ORAL ARGUMENT NOT YET SCHEDULED

UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

American Lung Association, *et al.*,	)	
Petitioners,	)	
v.	)	No. 19-1140 (and consolidated cases)
U.S. Environmental Protection Agency, *et al.*,	)	
Respondents.	)	

PUBLIC HEALTH AND ENVIRONMENTAL PETITIONERS' MOTION TO COMPLETE THE RECORD FOR JUDICIAL REVIEW

Public Health and Environmental Petitioners (petitioners in Nos. 19-1140, 19-1166 and 19-1173) hereby move pursuant to Federal Rule of Appellate Procedure 16(b) for an order requiring respondent Environmental Protection Agency ("EPA") to complete the administrative record by including certain documents in the Certified Index.

These petitions challenge EPA actions, published at 84 Fed. Reg. 32,520 (July 8, 2019), that repealed EPA's Clean Power Plan and replaced it with a new rule, titled the Affordable Clean Energy or "ACE" Rule, that nominally regulates carbon dioxide emissions from coal-burning power plants. This motion seeks to

complete the record to include documents concerning information that became available only after the close of the comment period, which EPA included in the rulemaking docket but has now excluded from the Certified Index to the Record. The documents are:

(1) a peer-reviewed, published research article and cover letter, submitted by the article's authors, addressing the economic and emissions impacts of the proposed ACE rule, based upon EPA's own modeling;

(2) submissions from state attorneys general and nongovernmental groups addressing the implications on the Clean Power Plan and ACE Rule of a major federal interagency report describing the impacts and risks of climate change in the United States;

(3) a comment letter concerning a prominent research firm's report showing a significant rise in carbon dioxide emissions from the U.S. power sector in 2018, including a sharp rise in emissions from natural-gas-fired power plants; and

(4) a newly published report documenting the high cost of existing coal-fired electricity generation relative to new renewable generation throughout most of the United States.

EPA contemporaneously included all of these documents in the electronic docket for the rulemaking, and also included the last document in the Certified Index filed on August 23, 2019. But EPA excluded the first four documents from

that Certified Index filed on August 23 (ECF No. 1803445) and deleted the remaining one in the Corrected Certified Index filed on October 7, 2019 (ECF No. 1809688). The documents provide important support for petitioners' challenges to the agency actions at issue here; they concern issues "of central relevance to the rulemaking." 42 U.S.C. §7607(d)(4)(B)(i). Documents required to be docketed under this provision of the Clean Air Act must also be included in the record for judicial review. *Id.* § 7607(d)(7)(A). Accordingly, the Court should order EPA to complete the record by including them in the Certified Index.

A. BACKGROUND

Fossil fuel-fired power plants are the nation's largest stationary sources of carbon dioxide pollution. Clean Air Act Section 111(d), 42 U.S.C. § 7411(d), directs EPA to issue emission guidelines for states to follow in establishing standards of performance for these sources, based on "the best system of emission reduction . . . adequately demonstrated," *id.* § 7411(a)(1). See *Am. Elec. Power Co. v. Connecticut*, 564 U.S. 410, 424 (2011).

In 2015, EPA promulgated the Clean Power Plan, 80 Fed. Reg. 64,662 (Oct. 23, 2015), to fulfill that statutory obligation. Two years later, the agency proposed to repeal the Clean Power Plan, 82 Fed. Reg. 48,035 (Oct. 16, 2017), and later proposed ACE as a replacement rule. 83 Fed. Reg. 44,746 (Aug. 31, 2018). Unlike the Clean Power Plan, which applied to coal-, oil-, and natural gas-fired

power plants and designated a "best system" that reflected the interconnected nature of the power sector and the full set of tools power companies actually use to manage emissions, ACE was premised solely on small improvements in the operating efficiency of coal-fired power plants.

On July 8, 2019, EPA issued a final rule that both rescinded the Clean Power Plan and finalized the ACE rule. 84 Fed. Reg. 32,520 ("Final Rule"). Petitions for review from Public Health and Environmental Petitioners, state and local governments, private companies and trade associations have been consolidated under No. 19-1140.

B. THE DOCUMENTS ADDRESSED IN THIS MOTION

The public comment period on EPA's ACE proposal ran from August 31, 2018, to October 31, 2018. As noted above, the Final Rule was published in the Federal Register on July 8, 2019. This motion concerns comment letters and related documents submitted after the comment period closed but well before the rule was finalized – each addressing important information and analysis that became available only after the comment period closed.

1. Peer-Reviewed Economic Analysis of the Rebound Effect from the ACE Proposal. On January 18, 2019, researchers from Boston University, Harvard School of Public Health, Resources for the Future, Science Policy Exchange, and Syracuse University submitted to EPA's docket their study entitled

"The Affordable Clean Energy Rule and the Impact of Emissions Rebound on Carbon Dioxide and Criteria Air Pollutant Emissions," which had been accepted for publication (and was later published) in the peer-reviewed journal ENVIRONMENTAL RESEARCH LETTERS. *See* Exhibit A (hereinafter "*Emissions Rebound Study*"). The article "uses results from EPA's Integrated Planning Model to compare the illustrative ACE scenarios to a no-policy scenario and a Clean Power Plan scenario," finding "that heat rate [*i.e.*, combustion-efficiency] improvements at regulated coal plants could lead to an emissions rebound effect, in which generation and emissions at those plants increase." *Id.* at 1. The study found that ACE "is expected to lead to increased CO_2 emissions at 28 percent of regulated coal plants in 2030 compared to no policy." *Id.* The *Emission Rebound Study* strongly corroborates, and provides key analytical support for, an objection expressed by numerous commenters during the comment period: that a rule based solely on improving the efficiency of coal-fired power plants was likely to achieve minimal overall reductions in power-sector carbon dioxide emissions, and actually threatened to *increase* emissions of carbon dioxide and other, locally harmful pollutants such as sulfur dioxide and nitrogen oxides from many plants.

Soon after submission, EPA placed the comment and the study in the docket as EPA-HQ-OAR-2017-0355-26648. However, the agency later excluded them from the Certified Index filed with this Court.

2. Comment Letters Regarding the *Fourth National Climate Assessment,* Volume II. On November 23, 2018, the US Global Change Research Program published its FOURTH ANNUAL NATIONAL CLIMATE ASSESSMENT, VOLUME II: IMPACTS, RISKS AND ADAPTATION IN THE UNITED STATES ("*Assessment*"), pursuant to the Global Change Research Act of 1990, 15 U.S.C. § 2936. As the comprehensive, interdisciplinary work of experts at EPA and twelve other federal agencies, the *Assessment* represents the federal government's most up-to-date understanding of the consequences of climate change for the United States. The report demonstrates that absent greater reductions in greenhouse gas pollution, "climate change is projected to impose substantial damages on the U.S. economy, human health, and the environment" and that unmitigated climate change could cause "irreversible" physical and ecological impacts. *Id.* at 1347.

Twenty state attorneys general filed two comment letters on December 11 and 21, 2018, attaching the *Assessment* and highlighted in detail its central relevance to various aspects of this rulemaking. See Exhibit B (containing both letters). On December 13, 2018, health and environmental groups also filed a comment letter attaching the *Assessment* and explaining its central relevance to the rulemaking. Exhibit C. These comments explained how the *Assessment*'s updated evaluation of health and environmental hazards from greenhouse gas pollution is centrally relevant to key issues in the ACE rulemaking, including the appropriate

degree of emission limitation under the Act, and the benefits of reducing (and costs of not reducing) emissions. *See, e.g.*, Ex. B, States' December 21 Letter at 8-9 (discussing how portions of the *Assessment* concerning electric power generation undercut EPA's proposed actions and its supporting reasoning); *id.* at 10-14 (describing impacts and hazards of climate change as undercutting proposed repeal of the Clean Power Plan and adoption of ACE rule); *id.* at 14-17 (describing how the *Assessment* calls into question EPA's economic analysis and highlights the economic benefits of reducing emissions that the proposal ignores).

EPA placed the comments in the electronic rulemaking docket soon after. Docket ID No. EPA-HQ-OAR-2017-0355-26640 (containing both state letters); Docket ID No. EPA-HQ-OAR-2017-0355-26637 (health and environmental organizations' comments). However, EPA excluded these documents from the Certified Index filed on August 23, 2019. After petitioners complained about that exclusion, EPA responded that it would amend the Certified Index to include the *Assessment* itself, but still declined to include the comment letters addressing the *Assessment*'s import for the rulemaking.

3. Comment Letter on Rhodium Group Report on 2018 Carbon Dioxide Emissions. On January 31, 2019, health and environmental groups submitted newly available research from Rhodium Group estimating the nation's carbon dioxide emissions for the first ten months of 2018 and finding a significant

increase in emissions (calculated by Rhodium at 34 million metric tons) compared the same period in 2017. *See* Comment of Center for Biological Diversity, *et al.*, concerning Rhodium Group, Energy & Climate Staff, Preliminary US Emissions Estimates for 2018 (Jan. 8, 2019) (*Rhodium Emissions Report*), submitted January 31, 2019, Docket ID No. EPA-HQ-OAR-2017-0355-26647 (Exhibit D). As the groups' comment letter demonstrated, this document is of central relevance to the rulemaking because, among other reasons, it contradicts the ACE proposal's contention that regulatory limits on power-sector carbon dioxide emissions are less urgent because "market forces" and other trends are "expected to result in declining power sector [carbon dioxide] emissions," 83 Fed. Reg. 44,746, 44,750 (Aug. 31, 2018), potentially rendering regulatory efforts "redundant," *id*. at 44,751.

Commenters argued that the *Rhodium Emissions Report* "indicates that power sector emission trends in fact contradict EPA's factual assumption and directly refutes the Proposal's implication that no—or only partial—regulation of existing fossil fuel-fired power plants is necessary to mitigate greenhouse gas emissions." *See* Exhibit D at 2. Commenters also noted that the significant rise in emissions documented by the Rhodium report was driven by a major increase in natural gas-fired generation, highlighting the compelling need for EPA to fulfill its duty under Section 111(d) to control pollution from natural gas-fired plants, which the agency had excluded from the ACE proposal. *Id.*

As in the other instances, EPA placed this comment in the electronic rulemaking docket. EPA-HQ-OAR-2017-0355-26647. The Response to Comment documents shows that EPA actually considered it.[1] But EPA nonetheless later excluded both the comment letter and the attached report from the Certified Index.

4. Comment Letter on "Coal Cost Crossover" Study. On April 12, 2019, Sierra Club submitted a comment letter concerning a report titled *The Coal Cost Crossover: Economic Viability of Existing Coal Compared to New Local Wind and Solar Resources*, published in March 2019 by Energy Innovation: Policy and Technology, LLC and Vibrant Clean Energy, LLC ("*Coal Cost Crossover Study*") (Exhibit E (comment without attachments)). The study analyzes the marginal costs of operating and maintaining the existing coal-fired power plants in the United States, as well as the levelized cost of electricity of new wind and solar resources throughout the country. It concludes that in 2018, approximately 74 percent of existing coal-fired generation could be replaced with new, cheaper wind or solar resources within a 35-mile range, and nearly 33 percent of coal units could be replaced with proximately-located new wind or solar resources that are at least 25

[1] EPA's Responses to Public Comments on the EPA's Proposed Emission Guidelines for Greenhouse Gas Emissions from Existing Electric Utility Generating Units, Ch. 10, p. 31 (June 2019) ("Other commenters stated that … a new study by Rhodium Group estimated that 2018 power sector CO2 emissions increased by 34 million metric tons"), EPA-HQ-OAR-2017-0355-26741.

percent cheaper. Sierra Club also submitted both the study and its underlying data files. This study relates to matters central to the economic and environmental analysis EPA must perform under the Clean Air Act and is thus centrally relevant to the rulemaking.

EPA placed the *Coal Cost Crossover Study* in the electronic docket as EPA-HQ-OAR-2017-0355-26650. The agency subsequently included the document in EPA's Certified Index filed on August 23, 2019, Certified Index, p. 6 (ECF No. 1803445), but omitted it from the Corrected Certified Index filed on October 7, 2019 (ECF No. 1809688).

* * * * *

In each instance, the comment letters and documents at issue were submitted promptly after the relevant underlying studies or information became available, and many months before the issuance of the Final Rule. In each case, EPA entered them in the rulemaking docket. Only after issuing the final rule did EPA decide to exclude these docketed materials from the Certified Index.

