and New England, and would reduce system production and customer costs.

- For a power industry association, co-authored a study to assess the carbon emission impacts of premature nuclear retirements. The study concluded that the vulnerability of some nuclear power plants to premature retirement could create a major threat to the attainment of desired CO_2 reduction. The analysis found that the retirement of a 1,000 megawatt nuclear plant could increase CO_2 emissions in the range of 4.1 to 6.7 million tons per year, or 0.52-0.84 tons per MWh of nuclear generation lost, depending on the region in which the nuclear retirement occurs. In addition, the increased level of CO_2 emissions arising from a premature nuclear retirement is not confined to the state in which the unit resides. In fact, in most cases the majority of this increase will occur outside the state, and a significant amount of the emissions increase will occur in states beyond those adjacent to the state experiencing the retirement.
- For an industry association, co-authored a study to analyze the potential implications for competitive wholesale electricity markets if new gas-fired combined cycle (CC) plants are not covered under the Clean Power Plan's (CPP) mass-based state implementation plans (SIPs). The authors found that if state implementation plans exclude new gas CC plants, the electric sector could fall short of the carbon dioxide (CO_2) reduction goals set by the CPP, while incurring higher system costs per ton of CO_2 avoided. In addition, Brattle simulations illustrated that excluding new gas CCs from the emissions cap would introduce a discrepancy in the economics facing new and existing gas CCs that are identical in all respects other than their in-service dates. New CCs would earn greater profits in the energy market because they would be compensated as if they were entirely non-emitting plants.
- For a power industry association, conducted analysis of the EPA's proposed rule for regulating CO_2 from existing sources under Section 111(d) of the Clean Air Act, focusing on potential economic impact to hydropower. Summarized key aspects of the rule, and assessed how the compliance options for states could differ from the BSER options in setting the target rates, and how states can utilize hydropower (existing or new) as a compliance option under the rule.
- For a western electric utility, evaluated the EPA's development of CO_2 rate targets in Arizona and assessed the reasonableness of projected pace and level of emission reductions. Conducted a detailed assessment of the assumptions and modeling approach in EPA's IPM simulations, and identified areas of improvements. Prepared a whitepaper to summarize the findings to be filed as part of the utility's comments to the EPA.
- For an electric utility in the western US, conducted a study to assess reliability and supply-chain implications of compliance with the EPA's Regional Haze Rule. Regional Haze Rule aims to reduce haze-forming pollution (primarily due to emissions of particulate matter and

its precursors SO_2 and NOX) that reduces visibility in parks and wilderness areas, especially in the western US. We assessed the impact of outages at coal units to tie-in the environmental retrofit equipment on available resources to meet the utility's load obligations in the future. In addition, we compared the historical retrofits on coal units in the region against projected retrofits to comply with Regional Haze Rule.

- Co-authored a study commissioned by the Midwest Independent Transmission System Operator (MISO), evaluated the feasibility of the large number of simultaneous environmental retrofits and new generation that may be needed for coal plants to comply with the EPA's Mercury and Air Toxics Standards (MATS) rule. The study found that compliance with the MATS rule posed significant challenges. The study took into account the historical level of actual retrofits and new generation construction, typical timelines to complete various types of projects, potential bottlenecks in specialized types of labor, and the required planned outages in coal plants to install and test the environment control equipment.
- Co-authored studies that analyze the economics of retirement decisions for each coal plant operating in the United States under proposed and emerging EPA air quality and water regulations, taking into account the predicted profitability and cost of replacement power for both regulated and unregulated plants. The regulations were expected to force coal plants to decide between retiring versus installing expensive control equipment to reduce emissions of SO_2, NOx, particulates, and hazardous air pollutants such as mercury, as well as cooling towers to reduce the use of cooling water.
- For a natural gas producer, analyzed the potential for change in natural gas demand as a result of the Waxman-Markey climate policy proposal. Using scenarios for new renewable capacity and price of natural gas relative to coal, analyzed effects of CO_2 prices on dispatch switching from coal-fired to gas-fired generation plants in various ISO regions, as well as on demand for gas in non-electric sectors.
- Assisted an electric utility in understanding the implications of the Waxman-Markey climate policy proposal on its renewable generation portfolio and its electricity sales to other regions. Our team identified opportunities and risks for specific renewable technologies due to provisions in the bill imposing renewable portfolio standards for electric utilities.
- For electric utility companies in the eastern US, analyzed the potential effects of existing and developing environmental legislation and regulation on the existing generation fleet. The assignment included reviewing and summarizing the regulations by pollutant, identifying the specific generation plants that these regulations could affect, and estimating economics of retirement for each plant under a regulatory scenario.

- Conducted screening analyses for electric utilities to assess their exposure to allowance costs in the near term and long term due to recent cap and trade climate policy proposals. Under alternative assumptions to comply with the regulations (from complete reliance on allowance purchases to reducing emissions to meet the economy-wide targets), estimated the potential cost of the policy net of free allowances under the proposal using various CO_2 price scenarios.
- For an electric utility, assisted in evaluating expected natural gas prices under potential CO_2 prices due to proposed federal climate policies in the US The analysis included modeling of changes in demand for natural gas in electric and non-electric sectors as a result of potential CO_2 prices, as well as feedback effects due to dispatch switching from coal-fired generation plants to gas-fired generation plants in electric sector.
- Helped a large energy company evaluate the implications of several climate policy options on US CO_2 emissions from electric and transportation sectors, and consumption and prices of electricity, natural gas, and coal. The analysis focused primarily on long-term implications for future generation capacity mix, and provided insights about the feedback effects between fuel prices, electricity prices, and electricity consumption.

WHOLESALE MARKET ANALYSIS AND ASSET VALUATION

- For MidContinent Independent System Operator (MISO), evaluated design options for the resource adequacy market to provide efficient signals to resource owners for making their resources available during hours when the system is at or near scarcity conditions. As a result of the increasing penetration of renewables in the MISO region as well as the increasing prevalence of common mode failures at fossil-fuel generation plants, MISO is evaluating design options with the understanding that critical resource adequacy periods will increasingly include periods outside the summer peak load hours. The Brattle team evaluated alternative mechanisms for accreditation of resources under a sub-annual resource adequacy construct and for MISO's modeling of planned and forced outages in determining planning reserve requirements, and compared these mechanisms against other RTOs' practices.
- For an asset management firm considering investing in a virtual trading company with operations in the US Regional Transmission Organizations (RTOs), performed due diligence analysis on the trading algorithm, profitability, achievable market size, and compliance with market monitoring rules.

- For a large electric utility in Canada, researched the industry practices on the wind integration service rates charged by balancing authorities in the US outside the organized wholesale power markets.
- For a group of market participants in Texas, managed a team to estimate the impacts of implementing marginal losses in the ERCOT market on system production costs, transmission losses, LMPs, load payments, and generator revenues. The Brattle team simulated the ERCOT power system using the PSO software, and calibrated the model to recent generation and load patterns. The study results were made public in a proceeding before the Texas Public Utility Commission.
- For a large group of generation owners and trade groups, conducted a study to estimate the above-market payments to certain merchant generation plants with 90-day fuel supply under the US DOE's proposed payments. While the DOE's rationale for the proposed payments was to improve the resilient operations of the power system, the study concluded that 1) there is no evidence supporting the premise that 90 days of on-site fuel at individual power generating plants would improve the resilience of the grid in the regions where the rule would apply, and that 2) implementing the proposed rule would undermine core market principles and diminish some of the most important advantages of competitive wholesale power markets.
- For a developer of biogas power plant, submitted expert testimony on outlook on projected long-term wholesale power prices in Arizona. Reviewed forward market prices for near term deliveries as of the execution date of a contract with the supplier of waste feedstock, and summarized the industry expectations for the timing of the need and cost to build new generation in the region.
- For a developer of solar PV generation plants, conducted research and analyses to identify potential opportunities for renewables to be offered to electric utilities as qualifying facilities (QFs) under the Public Utilities Regulatory Policies Act (PURPA). Summarized the states with the largest penetration of renewable QFs and most favorable contract/pricing terms, and presented the likely outlook on avoided cost rates by region.
- For an investment firm, evaluated the projected net margins from energy and capacity markets in the Northeast for a new gas-fired generation plant. Assessed the key market drivers and risk factors associated with the plant's future performance, and conducted analyses to assess the implications for the asset's market value.
- For an independent power producer, analyzed the market trends in California power markets and explored potential value drivers of the client's existing gas-fired combined-

cycle plant in California. The Brattle team simulated the long-term wholesale energy prices in the Southern California region, and developed a modeling tool to analyze the projected capacity payments for existing resources under the California's local resource adequacy construct.

- Assisted an electric utility in performing a valuation of a coal-fired unit. Managed the analysis to model the projected revenues from energy and capacity markets, as well as to project variable and fixed operating costs and environmental compliance costs in the future. Various market and regulatory scenarios are considered and presented to the client.
- For an investor, performed a valuation analysis of a potential new gas combustion turbine (CT) in Texas. Developed scenarios for future energy-only and capacity markets, estimated regional reserve margins under a few load growth scenarios. In addition to estimating annual energy margins using a virtual commitment and dispatch model, estimated the projected run-hours for the new CT.
- For an investor, co-authored a valuation analysis of a large gas-fired cogeneration facility in the Midwest. In addition to projecting energy and capacity prices in the region under the key uncertainties on gas prices, coal plant retirements, and renewable generation additions, the study analyzed the projected revenues under the existing long-term sale contracts to provide energy and steam.
- Co-lead of team to assist a municipal electric utility in the Midwest US to sell a portion of its share of energy and capacity from a new coal plant. The Brattle team acted as the sale advisor to design the sale process, solicit bids, prepare informational documents, and evaluate the bids.
- For a Regional Transmission Organization (RTO) in the Midwest US, estimated the future costs and benefits from an electric utility joining that RTO as a member, compared to stand-alone and an alternative RTO membership. The analysis included impact on production cost savings, existing transmission constraints and interconnection capacities, wholesale trading activity, load diversity benefits, generation investment savings, and allocation of transmission costs and revenues.
- For a power plant developer, estimated the market potential for new wind, solar and gas peaking plants in the Eastern Interconnection. The Brattle team worked in close coordination with the client to develop and refine assumptions and scenarios on future fuel prices, capital costs of new plants, federal tax credits as well as federal climate policy. Economic potential for new generation alternatives was estimated by using Brattle's in-

house simulation model Xpand, which optimizes plant dispatch as well as generation entry and retirements in order to meet future electric demand and reserve margin requirements.

- For an electric cooperative in the Midwest, conducted studies to evaluate the impact of planned new wind and gas combined-cycle units at alternative locations on the nodal energy prices and net revenues for generation fleet owned by the cooperative. Provided analytical support to assess likely allocations of auction revenue rights for hedging congestion.
- For a large merchant generation company in PJM, assessed the likely causes of high energy prices during the polar vortex events. Analyzed the impact of each driver on market prices, and conducted simulations to evaluate the likely market prices in the future under similar weather conditions and sensitivities for coal plant retirements, increased penetration of demand-resources, and expected gas prices.
- For a large coal company, assisted in designing and evaluating innovative coal supply contracts with power plants. The project team developed a customized tool to simulate the regional energy and capacity prices in the eastern power markets, and evaluated the profitability of various types of supply contracts from the perspective of the coal company and the power plant. In addition, the Brattle team identified coal-fired power plants that could be potential candidates to benefit from signing innovative coal supply contracts.
- For a group of electric utilities in the Midwest, led a team to assess the energy-related costs and benefits of joining an RTO. Using a nodal pricing simulation software, the team estimated the net costs to customers of the utilities with respect to energy, congestion, marginal losses, and allocation of financial transmission rights and loss refunds under each configuration (stand-alone and RTO membership).
- For clients in PJM, examined the variability of historical congestion patterns to help assess the reasonableness of the utilities' FTR/ARR acquisition strategies.
- Provided consulting services on the impact of moving into a Locational Marginal Price (LMP) market design for a client in WECC. In addition to quantifying the expected congestion cost exposure under LMP market design, examined the impacts of potential mitigating solutions on the cost exposure and on the client's ability to hedge these costs through acquisition of financial instruments.
- Estimated the economic benefits of a proposed power plant in California. The project included an analysis of benefits from reduced market-clearing prices, avoided/deferred transmission upgrades, and reliability improvements.

- For an independent power producer, assessed the competitive offer price for its planned gas-fired generation unit in the PJM capacity market. Under key scenarios reflecting uncertainty in market fundamentals and in reasonable modeling assumptions, estimated the net cost of new entry (Net CONE) for the generation plant using plant-specific cost and performance information supplemented by publicly available estimates for generic plants. The key modeling assumptions driving the range of results were the appropriate methodology to levelize overnight capital costs and the appropriate time period over which the costs of the generation plant would be recovered in the PJM markets.
- Assisted an energy company to understand the fundamentals of the PJM capacity markets to inform the company's bidding strategy in the capacity auctions. Conducted a training session to go over the auction clearing mechanism, simulation of the market-clearing prices and quantities and alternative methodologies to project future market supply curves.
- For an energy trading company in western US, assessed the CAISO's historical calculations of nodal energy prices at specific locations. The focus of the assessment was to understand the impact of modeling differences between day-ahead energy markets and annual Congestion Revenue Rights (CRRs) auctions on the nodal energy prices at those locations. The findings of this assessment were used to support a complaint at FERC.
- For a transmission owner in Canada, assessed whether the proposed procedures to coordinate the Available Transmission Capacity (ATC) on its interfaces with neighboring systems are consistent with the FERC requirements and the practices of US counterparts. ATC coordination is required under FERC Order 890 in order to ensure that ATCs are calculated in a consistent manner by transmission providers and transmission service is provided in a non-discriminatory manner.
- For a Regional Transmission Operator (RTO) in eastern US, assisted in the preparation two expert reports regarding an alleged manipulation of market credit rules through its trading activity in the FTR markets. The analysis involved a review of the trading activity and an assessment of risks assumed by the trader through a review of historical congestion prices.
- Submitted a rebuttal and surrebuttal testimony jointly before the Pennsylvania Public Utilities Commission on the causes of an episode of high locational marginal prices (LMPs) experienced by a small electric utility in PJM wholesale energy markets. Using data on potential causes of high congestion and detailed market simulation modeling, identified several causes including increased virtual bidding activity, reduced transmission capability, and changes to physical characteristics of certain transmission assets.

- For an electric utility considering joining an RTO, managed transmission flow analyses of generation and load deliverability, as well as LMP market simulations to assess the effects of the company's move on prices in its service territory.
- Co-authored a report reviewing the results and the performance of the ISO-NE Forward Capacity Market (FCM) auctions conducted for the 2010/2011 and 2011/2012 commitment periods.
- Submitted affidavit at the Public Utilities Commission of Texas (PUCT) regarding a proposed rule to allocate costs of procuring replacement reserves to market participants in ERCOT.
- Analyzed the economic and network impacts of a utility signing renewable energy contracts with several potential renewable generation projects. Using market simulation tools such as MarketSymTM and PowerworldTM, simulated an entire reliability council to assess whether each of the potential renewable generation projects would cause additional transmission constraints, and estimated the impacts of these projects on LMPs across the region.
- Assisted an electric utility before the energy regulator in Quebec, Regie De l'Energie, involving third-party access to an electric transmission system owned and operated by another company.
- Assisted numerous clients in examining the potential for exercise of horizontal and vertical market power under FERC's market power tests as a result of asset acquisitions, mergers, and as part of periodical market-based rate (MBR) filings.
- Helped a client assess the potential liability and market impacts associated with offering the output of an out-of-service generation unit to the ISO-NE markets.
- Led the efforts to prepare a report assessing the implications of the Open Access Transmission Tariff (OATT) filed by Midwest ISO on market efficiency and gaming opportunities.
- Contributed to Brattle's investigation of the California power crisis on issues involving physical or economic withholding and manipulative gaming strategies such as double-selling, circular scheduling, wheel-out, simulation of real-time energy, and ancillary services markets.
- Estimated the potential for the exercise of market power in a load pocket in the northeast US power markets. The study simulated strategic behavior in order to assess the price risk for a distribution company due to congested transmission facilities.

RETAIL ELECTRIC RATES – COST ESTIMATION AND RECOVERY

- For an electric utility in the Western US, managed a team to support expert testimony before Oregon and Wyoming regulators with respect to the appropriate recovery mechanisms for fuel and purchased power costs. Demonstrated the historical persistency of under-recovery of such costs due to the inherent asymmetric nature of the difference between actual net purchased power costs and year-ahead deterministic forecasts. Compared the existing true-up methodology for that utility against the common industry practices across the US with respect to the use of variance deadbands, earnings tests and sharing arrangements between ratepayers and shareholders.
- For multiple clients including a university, several hospitals and a hotel and shopping complex in Pennsylvania, conducted economic due diligence studies on the potential cost savings from installing an on-site combined heat and power (CHP) facility that would offset the power and heating needs. Reviewed the key drivers of the potential cost savings including net metering revenues from excess generation output from the CHP plant, reduction in cost of purchasing grid power, and future market prices for power and fuels. Presented the findings to the executive teams and provided analytical support in contract negotiations.
- For an investor in distributed gas-fired generation assets in Texas, conducted a study on future savings in transmission and distribution service costs, and potential market penetration of distributed energy resources. The Brattle team reviewed key aspects of the wholesale market structure that directly impact the long term stability of the transmission tariff rate, and identified potential risks and mitigating factors associated with possible changes to the design of the market.
- For a retail electric provider in ERCOT, analyzed the costs and savings in its contract with a large customer to provide various services.
- In a merger involving two electric companies in the Eastern US, analyzed the impacts of the merger on competition in retail electricity markets. Both companies owned electric distribution companies, transmission assets, generation resources, and retail electricity providers in several states. The analysis involved assessment of whether the increased market share in wholesale energy markets affects retail competition, number of suppliers in retail electricity markets, ease of entry and exit to provide electricity to retail customers directly or through Default Service (DS) procurements, and potential for abusing affiliate relationships with the electric distribution company to favor the retail electricity provider affiliate.

- For an association of suite meter providers in Canada, analyzed whether the incumbent electric utility had been cross-subsidizing the provision of suite meters to its residential customers at the expense of its other customers. The analysis involved a comparison of the estimated fully-allocated costs of providing suite meters to the net revenues from these customers under the regulated retail rates under alternative assumptions on the costs of meters and types of suite meter installations.
- Prepared a marginal cost study for an integrated electric utility in the PJM region. The study estimated the incremental costs to the utility of serving additional demand and customers by time period, sub-region, and customer class.
- For a large electric customer of a utility in western US, assisted in evaluating the utility's proposed rate design. Specifically, provided an assessment of alternative methods to classify generation costs (as demand, energy, or customer related) and to allocate the fixed costs among customer classes. The analysis also included an assessment of the treatment of the costs and revenues associated with off system sales in determining the revenues to be recovered from various customer classes.
- For an electric customer in US, analyzed whether a proposed change in rates by the electric utility would result in just and reasonable rates for transmission level and station service customers. The resulting testimony assessed whether the proposed rates were consistent with fundamental principles of ratemaking such as cost causation and rate stability, and compared the proposed rate design to the rate options provided by utilities in other jurisdictions for transmission level and station service customers. The parties settled the case with reduced rates for the client based on the lower cost of serving transmission level customers relative to distribution level customers.
- For an electric utility planning to install smart meters and in-home displays in the eastern US, assisted in estimating the likely benefits to retail customers and to the utility. The quantified benefits to the utility company mostly came from reduced costs of meter reading and outage managements, whereas the customer benefits came from reduced costs of energy, capacity, and carbon emissions as a result of reduced peak load and annual energy consumption.
- Co-managed a case regarding a Texas electric utility company auctioning off its generation assets in order to determine its stranded costs. The project team assessed whether the market value of the utility's jointly-owned generation assets was depressed due to the rights of first refusal (ROFR) provisions attached to these assets, and whether the utility company failed to take commercially reasonable steps to mitigate its stranded costs.

- Helped a client analyze the cost of providing ancillary services (reserves, regulation, voltage support, etc.) from its hydroelectric generation facilities. The analysis required special emphasis to deal with the implications of separating cost of energy and ancillary services on the electricity rates of different customer types.

ARTICLES & PUBLICATIONS

- "A Review of Coal-Fired Electricity Generation in the US," with Long Lam, Jadon Grove and Natalie Northrup, prepared for The Center for Applied Environmental Law and Policy. (April 27, 2023)
- "Rail Delivery Disruptions in the US in 2022: An Overview of Scale and Extent," with Nicholas Powers, prepared for Alliant Energy. (March 30, 2023)
- "A Pathway to Decarbonization: Generation Cost & Emissions Impact of Proposed NC Energy Legislation," with Michael Hagerty, Matt Witkin, Julia Olszewski, and Frederick Corpuz, prepared for Cypress Creek Renewables (August 31, 2021)
- "Western Energy Imbalance Service and SPP Western RTO Participation Benefits," with John Tsoukalis, Johannes P. Pfeifenberger, Sophie Leamon, Carson Peacock, and Sharan Ganjam, prepared for Southwest Power Pool (December 2, 2020)
- "The Role of Economics in Evaluating Contractual Performance Defenses: Emerging Disputes on COVID-Related Force Majeure Claims," with Shaun D. Ledgerwood, Peter S. Fox-Penner, and Jake Zahniser-Word (September 2020)
- "The Brattle Group's Notes on the Affordable Clean Energy Rule," with David Luke Oates, Michael Hagerty, Yingxia Yang, and Marc Chupka (August 23, 2018)
- "The Cost of Preventing Baseload Retirements: A Preliminary Examination of the DOE Memorandum," with Richard Sweet, Kelly Oh, and Marc Chupka, prepared for Advanced Energy Economy (AEE), American Petroleum Institute (API), American Wind Energy Association (AWEA), Electricity Consumers Resource Council (ELCON), Electric Power Supply Association (EPSA), and Natural Gas Supply Association (NGSA) (July 19, 2018)
- "New Technologies and Old Issues under PURPA," with Robert S. Mudge, Mar Chupka, and Peter Cahill, Norton Rose Fulbright's *Project Finance NewsWire* (February 26, 2018)
- "The Future of Cap-and-Trade Program in California: Will Low GHG Prices Last Forever?" with Yingxia Yang, Michael Hagerty, Ashley Palmarozzo, Hannah Sheffield, Marc Chupka, and Frank C. Graves (December 5, 2017)

- "Comments on Expanding CES Eligibility to Existing Nuclear Units," with Onur Aydin, David Luke Oates, Tony Lee, and Kelly Oh, prepared for NextEra Energy Resources and presented to the Massachusetts Department of Environmental Protection in response to the proposed Clean Energy Standard-Existing (CES-E) (November 30, 2017)
- "The Future of the U.S. Coal Generation Fleet," with Marc Chupka, Dean M. Murphy, Samuel A. Newell, and Ira H. Shavel, ABA Antitrust Section Transportation and Energy Industries Committee Fall 2017 newsletter (November 30, 2017)
- "Evaluation of the DOE's Proposed Grid Resiliency Pricing Rule," with Judy Chang, Marc Chupka, Samuel A. Newell, and Ira H. Shavel, prepared for NextEra Energy, Inc. (October 26, 2017)
- "Impacts of Marginal Loss Implementation in ERCOT," with Toshiki Bruce Tsuchida, Rebecca Carroll, Colin McIntyre, and Ariel Kaluzhny, prepared for Ad Hoc Group, including Vistra Energy, The Wind Coalition, and First Solar (October 11, 2017)
- "Nuclear Retirement Effects on CO_2 Emissions: Preserving a Critical Clean Resource," with Marc Chupka, Frank C. Graves, Dean Murphy, and Ioanna Karkatsouli (December 2016)
- "Covering New Gas-Fired Combined Cycle Plants under the Clean Power Plan: Implications for Economic Efficiency and Wholesale Electricity Markets," with Judy Chang, Kathleen Spees, and Tony Lee (November 2016)
- "The Clean Power Plan: Focus on Implementation and Compliance," with Marc Chupka, Judy Chang, Ira H. Shavel, Kathleen Spees, Jürgen Weiss, Pearl Donohoo-Vallett, Michael Hagerty, Michael A. Kline, prepared as a Brattle Policy Brief (January 2016)
- "EPA's Proposed Clean Power Plan: Implications for States and the Electricity Industry," with Kathleen Spees, Michael Hagerty, Samuel A. Newell, Dean Murphy, Marc Chupka, Jürgen Weiss, Judy Chang, and Ira Shavel, prepared as a Brattle Policy Brief (June 2014)
- "Coal Plant Retirements: Feedback Effects on Wholesale Electricity Prices," with Onur Aydin and Frank C. Graves (November 2013)
- "Potential Coal Plant Retirements: 2012 Update," with Frank C. Graves and Charles Russell, published by The Brattle Group, Inc. (October 2012)
- "Supply Chain and Outage Analysis of MISO Coal Retrofits for MATS," with Kathleen Spees, Quincy Liao, and Steve Eisenhart (May 2012)
- "State Regulatory Hurdles to Utility Environmental Compliance," with Philip Q. Hanser and Bin Zhou, *Electricity Journal* (April 2012)

- "Decision Complexities in Utility Resource Planning and Environmental Compliance Investment," with Frank C. Graves, chapter in EPRI report "The Market Backdrop to US Power Generation Coal Technology Goal-Setting and Learning (September 2011)
- "Marginal Cost Analysis in Evolving Power Markets: The Foundation of Innovative Pricing, Energy Efficiency Programs, and Net Metering Rates," with Philip Q. Hanser, The Brattle Group Energy Newsletter Issue 2 (2010)
- "Virtual Bidding: The Good, the Bad, and the Ugly – Experience of RTOs with Virtual Bidding and Implications for Market Participants' Hedging Congestion Costs," with Attila Hajos and Philip Q. Hanser, *Electricity Journal* (June 2010)
- "Can the US Congressional Ethanol Mandate be Met?" with Evan Cohen, Michael I. Cragg, David Hutchings, and Minal Shankar, The Brattle Group discussion paper (May 2010)
- "Prospects for Natural Gas Under Climate Policy Legislation: Will There be a Boom in Gas Demand?" with Steven H. Levine and Frank C. Graves, The Brattle Group discussion paper (March 2010)
- "Internal Market Monitoring Unit Review of the Forward capacity Market Auction Results and Design Elements," with Dave Laplante, Hung-po Chao, Samuel A. Newell, and Attila Hajos, filed at FERC by ISO-NE (June 5, 2009)
- "CO_2 Price Volatility: Consequences and Cures," with Frank C. Graves, The Brattle Group discussion paper (January 2009)
- A Lexicon entry for "A Theory of Incentives in Procurement and Regulation – Laffont&Tirole," with Richard Arnott, Lexikon der Okonomischen Werke (2006)
- Contributing author for the Energy Bar Association Antitrust Committee's report on 2005 Antitrust Development
- "The CAISO's Physical Validation Settlement Service: A Useful Tool for All LMP Based Markets," with Philip Q. Hanser, Jared S. des Rosiers, and Joseph B. Wharton, *Electricity Journal* (October 2005)
- "The Design of Tests for Horizontal Market Power in Market-Based Rate Proceedings," with James Bohn and Philip Q. Hanser, *Electricity Journal* (May 2002)
- "Financial Transmission Rights: Implementation Issues," with Philip Q. Hanser, working paper (February 2002)
- "An Analysis of Incentives and Regulation in Providing Capacity and Reliability in Power Transmission Networks," unpublished PhD thesis for Boston College (September 2000)

PRESENTATIONS & SPEAKING ENGAGEMENTS

- "Cashing In On CHP: Increasing Energy Reliability and Savings with Combined Heat and Power (CHP)," with Frank C. Graves, Alan Seltzer, and John Povilaitis (June 3, 2021)
- "FERC's Recent Ruling on PURPA: Variable Energy Rate Option," EUCI Online Conference (December 15, 2020)
- "PURPA Notice of Proposed Rulemaking 2019," NRRI PURPA Perspectives Webinar (January 29, 2020)
- "PURPA Resurgence and Avoided Costs," EUCI Symposium (September 9, 2019)
- "Future of Coal: Clean Power Plan, Market Drivers, and Other Regulations," American Coal Ash Association's (ACAA) 2017 Winter Membership Meeting (January 25, 2017)
- "CO_2 Regulations and Coal," Energy Bar Association's (EBA) Energizer: Ongoing Climate Imperative (November 10, 2016)
- "Update on Clean Imperative and Sectoral Responses in the US Power Industry," with Robert S. Mudge, Susan Nickey, Allyson Umberger Browne, and Elias B. Hinckley, American Bar Association (ABA) Business Law Section's Annual Meeting (September 8, 2016)
- "The Clean Power Plan: Retirements and Reliability," Wisconsin Energy Institute 2015 Energy Summit (October 2015)
- "The Clean Power Plan: Retirements and Reliability," with Michael Hagerty, Yingxia Yang, and Nicole Irwin, EUCI Conference (April 1, 2015)
- "Hydropower and the EPA Section 111(d) Proposal," with Marc Chupka and Kathleen Spees, National Hydropower Association (August 12, 2014)
- "Coal Plant Retirements and Market Impacts," Wärtsilä Flexible Power Symposium (February 5, 2014)
- "U.S. Coal Plant Retirements: Outlook and Implications," Coaltrans West Coast Conference (June 14, 2013)
- "U.S. Coal Plant Retirements: Outlook and Implications," West LegalEd Center CLE Webcast (January 24, 2013)
- "Environmental Retrofits: Costs and Supply Chain Constraints," MISO Annual Stakeholders' Meeting (June 2012)

- "Potential Coal Plant Retirements in U.S. and Impact on Gas Demand," CERI Conference (February 27, 2012)
- "Potential Coal Plant Retirements and Retrofits Under Emerging Environmental Regulations," Minnesota Rural Electric Association (MREA) Annual Meeting (August 10, 2011)
- "Potential Coal Plant Retirements in ERCOT Under Emerging Environmental Regulations," with Frank C. Graves, Public Utility Commission of Texas workshop on Potential Environmental Regulations and Resource Adequacy (June 22, 2011)
- "The Regulatory Landscape for Coal-Fired Power: EPA Rules and Implications," with Frank C. Graves and Marc Chupka, EUCI Conference (January 24, 2011)
- "Potential Coal Plant Retirements under Emerging Environmental Regulations," with Frank C. Graves, Gunjan Bathla, and Lucas Bressan, EUCI Webinar (December 8, 2010)
- "Financial Instruments in Power Markets: Virtual Bids and FTRs," with Attila Hajos and Philip Q. Hanser, EUCI Conference (July 19, 2010)
- "Marginal Cost Studies in Ratemaking and Implications of Federal Climate Policy," Southeastern Electric Exchange Rates and Regulation Section Meeting (October 28, 2009)
- "CO_2 Price Volatility Delays Clean Generation Investment," Law Seminars International's Renewable Energy in New England Conference (June 25, 2009)
- "What to Expect from Electric Power and Transport Sectors in Response to U.S. Climate Policy," Rutgers University Center for Research in Regulated Industries (January 18, 2008)
- "Financial Transmission Rights: Necessary or Burdensome?" with Philip Q. Hanser, IAEE Conference (June 7, 2006)
- "Regulation of Transmission Investment and Reliability in Power Networks," METU International Conference in Economics V (September 2001)

SELECTED HONORS & AWARDS

1999	Summer Dissertation Award, Boston College Graduate School of Arts and Sciences
1998	Summer Dissertation Award, Boston College H. Michael Mann Fund
1991–1993	Scholarship, Yasar Holding Company

1988–1993 Tuition Scholarship and Stipend towards the completiton of BSc in Industrial Engineering, Turkish Ministry of Education

PROFESSIONAL ASSOCIATIONS & MEMBERSHIPS

2021–Present **American Bar Association (ABA)**
Sections: Litigation; Environment, Energy, and Resources; Infastructure and Related Industries

2022–Present **Energy Bar Association (EBA)**

LANGUAGES

- Turkish (native)

DECLARATION OF PATRICIO SILVA

I, Patricio Silva, declare:

1. I am a Principal Associate at Synapse Energy Economics, a research and consulting firm that specializes in power sector, environmental, and climate analysis. I received my J.D. from the University of Arizona College of Law and a B.A. in Government from Colby College. In my role at Synapse, I provide economic analysis of technologies and policies, perform electricity policy modeling, evaluate distribution system infrastructure, evaluate utility mergers, and evaluate air emissions of electricity generation.

2. Prior to working at Synapse, I worked for 12 years for the New England Independent System Operator, which manages the wholesale electricity markets for six states in the northeastern United States. There, I evaluated the impact of air pollution, water use, wildlife protection, and state and federal land-use laws and regulations on power system operations and system reliability. I also conducted assessments on environmental compliance impacts on all aspects of bulk power system operations including restoration and interconnection constraints.

3. I have participated in state and federal regulatory proceedings on a range of matters related to electric power generation and fuel supply: carbon emissions reduction trading markets; winter and summer power and fuel supply adequacy assessments; interregional transmission constraint studies; and integrating renewable generation into bulk power systems. I have testified before Congress and electric power siting boards and environmental review commissions in Illinois, Indiana, and Wisconsin. I have also participated in proceedings before the Federal Energy Regulatory Commission, state public utility commissions, electric power siting boards, and environmental review commissions in California, Connecticut, Massachusetts, Maine, Illinois, Indiana, Ohio, Oregon, New Hampshire, New Mexico, and Wisconsin involving preparing discovery, testimony, and affidavits. My CV is attached as Exhibit A.

4. The U.S. Environmental Protection Agency ("EPA") has promulgated a Final Rule establishing its Federal "Good Neighbor Plan" to address states' obligations to eliminate significant contribution to nonattainment, or interference with maintenance, of the 2015 Ozone National Ambient Air

Quality Standards in other states, published at 88 Fed. Reg. 36,654 (June 5, 2023) ("Final Rule"). The Final Rule will help reduce nitrogen oxides ("NO_X") emissions both from electric generating units ("EGUs"), such as coal-fired and natural-gas-fired power plants, and from non-EGU facilities in the iron and steel, paper, glass, cement, and other industries. Those NO_X reductions will create substantial public health and other economic benefits that dramatically outweigh the costs of implementing the Final Rule.

5. One key element of the Final Rule is a set of changes to the Cross State Air Pollution Rule ("CSAPR") Group 3 Trading Program, a cap-and-trade system that allocates emissions permits called allowances to a market that limits the ozone-season NO_X emissions of regulated EGUs. EPA's Final Rule, among other requirements, requires EGUs in 22 states to participate in the revised version of the CSAPR Group 3 Trading Program, establishes the minimum number of emissions allowances comprising each state's budget in the years 2023 through 2029, and establishes a mechanism for determining the number of emissions allowances available in subsequent years. Simultaneously, the Final Rule confirms the addition of new features to the allowance-based trading program such as backstop daily emissions rate limits for large coal-fired units and banking recalibration, to name a few.

6. Since EPA promulgated the Final Rule, some states have sought orders staying the implementation of the Final Rule. So far, U.S. Courts of Appeals have issued stay orders for 12 states, pending judicial review on the merits. Those states include Alabama, Arkansas, Kentucky, Louisiana, Minnesota, Mississippi, Missouri, Nevada, Oklahoma, Texas, Utah, and West Virginia.[1] This leaves 10 states with EGUs still covered by the Final Rule. These stays do not remove states' obligations to reduce NO_X emissions via CSAPR under earlier versions of the Good Neighbor Rule, however, which are intended to achieve the 2008, or in some cases, the 1997 ozone NAAQS. As a result, EPA has published regulatory revisions that, for the moment, clarify that states covered by stay orders will no

[1] 88 Fed. Reg. 49,295, 49,296-49,297 (July 31, 2023), available at https://www.govinfo.gov/content/pkg/FR-2023-07-31/pdf/2023-14180.pdf; 88 Fed. Reg. 67,102, 67,103 (September 29, 2023), available at https://www.govinfo.gov/content/pkg/FR-2023-09-29/pdf/2023-21040.pdf.

longer be covered as part of the Group 3 trading program, but will still be covered under pre-existing programs.[2] In essence, while these states will still need to reduce NO_X emissions in line with preexisting obligations, they and their allocations of allowances have been removed, at least for the moment, from the Group 3 trading program established by the Final Rule.

7. Despite this temporary reduction in the Final Rule's near-term coverage of states under the Group 3 allowance trading program, the Final Rule's emissions trading program is still reasonable and workable and has a high likelihood of achieving pollution reductions that create large public health benefits without endangering reliability or causing large electric rate increases. In this Declaration, I discuss analysis I performed that shows there will very likely be sufficient NO_X allowances available for compliance with the Final Rule in 2023 through 2025 in the 10 states currently without stay orders and covered EGUs, in light of ongoing changes in the electric generation industry. I also discuss how the Final Rule will support fuel diversity and reliability, how the *Inflation Reduction Act of 2022* ("Inflation Reduction Act") will support compliance, and how the Final Rule will create substantial public health and economic benefits. Last, I discuss reasons why the Final Rule, despite imposing compliance costs on certain EGUs, will not necessarily cause an increase in electricity rates.

There Is Sufficient Liquidity in the NOx Allowance Market to Accommodate EPA's Changes to the Group 3 Emissions Trading Program

8. As I explain below, opponents of the Final Rule have argued that EPA developed unrealistically stringent emissions allowance budgets for at least certain regulated states. According to my analysis, however, not only are there sufficient allowances, but there will be excess allowances in the market in 2023 through 2026, and very likely beyond, regardless of the current stay orders in place for 12 of the original 22 states. In fact, there is evidence that even if states were unable to trade with one another, each likely has enough allowances to meet its compliance obligations.

9. EPA developed the number of Group 3 ozone season NO_X emissions allowances

[2] 87 Fed. Reg. at 49,297; 88 Fed. Reg. at 67,104.

budgeted in the Final Rule by modeling different methods for reducing NO_X across all regulated EGUs.[3] The sum of a state's remaining EGU emissions in each year, accounting for modeled emissions reductions, became each state's preset emissions budget in each year from 2023 to 2029. Across these years, additional NO_X reduction measures as part of a staged compliance plan yield progressively lower emissions budgets.

10. In 2023, for example, EPA modeled the impact of unit-level optimization of existing NO_X controls during the ozone season.[4] Starting in 2024, the same optimization was included, with the addition of state-of-the-art combustion controls.[5] Also starting in 2024, the Final Rule includes a daily backstop emissions rate for all coal EGUs equipped with selective catalytic reduction ("SCR"). In 2026, allowance budgets declined further because the modeling reduced emissions for coal units larger than 100 megawatts by half of the amount anticipated to result from retrofitting with SCR. In 2027, all these coal units were modeled with ozone season NO_X emissions reductions equivalent to SCR installation. Later years involve continued emissions reductions in line with available control options. Collectively, these measures and others result in a year-over-year decline in the Final Rule's ozone season NO_X budget similar to the decline in emissions seen in previous years (Figure 1)

[3] CSAPR NOx Ozone Season Group 3 Trading Program includes EGUs in twenty-two states (Alabama, Arkansas, Illinois, Indiana, Kentucky, Louisiana, Maryland, Michigan, Minnesota, Mississippi, Missouri, Nevada, New Jersey, New York, Ohio, Oklahoma, Pennsylvania, Texas, Utah, Virginia, West Virginia, and Wisconsin), beginning with the 2023 ozone season.

[4] These include Selective Catalytic Reduction ("SCR") units and Selective Non-Catalytic Reduction ("SNCR") units.

[5] This includes reducing the allowance bank in each state, after compliance, by multiplying it by the ratio of 21 percent of the sum of state emissions budgets in the upcoming year and the sum of banked allowances across all states. For example, if the banked allowances at the end of 2023 were 1000 allowances and the budget in 2024 were 100 allowances, each state's bank would be multiplied by (21/1000), and only the allowances remaining would roll over into 2024.

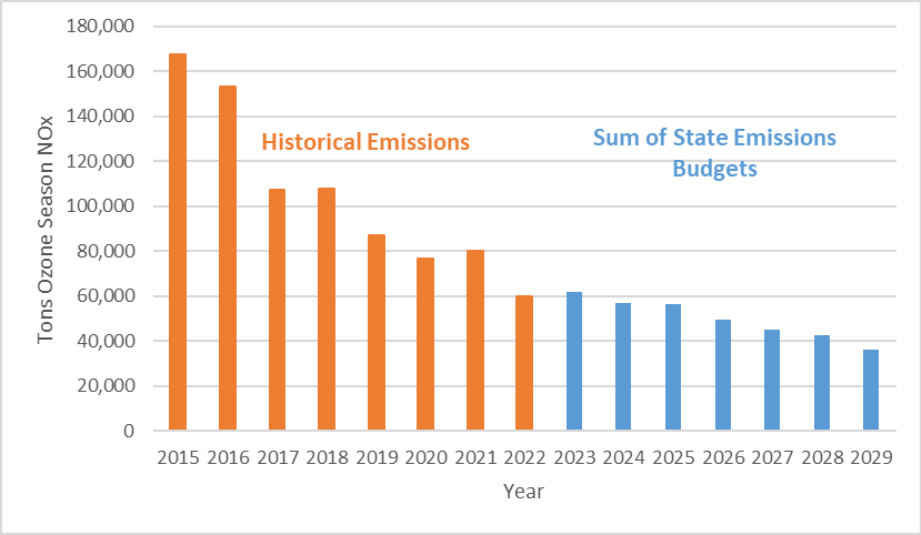

Figure 1. Historical ozone season NOx emissions and future NOx emissions according to Final Rule emissions budgets

Source: Historical data from EPA Clean Air Markets Program Data 2015–2022 for ozone season NO_X emissions.[6] Final Rule emissions summed from state emissions budgets.[7] Pictured data includes 10 states without stay orders: Illinois, Indiana, Maryland, Michigan, New Jersey, New York, Ohio, Pennsylvania, Virginia, and Wisconsin. 2023 budget includes prorating.

11. EPA's method responded to technical comments and concerns raised in response to the Proposed Plan, published at 87 Fed. Reg. 20,036 (Apr. 6, 2022) ("Proposed Rule"). Commenters raised concerns that EPA's budget-setting method and the NO_X mitigation measures modeled were too strict and inflexible. Specifically, they argued that the backstop emissions rate was too strict,[8] that emissions reductions achieved through SCR and SNCR optimization were too ambitious,[9] that generation-shifting was "unrealistic,"[10] and that not all units could realistically retrofit with SCR units in 2026.[11]

[6] EPA, *Clean Air Markets Program Data*, https://campd.epa.gov/data/custom-data-download (last updated Mar. 6, 2023).
[7] EPA, State Budgets Under the Good Neighbor Plan for the 2015 Ozone NAAQs, https://www.epa.gov/csapr/state-budgets-under-good-neighbor-plan-2015-ozone-naaqs (last updated Mar. 15, 2023).
[8] *See, e.g.,* Power Generators Air Coalition, Comment Letter on Proposed Rule: Federal Implementation Plan Addressing Regional Ozone Transport for the 2015 Ozone NAAQS ("Proposed Rule"), at 45 (June 21, 2022), https://www.regulations.gov/comment/EPA-HQ-OAR-2021-0668-0551.
[9] *See*, *e.g.*, Kentucky Attorney General Office et al., Comment Letter on Proposed Rule, at 9-10 (June 21, 2022), https://www.regulations.gov/comment/EPA-HQ-OAR-2021-0668-0382.
[10] *See*, *e.g.*, J. Edward Cichanowicz et al., Nat'l Rural Elec. Coop. Ass'n, Technical Comments on Electric Generating Unit Control Technology Options and Emission Allocations Proposed by the Environmental Protection Agency in
Support of the Proposed 2015 Ozone NAAQS Transport Rule, at 2 (June 21, 2022), https://www.regulations.gov/comment/EPA-HQ-OAR-2021-0668-0409.
[11] *See id.* at 1.

12. In response to those concerns, EPA adjusted the Final Rule to increase flexibility while maintaining stringency. For example, from the Proposed Rule to the Final Rule, EPA modified the allowance bank adjustment mechanism to increase the number of allowances that can roll over each year until 2029.[12] EPA also added a 50-ton threshold to the backstop emissions rate for large coal units with SCR controls, which will give units greater flexibility during start-up (88 Fed. Reg. at 36,673). The Final Rule also delayed the application of the backstop emissions rate for large coal-fired units without existing SCR controls from 2027 to as late as 2030 (*compare id.* at 36,667, *with* 87 Fed. Reg. at 20,105 as late as 2030). For further flexibility, EPA decided to phase in the emissions reductions commensurate with assumed EGU post-combustion emissions control retrofits across two years—2026 and 2027 (88 Fed. Reg. at 36,755). EPA also removed generation-shifting as a compliance strategy from its calculation of state emissions budgets.[13] As a result, the emissions budgets in the Final Rule, while still stringent, have increased compared to the proposal by a total of about 8 percent from 2023 to 2026 (*compare* 87 Fed. Reg. at 20,118-19, *with* 88 Fed. Reg. at 36,785-86).

13. To analyze whether there will be adequate allowances in a NO_X market comprised of the 10 states without stay orders, given the budgets set in the Final Rule, I built a spreadsheet model that forecasts state-level ozone season NO_X emissions from EGUs and available Group 3 allowances in each year from 2023 to 2026. Table 1 shows my methods for estimating EGU ozone season NO_X emissions in each year, banked allowances, total allowances available, and total allowances needed for compliance. As the table shows, I was very conservative in how I estimated regulated EGUs' annual NO_X emissions and available allowances; I assumed no additional

[12] The bank adjustment mechanism in the Proposed Rule and Final Rule reduces each state's bank available for the following ozone season's compliance by multiplying it by the ratio of a fraction of the sum of state emissions budgets and the sum of banked allowances left after compliance. In the Proposed Rule, the numerator was equal to the sum of state emissions budgets multiplied by 10.5 percent; the Final Rule replaced the 10.5 percent multiplier with 21 percent, increasing the adjustment factor.

[13] *See* EPA, *Regulatory Impact Analysis for the Final Federal Good Neighbor Plan Addressing Regional Ozone Transport for the 2015 Ozone National Ambient Air Quality Standard,* at 20 nn.4 (Mar. 2023), https://www.epa.gov/system/files/documents/202303/SAN%208670%20Federal%20Good%20Neighbor%20Plan%2020230315%20RIA_Final.pdf ("Final Rule RIA").

reductions whatsoever as a result of the Final Rule, and I assumed no incoming bank of allowances in 2023 for simplicity. I estimated the change in NO_X emissions after 2022 in each year from 2023–2026 based solely on a decline in coal generation and gas generation as forecast by the EIA's 2023 Annual Energy Outlook (AEO 2023) Reference Case, which was released shortly after the Final Rule, but which does not include the impact of the Final Rule.[14] The purpose of this method is to show that given a continuation in the longstanding trend of declining coal generation that predates and is independent of the Final Rule, coupled with a forecasted decline in gas generation, the Group 3 allowance budgets prescribed in the Final Rule will very likely be sufficient to meet market needs. Although data for 2023's monthly coal generation and NOx data is not yet fully available, early reports from the Energy Information Administration indicate that, as of June 2023, EIA expected coal generation to be 15% less in the summer of 2023 compared to summer 2022—a far greater reduction than what I modeled, reinforcing how conservative my analysis is.[15]

Table 1. Methods used in analysis

Methodology Type	2023	2024	2025	2026
Methodology for estimating banked allowances heading into the year	No banked allowances were included in analysis.	After subtracting allowances needed for compliance in the previous year, the remaining bank was multiplied by the ratio between the total emissions budget of this year across all 10 states (prescribed by the Final Rule) multiplied by 21% and the total quantity of banked allowances. This adjusted the bank downward for each state.	Same method as 2024	Same method as 2024
Methodology for total allowances available for compliance	Only allowances included in EPA's prorated state budgets were included.	Available banked allowances from the end of the previous year (after the bank adjustment) were added to the state emissions budgets specified by the Final Rule.	Same method as 2024	Same method as 2024

[14] EIA, *Annual Energy Outlook 2023* (Mar. 16, 2023), https://www.eia.gov/outlooks/aeo.
The bank adjustment mechanism in the Proposed Rule and Final Rule reduces each state's bank available for the following ozone season's compliance by multiplying it by the ratio of a fraction of the sum of state emissions budgets and the sum of banked allowances left after compliance. In the Proposed Rule, that fraction was equal to the sum of state emissions budgets multiplied by 10.5 percent; the Final Rule replaced the 10.5 percent multiplier with 21 percent.
[15] EIA, Today in Energy (June 8, 2023), https://www.eia.gov/todayinenergy/detail.php?id=56760#:~:text=Between%20June%202022%20and%20May,summer%20compared%20with%20last%20summer.

Methodology for estimating NOx emissions	2022 ozone season NOx emissions data for all 10 states with regulated EGUs is from EPA CAMPD annual data. The state-specific proportion of ozone season NOx in 2022 from coal plants versus gas plants was used to forecast ozone season NOx emissions in each year 2023–2026 based on the anticipated change in national coal generation and gas generation forecast by EIA's 2023 Annual Energy Outlook.			
Methodology for estimating allowances needed for compliance	Each forecasted ton of ozone season NOx was assumed to retire one Group 3 allowance.	The quantity of allowances turned in for compliance was equal to the sum of two elements: (1) tons of NOx emissions emitted in a state above 121% of a state's emissions budget (known as each state's "assurance level") consumed 3 allowances rather than one. (2) tons of NOx equal to or less than 121% of a state's emissions budget each consumed one allowance.	Same method as 2024	Same method as 2024

14. As I have noted, my analysis depends on the Reference Case of EIA's AEO 2023, which forecasts that coal generation throughout the United States will initially increase in 2024, then continue to decrease (Table 2).[16] Since coal generation contributed, on average, 65 percent of ozone season NO_X emissions from the power sector in 2022 across the 10 states I examined, I adjusted the effect that changes in coal generation and gas generation have on total NO_X appropriately. The total ozone season NOx reduction I modeled from 2023 to 2026, on average across the 10 states, is about 22 percent. For comparison, EPA's baseline modeling for the EGUs in the 22 states originally covered under the Final Rule indicates ozone season NOx emissions will decline even further, by about 27 percent, even without the Final Rule due to market forces.[17]

Table 2. Change in coal generation from AEO 2023 and assumed impact on ozone season NO_X

Year	2023	2024	2025	2026
Annual change in coal generation	-5.9%	5.2%	-8.4%	-14.3%
Annual change in gas generation	-6.7%	-7.0%	-5.1%	-4.5%
Assumed annual change in NO_X due to change in coal and gas generation	-6%	1%	-7%	-11%

[16] For the purposes of my analysis, I make the simplifying assumption that coal and gas generation during the ozone season declines in line with the average annual change in coal and gas generation according to AEO 2023.
[17] Final Rule RIA, *supra note 13,* at 148 tbl.4-6.

15. Notably, AEO 2023 did not factor in the impact of the Proposed Rule or Final Rule. It also did not factor in more recent to coal unit effluent limitation guidelines.[18] This means that the decline in coal generation seen in AEO 2023 is due to entirely independent factors—primarily the lower cost of alternative generation from gas and clean energy sources.

16. Using this estimate of annual NO_X emissions, my analysis shows that based upon the decline in coal generation alone, there will likely be an allowance surplus of 9 percent in 2023, rising to 44 percent in 2026. This shows that even if the emissions reduction measures anticipated by the Final Rule dramatically underperform or regulated EGUs fail to adopt the control measures EPA expects, there will still very likely be adequate allowances in the market until 2026 (Table 3).

Table 3. Model results

Year	**2023**	**2024**	**2025**	**2026**
Incoming bank	0	5,242	9,579	10,354
Total budget	62,010	56,940	56,649	49,303
Total available allowances	62,010	62,182	66,228	59,657
Estimated ozone season emissions	56,768	60,017	46,848	41,062
Allowances needed	56,768	52,603	46,848	41,352
Remaining allowances before bank recalibration	5,242	9,579	19,380	18,305
Surplus % of allowances beyond those needed for compliance	9%	18%	41%	44%

17. Note that I do not include any incoming allowance bank in 2023, despite provisions that allow this.[19] I did not include these allowances due to data availability, to keep my analysis simple, and to be conservative. With an incoming bank in 2023, however, the likelihood increases that

[18] As stated in the Coal Market Module documentation of AEO 2023, AEO 2023 is based on current laws and regulations in effect as of September 30, 2022. While the coal market module does account for CSAPR, it includes only the CSAPR finalized in 2015 and updated in 2021, which established Group 3 and required 12 states to update emissions budgets for NOx. EIA, *Assumptions to the Annual Energy Outlook 2023: Coal Market Module* (Mar. 2023), https://www.eia.gov/outlooks/aeo/assumptions/pdf/CMM_Assumptions.pdf.

[19] US EPA, FACT SHEET Creation of an Additional Group 3 Allowance Bank for the 2023 Control Period (June 2023), https://www.epa.gov/system/files/documents/2023-03/Creation%20of%20an%20Additional%20Group%203%20Allowance%20Bank%20for%20the%202023%20Control

there will be adequate Group 3 allowances in the market to meet total market demand, particularly in 2023 and 2024, before bank recalibration mitigates the effect. Furthermore, compliance with EPA's Final Rule includes measures that will further reduce NO_X emissions, namely: SCR and SNCR optimization; state-of-the-art combustion controls; a backstop daily emissions rate; and emissions reductions commensurate with SCR or SNCR retrofitting beginning in 2026.

18. One element I did not directly model in my analysis was the Final Rule's backstop daily emissions rate, which will take effect for coal units greater than 100 megawatts with SCR controls in 2024. If one of these units exceeds the backstop emissions rate, the Final Rule mandates that each ton of ozone season NOX emitted above the daily rate after the first 50 will require three allowances to be turned in rather than one. This facet of the Final Rule will likely increase demand for allowances. However, as I have explained, I have conservatively overestimated NOX emissions by not including any reductions due to SCR optimization, SNCR optimization, state-of-the-art combustion controls, or mandatory emissions reductions commensurate to installing additional post-combustion emissions controls. Further, the imposition of the backstop emissions rate will itself reduce demand for allowances, since compliance across most units and most hours will reduce emissions relative to what I have modeled. Finally, the 50-ton limit before the 3:1 allowance ratio takes effect has increased flexibility, further ensuring that there will be adequate allowances to satiate demand.

EPA's Final Rule Will Support Generation Diversity and System Reliability

19. Some opponents of EPA's Good Neighbor Plan have argued that EGU closures and the subsequent shift in the resource mix as a result of the Final Rule will negatively impact fuel diversity and threaten electric system reliability.[20] Independent system operators, regional transmission organizations, and other entities tasked with maintaining the reliability of the bulk power system in the Eastern, Western, and Texas grids also raised concerns following the release of EPA's Proposed Rule.[21]

[20] *See,* e.g., Cichanowicz et al., *supra* note 10, at 63-64.
[21] See, e.g., PJM Interconnection, Comment Letter on Proposed Rule (June 21, 2022), https://www.regulations.gov/comment/EPA-HQ-OAR-2021-0668-0412; Electric Reliability Council of Texas et al.,

In response, EPA worked extensively with affected regional transmission organizations to address their reliability concerns.[22]

20. Remaining arguments related to reliability concerns ignore the integrated operation of the balancing areas operating in the Eastern and Western interconnections, where power flows between adjacent balancing areas can help alleviate energy demand even in the midst of summer peak demand. For example, the Midcontinent Independent System Operator noted this year that improvements in load forecasting, planning procedures, advanced scheduling of resources, and about 8.5 gigawatts of imports from adjacent balancing areas helped meet August's 125 gigawatt summer demand peak demand without disruption to customers.[23] Other operators have had to resort to more drastic measures, but nevertheless preserved reliability. On September 7, 2023, for example the Electric Reliability Council of Texas, with 6.4 gigawatts of thermal generating capacity unavailable in Texas due to unplanned outages, and limited import capacity from adjacent balancing areas, requested a waiver of environmental limits for 17 individual fossil fired-generating units (8.1 gigawatts at 16 natural gas-fired units, and 0.61 gigawatts at 1 coal-fired unit) to help meet a peak demand of 84.2 gigawatts on September 8, 2023.[24] Both examples demonstrate the robustness of reliability standards and procedures system operators follow in meeting summer peak demand episodes and also underscore the increasing importance of increasing access to a diverse range of generation and transmission resources in all balancing areas. Based on my analysis, I do not find that implementation of the Final Rule will cause

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Comment Leter on Proposed Rule (June 21, 2022), https://www.regulations.gov/comment/EPA-HQ-OAR-2021-0668-0413.

[22] *See* 88 Fed. Reg. at 36,679; *EPA Good Neighbor Rule Plan Reflects PJM and Industry Input*, PJM INSIDE LINES (Mar. 16, 2023), https://insidelines.pjm.com/epa-good-neighbor-plan-reflects-pjm-and-industry-input/.

[23] MISO, *Overview of August 24th, 2023 Maximum Generation Event*, Reliability Subcommittee (October 3, 2023), https://cdn.misoenergy.org/20231003%20RSC%20Item%2005%20Overview%20of%20August%2024%20Max%20Gen%20Event630385.pdf. At the time of the peak MISO relied on: coal (46.1 GW); natural gas (45.8 GW); nuclear (10.7 GW); wind (9.3 GW); imports (8.5 GW); other (4.1 GW); and solar (2.6 GW).