In response to requests that EPA correct the Certified Index to include these documents, litigation counsel for EPA responded that the agency "had not determined" the documents are of central relevance to the rulemaking. *See* Letter from Benjamin Carlisle, U.S. Department of Justice, to Sean H. Donahue and Michael J. Myers at 2 (Sept. 27, 2019) (Exhibit F). However, EPA has

provided no such determination, still less explanation for it, with respect to any of the documents in question.

ARGUMENT

A. Statutory Standards Governing the Compilation of the Record

Judicial review of Clean Air Act rulemaking is confined to the administrative record, the content of which is defined by statute. 42 U.S.C. § 7607(d)(7)(A). This Court has the authority to direct an agency to correct "any omission" in the record. Fed. R. App. P. 16(b); *see Lead Indus. Ass'n v. EPA*, 647 F.2d 1130, 1183 (D.C. Cir. 1980) (parties may seek order that the agency include in review record materials "required by the statute and wrongfully omitted by EPA").

Section 307(d) of the Clean Air Act contains detailed requirements governing the rulemaking process and judicial review. 42 U.S.C. § 7607(d). While these provisions prize orderly, timely and conclusive administrative action, the "legislative history of Section 307(d) cautions the Agency against attempting to create a one-sided record by excluding from it material unfavorable to the Agency's position." *Lead Indus. Ass'n*, 647 F.2d at 1183 (citing H.R. Rep. No. 95-294 at 320 (1977)).

Under the statute, EPA must establish a "rulemaking docket" beginning "[n]o later than the date of proposal of any action to which [subsection 307(d)]

applies." 42 U.S.C. § 7607(d)(2). With respect to placing comments and other submissions in the docket, the statute provides:

> Promptly upon receipt by the agency, all written comments and documentary information on the proposed rule received from any person for inclusion in the docket during the comment period shall be placed in the docket. … All documents which become available after the proposed rule has been published and which the Administrator determines are of central relevance to the rulemaking shall be placed in the docket as soon as possible after their availability.

42 U.S.C. § 7607(d)(4)(B)(i).[2]

The statute defines "the record for judicial review" to include materials included in the docket pursuant to clause 307(d)(4)(B)(i). *See* Section 307(d)(7)(A), 42 U.S.C. § 7607(d)(7)(A) ("The record for judicial review shall consist exclusively of the material referred to in paragraph (3), *clause (i) of paragraph (4)(B),* and subparagraphs (A) and (B) of paragraph (6).") (emphasis added). The only docketed dockets that are *not* included in the record under this provision are those described by Section 307(d)(4)(B)(ii) (which are related to interagency review).

[2] In the pre-Internet age, EPA implemented these provisions by maintaining a paper docket in a docket room filled with filing cabinets full of both agency-generated documents and comments from members of the public. Now EPA maintains the docket electronically. Unlike with the Court's electronic filing system, however, comments submitted to the agency are not posted automatically for public view on the electronic docket. Rather, agency personnel screen and then post them, usually after at least a few days' delay.

Congress enacted the Act's distinctive docket and record provisions in the 1977 amendments, establishing a carefully prescribed procedure for compiling the record contemporaneously during the rulemaking, to replace the practice of reconstructing the record "historically" at the end of Clean Air Act rulemakings. *See* H.R. REP. No. 95-294, at 319-20 (1977) (citing and adopting the approach advocated in Pedersen, *Formal Records and Informal Rulemaking*, 85 Yale L.J. 38 (1975)).

As the House Committee stated when adopting these provisions: "the agency has at least as great an obligation to include any such documents that contradict its position as it does to include those that support it." H.R. Rep. No. 95-295, at 320 (1977). *See also Lead Indus. Ass'n*, 647 F.2d at 1183.

With respect to comments submitted after the close of the comment period but well before the agency takes final action, EPA's practice over several decades has been inclusive. In the Clean Power Plan rulemaking, for example, the agency placed many such comments in the docket and included them in the Certified Index to the Record.[3] In Movants' experience it is, at the least, highly unusual for EPA to

[3] *See, e.g.*, Record Index for Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, No. 15-1363 at p.1504 (D.C. Cir. Dec. 21, 2015), ECF No. 1589852 (including June 15, 2015 substantive comments filed on behalf of the Utility Air Regulatory Group, about six weeks before the final rule was signed on August 3, 2015).

exclude docketed documents – with or without making an explicit determination as to central relevance – when compiling the Certified Index after litigation has commenced.

B. EPA's Exclusion of the Documents from the Certified Index is Unjustified.

As explained above, all of the documents at issue were contemporaneously included in the rulemaking docket. After the completion of the rulemaking, however, EPA excluded them from the Certified Index. The agency does not have valid grounds for excluding the documents.

As an initial matter, this belated exclusion of the documents is out of step with the carefully prescribed procedure set forth in Section 307(d). During the rulemaking, EPA (correctly) placed each of these documents in the docket, without disagreeing with commenters' demonstrations that the documents were of central relevance. EPA now asserts the power to exclude these materials from the record for review, and without any explanation. This procedure recalls the post hoc, ad hoc, and selective approach to record materials that the 1977 reforms were intended to banish. *See* Pederson, 85 Yale L.J. at 72-73.

Even if EPA enjoys some power to exclude docketed materials from the record for judicial review after the rule is finalized, the agency had no discretion to exclude the particular documents at issue here. EPA may have some latitude in deciding during the course of the rulemaking what materials should be deemed

centrally relevant, but the statute does not give the agency a blank check even then, let alone *after* the rulemaking is over. To the contrary, the statute imposes a mandatory obligation; centrally relevant documents "*shall* be placed in the docket as soon as possible after their availability." Section 307(d)(4)(B)(i) (emphasis added). *See also American Petroleum Inst. v. Costle*, 665 F.2d 1176, 1190 (D.C. Cir. 1981) (Section 307(d)(4)(B)(i) "*requires* the Administrator to place in the docket all documents, even those not submitted during the comment period, determined to be 'centrally relevant' to the rulemaking.") (emphasis added).[4]

EPA's decision not to include a document submitted after the comment deadline is reviewable and subject to reasoned decision-making requirements. *See id.* (reviewing EPA's decision to not to include late comments and concluding that agency "correct[ly]" determined that subject-matter of comments was legally irrelevant to rulemaking); *see also Appalachian Power Co. v. EPA*, 249 F.3d 1032, 1059 (D.C. Cir. 2001) (upholding EPA's decision to disregard materials submitted by state of North Carolina because the agency had "already finalized" the relevant portions of the rulemaking by the time the state submitted the materials). *See also* 42 U.S.C. § 7607(d)(8) (providing for judicial review of "procedural

[4] It would obviously be unlawful for EPA to adopt a *per se* exclusion of all comments submitted after the comment period, as that would render 42 U.S.C. § 7607(d)(4)(B)(i) a nullity.

determinations made by the Administrator under this subsection" "at the time of substantive review of the rule.").

Thus, even if EPA's recent decision to exclude the documents from the record were (charitably) deemed an implicit judgment that the documents are not "of central relevance," any such judgment is subject to review here. The Court should find that EPA's course reversal after including these materials in the docket unreasonable, especially in light of the agency's duty to include both information unhelpful to its position, since each of the disputed documents – submitted well before finalization of the rule – is demonstrably of central relevance to the rulemaking.

1. The *Emissions Rebound Study* Is of Central Relevance to the Rulemaking.

The *Emissions Rebound Study* is plainly of "central relevance" to the ACE rulemaking. As far as Movants are aware, this is the only peer-reviewed analysis submitted to the docket that specifically examines the proposed ACE rule's potential to cause increased generation and emissions at coal-fired power plants across the country. Among other things, the authors explain how the coal-fired plant efficiency improvements that EPA designated as the "best system of emission reduction" can incentivize increased operation – thereby *increasing* emissions of carbon dioxide and other pollutants – at coal-fired power plants. *Emissions Rebound Study* at 2.

The study utilizes EPA's own modeling platform to demonstrate that the heat-rate improvements contemplated by the proposed ACE rule would increase annual carbon dioxide emissions at 28 percent of the nation's coal-fired power plants by 2030, relative to what would be expected with no rule in place. *Id.* at 5. The authors also compare EPA's projections of carbon dioxide emissions at a national level both for individual years and on a cumulative basis, demonstrating that more aggressive deployment of the ACE Rule's heat-rate-only "best system" can *increase* overall levels of carbon pollution rather than decrease them. *Id.* at 11, Table 1. In addition, the study finds that under ACE as many as 19 states would see increases in sulfur dioxide pollution in 2030, and 20 states and the District of Columbia would see increases in nitrogen oxides pollution in 2030, compared to no rule at all. *Id.* at 6.

In short, the study speaks directly and authoritatively to the risk that the coal-fired plant efficiency improvements required by ACE will have a "rebound effect" that will undermine the carbon pollution reductions the rule purports to achieve, and that will cause higher levels of health-harming pollution in many states. These impacts are central to evaluating the effects of the ACE Rule's approach on air pollution, which is a statutory factor that EPA must consider when it designates a "best system" under section 111 of the Act. *See* 84 Fed. Reg. at 32,532 n.151 (citing *Sierra Club v. Costle*, 657 F.2d 298, 326 (D.C. Cir. 1981)).

Indeed, EPA specifically requested comment on the "rebound effect" in the proposed ACE Rule, and EPA recognized there that the rebound effect was a principal reason why earlier, in the Clean Power Plan, the agency had rejected heat rate improvements, standing alone, as the "best system." 83 Fed. Reg. at 44,756; *id.* at 44,761.[5]

EPA has given no reason to exclude the *Emissions Rebound Study* – nor could it. *Cf. Am. Petroleum Inst.*, 665 F.2d at 1190. Regarding the potential rebound effect, EPA stated:

> The modeling and analysis show individual units and the entire coal fleet reducing emission rates, as well as an aggregate decrease in mass emissions. As such, any potential "rebound effect" is determined to be small and manageable (if necessary) and does not require any specific remedy in the final rule.

84 Fed. Reg. 32,520, 32,543 (July 8, 2019). Omitted here is any consideration of mass emissions at the level of individual sources—an analysis the *Emissions Rebound Study* furnishes in detail. A rule that *increases* emissions at large numbers of individual sources even while identifying a "source-oriented" "best system of emission reduction" is arbitrary and inconsistent with the manifest purpose of

[5] Several Movants addressed the rebound effect in their comments. E.g., EPA-HQ-OAR-2017-0355-24260 (joint environmental group comments on "best system" issues) at 59-60; EPA-HQ-OAR-2017-0355-23806 (Clean Air Task Force comments) at 18-41.

Section 111 to reduce air pollution and its attendant harms to public health and welfare.

A peer reviewed study, by highly qualified, independent experts, dedicated entirely to a detailed technical evaluation of the agency's proposed rule, relying upon the agency's own modeling, is not only "centrally relevant"; it is exactly the kind of submission that EPA – or any agency – should welcome as a valuable aid to devising sound policy. While the study was published and submitted two-and-a-half months after the comment period closed, the commenters promptly submitted it once the technical work and peer-review were completed – and, in any event, Section 307(d)(4)(B)(i) is explicit that the passing of the comment-deadline alone is not grounds for rejecting centrally relevant documents. EPA thus acted arbitrarily in excluding the *Emissions Rebound Study* from the Certified Index.

1. The Comments on the *Fourth National Climate Assessment* Are Centrally Relevant.

As noted above, in response to objections from Petitioners, EPA agreed to amend the Certified Index to add the *Fourth National Climate Assessment* itself, but declined to accept the comments from state attorneys general and public health and environmental groups documenting how that major governmental report bears on the rulemaking. For the same reason that (as EPA now acknowledges) the *Assessment* itself belongs in the record, so too do the comments that detail how the *Assessment*'s findings should have been considered in determining the appropriate

standard of performance and when analyzing the health, environmental, and economic consequences of EPA's proposal. *See* pp. 6-7, *supra*; Exhibits B & C. EPA has provided no basis to support its course of action regarding those comments.