[24] ERCOT, *Notice of U.S. Department of Energy Section 202(c) Order Affecting the ERCOT Region* (September 7, 2023), https://www.ercot.com/services/comm/mkt_notices/M-C090723-01, and https://www.ercot.com/about/legal/doe202c. At the time of the Sep. 8, 2023 peak, ERCOT relied on: natural gas (48.7 GW); solar 11.8 GW; coal (11.7 GW); wind (5.5 GW); nuclear (4.9 GW); power storage (0.3 GW); hydro (0.2 GW).

many coal plant retirements, and in any case, coal plant closures have not and will not cause reliability problems. In addition, as I discuss, there is strong evidence that accelerated coal unit closures and the continued build-out of clean generation sources will improve overall system reliability, energy security, and resiliency.

21. EPA's Final Rule does not mandate fossil unit retirement or a decline in generation. As EPA states, the "owner or operator of an EGU has flexibility in determining how it will meet [emissions reduction] requirement[s], whether through the add-on emissions controls that the EPA has selected […], or through some other method or methods of compliance" (88 Fed. Reg. at 36,680). Nor does the Final Rule impose an "anti-coal bias" on states and the nation's electricity supply, as the coal advocate group America's Power suggests.[25] Rather, the Final Rule regulates NO_X emissions, which represent one component of EGU operations. It does so by offering a variety of compliance options that enable units to continue functioning into the future: retrofitting with additional environmental controls, adjusting fuel inputs, improving efficiency of current environmental controls, or buying emissions allowances, to name a few.[26] To the extent that coal units do retire between now and 2030, there are many other factors in play; S&P Global, for example, projects that of the 58.7 gigawatts of U.S. coal generating capacity projected to retire through 2030, an estimated 24.3 gigawatts (or 41.4 percent) are attributable to Inflation Reduction Act incentives for other generating technologies.[27]

22. In the event of a reliability emergency, the Final Rule would not constrain a unit's ability to obtain emergency waiver authorizations from the Department of Energy under *Federal Power Act* section 202(c), 16 U.S.C. § 824a(c), which may allow it to operate beyond its environmental

[25] Ethan Howland, *Power Plant Owners in 22 States Face Tighter NOX Requirements Under EPA's Final Good Neighbor Rule*, UTIL. DIVE (Mar. 15, 2023), https://www.utilitydive.com/news/EPA-ozone-good-neighbor-rule-nox-coal-power-plant-/645082/.
[26] *See* Final Rule RIA, *supra note 13*, at ES-9.
[27] Taylor Kuykendall et al., *Inflation Reduction Act to Accelerate U.S. Coal Plant Retirements*, S&P GLOBAL (Feb. 10, 2023), https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/inflation-reductionact-to-accelerate-us-coal-plant-retirements-74196498.

permit limits for a limited period to restore system reliability.[28] The Department of Energy and EPA also announced a memorandum of understanding detailing a framework for interagency consultation to coordinate monitoring and any actions that might be required to ensure continued system reliability.[29]

23. To the extent that coal-unit or grid operators make the economic decision to reduce coal generation following the implementation of the Final Rule, that is consistent with the principle of economic dispatch that underlies the modern grid. It is also consistent with longstanding trends in the electric power industry, which has steadily replaced coal capacity with a combination of less expensive gas, solar, wind, storage, energy efficiency, and demand response for more than two decades. This decline predates the Final Rule and indicates a larger industry trend toward resource diversification and away from coal-powered generation. According to the EIA, roughly 10 gigawatts of coal-fired EGUs retired each year between 2012 to 2021. Evidence for a continuation of this decline independent of the Final Rule is very strong; coal owners have already planned to retire nearly a quarter of the U.S. coal fleet operating today by 2029.[30] EIA's AEO 2023, which as I have stated did not account for the Final Rule at issue here, forecasts that coal capacity will decline even further due to market forces:

> "As a result of renewables growth, we project that U.S. coal-fired generation capacity will decline sharply by 2030 to about 50% of current levels (about 200 [gigawatts]) with a more gradual decline thereafter. We project between 23 [gigawatts] and 103 [gigawatts] of coal-fired capacity operating in 2050 (Figure 6). The [Inflation Reduction Act of 2022] provides additional incentives to wind and solar power generation, which accelerates the near-term decline of electric power sector coal-fired generating capacity and hastens the

[28] *See* DOE, *DOE's Use of Federal Power Act Emergency Authority*, https://www.energy.gov/ceser/does-usefederal-power-act-emergency-authority (last visited Apr. 13, 2023) (listing past section 202(c) emergency orders).
[29] DOE & EPA, *Joint Memorandum on Interagency Communication and Consultation on Electric Reliability* (Mar. 9, 2023), https://www.epa.gov/system/files/documents/2023-03/DOEEPA%20Electric%20Reliability%20MOU.pdf
[30] Tyson Brown, *Nearly a Quarter of the Operating U.S. Coal-Fired Fleet Scheduled to Retire by 2029*, EIA (Nov. 7, 2022), https://www.eia.gov/todayinenergy/detail.php?id=54559#:~:text=Between%202012%20and%202021%2C%20an,capacity%20was%20retired%20each%20year. According to EIA, planned retirements are concentrated amongst relatively older, less efficient coal units facing higher operating and maintenance costs, which make them less competitive.

timeline for retirement in the U.S. coal fleet."[31]

According to EPA's Regulatory Impact Analysis for the Final Rule, 14 gigawatts of coal units in total are expected to retire as a result of implementation of the Final Rule by 2030, representing less than 1.5 percent of all capacity in the United States.[32] This is also equivalent to about 7 percent of the coal capacity forecasted to retire by 2030 according to EIA's AEO 2023, quoted above. Since EPA and EIA both use optimization models that retire the least economic units first, it is likely that there is considerable overlap between the coal units that retire in EPA's analysis as a result of the Final Rule and those that retire in EIA's forecast regardless of the Final Rule.

24. Nor should retiring coal generation be viewed through an oversimplified lens as a reduction in grid reliability. Rather, it should be viewed as a transition away from older and increasingly less reliable units poorly suited to meet the needs of the modern grid. Coal plants have relatively slow ramp rates compared to faster ramping resources, such as natural gas units and storage, and analyses have found that some coal units will not show up for a capacity or energy need within the operating day if they are not committed in advance.[33] This makes coal units poorly suited to provide the flexibility needed to manage the needs of a grid increasingly composed of intermittent renewables.[34] Furthermore, the 41 year- old average age of a coal unit in the United States as of 2022 is concerning.[35] As this machinery continues to age, the cost of maintenance goes up and units become more prone to mechanical failure, leading to unforced outages that are difficult to predict and can

[31] EIA, *Annual Energy Outlook 2023*, Administrator's Forward (Mar. 16, 2023), https://www.eia.gov/outlooks/aeo/narrative/#casedescriptons.
[32] Final Rule RIA, *supra note 13*, at 272. In 2022, the electricity sector had roughly 1,200 GW of capacity installed in the U.S. See Am. Pub. Power Ass'n, *America's Electricity Generating Capacity 2022 Update* (Mar. 2022), https://www.publicpower.org/resource/americas-electricity-generating-capacity.
[33] Jason Frost et al., *The Impact of Resource Inflexibility on Capacity Accreditation in New England*, SYNAPSE ENERGY ECON. 4, 12 (Mar. 2023), https://www.sierraclub.org/sites/www.sierraclub.org/files/2023-03/Capacity%20Accreditation%20for%20Inflexible%20Resources%202023_03_07%20%281%29.pdf.
[34] DOE, *The Importance of Flexible Electricity Supply* (May 2011), https://www1.eere.energy.gov/solar/pdfs/50060.pdf.
[35] *Average Age of Existing Coal Power Plants in Selected Regions in 2020*, INT'L ENERGY AGENCY, https://www.iea.org/data-and-statistics/charts/average-age-of-existing-coal-power-plants-in-selected-regions-in-2020 (last updated Oct. 26, 2022).

prevent units from coming online or functioning as expected.[36] Lastly, events such Winter Storm Uri in Texas and Winter Storm Elliott across the eastern United States illustrate that coal generation cannot always be counted on in critical conditions such as extreme weather events. During the infamous blackouts in February of 2021, almost half of Texas's coal fleet tripped offline.[37] Winter Storm Elliott caused 90.5 gigawatts of unplanned generating outages at 1,702 individual generating units, with FERC, NERC and regional system operators staff identifying 825 natural gas-fired generating units (47 percent of operating capacity) and 415 coal-fired generating units (12 percent of operating capacity) in the Eastern Interconnection, serving the eastern United States, that experienced outages or significant reductions in output during the December 2023 storm event.[38]

25. Meanwhile, solar, wind, and battery capacity compose the vast majority of electric generating capacity brought online so far in 2023 and planned for the rest of the year, while coal continues to decline.[39] Overall, there are 1,300 gigawatts of solar, wind, and battery capacity seeking grid interconnection according to the Lawrence Berkeley National Laboratory.[40] While solar and wind are intermittent, their generation profiles are increasingly well understood, and energy storage is increasing the amount of clean energy that can be delivered on demand to the grid.[41] The National Renewable Energy Laboratory has also found that renewable energy strengthens energy security because it further

[36] EIA, *Generating Unit Annual Capital and Life Extension Costs Analysis* (2019), https://www.eia.gov/analysis/studies/powerplants/generationcost/pdf/full_report.pdf.
[37] Garrett Golding, *Texas Electrical Grid Remains Vulnerable to Extreme Weather Events*, FED. RES. BANK DALL. (Jan. 17, 2023), https://www.dallasfed.org/research/economics/2023/0117 (noting improvements in regional weatherization standards, fuel supply chain mapping, and operating standards adopted since the February 2021 winter storm event did not alleviate continuing power system vulnerabilities, observed during the December 2022 cold snap that included forced outages of 10 GW of fossil-fired capacity and 6 GW of renewable capacity during winter peak demand of 73 GW).
[38] FERC-NERC, Joint Staff December 2022 Winter Storm Elliott Grid Operations: Key Findings and Recommendations (Sep. 21, 2023), https://www.ferc.gov/news-events/news/presentation-ferc-nerc-regional-entity-joint-inquiry-winter-storm-elliott.
[39] EIA, *Developers added 16.8 GW of U.S. utility-scale generating capacity in first-half of 2023* (August 2023), https://www.eia.gov/todayinenergy/detail.php?id=57340
[40] DOE, *DOE Launches New Initiative to Improve Clean Energy Interconnection* (Oct. 17, 2022), https://www.energy.gov/eere/wind/articles/doe-launches-new-initiative-improve-clean-energy-interconnection.
[41] *See* Nat'l Renewable Energy Lab., *Wind Integration Data and Tools*, https://www.nrel.gov/grid/wind-integration-data.html (last visited Apr. 13, 2023); Nat'l Renewable Energy Lab., *Solar Resource Data and Tools*, https://www.nrel.gov/grid/solar-resource/renewable-resource-data.html (last visited Apr. 13, 2023); EIA, *Battery Storage in the United States: An Update on Market Trends* (Aug. 16, 2021), https://www.eia.gov/analysis/studies/electricity/batterystorage/.

diversifies the grid's resource mix. Resource diversification reduces reliance on any one specific fuel type and hedges against reliability and security risks such as fuel supply constraints and price fluctuations.[42] Because renewable energy increases the share of domestic production of "fuel," it also insulates ratepayers and energy markets from major geopolitical events, thereby increasing energy security. Furthermore, deploying distributed renewable energy resources promotes electric reliability by reducing the likelihood of outages due to large-scale, single-point of failure power plants.[43] This strengthens the system's overall resiliency to extreme weather impacts and security threats since there are fewer points of critical energy infrastructure.

The Emissions Allowance Prices of the 2022 Ozone Season Are Not Indicative of the Cost of Compliance with the Final Rule

26. Group 3 allowance prices in 2022 are not an indicator of the forward-going cost of Group 3 allowances or of the cost of compliance with the Final Rule. This is clearly shown by the state of current allowance prices, which have fallen substantially from their 2022 high. As of August 17, 2023, the spot price for 2023 vintage Group 3 NOx allowances was about $3,200—far below the $12,326 average price in the first six months of 2023 and the $19,759.75 average price for 2022.[44]

27. There are several reasons for the decline in CSAPR Group 3 NOx allowance prices. First, the increase in CSAPR Group 3 seasonal allowance prices in 2022 was due, in large part, to temporary phenomena unique to that year. Russia's invasion of Ukraine in February 2022, for example, had the effect of increasing natural gas prices, which increased the cost to run gas power plants in the United States. This along with record high summer power burn domestically, in some cases associated with extreme weather conditions in portions of the United States, drove the average cost of wholesale

[42] Sadie Cox, Laura Beshilas & Eliza Hotchkiss, *Renewable Energy to Support Energy Security*, NAT'L RENEWABLE
ENERGY LAB. (2019), https://www.nrel.gov/docs/fy20osti/74617.pdf.
[43] EPA, *The Multiple Benefits of Energy Efficiency and Renewable Energy*, at I-10 (2018), epa.gov/sites/default/files/2018-07/documents/mbg_1_multiplebenefits.pdf.
[44] Monitoring Analytics, L.L.C., *2023 Quarterly State of the Market Report for PJM,* § 8, at 444 (Aug. 10, 2023), https://www.monitoringanalytics.com/reports/PJM_State_of_the_Market/2023/2023q2-som-pjm-sec8.pdf, *2022 State of the Market Report for PJM,* § 8, at 436 (Mar. 9, 2023), https://www.monitoringanalytics.com/reports/PJM_State_of_the_Market/2022/2022-som-pjm-sec8.pdf.

natural gas in 2022 to its highest level since 2008.[45] Higher marginal costs to run gas units meant that coal units competing with gas could afford to pay more for allowances while maintaining a similar level of competitiveness.[46] This contributed to higher demand for allowances, and higher prices. Since spiking during 2022, natural gas prices have declined and are expected to continue to decline however,[47] thereby lessening this upward pressure on allowance prices.

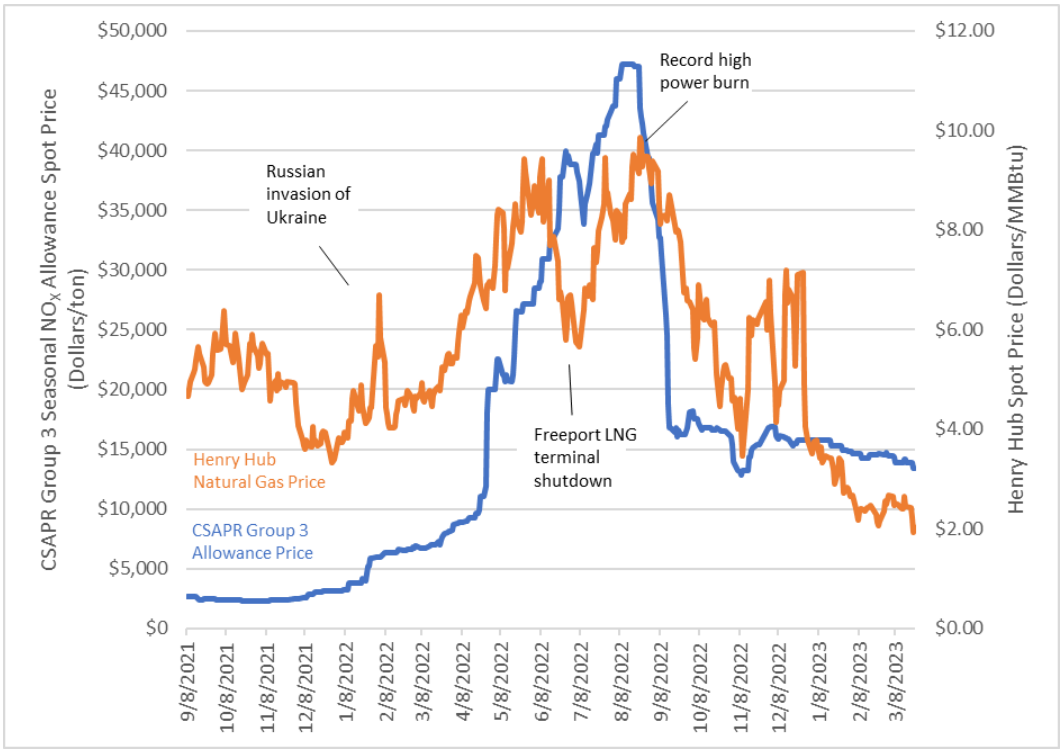
28. Second, as stated by S&P Global, uncertainty over the publication of the Final Rule also increased the allowance price by increasing demand.[48] That uncertainty is now largely resolved, and emissions budgets have been established with greater certainty through 2029. With this information, unit operators can optimize allowance purchases and other compliance options. Allowance prices over the next several years will depend on the extent to which covered units decrease their emissions, power market prices, fuel price volatility, and many other factors. Historical examples of other emissions trading programs show that short-term trends and price volatility, particularly in response to new program design implementation, do not indicate the long-term price of compliance.[49] For example, initial allowance price volatility observed during implementation of the NO_X Budget Program in 2003 was attributable in part to uncertainty flowing from litigation-related delays in adopting certain requirements.[50]

29. In 2022, reported CSAPR Group 3 NO_X compliance costs varied amongst affected generators due to generating technology, fuel type, age, and location. The latter factor subjects them to differences in design elements of the energy markets and fuel supply chains across the eastern United

[45] Kirby Lawrence*, Average Cost of Wholesale U.S. Natural Gas in 2022 Highest Since 2008*, EIA (Jan. 9, 2023), https://www.eia.gov/todayinenergy/detail.php?id=55119#.
[46] *2022 Ozone Season NOx Prices Rise with Natural Gas Prices*, S&P GLOBAL (July 14, 2022), https://www.spglobal.com/commodityinsights/en/ci/research-analysis/2022-ozone-season-nox-prices-rise-with-natural-gas-prices.html.
[47] EIA, ANNUAL ENERGY OUTLOOK 2023, tbl.3, https://www.eia.gov/outlooks/aeo/data/browser/#/?id=3-AEO2023&region=1-0&cases=ref2023&start=2021&end=2050&f=A&linechart=~ref2023-d020623a.38-3-AEO2023.1-0&map=ref2023-d020623a.4-3-AEO2023.1-0&ctype=linechart&sourcekey=0.
[48] *2022 Ozone Season NOx Prices*, supra note 46.
[49] *See* Richard Schmalensee & Robert N. Stavins, L*essons Learned from Three Decades of Experience with Cap and Trade*, 11 REV. ENVTL. ECON. & POL'Y 59 (2017)
[50] *Id.* at 65; Alan Farrell, *The NOX Budget: A Look at the First Year*, 13 ELECTRICITY J. 83 (2000).

States. The estimated portion of load-weighted average locational marginal price during 2022 for Group 3 allowances ranged from $2.31 to $20 per megawatt-hour across regional energy markets that require generators to decompose their power generation offers.[51] Figure 2 below shows how CSAPR Group 3 allowance spot prices tracked natural gas spot prices at the Henry Hub (Louisiana) national benchmark. As the figure shows, allowance spot prices reacted to increasing demand for U.S. liquefied natural gas ("LNG") exports to Europe and weather-related demand for natural-gas-fired electricity generation, which was interrupted by the June 8, 2022 shutdown of the Freeport LNG terminal.

Figure 1. CSAPR Group 3 seasonal NO_X allowance spot price vs. Henry Hub spot price



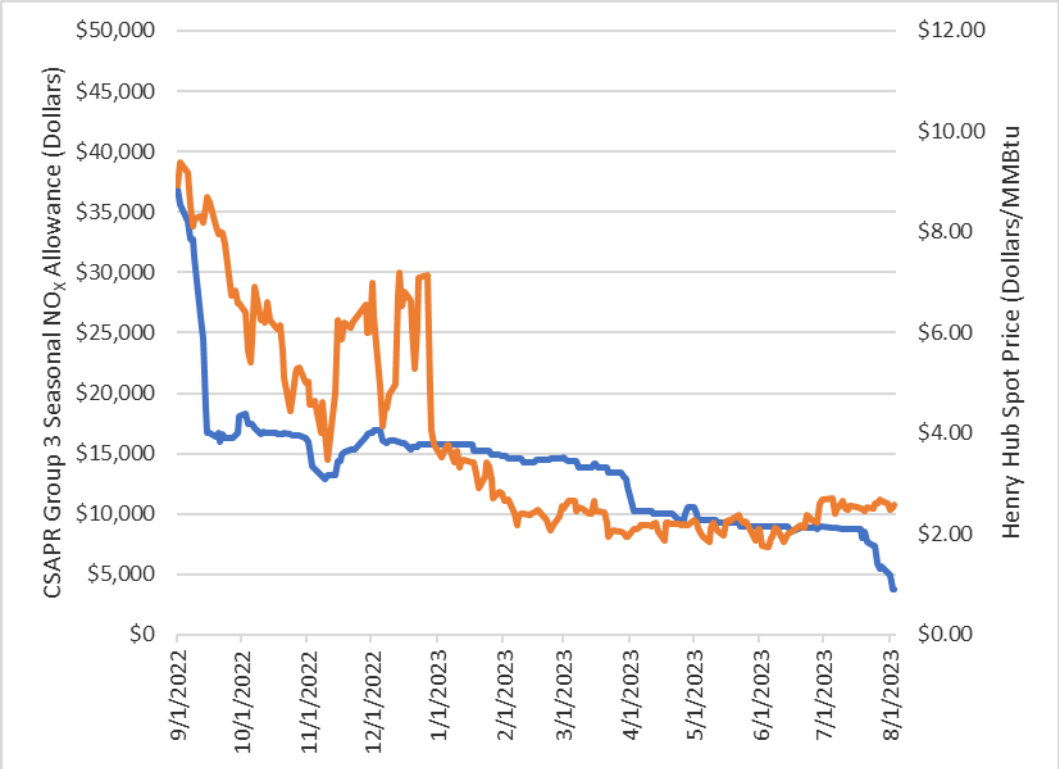
Sources: S&P Capital IQ Commodity Charting, 2022 CSAPR NOx Allowance Seasonal, Henry Hub Sport Natural Gas Price

[51] Monitoring Analytics, L.L.C., *2022 State of the Market Report for PJM*, § 8, at 436 (Mar. 9, 2023), https://www.monitoringanalytics.com/reports/PJM_State_of_the_Market/2022/2022-som-pjm-sec8.pdf. Based on offer data submitted by affected CSAPR generators during 2022, the market monitor calculated CSAPR Group 3 NOx compliance costs averaged $2.31/MWh in PJM (or 2.88% of the 2022 PJM load-weighted, average, real-time locational marginal price, $80.14/MWh). The Midcontinent Independent System Operator (MISO) internal market monitor calculated that CSAPR Group 3 NOx allowance prices "increased production costs of affected units by around $20 per MWh, despite several suppliers not fully reflecting these costs in their offers." David Patton, Potomac Econ., IMM Quarterly Report: Summer 2022, slide 4 (Oct. 13, 2022), https://cdn.misoenergy.org/2022%20IMM%20Quarterly%20Report%20Summer626733.pptx.

(Accessed March 24, 2023); EIA, Average cost of wholesale U.S. natural gas in 2022 highest since 2008 (January 9, 2023), https://www.eia.gov/todayinenergy/detail.php?id=55119.

30. Figure 3 below shows how CSAPR Group 3 allowance prices continued to track natural gas spot prices at the Henry Hub (Louisiana) national benchmark as they declined 73 percent from September 2022 through August 2023. The estimated portion of load-weighted average locational marginal price during the first six months of 2023 for Group 3 allowances fell to $0.52 per megawatt-hour, a 10.1 percent decrease in proportion to the total price per megawatt-hour, compared to $1.08 per megawatt-hour in the first six months of 2022 across the PJM regional energy market.[52]

Figure 2. Q2 2022- Q3 2023 CSAPR Group 3 seasonal NO_X allowance spot price vs. Henry Hub spot price



Sources: S&P Capital IQ Commodity Charting, 2022-2023 CSAPR Group 3 NO_X Allowance Seasonal, Henry Hub Sport Natural Gas Price (Accessed August 4, 2023); EIA, Natural gas prices fall in first half of 2023 amid record production and mild temperatures (July 24, 2023), https://www.eia.gov/todayinenergy/detail.php?id=57200.

[52] Monitoring Analytics, L.L.C., *2023 Quarterly State of the Market Report for PJM,* § 8, at 444 (Aug. 10, 2023), https://www.monitoringanalytics.com/reports/PJM_State_of_the_Market/2023/2023q2-som-pjm-sec8.pdf.

31. Since the release of the Proposed Rule, the passage of the Inflation Reduction Act has also dramatically altered the energy cost landscape. As EPA states, "The impact of the Inflation Reduction Act is to increase the economic competitiveness of lower emitting and renewable technologies relative to the higher emitting technologies that this rule seeks to regulate."[53] This is primarily through expanded and extended tax credits for wind, solar, energy storage, and other clean energy resources.[54]

32. The Inflation Reduction Act will also reduce the cost of regulatory compliance.[55] In the near term, from 2023 to 2027, EPA's modeling shows that the Inflation Reduction Act will reduce compliance costs at EGUs across the 22 original states covered under the Final Rule by 7 percent; from 2023 to 2045, the estimated impact is a compliance cost reduction of 57 percent. Annual costs are also substantially lower through 2026 (Table 4). These cost differentials may not be identical in the 10 states currently without stay orders, but the result is almost certainly directionally consistent.

Table 4. EPA's forecasted compliance costs at EGUs with and without the Inflation Reduction Act (2022$)

Timeframe	Final Rule	Final Rule + Inflation Reduction Act	Impact of Inflation Reduction Act
2023-2027 (Annualized)	17	16	-7%
2023-2045 (Annualized)	540	236	-56%
2023 (Annual)	69	57	-18%
2024 (Annual)	-6	-20	-240%
2025 (Annual)	-6	-20	-240%
2026 (Annual)	-6	-20	-240%
2027 (Annual)	29	81	179%
2030 (Annual)	848	694	-18%
2035 (Annual)	983	357	-64%
2045 (Annual)	219	196	-10%

Source: Regulatory Impact Analysis for the Final Rule, Table 4A-2, adjusted from 2016$ to 2022$.

[53] Final Rule RIA, *supra note 13*, at 186.
[54] EPA, *The Inflation Reduction Act*, https://www.epa.gov/green-power-markets/inflation-reduction-act (last updated Mar. 28, 2023).
[55] These elements include production tax credits and investment tax credits, a capital cost adjustment to reflect the Inflation Reduction Act's impact on improvements to manufacturing capability, a carbon capture and storage tax credit, continued operation of nuclear plants, and additional features. See Final Rule RIA, *supra note 13*, at 185 tbl.4A-1 (describing Inflation Reduction Act provisions modeled by EPA).

The Final Rule Will Create Significant Public Health and Economic Benefits that Vastly Outweigh Compliance Costs in Each Year of Implementation

33. Opponents of EPA's Final Rule have argued that impacts on EGUs and non-EGUs will cause closures that result in job losses, lost tax revenues, and other economic impacts. They have argued that these economic impacts will interfere with the prosperity and growth of state economies or the United States economy at large. Those arguments, however, omit the significant economic and public health benefits of implementing the Final Rule. They also omit the fact that coal generation and capacity are already in rapid decline and will continue to decline regardless of the Final Rule. This ongoing shift demands attention as part of a transition to clean energy but is not rooted exclusively in the design of the Final Rule and should not be a barrier to its implementation. Likewise, as EPA acknowledges in its Regulatory Impact Analysis, labor impacts from the Final Rule on non-EGU facilities are difficult to assess due to background changes in the regulated industries, but recent legislation provides resources to promote positive impacts.

34. Mitigating NO_X from EGUs and non-EGUs will create significant public health benefits. This is because NO_X undergoes a series of chemical reactions once emitted that contribute to downwind particulate matter ("PM") and ozone pollution, both of which negatively impact human health. According to EPA's Regulatory Impact Analysis, implementing the Final Rule across the original 22 states will create human health benefits with an estimated net-present-value between $112 million and $987 million in 2023 and between $3.3 billion and $16.8 billion (2022 dollars) in 2026, depending on the discount rate and methodology for calculating mortality risk.[56] This human health benefit includes reductions in PM and ozone due to NO_X reductions from EGUs and Non-EGUs.[57] With benefits on this scale, even reducing the number of affected states to less than half—that is, implementing the Final Rule in the

[56] *See* Final Rule RIA, *supra note 13*, at 34 tbl.ES-8. These values have been adjusted from $2.8 billion and $14 billion in 2016$, respectively, using the GDP deflator available from FRED Economic Data. FRED Econ. Data, *Gross Domestic Product: Implicit Price Deflator*, https://fred.stlouisfed.org/series/GDPDEF (last visited Apr. 13, 2023).

[57] Final Rule RIA, *supra note 13*, at 42 tbl.ES-12. These values have been adjusted from $57 million and $570 million in 2016 dollars, respectively, using the GDP deflator available from FRED Economic Data. FRED Econ. Data, *supra* note 50.

10 states with covered EGUs that are unaffected by stay orders—will produce enormous public health benefits.

35. For my analysis, I examined a subset of the benefits created by the Final Rule in the 10 states with covered EGUs that are unaffected by stay orders. Specifically, I examined the beneficial health impacts of reducing ozone season NOx on PM only, from the EGU sector only, and from 2023 to 2026 only, for only the 10 states that are not currently covered by stay orders. This analysis shows that benefits from PM reductions from the EGU sector alone, across only the ozone seasons through 2026, are enormous. To perform this analysis, I used EPA's Co-Benefits Risk Assessment Health Impacts Screening and Mapping Tool ("COBRA"). COBRA enables a user to specify NO_X emissions reductions at the county level. It then uses air modeling to estimate the impact on downwind PM and associated health impacts. COBRA's final step is to convert these health impacts into economic impacts. As an input into COBRA, I aggregated the Final Rule's unit-level emissions reductions in each year at the county level in the 10 states with covered EGUs unaffected by stays and produced the results found in Table 5. As Table 5 shows, from 2023 to 2026, the net present value of the benefits from PM reduction due to ozone season NOx reductions from regulated EGUs totals between $719 million and $1.6 billion. Table 6 shows the discounted benefits on an annual basis.

Table 5. Health impacts of reduced PM due to EGU NO_x reductions attributable to the Final Rule

Health Endpoint	**Change in Incidence (Cases 2023-2026)**		**Net Present Value 2023-2026, 3% Discount Rate (Millions 2023$)**	
	Low Estimate	***High Estimate***	***Low Estimate***	***High Estimate***
Mortality	70.0	158.4	$707.45	$1,601.34
Nonfatal Heart Attacks	7.5	69.8	$1.12	$10.37
Infant Mortality	0.3		$3.93	
Hospital Admits, All Respiratory	17.2		$0.58	
Hospital Admits, Cardiovascular (except heart attacks)	17.2		$0.81	
Acute Bronchitis	83.8		$0.05	

Upper Respiratory Symptoms	1516.0	$0.06	
Lower Respiratory Symptoms	1065.8	$0.03	
Emergency Room Visits, Asthma	36.1	$0.02	
Asthma Exacerbation	1586.9	$0.11	
Minor Restricted Activity Days	45872.2	$3.72	
Work Loss Days	7739.4	$1.43	
Total NPV		**$719.30**	**$1,622.44**

Table 6. Annual health benefits from PM reductions due to NO_X reductions at EGUs (Millions 2023$)

Discount Rate	2023		2024		2025		2026	
	Low	High	Low	High	Low	High	Low	High
3%	$165	$372	$160	$351	$172	$389	$231	$521

36. Although EPA has not published a regulatory impact analysis specific to the 10 states with EGUs not covered by stay orders, EPA's analysis of all 22 states covered under the Final Rule indicates that these health benefits will dramatically outweigh the cost of implementing the program.[58] Based on my analysis of the benefits in this subset of 10 states, I see no reason why the same should not hold true for them.

37. As NO_X reductions create health benefits throughout the United States, the Final Rule will also create labor impacts at regulated EGUs and non-EGUs. These labor impacts are likely to be very small at EGUs, particularly in the context of existing changes in the electric power industry. At non-EGUs, impacts are difficult to predict given significant background changes in labor utilization independent of the Final Rule; but as I describe below, new resources are now available through recent legislation to mitigate impacts.

[58] *Supra* note 56.

38. EPA separates job-related impacts from the Final Rule into two categories: changes in non-recurring jobs related to construction, and changes in recurring labor utilization associated with jobs such as operation and maintenance of facilities and fuel extraction.[59] Among covered EGUs, non-recurring construction jobs are expected to increase through 2030 due to a need to install new pollution controls and build additional generation capacity (primarily natural gas and solar photovoltaic).[60] In terms of recurring jobs, EPA's Regulatory Impact Analysis projects that in 2023, across all 22 states originally covered under the Final Rule, the impact is less than 100 job-years. In 2025, the loss of recurring jobs at existing EGUs is balanced by the gain in jobs at new EGUs. In 2030, EPA's analysis indicates that the loss of jobs from existing capacity will exceed the increase in jobs related to new capacity.[61] The total net decrease in recurring employment, however, is less than 4,000 job-years in 2030—a minute component of employment in the power sector, which employs approximately one million Americans.[62]

39. In the longer term, as the electric industry continues to shift to clean energy sources, the number of jobs available will continue to shift from coal to renewables.[63] This change is already well on its way; from 2015 to 2019, the solar and wind electric power generation sectors added 83,000 jobs while the coal fuels sector lost 17,000 jobs. (Also in this time, the petroleum and natural gas fuels sector added 73,000 jobs.)[64] The prospects for job growth in clean energy are strong and there are "relatively high job multipliers in renewables," according to an IMF study called, *Jobs Impact of Green Energy*.[65]

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[59] Final Rule RIA, *supra note 13*, at 272.
[60] *Id.*
[61] *Id.*
[62] *Id.* at 273; Int'l Renewable Energy Agency & Int'l Labour Org., *Renewable Energy and Jobs: Annual Review 2022*, at 38 (2022), https://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/documents/publication/wcms_856649.pdf.
[63] Phil Jordan, BW Research P'ship, *Wages, Benefits, and Change*, at 13 (Apr. 6, 2021), https://static1.squarespace.com/static/5a98cf80ec4eb7c5cd928c61/t/60772d6c9a200430a1ff75a5/1618423165067/2020+Wage+Report+Presentation-April+6+Webinar_+Final.pdf (presentation to National Association of State Energy Officials).
[64] See *id.*
[65] Jaden Kim & Adil Mohommad, *Jobs Impact of Green Energy*, INT'L MONETARY FUND 8 (May 27, 2022), https://www.imf.org/en/Publications/WP/Issues/2022/05/27/Jobs-Impact-of-Green-Energy-518411.

40. In the non-EGU sector, EPA acknowledges that the NO_X-emitting industries regulated by the Final Rule are already experiencing significant background changes in labor utilization. The pipeline transportation of natural gas and cement and concrete manufacturing categories, for example, experienced 19 percent and 17 percent increases in employment from 2011 to 2020, respectively. In contrast, the iron, steel, and ferroalloy manufacturing category and the pulp, paper, and paperboard mills category experienced a 10 percent and 15 percent decline, respectively, in the same time period.[66] This changing background highlights how dynamic these industries already are, and the rapid changes make it difficult to predict how these industries will respond to the Final Rule. Covered non-EGU industries also show substantial differences in employment per million dollars of output, which highlights how differently they may respond to changes in cost that affect output.[67]

41. Additional measures of the Inflation Reduction Act and other sources of funding are likely to support non-EGU facilities' compliance with the Final Rule. These include grant awards under Section 50161 of the Inflation Reduction Act, the *Advanced Industrial Facilities Deployment Program*, which allocates more than $5.8 billion to the Department of Energy for competitive financial assistance to projects that implement advanced industrial technology at energy-intensive industrial and manufacturing facilities. Grants under this program award up to 50 percent of project costs for projects that include retrofits, upgrades, or operational improvements that reduce greenhouse gas emissions. In the process, industrial facilities can also reduce NO_X, supporting compliance with the Final Rule. This pool of funding will be available with the Office of Clean Energy Demonstrations until September 30, 2026.[68]

42. The Inflation Reduction Act also expanded the 48C Advanced Energy Project Credit to include industrial emissions reductions.[69] Eligible industrial projects include those that, along with

[66] Final Rule RIA, *supra note 13*, at 274.
[67] *Id.* at 275
[68] White House, *Inflation Reduction Act Guidebook,* https://www.whitehouse.gov/cleanenergy/inflation-reduction--act-guidebook/ (last visited Apr. 13, 2023).
[69] White House, *Building a Clean Energy Economy: A Guidebook to the Inflation Reduction Act's Investments in*

additional options, equip industrial or manufacturing facilities with technology designed to reduce greenhouse gas emissions by at least 20 percent and will be eligible for a 10 percent tax credit adder.[70] These tax incentives are already increasing the value of existing transmission grid interconnection points at facilities with retired coal-fired electric generating units.[71] An Energy Community Bonus Credit is also now available and will provide $10 billion of allocations, at least $4 billion of which are reserved for projects in coal communities.[72]

43. Likewise, the DOE's Office of Clean Energy Demonstrations, funded by the *Bipartisan Infrastructure Law* and the Inflation Reduction Act, has $6.3 billion available through grants, cooperative agreements, and other arrangements to support decarbonization in the iron and steel, cement and concrete, chemicals and refining, food and beverage, paper and forest products, aluminum, and other energy- intensive manufacturing industries.[73] Again, decarbonizing these industries through advanced industrial technologies and greater efficiency offers a pathway to reduce fossil energy reliance, reduce NO_X, and comply with the Final Rule. The Office of Clean Energy Demonstrations will be looking for projects that have the highest impact for job creation.[74]

44. The Department of Energy also announced an "Industrial Efficiency and Decarbonization" funding opportunity, which is a $104 million funding opportunity through the Advanced Manufacturing Office. This opportunity will fund high-impact, applied research and demonstration projects in order to expedite the adoption of transformational industrial technology

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Clean Energy and Climate Action (Jan. 2023), https://www.whitehouse.gov/wp-content/uploads/2022/12/InflationReduction-Act-Guidebook.pdf.

[70] *Id.*

[71] Charles River Assocs., *Coal-Retirement Energy Communities: Analysis of Emerging Tax Credit Opportunities from the Inflation Reduction Act* (Nov. 1, 2022), https://www.crai.com/insights-events/publications/coal-retirementenergy-communities/.

[72] IRS, Notice 2023-29, *Energy Community Bonus Credit Amounts Under the Inflation Reduction Act of 2022* (Apr. 4, 2023), https://www.irs.gov/pub/irs-drop/n-23-29.pdf. Eligible energy communities include those hosting a coal-fired electric generating unit classified as retired at any time since December 31, 2009 in the EIA Electric Generator Inventory (EIA Form 860).

[73] DOE Office of Clean Energy Demos., *Industrial Demonstrations Program,* https://www.energy.gov/oced/industrial-demonstrations-program (last visited Apr. 13, 2023).

[74] DOE Office of Clean Energy Demos., *Portfolio*, https://www.energy.gov/oced/portfolio (last visited Apr. 13, 2023).

necessary to increase energy efficiency across industry. Selected projects are also expected to contribute to the Justice40 initiative, which has set a goal that 40 percent of overall benefits of government energy and climate investments flow to disadvantaged communities.[75]

The Final Rule Will Not Necessarily Increase Electricity Rates

45. As I acknowledge, compliance with the Final Rule will impose additional costs on certain EGUs. However, EPA's Regulatory Impact Analysis forecasts that at a national level, changes in electric rates will be miniscule. In both 2023 and 2025, EPA forecasts an increase in average national retail rates of less than 0.2 percent—about 0.00019 cents per kilowatt-hour. By 2030, EPA estimates that the increase in national average retail electricity prices will still be less than 1 percent.[76] This average increase is already very small, but given the rate of technological change and utilities' ability to seek least-cost generation resources, even this small increase may be avoided.

46. The specter of increased costs at a subset of power units does not necessarily mean an increase in rates for electricity customers. As I explain in this section, utilities have the option—and in many states the responsibility—to reevaluate their portfolios when the energy cost landscape changes. That change may be prompted by a new EPA rule, by a new law like the Inflation Reduction Act, by falling clean technology costs, or other factors. Doing so not only minimizes risks for investors by avoiding the risk of stranded assets, but it also minimizes the risk of higher rates for the utility customers who will ultimately shoulder the cost of capital investments. Changes in forward-going unit operating costs caused by the Final Rule should therefore prompt prudent utilities to review covered units relative to alternatives to investigate whether they fit into a least-cost portfolio of resources capable of meeting system needs. If covered units do continue to operate, the cost that a utility seeks to recover in rates depends on the cost of its entire rate base, not just one segment that experiences higher costs. In the longer term, a continuation of the movement away from NO_X-emitting coal-fired power generation also

[75] DOE Office of Energy Efficiency & Renewable Energy, *EERE Funding Opportunity Exchange,* https://eereexchange.energy.gov/Default.aspx#FoaId10dee44f-2348-4613-b787-cfe653cbe32b (last visited Apr. 13, 2023).
[76] Final Rule RIA, *supra note 13*, at 164-68

represents a shift away from one of the costliest generation resources, both in terms of the levelized cost of energy and from the perspective of future environmental compliance costs.

47. Utilities interested in minimizing risk for investors and for ratepayers should base every financial decision on an objective economic analysis, and every major investment should prompt a reevaluation of alternatives. Increased compliance costs at an EGU will only increase that unit's contribution to rates if it is assumed that the EGU must continue to run at the same level, which is rarely the case. When the economics of a power unit change, the economics of the decision to use that plant should also change. This requires a utility to take responsibility and perform analysis to optimize its system, even if that analysis is not explicitly demanded by a regulatory commission.

48. Now that the Final Rule has been released, the onus is on utilities to perform resource planning, ideally using optimized capacity expansion modeling, to develop a least-cost portfolio of generation resources. Merchant generators must also now assess whether they would be best served to continue running or to retire and replace fossil generators with alternatives. This quantitative process can help determine if covered EGUs should continue to run or if it would be less costly to replace them with alternatives. This replacement can result in lower system costs overall, meaning that the potential for higher costs at a specific EGU, by prompting a transition to lower-cost alternatives, can have the counterintuitive effect of lowering that covered EGU's contribution to rates. The impact of a specific EGU's compliance costs on rates, therefore, is not as simple as adding the cost of compliance into the rate base. Rather, the incremental cost to rates as a result of new regulation is the difference between the cost of compliance and the cost of replacement with alternatives.

49. In the event that a subset of units' forward-going costs increases and those units continue to run, that also does not mean that rates must increase. The total cost that a utility seeks to recover through rates depends on many factors. The rising level of electric vehicle adoption, for example, which is unrelated to the Final Rule, can decrease electric rates for all customers if utility revenues from EV

charging exceed the utility system cost.[77] For this reason and many others it is not possible to make a blanket statement that increased compliance costs at EGUs that continue to run will increase electric rates of affected utilities.

50. What is certain is that for many years now, utilities have been diversifying away from NO_X-intensive coal generation by building gas, wind, solar, energy storage, and other resources. This diversification has reduced the amount of capacity that would have otherwise been subject to the Final Rule and increased the quantity of lower-cost capacity, buffering the cost impacts of fossil-energy-related environmental regulation. As shown in Lazard's most recent levelized cost of energy analysis, this diversification away from coal also largely represents a shift to cheaper generation types. Unsubsidized wind, solar, and combined-cycle gas plants are less expensive on a levelized cost basis than coal.[78] The Inflation Reduction Act has lowered the cost of clean energy even further, through extended and expanded tax credits now available for wind, solar, storage, and other forms of clean energy. A continued shift away from coal can help shift the overall system away from an expensive generation resource, which can put downward pressure on rates.

[77] Jason Frost et. al., Synapse Energy Econ., *Electric Vehicles Are Driving Electric Rates Down* (2019), https://www.synapse-energy.com/sites/default/files/EVs-Driving-Rates-Down-8-122.pdf.
[78] Lazard, *Lazard's Levelized Cost of Energy Analysis - Version 15.0* (Oct. 2021), https://www.lazard.com/media/sptlfats/lazards-levelized-cost-of-energy-version-150-vf.pdf.

I declare under penalty of perjury that the foregoing is true and correct.

Executed in Shrewsbury, Massachusetts on October 26, 2023.

Patricio Silva

Exhibit A

Patricio Silva, Principal Associate

Synapse Energy Economics I 485 Massachusetts Avenue, Suite 3 I Cambridge, MA 02139 I 617-453-7069

psilva@synapse-energy.com

PROFESSIONAL EXPERIENCE

Synapse Energy Economics, Inc., Cambridge, MA. *Principal Associate, May* 2022 – Present

- Examines adequacy and the economic impacts of proposed utility decarbonization and clean energy plans
- Evaluates environmental compliance assumptions used by utilities in major regulatory filings in decarbonization and environmental compliance proceedings
- Assesses impacts of proposed and existing state and federal environmental regulations on the electric and natural gas sectors

ISO New England, Holyoke, MA. *Senior Analyst,* 2011 – 2022

Responsible for evaluating state and federal air, water, climate, renewable and energy efficiency regulations and legislation for their potential impacts on the reliability of the existing and future New England electric generation and transmission capacity.

- Managed stakeholder Environmental Advisory Group interacting with ISO New England, reporting studies and developments of the environmental performance of New England bulk power system.
- Developed and maintained external relationships with program staff regarding policy and regulatory matters at various state agencies across New England, the US Environmental Protection Agency, the Department of Energy, and the Federal Energy Regulatory Commission.
- Evaluated impact of Regional Greenhouse Gas Initiative and other state greenhouse gas reduction initiatives on existing and future New England electric generation and transmission capacity.
- Provided briefings to New England congressional delegation and state representatives.
- Developed and managed outreach for monthly survey of distribution utilities for interconnection of distributed generation, including solar photovoltaic and storage, interacting with state regulators and elected officials
- Managed development of interregional transmission reports, assisted with development annual regional planning reports and prepare analyses, presentation materials, and web content for external and internal audiences.

Massachusetts Department of Environmental Protection, Boston, MA. *Environmental Analyst*, 2009 – 2011

Provided technical and policy support on emissions monitoring and compliance matters affecting 45

electric generating units at 22 power plants across Massachusetts. Analyzed compliance filings, electronic reporting and observed stack testing, advising state and federal enforcement and permitting staff. Recommended enforcement actions and assisted facility compliance staff with implementation of various air pollution regulations.

- Administered the Massachusetts Ozone Nitrogen Oxide (NOx) allowance public benefit and new unit set aside programs, awarding renewable and energy efficiency projects emission allowance awards after evaluating candidate projects.
- Oversaw implementation of Massachusetts mercury emissions reduction and monitoring requirements for coal-fired electric generating units. Provided technical assistance to other state and regional agencies in development and implementation of mercury emissions reduction and monitoring requirements for stationary sources.

Environmental Defense, Boston, MA. *Air Monitoring Project Manager*, 2004 – 2005

Conducted ambient air pollution sampling field studies of urban and rural locations impacted by diesel emissions, used resulting emissions data to support diesel emission pollution control retrofit projects. Evaluated and recommended pollution reduction technology options for heavy and light duty vehicles. Procured monitoring equipment and supervised staff, volunteers and consultants in ambient monitoring studies of diesel particulate matter emissions in urban and rural field studies in California and Massachusetts.

Natural Resources Defense Council, Washington, D.C. *Midwest Activities Coordinator*, 1999 – 2003

Responsible for formulating and executing ozone, mercury, and greenhouse gas emissions reduction strategies for state and national legislative and regulatory policy matters. Provided energy and environmental advocacy focusing on the Great Lakes Region on regional and international air pollution reduction strategies for stationary and mobile sources

- Coordinated research and advocacy on state and national stationary and mobile source emission reduction efforts involving the EPA, DOE and the FERC
- Prepared and delivered testimony before administrative and legislative agencies, state regulatory commissions, and Congress
- Prepared range of advocacy and communication materials, including analytical reports, web advocacy, opinion editorials
- Participated on collaborative projects including Keystone Center Dialogue on Natural Gas Infrastructure, Sustainable Energy Coalition, and National Wind Coordinating Committee.
- Responsible for all aspects of fundraising including initial solicitation, preparation of grant proposals, presentations to foundation staff, grant award reports.

Environmental Futures, INC., Boston, MA. *Assistant Project Manager*, 1997 – 1999

- Responsible for providing environmental regulatory compliance guidance to clients as part of management consulting group portfolio.
- Analyzed and advised clients on impacts of state and federal legislative and regulatory developments regarding electric utility restructuring and actions by EPA, the FERC, and National Energy Board of Canada
- Conducted due diligence assessments of potential environmental risks and liabilities for potential buyers, recommended mitigation strategies and estimated compliance costs
- Prepared presentations, testimony, speeches, press advisories, organized editorial board briefings and press events

Citizens for a Better Environment Milwaukee, WI. *Midwest Activities Coordinator*, 1995 – 1997

- Analyzed public health research, air pollution emissions trends, state and federal regulatory developments on air quality, electric utility restructuring, regional transportation policy, preparing reports, advocacy materials, testimony, and public comments.
- Organized workshops and town hall meetings for members and general public on impact of state and federal environmental and energy policies, helping identify opportunities for public input.

PUBLICATIONS

Frost, J., J. Litynski, S. Chavin, P. Silva. 2023. *The Impact of Resource Inflexibility on Capacity Accreditation in New England*. Synapse Energy Economics for Sierra Club.

EDUCATION

University of Arizona College of Law, Tucson, AZ
J.D, 1993
Colby College, Waterville, ME
Bachelor of Arts in Government, 1984

Resume updated April 2023

DECLARATION of DR. RANAJIT (RON) SAHU

I, Dr. Ranajit (Ron) Sahu, declare:

1. I am an engineer by training and an environmental/energy consultant. A copy of my resume is provided in Attachment A.

2. I provide the following opinions based on my review of the U.S. Environmental Protection Agency's (EPA) final rulemaking titled "Federal 'Good Neighbor Plan' for the 2015 Ozone National Ambient Air Quality Standards" and published at 88 Fed. Reg. 36,654 (June 5, 2023) ("Final Rule"), as well as various supporting materials and public comments in the docket for that rulemaking, Docket ID No. EPA-HQ-OAR-2021-0668. I understand the Final Rule requires nitrogen oxides (NOx) emissions reductions from covered fossil fuel-fired power plants in 22 states.

3. In particular, my opinions as expressed in this Declaration are informed by my experience as a testifying Expert Witness in several matters pertaining to power plants (especially coal-fired power plants, as noted in the Annex A to Attachment A) and their environmental controls including the use of in-boiler combustion controls as well as post-combustion controls such as Selective Catalytic Reduction (SCR) and Selective Non-Catalytic Reduction (SNCR) for the control of NOx, the pollutant relevant to this matter. My relevant litigation experience in these matters involved Plaintiff-side work on behalf of EPA, various states, and other entities such as major environmental organizations.

4. Specifically relevant to this matter, my experience as a litigation Expert Witness provided me with considerable insight into planning decisions by power plant operators relating to environmental controls, including vendor discussions, which are often not available in the public record, and which, to my knowledge, are not in the public docket for this matter. Examples of relevant facts include the consideration of SCR and SNCR as NOx controls, their costs, and

schedules for their implementation, as well as costs for in-boiler combustion controls such as low-NOx burners, ultra low-NOx burners, many variants of air- and fuel-staging for NOx reduction including various types of over-fire air in boilers, and the use of adaptive and learning-based techniques such as neural networks.

5. Based on this experience, I am aware that power plant operators rely on additional performance data in their decision-making for environmental matters such as NOx reduction beyond what they are obligated to report publicly to EPA or to the U.S. Energy Information Administration, such as the hourly NOx rates and mass, hourly heat input, and generation data. In particular, power plant operators in the United States gather and report data to the North American Electric Reliability Corporation's (NERC) Generating Availability Data System, or "GADS," that is only available to reporting entities. Operators also use their knowledge of unit operating constraints, such as power ramp rates and minimum operating loads, which is critical for assessment of SCR—for example, to evaluate the impact of SCR on bids to provide power or other services into wholesale markets operated by regional transmission organizations and independent system operators. This type of information is also not publicly available typically.

6. I also am aware that many power plant operators are active members of industry trade associations such as the Electric Power Research Institute (EPRI) and Edison Electric Institute (EEI)—and this allows them to gain valuable insight into how their peers run and operate their facilities, including how their peers run and operate NOx controls to achieve lower NOx emissions.

7. My overall opinion is that the Final Rule is on sound technical footing—including EPA's expectations of the levels of NOx emissions reductions that can be achieved by various units

as well as the timelines and schedules required to achieve them and the costs that would be incurred in achieving the levels of NOx reductions expected.

8. I have thoroughly reviewed the comments submitted by various power plant operators and others on this specific rulemaking as well as comments submitted by various power plant operators in similar prior rulemakings objecting to one or more aspects (such as the technical feasibility, schedule, and/or cost) of NOx reduction via SCR. For the reasons described below, I find those objections to be significantly flawed or overstated.

The Power Plant Industry Has Extensive Experience with the Control Technologies in the Good Neighbor Rule

9. None of the NOx-reduction approaches considered by EPA in the Final Rule are new or novel. The power plant industry now has millions of operating hours of experience for each and every one of the controls that EPA considered, including SCR and SNCR and the various combustion controls.

10. Based on my 23 years of experience with power plants, including the types of coal-fired power plants that are regulated by this rule in the covered states, I attest that each of these plants and the units in them have been or are subject to numerous NOx-reduction requirements under the federal Clean Air Act, including, as applicable: requirements related to the various ozone National Ambient Air Quality Standards (NAAQS) (for which NOx is a precursor pollutant)—including prior ozone transport rules such as the Cross-State Air Pollution Rule and Revised Cross-State Air Pollution Rule Update, requirements related to the fine particulate matter NAAQS (for which NOx is also a precursor), regional haze requirements (for which NOx is a precursor and contributor), Best Available Control Technology (BACT)/Lowest Achievable Emission Rate (LAER) requirements under the New Source Review program, Reasonably Available Control

Technology (RACT) requirements in certain ozone nonattainment areas, and New Source Performance Standards (NSPS) requirements. In addition, there may also be additional state-level regulations that require covered power plants to reduce NOx emissions. And, the coal-fired power plant industry has been subject to substantial litigation. As a result, many coal-fired power plant units and also many gas-fired power plant units have installed either SCR or SNCR as post-combustion NOx controls (as reflected in the record for the Final Rule,[1] and which I discuss later). Thus, the technical feasibility of these controls is not in question.

11. Of necessity, EPA's analysis of current NOx levels and performance relies on data produced by various power plant units, as reported, for example, to the EPA's Clean Air Markets Program Data database. However, it is crucial to note that such performance data do not reflect the full technical capability of NOx controls (whether in-boiler combustion controls and work practices or add-on controls such as SCR) in place. Rather, the reported performance data reflect what units need to do just to stay in compliance with permit limits—which may not be very stringent and may not therefore require that installed controls be operated to their fullest technical capability. As such, there is often room to do better. The Final Rule will unlock some of that gap between actual (less stringent than that achievable by NOx reduction technology) and technically-feasible emissions-control performance because operators will have greater incentive to generate and sell allowances by doing better than the target NOx rates.

Coal-fired Units Can Feasibly Install SCR/SNCR Controls by 2026

[1] U.S. EPA, *Appendix A: Final Rule State Emissions Budget Calculations and Engineering Analytics (xlsx)* (2023), *available at* https://www.epa.gov/csapr/good-neighbor-plan-2015-ozone-naaqs#:~:text=Appendix%20A%3A%20Final%20Rule%20State%20Emissions%20Budget%20Calculations%20and%20Engineering%20Analytics%20(xlsx).

12. It is my opinion that for each of those relatively few coal-fired units that have not yet installed SCR (*i.e.*, do not have either SNCR or SCR, or just have SNCR but not SCR), the operator of every such unit has or should have, at one time or another, seriously evaluated the implementation of SCR. This is simply prudent planning given the regulatory landscape noted above. Their prior evaluation of SCR installation is particularly relevant in this matter because an operator's schedule for implementation for SCR could be shorter than that presumed by EPA in the Final Rule (*i.e.*, by 2026 or 2027), given the pre-planning, design studies, location and routing options, and other basic evaluations that have likely already been conducted for such units. In other words, it is my opinion that any current coal-fired power plant without SCR at one or more of its units at present has already evaluated the technical feasibility and implementation of SCR at such units before choosing not to implement SCR for various reasons, mainly economic. To presume that such evaluations would begin from scratch once the Final Rule takes effect is simply not credible. To presume that this planning and engineering (such as for conceptual studies and the development of design basis) has not been conducted, and therefore including additional time for such preliminary work, is a generous presumption. And as noted in the final rule, the EPA is phasing in fleetwide installation for SCR over a 48-month time period, which includes 24 weeks for "Conceptual Studies/Design Basis."[2] And SNCR would require about 12 to 18 months for installation, which includes 16 weeks for "Conceptual Studies/Design Basis."[3]

[2] U.S. EPA, *Typical SCR and SNCR Schedule*, Dkt No. EPA-HQ-OAR-2021-0668-0975, at 1; Federal ''Good Neighbor Plan'' for the 2015 Ozone National Ambient Air Quality Standards, 88 Fed. Reg. 36,654, 36,728 (June 5, 2023).
[3] U.S. EPA, *Typical SCR and SNCR Schedule*, Dkt No. EPA-HQ-OAR-2021-0668-0975, at 2.

13. Since SCRs have been implemented at existing, complex plants in 30-35 months starting from scratch, it is my opinion that SCR can be implemented in the timeframes noted in the Final Rule.[4]

14. I also note that the Final Rule allows for trading of allowances and establishes an allowance-based trading program. Allowance trading provides additional compliance flexibility in the unlikely event that more time is needed to implement SCR at a particular unit, given highly specific and unique needs.

15. As to the costs associated with the Final Rule, there is no evidence in the record demonstrating that the costs of installing NOx pollution controls would be substantial and/or that such controls would not be cost-effective. As noted above, a substantial portion of the industry is using SCR already, which undercuts any argument that SCR is not cost-effective as a general matter. To the extent that an individual unit may find that SCR would tend to be at the higher end of cost-effectiveness mainly because it is using other less-than-SCR levels of controls (*i.e.*, SNCR or forms of combustion controls) resulting in lower SCR-inlet NOx levels and consequently lower total NOx removed by the SCR, that unit could evaluate the use of "hybrid SCR" (*i.e.*, SNCR followed by a smaller in-duct SCR) to minimize costs.

16. I am aware that certain members of the industry have argued that the timelines specified in the Final Rule for NOx reduction are infeasible on the theory that the United States does not have the resources (engineering, design, manufacturing, construction trade personnel, etc.) to implement the required number of new and additional controls. This argument is based on a fundamentally flawed premise that resources to implement NOx-reduction controls must or will be U.S.-based. While it was true at some point in the past (approximately the mid-1990s) that the

[4] *See id.* at 1.

United States lagged behind Japan and Germany in terms of engineering, design, and construction capacity for implementing SCRs, that is certainly not the case today. Engineering and design capacity for SCRs (and, in general) is now a global resource. It is the norm rather than the exception that U.S.-based engineering firms routinely use talented design engineers from all over the world to support projects. This includes staff from Japan, China, Korea, India, the Philippines, Turkey, various European Union countries, and many more. Many of these countries, particularly China and Japan, have substantially achieved or even leap-frogged U.S.-based SCR performance. Similarly, it is the norm rather than the exception for global construction firms to support large projects using staff drawn from all over the world. Thus, any arguments that there are not sufficient U.S.-based resources to implement the controls needed in the timeframes contemplated by EPA in the Final Rule rely on a parochialism that was never true to begin with, and is even less true and not a factor today.

Units Can Feasibly Upgrade their NOx Combustion Controls by the 2024 Ozone Season

17. Facilities can feasibly upgrade their NOx combustion controls by the 2024 ozone season. Upgrading NOx combustion controls requires that the facility modify the types of burners used in the boilers to low-NOx or ultra low NOx burners, implement advanced air staging to complete combustion while minimizing NOx emissions, using additional sensors and instrumentation to fully map the operating envelope and optimize/minimize NOx generation across the operating load range – using neural network or other adaptive learning technologies, maintaining equipment with preventive maintenance approaches, and others. These types of optimization can be implemented in months to less than a year. Of course, since facilities have been on notice that NOx reductions would be required, it is reasonable to presume that these types

of optimization would already be under consideration/implementation, making the timeline to achieve additional NOx reductions even shorter. It is my experience that upgrading NOx combustion controls can be cost-effective since significant NOx reductions can be achieved for relatively modest capital costs and also modest incremental operating costs. While the specifics of costs and benefits will depend on plant-by-plant assessments, it is my opinion, based on my experience and knowledge, that costs incurred to upgrade combustion controls are not likely to adversely affect the overall economics of the power plant's operations or adversely affect the economic viability of the operating entities.

Units with Existing Controls Can Optimize These Controls in the Near-term

18. Optimizing existing controls during the 2023, 2024, and 2025 ozone seasons is a feasible and cost-effective measure to reduce NOx emissions.

19. For example, optimizing SCR can involve improving catalyst activity by changing catalysts, monitoring catalyst reactivity and implementing catalyst management to maintain such activity at a high level by either regenerating catalysts or including new catalysts; improving the distribution of the ammonia injection system to provide uniform distribution of ammonia and proper mixing of the ammonia with the NOx in the inlet to the catalysts; ensuring that there are no leakage paths by which exhaust gases cannot escape the catalyst; reducing the minimum operating temperature at which the catalyst is effective at reducing NOx by a number of means; and others.

20. Similarly, SNCR optimization can require conducting modeling of the boiler and optimizing the locations and direction of injection of the ammonia or reducing agent into the boiler; and to manage this dynamically as a function of unit load.

21. These types of optimization can be done in time periods that are months to around a year. Of course, since most facilities have been on notice that NOx reductions would be required,

it is a reasonable assumption that optimization of their existing controls would already have been conducted or should be in the process of being conducted in order to maximize the benefit of the installed controls for the 2023 ozone season. To the extent units with controls such as SCR have idled such controls, bringing them back into operation can be accomplished in a matter to days to weeks since that involves obtaining/restocking adequate amounts of the reducing reagent (urea or ammonia - both readily available) and conducting a physical inspection of the reagent injection system and the idled SCR. Thus, these units with idle SCRs can have their SCRs be brought on-line for the 2023 ozone season the process of being conducted in order to maximize the benefit of the installed controls.

22. Given the already sunk cost of the control equipment, optimization is a cost-effective measure because relatively small additional investments can result in significant emissions reductions. It is my opinion, based on my decades of air pollution consulting and knowledge of these control systems that the costs of optimization are miniscule compared to costs of running a power plant and should not in any way financially adversely impact operating power plants.

My Detailed Assessment of The Rule Further Supports That Units Can Feasibly Comply With The Rule in The Near-Term

23. The goal of this assessment is to demonstrate that my opinions above are supported by a thorough review of EPA's analysis. For this, I rely on a number of tables referenced in the paragraphs below. All of the Tables are provided in Attachment B.

24. The universe of units in the states at issue and covered by the rule is 2140 by my count. Of these, based on a review of recent (year 2021) NOx performance, no additional NOx controls or any changes are needed for 1713 units or 80% of this universe. This alone shows that

EPA's requirements are properly targeted and focus on the remaining 20% of the units where NOx emission rates are higher than the entire population of units. I have analyzed these remaining 427 of the 2140 units in two groups.

25. The second of these two groups consists of 202 units that collectively accounted for roughly 4% of the NOx emissions of the 427 units in 2021. Almost all of these are gas-fired units. I do not specifically address these 202 units other than to note that a spot-check reveals that in several instances units with high NOx rates in 2021 had reduced NOx rates in 2022 – indicating that specific operational aspects in 2021 (such as load factors) may have contributed to the higher NOx rates in 2021 but that may not be the case in every year. It is my opinion that given the NOx mass emissions from these 202 units, they can come into compliance using a combination of load profile alterations (where possible), use of additional controls (if needed) and/or purchases of allowances.

26. I focus now on the first group (out of the 427 units) of 225 units where most of the NOx compliance requirements will fall.[5] A substantial majority of these 225 units (147 of them) need not do anything additional by 2023/2024 given their 2021 performance[6] or very minor adjustments where the expected 2023/2024 rates are within 4% of the 2021 rates.[7] That leaves 78 units where the 2023/2024 rates are lower than 2021 rates requiring some degree of combustion optimization. Of these 78 units, 65 (or 83.3%) already have either SCR or SNCR installed and only 13 remaining units do not have one or the other of these controls.[8]

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[5] *See* Attach. B, tbl. 1. Table 1 shows the 2021 NOx rates for these units as well as the 2023/2024 optimized NOx rates. The ratio of the 2021 rates to the 2023/2024 rates is shown in the last column.

[6] The ratio at the last column in Table 1 is 1.0. *Id.*

[7] This is shown at the bottom of Table 1 in red in the ratio column. *Id.*

[8] *Id.* I have highlighted these 13 units with brown shading in Table 1. They are as follow: Brunner Island Units 1, 2 and 3; Daniel Electric Unit 1; Muskogee Unit 6; Mill Creek Units 1

27. It is likely, in my opinion, that compliance with the 2023/2024 rates for the 13 units that do not have SCR and SNCR will require some combination of implementing combustion modifications and purchasing allowances or just implementation of combustion modifications without the need for allowances. Should allowances be needed, the amount will depend on how these units are operated and to what degree they can (or have) reduced their 2021 NOx rates using combustion modifications – such as the use of better burners, air staging, and optimization – all of which are feasible to be installed in relatively short times (i.e., twelve or fewer months).

28. For these 65 units reflected as having SCR or SNCR, it is my opinion that the 2023/2024 rates can be met by running and/or optimizing these existing controls.[9] I note that some of these units appear not to be running their SCRs or SNCRs at all, or to be running their SCRs or SNCRs very poorly.[10] It is my opinion that the SCRs at these units were not being run properly. In fact, their 2022 rates, shown in comparison, are considerably lower. Thus, even if these units and similar ones cannot reach their 2023/2024 rates reflecting combustion controls—which, in my opinion, is unlikely—they can come much closer to the 2023/2024 rates, minimizing the need for additional NOx allowances.

29. By my analysis, the 2026 rates will require the installation of SCR for the 151 units that do not have SCR presently.[11] I have assumed that even the 20 units with SNCR will likely

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and 2; Shawnee Units 6-9; and R D Green Units 1 and 2. Table 1 also shows the 2022 NOx rates for these 13 units. I note that the Brunner Island and R D Green units have substantially lower NOx rates reported in 2022.

[9] Table 1 also shows the 65 units that need to reduce their 2021 NOx emissions to meet the 2023/2024 rates which already have SCR or SNCR. These are shown in rows with yellow highlighting in the last column and no brown shading. *Id.*

[10] Attach B., tbl 2. In Table 2, units highlighted in blue in the 2021 rate column have very high NOx rates. For example, New Madrid Unit 1 had a 2021 NOx rate of 0.6515 lb/MMBtu and Unit 2 had a NOx rate of 0.611 lb/MMBtu.

[11] These are shown in brown highlighting in Table 2. *Id.* Table 2 shows the comparisons (i.e. ratios) of the 2021 and the 2023/2024 rates to the 2026 ("Half SCR") required rates for 157 units,

need SCR to meet the 2026 rates. Alternatively, an operator could choose to buy allowances. Given the time available (i.e., slightly under 3 years), as well as the planning and design activities that owners and operators of the coal units have likely already completed, as I have noted prior, and the global reach of the SCR supply-chain, it is my opinion that compliance with the 2026 rates is feasible by installing SCR in the time allowed. Of course, there is the extra incentive to install SCRs that are capable of not just meeting the 2026 rates but to achieve even lower NOx levels since doing so can generate allowances for sale.

30. There are 144 units with reduced rates in 2027 as compared to 2026 and there are 82 units with the same rates in 2027 and 2026.[12] In addition, there are 14 units with 2027 rates that are very close to (within 4%) of their 2026 rates. Where the 2026 and 2027 rates differ substantially, these units can either choose to meet the 2027 rates with SCR installation by 2026 and thus generate allowances earlier or they have an extra year to install SCR to meet the 2027 rates. Either option is feasible to meet the compliance goals.

31. In addition to the 30-day average values discussed in the prior paragraphs, these units of 100 MW or more have to meet the daily NOx rates of 0.14 lb/MMBtu. I identified 142 coal units of 100 MW or more.[13] I identified the counts of the days in the 2021 and 2022 ozone seasons where this rate is exceeded, as well as the average daily NOx rate when they exceed the 0.14 lb/MMBtu daily rate.[14] I also identified if a unit currently has an SCR or SNCR. I note that

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of which 6 have SCR and 20 have SNCR. *Id.* I have not included the two Sammis units which are already performing well and have reported NOx rates that are very close to the 2026 rate.

[12] Attach B., tbl 3. Table 3 shows the 2027 rates as compared to the 2026 and 2021 rates (i.e., the ratios of these rates).

[13] Attach B., tbl. 4. Table 4 shows the 142 coal units of 100 MW or more.

[14] Table 4 shows the counts of the days in the 2021 and 2022 ozone seasons where this rate is exceeded, as well as the average daily NOx rate when they exceed the 0.14 lb/MMBtu daily rate. Table 4 also shows if a unit currently has an SCR or SNCR. *Id.* I have highlighted in yellow those cells where the daily rate of 0.14 lb/MMBtu was exceeded frequently based on a

many of the units have SCRs and SNCRs already. It is my opinion that for those units, proper operation of these controls should result in far better compliance with the 0.14 lb/MMBtu daily rate during the ozone season. And, on days where the rate is exceeded, such as during startups/shutdowns, the allowances needed for compliance should not be numerous since the heat inputs would not be large. I also note that EPA is excluding the first 50 tons from excess (i.e., when the unit has daily NOx rates greater than 0.14 lb/MMBtu) NOx emissions for purposes of obtaining allowances. I also note the improved performance of units such as New Madrid 1 and 2 in 2022 as compared to 2021.[15]

32. As noted prior, some units with SCR already installed, such as New Madrid Units 1 and 2 and Thomas Hill Units 1 and 2 had high daily NOx rates in 2021. I reviewed their 2022 performance to assess how many NOx allowances they may need if they performed as they did in 2022 (which was better than their 2021 performance).

33. Per EPA, based on that analysis, New Madrid Unit 1 would need 319 allowances if it operates as it did in 2022. [16] However, a substantially large quantity of NOx was emitted on a handful of days during the ozone season; it appears that the SCR on this unit either did not operate

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qualitative review of the performance data (regardless of how much above this daily rate the unit was performing) and instances where the number of days when the daily rate was exceeded was not large (again, based on a qualitative assessment) but the NOx level was much greater than 0.14 lb/MMBtu when the 0.14 lb/MMBtu rate was exceeded. *Id.* I have highlighted in yellow those cells where the daily rate of 0.14 lb/MMBtu was exceeded frequently based on a qualitative review of the performance data (regardless of how much above this daily rate the unit was performing) and instances where the number of days when the daily rate was exceeded was not large (again, based on a qualitative assessment) but the NOx level was much greater than 0.14 lb/MMBtu when the 0.14 lb/MMBtu rate was exceeded. *Id.* Finally, I have highlighted (in red) those units that have both high daily NOx rates as well as large numbers of days in the ozone seasons (in 2021 and/or 2022) when the daily rate was exceeded. *Id.*

[15] 2021 rates shown in table 1. *See* Attach B. tbl. 1.

[16] Attach B. tbl. 5A.

at all or did so very poorly on these days.[17] Excluding these, i.e., assuming that the unit would have operated with lower NOx in the yellow days, the number of allowances needed for this unit would be zero.

34. Similarly, New Madrid Unit 2 would require 4801 allowances had it operated as it did in 2022.[18] Again, a driver of this allowance need are the handful of days where the SCR does not seem to be operational.[19] Excluding these days, the allowance needed drops to 106, which is 2.21% of 4801.

35. There is similar data for Thomas Hill Unit 1.[20] Operating as it did in 2022 would require 1108 allowances. Excluding the high-NOx days, drops the required allowances to just 1 – or 0.08% of 1108.

36. Finally, for Thomas Hill Unit 2, 815 allowances would be needed if it operated as it did during the 2022 ozone season.[21] This drops to just 24 allowances (or 2.93% of 815) if the high-NOx days are eliminated by properly operating its SCR at all times.

37. Thus, proper operation of SCR on these worst-performing units dramatically reduces the need for allowances.

38. As overall conclusion, I support EPA's Good Neighbor rule as it would apply to the power plant sector. As I have noted, EPA properly focuses on the subset of plants/units that have higher NOx emissions; requires reasonable target rates given the capabilities of the add-on controls and fuels at issue; and also provides a reasonable timeline to achieve compliance by implementing those controls.

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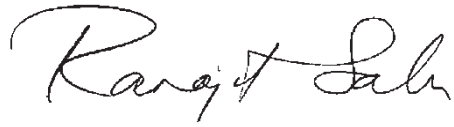
[17] These days are shown in yellow highlights in the last column of Table 5A. *Id.*
[18] Attach B, tbl. 5b.
[19] These days are shown in yellow highlights in the last column of Table 5B. *Id.*
[20] Attach B, tbl. 5C.
[21] Attach B, tbl 5D.

I declare that the above is true and accurate under the penalty of perjury.

Executed in Alhambra, California on August 6, 2023.



Dr. Ranajit (Ron) Sahu

Attachment A – Resume

RANAJIT (RON) SAHU, PH.D, CEM (NEVADA)

CONSULTANT, ENVIRONMENTAL AND ENERGY ISSUES

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Alhambra, CA 91801
Phone: 702.683.5466
e-mail (preferred): ronsahu@gmail.com; sahuron@earthlink.net

EXPERIENCE SUMMARY

Dr. Sahu has over thirty two years of experience in the fields of environmental, mechanical, and chemical engineering including: program and project management services; design and specification of pollution control equipment for a wide range of emissions sources including stationary and mobile sources; soils and groundwater remediation including landfills as remedy; combustion engineering evaluations; energy studies; multimedia environmental regulatory compliance (involving statutes and regulations such as the Federal CAA and its Amendments, Clean Water Act, TSCA, RCRA, CERCLA, SARA, OSHA, NEPA as well as various related state statutes); transportation air quality impact analysis; multimedia compliance audits; multimedia permitting (including air quality NSR/PSD permitting, Title V permitting, NPDES permitting for industrial and storm water discharges, RCRA permitting, etc.), multimedia/multi-pathway human health risk assessments for toxics; air dispersion modeling; and regulatory strategy development and support including negotiation of consent agreements and orders.

He has over thirty years of project management experience and has successfully managed and executed hundreds of projects in this time period. This includes basic and applied research projects, design projects, regulatory compliance projects, permitting projects, energy studies, risk assessment projects, and projects involving the communication of environmental data and information to the public.

He has provided consulting services to numerous private sector, public sector and public interest group clients. His major clients over the past three decades include various trade associations as well as individual companies such as steel mills, petroleum refineries, chemical plants, cement manufacturers, aerospace companies, power generation facilities, lawn and garden equipment manufacturers, spa manufacturers, chemical distribution facilities, land development companies, and various entities in the public sector including EPA, the US Dept. of Justice, several states (including New York, New Jersey, Connecticut, Kansas, Oregon, New Mexico, Pennsylvania, and others), various agencies such as the California DTSC, and various cities and municipalities. Dr. Sahu has executed projects in all 50 US states, numerous local jurisdictions and internationally.

In addition to consulting, for approximately two decades, Dr. Sahu taught numerous courses in several Southern California universities as adjunct faculty, including UCLA (air pollution), UC Riverside (air pollution, process hazard analysis), and Loyola Marymount University (air pollution, risk assessment, hazardous waste management). He also taught at Caltech, his alma mater (various engineering courses), at the University of Southern California (air pollution controls) and at California State University, Fullerton (transportation and air quality).

Dr. Sahu has and continues to provide expert witness services in a number of environmental and engineering areas discussed above in both state and Federal courts as well as before administrative bodies (please see Annex A).

EXPERIENCE RECORD

2000-present **Independent Consultant.** Providing a variety of private sector (industrial companies, land development companies, law firms, etc.), public sector (such as the US Department of Justice), and public interest group clients with project management, environmental consulting, project management, as well as regulatory and engineering support consulting services.

1995-2000 Parsons ES, **Associate, Senior Project Manager and Department Manager for** Air Quality/Geosciences/Hazardous Waste Groups, Pasadena, CA.

Parsons ES, **Manager for Air Source Testing Services**. Responsible for the management of 8 individuals in the area of air source testing and air regulatory permitting projects located in Bakersfield, California.

1992-1995 Engineering-Science, Inc. **Principal Engineer and Senior Project Manager** in the air quality department.

1990-1992 Engineering-Science, Inc. **Principal Engineer and Project Manager** in the air quality department.

1989-1990 Kinetics Technology International, Corp. **Development Engineer.** Involved in thermal engineering R&D and project work related to low-NOx ceramic radiant burners, fired heater NOx reduction, SCR design, and fired heater retrofitting.

1988-1989 Heat Transfer Research, Inc. **Research Engineer**. Involved in the design of fired heaters, heat exchangers, air coolers, and other non-fired equipment. Also did research in the area of heat exchanger tube vibrations.

EDUCATION

1984-1988 Ph.D., Mechanical Engineering, California Institute of Technology (Caltech), Pasadena, CA.

1984 M. S., Mechanical Engineering, California Institute of Technology (Caltech), Pasadena, CA.

1978-1983 B. Tech (Honors), Mechanical Engineering, Indian Institute of Technology (IIT) Kharagpur, India

TEACHING EXPERIENCE

Caltech

"Thermodynamics," Teaching Assistant, California Institute of Technology, 1983, 1987.

"Air Pollution Control," Teaching Assistant, California Institute of Technology, 1985.

"Caltech Secondary and High School Saturday Program," - taught various mathematics (algebra through calculus) and science (physics and chemistry) courses to high school students, 1983-1989.

"Heat Transfer," - taught this course in the Fall and Winter terms of 1994-1995 in the Division of Engineering and Applied Science.

“Thermodynamics and Heat Transfer,” Fall and Winter Terms of 1996-1997.

U.C. Riverside, Extension

"Toxic and Hazardous Air Contaminants," University of California Extension Program, Riverside, California. Various years since 1992.

"Prevention and Management of Accidental Air Emissions," University of California Extension Program, Riverside, California. Various years since 1992.

"Air Pollution Control Systems and Strategies," University of California Extension Program, Riverside, California, Summer 1992-93, Summer 1993-1994.

"Air Pollution Calculations," University of California Extension Program, Riverside, California, Fall 1993-94, Winter 1993-94, Fall 1994-95.

"Process Safety Management," University of California Extension Program, Riverside, California. Various years since 1992-2010.

"Process Safety Management," University of California Extension Program, Riverside, California, at SCAQMD, Spring 1993-94.

"Advanced Hazard Analysis - A Special Course for LEPCs," University of California Extension Program, Riverside, California, taught at San Diego, California, Spring 1993-1994.

"Advanced Hazardous Waste Management" University of California Extension Program, Riverside, California. 2005.

Loyola Marymount University

"Fundamentals of Air Pollution - Regulations, Controls and Engineering," Loyola Marymount University, Dept. of Civil Engineering. Various years beginning 1993.

"Air Pollution Control," Loyola Marymount University, Dept. of Civil Engineering, Fall 1994.

"Environmental Risk Assessment," Loyola Marymount University, Dept. of Civil Engineering. Various years beginning 1998.

"Hazardous Waste Remediation" Loyola Marymount University, Dept. of Civil Engineering. Various years beginning 2006.

University of Southern California

"Air Pollution Controls," University of Southern California, Dept. of Civil Engineering, Fall 1993, Fall 1994.

"Air Pollution Fundamentals," University of Southern California, Dept. of Civil Engineering, Winter 1994.

University of California, Los Angeles

"Air Pollution Fundamentals," University of California, Los Angeles, Dept. of Civil and Environmental Engineering, Spring 1994, Spring 1999, Spring 2000, Spring 2003, Spring 2006, Spring 2007, Spring 2008, Spring 2009.

International Programs

"Environmental Planning and Management," 5 week program for visiting Chinese delegation, 1994.

"Environmental Planning and Management," 1 day program for visiting Russian delegation, 1995.

"Air Pollution Planning and Management," IEP, UCR, Spring 1996.

"Environmental Issues and Air Pollution," IEP, UCR, October 1996.

PROFESSIONAL AFFILIATIONS AND HONORS

President of India Gold Medal, IIT Kharagpur, India, 1983.

Member of the Alternatives Assessment Committee of the Grand Canyon Visibility Transport Commission, established by the Clean Air Act Amendments of 1990, 1992.

American Society of Mechanical Engineers: Los Angeles Section Executive Committee, Heat Transfer Division, and Fuels and Combustion Technology Division, 1987-mid-1990s.

Air and Waste Management Association, West Coast Section, 1989-mid-2000s.

PROFESSIONAL CERTIFICATIONS

EIT, California (#XE088305), 1993.

REA I, California (#07438), 2000.

Certified Permitting Professional, South Coast AQMD (#C8320), since 1993.

QEP, Institute of Professional Environmental Practice, 2000 - 2021.

CEM, State of Nevada (#EM-1699).

PUBLICATIONS (PARTIAL LIST)

"Physical Properties and Oxidation Rates of Chars from Bituminous Coals," with Y.A. Levendis, R.C. Flagan and G.R. Gavalas, *Fuel*, **67**, 275-283 (1988).

"Char Combustion: Measurement and Analysis of Particle Temperature Histories," with R.C. Flagan, G.R. Gavalas and P.S. Northrop, *Comb. Sci. Tech.* **60**, 215-230 (1988).

"On the Combustion of Bituminous Coal Chars," PhD Thesis, California Institute of Technology (1988).

"Optical Pyrometry: A Powerful Tool for Coal Combustion Diagnostics," *J. Coal Quality*, **8**, 17-22 (1989).

"Post-Ignition Transients in the Combustion of Single Char Particles," with Y.A. Levendis, R.C. Flagan and G.R. Gavalas, *Fuel*, **68**, 849-855 (1989).

"A Model for Single Particle Combustion of Bituminous Coal Char." Proc. ASME National Heat Transfer Conference, Philadelphia, **HTD-Vol. 106**, 505-513 (1989).

"Discrete Simulation of Cenospheric Coal-Char Combustion," with R.C. Flagan and G.R. Gavalas, *Combust. Flame*, **77**, 337-346 (1989).

"Particle Measurements in Coal Combustion," with R.C. Flagan, in "**Combustion Measurements**" (ed. N. Chigier), Hemisphere Publishing Corp. (1991).

"Cross Linking in Pore Structures and Its Effect on Reactivity," with G.R. Gavalas in preparation.

"Natural Frequencies and Mode Shapes of Straight Tubes," Proprietary Report for Heat Transfer Research Institute, Alhambra, CA (1990).

"Optimal Tube Layouts for Kamui SL-Series Exchangers," with K. Ishihara, Proprietary Report for Kamui Company Limited, Tokyo, Japan (1990).

"HTRI Process Heater Conceptual Design," Proprietary Report for Heat Transfer Research Institute, Alhambra, CA (1990).

"Asymptotic Theory of Transonic Wind Tunnel Wall Interference," with N.D. Malmuth and others, Arnold Engineering Development Center, Air Force Systems Command, USAF (1990).

"Gas Radiation in a Fired Heater Convection Section," Proprietary Report for Heat Transfer Research Institute, College Station, TX (1990).

"Heat Transfer and Pressure Drop in NTIW Heat Exchangers," Proprietary Report for Heat Transfer Research Institute, College Station, TX (1991).

"NOx Control and Thermal Design," Thermal Engineering Tech Briefs, (1994).

“From Purchase of Landmark Environmental Insurance to Remediation: Case Study in Henderson, Nevada,” with Robin E. Bain and Jill Quillin, presented at the AQMA Annual Meeting, Florida, 2001.

“The Jones Act Contribution to Global Warming, Acid Rain and Toxic Air Contaminants,” with Charles W. Botsford, presented at the AQMA Annual Meeting, Florida, 2001.

PRESENTATIONS (PARTIAL LIST)

"Pore Structure and Combustion Kinetics - Interpretation of Single Particle Temperature-Time Histories," with P.S. Northrop, R.C. Flagan and G.R. Gavalas, presented at the AIChE Annual Meeting, New York (1987).

"Measurement of Temperature-Time Histories of Burning Single Coal Char Particles," with R.C. Flagan, presented at the American Flame Research Committee Fall International Symposium, Pittsburgh, (1988).

"Physical Characterization of a Cenospheric Coal Char Burned at High Temperatures," with R.C. Flagan and G.R. Gavalas, presented at the Fall Meeting of the Western States Section of the Combustion Institute, Laguna Beach, California (1988).

"Control of Nitrogen Oxide Emissions in Gas Fired Heaters - The Retrofit Experience," with G. P. Croce and R. Patel, presented at the International Conference on Environmental Control of Combustion Processes (Jointly sponsored by the American Flame Research Committee and the Japan Flame Research Committee), Honolulu, Hawaii (1991).

"Air Toxics - Past, Present and the Future," presented at the Joint AIChE/AAEE Breakfast Meeting at the AIChE 1991 Annual Meeting, Los Angeles, California, November 17-22 (1991).

"Air Toxics Emissions and Risk Impacts from Automobiles Using Reformulated Gasolines," presented at the Third Annual Current Issues in Air Toxics Conference, Sacramento, California, November 9-10 (1992).

"Air Toxics from Mobile Sources," presented at the Environmental Health Sciences (ESE) Seminar Series, UCLA, Los Angeles, California, November 12, (1992).

"Kilns, Ovens, and Dryers - Present and Future," presented at the Gas Company Air Quality Permit Assistance Seminar, Industry Hills Sheraton, California, November 20, (1992).

"The Design and Implementation of Vehicle Scrapping Programs," presented at the 86th Annual Meeting of the Air and Waste Management Association, Denver, Colorado, June 12, 1993.

"Air Quality Planning and Control in Beijing, China," presented at the 87th Annual Meeting of the Air and Waste Management Association, Cincinnati, Ohio, June 19-24, 1994.

Annex A

Expert Litigation Support

A. Occasions where Dr. Sahu has provided Written or Oral testimony before Congress:

1. In July 2012, provided expert written and oral testimony to the House Subcommittee on Energy and the Environment, Committee on Science, Space, and Technology at a Hearing entitled "Hitting the Ethanol Blend Wall – Examining the Science on E15."

B. Matters for which Dr. Sahu has provided affidavits and expert reports include:

2. Affidavit for Rocky Mountain Steel Mills, Inc. located in Pueblo Colorado – dealing with the technical uncertainties associated with night-time opacity measurements in general and at this steel mini-mill.
3. Expert reports and depositions (2/28/2002 and 3/1/2002; 12/2/2003 and 12/3/2003; 5/24/2004) on behalf of the United States in connection with the Ohio Edison NSR Cases. *United States, et al. v. Ohio Edison Co., et al.*, C2-99-1181 (Southern District of Ohio).
4. Expert reports and depositions (5/23/2002 and 5/24/2002) on behalf of the United States in connection with the Illinois Power NSR Case. *United States v. Illinois Power Co., et al.*, 99-833-MJR (Southern District of Illinois).
5. Expert reports and depositions (11/25/2002 and 11/26/2002) on behalf of the United States in connection with the Duke Power NSR Case. *United States, et al. v. Duke Energy Corp.*, 1:00-CV-1262 (Middle District of North Carolina).
6. Expert reports and depositions (10/6/2004 and 10/7/2004; 7/10/2006) on behalf of the United States in connection with the American Electric Power NSR Cases. *United States, et al. v. American Electric Power Service Corp., et al.*, C2-99-1182, C2-99-1250 (Southern District of Ohio).
7. Affidavit (March 2005) on behalf of the Minnesota Center for Environmental Advocacy and others in the matter of the Application of Heron Lake BioEnergy LLC to construct and operate an ethanol production facility – submitted to the Minnesota Pollution Control Agency.
8. Expert Report and Deposition (10/31/2005 and 11/1/2005) on behalf of the United States in connection with the East Kentucky Power Cooperative NSR Case. *United States v. East Kentucky Power Cooperative, Inc*., 5:04-cv-00034-KSF (Eastern District of Kentucky).
9. Affidavits and deposition on behalf of Basic Management Inc. (BMI) Companies in connection with the BMI vs. USA remediation cost recovery Case.
10. Expert Report on behalf of Penn Future and others in the Cambria Coke plant permit challenge in Pennsylvania.
11. Expert Report on behalf of the Appalachian Center for the Economy and the Environment and others in the Western Greenbrier permit challenge in West Virginia.
12. Expert Report, deposition (via telephone on January 26, 2007) on behalf of various Montana petitioners (Citizens Awareness Network (CAN), Women's Voices for the Earth (WVE) and the Clark Fork Coalition (CFC)) in the Thompson River Cogeneration LLC Permit No. 3175-04 challenge.
13. Expert Report and deposition (2/2/07) on behalf of the Texas Clean Air Cities Coalition at the Texas State Office of Administrative Hearings (SOAH) in the matter of the permit challenges to TXU Project Apollo's eight new proposed PRB-fired PC boilers located at seven TX sites.
14. Expert Testimony (July 2007) on behalf of the Izaak Walton League of America and others in connection with the acquisition of power by Xcel Energy from the proposed Gascoyne Power Plant – at the State of Minnesota, Office of Administrative Hearings for the Minnesota PUC (MPUC No. E002/CN-06-1518; OAH No. 12-2500-17857-2).

15. Affidavit (July 2007) Comments on the Big Cajun I Draft Permit on behalf of the Sierra Club – submitted to the Louisiana DEQ.

16. Expert Report and Deposition (12/13/2007) on behalf of Commonwealth of Pennsylvania – Dept. of Environmental Protection, State of Connecticut, State of New York, and State of New Jersey (Plaintiffs) in connection with the Allegheny Energy NSR Case. *Plaintiffs v. Allegheny Energy Inc., et al.,* 2:05cv0885 (Western District of Pennsylvania).

17. Expert Reports and Pre-filed Testimony before the Utah Air Quality Board on behalf of Sierra Club in the Sevier Power Plant permit challenge.

18. Expert Report and Deposition (October 2007) on behalf of MTD Products Inc., in connection with *General Power Products, LLC v MTD Products Inc*., 1:06 CVA 0143 (Southern District of Ohio, Western Division) .

19. Expert Report and Deposition (June 2008) on behalf of Sierra Club and others in the matter of permit challenges (Title V: 28.0801-29 and PSD: 28.0803-PSD) for the Big Stone II unit, proposed to be located near Milbank, South Dakota.

20. Expert Reports, Affidavit, and Deposition (August 15, 2008) on behalf of Earthjustice in the matter of air permit challenge (CT-4631) for the Basin Electric Dry Fork station, under construction near Gillette, Wyoming before the Environmental Quality Council of the State of Wyoming.

21. Affidavits (May 2010/June 2010 in the Office of Administrative Hearings))/Declaration and Expert Report (November 2009 in the Office of Administrative Hearings) on behalf of NRDC and the Southern Environmental Law Center in the matter of the air permit challenge for Duke Cliffside Unit 6. Office of Administrative Hearing Matters 08 EHR 0771, 0835 and 0836 and 09 HER 3102, 3174, and 3176 (consolidated).

22. Declaration (August 2008), Expert Report (January 2009), and Declaration (May 2009) on behalf of Southern Alliance for Clean Energy in the matter of the air permit challenge for Duke Cliffside Unit 6. *Southern Alliance for Clean Energy et al., v. Duke Energy Carolinas, LLC*, Case No. 1:08-cv-00318-LHT-DLH (Western District of North Carolina, Asheville Division).

23. Declaration (August 2008) on behalf of the Sierra Club in the matter of Dominion Wise County plant MACT.us

24. Expert Report (June 2008) on behalf of Sierra Club for the Green Energy Resource Recovery Project, MACT Analysis.

25. Expert Report (February 2009) on behalf of Sierra Club and the Environmental Integrity Project in the matter of the air permit challenge for NRG Limestone's proposed Unit 3 in Texas.

26. Expert Report (June 2009) on behalf of MTD Products, Inc., in the matter of *Alice Holmes and Vernon Holmes v. Home Depot USA, Inc., et al.*

27. Expert Report (August 2009) on behalf of Sierra Club and the Southern Environmental Law Center in the matter of the air permit challenge for Santee Cooper's proposed Pee Dee plant in South Carolina).

28. Statements (May 2008 and September 2009) on behalf of the Minnesota Center for Environmental Advocacy to the Minnesota Pollution Control Agency in the matter of the Minnesota Haze State Implementation Plans.

29. Expert Report (August 2009) on behalf of Environmental Defense, in the matter of permit challenges to the proposed Las Brisas coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

30. Expert Report and Rebuttal Report (September 2009) on behalf of the Sierra Club, in the matter of challenges to the proposed Medicine Bow Fuel and Power IGL plant in Cheyenne, Wyoming.

31. Expert Report (December 2009) and Rebuttal reports (May 2010 and June 2010) on behalf of the United States in connection with the Alabama Power Company NSR Case. *United States v. Alabama Power Company*, CV-01-HS-152-S (Northern District of Alabama, Southern Division).

32. Pre-filed Testimony (October 2009) on behalf of Environmental Defense and others, in the matter of challenges to the proposed White Stallion Energy Center coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

33. Pre-filed Testimony (July 2010) and Written Rebuttal Testimony (August 2010) on behalf of the State of New Mexico Environment Department in the matter of Proposed Regulation 20.2.350 NMAC – *Greenhouse Gas Cap and Trade Provisions,* No. EIB 10-04 (R), to the State of New Mexico, Environmental Improvement Board.

34. Expert Report (August 2010) and Rebuttal Expert Report (October 2010) on behalf of the United States in connection with the Louisiana Generating NSR Case. *United States v. Louisiana Generating, LLC*, 09-CV100-RET-CN (Middle District of Louisiana) – Liability Phase.

35. Declaration (August 2010), Reply Declaration (November 2010), Expert Report (April 2011), Supplemental and Rebuttal Expert Report (July 2011) on behalf of the United States in the matter of DTE Energy Company and Detroit Edison Company (Monroe Unit 2). *United States of America v. DTE Energy Company and Detroit Edison Company*, Civil Action No. 2:10-cv-13101-BAF-RSW (Eastern District of Michigan).

36. Expert Report and Deposition (August 2010) as well as Affidavit (September 2010) on behalf of Kentucky Waterways Alliance, Sierra Club, and Valley Watch in the matter of challenges to the NPDES permit issued for the Trimble County power plant by the Kentucky Energy and Environment Cabinet to Louisville Gas and Electric, File No. DOW-41106-047.

37. Expert Report (August 2010), Rebuttal Expert Report (September 2010), Supplemental Expert Report (September 2011), and Declaration (November 2011) on behalf of Wild Earth Guardians in the matter of opacity exceedances and monitor downtime at the Public Service Company of Colorado (Xcel)'s Cherokee power plant. No. 09-cv-1862 (District of Colorado).

38. Written Direct Expert Testimony (August 2010) and Affidavit (February 2012) on behalf of Fall-Line Alliance for a Clean Environment and others in the matter of the PSD Air Permit for Plant Washington issued by Georgia DNR at the Office of State Administrative Hearing, State of Georgia (OSAH-BNR-AQ-1031707-98-WALKER).

39. Deposition (August 2010) on behalf of Environmental Defense, in the matter of the remanded permit challenge to the proposed Las Brisas coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

40. Expert Report, Supplemental/Rebuttal Expert Report, and Declarations (October 2010, November 2010, September 2012) on behalf of New Mexico Environment Department (Plaintiff-Intervenor), Grand Canyon Trust and Sierra Club (Plaintiffs) in the matter of *Plaintiffs v. Public Service Company of New Mexico* (PNM), Civil No. 1:02-CV-0552 BB/ATC (ACE) (District of New Mexico).

41. Expert Report (October 2010) and Rebuttal Expert Report (November 2010) (BART Determinations for PSCo Hayden and CSU Martin Drake units) to the Colorado Air Quality Commission on behalf of Coalition of Environmental Organizations.

42. Expert Report (November 2010) (BART Determinations for TriState Craig Units, CSU Nixon Unit, and PRPA Rawhide Unit) to the Colorado Air Quality Commission on behalf of Coalition of Environmental Organizations.

43. Declaration (November 2010) on behalf of the Sierra Club in connection with the Martin Lake Station Units 1, 2, and 3. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation Company LLC*, Case No. 5:10-cv-00156-DF-CMC (Eastern District of Texas, Texarkana Division).

44. Pre-Filed Testimony (January 2011) and Declaration (February 2011) to the Georgia Office of State Administrative Hearings (OSAH) in the matter of Minor Source HAPs status for the proposed Longleaf Energy Associates power plant (OSAH-BNR-AQ-1115157-60-HOWELLS) on behalf of the Friends of the Chattahoochee and the Sierra Club).

45. Declaration (February 2011) in the matter of the Draft Title V Permit for RRI Energy MidAtlantic Power Holdings LLC Shawville Generating Station (Pennsylvania), ID No. 17-00001 on behalf of the Sierra Club.

46. Expert Report (March 2011), Rebuttal Expert Report (June 2011) on behalf of the United States in *United States of America v. Cemex, Inc.*, Civil Action No. 09-cv-00019-MSK-MEH (District of Colorado).

47. Declaration (April 2011) and Expert Report (July 16, 2012) in the matter of the Lower Colorado River Authority (LCRA)'s Fayette (Sam Seymour) Power Plant on behalf of the Texas Campaign for the Environment. *Texas Campaign for the Environment v. Lower Colorado River Authority,* Civil Action No. 4:11-cv-00791 (Southern District of Texas, Houston Division).

48. Declaration (June 2011) on behalf of the Plaintiffs MYTAPN in the matter of Microsoft-Yes, Toxic Air Pollution-No (MYTAPN) v. State of Washington, Department of Ecology and Microsoft Corporation Columbia Data Center to the Pollution Control Hearings Board, State of Washington, Matter No. PCHB No. 10-162.

49. Expert Report (June 2011) on behalf of the New Hampshire Sierra Club at the State of New Hampshire Public Utilities Commission, Docket No. 10-261 – the 2010 Least Cost Integrated Resource Plan (LCIRP) submitted by the Public Service Company of New Hampshire (re. Merrimack Station Units 1 and 2).

50. Declaration (August 2011) in the matter of the Sandy Creek Energy Associates L.P. Sandy Creek Power Plant on behalf of Sierra Club and Public Citizen. *Sierra Club, Inc. and Public Citizen, Inc. v. Sandy Creek Energy Associates, L.P.,* Civil Action No. A-08-CA-648-LY (Western District of Texas, Austin Division).

51. Expert Report (October 2011) on behalf of the Defendants in the matter of *John Quiles and Jeanette Quiles et al. v. Bradford-White Corporation, MTD Products, Inc., Kohler Co., et al.,* Case No. 3:10-cv-747 (TJM/DEP) (Northern District of New York).

52. Declaration (October 2011) on behalf of the Plaintiffs in the matter of *American Nurses Association et. al. (Plaintiffs), v. US EPA (Defendant)*, Case No. 1:08-cv-02198-RMC (US District Court for the District of Columbia).

53. Declaration (February 2012) and Second Declaration (February 2012) in the matter of *Washington Environmental Council and Sierra Club Washington State Chapter v. Washington State Department of Ecology and Western States Petroleum Association,* Case No. 11-417-MJP (Western District of Washington).

54. Expert Report (March 2012) and Supplemental Expert Report (November 2013) in the matter of *Environment Texas Citizen Lobby, Inc and Sierra Club v. ExxonMobil Corporation et al.,* Civil Action No. 4:10-cv-4969 (Southern District of Texas, Houston Division).

55. Declaration (March 2012) in the matter of *Center for Biological Diversity, et al. v. United States Environmental Protection Agency,* Case No. 11-1101 (consolidated with 11-1285, 11-1328 and 11-1336) (US Court of Appeals for the District of Columbia Circuit).

56. Declaration (March 2012) in the matter of *Sierra Club v. The Kansas Department of Health and Environment*, Case No. 11-105,493-AS (Holcomb power plant) (Supreme Court of the State of Kansas).

57. Declaration (March 2012) in the matter of the Las Brisas Energy Center *Environmental Defense Fund et al., v. Texas Commission on Environmental Quality,* Cause No. D-1-GN-11-001364 (District Court of Travis County, Texas, 261st Judicial District).

58. Expert Report (April 2012), Supplemental and Rebuttal Expert Report (July 2012), and Supplemental Rebuttal Expert Report (August 2012) on behalf of the states of New Jersey and Connecticut in the matter of the Portland Power plant *State of New Jersey and State of Connecticut (Intervenor-Plaintiff) v. RRI Energy Mid-Atlantic Power Holdings et al.,* Civil Action No. 07-CV-5298 (JKG) (Eastern District of Pennsylvania).

59. Declaration (April 2012) in the matter of the EPA's EGU MATS Rule, on behalf of the Environmental Integrity Project.

60. Expert Report (August 2012) on behalf of the United States in connection with the Louisiana Generating NSR Case. *United States v. Louisiana Generating, LLC*, 09-CV100-RET-CN (Middle District of Louisiana) – Harm Phase.

61. Declaration (September 2012) in the Matter of the Application of *Energy Answers Incinerator, Inc.* for a Certificate of Public Convenience and Necessity to Construct a 120 MW Generating Facility in Baltimore City, Maryland, before the Public Service Commission of Maryland, Case No. 9199.

62. Expert Report (October 2012) on behalf of the Appellants (Robert Concilus and Leah Humes) in the matter of Robert Concilus and Leah Humes v. Commonwealth of Pennsylvania Department of Environmental Protection and Crawford Renewable Energy, before the Commonwealth of Pennsylvania Environmental Hearing Board, Docket No. 2011-167-R.

63. Expert Report (October 2012), Supplemental Expert Report (January 2013), and Affidavit (June 2013) in the matter of various Environmental Petitioners v. North Carolina DENR/DAQ and Carolinas Cement Company, before the Office of Administrative Hearings, State of North Carolina.

64. Pre-filed Testimony (October 2012) on behalf of No-Sag in the matter of the North Springfield Sustainable Energy Project before the State of Vermont, Public Service Board.

65. Pre-filed Testimony (November 2012) on behalf of Clean Wisconsin in the matter of Application of Wisconsin Public Service Corporation for Authority to Construct and Place in Operation a New Multi-Pollutant Control Technology System (ReACT) for Unit 3 of the Weston Generating Station, before the Public Service Commission of Wisconsin, Docket No. 6690-CE-197.

66. Expert Report (February 2013) on behalf of Petitioners in the matter of Credence Crematory, Cause No. 12-A-J-4538 before the Indiana Office of Environmental Adjudication.

67. Expert Report (April 2013), Rebuttal report (July 2013), and Declarations (October 2013, November 2013) on behalf of the Sierra Club in connection with the Luminant Big Brown Case. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation Company LLC*, Civil Action No. 6:12-cv-00108-WSS (Western District of Texas, Waco Division).

68. Declaration (April 2013) on behalf of Petitioners in the matter of *Sierra Club, et al., (Petitioners) v Environmental Protection Agency et al. (Resppondents),* Case No., 13-1112, (Court of Appeals, District of Columbia Circuit).

69. Expert Report (May 2013) and Rebuttal Expert Report (July 2013) on behalf of the Sierra Club in connection with the Luminant Martin Lake Case. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation Company LLC*, Civil Action No. 5:10-cv-0156-MHS-CMC (Eastern District of Texas, Texarkana Division).

70. Declaration (August 2013) on behalf of A. J. Acosta Company, Inc., in the matter of *A. J. Acosta Company, Inc., v. County of San Bernardino*, Case No. CIVSS803651.

71. Comments (October 2013) on behalf of the Washington Environmental Council and the Sierra Club in the matter of the Washington State Oil Refinery RACT (for Greenhouse Gases), submitted to the Washington State Department of Ecology, the Northwest Clean Air Agency, and the Puget Sound Clean Air Agency.

72. Statement (November 2013) on behalf of various Environmental Organizations in the matter of the Boswell Energy Center (BEC) Unit 4 Environmental Retrofit Project, to the Minnesota Public Utilities Commission, Docket No. E-015/M-12-920.

73. Expert Report (December 2013) on behalf of the United States in *United States of America v. Ameren Missouri*, Civil Action No. 4:11-cv-00077-RWS (Eastern District of Missouri, Eastern Division).

74. Expert Testimony (December 2013) on behalf of the Sierra Club in the matter of Public Service Company of New Hampshire Merrimack Station Scrubber Project and Cost Recovery, Docket No. DE 11-250, to the State of New Hampshire Public Utilities Commission.

75. Expert Report (January 2014) on behalf of Baja, Inc., in *Baja, Inc., v. Automotive Testing and Development Services, Inc. et. al*, Civil Action No. 8:13-CV-02057-GRA (District of South Carolina, Anderson/Greenwood Division).

76. Declaration (March 2014) on behalf of the Center for International Environmental Law, Chesapeake Climate Action Network, Friends of the Earth, Pacific Environment, and the Sierra Club (Plaintiffs) in the matter of *Plaintiffs v. the Export-Import Bank (Ex-Im Bank) of the United States*, Civil Action No. 13-1820 RC (District Court for the District of Columbia).

77. Declaration (April 2014) on behalf of Respondent-Intervenors in the matter of *Mexichem Specialty Resins Inc., et al., (Petitioners) v Environmental Protection Agency et al.,* Case No., 12-1260 (and Consolidated Case Nos. 12-1263, 12-1265, 12-1266, and 12-1267), (Court of Appeals, District of Columbia Circuit).

78. Direct Prefiled Testimony (June 2014) on behalf of the Michigan Environmental Council and the Sierra Club in the matter of the Application of DTE Electric Company for Authority to Implement a Power Supply Cost Recovery (PSCR) Plan in its Rate Schedules for 2014 Metered Jurisdictional Sales of Electricity, Case No. U-17319 (Michigan Public Service Commission).

79. Expert Report (June 2014) on behalf of ECM Biofilms in the matter of the US Federal Trade Commission (FTC) v. ECM Biofilms (FTC Docket #9358).

80. Direct Prefiled Testimony (August 2014) on behalf of the Michigan Environmental Council and the Sierra Club in the matter of the Application of Consumers Energy Company for Authority to Implement a Power Supply Cost Recovery (PSCR) Plan in its Rate Schedules for 2014 Metered Jurisdictional Sales of Electricity, Case No. U-17317 (Michigan Public Service Commission).

81. Declaration (July 2014) on behalf of Public Health Intervenors in the matter of *EME Homer City Generation v. US EPA* (Case No. 11-1302 and consolidated cases) relating to the lifting of the stay entered by the Court on December 30, 2011 (US Court of Appeals for the District of Columbia).

82. Expert Report (September 2014), Rebuttal Expert Report (December 2014) and Supplemental Expert Report (March 2015) on behalf of Plaintiffs in the matter of *Sierra Club and Montana Environmental Information Center (Plaintiffs) v. PPL Montana LLC, Avista Corporation, Puget Sound Energy, Portland General Electric Company, Northwestern Corporation, and Pacificorp (Defendants)*, Civil Action No. CV 13-32-BLG-DLC-JCL (US District Court for the District of Montana, Billings Division).

83. Expert Report (November 2014) on behalf of Niagara County, the Town of Lewiston, and the Villages of Lewiston and Youngstown in the matter of CWM Chemical Services, LLC New York State Department of Environmental Conservation (NYSDEC) Permit Application Nos.: 9-2934-00022/00225, 9-2934-00022/00231, 9-2934-00022/00232, and 9-2934-00022/00249 (pending).

84. *Declaration (January 2015) relating to Startup/Shutdown in the MATS Rule (EPA Docket ID No. EPA-HQ-OAR-2009-0234) on behalf of the Environmental Integrity Project.*

85. Pre-filed Direct Testimony (March 2015), Supplemental Testimony (May 2015), and Surrebuttal Testimony (December 2015) on behalf of Friends of the Columbia Gorge in the matter of the Application for a Site Certificate for the Troutdale Energy Center before the Oregon Energy Facility Siting Council.

86. Brief of Amici Curiae Experts in Air Pollution Control and Air Quality Regulation in Support of the Respondents, On Writs of Certiorari to the US Court of Appeals for the District of Columbia, No. 14-46, 47, 48. *Michigan et. al., (Petitioners) v. EPA et. al., Utility Air Regulatory Group (Petitioners) v. EPA et. al., National Mining Association et. al., (Petitioner) v. EPA et. al.,* (Supreme Court of the United States).

87. Expert Report (March 2015) and Rebuttal Expert Report (January 2016) on behalf of Plaintiffs in the matter of *Conservation Law Foundation v. Broadrock Gas Services LLC, Rhode Island LFG GENCO LLC, and Rhode Island Resource Recovery Corporation (Defendants)*, Civil Action No. 1:13-cv-00777-M-PAS (US District Court for the District of Rhode Island).

88. Declaration (April 2015) relating to various Technical Corrections for the MATS Rule (EPA Docket ID No. EPA-HQ-OAR-2009-0234) on behalf of the Environmental Integrity Project.

89. Direct Prefiled Testimony (May 2015) on behalf of the Michigan Environmental Council, the Natural Resources Defense Council, and the Sierra Club in the matter of the Application of DTE Electric Company for Authority to Increase its Rates, Amend its Rate Schedules and Rules Governing the Distribution and Supply of Electric Energy and for Miscellaneous Accounting Authority, Case No. U-17767 (Michigan Public Service Commission).

90. Expert Report (July 2015) and Rebuttal Expert Report (July 2015) on behalf of Plaintiffs in the matter of *Northwest Environmental Defense Center et. al., v. Cascade Kelly Holdings LLC, d/b/a Columbia Pacific Bio-Refinery, and Global Partners LP (Defendants)*, Civil Action No. 3:14-cv-01059-SI (US District Court for the District of Oregon, Portland Division).

91. Declaration (August 2015, Docket No. 1570376) in support of "Opposition of Respondent-Intervenors American Lung Association, et. al., to Tri-State Generation's Emergency Motion;" Declaration (September 2015, Docket No. 1574820) in support of "Joint Motion of the State, Local Government, and Public Health Respondent-Intervenors for Remand Without Vacatur;" Declaration (October 2015) in support of "Joint Motion of the State, Local Government, and Public Health Respondent-Intervenors to State and Certain Industry Petitioners' Motion to Govern, *White Stallion Energy Center, LLC v. US EPA*, Case No. 12-1100 (US Court of Appeals for the District of Columbia).

92. Declaration (September 2015) in support of the Draft Title V Permit for Dickerson Generating Station (Proposed Permit No 24-031-0019) on behalf of the Environmental Integrity Project.

93. Expert Report (Liability Phase) (December 2015) and Rebuttal Expert Report (February 2016) on behalf of Plaintiffs in the matter of *Natural Resources Defense Council, Inc., Sierra Club, Inc., Environmental Law and Policy Center, and Respiratory Health Association v. Illinois Power Resources LLC, and Illinois Power Resources Generating LLC (Defendants)*, Civil Action No. 1:13-cv-01181 (US District Court for the Central District of Illinois, Peoria Division).

94. Declaration (December 2015) in support of the Petition to Object to the Title V Permit for Morgantown Generating Station (Proposed Permit No 24-017-0014) on behalf of the Environmental Integrity Project.

95. Expert Report (November 2015) on behalf of Appellants in the matter of *Sierra Club, et al. v. Craig W. Butler, Director of Ohio Environmental Protection Agency et al.,* ERAC Case No. 14-256814.

96. Affidavit (January 2016) on behalf of Bridgewatch Detroit in the matter of *Bridgewatch Detroit v. Waterfront Petroleum Terminal Co., and Waterfront Terminal Holdings, LLC.*, in the Circuit Court for the County of Wayne, State of Michigan.

97. Expert Report (February 2016) and Rebuttal Expert Report (July 2016) on behalf of the challengers in the matter of the Delaware Riverkeeper Network, Clean Air Council, et. al., vs. Commonwealth of Pennsylvania Department of Environmental Protection and R. E. Gas Development LLC regarding the Geyer well site before the Pennsylvania Environmental Hearing Board.

98. Direct Testimony (May 2016) in the matter of Tesoro Savage LLC Vancouver Energy Distribution Terminal, Case No. 15-001 before the State of Washington Energy Facility Site Evaluation Council.

99. Declaration (June 2016) relating to deficiencies in air quality analysis for the proposed Millenium Bulk Terminal, Port of Longview, Washington.

100. Declaration (December 2016) relating to EPA's refusal to set limits on PM emissions from coal-fired power plants that reflect pollution reductions achievable with fabric filters on behalf of Environmental Integrity Project, Clean Air Council, Chesapeake Climate Action Network, Downwinders at Risk represented by Earthjustice in the matter of *ARIPPA v EPA, Case No. 15-1180.* (D.C. Circuit Court of Appeals).

101. Expert Report (January 2017) on the Environmental Impacts Analysis associated with the Huntley and Huntley Poseidon Well Pad on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

102. Expert Report (January 2017) on the Environmental Impacts Analysis associated with the Apex Energy Backus Well Pad on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

103. Expert Report (January 2017) on the Environmental Impacts Analysis associated with the Apex Energy Drakulic Well Pad on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

104. Expert Report (January 2017) on the Environmental Impacts Analysis associated with the Apex Energy Deutsch Well Pad on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

105. Affidavit (February 2017) pertaining to deficiencies water discharge compliance issues at the Wood River Refinery in the matter of *People of the State of Illinois (Plaintiff) v. Phillips 66 Company, ConocoPhillips Company, WRB Refining LP (Defendants)*, Case No. 16-CH-656, (Circuit Court for the Third Judicial Circuit, Madison County, Illinois).

106. Expert Report (March 2017) on behalf of the Plaintiff pertaining to non-degradation analysis for waste water discharges from a power plant in the matter of *Sierra Club (Plaintiff) v. Pennsylvania Department of Environmental Protection (PADEP) and Lackawanna Energy Center*, Docket No. 2016-047-L (consolidated), (Pennsylvania Environmental Hearing Board).

107. Expert Report (March 2017) on behalf of the Plaintiff pertaining to air emissions from the Heritage incinerator in East Liverpool, Ohio in the matter of *Save our County (Plaintiff) v. Heritage Thermal Services, Inc. (Defendant), Case No. 4:16-CV-1544-BYP*, (US District Court for the Northern District of Ohio, Eastern Division).

108. Rebuttal Expert Report (June 2017) on behalf of Plaintiffs in the matter of *Casey Voight and Julie Voight (Plaintiffs) v Coyote Creek Mining Company LLC (Defendant),* Civil Action No. 1:15-CV-00109 (US District Court for the District of North Dakota, Western Division).

109. Expert Affidavit (August 2017) and Penalty/Remedy Expert Affidavit (October 2017) on behalf of Plaintiff in the matter of *Wildearth Guardians (Plaintiff) v Colorado Springs Utility Board (Defendant,)* Civil Action No. 1:15-cv-00357-CMA-CBS (US District Court for the District of Colorado).