2. The *Rhodium Emissions Report* Is Centrally Relevant.

Similarly, the *Rhodium Emissions Report* and the accompanying comments are centrally relevant for reasons explained above and in the comment itself. *See* Exhibit D. The comment and Report undercut the proposal's suggestion that the need for regulatory controls on carbon dioxide emissions from power plants has been reduced or eliminated by market-driven trends that EPA projected would continue. *Id.* at 1-2. Especially significant is the report's data on recent sharp increases in natural gas-fired power plant emissions, *id.* at 2, which directly support Petitioners' concerns (which were raised in timely comments) that the ACE rule unlawfully and arbitrarily leaves carbon dioxide pollution from natural gas-fired power plants wholly unregulated. *See, e.g.*, Comments of Appalachian Mountain Club, *et al.*, Document ID No. EPA-HQ-OAR-2017-0355-24260, at 61-64 (Oct. 31, 2018). As noted above, the Response to Comment document shows EPA did consider these documents. *Supra*, pp. 8-9 & n.1. Both the *Rhodium Emissions Report* and the public comment about it are of "central relevance" to the rulemaking and properly part of the record for judicial review.

3. The *Coal Cost Crossover Report* is Centrally Relevant.

EPA has not provided any basis to exclude the Coal Cost Crossover study and accompanying comment from the record, let alone *remove* them from the Certified Index after they were included. This submission is centrally relevant to the rulemaking; it demonstrates that the substantial majority of existing coal-fired plants – the very sources regulated under the ACE Rule – could now be replaced with new zero-emitting resources that are cheaper. *See* Exhibit E. That point is relevant to numerous key issues in this rulemaking, especially to EPA's current claim that the Clean Power Plan's approach to regulation, which allowed sources to reduce emissions by adopting cleaner generation, would have such significant or "transformative" economic impacts as to warrant special skepticism under the so-called "major questions" doctrine. 82 Fed. Reg. 48,035, 48,032 (Oct. 16, 2017). *See also* Exhibit E at 2.

C. The Act's Administrative Reconsideration Provision Does Not Alter EPA's Obligation to Include the Documents in the Certified Index.

EPA is expected to argue that Movants must file a petition for administrative reconsideration in order to pursue their complaints about the exclusion of the documents. *See* Exhibit F at 2. That argument is incorrect.

Section 307(d)(4)(B)(i), addressing docketing of post-comment period materials, is distinct from Section 307(d)(7)(B), the provision dealing with reconsideration. The latter provides that "[on]ly an objection to a rule or procedure

which was raised with reasonable specificity during the period for public comment (including any public hearing) may be raised during judicial review," and requires EPA to convene administrative reconsideration proceedings if an "objection" that could not practicably be raised during the comment period "is of central relevance to the outcome of the rule[.]" 42 U.S.C. § 7607(d)(7)(B).

Section 307(d)(4)(B)(i) addresses a different problem. The treatment of comments and other documents that become available after the close of the comment period is different from the handling of "objections" that were not presented to the agency during the comment period. A post-comment-period submission is "of central relevance" if it provides important evidentiary or legal support for an objection or argument that *was* made during the comment period. In contrast, Section 307(d)(7)(B)'s mandatory exhaustion and reconsideration requirements are triggered only when the relevant "objection" was not raised during the comment period, *see Clean Air Council v. Pruitt*, 862 F.3d 1, 8 (D.C. Cir. 2017). Centrally relevant documents submitted after the comment period that support an argument or objection made during the comment period do not require exhaustion via reconsideration petition.

The materials at issue here provide key support for objections already made during the comment period. For example, Petitioners' rulemaking comments, for example, already objected that the proposed ACE Rule's definition of "best

system" would, perversely, increase emissions at many coal plants by encouraging increased operation of those plants. *See* p. 18 & n.5, *infra*. But the peer-reviewed *Emissions Rebound Study*, produced by independent experts using EPA's own data, provided critical support for those objections by examining that issue in detail using formal methods and quantifying the gravity of the "rebound" problem. EPA therefore had a mandatory duty to include the study in the docket under Section 307(d)(4)(B)(i). EPA may not shirk its duty to include centrally relevant documents such as the *Emission Rebound Study* by recharacterizing them as late-arising "objections" subject exclusively to the administrative reconsideration process.

The same points apply to the other submissions at issue in this motion. These post-comment period, pre-finalization submissions provide important evidence for objections that Petitioners and others made during the comment period. They are of central relevance to the rulemaking, and under Section 307(d)(4)(B)(i) and 307(d)(7)(A), they must be included in the record for judicial review. EPA cannot lawfully relegate these centrally relevant documents to obscurity by demanding that they be the subject of administrative reconsideration petitions.

CONCLUSION

For the foregoing reasons, the Court should direct EPA to correct the Certified Index to include the documents identified in this motion.

Respectfully submitted,

/s/ Sean H. Donahue

/s/ Joanne Spalding
Joanne Spalding
Sierra Club
2101 Webster Street, Suite 1300
Oakland, CA 94612
(415) 977-5725
joanne.spalding@sierraclub.org

Alejandra Núñez
Andres Restrepo
Sierra Club
50 F Street NW, 8th Floor
Washington, DC 20001
(202) 650-6062
alejandra.nunez@sierraclub.org
andres.restrepo@sierraclub.org

Vera Pardee
Law Office of Vera Pardee
726 Euclid Avenue
Berkeley, CA 94708
(858) 717-1448
pardeelaw@gmail.com
Counsel for Sierra Club

Sean H. Donahue
Susannah L. Weaver
Donahue, Goldberg, Weaver,
& Littleton
1008 Pennsylvania Ave., SE
Washington, DC 20003
(202) 277-7085
sean@donahuegoldberg.com
susannah@donahuegoldberg.com

Tomás Carbonell
Martha Roberts
Benjamin Levitan
Vickie L. Patton
Environmental Defense Fund
1875 Connecticut Ave., NW
Suite 600
Washington, DC 20009
(202) 387-3500
tcarbonell@edf.org
mroberts@edf.org
blevitan@edf.org
vpatton@edf.org
Counsel for Environmental Defense Fund

/s/ James P. Duffy
Ann Brewster Weeks
James P. Duffy
Clean Air Task Force
114 State Street, 6th Floor
Boston, MA 02109
(617) 359-4077
aweeks@catf.us
jduffy@catf.us
Counsel for American Lung Association, American Public Health Association, Appalachian Mountain Club, Clean Air Council, Clean Wisconsin, Conservation Law Foundation, and Minnesota Center for Environmental Advocacy

/s/ Howard Learner
Howard Learner
Scott Strand
Alda Yuan
Environmental Law & Policy Center
35 E Wacker Dr. Suite 1600
Chicago, IL 60601
(312) 673-6500
hlearner@elpc.org
sstrand@elpc.org
ayuan@elpc.org
Counsel for Environmental Law & Policy Center

/s/ David Doniger
David Doniger
Benjamin Longstreth
Melissa J. Lynch
Natural Resource Defense Council
1152 15th Street, NW, Suite 300
Washington, DC 20005
(202) 289-2403
ddoniger@nrdc.org
blongstreth@nrdc.org
llynch@nrdc.org
Counsel for Natural Resources Defense Council

/s/ Brittany E. Wright
Brittany E. Wright
Jon A. Mueller
Chesapeake Bay Foundation
6 Herndon Avenue
Annapolis, MD 21403
(443) 482-2077
bwright@cbf.org
jmueller@cbf.org
Counsel for Chesapeake Bay Foundation Inc.

/s/ Clare Lakewood
Clare Lakewood
Howard M. Crystal
Center for Biological Diversity
1212 Broadway, Suite 800
Oakland, CA 94612
(415) 844-7121
clakewood@biologicaldiversity.org
hcrystal@biologicaldiversity.org
Counsel for Center for Biological Diversity

Dated: October 7, 2019

CERTIFICATE OF COMPLIANCE

I certify that the foregoing motion is presented in a proportionately spaced, 14-point font and that, according to the Microsoft Word's word-count function, the relevant portions of the document contain 5,064 words.

/s/ Sean H. Donahue

CERTIFICATE OF SERVICE

I certify that on October 7, 2019, I served copies of the foregoing Public Health and Environmental Petitioners' Motion to Complete the Record for Judicial Review by filing it through the Court's electronic filing system, which will provide copies to all registered counsel.

/s/ Sean H. Donahue

EXHIBITS

Exhibit A: Comment from Amelia T. Keyes, Kathleen F. Lambert, Dallas Burtraw, Jonathan J. Buonocore, Jonathan I. Levy & Charles T. Driscoll, concerning their article, *The Affordable Clean Energy Rule and the Impact of Emissions Rebound on Carbon Dioxide and Criteria Air Pollutant Emissions*, as accepted for publication in ENVIRONMENTAL RESEARCH LETTERS [subsequently published at 14 Environ. Res. Lett. 44018 (2019)] submitted Jan. 18, 2019, Docket ID No. EPA-HQ-OAR-2017-0355-26648

Exhibit B: Comment Letter of December 21, 2018 from Attorneys General of 20 States and the District of Columbia, et al., concerning UNITED STATES GLOBAL CHANGE RESEARCH PROGRAM, FOURTH NATIONAL CLIMATE ASSESSMENT, VOLUME II: IMPACTS, RISKS AND ADAPTATION IN THE UNITED STATES (2018), and Letter of December 11, 2018, from 20 State Attorneys General, *et a*l., concerning Assessment, Docket ID No. EPA-HQ-OAR-2017-0355-26640

Exhibit C: Comment of Center for Biological Diversity, et al., concerning United States Global Change Research Program, UNITED STATES GLOBAL CHANGE RESEARCH PROGRAM, FOURTH NATIONAL CLIMATE ASSESSMENT, VOLUME II: IMPACTS, RISKS AND ADAPTATION IN THE UNITED STATES (2018), submitted December 13, 2013, Docket ID No. EPA-HQ-OAR-2017-0355-26637

Exhibit D: Comment of Center for Biological Diversity, *et al*., concerning Rhodium Group, Energy & Climate Staff, *Preliminary US Emissions Estimates for 2018* (Jan. 8, 2019) [without attachments], submitted January 31, 2019, Docket ID No. EPA-HQ-OAR-2017-0355-26647

Exhibit E: Comment of Sierra Club concerning Energy Innovation: Policy and Technology, LLC and Vibrant Clean Energy, LLC, *The Coal Cost Crossover: Economic Viability of Existing Coal Compared to New Local Wind and Solar Resources* (March 2019), submitted April 12, 2019, Docket ID No. EPA-HQ-OAR-2017-0355-26650

Exhibit F: Letter from Benjamin Carlisle, U.S. Department of Justice, to Sean H. Donahue and Michael J. Myers (Sept. 27, 2019)

Exhibit A:

Comment from Amelia T. Keyes, Kathleen F. Lambert, Dallas Burtraw, Jonathan J. Buonocore, Jonathan I. Levy & Charles T. Driscoll concerning their article, *The Affordable Clean Energy Rule and the Impact of Emissions Rebound on Carbon Dioxide and Criteria Air Pollutant Emissions*, as accepted for publication in ENVIRONMENTAL RESEARCH LETTERS [subsequently published at 14 Environ. Res. Lett. 44018 (2019)] submitted Jan. 18, 2019,
Docket ID No. EPA-HQ-OAR-2017-0355-26648

January 18, 2019

US Environmental Protection Agency
EPA Docket Center (EPA/DC), Mail Code 28221T
1200 Pennsylvania Avenue, NW
Washington, DC 20460

Attention Docket ID No. EPA-HQ-OAR-2017-0355

We are pleased to submit our article titled, "The Affordable Clean Energy Rule and the Impact of Emissions Rebound on Carbon Dioxide and Criteria Air Pollutant Emissions," forthcoming in the journal *Environmental Research Letters*, as a comment to the United States Environmental Protection Agency (EPA) on its proposed Affordable Clean Energy (ACE) rule.

The article provides an analysis of the expected impacts of the proposed ACE rule. This analysis uses results from EPA's Integrated Planning Model to compare the illustrative ACE scenarios to a no-policy scenario and a Clean Power Plan scenario. In short, we find that heat rate improvements at regulated coal plants could lead to an emissions rebound effect, in which generation and emissions at those plants increase. ACE is expected to lead to increased CO_2 emissions at 28 percent of regulated coal plants in 2030 compared to no policy. As a result, ACE increases CO_2 emissions by up to 8.7 percent in eighteen states plus the District of Columbia in 2030 compared to no policy. Additionally, ACE increases SO_2 and NO_x emissions in nineteen states and twenty states plus DC, respectively, in 2030 compared to no policy.

This article is accepted and forthcoming in a peer reviewed scholarly publication, *Environmental Research Letters*. The full reference, website link, and accepted manuscript are provided on the following page.

The views expressed here are solely those of the individual authors and do not necessarily represent the views of other experts and officers at affiliated institutions.

Respectfully submitted:

Charles T. Driscoll, Ph.D.
University Professor, Department of Civil and Environmental Engineering
National Academy of Engineering Sciences, member
Syracuse University
Syracuse, NY
Email: ctdrisco@syr.edu
Phone: 315.443.3434

Kathleen F. Lambert, M.S.
Director, Science Policy Exchange
Email: kathleen.lambert3@gmail.com
Phone: 802.436.1000

Jonathan J. Buonocore, Sc.D.
Research Associate; Program Leader – Climate, Energy, and Health
Center For Health and the Global Environment | Harvard T.H. Chan School of Public Health
Landmark Center 4th Floor West, Suite 415

401 Park Drive, PO Box 15677
Boston, MA 02215
Email: jbuonocore@mail.harvard.edu
Phone: 617.384.5663

Dallas Burtraw, Ph.D.
Darius Gaskins Senior Fellow
Resources for the Future
1616 P St. NW, Suite 600
Washington, DC 20036
Email: burtraw@rff.org
Phone: 202.328.5087

Amelia T. Keyes
Research Assistant
Resources for the Future
1616 P St. NW, Suite 600
Washington, DC 20036
Email: keyes@rff.org
Phone: 202.328.5110

Jonathan I. Levy, Sc.D.
Professor and Chair, Department of Environmental Health
Boston University School of Public Health
715 Albany St., T4W
Boston, MA 02118-2526
Email: jonlevy@bu.edu
Phone: 617.358.2460

Environmental Research Letters

ACCEPTED MANUSCRIPT • OPEN ACCESS

The Affordable Clean Energy Rule and the Impact of Emissions Rebound on Carbon Dioxide and Criteria Air Pollutant Emissions

To cite this article before publication: Amelia Trafton Keyes *et al* 2019 *Environ. Res. Lett.* in press https://doi.org/10.1088/1748-9326/aafe25

The Affordable Clean Energy Rule and the Impact of Emissions Rebound on Carbon Dioxide and Criteria Air Pollutant Emissions

Amelia T. Keyes, Kathleen F. Lambert, Dallas Burtraw, Jonathan J. Buonocore, Jonathan I. Levy, and Charles T. Driscoll

Abstract

The Affordable Clean Energy (ACE) rule, the U.S. Environmental Protection Agency's (EPA) proposed replacement of the Clean Power Plan (CPP), targets heat rate improvements at individual coal plants in the U.S. Due to greater plant efficiency, such heat rate improvements could lead to increased generation and emissions, known as an emissions rebound effect. The EPA Regulatory Impact Analysis (RIA) for ACE and other analyses to date have not quantified the magnitude and extent of an emissions rebound. We analyze the estimated emissions rebound of carbon dioxide (CO_2) and criteria pollutants sulfur dioxide (SO_2) and nitrogen oxides (NO_X), using results from the EPA's power sector model, under the ACE in 2030 at model coal plants and at the state and national levels compared to both no policy and the CPP. We decompose emissions changes under a central illustrative ACE scenario and find evidence of a state-level rebound effect. Although the ACE reduces the emissions intensity of coal plants, it is expected to increase the number of operating coal plants and amount of coal-fired electricity generation, with 28 percent of model plants showing higher CO_2 emissions in 2030 compared to no policy. As a result, the ACE only modestly reduces national power sector CO_2 emissions and increases CO_2 emissions by up to 8.7 percent in eighteen states plus the District of Columbia in 2030 compared to no policy. We also find that the ACE increases SO_2 and NO_X emissions in nineteen states and twenty states plus DC, respectively, in 2030 compared to no policy, with implications for air quality and public health. We compare our findings to other model years, additional EPA ACE scenarios, and other modeling results for similar policies, finding similar outcomes. Our results demonstrate the importance of considering the emissions rebound effect and its effect on sub-national emissions outcomes in evaluating the ACE and similar policies targeting heat rate improvements.

1. Introduction

The United States Environmental Protection Agency (EPA) in August 2018 released its proposed Affordable Clean Energy (ACE) rule. The ACE is the proposed replacement to the existing EPA Clean Power Plan (CPP), the carbon dioxide (CO_2) emissions standard for existing power plants. EPA has a legal obligation to regulate greenhouse gas emissions from existing power plants, which was affirmed by the Supreme Court's 2007 decision in *Massachusetts v Environmental Protection Agency* and triggered by the EPA's formal finding in 2009 that greenhouse gas emissions endanger public health and welfare (Mass v EPA 2007, EPA 2009).

The CPP was finalized in 2015 and established state-based CO_2 emissions goals for affected fossil fuel-fired power plants. The CPP identifies a number of flexible compliance options as part of the "best system of emissions reductions" (BSER) that the EPA is charged with identifying under section 111(d) of the Clean Air Act. It allows emissions reductions to come from carbon intensity reductions at individual plants—including heat rate improvements or fuel cofiring at the source—or from the substitution of generation towards less carbon-intensive and zero-carbon energy sources (EPA 2015a). Averaging across electricity generating units (EGUs) and intra- and inter-state trading among units are also allowed. Given the flexible compliance structure, the CPP can be termed a "systems-based" standard. At the time it was

finalized, it was estimated that the CPP would decrease CO_2 emissions by 415 million tons, or 19 percent, below a business as usual base case level, or 32 percent below 2005 levels, by 2030 (EPA 2015b).

The proposed ACE instead employs a narrow "source-based" regulation, which defines and limits the legally relevant BSER as heat rate improvement opportunities at individual coal plants (EPA 2018a). Heat rate is the amount of fuel input (Btu) used to produce a kWh of electricity; a lower heat rate indicates a more efficient unit, which emits less CO_2 per kWh. As a general rule of thumb, a reduction of 10 million Btu equals roughly a one-ton reduction in CO_2 for coal EGUs. There is considerable heterogeneity in the heat rate of U.S. coal plants and substantial opportunity to make coal plants more efficient (Linn et al. 2014, Sargent & Lundy 2009, Staudt & Macedonia 2014, DiPietro & Krulla 2010, DOE/NETL 2009, MIT 2009, SFA 2009, Campbell 2013). ACE sets standards for emissions rate improvements at facilities, but because these standards are based solely on estimated potential for heat rate improvements, we refer to this type of source-based option as a heat rate improvement standard. ACE does not include fuel cofiring among its described emission reduction options. States would be required to submit plans to EPA to implement the rule, taking into account criteria such as remaining useful life, and it is possible states would propose to allow co-firing to achieve comparable emissions reductions. The ACE also allows for the possibility that states determine that no emissions reduction options are feasible.

With the issuance of the proposed replacement regulation, the EPA released a regulatory impact analysis (RIA) that models emissions under the ACE compared to a reference scenario with the CPP and a scenario with no power plant carbon standard (EPA 2018b). The RIA includes projections of national power section emissions outcomes, but does not examine or quantify the role that a potential emissions rebound effect may play in driving the emissions outcomes. The rebound effect is a phenomenon in which facilities with high baseline emissions rates are made more efficient through investments to reduce their heat rates, and consequently operate more frequently and remain in operation for a longer period. This phenomenon is well documented in the environmental economics literature, though the majority of evidence focuses on energy efficiency (Greening et al. 2000, Sorrell et al. 2009). Previous studies have found evidence that an emissions rebound effect can diminish emissions reductions or even lead to emissions increases following heat rate improvements at high-emissions facilities (Linn et al. 2014, Keyes et al. 2018), but no other studies have specifically examined the role of an emissions rebound in the ACE.

We analyze the model-plant level results published by EPA to better understand the predicted impact of ACE on CO_2 emissions from coal plants and the potential impact on total CO_2 emissions at national and state levels (EPA 2018b). We also analyze the changes in emissions of co-pollutants including sulfur dioxide (SO_2) and nitrogen oxides (NO_X), which affect local air quality and human health.

We conduct a formal decomposition analysis of the estimated national changes in generation and CO_2 emissions between the ACE and a no-policy scenario to examine the underlying drivers of the emissions changes and to estimate the contribution of a potential emissions rebound effect. We provide decomposition results for states that are estimated to experience emissions increases under the source-based ACE rule.

Our analysis largely evaluates the impacts of ACE based on 2030 projections for a central case we selected from EPA's three illustrative ACE modeling scenarios. In addition, we compare these results to emissions results for 2021–2050 and for the EPA's two other illustrative ACE cases.

This analysis builds upon a study by the same authors that independently models potential national and state level CO_2 emissions impacts in 2030 for a source-based scenario compared to a scenario with no power plant carbon standard and to a flexible systems-based scenario similar to the CPP (Keyes et al. 2018). Our findings on the emissions rebound effect are compared to the results of Keyes et al. (2018).

2. Methods

2.1. Data

We conduct our analysis using results from the EPA's policy scenario modeling for the ACE RIA. EPA used the Integrated Planning Model (IPM) to estimate power sector outcomes from 2021–2050. IPM is a dynamic linear programming engineering-economic model of the US power sector. It maps almost 13,000 existing and planned EGUs into about 1,700 model plants. The model differentiates power sector outcomes into demand and supply regions and accounts for interstate electricity trade. IPM is solved with fixed electricity demand. EPA uses IPM to project emissions of CO_2 and co-pollutants and a number of other outcomes under various policy scenarios.[1]

Five scenarios were modeled using IPM: a scenario with no power plant carbon standard, an illustrative scenario with the CPP, and three illustrative ACE scenarios that represent potential state determinations of performance standards and compliance with those standards (EPA 2018b). The CPP scenario assumes a rate-based implementation applied only to existing fossil-fired EGUs, one of multiple options available to states. Each ACE scenario assumes uniform heat rate improvement (HRI) potential at all coal plants and uniform cost per kW of HRI investment. The ACE scenarios differ in their assumptions about the status of the New Source Review (NSR) provision of the U.S. Clean Air Act. NSR currently requires permitting for major generation sources that make major modifications. ACE introduces a change in NSR to allow major sources to avoid triggering NSR if modifications do not affect their hourly rate of emissions. The first ACE scenario, 2 percent HRI at $50/kW at coal plants, assumes that the EPA's proposed revisions to the NSR requirements are not implemented and therefore identifies relatively modest opportunities for heat rate improvements; the second scenario, 4.5 percent HRI at $50/kW, assumes NSR revisions are implemented and identifies greater opportunities for heat rate improvements; and the third scenario, 4.5 percent HRI at $100/kW, also assumes NSR revisions are implemented but assumes heat rate improvements have a higher cost, which is more appropriate for plants with relatively low capacity or limited remaining useful life.

Our analysis uses the published output from EPA's IPM model runs. We use the IPM State Emissions datasets to examine total emissions of CO_2 and co-pollutants SO_2 and NO_X at the state and national level. Additionally, we use the IPM RPE datasets, which provide projections of fuel generation and emissions (CO_2, SO_2 and NO_X) for each model plant to evaluate outcomes. Our analysis focuses on emissions outcomes in 2030 for the 4.5 percent HRI at $50/kW scenario compared to the CPP and no-policy scenarios. We choose this scenario as our ACE central case because it incorporates the implementation of EPA's proposed NSR reform and a lower cost of HRI investment. We also compare these results with the other two ACE scenarios and to results for 2021–2050.

[1] See EPA (2018b) for a detailed description of modeling assumptions and inputs.

2.2. Decomposition Analysis

To analyze estimated changes in EGU generation and associated emissions, we use a logarithmic mean decomposition index (LMDI) approach, based on Ang (2015). We implement Model 1 in Table 1 of Ang (2015) and substitute CO_2 emissions for energy consumption (E) and electricity generation for industrial output (Q). This method follows from that used in Palmer et al. (2018) to decompose modeled emissions changes under a carbon tax. We estimate the contribution of three factors to the change in emissions under the ACE compared to the no-policy scenario: activity, structure, and intensity. The activity factor is emissions changes associated with changes in total electricity generation; the structure factor is emissions changes associated with shifts in generation among fuel types; and the intensity factor is emissions changes associated with changes in emission intensity within fuel types.

The emission intensity of fuel types (the intensity factor) is the factor targeted by a heat rate improvement standard and it can change when a policy causes various fossil fuel plants to improve their efficiency. Under a heat rate improvement standard, the intensity factor contributes to emissions reductions if the standard successfully reduces the emission intensity of coal plants.