110. Expert Report (August 2017) on behalf of Appellant in the matter of *Patricia Ann Troiano (Appellant) v. Upper Burrell Township Zoning Hearing Board (Appellee)*, Court of Common Pleas of Westmoreland County, Pennsylvania, Civil Division.

111. Expert Report (October 2017), Supplemental Expert Report (October 2017), and Rebuttal Expert Report (November 2017) on behalf of Defendant in the matter of *Oakland Bulk and Oversized Terminal (Plaintiff) v City of Oakland (Defendant,)* Civil Action No. 3:16-cv-07014-VC (US District Court for the Northern District of California, San Francisco Division).

112. Declaration (December 2017) on behalf of the Environmental Integrity Project in the matter of permit issuance for ATI Flat Rolled Products Holdings, Breckenridge, PA to the Allegheny County Health Department.

113. Expert Report (Harm Phase) (January 2018), Rebuttal Expert Report (Harm Phase) (May 2018) and Supplemental Expert Report (Harm Phase) (April 2019) on behalf of Plaintiffs in the matter of *Natural Resources Defense Council, Inc., Sierra Club, Inc., and Respiratory Health Association v. Illinois Power Resources LLC, and Illinois Power Resources Generating LLC (Defendants)*, Civil Action No. 1:13-cv-01181 (US District Court for the Central District of Illinois, Peoria Division).

114. Declaration (February 2018) on behalf of the Chesapeake Bay Foundation, et. al., in the matter of the Section 126 Petition filed by the state of Maryland in *State of Maryland v. Pruitt (Defendant)*, Civil Action No. JKB-17-2939 (Consolidated with No. JKB-17-2873) (US District Court for the District of Maryland).

115. Direct Pre-filed Testimony (March 2018) on behalf of the National Parks Conservation Association (NPCA) in the matter of *NPCA v State of Washington, Department of Ecology and BP West Coast Products, LLC*, PCHB No. 17-055 (Pollution Control Hearings Board for the State of Washington.

116. Expert Affidavit (April 2018) and Second Expert Affidavit (May 2018) on behalf of Petitioners in the matter of *Coosa River Basin Initiative and Sierra Club (Petitioners) v State of Georgia Environmental Protection Division, Georgia Department of Natural Resources (Respondent) and Georgia Power Company (Intervenor/Respondent)*, Docket Nos: 1825406-BNR-WW-57-Howells and 1826761-BNR-WW-57-Howells, Office of State Administrative Hearings, State of Georgia.

117. Direct Pre-filed Testimony and Affidavit (December 2018) on behalf of Sierra Club and Texas Campaign for the Environment (Appellants) in the contested case hearing before the Texas State Office of Administrative Hearings in Docket Nos. 582-18-4846, 582-18-4847 (Application of GCGV Asset Holding, LLC for Air Quality Permit Nos. 146425/PSDTX1518 and 146459/PSDTX1520 in San Patricio County, Texas).

118. Expert Report (February 2019) on behalf of Sierra Club in the State of Florida, Division of Administrative Hearings, Case No. 18-2124EPP, Tampa Electric Company Big Bend Unit 1 Modernization Project Power Plant Siting Application No. PA79-12-A2.

119. Declaration (March 2019) on behalf of Earthjustice in the matter of comments on the renewal of the Title V Federal Operating Permit for Valero Houston refinery.

120. Expert Report (March 2019) on behalf of Plaintiffs for Class Certification in the matter of *Resendez et al v Precision Castparts Corporation* in the Circuit Court for the State of Oregon, County of Multnomah, Case No. 16cv16164.

121. Expert Report (June 2019), Affidavit (July 2019) and Rebuttal Expert Report (September 2019) on behalf of Appellants relating to the NPDES permit for the Cheswick power plant in the matter of *Three Rivers Waterkeeper and Sierra Club (Appellants) v. State of Pennsylvania Department of Environmental Protection (Appellee) and NRG Power Midwest (Permittee)*, before the Commonwealth of Pennsylvania Environmental Hearing Board, EHB Docket No. 2018-088-R.

122. Affidavit/Expert Report (August 2019) relating to the appeal of air permits issued to PTTGCA on behalf of Appellants in the matter of *Sierra Club (Appellants) v. Craig Butler, Director, et. al., Ohio EPA (Appellees)* before the State of Ohio Environmental Review Appeals Commission (ERAC), Case Nos. ERAC-19-6988 through -6991.

123. Expert Report (October 2019) relating to the appeal of air permit (Plan Approval) on behalf of Appellants in the matter of *Clean Air Council and Environmental Integrity Project (Appellants) v. Commonwealth of Pennsylvania Department of Environmental Protection and Sunoco Partners Marketing and Terminals L.P.*, before the Commonwealth of Pennsylvania Environmental Hearing Board, EHB Docket No. 2018-057-L.

124. Expert Report (December 2019), Affidavit (March 2020), Supplemental Expert Report (July 2020), and Declaration (February 2021) on behalf of Earthjustice in the matter of *Objection to the Issuance of PSD/NSR and Title V permits for Riverview Energy Corporation*, Dale, Indiana, before the Indiana Office of Environmental Adjudication, Cause No. 19-A-J-5073.

125. Affidavit (December 2019) on behalf of Plaintiff-Intervenor (Surfrider Foundation) in the matter of *United States and the State of Indiana (Plaintiffs), Surfrider Foundation (Plaintiff-Intervenor), and City of Chicago (Plaintiff-Intervenor) v. United States Steel Corporation (Defendant),* Civil Action No. 2:18-cv-00127 (US District Court for the Northern District of Indiana, Hammond Division).

126. Declarations (January 2020, February 2020, May 2020, July 2020, and August 2020) and Pre-filed Testimony (April 2021) in support of Petitioner's Motion for Stay of PSCAA NOC Order of Approval No. 11386 in the matter of the *Puyallup Tribe of Indians v. Puget Sound Clean Air Agency (PSCAA) and Puget Sound Energy (PSE),* before the State of Washington Pollution Control Hearings Board, PCHB No. P19-088.

127. Expert Report (April 2020) on behalf of the plaintiff in the matter of Orion Engineered Carbons, GmbH (Plaintiff) vs. Evonik Operations, GmbH (formerly Evonik Degussa GmbH) (Respondent), before the German Arbitration Institute, Case No. DIS-SV-2019-00216.

128. Expert Independent Evaluation Report (June 2020) for *PacifiCorp's Decommissioning Costs Study Reports dated January 15, 2020 and March 13, 2020 relating to the closures of the Hunter, Huntington, Dave Johnston, Jim Bridger, Naughton, Wyodak, Hayden, and Colstrip (Units 3&4) plants*, prepared for the Oregon Public Utility Commission (Oregon PUC).

129. Direct Pre-filed Testimony (July 2020) on behalf of the Sierra Club in the matter of *the Application of the Ohio State University for a certificate of Environmental Compatibility and Public Need to Construct a Combined Heat and Power Facility in Franklin County, Ohio*, before the Ohio Power Siting Board, Case No. 19-1641-EL-BGN.

130. Expert Report (August 2020) and Rebuttal Expert Report (September 2020) on behalf of WildEarth Guardians (petitioners) in the matter of *the Appeals of the Air Quality Permit No. 7482-M1 Issued to 3 Bear Delaware Operating – NM LLC (EIB No. 20-21(A) and Registrations Nos. 8729, 8730, and 8733 under General Construction Permit for Oil and Gas Facilities (EIB No. 20-33 (A)*, before the State of New Mexico, Environmental Improvement Board.

131. Expert Report (July 2020) on the *Initial Economic Impact Analysis (EIA) for A Proposal To* Regulate *NOx Emissions from Natural Gas Fired Rich-Burn Natural Gas Reciprocating Internal Combustion Engines (RICE) Greater Than 100 Horsepower* prepared on behalf of Earthjustice and the National Parks Conservation Association in the matter of Regulation Number 7, Alternate Rules before the Colorado Air Quality Control Commission.

132. Expert Report (August 2020) and Supplemental Expert Report (February 2021) on the Potential Remedies to Avoid Adverse Thermal Impacts from the Merrimack Station on behalf of Plaintiffs in the matter of *Sierra Club Inc. and the* Conservation *Law Foundation (Plaintiffs) v. Granite Shore Power, LLC et. al., (Defendants)*, Civil Action No. 19-cv-216-JL (US District Court for the District of New Hampshire.)

133. Expert Report (August 2020) and Supplemental Expert Report (December 2020) on behalf of Plaintiffs in the matter of *PennEnvironment Inc., and Clean Air Council (Plaintiffs) and Allegheny County Health Department (Plaintiff-Intervenor) v. United States Steel Corporation (Defendant)*, Civil Action No. 2-19-cv-00484-MJH (US District Court for the Western District of Pennsylvania.)

134. Pre-filed Direct Testimony (October 2020) and Sur-rebuttal Testimony (November 2020) on behalf of petitioners (Ten Persons Group, including citizens, the Town of Braintree, the Town of Hingham, and the City of Quincy)

in the matter of Algonquin Gas Transmission LLC, Weymouth MA, No. X266786 Air Quality Plan Approval, before the Commonwealth of Massachusetts, Department of Environmental Protection, the Office of Appeals and Dispute Resolution, OADR Docket Nos. 2019-008, 2019-009, 2019010, 2019-011, 2019-012 and 2019-013.

135. Expert Report (November 2020) on behalf of Protect PT in the matter of *Protect PT v. Commonwealth of Pennsylvania Department of Environmental Protection and Apex Energy (PA) LLC*, before the Commonwealth of Pennsylvania Environmental Hearing Board, Docket No. 2018-080-R (consolidated with 2019-101-R)(the "Drakulic Appeal").

136. Expert Report (December 2020) on behalf of Plaintiffs in the matter of *Sierra Club Inc. (Plaintiff) v. GenOn Power Midwest LP (Defendants)*, Civil Action No. 2-19-cv-01284-WSS (US District Court for the Western District of Pennsylvania.)

137. Pre-filed Testimony (January 2021) on behalf of the Plaintiffs (Shrimpers and Fishermen of the Rio Grande Valley represented by Texas RioGrande Legal Aid, Inc.) in the matter of the Appeal of Texas Commission on Environmental Quality (TCEQ) Permit Nos. 147681, PSDTX1522, GHGPSDTX172 for the Jupiter Brownsville Heavy Condensate Upgrader Facility, Cameron County, before the Texas State Office of Administrative Hearings, SOAH Docket No. 582-21-0111, TCEQ Docket No. 2020-1080-AIR.

138. Expert Reports (March 2021 and May 2021) regarding the Aries Newark LLC Sludge Processing Facility, Application No. CPB 20-74, Central Planning Board, City of Newark, New Jersey.

139. Expert Report (April 2021) for *Charles Johnson Jr. (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant),* Civil Action No. 2:20-CV-01329 (Related to 12-968 BELO in MDL No. 2179). (US District Court for the Eastern District of Louisiana, New Orleans Division).

140. Expert Report (April 2021) for *Floyd Ruffin (Plaintiff), v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 2:20-cv-00334-CJB-JCW (US District Court for the Eastern District of Louisiana, New Orleans Division).

141. Expert Report (April 2021) and Sur-Rebuttal Report (June 2021) on behalf of the Plaintiffs in the matter of *Modern Holdings, LLC, et al. (Plaintiffs) v. Corning Inc., et al. (Defendants)*, Civil Action No. 5:13-cv-00405-GFVT, (US District Court for the Eastern District of Kentucky, Central Division at Lexington).

142. Expert Report (May 2021) for *Clifford Osmer (Plaintiff) v. BP Exploration and Production Inc., et. al., (Defendants)* related to No. 18-CV-12557 (US District Court for the Eastern District of Louisiana).

143. Expert Report (May 2021) and Rebuttal Expert Report (January 2022) for *James Noel (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant),* Civil Action No. 1:19-CV-00694-JB-MU-C (US District Court for the Southern District of Alabama, Southern Division).

144. Expert Report (June 2021) and Declarations (May 2021 and June 2021) on behalf of Plaintiffs in the matter of *Sierra Club (Plaintiff) v. Woodville Pellets, LLC (Defendant)*, Civil Action No. 9:20-cv-00178-MJT (US District Court for the Eastern District of Texas, Lufkin Division.)

145. Expert Witness Disclosure (June 2021) on behalf of the Plaintiffs in the matter of *Jay Burdick, et. al., (Plaintiffs) v. Tanoga Inc. (d/b/a Taconic) (Defendant)*, Index No. 253835, (State of New York Supreme Court, County of Rensselaer).

146. Expert Report (June 2021) on behalf of Appellants in the matter of *PennEnvironment and Earthworks (Appellants) v. Commonwealth of Pennsylvania Department of Environmental Protection (Appellee) and MarkWest Liberty Midstream and resource, LLC (Permittee)*, before the Commonwealth of Pennsylvania Environmental Hearing Board, EHB Docket No. 2020-002-R.

147. Expert Report (June 2021) for *Antonia Saavedra-Vargas (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 2:18-CV-11461 (US District Court for the Eastern District of Louisiana, New Orleans Division).

148. Affidavit (June 2021) for Lourdes Rubi in the matter of *Lourdes Rubi (Plaintiff) v. BP Exploration and Production Inc., et. al., (Defendants)*, related to 12-968 BELO in MDL No. 2179 (US District Court for the Eastern District of Louisiana, New Orleans Division).

149. Expert Report (June 2021) for *Wallace Smith (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 2:19-CV-12880 (US District Court for the Eastern District of Louisiana, New Orleans Division).

150. Declaration (July 2021) on behalf of Plaintiffs in the matter of *Stephanie Mackey and Nick Migliore, on behalf of themselves and all others similarly situated (Plaintiffs) v. Chemtool Inc. and Lubrizol Corporation (Defendants)*, Case No. 2021-L-0000165, State of Illinois, Circuit Court of the 17th Judicial Circuit, Winnebago County.

151. Declaration (July 2021, August 2021) on behalf of Petitioners in the matter of the Petition for a Hearing on the Merits Regarding Air Quality Permit No. 3340-RMD issued to New Mexico Terminal Services, LLC by *Mountain View Neighborhood Association et. al., (Petitioners) v. City of Albuquerque Environmental Health Department*, AQCB Petition No. 2020-1 before the Albuquerque-Bernalillo County Air Quality Control Board.

152. Expert Disclosure (September 2021) on behalf of the Plaintiffs in the matter of *State of New York, Town of Hempstead, Town of Brookhaven, Incorporated Village of Garden City and Long Island Power Authority et. al., (Plaintiffs) v. Covanta Hempstead Company et. al., (Defendants)*, Index No. 7549/2013 before the Supreme Court of the State of New York, County of Nassau.

153. Expert Report (October 2021) for *John A. Battiste (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant),* Civil Action No. 1:21-CV-00118 (US District Court for the Southern District of Alabama, Mobile Division)

154. Declaration/Expert Report (October 2021) for *Charles K. Grasley et. al., (Plaintiffs) v. Chemtool Incorporated (Defendant)*, Case No. 2021-L-0000162 (State of Illinois, In the Circuit Court of the 17th Judicial Circuit, Winnebago County).

155. Declaration (October 2021) and Expert Report (November 2021) on behalf of the Plaintiffs in the matter of Toll Brothers, Inc., and Porter Ranch Development Company (Plaintiffs) v. Sempra Energy, Southern California Gas Company et. al., (Defendants), Southern California [Aliso Canyon] Gas Leak Cases, JCCP No.: 4861, Lead Case No.: BC674622, Superior Court of the State of California for the County of Los Angeles.

156. Expert Report (November 2021) and Declaration (September 2022) on behalf of Plaintiffs in Re: Deepwater Horizon BELO Cases, Case No. 3:19cv963-MCR-GRJ (US District Court for the Northern District of Florida, Pensacola Division).

157. Declaration (November 2021) for the *United States of America and the State of Kansas, Department of Health and Environment (Plaintiffs) v. Coffeyville Resources Refining & Marketing, LLC (Defendant)*, Civ. No. 6:04-cv-01064-JAR-KGG (US District Court for the District of Kansas).

158. Expert Report/Affidavit (December 2021) on behalf of the City of Detroit in the matter of Marathon Petroleum Company (Claimant) v. City of Detroit Building Safety Engineering and Environmental Department, BSEED Case No. MCR 2018-2525, DAH Appeal No. 21-SWA-01, before the State of Michigan, City of Detroit Department of Appeals and Hearings.

159. Expert Report (December 2021) for *John Pabst (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 21-CV-00290 (US District Court for the Eastern District of Louisiana).

160. Expert Report (December 2021) for *Audrey Annette Tillery-Perdue individually and as person representative of the estate of Eddie Lewis Perdue (Plaintiff) v. BP Exploration and Production Inc., et. al., (Defendant)*, Civil Action No. 5:19-cv-00052-MCR-GRJ (US District Court for the Northern District of Florida, Pensacola Division).

161. Expert Report (February 2022) for *Richard Dufour (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 19-cv-00591 (US District Court for the Southern District of Mississippi).

162. Expert Report (February 2022) and Rebuttal Expert Report (June 2022, in preparation) for *Kamuda (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-010475 (Circuit Court of Cook County, Illinois).

163. Expert Report (February 2022) in the matter of the *Appeal Petition for Hearing on Air Quality Permit No. 8585 on behalf of Earth Care New Mexico et. al., (Petitioners) v. New Mexico Environment Department and Associated Asphalt and Materials, LLC (Applicant),* No. EIB 21-48 before the State of New Mexico Environmental Improvement Board.

164. Expert Report (March 2022) and Affidavit (June 2022) in the matter of Clean Air Council et. al., (Appellants) v. Commonwealth of Pennsylvania, Department of Environmental Protection (Appellee) and Renovo Energy Center (Permittee) EHB Docket No. 2021-055-R before the Commonwealth of Pennsylvania Environmental Hearing Board.

165. Declaration (March 2022) in the matter of Max Midstream Texas LLC Air Quality Permit No. 162941 for the Seahawk Crude Condensate Terminal in Calhoun County Texas, TCEQ Docket No. 2022-0157-AIR, before the Texas Commission on Environmental Quality.

166. Expert Pre-filed Testimony (April 2022) in the matter of Application of TPC Group LLC for New State and PSD Air Quality Permits (various), TCEQ Docket No. 2021-1422-AIR, SOAH Docket No. 582-22-0799, Before the Texas State Office of Administrative Hearings.

167. Expert Report (April 2022) and Rebuttal Report (August 2022) for *Teresa Fornek (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-010744 (Circuit Court of Cook County, Illinois.)

168. Rule 26 Disclosure (May 2022) in the matter of the *Water Works and Sewer Board of the City of Gadsden (*Plaintiff*) v. 3M Company, et. al., (Defendants)*, Civil Action No.: 31 CV-2016-900676.00 (Circuit County of Etowah County, Alabama)

169. Expert Report (June 2022) for *Heather Schumacher (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-011939 (Circuit Court of Cook County, Illinois.)

170. Expert Report (June 2022), Rebuttal Reports (August 2022, September 2022) for Plaintiffs in *Phylliss Grayson et. al. (Plaintiffs), v Lockheed Martin Corporation (Defendant),* Case No. 6:20-cv-01770. (US District Court for the Middle District of Florida – Orlando Division.)

171. Expert Affidavit (July 2022) for Center for Environmental Rights in connection with the 2019 South Africa Integrated Resource Plan in *African Climate Alliance et. al. v. The Minister of Mineral Resources and Energy et. al.*, in the High Court of South Africa, Gauteng Division, Pretoria.

172. Expert Affidavit (July 2022) for Center for Environmental Rights in connection with the Limpopo Mine (Lephalale Coal Mines Ltd.) in *Earthlife Africa v. The Minister of Forestry, Fisheries and Environment et. al.*, in the High Court of South Africa, Gauteng Division, Pretoria, Case No. 9149/2022.

173. Pre-filed Testimony (July 2022) and Rebuttal Testimony (September 2020) on behalf of the Puyallup Tribe of Indians in the matter of *Washington Utilities and Transportation Commission (Complainant) v. Puget Sound Energy (Respondent)* before the Washington Utilities and Transportation Commission, Docket UE-220066 and UG-220067 (Consolidated).

174. Expert Affidavit (October 2022) for *Concerned Citizens of Cook County GA (Petitioner) v. Georgia Department of Natural Resources (Respondent) and Spectrum Energy Georgia, LLC (Respondent Intervenor)* before the Office of State Administrative Hearings, State of Georgia, Docket No: 2303405-OSAH-BNR-AQ-37-Barnes.

C. Occasions where Dr. Sahu has provided oral testimony <u>in depositions, at trial or in similar proceedings</u> include the following:

175. Deposition on behalf of Rocky Mountain Steel Mills, Inc. located in Pueblo, Colorado – dealing with the manufacture of steel in mini-mills including methods of air pollution control and BACT in steel mini-mills and opacity issues at this steel mini-mill.

176. Trial Testimony (February 2002) on behalf of Rocky Mountain Steel Mills, Inc. in Denver District Court.

177. Trial Testimony (February 2003) on behalf of the United States in the Ohio Edison NSR Cases, *United States, et al. v. Ohio Edison Co., et al.*, C2-99-1181 (Southern District of Ohio).

178. Trial Testimony (June 2003) on behalf of the United States in the Illinois Power NSR Case, *United States v. Illinois Power Co., et al.*, 99-833-MJR (Southern District of Illinois).

179. Deposition (10/20/2005) on behalf of the United States in connection with the Cinergy NSR Case. *United States, et* al. *v. Cinergy Corp., et al.*, IP 99-1693-C-M/S (Southern District of Indiana).

180. Oral Testimony (August 2006) on behalf of the Appalachian Center for the Economy and the Environment re. the Western Greenbrier plant, WV before the West Virginia DEP.

181. Oral Testimony (May 2007) on behalf of various Montana petitioners (Citizens Awareness Network (CAN), Women's Voices for the Earth (WVE) and the Clark Fork Coalition (CFC)) re. the Thompson River Cogeneration plant before the Montana Board of Environmental Review.

182. Oral Testimony (October 2007) on behalf of the Sierra Club re. the Sevier Power Plant before the Utah Air Quality Board.

183. Oral Testimony (August 2008) on behalf of the Sierra Club and Clean Water re. Big Stone Unit II before the South Dakota Board of Minerals and the Environment.

184. Oral Testimony (February 2009) on behalf of the Sierra Club and the Southern Environmental Law Center re. Santee Cooper Pee Dee units before the South Carolina Board of Health and Environmental Control.

185. Oral Testimony (February 2009) on behalf of the Sierra Club and the Environmental Integrity Project re. NRG Limestone Unit 3 before the Texas State Office of Administrative Hearings (SOAH) Administrative Law Judges.

186. Deposition (July 2009) on behalf of MTD Products, Inc., in the matter of *Alice Holmes and Vernon Holmes v. Home Depot USA, Inc., et al*.

187. Deposition (October 2009) on behalf of Environmental Defense and others, in the matter of challenges to the proposed Coleto Creek coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

188. Deposition (October 2009) on behalf of Environmental Defense, in the matter of permit challenges to the proposed Las Brisas coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

189. Deposition (October 2009) on behalf of the Sierra Club, in the matter of challenges to the proposed Medicine Bow Fuel and Power IGL plant in Cheyenne, Wyoming.

190. Deposition (October 2009) on behalf of Environmental Defense and others, in the matter of challenges to the proposed Tenaska coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH). (April 2010).

191. Oral Testimony (November 2009) on behalf of the Environmental Defense Fund re. the Las Brisas Energy Center before the Texas State Office of Administrative Hearings (SOAH) Administrative Law Judges.

192. Deposition (December 2009) on behalf of Environmental Defense and others, in the matter of challenges to the proposed White Stallion Energy Center coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

193. Oral Testimony (February 2010) on behalf of the Environmental Defense Fund re. the White Stallion Energy Center before the Texas State Office of Administrative Hearings (SOAH) Administrative Law Judges.

194. Deposition (June 2010) on behalf of the United States in connection with the Alabama Power Company NSR Case. *United States v. Alabama Power Company*, CV-01-HS-152-S (Northern District of Alabama, Southern Division).

195. Trial Testimony (September 2010) on behalf of Commonwealth of Pennsylvania – Dept. of Environmental Protection, State of Connecticut, State of New York, State of Maryland, and State of New Jersey (Plaintiffs) in connection with the Allegheny Energy NSR Case in US District Court in the Western District of Pennsylvania. *Plaintiffs v. Allegheny Energy Inc., et al.,* 2:05cv0885 (Western District of Pennsylvania).

196. Oral Direct and Rebuttal Testimony (September 2010) on behalf of Fall-Line Alliance for a Clean Environment and others in the matter of the PSD Air Permit for Plant Washington issued by Georgia DNR at the Office of State Administrative Hearing, State of Georgia (OSAH-BNR-AQ-1031707-98-WALKER).

197. Oral Testimony (September 2010) on behalf of the State of New Mexico Environment Department in the matter of Proposed Regulation 20.2.350 NMAC – *Greenhouse Gas Cap and Trade Provisions,* No. EIB 10-04 (R), to the State of New Mexico, Environmental Improvement Board.

198. Oral Testimony (October 2010) on behalf of the Environmental Defense Fund re. the Las Brisas Energy Center before the Texas State Office of Administrative Hearings (SOAH) Administrative Law Judges.

199. Oral Testimony (November 2010) regarding BART for PSCo Hayden, CSU Martin Drake units before the Colorado Air Quality Commission on behalf of the Coalition of Environmental Organizations.

200. Oral Testimony (December 2010) regarding BART for TriState Craig Units, CSU Nixon Unit, and PRPA Rawhide Unit) before the Colorado Air Quality Commission on behalf of the Coalition of Environmental Organizations.

201. Deposition (December 2010) on behalf of the United States in connection with the Louisiana Generating NSR Case. *United States v. Louisiana Generating, LLC*, 09-CV100-RET-CN (Middle District of Louisiana).

202. Deposition (February 2011 and January 2012) on behalf of Wild Earth Guardians in the matter of opacity exceedances and monitor downtime at the Public Service Company of Colorado (Xcel)'s Cherokee power plant. No. 09-cv-1862 (D. Colo.).

203. Oral Testimony (February 2011) to the Georgia Office of State Administrative Hearings (OSAH) in the matter of Minor Source HAPs status for the proposed Longleaf Energy Associates power plant (OSAH-BNR-AQ-1115157-60-HOWELLS) on behalf of the Friends of the Chattahoochee and the Sierra Club).

204. Deposition (August 2011) on behalf of the United States in *United States of America v. Cemex, Inc.*, Civil Action No. 09-cv-00019-MSK-MEH (District of Colorado).

205. Deposition (July 2011) and Oral Testimony at Hearing (February 2012) on behalf of the Plaintiffs MYTAPN in the matter of Microsoft-Yes, Toxic Air Pollution-No (MYTAPN) v. State of Washington, Department of Ecology and Microsoft Corporation Columbia Data Center to the Pollution Control Hearings Board, State of Washington, Matter No. PCHB No. 10-162.

206. Oral Testimony at Hearing (March 2012) on behalf of the United States in connection with the Louisiana Generating NSR Case. *United States v. Louisiana Generating, LLC*, 09-CV100-RET-CN (Middle District of Louisiana).

207. Oral Testimony at Hearing (April 2012) on behalf of the New Hampshire Sierra Club at the State of New Hampshire Public Utilities Commission, Docket No. 10-261 – the 2010 Least Cost Integrated Resource Plan (LCIRP) submitted by the Public Service Company of New Hampshire (re. Merrimack Station Units 1 and 2).

208. Oral Testimony at Hearing (November 2012) on behalf of Clean Wisconsin in the matter of Application of Wisconsin Public Service Corporation for Authority to Construct and Place in Operation a New Multi-Pollutant Control Technology System (ReACT) for Unit 3 of the Weston Generating Station, before the Public Service Commission of Wisconsin, Docket No. 6690-CE-197.

209. Deposition (March 2013) in the matter of various Environmental Petitioners v. North Carolina DENR/DAQ and Carolinas Cement Company, before the Office of Administrative Hearings, State of North Carolina.

210. Deposition (August 2013) on behalf of the Sierra Club in connection with the Luminant Big Brown Case. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation Company LLC*, Civil Action No. 6:12-cv-00108-WSS (Western District of Texas, Waco Division).

211. Deposition (August 2013) on behalf of the Sierra Club in connection with the Luminant Martin Lake Case. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation Company LLC*, Civil Action No. 5:10-cv-0156-MHS-CMC (Eastern District of Texas, Texarkana Division).

212. Deposition (February 2014) on behalf of the United States in *United States of America v. Ameren Missouri*, Civil Action No. 4:11-cv-00077-RWS (Eastern District of Missouri, Eastern Division).

213. Trial Testimony (February 2014) in the matter of *Environment Texas Citizen Lobby, Inc and Sierra Club v. ExxonMobil Corporation et al.,* Civil Action No. 4:10-cv-4969 (Southern District of Texas, Houston Division).

214. Trial Testimony (February 2014) on behalf of the Sierra Club in connection with the Luminant Big Brown Case. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation Company LLC*, Civil Action No. 6:12-cv-00108-WSS (Western District of Texas, Waco Division).

215. Deposition (June 2014) and Trial (August 2014) on behalf of ECM Biofilms in the matter of the *US Federal Trade Commission (FTC) v. ECM Biofilms* (FTC Docket #9358).

216. Deposition (February 2015) on behalf of Plaintiffs in the matter of *Sierra Club and Montana Environmental Information Center (Plaintiffs) v. PPL Montana LLC, Avista Corporation, Puget Sound Energy, Portland General Electric Company, Northwestern Corporation, and Pacificorp (Defendants)*, Civil Action No. CV 13-32-BLG-DLC-JCL (US District Court for the District of Montana, Billings Division).

217. Oral Testimony at Hearing (April 2015) on behalf of Niagara County, the Town of Lewiston, and the Villages of Lewiston and Youngstown in the matter of CWM Chemical Services, LLC New York State Department of Environmental Conservation (NYSDEC) Permit Application Nos.: 9-2934-00022/00225, 9-2934-00022/00231, 9-2934-00022/00232, and 9-2934-00022/00249 (pending).

218. Deposition (August 2015) on behalf of Plaintiff in the matter of *Conservation Law Foundation (Plaintiff) v. Broadrock Gas Services LLC, Rhode Island LFG GENCO LLC, and Rhode Island Resource Recovery Corporation (Defendants)*, Civil Action No. 1:13-cv-00777-M-PAS (US District Court for the District of Rhode Island).

219. Testimony at Hearing (August 2015) on behalf of the Sierra Club in the matter of *Amendments to 35 Illinois Administrative Code Parts 214, 217, and 225* before the Illinois Pollution Control Board, R15-21.

220. Deposition (May 2015) on behalf of Plaintiffs in the matter of *Northwest Environmental Defense Center et. al., (Plaintiffs) v. Cascade Kelly Holdings LLC, d/b/a Columbia Pacific Bio-Refinery, and Global Partners LP (Defendants)*, Civil Action No. 3:14-cv-01059-SI (US District Court for the District of Oregon, Portland Division).

221. Trial Testimony (October 2015) on behalf of Plaintiffs in the matter of *Northwest Environmental Defense Center et. al., (Plaintiffs) v. Cascade Kelly Holdings LLC, d/b/a Columbia Pacific Bio-Refinery, and Global Partners LP (Defendants)*, Civil Action No. 3:14-cv-01059-SI (US District Court for the District of Oregon, Portland Division).

222. Deposition (April 2016) on behalf of the Plaintiffs in *UNatural Resources Defense Council, Respiratory Health Association, and Sierra Club (Plaintiffs) v. Illinois Power Resources LLC and Illinois Power Resources Generation LLC (Defendants)*, Civil Action No. 1:13-cv-01181 (Central District of Illinois, Peoria Division).

223. Trial Testimony at Hearing (July 2016) in the matter of Tesoro Savage LLC Vancouver Energy Distribution Terminal, Case No. 15-001 before the State of Washington Energy Facility Site Evaluation Council.

224. Trial Testimony (December 2016) on behalf of the challengers in the matter of the Delaware Riverkeeper Network, Clean Air Council, et. al., vs. Commonwealth of Pennsylvania Department of Environmental Protection and R. E. Gas Development LLC regarding the Geyer well site before the Pennsylvania Environmental Hearing Board.

225. Trial Testimony (July-August 2016) on behalf of the United States in *United States of America v. Ameren Missouri*, Civil Action No. 4:11-cv-00077-RWS (Eastern District of Missouri, Eastern Division).

226. Trial Testimony (January 2017) on the Environmental Impacts Analysis associated with the Huntley and Huntley Poseidon Well Pad Hearing on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

227. Trial Testimony (January 2017) on the Environmental Impacts Analysis associated with the Apex energy Backus Well Pad Hearing on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

228. Trial Testimony (January 2017) on the Environmental Impacts Analysis associated with the Apex energy Drakulic Well Pad Hearing on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

229. Trial Testimony (January 2017) on the Environmental Impacts Analysis associated with the Apex energy Deutsch Well Pad Hearing on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

230. Deposition Testimony (July 2017) on behalf of Plaintiffs in the matter of *Casey Voight and Julie Voight v Coyote Creek Mining Company LLC (Defendant)* Civil Action No. 1:15-CV-00109 (US District Court for the District of North Dakota, Western Division).

231. Deposition Testimony (November 2017) on behalf of Defendant in the matter of *Oakland Bulk and Oversized Terminal (Plaintiff) v City of Oakland (Defendant,)* Civil Action No. 3:16-cv-07014-VC (US District Court for the Northern District of California, San Francisco Division).

232. Deposition Testimony (December 2017) on behalf of Plaintiff in the matter of *Wildearth Guardians (Plaintiff) v Colorado Springs Utility Board (Defendant)* Civil Action No. 1:15-cv-00357-CMA-CBS (US District Court for the District of Colorado).

233. Deposition Testimony (January 2018) in the matter of National Parks Conservation Association (NPCA) v. State of Washington Department of Ecology and British Petroleum (BP) before the Washington Pollution Control Hearing Board, Case No. 17-055.

234. Trial Testimony (January 2018) on behalf of Defendant in the matter of *Oakland Bulk and Oversized Terminal (Plaintiff) v City of Oakland (Defendant,)* Civil Action No. 3:16-cv-07014-VC (US District Court for the Northern District of California, San Francisco Division).

235. Trial Testimony (April 2018) on behalf of the National Parks Conservation Association (NPCA) in the matter of NPCA v State of Washington, Department of Ecology and BP West Coast Products, LLC, PCHB No. 17-055 (Pollution Control Hearings Board for the State of Washington.

236. Deposition (June 2018) (harm Phase) on behalf of Plaintiffs in the matter of *Natural Resources Defense Council, Inc., Sierra Club, Inc., and Respiratory Health Association v. Illinois Power Resources LLC, and Illinois Power Resources Generating LLC (Defendants)*, Civil Action No. 1:13-cv-01181 (US District Court for the Central District of Illinois, Peoria Division).

237. Trial Testimony (July 2018) on behalf of Petitioners in the matter of *Coosa River Basin Initiative and Sierra Club (Petitioners) v State of Georgia Environmental Protection Division, Georgia Department of Natural Resources (Respondent) and Georgia Power Company (Intervenor/Respondent)*, Docket Nos: 1825406-BNR-WW-57-Howells and 1826761-BNR-WW-57-Howells, Office of State Administrative Hearings, State of Georgia.

238. Deposition (January 2019) and Trial Testimony (January 2019) on behalf of Sierra Club and Texas Campaign for the Environment (Appellants) in the contested case hearing before the Texas State Office of Administrative Hearings in Docket Nos. 582-18-4846, 582-18-4847 (Application of GCGV Asset Holding, LLC for Air Quality Permit Nos. 146425/PSDTX1518 and 146459/PSDTX1520 in San Patricio County, Texas).

239. Deposition (February 2019) and Trial Testimony (March 2019) on behalf of Sierra Club in the State of Florida, Division of Administrative Hearings, Case No. 18-2124EPP, Tampa Electric Company Big Bend Unit 1 Modernization Project Power Plant Siting Application No. PA79-12-A2.

240. Deposition (June 2019) relating to the appeal of air permits issued to PTTGCA on behalf of Appellants in the matter of *Sierra Club (Appellants) v. Craig Butler, Director, et. al., Ohio EPA (Appellees)* before the State of Ohio Environmental Review Appeals Commission (ERAC), Case Nos. ERAC-19-6988 through -6991.

241. Deposition (September 2019) on behalf of Appellants relating to the NPDES permit for the Cheswick power plant in the matter of *Three Rivers Waterkeeper and Sierra Club (Appellants) v. State of Pennsylvania Department of Environmental Protection (Appellee) and NRG Power Midwest (Permittee)*, before the Commonwealth of Pennsylvania Environmental Hearing Board, EHB Docket No. 2018-088-R.

242. Deposition (December 2019) on behalf of the Plaintiffs in the matter of David Kovac, individually and on behalf of wrongful death class of Irene Kovac v. BP Corporation North America Inc., Circuit Court of Jackson County, Missouri (Independence), Case No. 1816-CV12417.

243. Deposition (February 2020, virtual) and testimony at Hearing (August 2020, virtual) on behalf of Earthjustice in the matter of *Objection to the Issuance of PSD/NSR and Title V permits for Riverview Energy Corporation*, Dale, Indiana, before the Indiana Office of Environmental Adjudication, Cause No. 19-A-J-5073.

244. Hearing (July 14-15, 2020, virtual) on behalf of the Sierra Club in the matter of *the Application of the Ohio State University for a certificate of Environmental Compatibility and Public Need to Construct a Combined Heat and Power Facility in Franklin County, Ohio*, before the Ohio Power Siting Board, Case No. 19-1641-EL-BGN.

245. Hearing (September 2020, virtual) on behalf of WildEarth Guardians (petitioners) in the matter of *the Appeals of the Air Quality Permit No. 7482-M1 Issued to 3 Bear Delaware* Operating – *NM LLC (EIB No. 20-21(A) and Registrations Nos. 8729, 8730, and 8733 under General Construction Permit for Oil and Gas Facilities (EIB No. 20-33 (A)*, before the State of New Mexico, Environmental Improvement Board.

246. Deposition (December 2020, March 4-5, 2021, all virtual) and Hearing (April 2021, virtual) in support of Petitioner's Motion for Stay of PSCAA NOC Order of Approval No. 11386 in the matter of the *Puyallup Tribe of Indians v. Puget Sound Clean Air Agency (PSCAA) and Puget Sound Energy (PSE),* before the State of Washington Pollution Control Hearings Board, PCHB No. P19-088.

247. Hearing (September 2020, virtual) on the *Initial Economic Impact Analysis (EIA) for A Proposal To* Regulate *NOx Emissions from Natural Gas Fired Rich-Burn Natural Gas Reciprocating Internal Combustion Engines (RICE) Greater Than 100 Horsepower* prepared on behalf of Earthjustice and the National Parks Conservation Association in the matter of Regulation Number 7, Alternate Rules before the Colorado Air Quality Control Commission.

248. Deposition (December 2020, virtual and Hearing February 2021, virtual) on behalf of the Plaintiffs (Shrimpers and Fishermen of the Rio Grande Valley represented by Texas RioGrande Legal Aid, Inc.) in the matter of the Appeal of Texas Commission on Environmental Quality (TCEQ) Permit Nos. 147681, PSDTX1522, GHGPSDTX172 for the Jupiter Brownsville Heavy Condensate Upgrader Facility, Cameron County, before the Texas State Office of Administrative Hearings, SOAH Docket No. 582-21-0111, TCEQ Docket No. 2020-1080-AIR.

249. Deposition (January 2021, virtual) on behalf of Plaintiffs in the matter of *PennEnvironment Inc., and Clean Air Council (Plaintiffs) and Allegheny County Health Department (Plaintiff-Intervenor) v. United States Steel Corporation (Defendant)*, Civil Action No. 2-19-cv-00484-MJH (US District Court for the Western District of Pennsylvania.)

250. Deposition (February 2021, virtual) on behalf of Plaintiffs in the matter of *Sierra Club Inc. (Plaintiff) v. GenOn Power Midwest LP (*Defendants*)*, Civil Action No. 2-19-cv-01284-WSS (US District Court for the Western District of Pennsylvania.)

251. Deposition (April 2021, virtual) on the Potential Remedies to Avoid Adverse Thermal Impacts from the Merrimack Station on behalf of Plaintiffs in the matter of *Sierra Club Inc. and the* Conservation *Law Foundation (Plaintiffs) v. Granite Shore Power, LLC et. al., (Defendants)*, Civil Action No. 19-cv-216-JL (US District Court for the District of New Hampshire.)

252. Deposition (June 2021, virtual) on behalf of Plaintiffs in the matter of *Sierra Club (Plaintiff) v. Woodville Pellets, LLC (Defendant)*, Civil Action No. 9:20-cv-00178-MJT (US District Court for the Eastern District of Texas, Lufkin Division).

253. Deposition (June 2021, virtual) on behalf of the Plaintiffs in the matter of *Modern Holdings, LLC, et al. (Plaintiffs) v. Corning Inc., et al. (Defendants)*, Civil Action No. 5:13-cv-00405-GFVT, (US District Court for the Eastern District of Kentucky, Central Division at Lexington).

254. Testimony (June 2021, virtual) regarding the Aries Newark LLC Sludge Processing Facility, Application No. CPB 20-74, (Central Planning Board, City of Newark, New Jersey).

255. Testimony at Hearing (October 2021) on behalf of Evraz Rocky Mountain Steel in the matter of Colorado's Proposed Revisions to Regulation 22, the Greenhouse Gas Emissions and Energy Management for the Manufacturing Sector in Colorado (GEMM Rule), before the Colorado Air Quality Control Commission.

256. Deposition (November 2021) for *Charles Johnson Jr. (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant),* Civil Action No. 2:20-CV-01329 (Related to 12-968 BELO in MDL No. 2179). (US District Court for the Eastern District of Louisiana).

257. Testimony at Hearing (November 2021) on behalf of *National Parks Conservation Association, et. al*., in the matter of the Proposed Revisions to Colorado's Regional Haze State Implementation Plan (SIP) and Colorado Regulation 23, before the Colorado Air Quality Control Commission.

258. Deposition (December 2021) on behalf of Plaintiffs in Re: Deepwater Horizon BELO Cases, Case No. 3:19cv963-MCR-GRJ (US District Court for the Northern District of Florida, Pensacola Division).

259. Deposition (December 2021) for *James Noel (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant),* Civil Action No. 1:19-CV-00694-JB-MU-C (US District Court for the Southern District of Alabama, Southern Division).

260. Testimony at Hearing (February 2022, virtual) in the matter of the *Appeal Petition for Hearing on Air Quality Permit No. 8585 on behalf of Earth Care New Mexico et. al., (Petitioners) v. New Mexico Environment Department and Associated Asphalt and Materials, LLC (Applicant),* No. EIB 21-48 before the State of New Mexico Environmental Improvement Board.

261. Deposition (March 2022) and Rebuttal Deposition (July 2022) for *Kamuda (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-010475 (Circuit Court of Cook County, Illinois.)

262. Deposition (April 2022, virtual) in the matter of Application of TPC Group LLC for New State and PSD Air Quality Permits (various), TCEQ Docket No. 2021-1422-AIR, SOAH Docket No. 582-22-0799, Before the Texas State Office of Administrative Hearings.

263. Deposition (May 2022, virtual) in the matter of the *Water Works and Sewer Board of the City of Gadsden (Plaintiff) v. 3M Company, et. al., (*Defendants*)*, Civil Action No.: 31 CV-2016-900676.00 (Circuit County of Etowah County, Alabama)

264. Deposition (June 2022 and September 2022, both virtual) for *Teresa* Fornek *(Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-010744 (Circuit Court of Cook County, Illinois.)

265. Deposition (June 2022, virtual) on behalf of the Plaintiffs in the matter of Toll Brothers, Inc., and Porter Ranch Development Company (Plaintiffs) v. Sempra Energy, Southern California Gas Company et. al., (Defendants), Southern California [Aliso Canyon] Gas Leak Cases, JCCP No.: 4861, Lead Case No.: BC674622, Superior Court of the State of California for the County of Los Angeles.

266. Deposition (July 2022) for *Richard Dufour (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 19-cv-00591 (US District Court for the Southern District of Mississippi).

267. Trial (August 2022) on behalf of the Plaintiffs in the matter of Modern *Holdings, LLC, et al. (Plaintiffs) v. Phillips (Defendants)*, Civil Action No. 5:13-cv-00405-GFVT, (US District Court for the Eastern District of Kentucky, Central Division at Lexington).

268. Trial (August 2022, in person) for *Susan Kamuda (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-010475 (Circuit Court of Cook County, Illinois).

269. Deposition (September 2022, virtual) for *Heather Schumacher (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-010744 (Circuit Court of Cook County, Illinois.)

270. Deposition (September 2022) on behalf of Plaintiffs in *Phylliss Grayson et. al. (Plaintiffs), v Lockheed Martin Corporation (Defendant),* Case No. 6:20-cv-01770. (US District Court for the Middle District of Florida – Orlando Division.)

271. Hearing (October 2022) on behalf of the Puyallup Tribe of Indians in the matter of *Washington Utilities and Transportation Commission (Complainant) v. Puget Sound Energy (Respondent)* before the Washington Utilities and Transportation Commission, Docket UE-220066 and UG-220067 (Consolidated).

272. Deposition (September 2022) for *Teresa Fornek (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-010475 (Circuit Court of Cook County, Illinois).

273. Trial (October 2022, in person) for *Teresa Fornek (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-010475 (Circuit Court of Cook County, Illinois).

Attachment B

Table 1 – List of 225 Units That Need to Reduce Their NOx Emissions

Plant, Unit Concatenate for 2023/2024	Count 2023/2024 No SCR/SNCR	2022 Rate	2021 Rate	2023 or 2024 Rate After Optimization)	Count 2023/2024 All Units	Compare 2023/2024 to 2021
Nelson Industrial Steam Company Unit=1A			0.1990	0.1990		1.0000
River Valley Unit=1A			0.2289	0.2289		1.0000
River Valley Unit=1B			0.2321	0.2321		1.0000
River Valley Unit=2A			0.2280	0.2280		1.0000
River Valley Unit=2B			0.2231	0.2231		1.0000
Southwestern Unit=8003			0.3089	0.3089		1.0000
Rausch Creek Generation, LLC Unit=031			0.1449	0.1449		1.0000
Little Gypsy Unit=3			0.2863	0.2863		1.0000
Riverside (4940) Unit=1502			0.2759	0.2759		1.0000
Watson Electric Generating Plant Unit=5			0.2744	0.2744		1.0000
Gerald Andrus Unit=1			0.2679	0.2679		1.0000
W A Parish Unit=WAP3			0.2477	0.2477		1.0000
Horseshoe Lake Unit=6			0.2409	0.2409		1.0000
Graham Unit=2			0.2381	0.2381		1.0000
Lake Catherine Unit=4			0.2361	0.2361		1.0000
Ninemile Point Unit=5			0.2306	0.2306		1.0000
Teche Power Station Unit=3			0.2293	0.2293		1.0000
Ninemile Point Unit=4			0.2019	0.2019		1.0000
Intermountain Unit=2SGA			0.3340	0.3340		1.0000
North Valmy Unit=1			0.3253	0.3253		1.0000
Northeastern Unit=3302			0.1903	0.1903		1.0000
Horseshoe Lake Unit=8			0.1894	0.1894		1.0000
Brame Energy Center Unit=1			0.1816	0.1816		1.0000
Hunter Unit=3			0.2955	0.2955		1.0000
Fort Martin Power Station Unit=2			0.2816	0.2816		1.0000
Intermountain Unit=1SGA			0.2768	0.2768		1.0000
North Valmy Unit=2			0.2663	0.2663		1.0000
Horseshoe Lake Unit=7			0.1543	0.1543		1.0000
W A Parish Unit=WAP4			0.1542	0.1542		1.0000
Sim Gideon Unit=3			0.1508	0.1508		1.0000
Big Sandy Unit=BSU1			0.1497	0.1497		1.0000
Nichols Station Unit=143B			0.1490	0.1490		1.0000
Sabine Unit=1			0.1459	0.1459		1.0000
Bonanza Unit=1-1			0.2400	0.2400		1.0000
O W Sommers Unit=1			0.1415	0.1415		1.0000
Sabine Unit=4			0.1389	0.1389		1.0000
East River Unit=60			0.1386	0.1386		1.0000
Seminole (2956) Unit=1			0.1362	0.1362		1.0000
Sioux Unit=1			0.2480	0.2253	1	1.1005
Watson Electric Generating Plant Unit=4			0.1352	0.1352		1.0000
Barry Unit=4			0.2692	0.1346	1	2.0000
Sioux Unit=2			0.2267	0.2207	1	1.0271
Little Gypsy Unit=2			0.1273	0.1273		1.0000
Huntington Unit=2			0.2109	0.2109		1.0000
Brunner Island, LLC Unit=1	1	0.0832	0.2476	0.1238	1	2.0000
Belle River Unit=2			0.2060	0.2060		1.0000
Welsh Power Plant Unit=3			0.2050	0.2050		1.0000
V H Braunig Unit=3			0.1214	0.1214		1.0000
Clifty Creek Unit=6			0.1994	0.1994		1.0000
Daniel Electric Generating Plant Unit=1	1	0.2776	0.2931	0.1990	1	1.4730

Clover Power Station Unit=2			0.2483	0.1990	1	1.2475
Muskogee Unit=6	1	0.3087	0.2953	0.1990	1	1.4837
Fort Martin Power Station Unit=1			0.2884	0.1990	1	1.4492
Mill Creek Unit=2	1	0.2576	0.2616	0.1990	1	1.3146
Mill Creek Unit=1	1	0.2616	0.2600	0.1990	1	1.3064
Shawnee Unit=6	1	0.2427	0.2501	0.1990	1	1.2566
Shawnee Unit=8	1	0.2412	0.2411	0.1990	1	1.2114
Shawnee Unit=9	1	0.2419	0.2407	0.1990	1	1.2094
Shawnee Unit=7	1	0.242	0.2405	0.1990	1	1.2083
Clover Power Station Unit=1			0.2127	0.1990	1	1.0687
Belle River Unit=1			0.1982	0.1982		1.0000
Brunner Island, LLC Unit=3	1	0.0665	0.2369	0.1185	1	2.0000
Brunner Island, LLC Unit=2	1	0.0751	0.2358	0.1179	1	2.0000
Seminole (2956) Unit=3			0.1178	0.1178		1.0000
Greene County Unit=2			0.1177	0.1177		1.0000
Welsh Power Plant Unit=1			0.1939	0.1939		1.0000
John S. Cooper Unit=1			0.1934	0.1934		1.0000
Hunter Unit=1			0.1924	0.1924		1.0000
Brame Energy Center Unit=2			0.1910	0.1910		1.0000
Greene County Unit=1			0.1142	0.1142		1.0000
Flint Creek Power Plant Unit=1			0.1897	0.1897		1.0000
Greenwood Unit=1			0.1135	0.1135		1.0000
Tolk Station Unit=172B			0.1859	0.1859		1.0000
E C Gaston Unit=4			0.1101	0.1101		1.0000
O W Sommers Unit=2			0.1101	0.1101		1.0000
Huntington Unit=1			0.1827	0.1827		1.0000
Ghent Unit=2			0.1813	0.1813		1.0000
J H Campbell Unit=1			0.1810	0.1810		1.0000
IPL - Petersburg Generating Station Unit=4			0.1807	0.1807		1.0000
Hugo Unit=1			0.1790	0.1790		1.0000
Jones Station Unit=151B			0.1067	0.1067		1.0000
Hunter Unit=2			0.1759	0.1759		1.0000
E C Gaston Unit=3			0.1052	0.1052		1.0000
R M Schahfer Generating Station Unit=18			0.1728	0.1728		1.0000
Seminole (2956) Unit=2			0.1028	0.1028		1.0000
Tolk Station Unit=171B			0.1711	0.1711		1.0000
R D Green Unit=G2	1	0.133	0.2034	0.1017	1	2.0000
R M Schahfer Generating Station Unit=17			0.1676	0.1676		1.0000
Harrington Station Unit=063B			0.1636	0.1636		1.0000
Limestone Unit=LIM2			0.1801	0.1632	1	1.1036
Shawnee Unit=3			0.1618	0.1618		1.0000
Shawnee Unit=5			0.1612	0.1612		1.0000
E C Gaston Unit=2			0.0966	0.0966		1.0000
White Bluff Unit=1			0.1599	0.1599		1.0000
Shawnee Unit=2			0.1597	0.1597		1.0000
Jones Station Unit=152B			0.0957	0.0957		1.0000
San Miguel Unit=SM-1			0.1645	0.1588	1	1.0357
R S Nelson Unit=6			0.1577	0.1577		1.0000
E C Gaston Unit=1			0.0925	0.0925		1.0000
Harrington Station Unit=061B			0.1535	0.1535		1.0000
Grand River Dam Authority Unit=2			0.1519	0.1519		1.0000
E F Barrett Unit=10			0.0892	0.0892		1.0000
White Bluff Unit=2			0.1474	0.1474		1.0000
Harrington Station Unit=062B			0.1466	0.1466		1.0000
Independence Unit=1			0.1456	0.1456		1.0000
Sabine Unit=3			0.0865	0.0865		1.0000
Coleto Creek Unit=1			0.1437	0.1437		1.0000
Martin Lake Unit=2			0.1413	0.1413		1.0000
Martin Lake Unit=1			0.1412	0.1412		1.0000
W H Sammis Unit=5			0.1397	0.1397		1.0000

Limestone Unit=LIM1			0.1374	0.1374		1.0000
Sherburne County Unit=2			0.1364	0.1364		1.0000
J K Spruce Unit=**1			0.1354	0.1354		1.0000
Sherburne County Unit=1			0.1349	0.1349		1.0000
Martin Lake Unit=3			0.1334	0.1334		1.0000
Sooner Unit=2			0.1334	0.1334		1.0000
Red Hills Generation Facility Unit=AA002			0.1162	0.1162		1.0000
R D Green Unit=G1	1	0.0943	0.1589	0.0795	1	2.0000
Independence Unit=2			0.1322	0.1322		1.0000
Sooner Unit=1			0.1308	0.1308		1.0000
Big Cajun 2 Unit=2B2			0.0775	0.0775		1.0000
Northeastern Unit=3313			0.1257	0.1257		1.0000
Sherburne County Unit=3			0.1248	0.1248		1.0000
Newton Unit=1			0.1245	0.1245		1.0000
Sabine Unit=5			0.0744	0.0744		1.0000
Big Cajun 2 Unit=2B3			0.1261	0.1222	1	1.0320
Columbia Unit=1			0.1197	0.1197		1.0000
Big Cajun 2 Unit=2B1			0.1188	0.1188		1.0000
Arthur Kill Unit=20			0.0709	0.0709		1.0000
Sikeston Unit=1			0.1163	0.1163		1.0000
Sam Seymour Unit=1			0.1088	0.1088		1.0000
Ghent Unit=3			0.1705	0.1705		1.0000
Sam Seymour Unit=3			0.1065	0.1065		1.0000
Sam Seymour Unit=2			0.1057	0.1057		1.0000
Boswell Energy Center Unit=4			0.1108	0.1037	1	1.0681
Powerton Unit=52			0.1025	0.1025		1.0000
Whitewater Valley Unit=1			0.3224	0.3224		1.0000
TES Filer City Station Unit=2			0.3619	0.3619		1.0000
Whitewater Valley Unit=2			0.3384	0.3384		1.0000
TES Filer City Station Unit=1			0.3722	0.3722		1.0000
Shawnee Unit=4			0.1592	0.1592		1.0000
Shawnee Unit=1			0.1591	0.1591		1.0000
Labadie Unit=3			0.0976	0.0976		1.0000
Powerton Unit=51			0.1051	0.0960	1	1.0950
Northport Unit=4			0.0564	0.0564		1.0000
Labadie Unit=2			0.0927	0.0927		1.0000
Labadie Unit=4			0.0924	0.0924		1.0000
Labadie Unit=1			0.0909	0.0909		1.0000
Rush Island Unit=1			0.0856	0.0856		1.0000
Powerton Unit=61			0.1055	0.0843	1	1.2509
Powerton Unit=62			0.1000	0.0833	1	1.1997
Rush Island Unit=2			0.0830	0.0830		1.0000
John S. Cooper Unit=2			0.1065	0.1065		1.0000
Red Hills Generation Facility Unit=AA001			0.0900	0.0900		1.0000
Clifty Creek Unit=4			0.1008	0.1008		1.0000
Clifty Creek Unit=5			0.0993	0.0993		1.0000
Mt. Carmel Cogeneration Unit=SG-101			0.0844	0.0844		1.0000
W H Sammis Unit=6			0.0850	0.0850		1.0000
W H Sammis Unit=7			0.0839	0.0839		1.0000
New Madrid Power Plant Unit=1		0.14	0.6515	0.0800	1	8.1436
New Madrid Power Plant Unit=2		0.2147	0.6110	0.0800	1	7.6377
Thomas Hill Energy Center Unit=MB2		0.1412	0.4000	0.0800	1	4.9996
Homer City Unit=1		0.1204	0.2217	0.0800	1	2.7718
Conemaugh Unit=1			0.1600	0.0720	1	2.2215
F B Culley Generating Station Unit=2			0.1759	0.0800	1	2.1990
Alcoa Allowance Management Inc Unit=4			0.1624	0.0800	1	2.0299
Grant Town Power Plant Unit=1B			0.3235	0.1600	1	2.0221
Grant Town Power Plant Unit=1A			0.3254	0.1611	1	2.0194
TS Power Plant Unit=001			0.0471	0.0236	1	2.0000
Conemaugh Unit=2			0.1395	0.0720	1	1.9381