The rebound effect is embodied in changes in the generation mix (the structure factor), which changes when a policy affects the relative competitiveness of generation sources. This can occur under a heat rate improvement standard if the standard improves the efficiency of coal plants and thus causes substitution towards coal away from other, lower-emitting generation sources. Our estimate of the rebound effect is likely conservative because the EPA's model holds total demand constant. If demand were allowed to change, the rebound effect would include both the structure factor and the activity factor. Change in demand can occur if the increased efficiency of coal lowers the cost of electricity generation and thus increases total electricity demand, as would be expected in organized wholesale power markets. In regulated markets, these investments could increase or decrease total costs, depending on the reason such investments are previously unrealized. Reasons could include inconsistent pass-through clauses, avoidance of triggering NSR, access to capital, and uncertainty about greenhouse gas regulations (Richardson et al. 2011, Campbell 2013, Linn et al. 2014). However, under constant demand, at the national level the activity factor in our analysis is not directly associated with the rebound effect. At the state level, a change in the activity factor can be associated with the rebound effect because changes in trade flows across states can lead to a net change in generation in some states. This effect is absorbed into the structure factor at the national level. Although electricity demand is held constant, total electricity generation (the activity factor) can still differ on the national level across model scenarios for several reasons: policies may cause changes in trade flows between the U.S. and Canada, or changes in state or regional generation within the U.S. These changes may affect the total amount of electricity transferred between regions, thus affecting total losses and generation.

3. Results

3.1. National and State Level CO_2 Emissions Changes

National CO_2 emissions are projected to be slightly lower under the ACE compared to no policy, and higher compared to the CPP, in all modeled years but 2050 (Table 1). In 2050, two of the three ACE scenarios have higher CO_2 emissions compared to no policy. Cumulative CO_2 emissions from 2021–2050 are slightly lower under all three ACE scenarios compared to no policy and slightly higher compared to the CPP. In 2030, compared to no policy, CO_2 emissions are projected to be 0.8 percent lower under the

4.5 percent HRI at $50/kW scenario, 0.7 percent lower under the 2 percent at $50/kW scenario, and 1.5 percent lower under the 4.5 percent at $100/kW scenario.

There is substantial variation in state-level outcomes under the ACE. For the 4.5 percent HRI at $50/kW scenario, eighteen states plus the District of Columbia are projected to experience at least small increases in CO_2 emissions in 2030 compared to no policy (Figure 1). The numbers are similar for the other two ACE scenarios: 16 states plus Washington, DC for the 2 percent at $50/kW scenario and 14 states plus Washington, DC for the 4.5 percent at $100/kW scenario. Compared to the CPP, 22 states and Washington, DC are projected to have emissions increases under the 4.5 percent HRI at $50/kW ACE scenario (Figure 2).[2]

3.2. Coal-Fired Power Plant CO_2 Emissions Changes

We examine the impact of the ACE on model coal-fired power plants to illustrate the main drivers of emissions changes by focusing on 2030 emissions for the 4.5 percent HRI at $50/kW scenario, which is our ACE central case. IPM's model coal plants are aggregated representations of constituent coal plants within states, 381 of which were operating in the U.S. in 2016 (EIA 2017a). Under EPA's projections of ACE, CO_2 emissions from coal plants are projected to be only slightly lower (0.6 percent) in 2030 compared to no policy (Table 2). While the emissions intensity of coal plants declines by 4.5 percent, the number of coal plants in operation and total coal-powered electricity generation increase. This shift offsets the benefits of emissions intensity improvements and causes the total emissions reduction to be small compared to the emissions intensity improvements.

Under the EPA's interpretation of section 111(d) of the Clean Air Act as constraining regulations to measures that can be taken at a source (power plant), total CO_2 emissions are actually projected to increase at a number of the affected plants. Of the 333 model coal plants that would be in operation in 2030 under no policy, 93 of those (or 28 percent) are projected to have higher total CO_2 emissions under the ACE. Additionally, under the ACE five additional model coal plants are projected to be operating in 2030 that would have been idled or retired under no policy.

3.3. Decomposition of CO_2 Emissions Changes

The decomposition shows the extent to which the rebound effect is projected to offset emissions reductions under the ACE. Total national emissions under the ACE are estimated to decrease by 14.3 million short tons (0.8 percent) compared to the no-policy scenario in 2030. Our decomposition analysis breaks down the three primary factors driving that change in emissions (Figure 3a). We find that reductions in emissions intensity within fuel types reduce emissions by 47.4 million tons, mainly due to the lower emissions intensity of coal generation. However, the rebound effect associated primarily with greater utilization of coal plants increases emissions by 32.4 million tons, partially offsetting the reductions from improvements in emissions intensity and resulting in smaller estimated total reductions. Note that the rebound effect is greater on a fleet basis, due to substitution to more efficient units, than researchers have estimated for an individual facility (e.g. Linn et al. 2014). A slight increase in total electricity generation drives emissions up by an additional 0.6 million tons.

[2] Conversely, 25 states are projected to have lower emissions under the the 4.5 percent at $100/kW scenario compared to the CPP. This is because the CPP creates performance standards for fossil generation sources, and emissions at EGUs can increase under the CPP if their level of generation increases. The CPP is a flexible standard aimed at achieving system-wide emissions reductions.

For the eighteen states plus DC projected to experience higher CO_2 emissions in 2030 under the ACE compared to no policy (Figure 1), total CO_2 emissions are expected to increase by 8.5 million tons. Decomposition reveals that emissions intensity improvements drive down emissions by 14.3 million tons, but these reductions are more than offset by generation mix shifts that drive up emissions by 21.4 million tons and greater total generation that drives up emissions by 1.4 million tons (Figure 3b). This rebound effect is caused mostly by shifts towards increased coal generation. Of the eighteen states that experience total increases in CO_2 emissions, fourteen states experience an emissions increase from coal-fired power plants in their state. In the other four states (California, Georgia, Massachusetts, and Oregon) plus DC, the emissions increases are mainly due to increased emissions from natural gas. Increases in state-level natural gas emissions could occur for several reasons that are specific to state and regional electricity markets. This pattern exposes another unintended consequence of the ACE that could diminish emissions reductions in some states.

Maryland has the greatest percent increase in emissions under the ACE compared to no policy in 2030 (8.7 percent) and provides an informative illustration of the emissions rebound effect. Maryland has two model coal plants in operation under the ACE, neither of which would be in operation with no policy in place. Thus, the shift in the generation mix towards coal drives up emissions by 0.8 million tons and causes an overall increase in emissions in the state (Figure 3c).

Interstate trade in electricity can exacerbate the emissions rebound in some states, because coal EGUs that become more efficient may compete not only with EGUs in their state but also others in their power market region. For example, the emissions intensity of coal in a net electricity exporting states like Alabama improves in 2030 under the ACE compared to no policy. However, coal generation and total generation increase in the state, suggesting that electricity exports increase. The increase in fossil generation drives up emissions by 2.2 million tons, offsetting the emissions intensity improvements and resulting in a net increase in emissions by 1 million tons.

3.4. Criteria Air Pollutant Emissions Changes

National SO_2 emissions in 2030 are projected by EPA to decrease by 0.7 percent under the ACE compared to no policy, with nineteen states showing SO_2 emissions increases (Figure 4). National NO_X emissions are projected by EPA to decrease by 1.0 percent, with twenty states plus DC showing emissions increases (Figure 5). Compared to the CPP, national SO_2 emissions are projected by EPA to be 5.9 percent higher under ACE and NO_X emissions are projected to be 5.0 percent higher.

4. Discussion

4.1. Comparison of Results

Our analysis of ACE impacts using EPA's RIA demonstrates the potential for a rebound effect to occur and limit decrease emissions reductions. Previous studies have found evidence that a rebound effect is associated with heat rate improvements at high-emissions rate facilities, and changes in the operation of these facilities diminishes the reduction in emissions that would otherwise occur (Linn et al. 2014). Moreover, because these facilities have lower operating costs after the heat rate improvements are made, they are likely to delay their ultimate retirement and may remain in service longer into the future (Burtraw et al. 2011). Our analysis suggests this is the case, because by 2050 CO_2 emissions under the ACE exceed emissions under no policy. This consideration is important since CO_2 is a stock pollutant that accumulates in the atmosphere each year.

We compare the results of this analysis to another study by the same authors (Keyes et al. 2018), in which the spatially explicit effects of scenarios constructed independently but similar to the ACE are modeled, including a source-based heat rate improvement standard. Keyes et al. (2018) uses results from IPM to compare their source-based scenario to a no-policy scenario and a systems-based scenario similar to the CPP. Because the modeling conducted for Keyes et al. (2018) is independent from that used by EPA in its ACE RIA, it provides an alternative estimate of emissions outcomes. Importantly, the results based on EPA's modeling can be compared only qualitatively to the Keyes et al. modeling results because baseline economic conditions differ between the two sets of model runs. Keyes et al. (2018) uses power sector modeling based on the electricity industry as it was configured in 2014, and the industry has since undergone substantial changes including retirement of many fossil units. Coal generation declined from 40 percent of total power generation in 2013 to 31 percent of total generation in 2017, and overall fossil fuels supplied 62 percent of total generation in 2017 compared to 67 percent in 2013 (EIA 2018). The analyses also employ different assumptions about policy design and implementation. For example, the source-based standard used in Keyes et al. (2018) includes cofiring up to 15 percent with natural gas or biomass as a compliance option, while the ACE does not consider cofiring as a candidate technology for BSER. Therefore, emissions projections in the EPA modeling results are lower for the no-policy case and the estimated emissions impacts of the source-based policy are smaller compared to Keyes et al. (2018) (Table 3). However, Keyes et al. (2018) affirm the finding that a rebound effect could lead to emissions increases at individual plants and in some states based on the EPA's modeling.

A notable result from EPA's RIA modeling is that the impact of the CPP on CO_2 emissions compared to no policy is small (4 percent reduction in 2030) compared to Keyes et al. (2018), EPA's 2015 RIA for the CPP final rule and the Energy Information Administration's 2017 Annual Energy Outlook (EPA 2015b, EIA 2017b). One reason for the relatively small impact of CPP in the ACE re-analysis is that EPA's ACE no-policy case includes less fossil fuel generation than previous RIAs. Another reason is the set of assumptions that EPA uses for CPP implementation in the ACE RIA, which assumes coverage only for existing generation sources rather than existing and new sources and no incremental energy efficiency investments. These assumptions reduce the projected emissions benefits under the CPP.

The proposed ACE rule, in addition to suggesting changes to power plant carbon standards, also would reform the NSR program for new and significantly modified facilities. As discussed above, the reform to NSR would allow power plants to avoid NSR review as long as their hourly rate of emissions do not increase. This reform may create a loophole for some plants to adopt HRI measures and potentially increase emissions. EPA's projections for the scenario incorporating NSR reform (4.5 percent HRI at $50/kW) and a scenario without NSR reform (2 percent HRI at $50/kW) shows minor impacts of NSR reform on CO_2 emissions.

4.2. Policy Implications

The CO_2 emissions impacts of the ACE have implications for the twenty states that have adopted greenhouse gas emissions targets (C2ES 2018). Twenty-two states plus DC are projected to have higher emissions under the ACE compared to the CPP, and eleven of these states plus DC currently have greenhouse gas emissions targets in place. These states can be expected to face more difficulty achieving their targets due to the replacement of the CPP. Further, of the eighteen states and DC projected to experience higher CO_2 emissions compared to no policy, seven—California, DC, Florida,

Maryland, Massachusetts, New York and Oregon—have greenhouse gas emissions targets. For these states, achieving their emissions targets may be more difficult under the ACE compared to having no federal power plant carbon standard in place.

The possibility for the rebound effect to lead to emissions increases at individual plants and for entire states raises the question whether the heat rate improvement standard proposed under ACE qualifies as the "best system of emissions reduction" (BSER) that EPA is charged with identifying in its development of a power plant carbon standard under section 111(d) of the Clean Air Act. The projected impact of the rebound effect on CO_2 emissions under the ACE should be taken into consideration in determining whether the BSER requirement has been satisfied.

The change in emissions of co-pollutants under the ACE also has implications for regional air quality and public health. SO_2 and NO_X are precursors to ambient $PM_{2.5}$ and NO_x emissions contribute to ambient ozone, both of which have effects on premature mortality and morbidity. States with increased emissions may experience greater difficulty achieving or maintaining the U.S. National Ambient Air Quality Standards established under the Clean Air Act. EPA estimates that, nationally, the ACE will lead to a slightly lower number of $PM_{2.5}$- and ozone-related premature deaths compared to no policy in 2030, but it estimates that ACE will substantially increase premature deaths compared to the CPP.

5. Conclusions

Our analysis finds that the projected emissions rebound effect in EPA's ACE RIA undermines emissions reductions from the ACE rule compared to both the CPP and to no power plant carbon standard. Although the emissions intensity of modeled coal plants decreases, the number of operating coal plants and the amount of coal-powered electricity generation increases. Under the ACE central case, the rebound effect causes emissions to increase at 28 percent of coal plants in 2030. As a result, total CO_2 emissions increase in eighteen states plus DC and national CO_2 emissions decrease by only 0.8 percent in 2030. Further, emissions of SO_2 decline by only 0.7 percent with increases in nineteen states, and emissions of NO_X decline by 1.0 percent with increases in 20 states plus DC. The other ACE scenarios evaluated show similar outcomes driven by a rebound effect.

Our finding that under a source-based power plant standard the rebound effect can undermine pollutant emissions decreases at the national level and lead to increased emissions at individual coal plants and in a number of states is substantiated by similar findings based on independent power sector modeling (Keyes et al. 2018). This result, which was not examined in the RIA for the ACE proposed rule, has implications for the defensibility of ACE as the Best System of Emissions Reductions, for the ability of some states to achieve their greenhouse gas emissions reduction targets, and for jurisdictions that experience poor air quality to protect public health.

Author Affiliations

Keyes: Research Assistant, Resources for the Future; Lambert: Co-founder and Director, Science Policy Exchange; Burtraw: Darius Gaskins Senior Fellow, Resources for the Future; Buonocore: Center for Climate, Health and the Global Environment, Harvard T.H. Chan School of Public Health; Levy: Professor of Environmental Health, Boston University; Driscoll: University Professor of Environmental Systems and Distinguished Professor of Civil & Environmental Engineering, Syracuse University.

Acknowledgements

The authors thank Habibollah Fakhraei for preparing the emissions maps and ICF for IPM modeling.

References

Ang, B.W. 2015. LMDI decomposition approach: a guide for implementation. Energy Policy 86, 233-238.

Burtraw, D., M. Woerman and A. Paul. 2011. Retail electricity price savings from compliance flexibility in greenhouse standards for stationary sources. Energy Policy 42, 67–77.

Campbell, R.J. 2013. Increasing the Efficiency of Existing Coal-Fired Power Plants. Congressional Research Service.

Center for Climate and Energy Solutions (C2ES). 2018. State Climate Policy Maps. Accessed 14 September 2018. https://www.c2es.org/content/state-climate-policy/

DiPietro, P. and K. Krulla. 2010. Improving the Efficiency of Coal-Fired Power Plants for near Term Greenhouse Gas Emissions Reductions. National Energy Technology Laboratory DOE/NETL-2010/1411.

Department of Energy/National Energy Technology Laboratory (DOE/NETL). 2009. Opportunities to improve the efficiency of existing coal-fired power plants. Technical workshop report, DOE/NETL, Rosemont, IL.

Greening, L.A., D.L. Greene and C. Difiglio. 2000. Energy efficiency and consumption — the rebound effect — a survey. Energy Policy 28, 389–401.

Keyes, A., K. Lambert, D. Burtraw, J. Buonocore, J. Levy and C. Driscoll. 2018. Carbon Standards Examined: A Comparison of At-the-Source and Beyond-the-Source Power Plant Carbon Standards. Resources for the Future Working Paper.

Linn, J., E. Mastrangelo and D. Burtraw. 2014. Regulating Greenhouse Gases from Coal Power Plants under the Clean Air Act. Journal of the Association of Environmental and Resource Economists 1, 97-134.

Massachusetts Institute of Technology (MIT). 2009. Retrofitting of Coal-fired Power Plants for CO2 Emissions Reductions. Massachusetts Institute of Technology (MIT); MIT Energy Initiative Symposium; March 2009; U.S.

Massachusetts v Environmental Protection Agency (EPA). 2007. https://www.law.cornell.edu/supct/html/05-1120.ZS.html

Palmer, K., A. Paul and A. Keyes. 2018. Changing baselines, shifting margins: How predicted impacts of pricing carbon in the electricity sector have evolved over time. Energy Economics 73, 371-379.

Richardson, N., Fraas, A., Burtraw, D., 2011. Greenhouse gas regulation under the clean air act: structure, effects, and implications of a knowable pathway. Environmental Law Reporter no. 41:10098–10120.

Sargent & Lundy. 2009. Coal-fired power plant heat rate reductions. Report SL-009597, Sargent & Lundy, Chicago.

SFA. 2009. Near-Term Technologies for Retrofit CO2 Capture and Storage of Existing Coal-fired Power Plants in the United States; White Paper for MIT Coal Retrofit Symposium; May 2009.

Sorrell, S., J. Dimitropoulos, M. Sommerville. 2009. Empirical estimates of the direct rebound effect: A review. Energy Policy 37, 1356–1371.

Staudt, J.E. and J. Macedonia. 2014. Evaluation of Heat Rates of Coal Fired Electric Power Boilers. Presented at the Power Plant Pollutant Control "MEGA" Symposium August 19-21, 2014, Baltimore, MD.

U.S. Energy Information Administration (EIA). 2017a. Electric Power Annual 2016, Table 4.1. https://www.eia.gov/electricity/annual/html/epa_04_01.html

_____. 2017b. Annual Energy Outlook 2017. https://www.eia.gov/outlooks/archive/aeo17/

_____. 2018. Electric Power Monthly: May 2018. https://www.eia.gov/electricity/monthly/

U.S. Environmental Protection Agency (EPA). 2009. Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act; Final Rule. https://www.epa.gov/sites/production/files/2016-08/documents/federal_register-epa-hq-oar-2009-0171-dec.15-09.pdf

_____. 2015a. Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units; Final Rule. https://www.gpo.gov/fdsys/pkg/FR-2015-10-23/pdf/2015-22842.pdf

_____. 2015b. Regulatory Impact Analysis for the Clean Power Plan Final Rule. https://www3.epa.gov/ttnecas1/docs/ria/utilities_ria_final-clean-power-plan-existing-units_2015-08.pdf

_____. 2018a. Emission Guidelines for Greenhouse Gas Emissions From Existing Electric Utility Generating Units; Revisions to Emission Guideline Implementing Regulations; Revisions to New Source Review Program. Proposed Rule. https://www.gpo.gov/fdsys/pkg/FR-2018-08-31/pdf/2018-18755.pdf

_____. 2018b. Regulatory Impact Analysis for the Proposed Emission Guidelines for Greenhouse Gas Emissions from Existing Electric Utility Generating Units; Revisions to Emission Guideline Implementing Regulations; Revisions to New Source Review Program. https://www.epa.gov/sites/production/files/2018-08/documents/utilities_ria_proposed_ace_2018-08.pdf

Tables

Table 1

National Power Sector CO_2 Emissions (million short tons)

	No Policy	CPP	4.5% HRI at $50/kW (ACE Central Case)	2% HRI at $50/kW	4.5% HRI at $100/kW
2021	1,710	1,701	1,709	1,709	1,707
2023	1,801	1,754	1,814	1,801	1,802
2025	1,829	1,780	1,812	1,816	1,799
2030	1,811	1,737	1,797	1,798	1,785
2035	1,794	1,728	1,787	1,783	1,772
2040	1,849	1,782	1,841	1,840	1,829
2045	1,843	1,782	1,832	1,833	1,821
2050	1,804	1,753	1,815	1,801	1,808
2021-2050 Cumulative (interpolated)	**54,469**	**52,694**	**54,261**	**54,195**	**53,920**

Table 2

Comparison of model coal plants between ACE Central Case and No-Policy Case, 2030

	No Policy	ACE Central Case	Change (level)	Change (percent)
Number of Model Coal Plants in Operation	333	338	5	1.5%
Total Generation (GWh)	937,757	975,633	37,877	4.0%
Total Emissions (Thousand short tons)	1,027,456	1,020,897	-6,559	-0.6%
Emissions Intensity (kg/kWh)	0.99	0.95	-0.04	-4.5%
Heat Rate (Btu/kWh)	10,395	9,930	-465	-4.5%

Table 3

Comparison of source-based scenario modeling results for 2030.

	Current Analysis based on EPA's ACE RIA	Keyes et al. (2018)
CO_2 Emissions under Source-based scenario, million short tons	1,797	2,386
CO_2 Emissions under No-Policy scenario, million short tons	1,811	2,451
Difference	*-0.8%*	*-2.6%*
CO_2 Emissions under Systems-based scenario, million short tons	1,737	1,466
Difference	*3.5%*	*63%*
Number of States with Emissions Increase Compared to No Policy scenario	18 states plus DC	8 states
Number of States with Emissions Increase Compared to Systems-based scenario	22 states plus DC	46 states

Figures

Figure 1

CO_2 Emissions under ACE Central Case compared to No-Policy Case, 2030

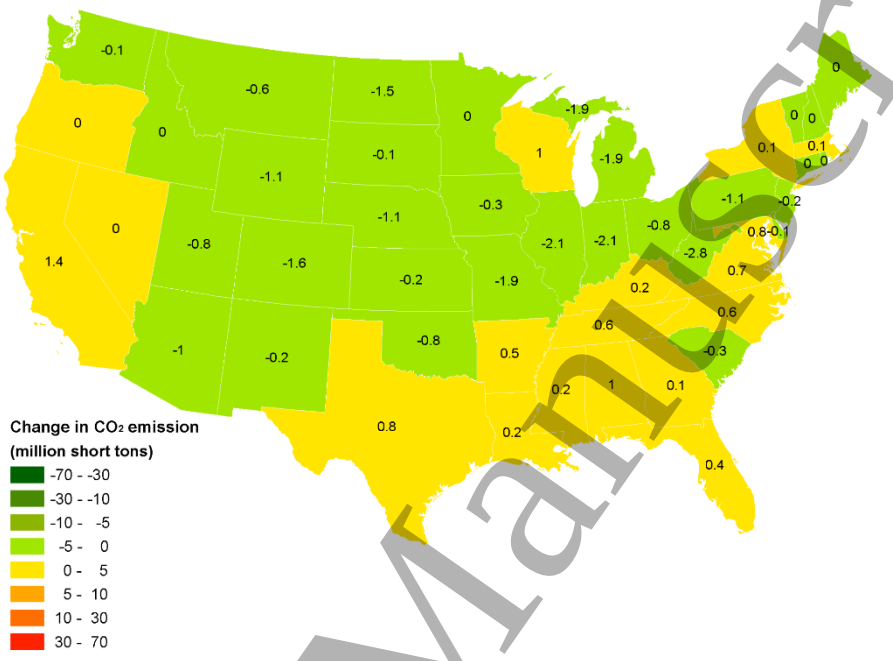
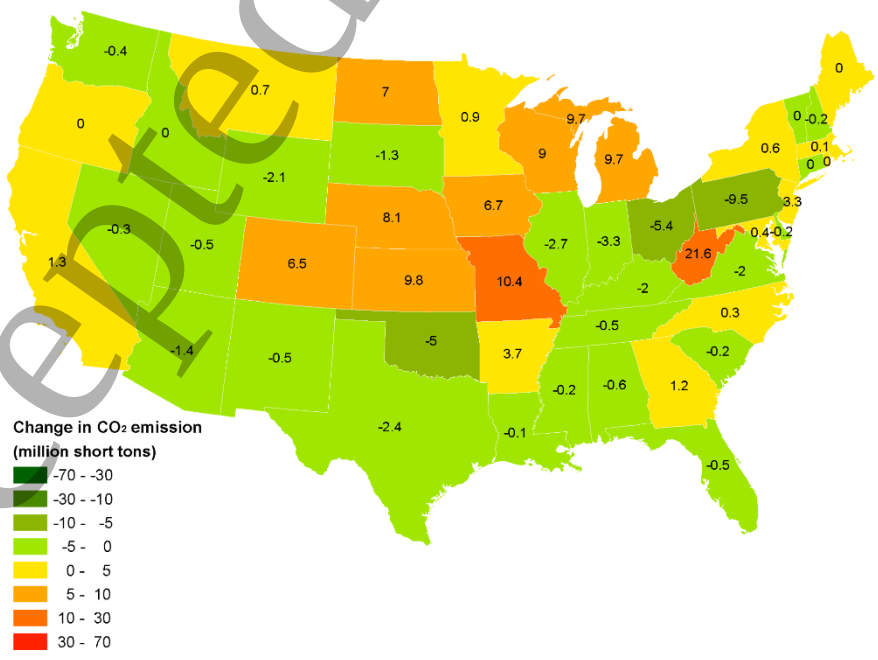
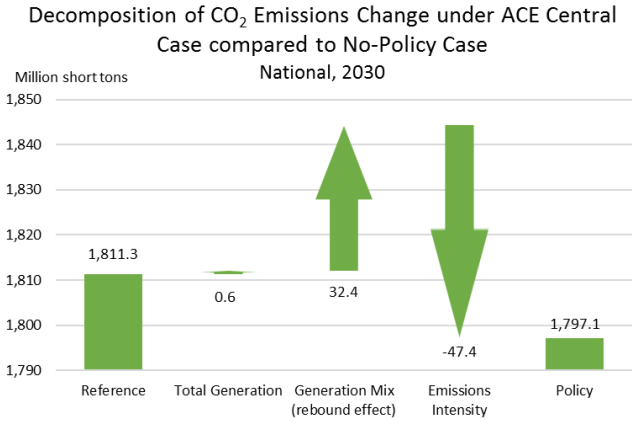