Cedar Bayou Unit=CBY2			0.0557	0.0300	1	1.8554
Thomas Hill Energy Center Unit=MB1			0.1458	0.0800	1	1.8227
Keystone Unit=1			0.1322	0.0750	1	1.7631
Manitowoc Unit=9			0.0817	0.0464	1	1.7585
Keystone Unit=2			0.1307	0.0750	1	1.7421
Cedar Bayou Unit=CBY1			0.0500	0.0300	1	1.6667
F B Culley Generating Station Unit=3			0.1274	0.0800	1	1.5930
John Twitty Energy Center Unit=1			0.1244	0.0800	1	1.5550
Gen J M Gavin Unit=1			0.1214	0.0800	1	1.5181
Brame Energy Center Unit=3-2			0.0401	0.0272	1	1.4775
Montour, LLC Unit=2			0.1149	0.0800	1	1.4365
Gen J M Gavin Unit=2			0.1070	0.0800	1	1.3377
Montour, LLC Unit=1			0.1067	0.0800	1	1.3343
Homer City Unit=2			0.1062	0.0800	1	1.3273
Seward Unit=2			0.1158	0.0878	1	1.3186
Michigan City Generating Station Unit=12			0.1033	0.0800	1	1.2915
John E Amos Unit=3			0.1017	0.0800	1	1.2719
Marion Unit=123			0.0951	0.0765	1	1.2437
Brame Energy Center Unit=3-1			0.0395	0.0324	1	1.2214
Thomas Hill Energy Center Unit=MB3			0.0976	0.0800	1	1.2205
East Bend Unit=2			0.0975	0.0800	1	1.2183
Homer City Unit=3			0.0957	0.0800	1	1.1964
Lake Hubbard Unit=2			0.0358	0.0300	1	1.1929
Allen S King Unit=1			0.0952	0.0800	1	1.1894
Twin Oaks Unit=U1			0.0968	0.0855	1	1.1325
Pleasants Power Station Unit=1			0.0900	0.0800	1	1.1250
H L Spurlock Unit=1			0.0888	0.0800	1	1.1098
IPL - Harding Street Station (EW Stout) Unit=60			0.0390	0.0352	1	1.1091
IPL - Petersburg Generating Station Unit=2			0.0886	0.0800	1	1.1081
IPL - Harding Street Station (EW Stout) Unit=70			0.0331	0.0300	1	1.1033
Pleasants Power Station Unit=2			0.0882	0.0800	1	1.1027
H L Spurlock Unit=2			0.0875	0.0800	1	1.0936
Spruance Genco, LLC Unit=BLR04A			0.0282	0.0259	1	1.0917
IPL - Petersburg Generating Station Unit=3			0.0869	0.0800	1	1.0857
Joliet 29 Unit=82			0.0994	0.0919	1	1.0824
Spruance Genco, LLC Unit=BLR03A			0.0311	0.0288	1	1.0792
Joliet 29 Unit=81			0.0988	0.0917	1	1.0767
Joliet 29 Unit=71			0.0846	0.0791	1	1.0697
Twin Oaks Unit=U2			0.0961	0.0901	1	1.0662
Spruance Genco, LLC Unit=BLR04B			0.0266	0.0251	1	1.0616
Joliet 29 Unit=72			0.0845	0.0802	1	1.0536
E C Gaston Unit=5			0.0832	0.0800		1.0397
AES Warrior Run Unit=001			0.0733	0.0711		1.0322
A B Brown Generating Station Unit=1			0.0826	0.0800		1.0320
Miami Fort Power Station Unit=8			0.0824	0.0800		1.0299
Seward Unit=1			0.1105	0.1075		1.0288
Plum Point Energy Station Unit=1			0.0818	0.0800		1.0220
New Castle Unit=4			0.0665	0.0656		1.0141
Panther Creek Energy Facility Unit=2			0.1314	0.1303		1.0085
Mountaineer (1301) Unit=1			0.0806	0.0800		1.0070
Clinch River Unit=2			0.1311	0.1302		1.0069
D B Wilson Unit=W1			0.0805	0.0800		1.0063
John E Amos Unit=1			0.0804	0.0800		1.0055
New Castle Unit=3			0.0712	0.0710		1.0034
South Oak Creek Unit=5			0.0800	0.0800		1.0003

Table 2 – Comparisons of 2026 Rates with 2023/2024 and 2021 Rates

Plant, Unit for 2026	2026 Rate After Half SCR	Count 2026 Units	Compare 2026 to 2023/2024	Compare 2026 to 2021
Nelson Industrial Steam Company Unit=1A	0.0995	1	2.0000	2.0000
River Valley Unit=1A	0.1144	1	2.0000	2.0000
River Valley Unit=1B	0.1160	1	2.0000	2.0000
River Valley Unit=2A	0.1140	1	2.0000	2.0000
River Valley Unit=2B	0.1116	1	2.0000	2.0000
Southwestern Unit=8003	0.1694	1	1.8229	1.8229
Rausch Creek Generation, LLC Unit=031	0.0800	1	1.8106	1.8106
Little Gypsy Unit=3	0.1582	1	1.8103	1.8103
Riverside (4940) Unit=1502	0.1530	1	1.8039	1.8039
Watson Electric Generating Plant Unit=5	0.1522	1	1.8029	1.8029
Gerald Andrus Unit=1	0.1490	1	1.7986	1.7986
W A Parish Unit=WAP3	0.1388	1	1.7839	1.7839
Horseshoe Lake Unit=6	0.1355	1	1.7785	1.7785
Graham Unit=2	0.1340	1	1.7762	1.7762
Lake Catherine Unit=4	0.1331	1	1.7746	1.7746
Ninemile Point Unit=5	0.1303	1	1.7697	1.7697
Teche Power Station Unit=3	0.1296	1	1.7686	1.7686
Ninemile Point Unit=4	0.1159	1	1.7413	1.7413
Intermountain Unit=2SGA	0.1920	1	1.7396	1.7396
North Valmy Unit=1	0.1877	1	1.7336	1.7336
Northeastern Unit=3302	0.1102	1	1.7277	1.7277
Horseshoe Lake Unit=8	0.1097	1	1.7265	1.7265
Brame Energy Center Unit=1	0.1058	1	1.7165	1.7165
Hunter Unit=3	0.1728	1	1.7106	1.7106
Fort Martin Power Station Unit=2	0.1658	1	1.6984	1.6984
Intermountain Unit=1SGA	0.1634	1	1.6940	1.6940
North Valmy Unit=2	0.1581	1	1.6838	1.6838
Horseshoe Lake Unit=7	0.0921	1	1.6744	1.6744
W A Parish Unit=WAP4	0.0921	1	1.6742	1.6742
Sim Gideon Unit=3	0.0904	1	1.6681	1.6681
Big Sandy Unit=BSU1	0.0898	1	1.6661	1.6661
Nichols Station Unit=143B	0.0895	1	1.6649	1.6649
Sabine Unit=1	0.0880	1	1.6590	1.6590
Bonanza Unit=1-1	0.1450	1	1.6551	1.6551
O W Sommers Unit=1	0.0857	1	1.6501	1.6501
Sabine Unit=4	0.0844	1	1.6447	1.6447
East River Unit=60	0.0843	1	1.6441	1.6441
Seminole (2956) Unit=1	0.0831	1	1.6390	1.6390
Sioux Unit=1	0.1377	1	1.6368	1.8014
Watson Electric Generating Plant Unit=4	0.0826	1	1.6368	1.6368
Barry Unit=4	0.0823	1	1.6354	3.2709
Sioux Unit=2	0.1354	1	1.6306	1.6747
Little Gypsy Unit=2	0.0786	1	1.6185	1.6185
Huntington Unit=2	0.1305	1	1.6167	1.6167
Brunner Island, LLC Unit=1	0.0769	1	1.6099	3.2198
Belle River Unit=2	0.1280	1	1.6093	1.6093
Welsh Power Plant Unit=3	0.1275	1	1.6078	1.6078
V H Braunig Unit=3	0.0757	1	1.6036	1.6036
Clifty Creek Unit=6	0.1247	1	1.5991	1.5991
Daniel Electric Generating Plant Unit=1	0.1245	1	1.5984	2.3544
Clover Power Station Unit=2	0.1245	1	1.5984	1.9940
Muskogee Unit=6	0.1245	1	1.5984	2.3715
Fort Martin Power Station Unit=1	0.1245	1	1.5984	2.3164
Mill Creek Unit=2	0.1245	1	1.5984	2.1013

Mill Creek Unit=1	0.1245	1	1.5984	2.0882
Shawnee Unit=6	0.1245	1	1.5984	2.0086
Shawnee Unit=8	0.1245	1	1.5984	1.9363
Shawnee Unit=9	0.1245	1	1.5984	1.9330
Shawnee Unit=7	0.1245	1	1.5984	1.9314
Clover Power Station Unit=1	0.1245	1	1.5984	1.7082
Belle River Unit=1	0.1241	1	1.5971	1.5971
Brunner Island, LLC Unit=3	0.0742	1	1.5959	3.1918
Brunner Island, LLC Unit=2	0.0739	1	1.5943	3.1885
Seminole (2956) Unit=3	0.0739	1	1.5939	1.5939
Greene County Unit=2	0.0738	1	1.5937	1.5937
Welsh Power Plant Unit=1	0.1220	1	1.5900	1.5900
John S. Cooper Unit=1	0.1217	1	1.5892	1.5892
Hunter Unit=1	0.1212	1	1.5875	1.5875
Brame Energy Center Unit=2	0.1205	1	1.5851	1.5851
Greene County Unit=1	0.0721	1	1.5839	1.5839
Flint Creek Power Plant Unit=1	0.1198	1	1.5828	1.5828
Greenwood Unit=1	0.0718	1	1.5819	1.5819
Tolk Station Unit=172B	0.1179	1	1.5760	1.5760
E C Gaston Unit=4	0.0701	1	1.5718	1.5718
O W Sommers Unit=2	0.0700	1	1.5716	1.5716
Huntington Unit=1	0.1163	1	1.5702	1.5702
Ghent Unit=2	0.1157	1	1.5677	1.5677
J H Campbell Unit=1	0.1155	1	1.5671	1.5671
IPL - Petersburg Generating Station Unit=4	0.1153	1	1.5665	1.5665
Hugo Unit=1	0.1145	1	1.5632	1.5632
Jones Station Unit=151B	0.0684	1	1.5612	1.5612
Hunter Unit=2	0.1130	1	1.5573	1.5573
E C Gaston Unit=3	0.0676	1	1.5562	1.5562
R M Schahfer Generating Station Unit=18	0.1114	1	1.5512	1.5512
Seminole (2956) Unit=2	0.0664	1	1.5481	1.5481
Tolk Station Unit=171B	0.1106	1	1.5477	1.5477
R D Green Unit=G2	0.0658	1	1.5443	3.0887
R M Schahfer Generating Station Unit=17	0.1088	1	1.5404	1.5404
Harrington Station Unit=063B	0.1068	1	1.5319	1.5319
Limestone Unit=LIM2	0.1066	1	1.5310	1.6896
Shawnee Unit=3	0.1059	1	1.5278	1.5278
Shawnee Unit=5	0.1056	1	1.5266	1.5266
E C Gaston Unit=2	0.0633	1	1.5262	1.5262
White Bluff Unit=1	0.1050	1	1.5236	1.5236
Shawnee Unit=2	0.1049	1	1.5231	1.5231
Jones Station Unit=152B	0.0628	1	1.5225	1.5225
San Miguel Unit=SM-1	0.1044	1	1.5211	1.5755
R S Nelson Unit=6	0.1039	1	1.5186	1.5186
E C Gaston Unit=1	0.0613	1	1.5103	1.5103
Harrington Station Unit=061B	0.1018	1	1.5086	1.5086
Grand River Dam Authority Unit=2	0.1010	1	1.5048	1.5048
E F Barrett Unit=10	0.0596	1	1.4967	1.4967
White Bluff Unit=2	0.0987	1	1.4934	1.4934
Harrington Station Unit=062B	0.0983	1	1.4914	1.4914
Independence Unit=1	0.0978	1	1.4887	1.4887
Sabine Unit=3	0.0583	1	1.4851	1.4851
Coleto Creek Unit=1	0.0969	1	1.4838	1.4838
Martin Lake Unit=2	0.0956	1	1.4771	1.4771
Martin Lake Unit=1	0.0956	1	1.4769	1.4769
W H Sammis Unit=5	0.0949	1	1.4730	1.4730
Limestone Unit=LIM1	0.0937	1	1.4664	1.4664
Sherburne County Unit=2	0.0932	1	1.4634	1.4634
J K Spruce Unit=**1	0.0927	1	1.4607	1.4607
Sherburne County Unit=1	0.0924	1	1.4590	1.4590

Martin Lake Unit=3	0.0917	1	1.4548	1.4548
Sooner Unit=2	0.0917	1	1.4547	1.4547
Red Hills Generation Facility Unit=AA002	0.0800	1	1.4519	1.4519
R D Green Unit=G1	0.0547	1	1.4519	2.9037
Independence Unit=2	0.0911	1	1.4511	1.4511
Sooner Unit=1	0.0904	1	1.4470	1.4470
Big Cajun 2 Unit=2B2	0.0538	1	1.4419	1.4419
Northeastern Unit=3313	0.0879	1	1.4310	1.4310
Sherburne County Unit=3	0.0874	1	1.4279	1.4279
Newton Unit=1	0.0873	1	1.4270	1.4270
Sabine Unit=5	0.0522	1	1.4252	1.4252
Big Cajun 2 Unit=2B3	0.0861	1	1.4191	1.4646
Columbia Unit=1	0.0849	1	1.4108	1.4108
Big Cajun 2 Unit=2B1	0.0844	1	1.4077	1.4077
Arthur Kill Unit=20	0.0504	1	1.4053	1.4053
Sikeston Unit=1	0.0832	1	1.3988	1.3988
Sam Seymour Unit=1	0.0794	1	1.3704	1.3704
Ghent Unit=3	0.1253	1	1.3614	1.3614
Sam Seymour Unit=3	0.0783	1	1.3611	1.3611
Sam Seymour Unit=2	0.0779	1	1.3579	1.3579
Boswell Energy Center Unit=4	0.0769	1	1.3494	1.4412
Powerton Unit=52	0.0762	1	1.3441	1.3441
Whitewater Valley Unit=1	0.2418	1	1.3333	1.3333
TES Filer City Station Unit=2	0.2714	1	1.3333	1.3333
Whitewater Valley Unit=2	0.2538	1	1.3333	1.3333
TES Filer City Station Unit=1	0.2791	1	1.3333	1.3333
Shawnee Unit=4	0.1196	1	1.3312	1.3312
Shawnee Unit=1	0.1196	1	1.3308	1.3308
Labadie Unit=3	0.0738	1	1.3226	1.3226
Powerton Unit=51	0.0730	1	1.3149	1.4398
Northport Unit=4	0.0432	1	1.3056	1.3056
Labadie Unit=2	0.0713	1	1.2992	1.2992
Labadie Unit=4	0.0712	1	1.2979	1.2979
Labadie Unit=1	0.0705	1	1.2904	1.2904
Rush Island Unit=1	0.0678	1	1.2623	1.2623
Powerton Unit=61	0.0672	1	1.2556	1.5706
Powerton Unit=62	0.0667	1	1.2499	1.4995
Rush Island Unit=2	0.0665	1	1.2480	1.2480
John S. Cooper Unit=2	0.0933	1	1.1423	1.1423
Red Hills Generation Facility Unit=AA001	0.0800	1	1.1246	1.1246
Clifty Creek Unit=4	0.0904	1	1.1152	1.1152
Clifty Creek Unit=5	0.0896	1	1.1076	1.1076
Mt. Carmel Cogeneration Unit=SG-101	0.0800	1	1.0547	1.0547
W H Sammis Unit=6	0.0825		1.0302	1.0302
W H Sammis Unit=7	0.0819		1.0235	1.0235
New Madrid Power Plant Unit=1	0.0800		1.0000	8.1436
New Madrid Power Plant Unit=2	0.0800		1.0000	7.6377
Thomas Hill Energy Center Unit=MB2	0.0800		1.0000	4.9996
Homer City Unit=1	0.0800		1.0000	2.7718
Conemaugh Unit=1	0.0720		1.0000	2.2215
F B Culley Generating Station Unit=2	0.0800		1.0000	2.1990
Alcoa Allowance Management Inc Unit=4	0.0800		1.0000	2.0299
Grant Town Power Plant Unit=1B	0.1600		1.0000	2.0221
Grant Town Power Plant Unit=1A	0.1611		1.0000	2.0194
TS Power Plant Unit=001	0.0236		1.0000	2.0000
Conemaugh Unit=2	0.0720		1.0000	1.9381
Cedar Bayou Unit=CBY2	0.0300		1.0000	1.8554
Thomas Hill Energy Center Unit=MB1	0.0800		1.0000	1.8227
Keystone Unit=1	0.0750		1.0000	1.7631
Manitowoc Unit=9	0.0464		1.0000	1.7585

Keystone Unit=2	0.0750		1.0000	1.7421
Cedar Bayou Unit=CBY1	0.0300		1.0000	1.6667
F B Culley Generating Station Unit=3	0.0800		1.0000	1.5930
John Twitty Energy Center Unit=1	0.0800		1.0000	1.5550
Gen J M Gavin Unit=1	0.0800		1.0000	1.5181
Brame Energy Center Unit=3-2	0.0272		1.0000	1.4775
Montour, LLC Unit=2	0.0800		1.0000	1.4365
Gen J M Gavin Unit=2	0.0800		1.0000	1.3377
Montour, LLC Unit=1	0.0800		1.0000	1.3343
Homer City Unit=2	0.0800		1.0000	1.3273
Seward Unit=2	0.0878		1.0000	1.3186
Michigan City Generating Station Unit=12	0.0800		1.0000	1.2915
John E Amos Unit=3	0.0800		1.0000	1.2719
Marion Unit=123	0.0765		1.0000	1.2437
Brame Energy Center Unit=3-1	0.0324		1.0000	1.2214
Thomas Hill Energy Center Unit=MB3	0.0800		1.0000	1.2205
East Bend Unit=2	0.0800		1.0000	1.2183
Homer City Unit=3	0.0800		1.0000	1.1964
Lake Hubbard Unit=2	0.0300		1.0000	1.1929
Allen S King Unit=1	0.0800		1.0000	1.1894
Twin Oaks Unit=U1	0.0855		1.0000	1.1325
Pleasants Power Station Unit=1	0.0800		1.0000	1.1250
H L Spurlock Unit=1	0.0800		1.0000	1.1098
IPL - Harding Street Station (EW Stout) Unit=60	0.0352		1.0000	1.1091
IPL - Petersburg Generating Station Unit=2	0.0800		1.0000	1.1081
IPL - Harding Street Station (EW Stout) Unit=70	0.0300		1.0000	1.1033
Pleasants Power Station Unit=2	0.0800		1.0000	1.1027
H L Spurlock Unit=2	0.0800		1.0000	1.0936
Spruance Genco, LLC Unit=BLR04A	0.0259		1.0000	1.0917
IPL - Petersburg Generating Station Unit=3	0.0800		1.0000	1.0857
Joliet 29 Unit=82	0.0919		1.0000	1.0824
Spruance Genco, LLC Unit=BLR03A	0.0288		1.0000	1.0792
Joliet 29 Unit=81	0.0917		1.0000	1.0767
Joliet 29 Unit=71	0.0791		1.0000	1.0697
Twin Oaks Unit=U2	0.0901		1.0000	1.0662
Spruance Genco, LLC Unit=BLR04B	0.0251		1.0000	1.0616
Joliet 29 Unit=72	0.0802		1.0000	1.0536
E C Gaston Unit=5	0.0800		1.0000	1.0397
AES Warrior Run Unit=001	0.0711		1.0000	1.0322
A B Brown Generating Station Unit=1	0.0800		1.0000	1.0320
Miami Fort Power Station Unit=8	0.0800		1.0000	1.0299
Seward Unit=1	0.1075		1.0000	1.0288
Plum Point Energy Station Unit=1	0.0800		1.0000	1.0220
New Castle Unit=4	0.0656		1.0000	1.0141
Panther Creek Energy Facility Unit=2	0.1303		1.0000	1.0085
Mountaineer (1301) Unit=1	0.0800		1.0000	1.0070
Clinch River Unit=2	0.1302		1.0000	1.0069
D B Wilson Unit=W1	0.0800		1.0000	1.0063
John E Amos Unit=1	0.0800		1.0000	1.0055
New Castle Unit=3	0.0710		1.0000	1.0034
South Oak Creek Unit=5	0.0800		1.0000	1.0003

Table 3 – Comparison of 2027 Rates with 2026 and 2021 Rates

Plant, Unit for 2027	2027 Rate After SCR	Compare 2027 and 2026 Rate	Count of units with change between 2026 and 2027	Compare 2027 to 2021
Nelson Industrial Steam Company Unit=1A	0.0995	1.00		2.0000
River Valley Unit=1A	0.1144	1.00		2.0000
River Valley Unit=1B	0.1160	1.00		2.0000
River Valley Unit=2A	0.1140	1.00		2.0000
River Valley Unit=2B	0.1116	1.00		2.0000
Southwestern Unit=8003	0.0300	5.65	1	10.2953
Rausch Creek Generation, LLC Unit=031	0.0800	1.00		1.8106
Little Gypsy Unit=3	0.0300	5.27	1	9.5437
Riverside (4940) Unit=1502	0.0300	5.10	1	9.1982
Watson Electric Generating Plant Unit=5	0.0300	5.07	1	9.1456
Gerald Andrus Unit=1	0.0300	4.97	1	8.9312
W A Parish Unit=WAP3	0.0300	4.63	1	8.2562
Horseshoe Lake Unit=6	0.0300	4.52	1	8.0309
Graham Unit=2	0.0300	4.47	1	7.9361
Lake Catherine Unit=4	0.0300	4.44	1	7.8712
Ninemile Point Unit=5	0.0300	4.34	1	7.6852
Teche Power Station Unit=3	0.0300	4.32	1	7.6427
Ninemile Point Unit=4	0.0300	3.86	1	6.7298
Intermountain Unit=2SGA	0.0500	3.84	1	6.6803
North Valmy Unit=1	0.0500	3.75	1	6.5069
Northeastern Unit=3302	0.0300	3.67	1	6.3446
Horseshoe Lake Unit=8	0.0300	3.66	1	6.3129
Brame Energy Center Unit=1	0.0300	3.53	1	6.0546
Hunter Unit=3	0.0500	3.46	1	5.9106
Fort Martin Power Station Unit=2	0.0500	3.32	1	5.6323
Intermountain Unit=1SGA	0.0500	3.27	1	5.5354
North Valmy Unit=2	0.0500	3.16	1	5.3257
Horseshoe Lake Unit=7	0.0300	3.07	1	5.1423
W A Parish Unit=WAP4	0.0300	3.07	1	5.1388
Sim Gideon Unit=3	0.0300	3.01	1	5.0264
Big Sandy Unit=BSU1	0.0300	2.99	1	4.9894
Nichols Station Unit=143B	0.0300	2.98	1	4.9675
Sabine Unit=1	0.0300	2.93	1	4.8646
Bonanza Unit=1-1	0.0500	2.90	1	4.7993
O W Sommers Unit=1	0.0300	2.86	1	4.7158
Sabine Unit=4	0.0300	2.81	1	4.6291
East River Unit=60	0.0300	2.81	1	4.6199
Seminole (2956) Unit=1	0.0300	2.77	1	4.5401
Sioux Unit=1	0.0500	2.75	1	4.9599
Watson Electric Generating Plant Unit=4	0.0300	2.75	1	4.5062
Barry Unit=4	0.0300	2.74	1	8.9724
Sioux Unit=2	0.0500	2.71	1	4.5339
Little Gypsy Unit=2	0.0300	2.62	1	4.2425
Huntington Unit=2	0.0500	2.61	1	4.2184
Brunner Island, LLC Unit=1	0.0300	2.56	1	8.2537
Belle River Unit=2	0.0500	2.56	1	4.1191
Welsh Power Plant Unit=3	0.0500	2.55	1	4.1000
V H Braunig Unit=3	0.0300	2.52	1	4.0453
Clifty Creek Unit=6	0.0500	2.49	1	3.9882
Daniel Electric Generating Plant Unit=1	0.0500	2.49	1	5.8625
Clover Power Station Unit=2	0.0500	2.49	1	4.9650
Muskogee Unit=6	0.0500	2.49	1	5.9050
Fort Martin Power Station Unit=1	0.0500	2.49	1	5.7677
Mill Creek Unit=2	0.0500	2.49	1	5.2321

Mill Creek Unit=1	0.0500	2.49	1	5.1997
Shawnee Unit=6	0.0500	2.49	1	5.0013
Shawnee Unit=8	0.0500	2.49	1	4.8213
Shawnee Unit=9	0.0500	2.49	1	4.8132
Shawnee Unit=7	0.0500	2.49	1	4.8092
Clover Power Station Unit=1	0.0500	2.49	1	4.2535
Belle River Unit=1	0.0500	2.48	1	3.9638
Brunner Island, LLC Unit=3	0.0300	2.47	1	7.8980
Brunner Island, LLC Unit=2	0.0300	2.46	1	7.8587
Seminole (2956) Unit=3	0.0300	2.46	1	3.9252
Greene County Unit=2	0.0300	2.46	1	3.9229
Welsh Power Plant Unit=1	0.0500	2.44	1	3.8784
John S. Cooper Unit=1	0.0500	2.43	1	3.8689
Hunter Unit=1	0.0500	2.42	1	3.8480
Brame Energy Center Unit=2	0.0500	2.41	1	3.8202
Greene County Unit=1	0.0300	2.40	1	3.8068
Flint Creek Power Plant Unit=1	0.0500	2.40	1	3.7934
Greenwood Unit=1	0.0300	2.39	1	3.7838
Tolk Station Unit=172B	0.0500	2.36	1	3.7175
E C Gaston Unit=4	0.0300	2.34	1	3.6703
O W Sommers Unit=2	0.0300	2.33	1	3.6686
Huntington Unit=1	0.0500	2.33	1	3.6538
Ghent Unit=2	0.0500	2.31	1	3.6266
J H Campbell Unit=1	0.0500	2.31	1	3.6205
IPL - Petersburg Generating Station Unit=4	0.0500	2.31	1	3.6136
Hugo Unit=1	0.0500	2.29	1	3.5790
Jones Station Unit=151B	0.0300	2.28	1	3.5576
Hunter Unit=2	0.0500	2.26	1	3.5180
E C Gaston Unit=3	0.0300	2.25	1	3.5066
R M Schahfer Generating Station Unit=18	0.0500	2.23	1	3.4566
Seminole (2956) Unit=2	0.0300	2.21	1	3.4258
Tolk Station Unit=171B	0.0500	2.21	1	3.4221
R D Green Unit=G2	0.0300	2.19	1	6.7786
R M Schahfer Generating Station Unit=17	0.0500	2.18	1	3.3519
Harrington Station Unit=063B	0.0500	2.14	1	3.2724
Limestone Unit=LIM2	0.0500	2.13	1	3.6026
Shawnee Unit=3	0.0500	2.12	1	3.2351
Shawnee Unit=5	0.0500	2.11	1	3.2250
E C Gaston Unit=2	0.0300	2.11	1	3.2211
White Bluff Unit=1	0.0500	2.10	1	3.1981
Shawnee Unit=2	0.0500	2.10	1	3.1942
Jones Station Unit=152B	0.0300	2.09	1	3.1885
San Miguel Unit=SM-1	0.0500	2.09	1	3.2897
R S Nelson Unit=6	0.0500	2.08	1	3.1542
E C Gaston Unit=1	0.0300	2.04	1	3.0844
Harrington Station Unit=061B	0.0500	2.04	1	3.0701
Grand River Dam Authority Unit=2	0.0500	2.02	1	3.0385
E F Barrett Unit=10	0.0300	1.99	1	2.9736
White Bluff Unit=2	0.0500	1.97	1	2.9482
Harrington Station Unit=062B	0.0500	1.97	1	2.9324
Independence Unit=1	0.0500	1.96	1	2.9118
Sabine Unit=3	0.0300	1.94	1	2.8840
Coleto Creek Unit=1	0.0500	1.94	1	2.8745
Martin Lake Unit=2	0.0500	1.91	1	2.8251
Martin Lake Unit=1	0.0500	1.91	1	2.8235
W H Sammis Unit=5	0.0500	1.90	1	2.7950
Limestone Unit=LIM1	0.0500	1.87	1	2.7479
Sherburne County Unit=2	0.0500	1.86	1	2.7272
J K Spruce Unit=**1	0.0500	1.85	1	2.7087
Sherburne County Unit=1	0.0500	1.85	1	2.6972

Martin Lake Unit=3	0.0500	1.83	1	2.6681
Sooner Unit=2	0.0500	1.83	1	2.6675
Red Hills Generation Facility Unit=AA002	0.0800	1.00		1.4519
R D Green Unit=G1	0.0300	1.82	1	5.2975
Independence Unit=2	0.0500	1.82	1	2.6436
Sooner Unit=1	0.0500	1.81	1	2.6166
Big Cajun 2 Unit=2B2	0.0300	1.79	1	2.5836
Northeastern Unit=3313	0.0500	1.76	1	2.5149
Sherburne County Unit=3	0.0500	1.75	1	2.4961
Newton Unit=1	0.0500	1.75	1	2.4905
Sabine Unit=5	0.0300	1.74	1	2.4794
Big Cajun 2 Unit=2B3	0.0500	1.72	1	2.5213
Columbia Unit=1	0.0500	1.70	1	2.3947
Big Cajun 2 Unit=2B1	0.0500	1.69	1	2.3768
Arthur Kill Unit=20	0.0300	1.68	1	2.3629
Sikeston Unit=1	0.0500	1.66	1	2.3264
Sam Seymour Unit=1	0.0500	1.59	1	2.1767
Ghent Unit=3	0.0800	1.57	1	2.1319
Sam Seymour Unit=3	0.0500	1.57	1	2.1302
Sam Seymour Unit=2	0.0500	1.56	1	2.1149
Boswell Energy Center Unit=4	0.0500	1.54	1	2.2151
Powerton Unit=52	0.0500	1.52	1	2.0494
Whitewater Valley Unit=1	0.2418	1.00		1.3333
TES Filer City Station Unit=2	0.2714	1.00		1.3333
Whitewater Valley Unit=2	0.2538	1.00		1.3333
TES Filer City Station Unit=1	0.2791	1.00		1.3333
Shawnee Unit=4	0.0800	1.50	1	1.9906
Shawnee Unit=1	0.0800	1.49	1	1.9889
Labadie Unit=3	0.0500	1.48	1	1.9524
Powerton Unit=51	0.0500	1.46	1	2.1015
Northport Unit=4	0.0300	1.44	1	1.8800
Labadie Unit=2	0.0500	1.43	1	1.8538
Labadie Unit=4	0.0500	1.42	1	1.8488
Labadie Unit=1	0.0500	1.41	1	1.8184
Rush Island Unit=1	0.0500	1.36	1	1.7112
Powerton Unit=61	0.0500	1.34	1	2.1098
Powerton Unit=62	0.0500	1.33	1	1.9990
Rush Island Unit=2	0.0500	1.33	1	1.6594
John S. Cooper Unit=2	0.0800	1.17	1	1.3317
Red Hills Generation Facility Unit=AA001	0.0800	1.00		1.1246
Clifty Creek Unit=4	0.0800	1.13	1	1.2603
Clifty Creek Unit=5	0.0800	1.12	1	1.2411
Mt. Carmel Cogeneration Unit=SG-101	0.0800	1.00		1.0547
W H Sammis Unit=6	0.0800	1.03		1.0623
W H Sammis Unit=7	0.0800	1.02		1.0482
New Madrid Power Plant Unit=1	0.0800	1.00		8.1436
New Madrid Power Plant Unit=2	0.0800	1.00		7.6377
Thomas Hill Energy Center Unit=MB2	0.0800	1.00		4.9996
Homer City Unit=1	0.0800	1.00		2.7718
Conemaugh Unit=1	0.0720	1.00		2.2215
F B Culley Generating Station Unit=2	0.0800	1.00		2.1990
Alcoa Allowance Management Inc Unit=4	0.0800	1.00		2.0299
Grant Town Power Plant Unit=1B	0.1600	1.00		2.0221
Grant Town Power Plant Unit=1A	0.1611	1.00		2.0194
TS Power Plant Unit=001	0.0236	1.00		2.0000
Conemaugh Unit=2	0.0720	1.00		1.9381
Cedar Bayou Unit=CBY2	0.0300	1.00		1.8554
Thomas Hill Energy Center Unit=MB1	0.0800	1.00		1.8227
Keystone Unit=1	0.0750	1.00		1.7631
Manitowoc Unit=9	0.0464	1.00		1.7585

Keystone Unit=2	0.0750	1.00		1.7421
Cedar Bayou Unit=CBY1	0.0300	1.00		1.6667
F B Culley Generating Station Unit=3	0.0800	1.00		1.5930
John Twitty Energy Center Unit=1	0.0800	1.00		1.5550
Gen J M Gavin Unit=1	0.0800	1.00		1.5181
Brame Energy Center Unit=3-2	0.0272	1.00		1.4775
Montour, LLC Unit=2	0.0800	1.00		1.4365
Gen J M Gavin Unit=2	0.0800	1.00		1.3377
Montour, LLC Unit=1	0.0800	1.00		1.3343
Homer City Unit=2	0.0800	1.00		1.3273
Seward Unit=2	0.0878	1.00		1.3186
Michigan City Generating Station Unit=12	0.0800	1.00		1.2915
John E Amos Unit=3	0.0800	1.00		1.2719
Marion Unit=123	0.0765	1.00		1.2437
Brame Energy Center Unit=3-1	0.0324	1.00		1.2214
Thomas Hill Energy Center Unit=MB3	0.0800	1.00		1.2205
East Bend Unit=2	0.0800	1.00		1.2183
Homer City Unit=3	0.0800	1.00		1.1964
Lake Hubbard Unit=2	0.0300	1.00		1.1929
Allen S King Unit=1	0.0800	1.00		1.1894
Twin Oaks Unit=U1	0.0855	1.00		1.1325
Pleasants Power Station Unit=1	0.0800	1.00		1.1250
H L Spurlock Unit=1	0.0800	1.00		1.1098
IPL - Harding Street Station (EW Stout) Unit=60	0.0352	1.00		1.1091
IPL - Petersburg Generating Station Unit=2	0.0800	1.00		1.1081
IPL - Harding Street Station (EW Stout) Unit=70	0.0300	1.00		1.1033
Pleasants Power Station Unit=2	0.0800	1.00		1.1027
H L Spurlock Unit=2	0.0800	1.00		1.0936
Spruance Genco, LLC Unit=BLR04A	0.0259	1.00		1.0917
IPL - Petersburg Generating Station Unit=3	0.0800	1.00		1.0857
Joliet 29 Unit=82	0.0919	1.00		1.0824
Spruance Genco, LLC Unit=BLR03A	0.0288	1.00		1.0792
Joliet 29 Unit=81	0.0917	1.00		1.0767
Joliet 29 Unit=71	0.0791	1.00		1.0697
Twin Oaks Unit=U2	0.0901	1.00		1.0662
Spruance Genco, LLC Unit=BLR04B	0.0251	1.00		1.0616
Joliet 29 Unit=72	0.0802	1.00		1.0536
E C Gaston Unit=5	0.0800	1.00		1.0397
AES Warrior Run Unit=001	0.0711	1.00		1.0322
A B Brown Generating Station Unit=1	0.0800	1.00		1.0320
Miami Fort Power Station Unit=8	0.0800	1.00		1.0299
Seward Unit=1	0.1075	1.00		1.0288
Plum Point Energy Station Unit=1	0.0800	1.00		1.0220
New Castle Unit=4	0.0656	1.00		1.0141
Panther Creek Energy Facility Unit=2	0.1303	1.00		1.0085
Mountaineer (1301) Unit=1	0.0800	1.00		1.0070
Clinch River Unit=2	0.1302	1.00		1.0069
D B Wilson Unit=W1	0.0800	1.00		1.0063
John E Amos Unit=1	0.0800	1.00		1.0055
New Castle Unit=3	0.0710	1.00		1.0034
South Oak Creek Unit=5	0.0800	1.00		1.0003

Table 4 – Large Coal Units and Their 2021 and 2022 Daily O3-Season NOx Rates

State, Plant, Unit, Year	Existing SCR	Existing SNCR	Count of Days 0.14+ in 2021 and 2022 O3 Season	Number of Days in O3 Season	% of Days in O3 Season	Average NOx Rate (for days 0.14+)	Priority Flag
AL E C Gaston 5 2021	Y		7	153	4.58%	0.259	
AL E C Gaston 5 2022	Y		3	153	1.96%	0.250	
AR Flint Creek Power Plant 1 2021			144	153	94.12%	0.192	
AR Flint Creek Power Plant 1 2022			131	153	85.62%	0.198	
AR Independence 1 2021			86	153	56.21%	0.166	
AR Independence 1 2022 Count			130	153	84.97%	0.185	
AR Independence 2 2021 Count			17	153	11.11%	0.160	
AR Independence 2 2022 Count			51	153	33.33%	0.154	
AR Plum Point Energy Station 1 2021	Y		1	153	0.65%	0.157	
AR White Bluff 1 2021 Count			123	153	80.39%	0.164	
AR White Bluff 1 2022 Count			119	153	77.78%	0.183	
AR White Bluff 2 2021 Count			91	153	59.48%	0.161	
AR White Bluff 2 2022 Count			125	153	81.70%	0.174	
IL Marion 123 2021 Count		Y	2	153	1.31%	0.145	
IL Marion 123 2022 Count		Y	2	153	1.31%	0.153	
IL Newton 1 2021 Count			3	153	1.96%	0.146	
IL Newton 1 2022 Count			16	153	10.46%	0.146	
IL Powerton 51 2021 Count		Y	17	153	11.11%	0.396	1
IL Powerton 51 2022 Count		Y	4	153	2.61%	0.661	
IL Powerton 52 2021 Count		Y	6	153	3.92%	0.370	
IL Powerton 52 2022 Count		Y	5	153	3.27%	0.281	
IL Powerton 61 2021 Count		Y	11	153	7.19%	9.933	
IL Powerton 61 2022 Count		Y	5	153	3.27%	0.314	
IL Powerton 62 2021 Count		Y	3	153	1.96%	0.210	
IL Powerton 62 2022 Count		Y	4	153	2.61%	0.272	
IN A B Brown Generating Station 1 2021	Y		14	153	9.15%	0.179	
IN A B Brown Generating Station 1 2022	Y		20	153	13.07%	0.215	1
IN A B Brown Generating Station 2 2022			6	153	3.92%	0.227	
IN Alcoa Allowance Management 4 2021	Y		62	153	40.52%	0.235	1
IN Alcoa Allowance Management 4 2022	Y		18	153	11.76%	0.176	
IN Clifty Creek 4 2021 Count	Y		19	153	12.42%	0.210	1
IN Clifty Creek 4 2022 Count	Y		6	153	3.92%	0.192	
IN Clifty Creek 5 2021 Count	Y		17	153	11.11%	0.196	
IN Clifty Creek 5 2022 Count	Y		9	153	5.88%	0.186	
IN Clifty Creek 6 2021 Count			20	153	13.07%	0.208	1
IN Clifty Creek 6 2022 Count			5	153	3.27%	0.160	
IN F B Culley Generating Station 3 2021	Y		75	153	49.02%	0.158	
IN F B Culley Generating Station 3 2022	Y		19	153	12.42%	0.163	
IN IPL - Petersburg 2 2021	Y		12	153	7.84%	0.190	
IN IPL - Petersburg 2 2022	Y		6	153	3.92%	0.230	
IN IPL - Petersburg 3 2021	Y		7	153	4.58%	0.192	
IN IPL - Petersburg 3 2022	Y		3	153	1.96%	0.180	
IN IPL - Petersburg 4 2021			117	153	76.47%	0.181	
IN IPL - Petersburg 4 2022			113	153	73.86%	0.176	
IN Michigan City 12 2021	Y		11	153	7.19%	0.279	
IN Michigan City 12 2022	Y		13	153	8.50%	0.224	
IN R M Schahfer 17 2021			116	153	75.82%	0.170	
IN R M Schahfer 17 2022			93	153	60.78%	0.158	
IN R M Schahfer 18 2021			139	153	90.85%	0.176	
IN R M Schahfer 18 2022			120	153	78.43%	0.173	
KY D B Wilson W1 2021 Count	Y		7	153	4.58%	0.198	
KY D B Wilson W1 2022 Count	Y		9	153	5.88%	0.212	
KY East Bend 2 2021 Count	Y		12	153	7.84%	0.188	

KY East Bend 2 2022 Count	Y		24	153	15.69%	0.228	1
KY Ghent 2 2021 Count			136	153	88.89%	0.173	
KY Ghent 2 2022 Count			136	153	88.89%	0.193	
KY Ghent 3 2021 Count	Y		130	153	84.97%	0.170	
KY Ghent 3 2022 Count	Y		135	153	88.24%	0.192	
KY H L Spurlock 1 2022 Count	Y		1	153	0.65%	0.173	
KY H L Spurlock 2 2021 Count	Y		2	153	1.31%	0.219	
KY H L Spurlock 2 2022 Count	Y		3	153	1.96%	0.261	
KY John S. Cooper 1 2021 Count			21	153	13.73%	0.214	1
KY John S. Cooper 1 2022 Count			19	153	12.42%	0.195	
KY John S. Cooper 2 2021 Count	Y		18	153	11.76%	0.189	
KY John S. Cooper 2 2022 Count	Y		12	153	7.84%	0.178	
KY Mill Creek 1 2021 Count			103	153	67.32%	0.261	1
KY Mill Creek 1 2022 Count			42	153	27.45%	0.259	1
KY Mill Creek 2 2021 Count			57	153	37.25%	0.261	1
KY Mill Creek 2 2022 Count			118	153	77.12%	0.257	1
KY Shawnee 1 2021 Count	Y		140	153	91.50%	0.163	
KY Shawnee 1 2022 Count	Y		129	153	84.31%	0.173	
KY Shawnee 2 2021 Count			135	153	88.24%	0.163	
KY Shawnee 2 2022 Count			117	153	76.47%	0.171	
KY Shawnee 3 2021 Count			126	153	82.35%	0.165	
KY Shawnee 3 2022 Count			125	153	81.70%	0.174	
KY Shawnee 4 2021 Count	Y		143	153	93.46%	0.163	
KY Shawnee 4 2022 Count	Y		123	153	80.39%	0.171	
KY Shawnee 5 2021 Count			138	153	90.20%	0.162	
KY Shawnee 5 2022 Count			130	153	84.97%	0.173	
KY Shawnee 6 2021 Count			125	153	81.70%	0.248	1
KY Shawnee 6 2022 Count			129	153	84.31%	0.242	1
KY Shawnee 7 2021 Count			153	153	100.00%	0.240	1
KY Shawnee 7 2022 Count			137	153	89.54%	0.242	1
KY Shawnee 8 2021 Count			153	153	100.00%	0.240	1
KY Shawnee 8 2022 Count			147	153	96.08%	0.241	1
KY Shawnee 9 2021 Count			153	153	100.00%	0.240	1
KY Shawnee 9 2022 Count			133	153	86.93%	0.242	1
LA Big Cajun 2 2B1 2021 Count		Y	7	153	4.58%	0.200	
LA Big Cajun 2 2B1 2022 Count		Y	2	153	1.31%	0.171	
LA Big Cajun 2 2B3 2021 Count		Y	1	153	0.65%	0.141	
LA Big Cajun 2 2B3 2022 Count		Y	2	153	1.31%	0.184	
LA Brame Energy Center 2 2021 Count		Y	150	153	98.04%	0.190	
LA Brame Energy Center 2 2022 Count		Y	151	153	98.69%	0.174	
LA R S Nelson 6 2021 Count			52	153	33.99%	0.178	
LA R S Nelson 6 2022 Count			117	153	76.47%	0.229	1
MD AES Warrior Run 1 2021 Count		Y	2	153	1.31%	0.172	
MD AES Warrior Run 1 2022 Count		Y	2	153	1.31%	0.172	
MI Belle River 1 2021 Count			129	153	84.31%	0.202	1
MI Belle River 1 2022 Count			106	153	69.28%	0.212	1
MI Belle River 2 2021 Count			135	153	88.24%	0.207	1
MI Belle River 2 2022 Count			137	153	89.54%	0.199	
MI J H Campbell 1 2021 Count			153	153	100.00%	0.187	
MI J H Campbell 1 2022 Count			138	153	90.20%	0.170	
MN Allen S King 1 2021 Count	Y		7	153	4.58%	0.253	
MN Allen S King 1 2022 Count	Y		9	153	5.88%	0.240	
MN Sherburne County 1 2021 Count			23	153	15.03%	0.145	
MN Sherburne County 1 2022 Count			44	153	28.76%	0.144	
MN Sherburne County 2 2021 Count			47	153	30.72%	0.145	
MN Sherburne County 2 2022 Count			35	153	22.88%	0.144	
MN Sherburne County 3 2021 Count			2	153	1.31%	0.151	
MN Sherburne County 3 2022 Count			44	153	28.76%	0.150	
MO John Twitty Energy Center 1 2021	Y		16	153	10.46%	0.263	1
MO John Twitty Energy Center 1 2022	Y		4	153	2.61%	0.160	

MO John Twitty Energy Center 2 2022	Y		1	153	0.65%	0.165	
MO Labadie 1 2022 Count			1	153	0.65%	0.157	
MO Labadie 2 2021 Count			2	153	1.31%	0.144	
MO Labadie 2 2022 Count			2	153	1.31%	0.198	
MO Labadie 3 2021 Count			3	153	1.96%	0.174	
MO Labadie 3 2022 Count			2	153	1.31%	0.168	
MO Labadie 4 2021 Count			1	153	0.65%	0.172	
MO Labadie 4 2022 Count			2	153	1.31%	0.196	
MO New Madrid Power Plant 1 2021	Y		53	153	34.64%	0.640	1
MO New Madrid Power Plant 1 2022	Y		29	153	18.95%	0.271	1
MO New Madrid Power Plant 2 2021	Y		139	153	90.85%	0.600	1
MO New Madrid Power Plant 2 2022	Y		38	153	24.84%	0.490	1
MO Rush Island 1 2021 Count			1	153	0.65%	0.170	
MO Rush Island 1 2022 Count			4	153	2.61%	0.178	
MO Rush Island 2 2021 Count			3	153	1.96%	0.176	
MO Rush Island 2 2022 Count			2	153	1.31%	0.192	
MO Sikeston 1 2021 Count			1	153	0.65%	0.147	
MO Sioux 1 2021 Count		Y	133	153	86.93%	0.253	1
MO Sioux 1 2022 Count		Y	96	153	62.75%	0.237	1
MO Sioux 2 2021 Count		Y	120	153	78.43%	0.231	1
MO Sioux 2 2022 Count		Y	111	153	72.55%	0.232	1
MO Thomas Hill Energy Center MB1 2021	Y		25	153	16.34%	0.361	1
MO Thomas Hill Energy Center MB1 2022	Y		32	153	20.92%	0.517	1
MO Thomas Hill Energy Center MB2 2021	Y		113	153	73.86%	0.484	1
MO Thomas Hill Energy Center MB2 2022	Y		27	153	17.65%	0.421	1
MO Thomas Hill Energy Center MB3 2021	Y		22	153	14.38%	0.190	
MO Thomas Hill Energy Center MB3 2022	Y		5	153	3.27%	0.166	
MS Daniel Electric Generating Plant 1 2021			141	153	92.16%	0.282	1
MS Daniel Electric Generating Plant 1 2022			71	153	46.41%	0.260	1
MS Red Hills Generation Facility AA001 2021			4	153	2.61%	0.185	
MS Red Hills Generation Facility AA001 2022			9	153	5.88%	0.155	
MS Red Hills Generation Facility AA002 2021			13	153	8.50%	0.210	
MS Red Hills Generation Facility AA002 2022			3	153	1.96%	0.162	
NV North Valmy 1 2021 Count			130	153	84.97%	0.324	1
NV North Valmy 1 2022 Count			129	153	84.31%	0.287	1
NV North Valmy 2 2021 Count			139	153	90.85%	0.265	1
NV North Valmy 2 2022 Count			135	153	88.24%	0.247	1
OH Gen J M Gavin 1 2021 Count	Y		16	153	10.46%	0.175	
OH Gen J M Gavin 1 2022 Count	Y		11	153	7.19%	0.203	
OH Gen J M Gavin 2 2021 Count	Y		9	153	5.88%	0.211	
OH Gen J M Gavin 2 2022 Count	Y		3	153	1.96%	0.184	
OH Miami Fort Power Station 8 2021 Count	Y		32	153	20.92%	0.174	
OH Miami Fort Power Station 8 2022 Count	Y		1	153	0.65%	0.146	
OH W H Sammis 5 2021 Count		Y	23	153	15.03%	0.172	
OH W H Sammis 5 2022 Count		Y	22	153	14.38%	0.179	
OH W H Sammis 6 2021 Count	Y		11	153	7.19%	0.178	
OH W H Sammis 6 2022 Count	Y		16	153	10.46%	0.181	
OH W H Sammis 7 2021 Count	Y		14	153	9.15%	0.184	
OH W H Sammis 7 2022 Count	Y		11	153	7.19%	0.176	
OK Grand River Dam Authority 2 2021 Count			65	153	42.48%	0.157	
OK Grand River Dam Authority 2 2022 Count			56	153	36.60%	0.155	
OK Hugo 1 2021 Count			77	153	50.33%	0.183	

OK Hugo 1 2022 Count			59	153	38.56%	0.189	
OK Muskogee 6 2021 Count			127	153	83.01%	0.289	1
OK Muskogee 6 2022 Count			82	153	53.59%	0.306	1
OK Northeastern 3313 2021 Count			10	153	6.54%	0.165	
OK Northeastern 3313 2022 Count			16	153	10.46%	0.162	
OK Sooner 1 2021 Count			2	153	1.31%	0.140	
OK Sooner 1 2022 Count			11	153	7.19%	0.154	
OK Sooner 2 2021 Count			11	153	7.19%	0.146	
OK Sooner 2 2022 Count			14	153	9.15%	0.152	
PA Conemaugh 1 2021 Count	Y		77	153	50.33%	0.225	1
PA Conemaugh 1 2022 Count	Y		2	153	1.31%	0.221	
PA Conemaugh 2 2021 Count	Y		67	153	43.79%	0.210	1
PA Conemaugh 2 2022 Count	Y		3	153	1.96%	0.193	
PA Homer City 1 2021 Count	Y		79	153	51.63%	0.267	1
PA Homer City 1 2022 Count	Y		9	153	5.88%	0.212	
PA Homer City 2 2021 Count	Y		16	153	10.46%	0.210	1
PA Homer City 2 2022 Count	Y		6	153	3.92%	0.199	
PA Keystone 1 2021 Count	Y		64	153	41.83%	0.208	1
PA Keystone 1 2022 Count	Y		4	153	2.61%	0.179	
PA Keystone 2 2021 Count	Y		52	153	33.99%	0.208	1
PA Keystone 2 2022 Count	Y		1	153	0.65%	0.181	
PA Montour, LLC 1 2021 Count	Y		12	153	7.84%	0.208	
PA Montour, LLC 1 2022 Count	Y		2	153	1.31%	0.171	
PA Montour, LLC 2 2021 Count	Y		13	153	8.50%	0.191	
PA Montour, LLC 2 2022 Count	Y		6	153	3.92%	0.218	
TX Coleto Creek 1 2021 Count			110	153	71.90%	0.147	
TX Coleto Creek 1 2022 Count			131	153	85.62%	0.167	
TX Harrington Station 061B 2021 Count			95	153	62.09%	0.157	
TX Harrington Station 061B 2022 Count			134	153	87.58%	0.168	
TX Harrington Station 062B 2021 Count			91	153	59.48%	0.157	
TX Harrington Station 062B 2022 Count			90	153	58.82%	0.168	
TX Harrington Station 063B 2021 Count			112	153	73.20%	0.168	
TX Harrington Station 063B 2022 Count			128	153	83.66%	0.201	1
TX J K Spruce **1 2021 Count			80	153	52.29%	0.148	
TX J K Spruce **1 2022 Count			67	153	43.79%	0.149	
TX Limestone LIM1 2021 Count		Y	28	153	18.30%	0.157	
TX Limestone LIM1 2022 Count		Y	133	153	86.93%	0.177	
TX Limestone LIM2 2021 Count		Y	95	153	62.09%	0.181	
TX Limestone LIM2 2022 Count		Y	119	153	77.78%	0.187	
TX Martin Lake 1 2021 Count			78	153	50.98%	0.152	
TX Martin Lake 1 2022 Count			59	153	38.56%	0.174	
TX Martin Lake 2 2021 Count			70	153	45.75%	0.163	
TX Martin Lake 2 2022 Count			3	153	1.96%	0.203	
TX Martin Lake 3 2021 Count			40	153	26.14%	0.159	
TX Martin Lake 3 2022 Count			6	153	3.92%	0.144	
TX Sam Seymour 1 2021 Count			8	153	5.23%	0.166	
TX Sam Seymour 1 2022 Count			20	153	13.07%	0.150	
TX Sam Seymour 2 2021 Count			2	153	1.31%	0.181	
TX Sam Seymour 3 2021 Count			6	153	3.92%	0.148	
TX Sam Seymour 3 2022 Count			17	153	11.11%	0.160	
TX San Miguel SM-1 2021 Count		Y	131	153	85.62%	0.168	
TX San Miguel SM-1 2022 Count		Y	111	153	72.55%	0.166	
TX Tolk Station 171B 2021 Count			110	153	71.90%	0.171	
TX Tolk Station 171B 2022 Count			84	153	54.90%	0.214	1
TX Tolk Station 172B 2021 Count			106	153	69.28%	0.181	
TX Tolk Station 172B 2022 Count			102	153	66.67%	0.152	
TX Twin Oaks U1 2021 Count		Y	12	153	7.84%	0.165	
TX Twin Oaks U1 2022 Count		Y	9	153	5.88%	0.154	
TX Twin Oaks U2 2021 Count		Y	2	153	1.31%	0.152	
TX Twin Oaks U2 2022 Count		Y	7	153	4.58%	0.155	

TX Welsh Power Plant 1 2021 Count			152	153	99.35%	0.192	
TX Welsh Power Plant 1 2022 Count			143	153	93.46%	0.177	
TX Welsh Power Plant 3 2021 Count			139	153	90.85%	0.205	1
TX Welsh Power Plant 3 2022 Count			123	153	80.39%	0.201	1
UT Bonanza 1-1 2021 Count			135	153	88.24%	0.239	1
UT Bonanza 1-1 2022 Count			146	153	95.42%	0.230	1
UT Hunter 1 2021 Count			149	153	97.39%	0.190	
UT Hunter 1 2022 Count			138	153	90.20%	0.180	
UT Hunter 2 2021 Count			153	153	100.00%	0.175	
UT Hunter 2 2022 Count			148	153	96.73%	0.177	
UT Hunter 3 2021 Count			148	153	96.73%	0.290	1
UT Hunter 3 2022 Count			146	153	95.42%	0.277	1
UT Huntington 1 2021 Count			150	153	98.04%	0.185	
UT Huntington 1 2022 Count			146	153	95.42%	0.180	
UT Huntington 2 2021 Count			151	153	98.69%	0.210	1
UT Huntington 2 2022 Count			144	153	94.12%	0.204	1
UT Intermountain 1SGA 2021 Count			142	153	92.81%	0.258	1
UT Intermountain 1SGA 2022 Count			93	153	60.78%	0.257	1
UT Intermountain 2SGA 2021 Count			153	153	100.00%	0.308	1
UT Intermountain 2SGA 2022 Count			153	153	100.00%	0.289	1
VA Clover Power Station 1 2021 Count		Y	56	153	36.60%	0.202	1
VA Clover Power Station 1 2022 Count		Y	25	153	16.34%	0.191	
VA Clover Power Station 2 2021 Count		Y	44	153	28.76%	0.227	1
VA Clover Power Station 2 2022 Count		Y	28	153	18.30%	0.232	1
WI Columbia 1 2022 Count			1	153	0.65%	0.144	
WI South Oak Creek 5 2022 Count	Y		1	153	0.65%	0.193	
WV Fort Martin Power Station 1 2021 Count		Y	132	153	86.27%	0.278	1
WV Fort Martin Power Station 1 2022 Count		Y	150	153	98.04%	0.237	1
WV Fort Martin Power Station 2 2021 Count		Y	124	153	81.05%	0.269	1
WV Fort Martin Power Station 2 2022 Count		Y	108	153	70.59%	0.225	1
WV John E Amos 1 2021 Count	Y		4	153	2.61%	0.254	
WV John E Amos 1 2022 Count	Y		3	153	1.96%	0.257	
WV John E Amos 3 2021 Count	Y		5	153	3.27%	0.184	
WV John E Amos 3 2022 Count	Y		7	153	4.58%	0.204	
WV Mountaineer (1301) 1 2021 Count	Y		1	153	0.65%	0.175	
WV Mountaineer (1301) 1 2022 Count	Y		9	153	5.88%	0.185	
WV Pleasants Power Station 1 2021 Count	Y		15	153	9.80%	0.243	
WV Pleasants Power Station 1 2022 Count	Y		15	153	9.80%	0.164	
WV Pleasants Power Station 2 2021 Count	Y		15	153	9.80%	0.220	
WV Pleasants Power Station 2 2022 Count	Y		12	153	7.84%	0.203	

Table 5A – New Madrid Unit 1 2022 Ozone Season Daily NOx

Facility Name	Unit ID	Date	Operating Time	Gross Load (MWh/day)	Heat Input (MMBtu/day)	NOx Mass (tons/day)	NOx Rate (lbs/MMBtu)	Delta Over 0.14	Allowance Needed (tons)
New Madrid	1	5/1/2022	24	12857	113472.9	7.92	0.143	0.003	0.17
New Madrid	1	5/2/2022	24	13156	116134.4	5.991	0.1061		
New Madrid	1	5/3/2022	24	14510	126654.8	6.673	0.1045		
New Madrid	1	5/4/2022	24	14551	129189	7.573	0.1175		
New Madrid	1	5/5/2022	24	14199	124892.1	7.416	0.1191		
New Madrid	1	5/6/2022	24	14243	125193.8	7.498	0.12		
New Madrid	1	5/7/2022	24	12862	113782.4	6.467	0.1141		
New Madrid	1	5/8/2022	24	11414	102138.9	6.228	0.1242		
New Madrid	1	5/9/2022	24	13360	117448.8	7.249	0.1258		
New Madrid	1	5/10/2022	24	13465	118135.5	7.499	0.1315		
New Madrid	1	5/11/2022	24	14003	122515.9	7.474	0.1229		
New Madrid	1	5/12/2022	24	13040	113858	7.178	0.1285		
New Madrid	1	5/13/2022	24	14799	128593.3	7.595	0.1182		
New Madrid	1	5/14/2022	24	14109	123043.8	7.59	0.1258		
New Madrid	1	5/15/2022	24	13716	120613.7	7.854	0.1357		
New Madrid	1	5/16/2022	24	13776	121525.4	7.248	0.12		
New Madrid	1	5/17/2022	24	13662	120540.9	7.291	0.1223		
New Madrid	1	5/18/2022	24	13533	118659.7	7.444	0.1271		
New Madrid	1	5/19/2022	24	13828	119530.7	7.243	0.1216		
New Madrid	1	5/20/2022	24	14278	123981.2	7.673	0.1252		
New Madrid	1	5/21/2022	24	14119	123849.3	7.669	0.1248		
New Madrid	1	5/22/2022	24	14120	125328.3	7.637	0.122		
New Madrid	1	5/23/2022	24	14451	128235.1	7.635	0.1193		
New Madrid	1	5/24/2022	24	12476	111028.9	7.718	0.1505	0.0105	0.58
New Madrid	1	5/25/2022	24	14183	124545.6	7.443	0.1196		
New Madrid	1	5/26/2022	24	13870	122324.3	6.783	0.1115		
New Madrid	1	5/27/2022	24	13778	122565.8	6.934	0.114		
New Madrid	1	5/28/2022	24	12671	112829.8	6.797	0.1221		
New Madrid	1	5/29/2022	24	12602	111944.5	6.784	0.1235		
New Madrid	1	5/30/2022	24	13111	116398.3	6.733	0.118		

New Madrid	1	5/31/2022	24	14641	128540.3	7.039	0.1095		
New Madrid	1	6/1/2022	24	14267	124339.1	6.87	0.1108		
New Madrid	1	6/2/2022	24	14687	128249.6	6.786	0.1058		
New Madrid	1	6/3/2022	24	13516	118860	8.675	0.1544	0.0144	0.86
New Madrid	1	6/4/2022	24	13467	118238.2	6.746	0.1163		
New Madrid	1	6/5/2022	24	13537	118716.5	6.502	0.1102		
New Madrid	1	6/6/2022	24	13978	122063.4	6.844	0.1134		
New Madrid	1	6/7/2022	24	13826	120664	7.084	0.1197		
New Madrid	1	6/8/2022	24	14295	125761.9	6.77	0.1078		
New Madrid	1	6/9/2022	24	14691	129955	6.937	0.1074		
New Madrid	1	6/10/2022	24	13934	123212.3	8.881	0.1502	0.0102	0.63
New Madrid	1	6/11/2022	24	13243	117533.7	8.652	0.1532	0.0132	0.78
New Madrid	1	6/12/2022	24	13361	117229.5	34.648	0.6036	0.4636	27.17
New Madrid	1	6/13/2022	24	13626	119852.2	30.818	0.5256	0.3856	23.11
New Madrid	1	6/14/2022	24	14366	126284.1	31.655	0.5051	0.3651	23.05
New Madrid	1	6/15/2022	24	14367	127151.9	33.2	0.5263	0.3863	24.56
New Madrid	1	6/16/2022	24	13894	123309.8	30.423	0.5009	0.3609	22.25
New Madrid	1	6/17/2022	23.98	14188.28	125104.602	30.926	0.5005	0.3605	22.55
New Madrid	1	6/18/2022	24	13898	124213.3	9.716	0.1694	0.0294	1.83
New Madrid	1	6/19/2022	24	13674	121539	6.64	0.1122		
New Madrid	1	6/20/2022	24	12694	113841.8	8.637	0.1564	0.0164	0.93
New Madrid	1	6/21/2022	24	12950	116652.7	6.952	0.1219		
New Madrid	1	6/22/2022	24	14350	128975.8	7.763	0.1201		
New Madrid	1	6/23/2022	24	13610	122339.5	7.372	0.1225		
New Madrid	1	6/24/2022	24	13674	123412.1	7.085	0.1142		
New Madrid	1	6/25/2022	24	13253	119801.7	7.341	0.1229		
New Madrid	1	6/26/2022	24	13716	123614.9	7.054	0.1162		
New Madrid	1	6/27/2022	24	13463	122074.1	7.674	0.1294		
New Madrid	1	6/28/2022	24	13425	121345	6.544	0.1093		
New Madrid	1	6/29/2022	24	13720	122054.6	6.409	0.1058		
New Madrid	1	6/30/2022	24	12636	113593.5	6.661	0.1204		
New Madrid	1	7/1/2022	24	13466	119566.4	6.769	0.114		
New Madrid	1	7/2/2022	24	13517	119955.4	6.588	0.1104		
New Madrid	1	7/3/2022	24	13515	120922.1	6.663	0.1114		

New Madrid	1	7/4/2022	24	13070	117364.8	6.418	0.1106		
New Madrid	1	7/5/2022	24	13066	116541.9	6.664	0.1171		
New Madrid	1	7/6/2022	24	13832	123661.8	6.552	0.1062		
New Madrid	1	7/7/2022	24	14030	125855.4	6.749	0.1075		
New Madrid	1	7/8/2022	24	14046	129048.9	7.568	0.1173		
New Madrid	1	7/9/2022	24	14194	129884.5	7.558	0.1164		
New Madrid	1	7/10/2022	24	13440	126332.7	7.384	0.117		
New Madrid	1	7/11/2022	24	13181	124199.2	7.299	0.1177		
New Madrid	1	7/12/2022	24	13548	126249.6	7.36	0.1167		
New Madrid	1	7/13/2022	24	13787	126714.8	7.407	0.117		
New Madrid	1	7/14/2022	24	13254	125275.7	7.368	0.1178		
New Madrid	1	7/15/2022	24	13661	125546.5	7.349	0.1172		
New Madrid	1	7/16/2022	24	13805	126936.8	7.409	0.1168		
New Madrid	1	7/17/2022	24	14336	129062.7	7.512	0.1164		
New Madrid	1	7/18/2022	24	12533	120695.7	7.059	0.117		
New Madrid	1	7/19/2022	24	12218	118230.9	8.124	0.1417	0.0017	0.10
New Madrid	1	7/20/2022	24	13818	127118	7.489	0.1178		
New Madrid	1	7/21/2022	24	14372	129254.4	7.534	0.1166		
New Madrid	1	7/22/2022	24	14254	129254.5	7.578	0.1173		
New Madrid	1	7/23/2022	24	14156	129612.3	8.068	0.1245		
New Madrid	1	7/24/2022	24	13866	128482.6	7.952	0.1239		
New Madrid	1	7/25/2022	24	14108	130625	8.145	0.1247		
New Madrid	1	7/26/2022	24	13427	127143.9	8.058	0.127		
New Madrid	1	7/27/2022	24	12346	121002.9	9.426	0.1658	0.0258	1.56
New Madrid	1	7/28/2022	0.1	7	310.92	0.049	0.318	0.178	0.03
New Madrid	1	7/29/2022	3.38	0	11277.486	0.891	0.158	0.018	0.10
New Madrid	1	7/30/2022	24	2335	79520.9	6.844	0.1734	0.0334	1.33
New Madrid	1	7/31/2022	24	13415	125915.9	7.983	0.1269		
New Madrid	1	8/1/2022	24	12719	124201.5	8.072	0.1303		
New Madrid	1	8/2/2022	24	13123	121571.9	7.134	0.1173		
New Madrid	1	8/3/2022	24	13498	119889.4	6.282	0.1058		
New Madrid	1	8/4/2022	24	14384	127533.6	7.76	0.1218		
New Madrid	1	8/5/2022	24	13544	120738.8	6.107	0.1017		
New Madrid	1	8/6/2022	24	13314	119125.5	6.15	0.1051		

New Madrid	1	8/7/2022	24	13503	120878.9	6.365	0.1075		
New Madrid	1	8/8/2022	24	14281	127079.7	6.16	0.0972		
New Madrid	1	8/9/2022	24	14006	124589.8	5.664	0.091		
New Madrid	1	8/10/2022	24	14205	126667.9	5.613	0.0887		
New Madrid	1	8/11/2022	24	13134	118151.7	5.37	0.0917		
New Madrid	1	8/12/2022	24	13262	119746.7	4.887	0.0824		
New Madrid	1	8/13/2022	24	13589	121968.4	4.991	0.083		
New Madrid	1	8/14/2022	24	12037	107766.5	6.777	0.1318		
New Madrid	1	8/15/2022	24	13189	117700.6	6.315	0.1116		
New Madrid	1	8/16/2022	24	13365	119721.2	4.363	0.0732		
New Madrid	1	8/17/2022	24	13305	119065.3	5.487	0.094		
New Madrid	1	8/18/2022	24	13324	118323	5.022	0.0854		
New Madrid	1	8/19/2022	24	12952	115114.6	5.02	0.0881		
New Madrid	1	8/20/2022	24	12608	112391.9	26.104	0.453	0.313	17.59
New Madrid	1	8/21/2022	24	13013	115454.5	11.969	0.2236	0.0836	4.83
New Madrid	1	8/22/2022	24	13260	117202.1	4.839	0.0846		
New Madrid	1	8/23/2022	24	12305	109780.9	4.277	0.0782		
New Madrid	1	8/24/2022	24	12252	108750.1	5.735	0.1107		
New Madrid	1	8/25/2022	24	13309	117927.8	29.878	0.5177	0.3777	22.27
New Madrid	1	8/26/2022	24	12502	111828	6.622	0.1222		
New Madrid	1	8/27/2022	24	12471	110812.6	6.441	0.118		
New Madrid	1	8/28/2022	24	12039	107583.7	5.754	0.1117		
New Madrid	1	8/29/2022	24	12805	114500.9	4.23	0.075		
New Madrid	1	8/30/2022	24	13213	116995.8	6.79	0.1159		
New Madrid	1	8/31/2022	24	13155	117525.4	6.307	0.1078		
New Madrid	1	9/1/2022	24	12759	114068.1	5.747	0.1031		
New Madrid	1	9/2/2022	24	12016	108188.9	5.251	0.0984		
New Madrid	1	9/3/2022	24	11975	107336.9	5.998	0.113		
New Madrid	1	9/4/2022	24	11501	105425.1	5.481	0.1037		
New Madrid	1	9/5/2022	24	11760	108577.1	5.419	0.1008		
New Madrid	1	9/6/2022	24	11655	112016.4	7.982	0.1561	0.0161	0.90
New Madrid	1	9/7/2022	16.85	6745.3	63130.265	9.408	0.4093	0.2693	8.50
New Madrid	1	9/8/2022	24	12242	109570.6	6.416	0.1199		
New Madrid	1	9/9/2022	24	12317	109746.5	5.979	0.1128		

New Madrid	1	9/10/2022	24	12360	109923.6	6.952	0.132		
New Madrid	1	9/11/2022	24	12232	109005.7	7.565	0.1427	0.0027	0.15
New Madrid	1	9/12/2022	24	11976	107300.8	7.046	0.1354		
New Madrid	1	9/13/2022	24	11756	106487	8.195	0.1539	0.0139	0.74
New Madrid	1	9/14/2022	24	11247	105063.3	5.763	0.1112		
New Madrid	1	9/15/2022	24	11129	104038.8	6.297	0.1207		
New Madrid	1	9/16/2022	24	11341	105787.8	5.884	0.1114		
New Madrid	1	9/17/2022	24	11867	110311.4	6.597	0.1209		
New Madrid	1	9/18/2022	24	11480	107282.4	6.358	0.1205		
New Madrid	1	9/19/2022	24	11717	108461	7.371	0.1379		
New Madrid	1	9/20/2022	24	10972	102640.4	7.854	0.1546	0.0146	0.75
New Madrid	1	9/21/2022	24	10726	101367.3	7.519	0.1502	0.0102	0.52
New Madrid	1	9/22/2022	24	10789	101668	7.54	0.1541	0.0141	0.72
New Madrid	1	9/23/2022	24	10929	102350.1	6.621	0.1327		
New Madrid	1	9/24/2022	24	10344	98299.9	6.766	0.1383		
New Madrid	1	9/25/2022	24	10869	101282	7.918	0.1593	0.0193	0.98
New Madrid	1	9/26/2022	24	10902	101539.7	6.725	0.1374		
New Madrid	1	9/27/2022	24	9315	90917.9	5.6	0.1237		
New Madrid	1	9/28/2022	24	6968	71755.4	4.7	0.1317		
New Madrid	1	9/29/2022	24	10902	104159.1	6.294	0.1222		
New Madrid	1	9/30/2022	24	10444	98275.1	5.694	0.1228		
						1240			**319**

Table 5B – New Madrid Unit 2 2022 Ozone Season Daily NOx

Facility Name	Unit ID	Date	Operating Time	Gross Load (MWh/day)	Heat Input (MMBtu/day)	NOx Mass (tons/day)	NOx Rate (lbs/MMBtu)	Delta Over 0.14	Allowance Needed (tons)
New Madrid	2	5/1/2022	24	12622	116170.2	7.649	0.1326		
New Madrid	2	5/2/2022	24	12451	114573.3	7.203	0.129		
New Madrid	2	5/3/2022	24	13495	124704.9	7.003	0.1123		
New Madrid	2	5/4/2022	24	13676	126480.7	7.28	0.1151		
New Madrid	2	5/5/2022	24	13351	122596.7	7.05	0.1151		
New Madrid	2	5/6/2022	24	13593	124261.9	7.418	0.1198		
New Madrid	2	5/7/2022	24	12594	114238.7	7.228	0.1296		
New Madrid	2	5/8/2022	24	11166	101422.4	9.057	0.1908	0.0508	7.73

New Madrid	2	5/9/2022	24	9236	82815.1	6.043	0.1474	0.0074	0.92
New Madrid	2	5/10/2022	24	9548	85551.7	6.069	0.1419	0.0019	0.24
New Madrid	2	5/11/2022	24	9551	85598.5	6.262	0.1463	0.0063	0.81
New Madrid	2	5/12/2022	24	9549	84989.2	5.679	0.1336		
New Madrid	2	5/13/2022	22.8	8686.6	77565.26	6.273	0.173	0.033	3.84
New Madrid	2	5/14/2022	0						
New Madrid	2	5/15/2022	6.08	6.08	444.98	0.023	0.0553		
New Madrid	2	5/16/2022	24	6289	60983.9	7.596	0.256	0.116	10.61
New Madrid	2	5/17/2022	24	11177	102133.9	6.885	0.1358		
New Madrid	2	5/18/2022	24	13027	118174.7	6.709	0.1138		
New Madrid	2	5/19/2022	24	13552	123177.6	6.947	0.1128		
New Madrid	2	5/20/2022	24	13373	121626.6	6.837	0.1126		
New Madrid	2	5/21/2022	24	12888	118906.3	6.849	0.1155		
New Madrid	2	5/22/2022	24	12206	114716.8	6.615	0.1157		
New Madrid	2	5/23/2022	24	13435	126523.5	7.095	0.1122		
New Madrid	2	5/24/2022	24	13112	121594.1	6.813	0.1123		
New Madrid	2	5/25/2022	24	12961	118002.3	6.784	0.1155		
New Madrid	2	5/26/2022	24	12148	110373.8	6.245	0.114		
New Madrid	2	5/27/2022	24	12818	118105.1	6.589	0.1119		
New Madrid	2	5/28/2022	24	12136	110538.6	6.308	0.1145		
New Madrid	2	5/29/2022	24	12247	110789.6	6.325	0.1148		
New Madrid	2	5/30/2022	24	12285	111263.2	6.323	0.1145		
New Madrid	2	5/31/2022	24	13535	123144.7	6.723	0.1091		
New Madrid	2	6/1/2022	24	13318	121158.8	6.424	0.1063		
New Madrid	2	6/2/2022	24	13515	124564.9	6.713	0.1078		
New Madrid	2	6/3/2022	24	13137	121327.8	6.27	0.1035		
New Madrid	2	6/4/2022	24	12441	113997.4	6.022	0.106		
New Madrid	2	6/5/2022	24	12409	112933.4	5.925	0.1052		
New Madrid	2	6/6/2022	24	12933	118492.2	6.383	0.1078		
New Madrid	2	6/7/2022	24	12912	118514.2	9.18	0.1597	0.0197	3.50
New Madrid	2	6/8/2022	24	13138	120773.8	6.361	0.1054		
New Madrid	2	6/9/2022	24	13120	120760.9	6.235	0.1035		
New Madrid	2	6/10/2022	24	12989	118608.2	7.257	0.1236		
New Madrid	2	6/11/2022	24	12361	112282.1	7.788	0.1417	0.0017	0.29

New Madrid	2	6/12/2022	24	12991	118547.7	31.437	0.5335	0.3935	69.97
New Madrid	2	6/13/2022	24	13010	119172.2	33.949	0.5765	0.4365	78.03
New Madrid	2	6/14/2022	24	13897	126425.8	34.574	0.548	0.408	77.37
New Madrid	2	6/15/2022	24	13607	123524.4	38.113	0.6213	0.4813	89.18
New Madrid	2	6/16/2022	24	13948	127299.4	35.767	0.5615	0.4215	80.49
New Madrid	2	6/17/2022	23.98	13772.96	126066.252	40.555	0.639	0.499	94.36
New Madrid	2	6/18/2022	24	12672	115928	10.752	0.2011	0.0611	10.62
New Madrid	2	6/19/2022	24	12412	113456.3	5.967	0.1056		
New Madrid	2	6/20/2022	24	12162	110783.1	5.88	0.107		
New Madrid	2	6/21/2022	24	12853	118482.6	6.207	0.105		
New Madrid	2	6/22/2022	24	13339	121893.5	6.308	0.1035		
New Madrid	2	6/23/2022	24	12938	117439.8	6.158	0.105		
New Madrid	2	6/24/2022	24	12731	115478.3	6.05	0.105		
New Madrid	2	6/25/2022	24	13158	119676.6	6.223	0.1042		
New Madrid	2	6/26/2022	24	13106	118970.8	6.196	0.1043		
New Madrid	2	6/27/2022	24	13185	119884.4	6.304	0.1053		
New Madrid	2	6/28/2022	24	12744	115637.5	6.094	0.106		
New Madrid	2	6/29/2022	24	11716	107678	5.688	0.1098		
New Madrid	2	6/30/2022	24	12588	115007	5.966	0.104		
New Madrid	2	7/1/2022	24	12737	116453.6	6.04	0.1041		
New Madrid	2	7/2/2022	24	13217	121496.1	6.36	0.1048		
New Madrid	2	7/3/2022	24	13103	120739.9	6.223	0.1032		
New Madrid	2	7/4/2022	24	13144	124223.4	52.686	0.835	0.695	129.50
New Madrid	2	7/5/2022	24	13126	123043	54.93	0.8879	0.7479	138.04
New Madrid	2	7/6/2022	24	13901	129895.7	59.242	0.9109	0.7709	150.20
New Madrid	2	7/7/2022	24	13888	130610.2	59.903	0.9169	0.7769	152.21
New Madrid	2	7/8/2022	24	13052	124648.1	16.175	0.2676	0.1276	23.86
New Madrid	2	7/9/2022	24	12656	122801.7	7.11	0.1161		
New Madrid	2	7/10/2022	24	12826	122800.4	7.011	0.1142		
New Madrid	2	7/11/2022	24	12500	119752.9	6.995	0.1173		
New Madrid	2	7/12/2022	24	12956	122671.7	7.047	0.115		
New Madrid	2	7/13/2022	24	13129	124729.8	7.112	0.114		
New Madrid	2	7/14/2022	24	12579	121800.7	7.101	0.117		
New Madrid	2	7/15/2022	24	12763	123015.6	7.077	0.1152		

New Madrid	2	7/16/2022	24	12966	124996.9	7.132	0.1141		
New Madrid	2	7/17/2022	24	13048	124386.3	8.939	0.1465	0.0065	1.21
New Madrid	2	7/18/2022	24	13681	129522	33.256	0.5155	0.3755	72.95
New Madrid	2	7/19/2022	24	12786	124314.2	56.896	0.9113	0.7713	143.83
New Madrid	2	7/20/2022	24	13792	130255.8	60.94	0.9353	0.7953	155.39
New Madrid	2	7/21/2022	24	13912	133357.9	63.105	0.9464	0.8064	161.31
New Madrid	2	7/22/2022	24	13823	135478.4	63.483	0.9365	0.7965	161.86
New Madrid	2	7/23/2022	24	12393	121501.4	54.827	0.8911	0.7511	136.89
New Madrid	2	7/24/2022	24	13144	128968.3	58.954	0.9092	0.7692	148.80
New Madrid	2	7/25/2022	24	14014	134698.6	63.219	0.9386	0.7986	161.36
New Madrid	2	7/26/2022	24	13377	129483.2	58.098	0.8907	0.7507	145.80
New Madrid	2	7/27/2022	24	12794	124792.4	8.791	0.1478	0.0078	1.46
New Madrid	2	7/28/2022	24	12676	126851.8	7.364	0.1161		
New Madrid	2	7/29/2022	24	12995	128422.8	7.448	0.116		
New Madrid	2	7/30/2022	24	13034	128733.3	7.467	0.116		
New Madrid	2	7/31/2022	24	13054	128141.1	7.432	0.116		
New Madrid	2	8/1/2022	24	13079	128724.8	9.567	0.149	0.009	1.74
New Madrid	2	8/2/2022	24	11898	114174.6	6.742	0.1196		
New Madrid	2	8/3/2022	24	12384	114482.3	5.698	0.1		
New Madrid	2	8/4/2022	24	13045	121648.7	6.041	0.0993		
New Madrid	2	8/5/2022	24	12480	116278.2	5.886	0.1013		
New Madrid	2	8/6/2022	24	12742	119233.9	6.049	0.1015		
New Madrid	2	8/7/2022	23.37	11812.43	110052.001	5.946	0.1315		
New Madrid	2	8/8/2022	0						
New Madrid	2	8/9/2022	0						
New Madrid	2	8/10/2022	2.93	2.93	304.027	0.018	0.098		
New Madrid	2	8/11/2022	24	3441	35970	6.069	0.3376	0.1976	10.66
New Madrid	2	8/12/2022	14.85	6936.3	63639.78	3.624	0.1351		
New Madrid	2	8/13/2022	7.1	7.1	687.1	0.033	0.0819		
New Madrid	2	8/14/2022	24	7994	75229.6	6.667	0.2219	0.0819	9.24
New Madrid	2	8/15/2022	15.68	5627.96	52706.944	2.717	0.1359		
New Madrid	2	8/16/2022	24	12347	113768.2	8.585	0.1806	0.0406	6.93
New Madrid	2	8/17/2022	24	12876	115814.5	7.223	0.1238		
New Madrid	2	8/18/2022	24	12803	114844.5	5.62	0.0978		

New Madrid	2	8/19/2022	24	12566	112520.2	4.802	0.0854		
New Madrid	2	8/20/2022	24	12166	108542.1	4.746	0.0883		
New Madrid	2	8/21/2022	24	12765	115202	4.814	0.0838		
New Madrid	2	8/22/2022	24	12988	116832.4	7.235	0.1226		
New Madrid	2	8/23/2022	24	12388	111473.8	5.86	0.104		
New Madrid	2	8/24/2022	24	12652	114929.2	5.118	0.0891		
New Madrid	2	8/25/2022	24	12153	110951.7	4.662	0.0843		
New Madrid	2	8/26/2022	24	12156	111606.3	4.532	0.0817		
New Madrid	2	8/27/2022	24	12583	115219.9	5.255	0.0905		
New Madrid	2	8/28/2022	24	12188	111144.1	4.273	0.0774		
New Madrid	2	8/29/2022	24	12868	119079.5	4.499	0.0755		
New Madrid	2	8/30/2022	24	12981	120537.8	4.823	0.08		
New Madrid	2	8/31/2022	24	12986	119408.2	5.05	0.0846		
New Madrid	2	9/1/2022	24	12739	117587.3	5.426	0.0923		
New Madrid	2	9/2/2022	24	12314	112567.8	5.641	0.1015		
New Madrid	2	9/3/2022	24	12049	109500.2	4.651	0.0853		
New Madrid	2	9/4/2022	24	12279	112211.6	7.225	0.1273		
New Madrid	2	9/5/2022	24	11992	108723.4	5.324	0.0988		
New Madrid	2	9/6/2022	24	11255	103128.3	5.048	0.0957		
New Madrid	2	9/7/2022	24	13042	119985.5	5.819	0.097		
New Madrid	2	9/8/2022	24	12627	115626.8	5.699	0.0989		
New Madrid	2	9/9/2022	24	12506	114435.1	6.18	0.1078		
New Madrid	2	9/10/2022	24	11902	108735.8	5.815	0.1068		
New Madrid	2	9/11/2022	24	12272	112764.4	6.088	0.108		
New Madrid	2	9/12/2022	24	11438	105705.8	7.397	0.1373		
New Madrid	2	9/13/2022	24	10679	99052.6	5.291	0.1065		
New Madrid	2	9/14/2022	24	9980	91660.3	4.962	0.1074		
New Madrid	2	9/15/2022	24	10863	99061.9	8.526	0.1669	0.0269	4.00
New Madrid	2	9/16/2022	24	11418	103485.4	5.388	0.106		
New Madrid	2	9/17/2022	24	10768	99275	5.36	0.1167		
New Madrid	2	9/18/2022	24	11373	103293.2	5.303	0.1033		
New Madrid	2	9/19/2022	24	10563	96910.8	5.165	0.1124		
New Madrid	2	9/20/2022	24	11022	100824.1	5.102	0.1016		
New Madrid	2	9/21/2022	24	10406	95806.6	5.053	0.1055		

New Madrid	2	9/22/2022	24	11141	104687	5.133	0.0977		
New Madrid	2	9/23/2022	24	10903	102575.5	5.319	0.104		
New Madrid	2	9/24/2022	24	10635	98505.8	5.187	0.1053		
New Madrid	2	9/25/2022	24	10597	98175.9	5.488	0.1117		
New Madrid	2	9/26/2022	24	10947	101996.9	6.546	0.1263		
New Madrid	2	9/27/2022	24	9227	86389.4	4.924	0.1169		
New Madrid	2	9/28/2022	24	4755	47810.9	4.972	0.2159	0.0759	5.44
New Madrid	2	9/29/2022	0.12	1.44	55.44	0.009	0.318	0.178	0.01
New Madrid	2	9/30/2022	0						
									4801

Table 5C – Thomas Hill Unit 1 (MB1) 2022 Ozone Season Daily NOx

Facility Name	Unit ID	Date	Operating Time	Gross Load (MWh/day)	Heat Input (MMBtu/day)	NOx Mass (tons/day)	NOx Rate (lbs/MMBtu)	Delta Over 0.14	Allowance Needed (tons)
Thomas Hill	MB 1	5/1/2022	24	4140	40722.6	11.621	0.5715	0.4315	26.36
Thomas Hill	MB 1	5/2/2022	6	746	7417.7	2.284	0.6123	0.4723	5.26
Thomas Hill	MB 1	5/3/2022	7.77	21	1053.606	0.277	0.483	0.343	0.54
Thomas Hill	MB 1	5/4/2022	24	3251	33772.7	10.428	0.6143	0.4743	24.03
Thomas Hill	MB 1	5/5/2022	24	4178	42080.1	13.335	0.6333	0.4933	31.14
Thomas Hill	MB 1	5/6/2022	21.75	3665.75	37434.775	11.421	0.6097	0.4697	26.37
Thomas Hill	MB 1	5/7/2022	3.82	0	290.978	0.078	0.49	0.35	0.15
Thomas Hill	MB 1	5/8/2022	24	2803	29795.4	8.465	0.6085	0.4685	20.94
Thomas Hill	MB 1	5/9/2022	24	3767	40260.9	10.639	0.5414	0.4014	24.24
Thomas Hill	MB 1	5/10/2022	24	3852	42362.1	10.174	0.487	0.347	22.05
Thomas Hill	MB 1	5/11/2022	24	3921	43368.4	11.133	0.5165	0.3765	24.49
Thomas Hill	MB 1	5/12/2022	24	3724	41137.5	12.864	0.6123	0.4723	29.14
Thomas Hill	MB 1	5/13/2022	24	4219	46100.6	14.356	0.6228	0.4828	33.39
Thomas Hill	MB 1	5/14/2022	24	4162	45266.3	12.065	0.5331	0.3931	26.69
Thomas Hill	MB 1	5/15/2022	24	3835	42827.3	11.833	0.5476	0.4076	26.18
Thomas Hill	MB 1	5/16/2022	24	3871	45545.3	12.568	0.5518	0.4118	28.13
Thomas Hill	MB 1	5/17/2022	24	4034	43629.1	10.799	0.496	0.356	23.30
Thomas Hill	MB 1	5/18/2022	24	3968	42437.5	10.947	0.5159	0.3759	23.93
Thomas Hill	MB 1	5/19/2022	24	3962	42724.7	12.171	0.5697	0.4297	27.54
Thomas Hill	MB 1	5/20/2022	24	3966	42403.5	12.33	0.5814	0.4414	28.08

Thomas Hill	MB 1	5/21/2022	24	3964	40860.5	12.506	0.6115	0.4715	28.90
Thomas Hill	MB 1	5/22/2022	24	3960	41363.7	12.323	0.5952	0.4552	28.24
Thomas Hill	MB 1	5/23/2022	1.68	278.88	2820.456	0.864	0.611	0.471	1.99
Thomas Hill	MB 1	5/24/2022	0						
Thomas Hill	MB 1	5/25/2022	0						
Thomas Hill	MB 1	5/26/2022	0						
Thomas Hill	MB 1	5/27/2022	0						
Thomas Hill	MB 1	5/28/2022	0						
Thomas Hill	MB 1	5/29/2022	0						
Thomas Hill	MB 1	5/30/2022	0						
Thomas Hill	MB 1	5/31/2022	0						
Thomas Hill	MB 1	6/1/2022	0						
Thomas Hill	MB 1	6/2/2022	0						
Thomas Hill	MB 1	6/3/2022	0						
Thomas Hill	MB 1	6/4/2022	0						
Thomas Hill	MB 1	6/5/2022	0						
Thomas Hill	MB 1	6/6/2022	0						
Thomas Hill	MB 1	6/7/2022	0						
Thomas Hill	MB 1	6/8/2022	0						
Thomas Hill	MB 1	6/9/2022	0						
Thomas Hill	MB 1	6/10/2022	0						
Thomas Hill	MB 1	6/11/2022	0						
Thomas Hill	MB 1	6/12/2022	0						
Thomas Hill	MB 1	6/13/2022	0						
Thomas Hill	MB 1	6/14/2022	0						
Thomas Hill	MB 1	6/15/2022	0						
Thomas Hill	MB 1	6/16/2022	0						
Thomas Hill	MB 1	6/17/2022	0						
Thomas Hill	MB 1	6/18/2022	13.09	0	893.835	0.076	0.1371		
Thomas Hill	MB 1	6/19/2022	16.49	201.82	4076.264	1.44	0.5711	0.4311	2.64
Thomas Hill	MB 1	6/20/2022	24	3472	37333.2	11.33	0.6185	0.4785	26.80
Thomas Hill	MB 1	6/21/2022	24	3944	43355.3	10.891	0.5033	0.3633	23.63
Thomas Hill	MB 1	6/22/2022	24	4204	45672.8	2.499	0.1097		
Thomas Hill	MB 1	6/23/2022	24	4208	45610.2	1.904	0.0835		

Thomas Hill	MB 1	6/24/2022	24	4199	45056.3	1.609	0.0715		
Thomas Hill	MB 1	6/25/2022	24	4192	44793.6	1.703	0.076		
Thomas Hill	MB 1	6/26/2022	24	4172	44987.9	1.873	0.0833		
Thomas Hill	MB 1	6/27/2022	24	4161	45117.7	1.865	0.0827		
Thomas Hill	MB 1	6/28/2022	24	4102	44379.2	1.774	0.0799		
Thomas Hill	MB 1	6/29/2022	24	3793	41284.4	1.841	0.09		
Thomas Hill	MB 1	6/30/2022	24	3877	41749	2.358	0.1171		
Thomas Hill	MB 1	7/1/2022	24	4084	43669.4	1.436	0.0659		
Thomas Hill	MB 1	7/2/2022	24	4171	44642.1	1.532	0.0686		
Thomas Hill	MB 1	7/3/2022	24	4171	44847.6	1.539	0.0686		
Thomas Hill	MB 1	7/4/2022	24	4185	44736.2	1.398	0.0625		
Thomas Hill	MB 1	7/5/2022	24	4171	44686	1.356	0.0607		
Thomas Hill	MB 1	7/6/2022	24	4174	44481.5	1.314	0.0591		
Thomas Hill	MB 1	7/7/2022	24	4170	44463.7	1.672	0.0752		
Thomas Hill	MB 1	7/8/2022	24	4158	44498.9	1.659	0.0746		
Thomas Hill	MB 1	7/9/2022	24	4150	44557.5	1.36	0.061		
Thomas Hill	MB 1	7/10/2022	24	3716	40203.6	1.574	0.0762		
Thomas Hill	MB 1	7/11/2022	24	4045	43135.1	1.552	0.0713		
Thomas Hill	MB 1	7/12/2022	24	4160	44427.8	1.378	0.062		
Thomas Hill	MB 1	7/13/2022	24	4157	44682.8	1.385	0.062		
Thomas Hill	MB 1	7/14/2022	24	4155	44907.5	1.333	0.0594		
Thomas Hill	MB 1	7/15/2022	24	4175	44493.3	1.302	0.0585		
Thomas Hill	MB 1	7/16/2022	24	4165	44318.1	1.513	0.0683		
Thomas Hill	MB 1	7/17/2022	24	4165	44264.6	1.5	0.0678		
Thomas Hill	MB 1	7/18/2022	24	4159	44652.3	1.525	0.0683		
Thomas Hill	MB 1	7/19/2022	24	3772	41024.8	1.755	0.082		
Thomas Hill	MB 1	7/20/2022	23.98	4044.54	43820.628	1.505	0.0686		
Thomas Hill	MB 1	7/21/2022	24	4145	45166.9	1.49	0.066		
Thomas Hill	MB 1	7/22/2022	24	4017	43536.7	1.526	0.0694		
Thomas Hill	MB 1	7/23/2022	24	3621	39258.5	1.254	0.0614		
Thomas Hill	MB 1	7/24/2022	24	3832	41246	1.309	0.0614		
Thomas Hill	MB 1	7/25/2022	24	3844	41410.5	1.571	0.0734		
Thomas Hill	MB 1	7/26/2022	24	4144	43760.7	1.943	0.089		
Thomas Hill	MB 1	7/27/2022	24	4149	44298.4	1.656	0.0748		

Thomas Hill	MB 1	7/28/2022	24	4069	43612.6	1.382	0.0633		
Thomas Hill	MB 1	7/29/2022	24	4132	44406.6	1.763	0.0794		
Thomas Hill	MB 1	7/30/2022	24	4137	44457.2	1.585	0.0713		
Thomas Hill	MB 1	7/31/2022	24	4151	44266	1.412	0.0638		
Thomas Hill	MB 1	8/1/2022	24	4167	44594.2	1.627	0.0729		
Thomas Hill	MB 1	8/2/2022	24	4156	44526.3	1.603	0.072		
Thomas Hill	MB 1	8/3/2022	24	4162	44797.4	1.619	0.0723		
Thomas Hill	MB 1	8/4/2022	24	4157	44980	1.56	0.0694		
Thomas Hill	MB 1	8/5/2022	24	4139	45056.9	1.52	0.0675		
Thomas Hill	MB 1	8/6/2022	24	4150	45120	1.461	0.0648		
Thomas Hill	MB 1	8/7/2022	24	3850	42030.3	1.584	0.0769		
Thomas Hill	MB 1	8/8/2022	24	4137	44898.9	1.459	0.065		
Thomas Hill	MB 1	8/9/2022	24	4130	44781.1	1.619	0.0723		
Thomas Hill	MB 1	8/10/2022	24	4124	44816.8	1.605	0.0716		
Thomas Hill	MB 1	8/11/2022	24	4120	44944.4	1.577	0.0702		
Thomas Hill	MB 1	8/12/2022	24	4118	44885.3	1.551	0.0691		
Thomas Hill	MB 1	8/13/2022	24	4127	44754.7	1.514	0.0677		
Thomas Hill	MB 1	8/14/2022	24	3550	38759.5	1.559	0.0807		
Thomas Hill	MB 1	8/15/2022	24	4006	43411.2	1.494	0.0685		
Thomas Hill	MB 1	8/16/2022	24	4102	44087	1.638	0.0743		
Thomas Hill	MB 1	8/17/2022	24	4104	44487	1.601	0.072		
Thomas Hill	MB 1	8/18/2022	24	4102	44545.8	1.686	0.0757		
Thomas Hill	MB 1	8/19/2022	24	4070	43748.7	1.379	0.063		
Thomas Hill	MB 1	8/20/2022	24	4019	43269.5	1.47	0.0679		
Thomas Hill	MB 1	8/21/2022	24	3997	43318.8	1.581	0.073		
Thomas Hill	MB 1	8/22/2022	24	3987	43366.6	1.669	0.077		
Thomas Hill	MB 1	8/23/2022	24	3986	43420.5	1.611	0.0743		
Thomas Hill	MB 1	8/24/2022	24	3963	43194.2	1.425	0.066		
Thomas Hill	MB 1	8/25/2022	24	3922	42595.8	1.329	0.0624		
Thomas Hill	MB 1	8/26/2022	24	3832	41787.2	1.681	0.0807		
Thomas Hill	MB 1	8/27/2022	24	3605	39425.2	1.563	0.0777		
Thomas Hill	MB 1	8/28/2022	24	3373	36703.9	1.539	0.0829		
Thomas Hill	MB 1	8/29/2022	24	3867	41977.6	1.474	0.0702		
Thomas Hill	MB 1	8/30/2022	24	3883	42457	1.633	0.0769		

Thomas Hill	MB 1	8/31/2022	24	3901	42627.7	1.451	0.0681		
Thomas Hill	MB 1	9/1/2022	24	3884	42589.6	1.633	0.0767		
Thomas Hill	MB 1	9/2/2022	24	3902	42523.3	1.579	0.0742		
Thomas Hill	MB 1	9/3/2022	6.42	926.04	10240.228	0.511	0.0973		
Thomas Hill	MB 1	9/4/2022	0.57	0	13.566	0	0.001		
Thomas Hill	MB 1	9/5/2022	23.6	1756	19966.54	5.355	0.505	0.365	10.93
Thomas Hill	MB 1	9/6/2022	24	3922	41602.3	4.669	0.2283	0.0883	5.51
Thomas Hill	MB 1	9/7/2022	24	3902	42473.5	1.534	0.0723		
Thomas Hill	MB 1	9/8/2022	24	3865	42335.7	1.537	0.0726		
Thomas Hill	MB 1	9/9/2022	24	3801	41477.4	1.736	0.0836		
Thomas Hill	MB 1	9/10/2022	24	3796	41443	1.701	0.082		
Thomas Hill	MB 1	9/11/2022	24	3798	40491.8	1.75	0.086		
Thomas Hill	MB 1	9/12/2022	24	3843	40987.8	1.735	0.0848		
Thomas Hill	MB 1	9/13/2022	24	3565	38561.2	1.828	0.093		
Thomas Hill	MB 1	9/14/2022	24	3447	37390.6	1.293	0.0669		
Thomas Hill	MB 1	9/15/2022	24	3394	36439.2	1.248	0.0664		
Thomas Hill	MB 1	9/16/2022	24	3559	38236.4	1.211	0.062		
Thomas Hill	MB 1	9/17/2022	24	3566	38513.2	1.514	0.0761		
Thomas Hill	MB 1	9/18/2022	24	3868	41143.2	1.485	0.0722		
Thomas Hill	MB 1	9/19/2022	24	3245	35129.2	1.39	0.0773		
Thomas Hill	MB 1	9/20/2022	24	2662	29471.4	1.045	0.0695		
Thomas Hill	MB 1	9/21/2022	24	2679	29738.2	1.064	0.0713		
Thomas Hill	MB 1	9/22/2022	24	3633	38291.5	1.319	0.0684		
Thomas Hill	MB 1	9/23/2022	24	3475	35597.1	1.455	0.0805		
Thomas Hill	MB 1	9/24/2022	24	3717	39244.9	1.66	0.0841		
Thomas Hill	MB 1	9/25/2022	24	3574	38622.6	1.721	0.0876		
Thomas Hill	MB 1	9/26/2022	21.84	2256.16	24488.15	1.406	0.195	0.055	2.02
Thomas Hill	MB 1	9/27/2022	24	3294	34958.5	3.622	0.2315	0.0915	4.80
Thomas Hill	MB 1	9/28/2022	20.38	1699.37	18562.231	1.531	0.3233	0.1833	5.10
Thomas Hill	MB 1	9/29/2022	24	3203	33871.6	5.385	0.366	0.226	11.48
Thomas Hill	MB 1	9/30/2022	24	3483	36783.2	1.883	0.1062		
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Table 5D – Thomas Hill Unit 2 (MB2) 2022 Ozone Season Daily NOx

Facility Name	Unit ID	Date	Operating Time	Gross Load (MWh/day)	Heat Input (MMBtu/day)	NOx Mass (tons/day)	NOx Rate (lbs/MMBtu)	Delta Over 0.14	Allowance Needed (tons)
Thomas Hill	MB2	5/1/2022	24	5568	55974.2	14.136	0.5051	0.3651	10.22
Thomas Hill	MB2	5/2/2022	24	5172	52532.6	13.697	0.5211	0.3811	10.01
Thomas Hill	MB2	5/3/2022	24	5568	55626.5	12.875	0.4629	0.3229	8.98
Thomas Hill	MB2	5/4/2022	24	5532	55861.1	12.881	0.4609	0.3209	26.89
Thomas Hill	MB2	5/5/2022	24	5483	54788.8	11.428	0.4173	0.2773	22.79
Thomas Hill	MB2	5/6/2022	24	5448	54022.6	11.004	0.4074	0.2674	21.67
Thomas Hill	MB2	5/7/2022	24	5448	54372.4	12.054	0.4434	0.3034	24.74
Thomas Hill	MB2	5/8/2022	24	5369	53226.6	11.553	0.434	0.294	23.47
Thomas Hill	MB2	5/9/2022	24	5098	50794.1	9.784	0.3854	0.2454	18.70
Thomas Hill	MB2	5/10/2022	24	5042	50145.7	9.002	0.3611	0.2211	16.63
Thomas Hill	MB2	5/11/2022	24	5026	51230.7	11.091	0.4355	0.2955	22.71
Thomas Hill	MB2	5/12/2022	24	4790	49182.2	11.122	0.4497	0.3097	22.85
Thomas Hill	MB2	5/13/2022	24	5208	52351.7	12.28	0.469	0.329	25.84
Thomas Hill	MB2	5/14/2022	24	5185	51794.3	11.15	0.4304	0.2904	22.56
Thomas Hill	MB2	5/15/2022	24	4982	50370.3	11.663	0.4628	0.3228	24.39
Thomas Hill	MB2	5/16/2022	2.25	293.75	2895.5	0.921	0.6427	0.5027	2.18
Thomas Hill	MB2	5/17/2022	0						
Thomas Hill	MB2	5/18/2022	0						
Thomas Hill	MB2	5/19/2022	0						
Thomas Hill	MB2	5/20/2022	0						
Thomas Hill	MB2	5/21/2022	0						
Thomas Hill	MB2	5/22/2022	0						
Thomas Hill	MB2	5/23/2022	0						
Thomas Hill	MB2	5/24/2022	0						
Thomas Hill	MB2	5/25/2022	0						
Thomas Hill	MB2	5/26/2022	0						
Thomas Hill	MB2	5/27/2022	0						
Thomas Hill	MB2	5/28/2022	0						
Thomas Hill	MB2	5/29/2022	13.51	0	1844.769	0.229	0.2241	0.0841	0.23

Thomas Hill	MB2	5/30/2022	24	3803	40430	11.297	0.5628	0.4228	25.64
Thomas Hill	MB2	5/31/2022	24	6839	68378.7	8.526	0.2509	0.1109	11.37
Thomas Hill	MB2	6/1/2022	24	6864	69091.6	3.488	0.101		
Thomas Hill	MB2	6/2/2022	24	6717	67357.6	3.434	0.1019		
Thomas Hill	MB2	6/3/2022	24	6850	68217	3.869	0.1133		
Thomas Hill	MB2	6/4/2022	24	6879	67841.6	3.583	0.1056		
Thomas Hill	MB2	6/5/2022	24	6888	67455	3.242	0.0961		
Thomas Hill	MB2	6/6/2022	24	6888	67470.1	3.464	0.1027		
Thomas Hill	MB2	6/7/2022	24	6869	67855.1	3.587	0.1057		
Thomas Hill	MB2	6/8/2022	24	6888	68306.5	3.614	0.1058		
Thomas Hill	MB2	6/9/2022	24	6799	67297.9	3.509	0.1042		
Thomas Hill	MB2	6/10/2022	24	6868	67974.1	3.355	0.0987		
Thomas Hill	MB2	6/11/2022	24	6869	67213.5	3.477	0.1035		
Thomas Hill	MB2	6/12/2022	24	6744	65875.1	3.404	0.1032		
Thomas Hill	MB2	6/13/2022	24	6922	67424	2.979	0.0885		
Thomas Hill	MB2	6/14/2022	24	6954	67803	2.745	0.081		
Thomas Hill	MB2	6/15/2022	23.98	6952.2	68204.278	3.082	0.0904		
Thomas Hill	MB2	6/16/2022	24	6956	68488.3	3.835	0.112		
Thomas Hill	MB2	6/17/2022	24	6845	68181.5	4.121	0.1205		
Thomas Hill	MB2	6/18/2022	24	6903	68963.8	5.288	0.1538	0.0138	1.43
Thomas Hill	MB2	6/19/2022	24	6902	69010.9	3.83	0.111		
Thomas Hill	MB2	6/20/2022	24	6912	69746.1	4.33	0.1245		
Thomas Hill	MB2	6/21/2022	24	6846	68208.1	4.123	0.121		
Thomas Hill	MB2	6/22/2022	24	6864	68218.1	3.323	0.0974		
Thomas Hill	MB2	6/23/2022	24	6864	67498.7	3.328	0.0986		
Thomas Hill	MB2	6/24/2022	24	6864	67521.5	3.489	0.1033		
Thomas Hill	MB2	6/25/2022	24	6865	67320	2.682	0.0797		
Thomas Hill	MB2	6/26/2022	24	6676	66737.9	2.879	0.0858		
Thomas Hill	MB2	6/27/2022	24	6862	68817.6	2.897	0.0842		
Thomas Hill	MB2	6/28/2022	24	6717	66811.5	2.954	0.0885		
Thomas Hill	MB2	6/29/2022	24	6508	64817.3	2.838	0.0868		
Thomas Hill	MB2	6/30/2022	24	6549	64801.8	2.883	0.0888		
Thomas Hill	MB2	7/1/2022	19.73	5281.75	52236.802	2.07	0.078		
Thomas Hill	MB2	7/2/2022	18.23	1588	18388.88	4.565	0.3878	0.2478	6.84

Thomas Hill	MB2	7/3/2022	24	6627	67230.1	3.159	0.0965		
Thomas Hill	MB2	7/4/2022	24	6864	67918.6	2.335	0.0688		
Thomas Hill	MB2	7/5/2022	24	6863	67534.5	2.748	0.0814		
Thomas Hill	MB2	7/6/2022	24	6864	68049.5	2.904	0.0853		
Thomas Hill	MB2	7/7/2022	24	6785	67913.6	3.019	0.0889		
Thomas Hill	MB2	7/8/2022	24	6723	67432.9	2.84	0.0843		
Thomas Hill	MB2	7/9/2022	24	6768	68288.3	2.574	0.0754		
Thomas Hill	MB2	7/10/2022	24	6301	63519.4	2.175	0.0675		
Thomas Hill	MB2	7/11/2022	24	6566	65528.1	2.444	0.0754		
Thomas Hill	MB2	7/12/2022	24	6863	68318	2.765	0.081		
Thomas Hill	MB2	7/13/2022	24	6773	67576.7	2.9	0.0856		
Thomas Hill	MB2	7/14/2022	24	6850	68221.3	2.604	0.0763		
Thomas Hill	MB2	7/15/2022	24	6869	67763.7	2.265	0.0668		
Thomas Hill	MB2	7/16/2022	24	6888	68290.8	2.587	0.0758		
Thomas Hill	MB2	7/17/2022	24	6866	68282.6	2.792	0.0818		
Thomas Hill	MB2	7/18/2022	24	6784	67608.3	2.509	0.0743		
Thomas Hill	MB2	7/19/2022	24	6524	64819.9	2.261	0.0693		
Thomas Hill	MB2	7/20/2022	24	6634	65897.5	2.446	0.0741		
Thomas Hill	MB2	7/21/2022	24	6766	67361.4	2.355	0.0699		
Thomas Hill	MB2	7/22/2022	24	6733	66791.6	2.502	0.0748		
Thomas Hill	MB2	7/23/2022	24	6151	61892	2.216	0.0704		
Thomas Hill	MB2	7/24/2022	24	6748	67076.8	2.49	0.0743		
Thomas Hill	MB2	7/25/2022	24	6419	64775.4	2.558	0.0785		
Thomas Hill	MB2	7/26/2022	24	6564	65766.2	2.698	0.082		
Thomas Hill	MB2	7/27/2022	24	6530	65371.6	2.793	0.0855		
Thomas Hill	MB2	7/28/2022	24	6467	64867.5	2.621	0.0807		
Thomas Hill	MB2	7/29/2022	24	6415	64432.1	2.629	0.0814		
Thomas Hill	MB2	7/30/2022	24	6526	65476.2	2.841	0.0868		
Thomas Hill	MB2	7/31/2022	24	6504	64983.2	2.84	0.0874		
Thomas Hill	MB2	8/1/2022	24	6410	63881.5	2.731	0.0854		
Thomas Hill	MB2	8/2/2022	24	6300	62822.9	2.563	0.0811		
Thomas Hill	MB2	8/3/2022	24	6481	64356.5	2.509	0.078		
Thomas Hill	MB2	8/4/2022	24	6504	65041.2	2.571	0.079		
Thomas Hill	MB2	8/5/2022	24	6498	65074.7	2.519	0.0774		

Thomas Hill	MB2	8/6/2022	24	6309	63170.2	2.631	0.083		
Thomas Hill	MB2	8/7/2022	24	5996	60669.1	2.541	0.0826		
Thomas Hill	MB2	8/8/2022	24	6433	64656	2.686	0.0831		
Thomas Hill	MB2	8/9/2022	24	6400	64553	2.876	0.0891		
Thomas Hill	MB2	8/10/2022	24	6321	64003.6	2.832	0.0884		
Thomas Hill	MB2	8/11/2022	24	6384	64438	2.746	0.0852		
Thomas Hill	MB2	8/12/2022	24	6384	64375.3	2.682	0.0833		
Thomas Hill	MB2	8/13/2022	24	6384	63993.1	2.793	0.0873		
Thomas Hill	MB2	8/14/2022	24	5961	60403.2	2.746	0.0903		
Thomas Hill	MB2	8/15/2022	24	6136	62106.6	2.738	0.088		
Thomas Hill	MB2	8/16/2022	24	6238	63198.2	3.142	0.0994		
Thomas Hill	MB2	8/17/2022	24	6178	62520.3	3.204	0.1025		
Thomas Hill	MB2	8/18/2022	24	6135	62021.1	3.097	0.0998		
Thomas Hill	MB2	8/19/2022	24	6192	61968.2	2.959	0.0955		
Thomas Hill	MB2	8/20/2022	24	6192	61955.3	3.073	0.0992		
Thomas Hill	MB2	8/21/2022	24	6192	62242.2	3.119	0.1003		
Thomas Hill	MB2	8/22/2022	24	6192	62463.1	2.9	0.0929		
Thomas Hill	MB2	8/23/2022	24	6192	62442.5	3.126	0.1001		
Thomas Hill	MB2	8/24/2022	24	6192	62377.3	3.153	0.1011		
Thomas Hill	MB2	8/25/2022	24	6135	61777.3	3.156	0.1021		
Thomas Hill	MB2	8/26/2022	24	6150	62137.6	2.859	0.092		
Thomas Hill	MB2	8/27/2022	24	6129	61684	2.978	0.0965		
Thomas Hill	MB2	8/28/2022	24	5705	57704.2	2.48	0.0856		
Thomas Hill	MB2	8/29/2022	24	6048	60856.8	2.952	0.097		
Thomas Hill	MB2	8/30/2022	24	6048	61294.3	3.051	0.0995		
Thomas Hill	MB2	8/31/2022	24	5992	61232.4	2.915	0.0951		
Thomas Hill	MB2	9/1/2022	24	6047	61680.4	3.158	0.1024		
Thomas Hill	MB2	9/2/2022	24	6026	61197.1	3.209	0.1049		
Thomas Hill	MB2	9/3/2022	24	5985	61147.6	3.16	0.1033		
Thomas Hill	MB2	9/4/2022	24	5945	60523	3.016	0.0997		
Thomas Hill	MB2	9/5/2022	24	5906	60047.8	3.151	0.105		
Thomas Hill	MB2	9/6/2022	24	5874	60169.1	3.094	0.1029		
Thomas Hill	MB2	9/7/2022	24	5856	59807.5	3.073	0.1028		
Thomas Hill	MB2	9/8/2022	24	5808	59365.9	3.313	0.1116		

Thomas Hill	MB2	9/9/2022	24	5856	59662.9	3.388	0.1136		
Thomas Hill	MB2	9/10/2022	24	5799	59210.3	3.175	0.1073		
Thomas Hill	MB2	9/11/2022	24	5738	58261.3	3.177	0.1099		
Thomas Hill	MB2	9/12/2022	24	5749	57717.1	4.416	0.1525	0.0125	1.08
Thomas Hill	MB2	9/13/2022	24	5363	54642.1	2.663	0.096		
Thomas Hill	MB2	9/14/2022	24	5572	56489.4	2.666	0.0938		
Thomas Hill	MB2	9/15/2022	24	5157	52935.6	2.203	0.0815		
Thomas Hill	MB2	9/16/2022	24	5433	55212.3	2.281	0.0816		
Thomas Hill	MB2	9/17/2022	24	5693	57318.3	2.618	0.0911		
Thomas Hill	MB2	9/18/2022	24	5808	57959.4	2.631	0.0908		
Thomas Hill	MB2	9/19/2022	24	5184	52918.9	2.304	0.086		
Thomas Hill	MB2	9/20/2022	24	4621	48425.7	7.008	0.2714	0.1314	9.54
Thomas Hill	MB2	9/21/2022	24	4380	46304.7	10.654	0.4564	0.3164	21.98
Thomas Hill	MB2	9/22/2022	24	6638	67026.6	17.687	0.5259	0.3859	38.80
Thomas Hill	MB2	9/23/2022	24	6074	61117.9	16.094	0.5336	0.3936	36.08
Thomas Hill	MB2	9/24/2022	0.25	5.25	100.875	0.028	0.556	0.416	0.06
Thomas Hill	MB2	9/25/2022	0						
Thomas Hill	MB2	9/26/2022	0						
Thomas Hill	MB2	9/27/2022	0						
Thomas Hill	MB2	9/28/2022	0						
Thomas Hill	MB2	9/29/2022	0						
Thomas Hill	MB2	9/30/2022	0						
									815

DECLARATION OF JAMES E. STAUDT, PH.D., CFA

I, James E. Staudt, make the following declaration under penalty of perjury that the following is true to the best of my knowledge, information and belief:

1. I am an engineer with a Chartered Financial Analyst (CFA) designation with decades of experience in all aspects of energy and air pollution control in the electricity generation (EGU) and non-EGU industrial sector, as reflected in my CV attached hereto as Exhibit 1. My graduate studies at MIT included research in combustion (how nitrogen oxide (NOx) is formed). I have been an expert on NOx emissions control since early in my career, at least since 1988 when I was a manager at Fuel Tech, a NOx control technology company and later as a manager of Research Cottrell's NOx control business. I have personally developed, designed, supplied, commissioned, and advised on NOx control technology utilized in the EGU and non-EGU sectors. I have written numerous publications, reports for clients, and other documents on NOx control technology for EGU and non-EGU applications. I have also published documents on the engineering and economic factors that impact the deployment of air pollution controls and the resources needed to meet regulatory requirements.