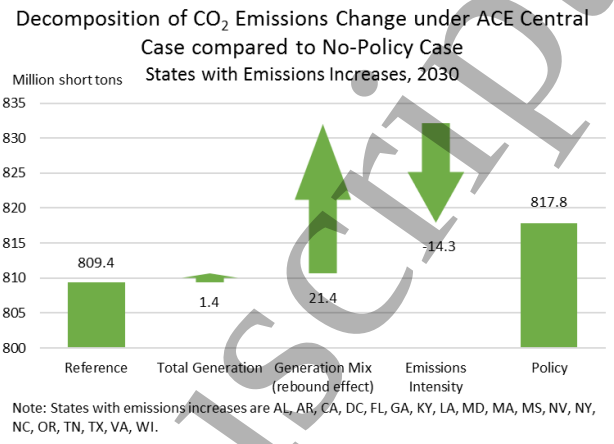
Figure 2

CO_2 Emissions under ACE Central Case compared to CPP Case, 2030



Figures 3a, 3b, 3c





Note: States with emissions increases are AL, AR, CA, DC, FL, GA, KY, LA, MD, MA, MS, NV, NY, NC, OR, TN, TX, VA, WI.

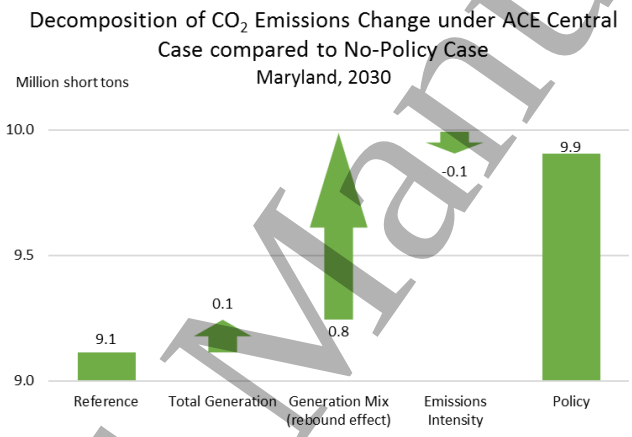


Figure 4

SO_2 Emissions under ACE Central Case compared to No-Policy Case, 2030

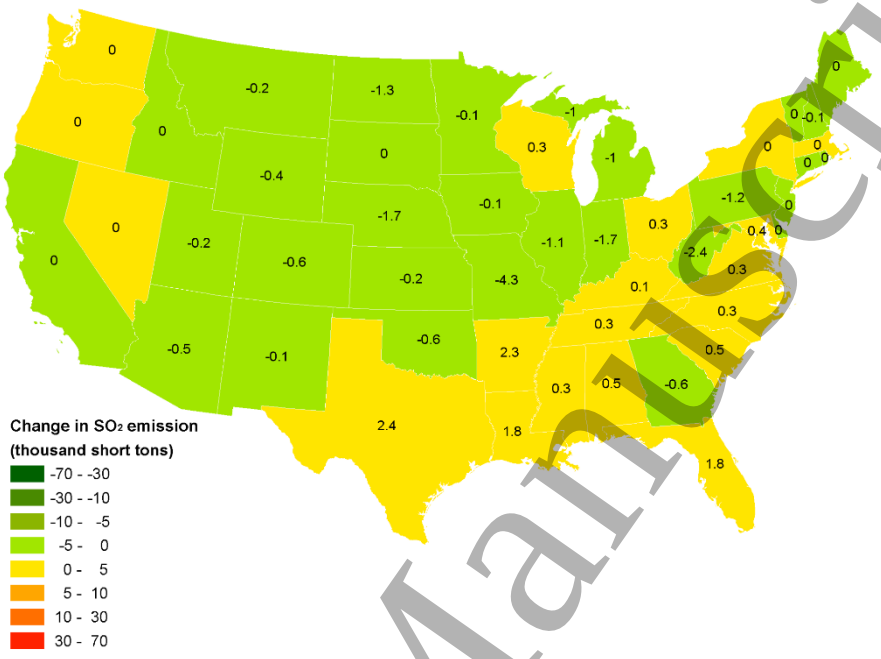


Figure 5

NO_x Emissions under ACE Central Case compared to No-Policy Case, 2030

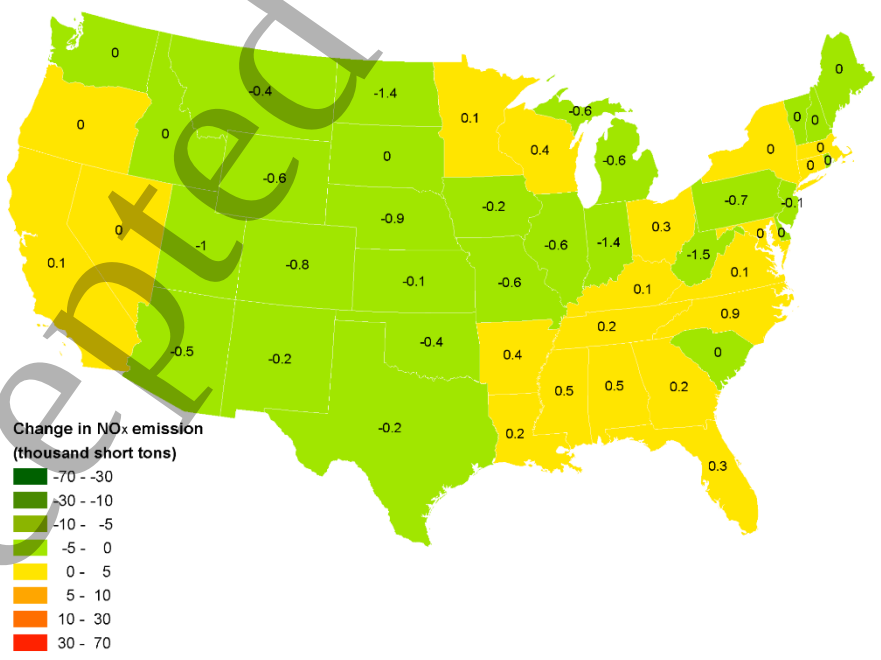


Exhibit B:

Comment of December 21, 2018 from Attorneys General of 20 States and the District of Columbia, *et al.*, concerning UNITED STATES GLOBAL CHANGE RESEARCH PROGRAM, FOURTH NATIONAL CLIMATE ASSESSMENT, VOLUME II: IMPACTS, RISKS AND ADAPTATION IN THE UNITED STATES (2018), and Letter of December 11, 2018, from 20 State Attorneys General, *et al.*, concerning same ASSESSMENT, Docket ID No. EPA-HQ-OAR-2017-0355-26640

From: Myers, Michael <Michael.Myers@ag.ny.gov>
Sent: Friday, December 21, 2018 12:30 PM
To: A-AND-R-DOCKET
Subject: Docket ID No. EPA-HQ-OAR-2017-0355
Attachments: 2018 1221 Final Detailed Ltr re NCA4 signed.pdf; 2018 12 11 Final Ltr re NCA4.pdf

Please find attached a supplemental comment letter with attachment. A hard copy of the letter, attachment, and report on disc is being sent by courier to the EPA Docket Center. Thank you.

Michael J. Myers
Senior Counsel for Air Pollution and Climate Change Litigation
Environmental Protection Bureau
New York State Attorney General
The Capitol
Albany, NY 12224
(518) 776-2382
michael.myers@ag.ny.gov

Attorneys General of New York, California, Connecticut, Delaware, Hawaii, Illinois, Iowa, Maine, Maryland, Massachusetts, Minnesota (by and through its Minnesota Pollution Control Agency), New Jersey, New Mexico, North Carolina, Oregon, Pennsylvania, Rhode Island, Vermont, Virginia, Washington, and the District of Columbia, the County Attorney of Broward (FL), and the City Attorneys/Corporation Counsel of Boulder (CO), Chicago, Los Angeles, New York, Philadelphia, and South Miami

December 21, 2018

Letter submitted via email: a-and-r-docket@epa.gov
Letter with copy of report submitted via courier to EPA Docket Center

Re: Docket ID No. EPA-HQ-OAR-2017-0355/Additional Comments re. Fourth National Climate Assessment

The undersigned State Attorneys General, City and County Attorneys, and Corporation Counsel (together "States and Cities") respectfully submit this letter along with a copy of the recent national climate assessment report issued by the Environmental Protection Agency and twelve other U.S. government agencies. *See* U.S. Global Change Research Program, "Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II," (D.R. Reidmiller et al. eds., 2018) (*"Assessment"*).[1] The States and Cities wrote Acting Administrator Wheeler on December 11, 2018 requesting withdrawal of EPA's proposed replacement of the Clean Power Plan, Emission Guidelines for Greenhouse Gas Emissions from Existing Electric Utility Generating Units; Revisions to Emission Guideline Implementing Regulations; Revisions to New Source Review Program," 83 Fed. Reg. 44,746 (Aug. 31, 2018) (proposed rule) in light of the Assessment's findings (letter attached hereto). We asked that, at a minimum, the comment period for the proposed rule be reopened so that the implications of the Assessment's findings could be adequately considered.

In our December 11 letter, we further stated our intent to submit a copy of the Assessment to the rulemaking docket for the proposed rule, which we are doing through this letter. This letter also highlights aspects of the Assessment that support or are relevant to points made in our comments on the proposed rule. Under the Clean Air Act, the Assessment must be included in the rulemaking docket because it is of "central relevance" to the proposed rule. *See* 42 U.S.C. § 7607(d)(4)(B)(i) ("All documents which become available after the proposed rule has been published and which the Administrator determines are of central relevance to the rulemaking shall be placed in the docket as soon as possible after their availability."). The Assessment's findings regarding extensive climate change harms and the need for prompt and

[1] The full report is available at: https://nca2018.globalchange.gov/. Because the size of the full report is extremely large, we are submitting a copy on disc with this letter to the rulemaking docket via overnight courier.

significant mitigation measures is centrally relevant to the lawfulness of EPA's proposed approach of requiring no emission reductions (or, at most, very limited emission reductions) from fossil-fueled power plants—one of the nation's largest sources of the greenhouse gas emissions—that EPA has found endanger public health and welfare.

As set forth below, the Assessment's findings are fully consistent with numerous points raised in our comments on the proposed rule dated October 31, 2018 ("Comments").[2] Certain relevant findings are discussed below, organized under the headings and subheadings in our rulemaking comments, including: I. Background, III. EPA's Revised Determinations of the Best System of Emission Reduction for Existing Fossil-Fueled Power Plants, V. Pollution Impacts of the Proposed Rule, and VII. Economic Impacts of the Proposal.

I. Background

A. Recent Evidence of Climate Change

As discussed in our Comments (pp. 4-6), the scientific evidence of climate change caused predominantly by the burning of fossil fuels has only grown since EPA promulgated the Clean Power Plan. In addition to the examples set forth in our Comments, the Assessment discusses many other instances, several of which are highlighted here:

- "Earth's climate is now changing faster than at any point in the history of modern civilization, primarily as a result of human activities."[3]
- "The impacts of global climate change are already being felt in the United States and are projected to intensify in the future."[4]
- "Climate change is transforming where and how we live and presents growing challenges to human health and quality of life, the economy, and the natural systems that support us."[5]
- "Increased atmospheric carbon dioxide levels change ocean conditions through three main factors: warming seas, ocean acidification, and deoxygenation. These factors are

---

[2] A copy of our main comments with appendices may be found in the docket at: https://www.regulations.gov/document?D=EPA-HQ-OAR-2017-0355-24817.