2. As a consultant, I have also advised facility owners, state and federal agencies, and suppliers of NOx control technology on the technical performance, cost, and application of NOx control technology to both non-EGU and EGU facilities. Some specific, relevant experience includes advising Illinois EPA on NOx Reasonable Available Control Technology (RACT) for Reciprocating Internal Combustion Engines (RICE) and for Industrial Sources in 2007-2009, preparing the Northeast States Coordinated Air Use Management's (NESCAUM's) Status Report on NOx: Control Technologies and Cost Effectiveness for Industrial Boilers, Gas Turbines, IC Engines and Cement Kilns in 2000, advising US EPA Region 9 on their

Regional Haze BART analyses, numerous assorted projects for US EPA and other clients with regard to Portland cement kilns, pulp and paper boilers, iron and steel facilities, and other non-EGU facilities.

3. With this background, I offer the following opinions regarding the finalized US EPA Good Neighbor Plan for the 2015 Ozone NAAQS.

I. EACH INDUSTRY CAN INSTALL THE NECESSARY CONTROLS AND COMPLY WITH THE REQUIRED EMISSIONS LIMITS

4. This opinion is supported by the following points:

- The technologies identified by EPA are technologies that have been widely applied in industry for the sources in the rule.
- The emission limits are consistent with what these technologies have been proven to achieve in practice.
- The rule provides flexibility in how to comply.

A. The technologies identified by EPA are technologies that have been widely applied in industry.

5. Table 1 is from the March 13, 2023 memo, "Summary of Final Rule Applicability Criteria and Emissions Limits for Non-EGU Emissions Units, Assumed Control Technologies for Meeting the Final Emissions Limits, and Estimated Emissions Units, Emissions Reductions, and Costs". This table identifies the technologies EPA assumed to be applied to meet the objectives of the rule. Having worked in the field of NOx control for decades, I am familiar with each of these industrial applications and NOx control methods, and I can state that these technologies have been commercially available and have been deployed in these applications for decades. For example, Selective non-catalytic reduction (SNCR) has been used in cement kilns and municipal waste combustors at least since the early 2000s. It has been used in solid fueled industrial boilers (including coal) since

the 1990s. Non-selective catalytic reduction (NSCR) has been widely used on rich-burn reciprocating internal combustion engines since the 1990s, or earlier. Selective Catalytic Reduction (SCR) has been deployed on lean-burn reciprocating internal combustion engines since the 2000s or perhaps earlier. Low NOx burners were being deployed in iron and steel furnaces and boilers fifteen years ago, when I worked with Illinois EPA on a steel mill facility in around 2008. The use of the technologies that EPA assumed could be deployed for each of these cases is easily demonstrated by a search of the EPA's RACT/BACT/LAER Clearinghouse (RBLC),[1] which shows permitted levels by source type, frequently shows the technology being used, and in some cases the results of any economic analysis.

6. Even technologies that may be identified as newer technologies, like Advanced Selective Non-catalytic Reduction (ASNCR) and LN (Low NOx combustion) and SNCR for municipal waste combustors for example, are more evolved versions of technologies that have been in use for decades in that application. Low NOx combustion and SNCR have been in use in municipal waste combustors for decades. Similarly, the technologies that are assumed for the other applications have been used extensively. The technologies used for RICE – Non-selective Catalytic Reduction (NSCR) for rich-burn engines and SCR or combustion control methods for lean-burn engines – have been available and deployed in these applications for many years. SNCR has been widely deployed at Portland cement facilities. Low NOx burners have been deployed for many years in furnaces and boilers used in all of the industries identified in Table 1. Low NOx burners, SNCR and SCR have been widely used in boilers using a range of fuels.

7. Because of the extensive amount of experience with these technologies, industry knows how to deploy them and operate them. There is also enough

[1] https://cfpub.epa.gov/rblc/index.cfm?action=Search.BasicSearch&lang=en.

experience with these control methods to reliably predict the performance of these technologies, which leads to the next point.

Table 1. Summary of Non-EGU Industries, Emissions Unit Types, Assumed Control Technologies that Meet Final Emissions Limits

Industry	Emissions Unit Type	Assumed Control Technologies that Meet Final Emissions Limits
Pipeline Transportation of Natural Gas	Reciprocating Internal Combustion Engines	Layered Combustion (2-cycle Lean Burn)[a] SCR (4-cycle Lean Burn) NSCR (4-cycle Rich Burn)
Cement and Concrete Product Manufacturing	Kilns	SNCR
Iron and Steel Mills and Ferroalloy Manufacturing	Reheat Furnaces	LNB
Glass and Glass Product Manufacturing	Furnaces	LNB
Iron and Steel Mills and Ferroalloy Manufacturing Metal Ore Mining Basic Chemical Manufacturing Petroleum and Coal Products Manufacturing Pulp, Paper, and Paperboard Mills	Boilers	LNB + FGR (Natural Gas, No Coal or Oil) SCR (Any Coal, Any Oil)
Solid Waste Combustors and Incinerators	Combustors or Incinerators	ANSCR[b] LN[tm] and SNCR [b,c]

[a] Several emissions units, or engines, in the 2019 inventory had Source Classification Codes (SCC) indicating that the units were reciprocating without specifying the type of engine. We assumed NSCR or layered combustion as the control for these emissions units.
[b] *Municipal Waste Combustor Workgroup Report*, prepared by the Ozone Transport Commission Stationary and Area Sources Committee, Revised April 2022.
[c] Covanta has developed a proprietary low NOx combustion system (LN^{TM}) that involves staging of combustion air. The system is a trademarked system and Covanta has received a patent for the technology.

B. The emission limits are consistent with what these technologies have been proven to achieve in practice.

8. The Technical Support Document prepared by EPA for the rule describes how EPA established emissions limits for the various source categories, and the emission limits in the rule are shown in Table 2, which is from a Technical Memorandum[2] also prepared for the rule. EPA gave strong, supporting information to demonstrate that the emissions levels are achievable. For example, EPA stated that some of the Ozone Transport Region (OTR) states already had emission limits

[2] US EPA Technical Memorandum, *Summary of Final Rule Applicability Criteria and Emissions Limits for Non-EGU Emissions Units, Assumed Control Technologies for Meeting the Final Emissions Limits, and Estimated Emissions Units, Emissions Reductions, and Costs*, March 15, 2023.

that were as stringent or more stringent than what is in the final Good Neighbor Rule. It is also possible to verify these emissions levels by review of the RBLC, which I have done and EPA stated that they did.

Table 2. Summary of Non-EGU Industries, Emissions Unit Types, Form of Final Emission Limits, and Final Emissions Limits[3]

Pipeline Transportation of Natural Gas

Engine type and fuel	NO_X emissions limit (g/hp-hr)
Natural Gas Fired Four Stroke Rich Burn	1.0
Natural Gas Fired Four Stroke Lean Burn	1.5
Natural Gas Fired Two Stroke Lean Burn	3.0

Cement and Concrete Products

Kiln type	NO_X emissions limit (lb/ton of clinker)
Long Wet	4.0
Long Dry	3.0
Preheater	3.8
Precalciner	2.3
Preheater/Precalciner	2.8

Iron and Steel Mills, Ferralloy Manufacturing.

Emissions unit	NO_X emissions standard or requirement (lb/mmBtu)
Reheat furnace	Test and set limit based on installation of Low-NO_X Burners.

Glass

Furnace type	NO_X emissions limit (lb/ton of glass produced)
Container Glass Manufacturing Furnace	4.0
Pressed/Blown Glass Manufacturing Furnace or Fiberglass Manufacturing Furnace	4.0
Flat Glass Manufacturing Furnace	7.0

Industrial boilers

Unit type	Emissions limit (lbs NO_X/mmBtu)
Coal	0.20
Residual oil	0.20
Distillate oil	0.12
Natural gas	0.08

Solid Waste Combustors and Incinerators

Combustor or incinerator, averaging period	NO_X emissions limit (ppmvd)
ppmvd on a 24-hour block averaging period	110
ppmvd on a 30-day rolling averaging period	105

[3] Federal Register / Vol. 88, No. 107 / Monday, June 5, 2023 / Rules and Regulations, pp. 36664-5

9. In fact, in some cases less expensive technologies than what is assumed in the analysis can be used to achieve the rule's emissions rates. For example, depending upon the fuel type and furnace design, it may not be necessary to use SCR to achieve below 0.20 lb/MMBtu on a coal-fired boiler. There are coal-fired electric utility boilers that burn Powder River Basin coal and achieve well under 0.20 lb/MMBtu solely with combustion controls. Circulating fluidized bed (CFB) boilers, which are very common for industrial applications, that operate on any coal, typically have emissions below 0.015 lb/MMBtu. Controls for CFBs may include with SNCR, but SCR is not necessary on a CFB to achieve below 0.15 lb/MMBtu. Therefore, I expect that many coal-fired industrial boilers will achieve under 0.20 lb/MMBtu with less costly controls than SCR, such as low NOx combustion methods perhaps in combination with SNCR.

C. The rule provides flexibility on how to comply.

10. For example, the rule allows facility-wide emission averaging for natural gas pipeline applications, which will reduce the number of engines that actually need to be retrofitted. In the rule, EPA also incorporated provisions for low use boilers and engines, etc., which will also reduce the number of units that must be retrofitted.

11. The rule does not mandate a specific technology. For the purpose of estimating the cost of the rule in a given application, EPA assumed the technologies in Table 1 which will achieve the rule's emissions rate. However, it is understood that some facilities may not select the technology assumed by EPA because a facility owner may find another approach that may be less expensive and will enable them to meet the requirements of the rule. As previously noted, in some cases other technologies may provide adequate NOx reduction to meet the limits in the rule.

12. In addition, the rule offers a process that may allow sources to have an additional year for compliance. Therefore, if a facility makes a good-faith effort to comply with the rule, but cannot, there is the ability to get a one-year extension.

II. EPA DID NOT UNDERESTIMATE COSTS FOR NON-EGU CONTROLS, AND ANY NEAR-TERM COSTS (PARTICULARLY IN 2023/24) WILL BE MANAGEABLE/MINIMAL AND NOT THREATEN THE CONTINUED EXISTENCE OF THESE BUSINESSES.

13. This opinion is supported by the following points:

- EPA selected the correct emissions control technologies for the applicable sources.
- EPA used a proven and accepted tool to evaluate the costs.
- Most costs are realized later in the project. So, there will be little cost incurred in the first year after the rule is issued.

A. EPA selected the correct emissions control technologies for the applicable source.

14. As noted earlier, the technologies that EPA identified for the various source types are technologies that have been deployed in these applications to achieve the emission reductions needed for the rule, or even lower emission levels. The Technical Support Document (TSD) discusses the technologies identified for each source type and the supporting information for the level of emission control in each case.

15. As noted earlier, in some cases less expensive methods than assumed in EPA's analysis may prove adequate to provide the emission reductions needed to meet the emissions limits of the rule.

B. EPA did not underestimate the costs.

16. For the proposal, EPA used its CoST tool for estimating the costs of controls for specific applications. This is a well-established tool that was developed for the purpose of estimating the cost of emission reductions for different technologies. It is widely used by regulatory agencies to assist them in estimating

the cost of controlling air pollution. However, for the final rule, EPA used a control measures database (CMDB) that could be integrated with the database of emission sources using a computer program to develop an estimate.

17. The methodology EPA used to estimate costs for the final rule is described in a Technical Memorandum.[4] EPA developed an emissions inventory of the units impacted by the final rule from the Emission Inventory System (EIS – a database of emission sources based upon input from states) as well as a list of municipal waste combustors and incinerators. They examined permits and made any updates to the inventory and determined the units that would need control.

18. As described in their technical memorandum EPA made a careful analysis by source category codes (SCCs) with information from permits and made adjustments where they found information in the permits that made them determine that information in the record was inconsistent with the SCC in the CMDB. Table 3 summarizes the number of units by industry and source type and the assumed control technology used to develop cost, and Table 4 shows the average estimated cost per ton. Both tables are from EPA's Technical Memorandum.

[4] US EPA Technical Memorandum, *Summary of Final Rule Applicability Criteria and Emissions Limits for Non-EGU Emissions Units, Assumed Control Technologies for Meeting the Final Emissions Limits, and Estimated Emissions Units, Emissions Reductions, and Costs*, March 15, 2023.

Table 3. Summary of Non-EGU Industries, Emissions Unit Types, Assumed Control Technologies that Meet Final Emissions Limits, Estimated Number of Control Installations

Industry/Industries	Emissions Unit Type	Assumed Control Technologies that Meet Final Emissions Limits	Estimated Number of Units Per Assumed Control
Pipeline Transportation of Natural Gas	Reciprocating Internal Combustion Engines	NSCR or Layered Combustion (Reciprocating)	323
		Layered Combustion (2-cycle Lean Burn)	394
		SCR (4-cycle Lean Burn)	158
		NSCR (4-cycle Rich Burn)	30
Cement and Concrete Product Manufacturing	Kiln	SNCR	16
Iron and Steel Mills and Ferroalloy Manufacturing	Reheat Furnaces	LNB	19
Glass and Glass Product Manufacturing	Furnaces	LNB	61
Iron and Steel Mills and Ferroalloy Manufacturing	Boilers	LNB + FGR (Natural Gas, No Coal or Oil)	151
Metal Ore Mining		SCR (Any Coal, Any Oil)	15
Basic Chemical Manufacturing Petroleum and Coal Products Manufacturing			
Pulp, Paper, and Paperboard Mills			
Solid Waste Combustors and Incinerators[a]	Combustors or Incinerators	ANSCR	57
		LN™ and SNCR	4
	Total		1,228

[a] Twelve MWCs have existing controls, and we estimated these units will use more reagent in those controls to meet the final emissions limits.

Table 4. Summary of Non-EGU Industries, Emissions Unit Types, Assumed Control Technologies, Estimated Average Cost/Ton (2016$)

Industry/Industries	Emissions Unit Type	Assumed Control Technologies that Meet Final Emissions Limits	Average Cost/Ton Values (2016$)
Pipeline Transportation of Natural Gas	Reciprocating Internal Combustion Engine	NSCR or Layered Combustion, Layered Combustion, SCR, NSCR	4,981
Cement and Concrete Product Manufacturing	Kiln	SNCR	1,632
Iron and Steel Mills and Ferroalloy Manufacturing	Reheat Furnaces	LNB	3,656
Glass and Glass Product Manufacturing	Furnaces	LNB	939
Iron and Steel Mills and Ferroalloy Manufacturing	Boilers	SCR or LNB + FGR	8,369
Metal Ore Mining			14,595
Basic Chemical Manufacturing			11,845
Petroleum and Coal Products Manufacturing			14,582
Pulp, Paper, and Paperboard Mills			14,134
Solid Waste Combustors and Incinerators	Combustors or Incinerators	ANSCR or LN™ and SNCR[a]	7,836
		Overall Average Cost/Ton	5,339

19. Based upon my experience with NOx controls and performing cost estimates for the purpose of estimating cost effectiveness, these costs are consistent with what I would expect. I am satisfied that the methodology that EPA used should result in a reasonable, if not conservatively high, estimate of the costs to comply with the rule.

C. Most costs are realized later in the project. So, there will be little cost incurred in the first year after the rule is issued.

20. I have personally been involved in the deployment of air pollution control systems at industrial sites. I worked for several years as a technology supplier. Later in my consulting practice, I advised industrial clients who deployed air pollution control technologies. As such, I am very familiar with how these projects are executed and how the costs are realized over the course of a project.

21. Air pollution control projects are conducted over a period of time where the greatest costs are realized in the latter portion of the project. Before any equipment can be ordered, it is necessary to perform sufficient engineering to ensure that equipment that will be ordered is specified correctly. For this reason, in the first months to a year, most of the costs will be associated with engineering and permitting, which are generally a small portion – perhaps ten percent or so – of a total project cost. Costs start to increase with procurement and especially as equipment and installation material arrives on site. Then, installation costs will increase further as installation labor installs equipment. As a result, most of the costs in the first year of a project will be a small portion of the total costs. The greatest costs are realized later in the project as equipment is procured, fabricated, delivered, installed and commissioned. Therefore, the businesses that need to install control technologies will not experience significant expenses in the first year after promulgation of the rule. Furthermore, my experience over these decades is that most facility owners delay expenses as long as possible since they generally don't

realize a financial benefit by acting sooner. So, I would expect that most expenditures will be in the final year before the emission limits must be met.

III. 2026 IS AN ACHIEVABLE TIMELINE TO INSTALL CONTROLS, AND THERE ARE ADEQUATE RESOURCES/SUPPLY FOR INSTALLING CONTROLS (PLUS EPA PROVIDES ADDITIONAL FLEXIBILITY FOR NON-EGUS THAT EXPERIENCE HARDSHIP).

22. This is supported by the following points:

- The time frame for deploying these projects is within the allotted time for the rule.
- Experience has shown that, while industry commonly claims that resources will not be available, it is consistently the case that they are.
- The rule permits an additional year if a company needs it.

A. The time frame for deploying these projects is well within the allotted time for the rule.

23. The rule requires controls to be in place prior to the 2026 ozone season, or just over three years from finalization of the rule. EPA conducted an evaluation of the time frame to deploy the various technologies. EPA engaged SC&A, Inc. to prepare a report, *NOx Emission Control Technology Installation Timing for Non-EGU Sources.* This report examined the timing for installation of various control technologies that would be applicable to the different non-EGU sources under the rule. The study showed the estimated number of installations, the number of months per installation, and the installation timeline in the event that there was a supply chain delay. The supply chain delay presumed a degree of limited resources based upon experience at the time during the COVID pandemic.

24. Being familiar with each of these technologies, and being familiar with execution of these projects, I can say that the estimates for execution of these projects

under normal circumstances appear reasonable, if anything on the long side, to me. All estimates are within a three-year period.

25. For most of the technologies, installations would be completed well within three years even under the supply chain delay scenario. In each case the projects could be executed in time under the normal estimated time to install. The only situations where EPA's contractor estimated that the time to install the technology on all facilities exceeded 36 months was in the case of supply chain delays for SNCR on Cement and Concrete Product Manufacturing, Layered Combustion or NSCR for RICE in pipeline transmission, SCR for non-EGU boilers and ASNCR for municipal waste combustors.

26. SNCR was identified as a technology that would be adversely impacted by supply chain issues. This was the case for both Cement and Concrete Products and Municipal Waste Combustion. It's important to keep in mind that an SNCR system is comprised of pumps, piping tanks, control equipment and injectors. Except for the injectors, the equipment is fairly standard equipment used in industry, and the injectors can be fabricated in numbers in a relatively short period of time by the large, industrial atomization system suppliers that supply a wide array of industries. Yet EPA's contractor determined that the SNCR suppliers might be constrained by the ability to manage a certain number of projects at a time. I don't believe that the SNCR suppliers will be constrained to the point where it would impact the ability of the industry to comply with the rule, as I will describe below.

27. Notably, the supply chain limited scenario was based upon the resources that were available at the point in time of the study, which will certainly change and are improving. I will provide some historical context. Since I have personally been involved in the design and deployment of SNCR systems on both EGU and non-EGU applications, I am deeply familiar with this technology and what is entailed in deploying it. EGU SNCR applications are an order of magnitude more

complex in scale and difficulty than non-EGU applications. There are many more injectors and injection levels, there are much larger pieces of equipment, and the challenges in designing the process for the narrow temperature window for SNCR in a coal fired EGU is much more difficult because EGU's vary load more frequently and over a wider range than industrial boilers, cement kilns, or MWCs. Yet, despite the much higher difficulty of these EGU projects, 25 coal-fired EGUs commissioned SNCR systems in 2005. Figure 1 is a graphical depiction of data from US EPA's National Electric Energy Database System (NEEDS) v5.15, and shows the number of SNCR systems placed online from the units included in that database. As shown, there was a rapid ramp up in deployments that peaked in 2005. The SNCR suppliers (of which there were only two significant suppliers in 2005) were able to respond very quickly to a rapid increase in demand. I can recall that they significantly increased their staffing to execute these projects, and they were able to do it. Simply put, experience in 2002 was a poor indication of what was possible in 2005, and I would argue that the state of the industry in 2022 may not be a good indicator of what can be done in 2025. As a result, I believe that it is likely that today's suppliers could also rapidly increase their ability to supply the market with SNCR systems, and I believe that the estimates for the supply chain limited scenarios will prove to be far too long.

Figure 1. Number of coal EGU SNCR systems by online date. From NEEDS v5.15

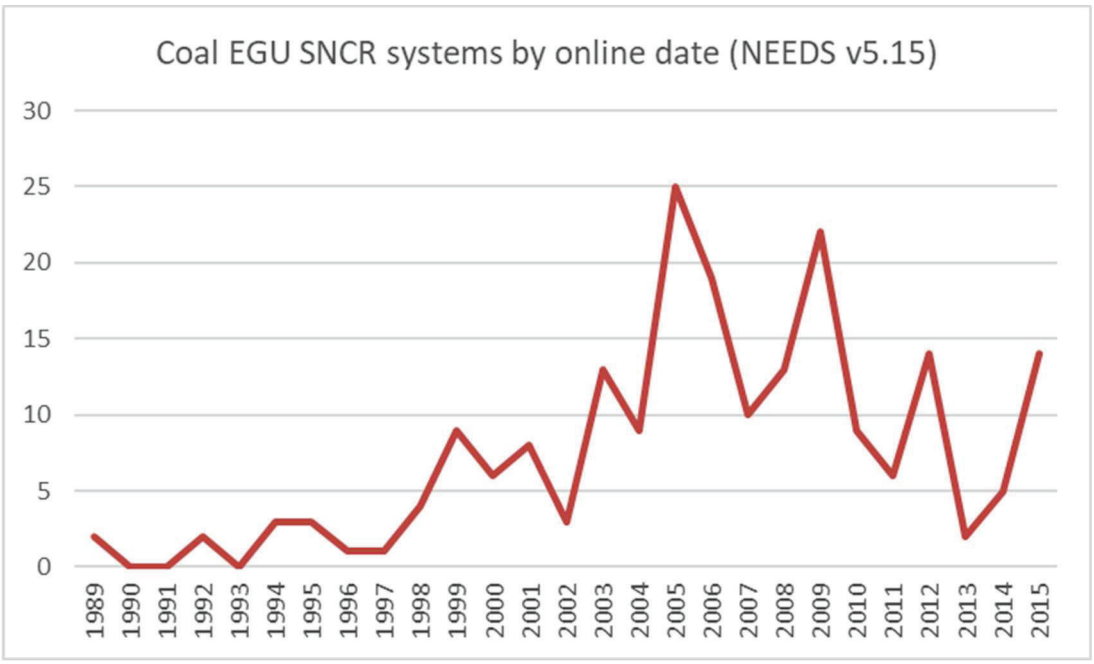
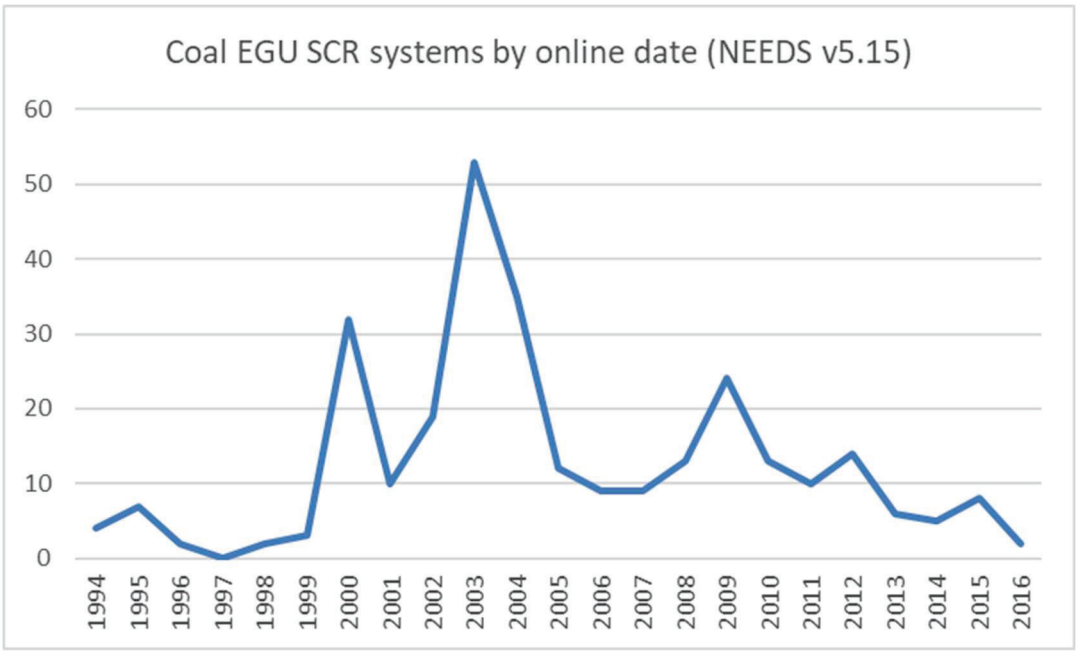


Figure 2 Number of coal EGU SCR systems by online date. From NEEDS v5.15



28. The analysis of time to install prepared for EPA also identified non-utility SCRs as a potential area for delay. Figure 2 is similar to Figure 1, except it shows installations of SCRs on coal fired EGUs. I'm also very familiar with SCR systems. The only specialized piece of equipment for SCR systems is the catalyst. There is lots of steel and other more generic material or hardware, but catalyst is really the only equipment that is unique to this application. Electric utility SCR systems, which require far more catalyst per project than non-EGU applications (probably around ten times as much on average because the boilers are much larger), were completed at a very rapid pace in the early 2000's, peaking at over 50 units being put online in 2003. This demonstrates why I would not envision catalyst or any other resources to be limiting for non-EGU SCR systems.

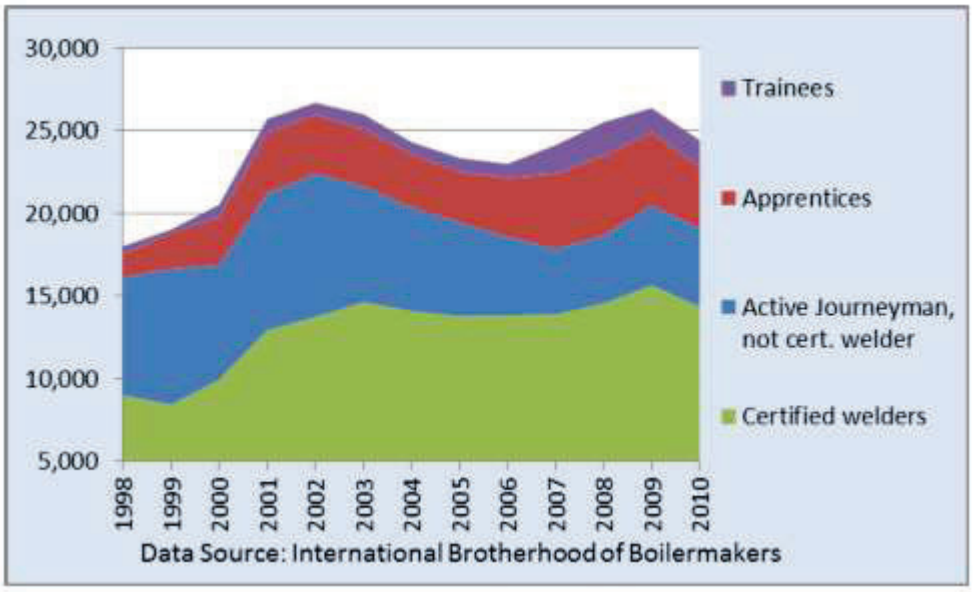
29. The other application where EPA's contractor identified a possible supply chain constraint was related to RICE engines that might utilize layered combustion. Many of these units that might use layered combustion could alternatively use NSCR. NSCR is a very widely used technology, and even gasoline motor vehicles use NSCR. NSCR was not identified as the limiting technology, and I would not expect that because NSCR catalyst is made for a large market of equipment. Specialized labor and equipment was identified for layered combustion, and EPA's contractor acknowledged that many of these engines could install NSCR. Therefore, gas pipeline transmission companies who cannot install the layered combustion in time have two options: 1) to install NSCR, or; 2) they may be able to average their emissions at a site per the averaging provisions of the rule. In fact, EPA determined that many RICE engines at natural gas transmission facilities may not even require any retrofit because of the provisions in the rule to allow averaging at a site.

B. Experience has shown that, while industry commonly claims that resources will not be available, it is consistently the case that they are.

30. The prior section explains why I believe that the rule can be met in time for 2026 ozone season compliance. It is important to note that, while the installation data of Figures 1 and 2 are accepted and irrefutable historical data, when the rules that motivated those SNCR and SCR installations were being developed, and even after they were finalized, the EGU industry argued that the resources were not available to comply with the rules. Arguments were made about the availability of SCR catalyst, and even the availability of labor to install the equipment. However, the market for equipment and for labor responded to install the equipment, and the EGU industry complied with the rules. As a result, I am confident that the non-EGU industries impacted by this rule will also be able to meet the requirements of the rule.

31. I will also provide an example for labor that relates to the prior two examples. Boilermakers are skilled laborers who play a key role in the installation of equipment on boilers of all sorts. They were essential for the installation of the SCRs that peaked around 2003 and for scrubbers that peaked in installation after that. In the 1990s the number of boilermakers dwindled as a result of low EGU construction activities. But, as Figure 3 shows, construction boilermaker membership grew quickly between 1998 and 2002 as demand for boilermakers increased to meet the needs for coal EGU retrofits of SCR as well as rapid increases in the installation of gas-fired EGUs. This response in labor supply to demand demonstrates that the supply of labor responded well to the increase in demand over that period of time, and that arguments that the resources wouldn't be available based upon boilermaker membership in the 1990s proved to be wrong. For this reason, I expect that the market will respond to the demand for skilled labor and resources that may result from this rule.

Figure 3. Construction Boilermaker Membership[5]



32. So, at this point in time, I have no reason to believe that the air pollution control industry will be unable meet the demands of this rule in a timely manner. I am confident that the resources will be there, and the equipment will be installed on time.

C. The rule permits an additional year if a company needs it.

33. EPA has incorporated a provision in the rule to allow companies that make a good-faith effort to install controls the opportunity to have a one-year extension in the event that circumstances prevent them from installing the equipment on time.

[5] Staudt, J., "Engineering and Economic Factors Affecting the Installation of Control Technologies– An Update", for US EPA Clean Air Markets Division, December 15, 2011, page 13, available at: https://www.andovertechnology.com /wp-content/uploads/2020/07/9_2002_Update_12152011.pdf.

IV. NON-EGU SOURCES EMIT LARGE AMOUNTS OF NOX, AND ARE THEREFORE IMPORTANT FOR IMPROVEMENT OF AIR QUALITY

34. Electric utilities have been reducing their emissions for years due to deployment of controls on EGUs and retirement of older, more polluting EGUs. As a result, non-EGU emissions have become much more important in the overall scheme of NOx emissions. According to Table ES-4 of the Regulatory Impact Analysis for the rule, in 2019 there were over 302,000 tons of NOx emitted from non-EGU sources during the 2019 ozone season. This rule is estimated to reduce non-EGU ozone season NOx emissions by nearly 45,000 tons. By comparison, the total ozone season NOx emissions from the EGU sector for 2023 in the Base Case is about 230,000 tons in the 22 affected states[6] - about two thirds that of the non-EGU emissions. The rule is estimated to reduce EGU ozone season NOx emissions by about 25,000 tons – about half that of the non-EGU emissions reductions.

35. To put the non-EGU emissions reductions in perspective, I have estimated how many coal-fired EGUs would be necessary to emit the same amount of pollution. The majority of coal-fired EGU capacity is equipped with SCR. A 600 MW coal-fired electric utility boiler equipped with SCR may emit roughly 0.05 lbs of NOx per million Btu. Assuming a heat rate of 10,000 Btu/kWhr and a capacity factor of 80%, over an ozone season it would emit about 440 tons of NOx.[7] It would take about 685 of those coal-fired EGUs (about 411,000 MW – more than double the total capacity of coal-fired EGUs in the United States[8]) running at a fairly high

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[6] See Table 4-6 of the Regulatory Impact Analysis.

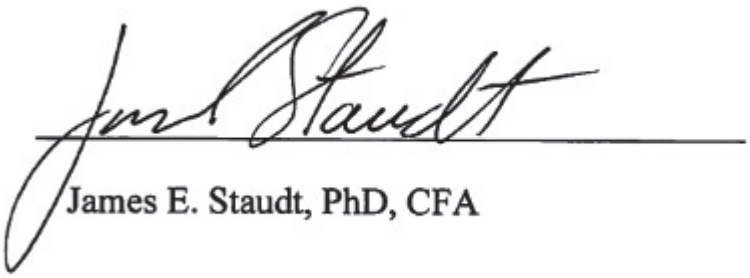
[7] 600 MW * 1000 kW/MW * 10,000 Btu/kW * (1 MMBtu/1,000,000 Btu) * 0.05 lb/MMBtu * 3672 hrs/ozone season * (1 ton/2000 lbs).

[8] According to the Energy Information Administration, in November 2022 there was about 201,000 MW of coal EGU capacity in the United States, see https://www.eia.gov/todayinenergy/detail.php?id=54559.

capacity factor to total the same emissions as what was emitted from the non-EGU sector in 2019.

36. So, it is clear that the non-EGU industries affected by this rule make a large contribution to ozone season NOx emissions in the 20 affected states. As a result, the emissions reductions of the rule for the non-EGU sector are important.

August 18, 2023
Date



James E. Staudt, PhD, CFA

V. EXHIBIT 1

A. Curriculum Vitae

James E. Staudt, Ph.D., CFA

Summary: Currently a consultant with decades of experience assisting companies and government agencies in the energy and environmental industries. Possess deep knowledge of business, finance and technology relating to these industries.

2019: Adjunct Professor, University of Massachusetts, Lowell
Teaching undergraduate engineering courses

2018: Adjunct Professor, Merrimack College
Developed syllabus and taught a new course in Engineering Economics for students in the Master of Science in Engineering Management program administered by the Mechanical Engineering department. Also taught Materials Science.

2013 – Present
Volunteer reviewer for the Mass Ventures START venture funding program for the Commonwealth of Massachusetts. START is a program funded by the Commonwealth of Massachusetts to assist Massachusetts-based companies that have been successful in the Federal Small Business Innovation Research (SBIR) program.

1997 – Present
President, Andover Technology Partners
Provided consulting services to

- United States and state government agencies in development of clean air and clean energy regulations. Regulatory actions that were developed using Dr. Staudt's analysis include
    - US EPA NESHAP: Coal- and Oil-Fired Electric Utility Steam Generating Units Review of the Residual Risk and Technology Review
    - US EPA Affordable Clean Energy Rule
    - US EPA Clean Power Plan
    - US EPA NOx SIP Call
    - US EPA Clean Air Interstate Rule
    - US EPA Clean Air Mercury Rule
    - US EPA Regional Haze Rule
    - Illinois Mercury Rule and NOx RACT rule

    - Consent Decree between US EPA, State of North Carolina and Tennessee Valley Authority
    - US EPA Cross State Air Pollution Rule
    - US EPA Mercury and Air Toxic Standards
    - National Emission Standards for Control of Hazardous Air Pollutants (NESHAP) for
        - Portland Cement Kilns
        - Industrial Boilers
        - Pulp and Paper Mills
        - Iron and Steelmaking Facilities
- Developers of air pollution control or clean air or clean energy technologies
    - Market and industry strategy analysis
- Owners of industrial facilities
    - Assisting clients in implementing and maintaining compliance with air emission regulations
- Investors in companies in clean air or clean energy technology space
    - Assisting clients with evaluating investments in clean energy or clean air technology companies

1995-1997

Senior Vice President, Spectrum Diagnostix (a subsidiary of Physical Sciences, Inc.) - Managed technology development and commercial operations for developer of diode laser based optical process instrumentation. Company was sold in 1997.

1990-1995

Product Director, NOx Control, Research-Cottrell – Managed engineering, operations, and sales of pollution control technologies to power plants and large industrial facilities

1990

Physical Sciences, Inc. – Managed a US Department of Energy research program on energy. Developed business plan for what would later become Spectrum Diagnostix.

1988-1990

Programs Manager, Fuel Tech, Inc., Managed technology process engineering and commercial demonstration programs for NOx control technology used at power plants and large industrial facilities.

1987-1988

Project Manager, Northern Research and Engineering Corporation. – Project manager for a turbomachinery design company owned by Ingersoll Rand.

1984-1987

Graduate student, Massachusetts Institute of Technology

1979-1984

US Naval Officer – Navy nuclear program

Publications

Dr. Staudt has published over 60 papers, journal articles or reports. In addition, he has also authored many reports for US EPA and other clients as part of his consulting practice that have been released to the public.

Education and Professional Credentials

- B.S. in Mechanical Engineering from the U.S. Naval Academy (1979)
- M.S. (1986) in Engineering from the Massachusetts Institute of Technology (M.I.T.)
- Ph.D. (1987) in Engineering from the Massachusetts Institute of Technology (M.I.T.) with a minor in Business Management
- Chartered Financial Analyst (CFA) designation (2001)
- US Navy Chief Engineer, nuclear power (1983)

Awards

2007 US Environmental Protection Agency Science and Technology Achievement Award

- *Providing the Public with a Comprehensive Summary of Technologies for Control of Mercury Emissions from Electric Utility Boilers*

1994 and 2010 Institute of Clean Air Companies (ICAC) Special Achievement Awards

Professional Associations

- Member, CFA Institute

Military Service

From 1979 to 1984 Dr. Staudt served as a commissioned officer in the U.S. Navy in the Engineering Department of the nuclear-powered aircraft carrier USS ENTERPRISE (CVN-65), attaining the rank of Lieutenant (O-3) prior to leaving the service.

B. Publications

Staudt, J., Analysis of PM and Hg Emissions and Controls from Coal-Fired Power Plants – Addendum, Analysis of the Cost of Complying with Lower Hg Emissions Levels, for Center for Applied Environmental Law and Policy (CAELP), January 5, 2023

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Staudt, J, Hoover, B., Trautner, P., McCool, S., Frey, J., "Optimization of Constellation Energy's SNCR System at Crane Units 1 and 2 Using Continuous Ammonia Measurement", The MEGA Symposium, Baltimore, MD, August 31-September 2, 2010

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Staudt, J.E., "Design Study of an MGR Direct Brayton-Cycle Power Plant", Ph.D. Thesis, Department of Mechanical Engineering, Massachusetts Institute of Technology, 1987.

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Staudt, J.E., "Ash Characterization and Deposition in Coal Water Slurry and Pulverized Coal Flames", Master's Thesis, Department of Mechanical Engineering, Massachusetts Institute of Technology, 1986.

Beér, J.M., Farmayan, W.F., Teare, J.D., Toqan, M.A., Benedek, K., Kang, S.W., Srinivasachar, S., Staudt, J.E., Walsh, P.M., and Tae-U, Yu., "The Combustion, Heat Transfer, Pollutant Emission and Ash Deposition Characteristics of Coal-Water Fuels", Phase III Program Final Report, The Energy Laboratory, Massachusetts Institute of Technology, November 1985.

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C. Government and Public Sector Consulting Projects

Title: Support to US EPA – Clean Air Markets Division
Client: EPA Clean Air Markets Division through ERG
Scope: Supporting US EPA, performing various analysis as needed.
Period of Performance: 2019-present

Title: Assistance on Affordable Clean Energy Plan
Client: EPA Clean Air Markets Division through ERG
Scope: Performed analysis of labor impacts of heat rate improvements and clean energy technologies.
Period of Performance: 2018-2019

Title: Assistance on Clean Power Plan
Client: Navajo Nation, through Navajo Tribal Utility Authority
Scope: Assisting Navajo Nation with technical analysis of Clean Power Plan proposal, to include interaction with electric utility companies, analysis of compliance options and meetings with EPA Assistant Administrator for Air and Radiation.
Period of Performance: 2014-2015

Title: Impact to Labor Demand from Heat Rate Improvements on Existing Fossil Power Plants
Client: EPA Clean Air Markets Division through ICF International
Scope: A review of technical methods and potential labor impacts of heat rate improvements that might result from EPA regulation of Greenhouse Gases (GHGs) from existing fossil power plants.
Period of Performance: 2013-2014

Title: Best Available Retrofit Technology (BART) analysis and BART related support
Client: EPA Regions 8 and 9 - through EC\R and ICF International, respectively
Scope: Performed BART technology and cost analysis for industrial sources and electric generating units (visibility analysis performed by others). Also assisted EPA regions respond to comments, as needed. Industrial sources included industrial boilers, cement kilns, lime kilns, combustion turbines, and reciprocating internal combustion engines.
Period of Performance: 2012-2016

Title: Candidate Control Measures for SO_2 Control from Industrial Sources
Client: Lake Michigan Air Directors Consortium (LADCO)
Scope: Performed a study and published a report that evaluated candidate SO2 control measures for a wide range of industrial sources in the LADCO region, to include: Industrial Boilers, Cement Kilns, Lime Kilns, Iron and Steel Mills, Refineries, Chemical Plants, Glass furnaces, and others. A report was published and is available on the LADCO website:
Period of Performance: 2011/2012

Title: Control Technologies to Reduce Conventional and Hazardous Air Pollutants from Coal-Fired Power Plants
Client: MJ Bradley and Associates and Northeast States for Coordinated Air Use Management
Scope: Prepared a report in collaboration with MJ Bradley and Associates on the topic of control technologies for control of NOx, SO2, and Air Toxics (particle matter, acid gases, mercury, etc.) for coal fired power plants and the application of these technologies for compliance with US EPA rules. A report was published by the Northeast States for Coordinated Air Use Management (NESCAUM).
Period of Performance: 2011

Title: Greenhouse Gas Mitigation Options Database (GMOD)
Client: US EPA (through Eastern Research Group and RTI International)
Scope: Developed Greenhouse Gas Technology Database for US EPA for power plants and cement kilns. Effort includes collection and analysis of data on performance and cost of various greenhouse gas control technologies including CO2 capture, IGCC, and others.
Period of Performance: Spring 2009-2010

Title: Emissions Control for Power Plants
Client: US EPA (through ICF Consulting)
Scope: Comprehensive evaluation of NOx, SO_2, and CO_2 emissions from power plants and development of capital cost, variable and fixed operating cost algorithms for control measures as well as impacts (energy use, water use, emissions reduction) for use in the Integrated Planning Model. Assisted EPA with analysis for Mercury and Air Toxic Standards, to include analysis of Information Collection Request (ICR) Data to determine emission levels and controls needed for different sources. Also analyzed the availability of and

demand for labor and other resources necessary for compliance with the MATS and Cross State Air Pollution Rule (CSAPR).

Period of Performance: Fall 2009-2012

Title: Emissions Control for Cement Kilns

Client: US EPA (through ICF Consulting and Eastern Research Group)

Scope: Comprehensive evaluation of NOx, SO_2, and CO_2 emissions from cement kilns, and development of capital cost, variable and fixed operating cost algorithms for control measures as well as impacts (energy use, water use, emissions reduction) for use in the US EPA Industrial Source Integrated Solutions (ISIS) Model.

Period of Performance: 2008-2010

Title: Emissions Control for Iron and Steel Mills

Client: US EPA (through Eastern Research Group)

Scope: Comprehensive evaluation of NOx, SO_2, and CO_2 emissions from Iron and Steel Mills, and development of capital cost, variable and fixed operating cost algorithms for control measures as well as impacts (energy use, water use, emissions reduction) for use in the US EPA ISIS Multi-Sector Model.

Period of Performance: 2009-2010

Title: Emissions Control for Pulp and Paper Mills

Client: US EPA (through RTI International)

Scope: Comprehensive evaluation of NOx, SO_2, and CO_2 emissions from Pulp and Paper Mills, and development of capital cost, variable and fixed operating cost algorithms for control measures as well as impacts (energy use, water use, emissions reduction) for use in the US EPA ISIS Multi-Sector Model.

Period of Performance: 2009-2010

Title: NOx Control – NOx RACT

Client: State of Illinois, Environmental Protection Agency, Bureau of Air (Contract with Lake Michigan Air Director's Consortium)

Scope: Providing technical support to the Illinois Environmental Protection Agency's Bureau of Air in developing rules for control of NOx at electric generating units, gas turbines and reciprocating engines and steel mills, cement plants, glass-manufacturing plants, refineries, and other industrial facilities.

Period of Performance: 2007-2009

Title: Best Available Retrofit Technology for EGU's in Illinois

Client: State of Illinois, Environmental Protection Agency, Bureau of Air (Contract with Lake Michigan Air Director's Consortium)
Scope: Providing technical support to the Illinois Environmental Protection Agency's Bureau of Air in evaluating BART for specific IL EGUs.
Period of Performance: 2007-2008

Title: Air Pollution Reduction at Tennessee Valley Authority Plants
Client: Attorney General of North Carolina
Scope: Providing expert witness analysis of methods to reduce air pollution from TVA coal power plants.
Period of Performance: 2006-2008

Title: NOx and SO_2 Cost of Control under the Clean Air Act Amendments
Client: US Environmental Protection Agency and ICF Consulting
Scope: Providing technical support to the US EPA Clean Air Markets Division and analyzing the cost of compliance with Title IV (NOx and SO_2 Acid Rain provisions) of the Clean Air Act Amendments (CAAA) and the NOx SIP Call and OTC NOx Budget Rule that were issued under Title I of the CAAA.
Period of Performance: 2006

Title: Mercury Emissions Control
Client: State of Illinois, Environmental Protection Agency, Bureau of Air (Contract with Lake Michigan Air Director's Consortium)
Scope: ATP provided technical support to the Illinois Environmental Protection Agency's Bureau of Air in developing a rule to meet the Illinois Governor's proposed reduction in Illinois power plant mercury emissions.
Period of Performance: 2006 - completed

Title: Update of Coal Utility Environmental Cost (CUECost) Model
Client: US EPA and ARCADIS, P.O. Box 13109, Research Triangle Park, NC 27709
Scope: ATP developed cost and performance algorithms for mercury emissions control including cobenefits, powdered activated carbon and halogenated powdered activated carbon. Also developed SO_2 control cost and performance algorithms. These and other updates were incorporated into EPA's CUECost model.
Period of Performance: 2005-2006

Title: SO_2 Control Cost and Performance

Client: US EPA and ICF Consulting, 9300 Lee Highway, Fairfax, VA 22031 (703) 934-3071

Scope: ATP supported ICF Consulting and US EPA in developing cost and performance models for limestone forced oxidation (LSFO) and Spray Drier Absorber technology that will be incorporated into the Integrated Planning Model. Reviews of installed installation data and vendor quotes was used to develop algorithms.

Period of Performance: 2005

Title: NOx Control Workshop, Dalian, China

Client: US Department of Energy, National Energy Technology Laboratory, and Arcadis

Scope: ATP developed and taught a workshop on NOx control methods, especially post combustion controls for coal-fired power plants, to Chinese delegates.

Period of Performance: 2005

Title: Reliability of Selective Catalytic Reduction (SCR) and Flue Gas Desulfurization (FGD) Systems for High Pollutant Removal Efficiencies on Coal Fired Utility Boilers

Client: US Environmental Protection Agency and ICF Consulting, 9300 Lee Highway, Fairfax, VA 22031 (703) 934-3071

Scope: ATP evaluated the reliability of recently installed SCR systems designed for very high removal efficiencies (over 90%) and also FGD technologies.

Period of Performance: 2004

Title: Performance and Cost of Mercury and Multipollutant Emission Control Technology Applications on Electric Utility Boilers, EPA-600/R-03/110 issued October 2003

Client: US EPA and ARCADIS, P.O. Box 13109, Research Triangle Park, NC 27709

Scope: ATP was the principal subcontractor to ARCADIS in evaluating the performance and cost of mercury and multipollutant control methods (NOx, SOx, PM, Hg) for the US EPA. ATP developed cost and performance models to assess the emission control strategies for control of mercury, NOx, SO_2 and PM and other pollutants for about 50 model plants. Results are documented in EPA report EPA-600/R-03/110 issued October 2003, which may be downloaded from EPA's web site.

Period of Performance: 2002-2003

Title: Cost and Performance of Pollution Controls

Client: US EPA and ICF Consulting, 9300 Lee Highway, Fairfax, VA 22031 (703) 934-3071

Scope: As a subcontractor to ICF Consulting, ATP has evaluated the cost and performance of state-of-the-art combustion NOx controls and the cost and performance experienced with Selective Catalytic Reduction systems installed in response to the NOx SIP Call. Project entailed review of public information and interviews with industry contacts to collect cost and performance information, and reporting of the information to EPA and ICF.

Period of Performance: fall 2002 – fall 2003

Title: Engineering and Economic Factors Affecting the Installation of Control Technologies for Multipollutant Strategies, EPA-600/R-02/073, October 2002

Client: US EPA and ARCADIS, P.O. Box 13109, Research Triangle Park, NC 27709

Scope: As a subcontractor to ARCADIS, ATP analyzed the feasibility of complying with Multipollutant Control programs under evaluation by EPA. Report examined the feasibility of mercury, SO_2, and NO_X control technology implementation based upon forecasted technology installation schedules for the Clear Skies Initiative.

Period of Performance: Fall 2001 - Spring 2002

Title: Status Report on NOx Controls for Gas Turbines, Cement Kilns, Industrial Boilers, Internal Combustion Engines – Technologies and Cost Effectiveness

Client: Northeast States for Coordinated Air Use Management

Scope: Comprehensive report on technologies, performance and cost effectiveness of methods to control NOx from gas turbines, cement kilns, industrial boilers, and internal combustion engines.

Period of Performance: released December 2000

Title: Status Report on NOx Control Technologies and Cost Effectiveness for Utility Boilers

Client: Northeast States for Coordinated Air Use Management

Scope: Comprehensive report on technologies, performance and cost effectiveness of methods to control NOx from utility boilers.

Period of Performance: released December 2000

D. Industrial Consulting Projects

Client: Constellation Energy
Scope: Advised client on air pollution control technologies for use at Constellation power plants.
Period of Performance: 2006 - 2009

Client: Chase Power
Scope: Advised client on emission control technologies for use at proposed 1200 MW petroleum coke fired power plant.
Period of Performance: 2007/8

Client: Arizona Public Service Company
Scope: Advised client on emission control technologies for use at Arizona Public Service utility coal plants.
Period of Performance: 2003/2004

Client: GE Contract Services, Newington Energy, Newington, NH
Scope: Advised client on emission control technology issues relating to combined-cycle power plant with two GE Frame 7F combined cycle.
Period of Performance: 2003/2004

Client: Dick Corp. at AES Granite Ridge, Londonderry, NH
Scope: Advised client on emission control technology issues relating to combined-cycle power plant with two Siemens Westinghouse 501G combined cycle turbines.
Period of Performance: 2003/2004

Client: Wyeth Biopharma, One Burtt Road, Andover, MA 01810
Scope: Advised client on emission control technologies associated with client's gas turbine cogeneration facility equipped with Solar Taurus combined cycle turbines.
Period of Performance: fall 2000 - spring 2001

Client: Allegheny Energy
Scope: Advised client on cost-effectiveness of various methods of complying with emission control requirements at a PURPA Qualifying Facility in the Allegheny system. Support included technical evaluation of alternatives and economic analysis of alternative, including evaluation of allowance trading.

Services included expert witness testimony in an arbitration hearing.
Period of Performance: spring 2000

Client: Texas Industries
Scope: Performed a comprehensive technical analysis on the NOx emission reduction process that is used on TXI and other cement kilns to increase production and reduce air pollution. Also advised TXI regarding emissions control methods for cement kilns.
Period of Performance: Fall 1999

Client: NRG Somerset Operations, 1606 Riverside Avenue, Somerset, MA 02726
Scope: Optimization of client's emission control system on coal-fired electric utility boiler. Significant improvements in system operation resulted from this program.
Period of Performance: 1999 through 2001

Client: Conectiv, Wilmington, DE
Scope: Optimization of client's emission control system on coal-fired electric utility boiler, including combustion tuning and consulting on SNCR operation.
Period of Performance: 1997, 1998, 2001, 2002

Client: PG&E Generating, 7500 Old Georgetown Road, Bethesda, MD 20814
Scope: Advised PG&E Generating on expected environmental upgrade costs on several electric generating plants that PG&E Generating was considering for acquisition.
Period of Performance: Spring 1999

E. Non Government Organizations

Client: Center for Environmental Law and Policy
Scope: Prepared reports on gas cofiring on coal-fired boilers, methods to improve PM and Hg emissions from coal-fired boilers, and methods to improve acid gas emissions from coal-fired utility boilers
Period of Performance: 2020-2022

Client: Environmental Defense Fund
Scope: Various reports and engineering studies, to include gas conversion of coal-fired utility boilers.
Period of Performance: 2010-2021

Client: Natural Resources Defense Council
Scope: Various engineering studies to examine heat rate improvements on power plants, commenting on EPA regulations.
Period of Performance: 2010-2018

Client: Sierra Club
Scope: engineering studies to include evaluation of SO2 methods on select power plants.
Period of Performance: roughly 2018

Declaration of Victoria R. Stamper

I, Victoria R. Stamper, declare that the following statements are true and correct to the best of my knowledge, information and belief, and are based on my personal knowledge.

1. I have thirty-four years of experience in the field of air pollution regulations and control. This experience includes ten years of work in government for the U.S. Environmental Protection Agency (EPA) and twenty years of work as a consultant. A copy of my Curriculum Vitae is attached as Exhibit A.
2. I received a Bachelor of Science Degree in Civil Engineering from Michigan State University in 1989.
3. In 1989, I began work for an environmental consulting firm in Seattle, Washington. I designed and implemented research projects on air pollution control systems and prepared air quality permit applications, including emissions calculations and preparation of data for air modeling.
4. From 1991 to 2001, I worked at the EPA Region VIII office in Denver as an Environmental Engineer. I became the lead staff member on new source review (NSR) requirements of state implementation plans. I reviewed all aspects of NSR permitting regulations to ensure compliance with federal regulations for each of the six states in EPA Region VIII. Over the course of ten years with the EPA, I

acquired expert knowledge on Clean Air Act requirements and federal regulations pertaining to NSR.

5. While working at EPA, I also developed expertise in evaluating PM-10 nonattainment plans and state pollution control regulations. I advised Indian tribes in developing tribal implementation plans and pre-construction permitting programs. I also worked on approvals of state visibility plans for national parks and wilderness areas (i.e., Federal Class I areas).
6. In 2001, after leaving the EPA, I was retained to research potential Clean Air Act violations, including violations of emission limits.
7. In 2003, I started an independent consulting business that provides technical services on air quality issues. My work has primarily been contracted by non-governmental organizations and is often from the perspective of outside review of work done by and for federal, state, and local air pollution control governmental agencies.
8. Since 2003, I have been and continue to be regularly retained to evaluate and provide comments and expert reports on proposed air quality permits for power plants and other industrial facilities. The scope of my permit reviews including evaluation of best available control technology (BACT) determinations, maximum achievable control technology (MACT) for control of air toxics, and emission inputs for air modeling analyses, among other things.

9. Since 2003, I have reviewed and have assisted with comments, or provided expert comments, on air construction and operating permits for numerous air pollution sources including, among other sources, natural gas compressor stations.

10. Beginning approximately in 2009, I began providing review and comments including expert reports on regional haze plans. The scope of my reviews included evaluating best available control technology (BART) and controls to achieve reasonable progress towards the national visibility goal. Over the past twenty years, I have conducted and/or reviewed cost analyses for various air pollution controls to be retrofitted to several types of industries including natural gas-fired reciprocating internal combustion engines (RICE).

11. In 2019 to 2020, I worked with another expert (Megan Williams) researching and writing a report regarding the cost-effectiveness of regional haze control retrofits, primarily regarding nitrogen oxides (NOx) emissions, for natural gas-fired RICE and other source categories associated with the oil and gas sector. As part of that work, I reviewed state, regional, and federal reports on the NOx controls available for natural gas-fired RICE and the cost-effectiveness of such controls. I also researched state and local government rulemakings that had imposed NOx control retrofit requirements on existing gas-fired RICE. The final report, entitled *Oil and Gas Sector Reasonable Progress Four-Factor Analysis of Controls for Five Source Categories: Natural Gas-Fired Internal Combustion Engines, Natural Gas Fired-*

Combustion Turbines, Diesel-Fired Engines, Natural Gas-Fired Heaters and Boilers, and Flaring and Incineration ("Oil and Gas Controls Report") was issued on March 6, 2020. An earlier version of report was included as an attachment to the Earthjustice et al. Comments on the rulemaking at issue in this case, and thus appears in the administrative record. *See* EPA-HQ-OAR-2021-0668-0758.

12. I have reviewed the portions of the *Federal "Good Neighbor Plan" for the 2015 Ozone National Ambient Air Quality Standards*, 88 Fed. Reg. 36,654 (Jun. 5, 2023) (the "Rule") that relate to EPA's NOx control requirements for natural gas-fired RICE, including supporting documents in the administrative record for the Good Neighbor Rule. I also have reviewed the Stay Motions filed by the various gas pipeline companies and trade associations[1] (Movants) and the declarations attached to those motions.

13. Based on my review of the final rule and associated documentation, the gas transmission industry is unlikely to have difficulty meeting the requirements of the Rule. The emission standards of the Rule are not as stringent as what many state and local air agencies have required for similar sized engines. EPA's determination that only about 900 engines will require retrofits is well supported

[1] Specifically, I reviewed the Stay Motions filed by Enbridge (U.S.), Inc. (ECF 2011121), TransCanada Pipeline USA LTD (ECF 2011451), Kinder Morgan, Inc. (ECF 2009836), and Interstate Natural Gas Association of America and American Petroleum Institute ECF 2009932).

by the record. Further, EPA has provided well-documented support for the compliance timelines of the rule. Finally, because gas transmission compressor stations have "significant overcapacity," performing the retrofits required to comply with this Rule should not cause disruptions in the gas supply.

The Pipeline Emission Standards in the Rule Reflect the Application of Cost-Effective Pollution Controls that Have Been Used for Decades.

14. The Good Neighbor Rule's emission limits for natural gas-fired RICE reflect the application of pollution controls that have been in use for decades and that have been determined to be cost-effective controls for gas-fired RICE in the context of numerous rulemakings, air permits, and BACT determinations. The Movants generally do not dispute that implementation of the NOx controls that would be required by the Good Neighbor Rule are technically feasible, nor have the Movants argued that the RICE NOx emission limits of the Good Neighbor Rule are not achievable. The Good Neighbor Rule's RICE NOx emission limits are no more stringent than the NOx emission limits that all new engines have had to meet since the 2007-2010 timeframe under the federal New Source Performance Standards (NSPS) at 40 C.F.R. Part 60, Subpart JJJJ. Since July 1, 2010, all spark ignition RICE engines greater than or equal to 500 horsepower (hp) have had to achieve a NOx emission limit of 1.0 grams per horsepower-hour (g/hp-hr), and the NOx emission limits applicable to engines under the Good Neighbor Rule range from

1.0 g/hp-hr to 3.0 g/hp-hr, depending on the engine type. 88 Fed. Reg. 36974-5 (June 5, 2023).

15. Compared to similar rules undertaken at the state and local level, the emission limits in EPA's Rule are actually quite conservative.[2] As discussed extensively in the Oil and Gas Controls Report that I co-authored, several state and local air agencies have adopted regulations that required existing natural gas-fired engines to retrofit pollution controls to meet lower NOx emission limits than required for similar engine types in EPA's Good Neighbor Rule. These limits were adopted generally to meet reasonably available control technology (RACT) requirements and best available retrofit control technology (BARCT, which applies in California), and costs were taken into account in making those RACT and BARCT determinations. Gas pipeline operators and other sources have successfully complied with these emission limits because the control technologies (layered combustion, selective catalytic reduction, and non-selective catalytic reduction) are mature and well-demonstrated from a technical perspective, readily available, and cost-effective.

[2] For four-stroke lean burn engines, the Rule imposes an emission limit of 1.5 g/hp-hr. As EPA noted, "some states have required limits equivalent to or even lower than 0.5 g/hp-hr" for these engines. Industrial Source TSD at 6 ("Many states … have already adopted emission limits similar to or even significantly more stringent than the" limits in the Rule). The limits for other types of engines are similarly conservative.

16. EPA estimated that the Good Neighbor Rule would reduce 77,392 tons of NOx per year, at an average cost effectiveness of $4,891/ton of NOx emissions removed.[3] Cost effectiveness is calculated by determining the annualized cost of a pollution control and dividing that by the annual emission reductions that the control will achieve. The $4,891/ton average cost-effectiveness value compares favorably to many other rules designed to reduce ozone pollution and also regional haze (particulate) pollution. For certain engines that have historically been operated less frequently, the cost-per-ton for installing and operating pollution controls will appear to be higher. That is because a particular unit's annual emissions are based on how many hours and days per year that the unit operates, and thus a NOx control retrofit at a unit that operates less will reduce less NOx on an annual basis (making a control seem less cost effective) compared to a NOx control retrofit at a unit that operates more. However, engines that may have been operated for a fewer number of hours in certain years may be operated for a higher number of hours at any time to address demand. Indeed, as stated in the Interstate Natural Gas Association of American (INGAA) comments on the proposed rule, gas transmission compressor stations typically include significant over-capacity to be

[3] *See* Summary of Final Rule Applicability Criteria and Emissions Limits for Non-EGU Emissions Units, Assumed Control Technologies for Meeting the Final Emissions Limits, and Estimated Emissions Units, Emissions Reductions, and Costs at 10-11, Tables 6, 8 [Docket ID EPA-HQ-OAR-2021-0668-0956].

able to effectively meet peak gas demand periods.[4] EPA reasonably explained why it was necessary to include all engines in the Good Neighbor Rule regardless of operating hours, to prevent operators from shifting utilization to less-used units instead of reducing emissions. 88 Fed. Reg. 36,746-6.

EPA Reasonably Estimated the Number of Engines that Will Require Retrofits

17. Some of the Movants assert that the May 1, 2026 compliance deadline of the Good Neighbor Rule is impossible to meet because EPA "vastly undercounted the pipeline engines that will need emission controls." *See* ECF 2009836 at 17-18 (Kinder Morgan); ECF 2011121 at 17-19 (Enbridge). Based on a review of the National Emissions Inventory, EPA determined that approximately 3,000 engines were subject to the rule and, of that, EPA determined that roughly one-third will require controls. 88 Fed. Reg. 36,824. It appears that the Movants' claims that EPA has undercounted the engines that would need to be controlled pertain to EPA's estimate that only one-third of the engines would need to be controlled under a facility-wide emissions averaging plan. However, EPA's estimate of the number of engines that would require controls under a facility-wide averaging plan

[4] Comments of the Interstate Natural Gas Association of America on the U.S. Environmental Protection Agency's Proposed Rule: "Proposed Federal implementation Plan Addressing Regional Ozone Transport for the 2015 Ozone National Ambient Air Quality Standard, June 21, 2022, at 12, attached as Exhibit 4 to the Enbridge Motion (ECF 2011121), Ex. 4.

was based on very conservative assumptions. For example, EPA assumed a controlled NOx rate of 0.5 g/hp-hr would be achieved at four-stroke rich burn engines, four-stroke lean burn engines, and two stroke lean burn engines. Note that EPA states that this emission level would be met with SCR, but rich burn engines could meet this emission level or lower with nonselective catalytic reduction (NSCR). Rich burn engines with NSCR can meet NOx emission rates as low as 0.16 g/hp-hr. *See* Oil and Gas Controls Report at ES-2, 49-50, and 53. Lean burn engines with SCR can meet NOx emission rates as low as 0.15 g/hp-hr. *See id.* at ES-2, 50, and 53. EPA also assumed that the uncontrolled engines emitted NOx rate a rate of 16 g/hp-hr. At least one commenter on EPA's proposed Good Neighbor Rule stated that this is an overestimate of the uncontrolled emission rates for the majority of gas engines. If EPA has overstated the uncontrolled NOx rates for engines, that would make facility-wide averaging easier to achieve, because a lower proportion of the uncontrolled engines' emissions would have to be offset by engines installing controls at a facility. Thus, EPA's estimate that one-third of the engines would need to install controls under its facility-wide averaging provisions is a reasonable estimate and could potentially overstate the number of engines that will be required to install controls under the Good Neighbor Rule and the facility-wide averaging approach.

18. There are several reasons why an engine might not have to undergo a retrofit in order to comply with the Good Neighbor Rule. Specifically, any engine built after July 2010 is already subject to a new source performance standard that is more stringent than any of the limits in the Rule.[5] With respect to two-stroke engines, any unit built after July 2007 will be compliant with the emission limits of the Rule.[6] Further, many of the upwind states subject to this Rule impose their own emission limits that are at least as stringent as the limits in the Rule.[7] Moreover, as discussed, the Rule allows for facility-wide emissions averaging, which will allow units that install controls to offset the emissions from other units at the same facility that do not install controls.

19. EPA's inventory indicates that many of the engines subject to the Rule are already compliant with its emission limit. EPA's "Pipeline Natural Gas - Engines Analysis data" spreadsheet includes a list of 1,994 engines that are subject to the Rule but

[5] Compare 40 C.F.R. § 52.41(c) with 40 C.F.R. Pt. 60, Subpt. JJJJ, Tbl. 1; see Industrial Source TSD at 6 (stating that "many of the newer engines subject to th[e] FIP are already required to meet … more stringent [new source performance standard] limits"); accord id. at 8.

[6] The Rule imposes a NOx emission limit of 3.0 g/hp-hr for these engines. Under 40 C.F.R. Pt. 60, Subpt. JJJJ, Tbl. 1, any two-stroke lean burn engine built after July 2007 was required to achieve a NOx emission limit of 2.0 g/hp-hr.

[7] *See* Industrial Source TSD at 6 ("Many states … have already adopted emission limits similar to or even significantly more stringent than the" limits in the Rule); see, e.g., 30 Tex. Admin. Code § 117.2110(a)(1) (emission limits for engines in the Dallas–Fort Worth areas that are more stringent than the limit in the Final Rule).

"not anticipated to need to be controlled under a facility-wide averaging plan."[8] The spreadsheet shows that many of the "Uncontrolled Units" have already installed a control technology such as selective non-catalytic reduction, non-selective catalytic reduction, or combustion controls.[9] The spreadsheet also suggests that many units were installed after the effective date of the new source performance standard.[10]

20. Movants' declarations contain certain statements that undermine their critiques of EPA's analysis. For example, Kenneth W. Grubb, a declarant for Kinder Morgan, states that at Kinder Morgan's Tennessee Gas Pipeline Station 214, the company operates 13 pipeline engines, of which nine "are already controlled and operating below the emissions thresholds in the Rule." EFC 2009836 at 408, ¶ 42. While this paragraph pertains to a single facility which may not be representative, Mr. Grubb's statement about that facility is inconsistent with the company's broader argument that most of the 3,000 engines subject to the Rule will need retrofits. In addition, Scott Yager states that INGAA's members "believe that approximately

[8] *See* "Pipeline Natural Gas - Engines Analysis data" spreadsheet, https://www.regulations.gov/search?filter=EPA-HQ-OAR-2021-0668-1050, at the "Readme" tab.

[9] *See id*., at the "Uncontrolled Units" tab, Column AS ("controls") and AG ("Permit Controls").

[10] *See* at the "Uncontrolled Units" tab, Column AO ("Unit Status Year"), showing that many units post-date the July 2010 new source performance standard.

1,220 pipeline engines" will require retrofits. *See* ECF 2009932 at 851, ¶ 8. This is only 315 engines more than EPA's estimate (approximately 905 engines), and thus not sufficient to demonstrate that EPA "vastly" undercounted the number of engines that will be required to retrofit controls.

21. EPA's detailed analysis supports the agency's finding that approximately 900 engines will require emission control retrofits to achieve the emission limits included in the Rule.[11] Most of the covered engines will not require a retrofit because (1) they were designed to comply with a more stringent new source performance standard, (2) they previously underwent a retrofit to comply with a different state or federal regulation, or (3) the operator will be able to comply with the Rule using a facility-wide averaging. If anything, EPA's analysis might overstate the number of engines that will need to be controlled, because it is based on conservative assumptions about how effective the retrofits will be at reducing emissions at the units that are subject to control.

Operators Should Be Able to Complete the NOx Pollution Control Retrofits by May 2026

[11] *See* Summary of Final Rule Applicability Criteria and Emissions Limits for Non-EGU Emissions Units at 9, Tbl. 5 (Mar. 15, 2023) (showing that 323 units are expected to install non-selective catalytic reduction or layered combustion, 394 two-stroke lean burn units are expected to install layered-combustion, 158 four-stroke lean burn engines are expected to install selective catalytic reduction, and 30 four-stroke lean burn units are expected to install non-selective catalytic reduction).

22. The Good Neighbor Rule generally requires that compliance with emission limits must be achieved by May 1, 2026. Movants argue that this compliance deadline is unreasonable. Part of Movants' arguments are based on an assumption that EPA underestimated the number of engines that would be required to retrofit controls but, as previously discussed, EPA has adequately justified its assumption that approximately one-third of the 3,000 engines subject to the rule will need to retrofit pollution controls. Movants also argued that EPA brushed aside time required for permitting, limitations in pollution control vendors and their ability/experience to meet the compliance timeline, and concerns about supply chain issues. However, EPA had an extensive review of all of these issues done for the Good Neighbor Rule, based on interviews with state permitting authorities and with pollution control vendors. *See* SC&A, NOx Emission Control Technology Installation Timing for Non-EGU Sources, Final Report, March 14, 2023.[12] This study found that rich burn engines should be able to install NSCR within 6 to 12 months, lean burn 2-cycle and similar engines could install layered

[12] Docket ID EPA-HQ-OAR-2021-0668-1077. Note that all of the interview notes are provided at this Docket ID, as well as the Final Report.

combustion within 6 to 12 months, and lean burn 4-cycle engines could install SCR within 10-19 months, including time for permitting.[13]

23. Experience at the state level shows that the gas industry can perform numerous pollution control retrofits in a relatively short amount of time. For example, the industry is currently in the process of retrofitting hundreds of RICE in Colorado, in response to emission standards adopted by the state's Air Quality Control Commission. In October 2020, Colorado adopted emission standards that were more stringent than the emission standards in EPA's Rule. *See* 5 Colo. Code Regs. § 1001-30:B.I(D)(5)(b), tbl.2. The rule required operators to retrofit at least 34% of the engines inside the Denver-Front Range Nonattainment Area by May 2022 or at least 20% of the engines located elsewhere in the state—less than two years after the standards were adopted. *See id.*, tbl.3. By May 2024, operators will need to have completed retrofits of 100% of engines in the nonattainment area and at least 50% of engines located elsewhere in the state. *See id.* Colorado anticipates that about 220 existing engines will ultimately need to get pollution control retrofits in order to comply with the standards.[14] Movant Kinder Morgan stated in its

[13] *See* SC&A, NOx Emission Control Technology Installation Timing for Non-EGU Sources, Final Report, March 14, 2023, at 25.

[14] *See* Colorado Air Quality Control Commission, Cost Benefit Analysis to Regulation 7 (Sept. 4, 2020) at 7–8, Table 1 (showing 14 two-stroke lean burn engines were expected to require retrofits); *id.* at 11, Table 4 (74 four-stroke rich burn engines were expected to require retrofits); *id.* at 13–14 (showing 135 four-stroke lean burn engines were expected to require retrofits). This Cost Benefit Analysis was included as an attachment to the Earthjustice et al. Comments on the

comments on this Rule that it "has implemented or is in the process of implementing modifications to Engines that will achieve over 7,000 tons per year" in response to rulemakings in Colorado and three other states, and that "[w]ith regard to Colorado, as of May 1, 2022, Kinder Morgan has achieved reductions of 564.2 tpy of NOx, and once the plan is fully implemented, the Company's potential to emit will be reduced by 3,000 tpy of NOx." ECF 2009836, Ex. B, at 311, n.8. Neither Kinder Morgan nor any other Movant asserts that compliance with the Colorado rule caused interruptions in gas service or any other difficulties. The success of similar state level programs supports EPA's determination that the compliance timelines in this Rule are reasonable.

24. With respect to timing to install controls if there are supply chain issues, the SC&A Timing report found potential time constraints for installing layered combustion controls at older engines (60 years or older) if there were supply chain issues, estimating that it could take up to 72 months to get controls installed on all units if there were supply chain disruptions.[15] The report acknowledges that this is a "highly conservative estimate," and noted that it is not clear which of these RICE

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rulemaking at issue in this case, and thus appears in the administrative record. *See* EPA-HQ-OAR-2021-0668-0758.

[15] *See* SC&A, NOx Emission Control Technology Installation Timing for Non-EGU Sources, Final Report, March 14, 2023 at ES-7.

might elect to apply combustion kits versus NSCR or another compliance option such as engine replacement or electrification.[16] The final Good Neighbor Rule provides generous compliance flexibilities. Specifically, if an operator cannot complete a retrofit in time, it can request extensions of up to three years pursuant to 40 C.F.R. § 52.40(d) and/or could request a less-stringent emission limit pursuant to 40 C.F.R. § 52.40(e). With these compliance flexibilities, there is absolutely no reason why any operator should have trouble complying with the Rule.

Compliance with the Rule Is Not Likely to Result in Disruption in the Gas Supply

25. Movants claim that the timeline for installation of controls could threaten reliable gas service. *See* ECF 201121 at 20 (Enbridge); ECF 2009836 at 14-15 (Kinder Morgan); ECF 2009932 at 24-25. Yet, Movants also argue that many of the "engines affected by the … Rule operate as backup units and are not needed to operate." Yager Decl. ¶ 14, ECF 2009932 (Addendum) (INGAA & Am. Petroleum Inst.). Such backup engines could be used while other engines are taken offline to install controls.

[16] *Id.*

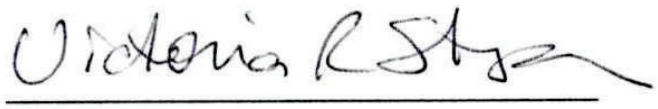
26. Documentation in the Good Neighbor Rule record state that "capacity utilization of compressor stations in the U.S. is about 40%." *See* SC&A, NOx Emission Control Technology Installation Timing for Non-EGUs Sources Report ES-8, 8 (2023), EPA-HQ-OAR-2021-0668-1077. INGAA has also stated that gas transmission compressor stations include "significant over-capacity" and that FERC certificate requirements "demand that these units be available to operate at capacities well-above typical operating conditions."[17] There are any number of reasons a compressor engine might need to be taken offline, which is one of the reasons that compressor stations are designed with excess capacity.

27. Given that the final Good Neighbor Rule allows for facility emissions averaging along with the fact that many engines already achieve emission rates that comply with the Good Neighbor Rule, it is very likely that pollution controls will not need to be installed at all engines at a compressor station. Between these facts and the excess compression capacity at compressor stations, the Good Neighbor Rule is very unlikely to result in disruptions in gas supply.

28. Pursuant to 28 U.S.C. § 1746, I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge and belief.

[17] Comments of the Interstate Natural Gas Association of America on the U.S. Environmental Protection Agency's Proposed Rule: "Proposed Federal Implementation Plan Addressing Regional Ozone Transport for the 2015 Ozone National Ambient Air Quality Standard" (Jun. 21, 2022), at ECF 2009932 at 650, & n.32.

Dated: August 17, 2023



Victoria R. Stamper

Exhibit A – Curriculum Vitae

Victoria R. Stamper
P.O. Box 9571
Boise, Idaho 83707
stamper.vr@gmail.com

Areas of Expertise

Comprehensive knowledge of the Clean Air Act **-** accomplished in the requirements for new source review (NSR) and prevention of significant deterioration (PSD) construction permits including review of Best Available Control Technology (BACT) determinations, Title V operating permits, Maximum Achievable Control Technology (MACT) Approvals, Class I area protection including regional haze plans and best available retrofit technology (BART) determinations, and state implementation plans for compliance with the national ambient air quality standards (NAAQS).

Significant experience in air pollution control technology evaluations– I have written expert reports addressing BART and reasonable progress controls for regional haze plans, reasonable available control technology (RACT) for nonattainment area SIPs, and BACT for new and modified source permits. This work entails researching and evaluating available air pollution controls, conducting and/or critiquing cost effectiveness analyses, researching control cost information, and proposing achievable emission limits for a particular source or source category. I have conducted such analyses for various types of industries, including fossil fuel-fired power plants, natural gas compressor stations, boilers, and heaters, lime kilns, and mining operations.

Professional Experience

Air Quality Consultant — April 2003 to Present
Boise, ID 83707

I provide consulting services on numerous air quality issues such as:

- Reviewing/preparing comments on all aspects of air quality construction and operating permit applications and permits for various industrial sources.
- Investigating facility compliance with federal and state air quality regulations.
- Reviewing and commenting on Class I regional haze and visibility protection plans, including pollution control technology, emissions reductions and cost-effectiveness calculations for BART and reasonable progress determinations.
- Evaluating nonattainment plans and control measures to attain the NAAQS.
- Evaluating and commenting on air quality analyses and environmental impact statements for proposed oil and gas development in the West.

Professional Experience (continued)

Environmental Engineer/Legal Assistant — May 2001 to April 2003
Reed Zars, Attorney at Law
Laramie, WY 82070

Responsibilities included:

- Investigating industrial facilities' compliance with Clean Air Act requirements through review of public documents.
- Researching pollution reduction measures and effectiveness.
- Preparing comments on proposed air quality construction and operating permits
- Reviewing and preparing written comments on proposed EPA state implementation plan approvals regarding topics such as opacity regulations, emission limit exemptions, Class I area visibility plans and permitting regulations.

New Source Review Program Manager — December 1990 to April 2001
Air and Radiation Program
U.S. Environmental Protection Agency, Region VIII
Denver, Colorado 80202

Responsibilities included:

- Serving as the Region VIII lead for state rules regarding the new source review and prevention of significant deterioration programs, as well as other industrial source control measures.
- Reviewing all aspects of prevention of significant deterioration increment analyses.
- Reviewing state implementation plans for consistency with requirements of Clean Air Act.
- Preparing documents to justify EPA approval or disapproval of state submittals.
- Educating and assisting tribes in developing regulations for tribal implementation plans.
- Participating in workgroups to ensure national consistency and provide input on rulemakings.
- Reviewing state operating permit programs under Title V of the Clean Air Act.
- Researching and compiling the EPA-approved state implementation plans.
- Developing and reviewing state implementation plans for particulate matter nonattainment areas, as well as assisting in the preparation of requests to redesignate to attainment.
- Reviewing environmental impact statements for consistency with the Clean Air Act.
- Serving as primary contact for air quality issues in the state of Wyoming.

Professional Experience (continued)

Environmental Engineer — August 1989-
Envirometrics, Inc. — July 1990
Seattle, Washington 98103

Responsibilities included:

- Designing components of research projects pertaining to pollution control systems.
- Developing testing criteria and measuring the effectiveness of these control systems.
- Preparing air pollution permit applications and related documentation for industrial sources.
- Compiling input data for modeling of ambient air quality impacts on Class I areas.
- Developing emission inventories.

Education

Bachelor of Science Degree
Civil Engineering, Michigan State University
East Lansing, Michigan

Selected Reports and Papers

- Stamper, V, Review and Comments on the Texas Regional Haze Federal Implementation Plan, July 25, 2023.
- Stamper, V, Review and Comments on the Reasonable Progress Controls for the Iowa Regional Haze Plan for the Second Implementation Period, March 14, 2023.
- Stamper, V., Review and Comments on Reasonable Progress Controls for the Minnesota Regional Haze Plan for the Second Implementation Period, October 5, 2022.
- Stamper, V., Review and Comments on Reasonable Progress Four-Factor Analyses Evaluated as Part of the Georgia Regional Haze Plan for the Second Implementation Period, July 25, 2022.
- Stamper, V., Review and Comments on Reasonable Progress Controls for the Arizona Regional Haze Plan for the Second Implementation Period, July 13, 2022.

Selected Reports and Papers (continued)

- Stamper, V., Review and Comments on Reasonable Progress Four-Factor Analyses for Sulfur Dioxide and Nitrogen Oxide Pollution Controls Evaluated as Part of the Utah Regional Haze Plan for the Second Implementation Period, May 27, 2022.

- Stamper, V., Review and Comments on Reasonable Progress Four-Factor Analyses for Sulfur Dioxide and Nitrogen Oxide Pollution Controls, Montana Regional Haze Plan for the Second Implementation Period, March 17, 2022.

- Stamper, V., Review and Comments on Washington Department of Ecology's Draft Regional Haze Plan for the Second Implementation Period: Long Term Strategy and Four-Factor Analysis of Controls, November 19, 2021.

- Stamper, V., Review and Comments on Reasonable Progress Four-Factor Analyses for Sulfur Dioxide and Nitrogen Oxide Pollution Controls Evaluated as Part of the Louisiana Regional Haze Plan for the Second Implementation Period, July 8, 2021.

- Stamper, V., Comments on BACT Analysis of the Alaska Department of Environmental Conservation's Proposed Air Quality Construction Permit for the Alaska Gasline Development Corporation Liquefaction Plant, December 4, 2020.

- Stamper, V. & Megan Williams, Assessment of Cost Effectiveness Analyses for Controls Evaluated in Four-Factor Analyses for Oil and Gas Facilities for the New Mexico Environment Department's Regional Haze Plan for the Second Implementation Period, Prepared for National Parks Conservation Association, July 2, 2020.

- Stamper, V. & Megan Williams, Oil and Gas Sector, Reasonable Progress Four-Factor Analysis of Controls for Five Source Categories: Natural Gas-Fired Engines, Natural Gas-Fired Turbines, Diesel-Fired Engines, Natural Gas-Fired Heaters and Boilers, Flaring and Incineration; Prepared for National Parks Conservation Association, March 6, 2020.

- Stamper, V., Reasonable Progress Analysis for Nitrogen Oxide Pollution Control Upgrades at Craig Unit 3, Martin Drake Units 1 and 2, Rawhide Unit 1, and Ray D. Nixon Unit 1, September 13, 2019.

- Stamper, V., Technical Support Document to Comments of Conservation Organizations; Proposed Revisions to Arkansas Regional Haze State Implementation Plan, February 1, 2018.

Selected Reports and Papers (continued)

- Stamper, V., Technical Support Document to Comments of Conservation Organizations; EPA Proposed Regional Haze and Interstate Visibility Transport Federal Implementation Plan for Texas, May 3, 2017.

- Stamper, V., Technical Support Document in Support of NPCA and RE Comments on PSD Permit No. 16-0, BP West Coast Products LLC Cherry Point Refinery, December 15, 2016.

- Stamper, V., Technical Support Document to Comments of Conservation Organizations; EPA's Proposed Rulemaking Regarding Utah's Regional Haze Plan, March 14, 2016.

- Stamper, V., Technical Support Document to Comments of Conservation Organizations; EPA's Proposed Regional Haze and Interstate Visibility Transport Federal Implementation Plan for Arkansas, August 5, 2015.

- Stamper, V., Technical Support Document to Comments of Conservation Organizations; EPA's Proposed Reasonable Progress Measures for Texas and Oklahoma, April 27, 2015.

- Stamper, V., Technical Support Document to Comments of Conservation Organizations, Proposed Federal Implementation Plan to Address Regional Haze Requirements for Navajo Generating Station Units 1, 2 and 3, December 30, 2013.

- Stamper, V., Technical Support Document to Comments of Conservation Organizations, EPA's Proposed Action on Wyoming Regional Haze, August 21, 2013.

- Stamper, V., Technical Support Document to Comments of Conservation Organizations; Proposed Wyoming Regional Haze Partial SIP Approval and Partial FIP, August 1, 2012.

- Stamper, V., C. Copeland, M. Williams, and T. Spencer (contributing editor), *Poisoning the Great Lakes: Mercury Emissions from Coal-Fired Power Plants in the Great Lakes Region*, Natural Resources Defense Council Publication, June 2012.

- Fox, Phyllis and V. Stamper, Technical Support Document to Comments of Conservation Organizations: Proposed Montana Regional Haze FIP, June 15, 2012.

- Stamper, V., Evaluation of Whether the SO2 Backstop Trading Program Proposed by the States of New Mexico, Utah and Wyoming and Albuquerque-Bernalillo County Will Result in Lower SO2 Emissions than Source-Specific BART, May 25, 2012.

- Technical Support Attachment to Comments of Conservation Organizations; Minnesota Regional Haze SIP Proposed Approval – February 21, 2012.

Selected Reports and Papers (continued)

- Stamper, V., Review of EPA's Proposed Best Available Control Technology (BART) Requirements for the Four Corners Power Plant on Navajo Nation Land, April 28, 2011.

- Stamper, V. and C. Copeland, *Stop the Rollbacks, Cleaner, Healthier Air for Colorado*, Environmental Defense publication, 2005.

- Banerjee, S. and V. Stamper, *Mercury Air Pollution: The Case for Rigorous MACT Standards For Subbituminous Coal*, prepared for Rocky Mountain Office of Environmental Defense and the Land and Water Fund of the Rockies, May 2003.

DECLARATION OF DANIEL PRULL

I, Daniel Prull, hereby declare pursuant to 28 U.S.C. 1746:

1. This declaration is based on my personal and professional knowledge. If called as a witness, I could and would testify competently and truthfully as to these matters.

2. I am the Deputy Director of Research Strategy and Analysis for the Sierra Club. I have held this position since March, 2022, and have worked for the Club for eight years. As part of my role with the Club, I analyze and am aware of the impacts different federal rules may have on the power sector and fossil fuel industry in general. In addition, I am familiar with financial information regarding the companies active in these sectors.

3. I am aware that EPA has recently promulgated a national rule to address ozone pollution transport across state lines, called the Good Neighbor Plan, to implement the Clean Air Act's Good Neighbor requirement for the 2015 ozone National Ambient Air Quality Standard. As part of my work for the Sierra Club, I have analyzed the compliance requirements of the rule for the power and fossil fuel sectors.

4. My understanding of the Good Neighbor Plan is that while the Rule would result in near-term emissions reductions and air quality improvements, the most significant requirements of the rule do not come into play until 2026 or later.

5. I am further aware that a number of polluter states and industry entities have challenged the Good Neighbor Plan in court, and that alleged high compliance costs are at issue in the case. These entities include Enbridge Inc., Kinder Morgan Inc., TransCanada Pipeline USA Ltd., Union Electric/Ameren, United States Steel Corp., and the trade groups American Iron and Steel Institute (AISI) and Midwest Ozone Group. In my opinion, industry is nonetheless well-situated to comply with the Good Neighbor Plan.

6. For example, Enbridge Inc. has a market capitalization of roughly $70 billion dollars, and has had total annual revenue of over $235 billion from 2018-2022, with $53 billion of that in 2022 alone.
7. Similarly, Kinder Morgan Inc. has a market capitalization of over $38 billion, and has had total annual revenue of nearly $75 billion from 2018-2022, with over $19 billion of that in 2022 alone.

8. Likewise, TransCanada Pipeline USA Ltd. is a subsidiary of TC Pipelines LLC, with a market cap of nearly $37 billion, and total annual revenue of over $68 billion from 2018-2022, with nearly $15 billion of that in 2022 alone.

9. Ameren Corp., the holding company for Union Electric d/b/a Ameren, which is a member of Midwest Ozone Group. Ameren Corp. has a market capitalization of nearly $21 billion, and has had total annual revenue of nearly $31 billion from 2018-2022, with nearly $8 billion of that in 2022 alone.

10. While AISI is a trade group, one of its "Producer Members" is Cleveland-Cliffs, Inc. Cleveland-Cliffs, Inc. has a market capitalization of nearly $8 billion, and total revenue of $53 billion from 2018-2022, with almost $23 billion of that in 2022 alone. In addition, it is my understanding that Cleveland-Cliffs, Inc. is in the process of attempting to acquire United States Steel Corp. with an offer price of $7.3 billion.

11. Accordingly, these industries are amply-resourced and very well-positioned to comply with the Good Neighbor Plan. Compliance costs are a very small fraction of overall revenues.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge and belief.

Dated: 8/18/2023

Daniel Prull

DECLARATION OF VERONICA SOUTHERLAND

I, Veronica Southerland, declare:

1. I have personal knowledge of the matters set forth herein and, if called to testify, I could and would testify to the truth of these facts.

2. I am a Scientist within the Global Clean Air program at Environmental Defense Fund ("EDF"). I have been with the organization since January 2023.

3. I received a Ph.D. in Environmental Health from the Milken Institute School of Public Health at the George Washington University, where I also received my Master of Public Health in Environmental Health Science and Policy.

4. At EDF, I focus on the use of high-resolution satellite-derived exposure data to estimate the health impacts of air pollution.

5. Prior to joining EDF, I contributed to proposed regulations to prevent the release of hazardous substances under the Clean Air Act and the Clean Water Act in the U.S. Environmental Protection Agency's Office of Land and Emergency Management. I have also worked in environmental and chemical policy at the U.S. Chemical Safety Board, the U.S. Department of Homeland Security and U.S. Department of Defense. My research and scholarship concerning air pollution health risks have been published in several journals, including *Lancet Planetary Health, GeoHealth* and *Environmental Health Perspectives*.

6. I am aware that, in June 2023, EPA published the *Federal "Good Neighbor Plan" for the 2015 Ozone National Ambient Air Quality Standards*, 88 Fed. Reg. 36,654 (June 5, 2023) ("Federal Implementation Plan"), which requires covered sources in 23 upwind states to limit nitrogen oxides ("NOx") emissions and reduce interstate transport of ozone pollution. I am aware that EPA found that these 23 states significantly contribute to problems with attaining and maintaining the 2015 ozone national ambient air quality standards in downwind states.

7. I am submitting this declaration in support of Environmental and Public Health Intervenors' Combined Response in Opposition to the Motions for Stay in *State of Utah v. U.S. EPA*, No. 23-1157, in the U.S. Court of Appeals for the District of Columbia Circuit.

8. I have reviewed the declaration of Elena Craft, former EDF Associate Vice President,[1] submitted in support of Environmental and Public Health Intervenors' Motion to Intervene in Support of Respondent (Craft Decl.).[2] I adopt and incorporate herein the portions of Ms. Craft's declaration concerning health effects from ozone exposure, health effects from fine particulate matter and sulfur dioxide pollution exposure, and decreases in dangerous air pollution as a result of the federal implementation plan. *See* Craft Decl. ¶¶ 9-43.

[1] Elena Craft has since departed EDF for a new position.
[2] *See* ECF 2007135, Declaration of Elena Craft.

Health Effects from Ozone Exposure

9. There is a broad scientific consensus that emissions of oxides of nitrogen ("NOx") and volatile organic compounds are precursors to ozone formation and that exposure to ozone is associated with significant public health effects. Ozone forms when volatile organic compounds and NOx react in the presence of heat and sunlight. This process becomes more pronounced in the summertime.

10. The American Lung Association estimates that there are more than 103 million people in the United States living in 124 counties with unhealthy levels of ozone pollution.[3] This population includes 23.6 million children and 15.4 million people age 65 or older.[4] People of color are almost four times more likely to be breathing the most polluted air than white people.[5]

11. A longstanding body of scientific research, including numerous EPA assessments, demonstrates that exposure to ground-level ozone harms human health and can cause heart disease, permanent lung damage, aggravation of asthma, and premature death from respiratory causes.[6]

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[3] Am. Lung Ass'n, *State of the Air 2023*, at 17 (2023), https://www.lung.org/getmedia/338b0c3c-6bf8-480f-9e6e-b93868c6c476/SOTA-2023.pdf.
[4] *Id.*
[5] *Id.* at 12.
[6] *See* EPA, *Health Effects of Ozone Pollution* (2022), https://www.epa.gov/ground-level-ozone-pollution/health-effects-ozone-pollution.

12. In its 2020 Integrated Scientific Assessment for Ozone, EPA concluded that "[r]ecent studies support and expand upon the strong body of evidence, which has been accumulating over many decades, that short-term ozone exposure causes respiratory effects."[7] Those effects can include decreases in lung function, asthma and chronic obstructive pulmonary disease exacerbations, and increases in respiratory-related hospital admissions and emergency room visits.[8]

13. EPA also concluded that there is a causal relationship or likely causal relationship between both short- and long-term ozone exposure and a broad range of harmful respiratory and metabolic effects in humans.[9] Short-term exposure is defined as hours, days, or weeks, and long-term exposure is measured in months to years.[10]

14. For short-term exposure, EPA found that "[e]pidemiologic studies continue to provide evidence that increased ozone concentrations are associated with a range of respiratory effects, including asthma exacerbation, chronic obstructive pulmonary disease (COPD) exacerbation, respiratory infection, and hospital admissions and emergency department visits for combined respiratory

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[7] EPA, *Integrated Science Assessment for Ozone and Related Photochemical Oxidants*, at IS-1, EPA/600/R-20/012 (Apr. 2020), https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=348522 ("2020 ISA").
[8] *Id.*
[9] *Id*. at IS-7, fig. IS-1.
[10] *Id*. at IS-23.

diseases."[11] Short-term exposure to ozone can have critical health implications. For instance, there is strong evidence of an association between out-of-hospital cardiac arrests and short-term exposure to ozone.[12] Timescales of exposure up to three hours in duration and also at the daily level on the day of the event were significant. This evidence augments the long-standing body of literature demonstrating the serious impacts from short-term exposure to ozone pollution.[13]

15. Short-term ozone exposure has also been linked to other cardiovascular effects. A large body of research provides robust evidence of the relationship between ozone and strokes, as well as some evidence for arrhythmias in those with pre-existing heart disease. A large meta-analysis of over 20 studies found a 2.45% increase in ischemic stroke rate per 10 parts per billion ("ppb") increase in ozone.[14] More recent work on the relationship between ozone exposure and arrhythmias also suggests a relationship in those with preexisting cardiac

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[11] *Id*. at IS-8.
[12] Zhiqiang Zong et al., *Association between Short-Term Exposure to Ozone and Heart Rate Variability: A Systematic Review and Meta-Analysis*, 19 Int'l J. Env't Res. & Pub. Health 11186 (2022), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9517606/; Katherine B. Ensor et al., *A Case-Crossover Analysis of Out-of-Hospital Cardiac Arrest and Air Pollution*, 127 Circulation 1192 (2013), https://www.ncbi.nlm.nih.gov/pubmed/23406673.
[13] *See* 2020 ISA, *supra* note 7, at IS-1.
[14] Wan-Shui Yang et al., *An evidence-based appraisal of global association between air pollution and risk of stroke*, 175 Int'l J. Cardiology 307 (2014).

disease. For example, one meta-analysis covering more than 400,000 participants in four studies (median ozone exposure 36 ppb) found a significant relationship, a 1% increase in rates of atrial fibrillation per 10 ppb ozone.[15]

16. There continues to be strong evidence for a relationship between short-term ozone concentrations and mortality and accumulating evidence for a relationship between long-term ozone exposure and mortality. Two large time series demonstrated a significant, non-linear relationship between short-term ozone concentration and mortality that was positive above concentrations of roughly 35-40 ppb.[16] A meta-analysis of a large number of studies of ozone and mortality found an increased risk of mortality among elderly people and younger adults.[17]

17. Long-term exposure to ozone likewise has critical health implications. EPA has concluded that there is "likely to be a causal relationship between long-term ozone exposure and respiratory effects."[18] Studies have reported positive associations between long-term ozone exposure and new-onset asthma, and

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[15] Qingmiao Shao et al., *Association between air pollution and development of atrial fibrillation: A meta-analysis of observational studies*, 45 Heart & Lung 557 (2016).
[16] Sanghyuk Bae et al., *Non-Linear Concentration-Response Relationships between Ambient Ozone and Daily Mortality*, 10 PLoS ONE 1 (2015); Philippe Collart et al., *Concentration–response curve and cumulative effects between ozone and daily mortality: an analysis in Wallonia, Belgium*, 28 Int'l J. Env't Health Res. 147 (2018).
[17] Michelle L. Bell et al., *Who is More Affected by Ozone Pollution? A Systematic Review and Meta-Analysis*, 180 Am. J. Epidemiology 15 (2014).
[18] 2020 ISA, *supra* note 7, at IS-8.

respiratory symptoms in children with asthma.[19]

18. EPA has also concluded that there is a "likely to be causal relationship" between short-term ozone exposure and metabolic effects.[20] Studies demonstrate "activation of sensory nerve pathways following ozone exposure that trigger the central neuroendocrine stress response, as indicated by increased corticosterone/cortisol and adrenaline production" and "associations between ozone exposure and perturbations in glucose and insulin homeostasis."[21] Those changes are often "accompanied by increased inflammatory markers in peripheral tissues and by changes in liver biomarkers."[22]

19. Long-term exposure to ozone has been associated with development and diagnosis of metabolic syndrome, increased incidence of type 2 diabetes, and diabetes-related mortality.[23]

20. Ozone pollution is particularly harmful for vulnerable populations, such as children, people with respiratory diseases or asthma, older adults, and people who are active outdoors, especially outdoor workers.[24] Children with asthma also face heightened risks from ozone exposure. Many studies have

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[19] *Id.*
[20] *Id.*
[21] *Id.*
[22] *Id.*
[23] *Id.*
[24] *See* EPA, *Health Effects of Ozone Pollution* (2022), https://www.epa.gov/ground-level-ozone-pollution/health-effects-ozone-pollution.

demonstrated that children with asthma experience decrements in lung function and increases in respiratory symptoms when exposed to ozone pollution.[25]

21. The Asthma and Allergy Foundation estimates that 25 million people, or 1 in 13 people, had asthma in the United States as of 2020.[26] Asthma is a leading cause of chronic disease among children in the United States, with over 4 million children in the United States having asthma. It results in over 790,000 emergency room visits and over 64,000 hospitalizations among children.[27] Asthma is a leading cause of missed school days each year and has been linked to diminished school performance.[28]

22. A study of almost 61 million Medicare patients conducted nationwide indicates a significant association between ozone exposure and all-cause mortality, with effects strongest in communities of color and those of low socioeconomic status. Effects were seen at ozone concentrations well below EPA's current health-

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[25] *See, e.g.*, Jaime E. Mirowsky, Lisa A. Dailey, & Robert B. Devlin, *Differential expression of pro-inflammatory and oxidative stress mediators induced by nitrogen dioxide and ozone in primary human bronchial epithelial cells*, 28 Inhalation Toxicology 374 (2016); 2020 ISA, *supra* note 7, at 6-120, 6-160.

[26] Asthma & Allergy Found. of America, *Asthma Facts and Figures* (Mar. 2023), https://aafa.org/asthma/asthma-facts/.

[27] CDC, *Most Recent National Asthma Data – Health Care Use*, https://www.cdc.gov/asthma/most_recent_national_asthma_data.htm (last visited April 11, 2023)

[28] CDC, *Asthma*, https://www.cdc.gov/healthyschools/asthma/index.htm#:~:text=Asthma%20is%20a%20leading%20chronic,are%20likely%20to%20have%20asthma (last visited April 11, 2023)

based standard.[29]

23. Ozone exposure is also associated with health effects other than cardiovascular, metabolic, or respiratory effects. A 2017 study suggested that ozone exposure may be linked to approximately 8,000 stillbirths per year.[30] Prolonged exposure to ozone may also accelerate cognitive decline in the early stages of dementia.[31]

24. In 2015, EPA strengthened the national health-based standard for ground-level ozone, lowering the standard from 75 ppb to 70 ppb. *See* 80 Fed. Reg. 65,292 (Oct. 26, 2015). The record for that rulemaking, however, along with subsequent scientific studies, demonstrates that health effects can occur at much lower levels, especially in sensitive populations. An 8-hour maximum limit of 60 ppb aligns with the 2020 ISA's finding of lung function impairments, pulmonary inflammation, injury, oxidative stress and other respiratory symptoms in children and adults exposed to ozone concentrations at that level or lower.[32] Many health

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[29] Qian Di et al., *Air Pollution and Mortality in the Medicare Population*, 376 New Eng. J. Med. 2513 (2017), https://www.nejm.org/doi/full/10.1056/NEJMoa1702747.

[30] Pauline Mendola et al., *Chronic and Acute Ozone Exposure in the Week Prior to Delivery is Associated with the Risk of Stillbirth*, 14 Int'l J. Env't Res. & Pub. Health 731 (2017), https://www.ncbi.nlm.nih.gov/pubmed/28684711.

[31] Ekaterina Galkina Cleary et al., *Association of Low-Level Ozone with Cognitive Decline in Older Adults*, 61 J. Alzheimer's Disease 67 (2018), https://www.ncbi.nlm.nih.gov/pubmed/29103040.

[32] 2020 ISA, *supra* note 7, at IS-24 to IS-25.

and medical associations also explained that more protective standards are needed. *See* 80 Fed. Reg. at 65,321–23, 65,355.

25. In addition, particular areas of the country are not in attainment with the current 70 ppb standard, and therefore frequently experience even unhealthier levels of air quality. These additionally unhealthy levels of ozone air quality can result in acute respiratory illness and other damaging health outcomes.

Health Effects from Fine Particulate Matter and Sulfur Dioxide Pollution Exposure

26. I am aware that the Federal Implementation Plan is also expected to result in reductions of fine particulate matter ("$PM_{2.5}$") and sulfur dioxide ("SO_2") pollution.

27. Particulate pollution, often called "soot," is a mixture of directly emitted particles, and tiny "secondary" particles formed in the atmosphere from SO_2, NOx, volatile organic compounds, and ammonia. The smallest particles are considered the most dangerous (particularly those less than 2.5 microns in diameter), as they are easily inhaled and reach deep into the lungs where they can trigger an inflammatory response. Similar to ozone pollution, particulate pollution

poses the highest risks for people with heart or lung disease, elderly people, and children.[33]

28. EPA has set a national ambient air quality standard to protect human health against the harms caused by $PM_{2.5}$ at12 micrograms per cubic meter ("$\mu g/m^3$"), as an annual average, 78 Fed. Reg. 3086 (Jan. 15, 2013), and the latest scientific evidence demonstrates far more protective standards are needed.[34] EPA recently proposed to strengthen the annual $PM_{2.5}$ standard to 9–10 $\mu g/m^3$. *See* 88 Fed. Reg. 5558 (Jan. 27, 2023). Numerous public health and medical organizations and experts called for an even stronger standard to properly protect human health.

29. According to the American Lung Association, nearly one in five people in the United States—more than 63.7 million—live in an area with too many days with unhealthy spikes in particle pollution, and more than 18.8 million people suffer from unhealthy year-round levels of particle pollution.[35] In the last few years, many U.S. cities reached their highest number of days with unhealthy levels of particle pollution ever reported.

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[33] *See* Am. Lung Ass'n, *Particle Pollution* (2022), https://www.lung.org/our-initiatives/healthy-air/outdoor/air-pollution/particle-pollution.html.
[34] *See* EPA, *Integrated Science Assessment (ISA) for Particulate Matter* (2019), https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=347534 ("2019 PM ISA"); EPA, *Supplement to the 2019 Integrated Science Assessment for Particulate Matter* (2022), https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=354490 ("2022 Supplement to PM ISA").
[35] *See* Am. Lung Ass'n, *State of the Air 2023*, *supra* note 3, at 13, 15.

30. Notably, the nation's limited network of fixed-site air pollution monitors does not detect all areas with elevated pollution levels. In 2018, a study compared satellite-derived data on $PM_{2.5}$ concentrations to data from the nation's monitors and found that more than 24 million people are living in areas with unhealthy levels of $PM_{2.5}$ that had been misclassified by EPA as healthy.[36]

31. Fine particulate matter, $PM_{2.5}$, is associated with a host of adverse health effects, including premature death, decreased lung function, allergic responses, chronic obstructive pulmonary disease, lung cancer, and both acute and chronic cardiovascular effects.[37] Whether measured against the current standard or any of the amended standards EPA is considering adopting, current ambient concentrations of particulate matter are considered a health risk in many locations throughout the country.[38]

32. According to a study published in the Proceedings of the National Academy of Sciences, $PM_{2.5}$ air pollution exposure is the largest environmental health risk factor in the United States, causing more than 100,000 premature deaths

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[36] Daniel M. Sullivan & Alan Krupnick, Resources for the Future, *Using Satellite Data to Fill the Gaps in the US Air Pollution Monitoring Network* 2 (2018), https://www.rff.org/publications/working-papers/using-satellite-data-to-fill-the-gaps-in-the-us-air-pollution-monitoring-network/.

[37] *See* 2019 PM ISA; 2022 Supplement to PM ISA.

[38] *See* EPA, PM2.5 Design Values, 2022, tbl.4a (County-level Design Values for the 2012 Annual PM2.5 NAAQS), https://www.epa.gov/system/files/documents/2023-05/PM25_DesignValues_2020_2022_FINAL_05_23_23.xlsx.

in 2011.[39] A study of more recent data concluded similar estimates of premature death per year associated with PM exposure.[40] People of color are exposed to particulate matter at higher rates. A 2021 study found that Black Americans are exposed to 21% greater $PM_{2.5}$ concentrations than the average American, while white Americans are exposed to 8% *lower* $PM_{2.5}$ concentrations than the average American.[41] And Black Americans are disproportionately exposed to $PM_{2.5}$ specifically from coal-fired power plants.[42]

33. A recent study, using a sample three times larger than all previous research combined, provides comprehensive evidence of the relationship between $PM_{2.5}$ and cardiac arrests. The study concluded that there is an increased risk of out-of-hospital cardiac arrest (OHCA) even from short-term exposure to low concentrations of $PM_{2.5}$.[43]

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[39] Andrew L. Goodkind et al., *Fine-scale damage estimates of particulate matter air pollution reveal opportunities for location-specific mitigation of emissions*, 116 Proc. Nat'l Acad. Sci. 8775 (2019), https://doi.org/10.1073/pnas.1816102116.
[40] Industrial Economics, *Analysis of PM2.5-Related Health Burdens Under Current and Alternative NAAQS* (2023), https://globalcleanair.org/files/2023/03/Updated-IEc-PM-NAAQS-Analysis-March-2023.pdf.
[41] Christopher W. Tessum et al., *$PM_{2.5}$ polluters disproportionately and systemically affect people of color in the United States*, 7 Science Advances (2021), https://www.science.org/doi/10.1126/sciadv.abf4491.
[42] *Id.* at 2, Fig. 1, H.
[43] Bing Zhao et al., *Short-term exposure to ambient fine particulate matter and out-of-hospital cardiac arrest: a nationwide case-crossover study in Japan*, 4 Lancet E15 (2020), https://www.thelancet.com/journals/lanplh/article/PIIS2542-5196(19)30262-1/fulltext.

34. According to EPA's Regulatory Impact Analysis for the Proposed Reconsideration of the National Ambient Air Quality Standards for Particulate Matter, released in December 2022 in parallel with the proposed revisions to the $PM_{2.5}$ National Ambient Air Quality Standards, the accumulation of published studies serves to strengthen the case for a causal association between PM exposure and respiratory inflammation and infection leading to premature mortality in children under five years of age.[44] In this document, EPA cites the findings of the Science Advisory Board – Health Effects Subcommittee,[45] which in turn references numerous corroborating studies linking PM exposure to many adverse health outcomes. The Regulatory Impact Analysis also cites a study by Woodruff et al. that finds associations between $PM_{2.5}$ and infant mortality.[46] More recent studies have found connections between $PM_{2.5}$ and preterm births, as well as low infant birth weight.[47]

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[44] *See* EPA, *Regulatory Impact Analysis for the Proposed Reconsideration of the National Ambient Air Quality Standards for Particulate Matter*, EPA-452/P-22-001 (2022), https://www.epa.gov/system/files/documents/2023-01/naaqs-pm_ria_proposed_2022-12.pdf.

[45] EPA Science Advisory Board Health Effects Subcommittee, *SAB Advice on the Use of Economy-Wide Models in Evaluating the Social Costs, Benefits, and Economic Impacts of Air Regulations*, EPA-SAB-17-012 (2017).

[46] *See* Tracey J. Woodruff, Jennifer D. Parker, & Kenneth C. Schoendorf, *Fine Particulate Matter (PM2.5) Air Pollution and Selected Causes of Post-Neonatal Infant Mortality in California*, 114 Env't Health Persp. 786 (2006).

[47] Rakesh Ghosh et al., *Ambient and household PM2. 5 pollution and adverse perinatal outcomes: A meta-regression and analysis of attributable global burden for 204 countries and territories*, 18 PLoS Med. 1 (Sep. 28, 2021).

35. With the publication of numerous studies involving the collection of data over an extended period of time,[48] the evidence linking particulate matter with premature mortality, significant lung damage, and other significant adverse health effects is strong. The extended observational period of these studies, combined with more sophisticated exposure assessments, continues to strengthen the evidence that particulate matter poses a significant health threat at current levels of exposure. A study released in 2012 reaffirmed decades' worth of analyses on the association of particulate pollution exposure to increased risk of premature mortality. The study found that every increase of 10 $\mu g/m^3$ in $PM_{2.5}$ pollution was associated with a 14% increased risk of "all-cause" mortality, a 26% increase in cardiovascular death, and a 37% increase in lung cancer death.[49]

36. The consistency of the data on $PM_{2.5}$ makes it possible to quantify the health benefits of reducing this type of pollution for a suite of health indicators,

[48] *See, e.g.*, Daniel Krewski et. al., *Extended Follow-Up and Spatial Analysis of the American Cancer Society Study Linking Particulate Air Pollution and Mortality*, Health Effects Inst. Res. Rep. 140 (2009); M. Brauer et al., *Air Pollution and Development of Asthma, Allergy and Infections in a Birth Cohort*, 29 Eur. Respiratory J. 879 (2007); W. James Gauderman et al., *Effect of Exposure to Traffic on Lung Development from 10 to 18 Years of Age: a Cohort Study*, 369 Lancet 571 (2007); Francine Laden et al., *Reduction in Fine Particulate Air Pollution and Mortality Extended Follow-up of the Harvard Six Cities Study*, 173 Am. J. Respiratory & Critical Care Med. 667 (2006).

[49] Johanna Lepeule et al., *Chronic Exposure to Fine Particles and Mortality: An Extended Follow-up of the Harvard Six Cities Study from 1974 to 2009*, 120 Env't Health Persp. 965 (2012).

including: premature mortality, bronchitis, hospital admissions for both respiratory and cardiovascular events, emergency room visits for asthma, nonfatal heart attacks, lower and upper respiratory illness, minor restricted-activity days, work loss days, asthma exacerbations, respiratory symptoms (asthmatic population), and infant mortality.[50]

37. Sulfur oxides are a group of ambient air pollutants emitted during the burning or combustion of fossil fuels and other industrial processes. Among them, SO_2 is the pollutant that causes the greatest concern for public health.

38. EPA has established health-based standards for SO_2, using the pollutant as an indicator for the full group of sulfur oxides. EPA reaffirmed in 2019 that a 1-hour daily maximum standard at a level of 75 ppb was necessary to protect human health. *See* 84 Fed. Reg. 9,866 (April 18, 2019).

39. Short-term exposure to SO_2 is linked to adverse respiratory effects, especially for at-risk populations such as those with asthma or other respiratory conditions.[51] Epidemiological studies link short-term SO_2 exposure to asthma-related hospital admissions, especially for children.[52]

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[50] *Id*.
[51] EPA, *Integrated Science Assessment (ISA) for Sulfur Oxides – Health Criteria*, EPA/600/R-17/451 (2017), https://www.epa.gov/isa/integrated-scienceassessment-isa-sulfur-oxides-health-criteria.
[52] *Id.* at xlix.

40. SO_2 emissions also react with other components in the air to form harmful PM.[53]

Dangerous Air Pollution Will Decrease as a Result of the Federal Implementation Plan

41. I am aware that the Federal Implementation Plan will require electric generating units and certain other industrial stationary sources in covered upwind states to reduce NOx emissions. The Federal Implementation Plan will result in a decrease in levels of ground-level ozone in downwind states because the concentration of ambient NOx, a critical component of ozone creation, will decrease.

42. Starting in 2023, the Federal Implementation Plan will achieve substantial emission reductions from covered sources in upwind states. EPA found that the rule, if fully implemented, would reduce NOx emissions by 10,000 tons in the 2023 ozone season, 21,000 tons in the 2024 ozone season, 32,000 tons in the 2025 ozone season, and 70,000 tons in the 2026 ozone season.[54] In addition to reducing NOx, the rule is also expected to reduce harmful SO_2 and $PM_{2.5}$ pollution

[53] EPA, *Sulfur Dioxide (SO_2) Pollution* (Feb. 16, 2023), https://www.epa.gov/so2-pollution/sulfur-dioxide-basics.

[54] EPA, *Regulatory Impact Analysis for the Final Federal Good Neighbor Plan Addressing Regional Ozone Transport for the 2015 Ozone National Ambient Air Quality Standard* 315-16 (2023), https://www.epa.gov/system/files/documents/2023-03/SAN%208670%20Federal%20Good%20Neighbor%20Plan%2020230315%20RIA_Final.pdf.

from covered sources. Reductions in NOx, SO_2, and $PM_{2.5}$ pollution will have a positive impact on the health of people who live, work, and attend school near covered sources.

43. EPA's analysis further shows that the NOx emissions reductions required by the Federal Implementation Plan will result in profound health and economic benefits for residents of downwind states. The reduction in ground-level ozone was expected to prevent 81.5 premature deaths, 110,000 cases of asthma symptoms, 640 cases of asthma onset, and 41,000 million lost school days in 2023.[55] In 2026, the Federal Implementation Plan is expected to prevent over 900 premature deaths, 1.2 million asthma symptoms, onset of 6,600 asthma cases, and 430 million lost school days in downwind states.[56]

44. If the Federal Implementation Plan were delayed, weakened, or set aside, higher levels of NOx, $PM_{2.5}$, and SO_2 would persist in both upwind and downwind states. These elevated levels of pollution will further harm individuals and communities in upwind and downwind states.

[55] *Id.* at 214.
[56] *Id*. at 215-16.

I declare under penalty of perjury that the foregoing is true and correct.

Executed in Charlottesville, Virginia on August 16th, 2023.

Veronica Southerland

Veronica Southerland