[3] U.S. Global Change Research Prog., "Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II: Report-in-Brief" at 24 (D.R. Reidmiller et al. eds., 2018) (*Report-in-Brief"*). A copy of the Report-in-Brief is available at: https://nca2018.globalchange.gov/downloads/NCA4_Report-in-Brief.pdf. Because the size of the Report-in-Brief is very large, we are submitting a copy on the disc with the full report via overnight courier.

[4] *Id.*

[5] *Id.* at 26.

transforming ocean ecosystems, and these transformations are already impacting the U.S. economy and coastal communities, cultures, and businesses."[6]

- "Climate-related changes in weather patterns and associated changes in air, water, food, and the environment are affecting the health and well-being of the American people, causing injuries, illnesses, and death."[7]
- "The impacts of climate change, variability, and extreme events outside the United States are affecting and are virtually certain to increasingly affect U.S. trade and economy, including import and export prices and businesses with overseas operations and supply chains."[8]
- "Global average sea level has risen by about 7–8 inches (about 16–21 cm) since 1900, with almost half this rise occurring since 1993."[9]
- "Since the 1960s, sea level rise has already increased the frequency of high tide flooding by a factor of 5 to 10 for several U.S. coastal communities."[10]
- "Annual average temperature over the contiguous United States has increased by 1.2°F (0.7°C) over the last few decades and by 1.8°F (1°C) relative to the beginning of the last century."[11]

B. Climate Change-Related Harms Impacting States and Cities

The Background section of our Comments also highlighted harms caused by climate change that our States and Cities are facing. *See* Comments at 6-8; *see also id.* at 87-92 & *Appendix A* (describing in harms in detail). The Assessment contains findings regarding climate change harms in each major region of the U.S., including those identified below in which the States and Cities are located. Several of these adverse impacts are highlighted below:

Hawaii

- ***Harms from ocean acidification and sea level rise.*** "Sea level rise is now beginning to threaten critical assets such as ecosystems, cultural sites and practices, economies, housing and energy, transportation, and other forms of infrastructure. By 2100, increases of 1–4 feet in global sea level are very likely, with even higher levels than the global average in the U.S.-Affiliated Pacific Islands. This would threaten the food and freshwater supply of Pacific island populations and jeopardize their continued sustainability and resilience. . . . Widespread coral reef bleaching and mortality have been occurring more frequently, and by mid-century these events are projected to occur annually, especially if current trends in emissions continue. Bleaching and acidification

[6] *Report-in-Brief* at 86.

[7] *Id.* at 102.

[8] *Id.* at 107.

[9] *Id.* at 65.

[10] *Id.* at 66.

[11] *Id.* at 65.

will result in loss of reef structure, leading to lower fisheries yields and loss of coastal protection and habitat.[12]

Midwest

- ***Reduced agricultural productivity due to increased temperatures and extreme precipitation.*** "[A]gricultural productivity (the ratio of outputs to inputs) is projected to decline by 2050 to the levels of the 1980s (that is, yields may increase but at the cost of substantial increases in inputs)."[13] "[I]ncreases in warm-season absolute humidity and precipitation have eroded soils, created favorable conditions for pests and pathogens, and degraded the quality of stored grain. Projected changes in precipitation, coupled with rising extreme temperatures before mid-century, will reduce Midwest agricultural productivity to the levels of the 1980s without major technological advances."[14] A 2017 study projects that increased growing-season temperatures in the Midwest will be the largest contributing factor to declines in the productivity of U.S. agriculture.[15]

- ***Harms to public health from extreme weather (increased flooding and high temperatures) and increased air pollution, allergens, and diseases.*** "Climate change is expected to worsen existing health conditions and introduce new health threats by increasing poor air quality days, extreme high temperature events, and heavy rainfalls; extending pollen seasons; and modifying the distribution of disease-carrying pests and insects."[16] "[T]he Midwest is projected to have the largest increase in extreme temperature-related premature deaths under the higher scenario (RCP8.5): by 2090, 2,000 additional premature deaths per year . . . are projected" according to EPA.[17]

- ***Harms to transportation and infrastructure from extreme weather, especially flooding.*** "A [2015] study of six Iowa bridges deemed to be critical infrastructure found that under all emission scenarios . . . each location was projected to have increased vulnerability from more frequent episodes of overtopping and potential scour [damage from erosion of bridge bases]. The EPA estimates that the annual cost of maintaining current levels of service on Midwestern bridges in the face of increased scour damage from climate change could reach approximately $400 million in the year 2050 under either the lower or higher scenario." "[In a 2017 analysis,] EPA has estimated that the Midwest is among the regions with the largest expected damages to infrastructure, including the highest estimated damages to roads, rising from $3.3 billion per year in 2050 to $6 billion per year in 2090 (in 2015 dollars) under a higher [emissions] scenario."[18]

---

[12] *Assessment* at 1243-44.

[13] *Id.* at 879.

[14] *Id.* at 907.

[15] *Id.* at 875.

[16] *Id.* at 896.

[17] *Id.* at 898.

[18] *Id.* at 905.

Northeast

- ***Adverse impacts from higher temperatures.*** By 2035, under lower or higher emission scenarios the Northeast region is projected to be, on average, more than 3.6°F warmer than it was in the preindustrial era—the largest such regional increase in the contiguous United States.[19] "The seasonality of the Northeast is central to the region's sense of place and is an important driver of rural economies," and decreasing seasonality is "already altering ecosystems and environments in ways that adversely impact tourism, farming, and forestry."[20] "Shorter, more moderate winters will present new challenges for rural industries," and trends towards increased rainfall intensity will pose significant challenges for agriculture.[21]

- ***Harms from ocean acidification and sea level rise.*** A variety of impacts result from oceans in the Northeast becoming warmer, higher, and more acidified. For example, warming and acidification are expected to substantially reduce populations of fish species and other marine species, including those that are economically and ecologically significant. Sea levels are expected to rise as much as 11 feet, threatening marshes, beaches, and other features of the Northeastern coastal environment.[22]

- ***Adverse effects from extreme weather.*** The effects of climate change, including increased coastal flooding and higher storm surges, will strain and damage the Northeast region's already-aging infrastructure. Areas of vulnerability include electrical systems, water supply, telecommunications, and transportation, just to name a few.[23] Extreme weather will adversely affect human health in significant ways. For instance, increased temperatures, including increases in extreme heat events, are likely to result in more hospital admissions and premature deaths. Increases in ground-level ozone—a consequence of higher temperatures, and a particular problem in the Northeast—will substantially increase premature deaths.[24]

Northwest

- ***Adverse impacts from hotter temperatures.*** In 2015, the Northwest experienced its warmest year on record, and the impacts are a prelude to what will become the norm by the mid-to-late 2000s. The warm winter led to record low mountain snowpack as precipitation fell largely as rain instead of snow. The 2015 "snow drought" caused irrigation shortages, agricultural losses, hydropower shortages, and fish die-offs,[25] including hundreds of thousands of sockeye salmon in the Columbia and Snake River

---

[19] *Assessment* at 675.

[20] *Id.* at 670.

[21] *Id.* at 680, 682.

[22] *Id.* at 687-93.

[23] *Id.* at 677.

[24] *Id.* at 700.

[25] *Id.* at 1066.

Basins.[26] The Washington State Department of Ecology allocated $7 million in drought relief funds for water supplies for irrigation or human consumption.[27] Lack of snowpack and the dry spring led to the most severe wildfire season in the Northwest's recorded history, causing damage to infrastructure in Washington and Idaho and air quality and health concerns.[28]

- ***Harms to marine resources.*** Also in 2015, the largest harmful algal bloom recorded on the West Coast closed commercial, recreational, and tribal fisheries, including salmon, shellfish, and Dungeness crab along the entire Northwest coast.[29]

Southeast

- ***Increased flooding.*** Due to increasing extreme rainfall events and sea level rise, low lying regions in the Southeast are projected to experience "daily high tide flooding by the end of the century."[30] The Southeast has experienced "increases in the number of days with more than 3 inches of precipitation and a 16% increase in observed 5-year maximum daily precipitation (the amount falling in an event expected to occur only once every 5 years)."[31]

- ***More incidences of diseases.*** Many southeastern cities are increasingly at risk due to vector-borne disease brought about by a changing climate.[32] Summer increases in dengue cases are expected across every state in the Southeast.[33] "The Southeast is also the region with the greatest projected increase in cases of West Nile neuro-invasive disease."[34]

- ***More heat waves.*** Increased frequency of heat waves is likely to occur particularly in southeastern cities.[35] For example, of the five large cities that have increasing trends exceeding the national average for all aspects of heat waves (timing, frequency, intensity, and duration), three of those cities are in the Southeast region—Birmingham, New

---

[26] *Assessment* at 1067.

[27] *Id.* at 1054.

[28] *Id.* at 1067.

[29] *Id.* at 1067.

[30] *Id.*, Ch. 19, Key Message 2.

[31] *Id.* at 762.

[32] *Id.*, Ch. 19, Key Message 1.

[33] *Id.* at 754.

[34] *Id.* at 755.

[35] *Id.*, Ch. 19, Key Message 1.

Orleans, and Raleigh.[36] Sixty-one percent of major Southeast cities are exhibiting some aspects of worsening heat waves, a higher percentage than any other region.[37]

- ***More wildfires.*** As explained in our Comments, rising temperatures and longer droughts will increase the frequency and intensity of wildfires. Comments at 7; *Appendix A* at A-41 (impacts of wildfires in North Carolina). The Assessment confirms these findings. For example, it also links the 2016 wildfires in the Southern Appalachians—the worst the region had seen in a century—to a combination of invasive insects and high temperatures linked to climate change.[38]

- ***Loss of coral reefs.*** "Coral elevation and volume in the Florida Keys have been declining in recent decades, and present-day temperatures in the region are already close to bleaching thresholds; hence, it is likely that many of the remaining coral reefs in the Southeast region will be lost in the coming decades."[39]

Southwest

- ***Increased flooding.*** "Climate models project an increase in the frequency of heavy downpours, especially through atmospheric rivers, which are narrow bands of highly concentrated storms that move in from the Pacific Ocean."[40] "Atmospheric rivers, which have caused many large floods in California, may increase in severity and frequency under climate change. In the winter of 2016–2017, a series of strong atmospheric rivers generated high runoff in northern California and filled reservoirs."[41]

- ***Harms from invasive species.*** "The forests and other ecosystems of the Southwest region that provide natural habitat and essential resources for people have declined in fundamental ways due in part to climate change. Vast numbers of trees have died across Southwest forests and woodlands, disproportionately affecting larger trees. Tree death in mid-elevation conifer forests doubled from 1955 to 2007 due in part to climate change."[42] "Climate change has also contributed to increased forest pest infestations, another major cause of tree death in Southwest forests and woodlands. Bark beetle infestations killed 7% of western U.S. forest area from 1979 to 2012, driven by winter warming due to climate change and by drought. Tree death from bark beetles in Colorado increased organic matter in local streams, elevating precursors of cancer-causing trihalomethane in local water treatment plants to levels that exceed the maximum contaminant levels for

---

[36] *Assessment* at 752.

[37] *Id.*

[38] *Id.*, Ch. 19, Key Message 3.

[39] *Id.*

[40] *Id.* at 1110.

[41] *Id.* at 1111-12.

[42] *Id.* at 1115.

drinking water specified by EPA. Without greenhouse gas emissions reductions, further increases in heat and drought could kill many more trees, especially affecting piñon pine, white-bark pine, and tall old-growth trees."[43]

- ***Decreased agricultural productivity.*** Drought-related agricultural changes, stricter drilling regulations, and rapid aquifer depletion have already led to a decline in irrigation in parts of the region. The 2011-16 California drought led to losses of more than 10,000 jobs and the fallowing of 540,000 acres (220,000 hectares), at a cost of $900 million in gross crop revenue in 2015.[44]

- ***More heat waves.*** Parts of the Southwest region experienced record-breaking heat in five of the six years from 2012 to 2017.[45] "[E]xposure to hotter temperatures and heat waves already leads to heat-associated deaths in Arizona and California. Mortality risk during a heat wave is amplified on days with high levels of ground-level ozone or particulate air pollution."[46]

III. EPA's Revised Determinations of the Best System of Emission Reduction for Existing Fossil-Fueled Power Plants

C. EPA's Revised Determination of the Best System of Emission Reduction for Coal Plants is Arbitrary and Capricious because EPA Failed to Consider Relevant Evidence

1. EPA has ignored relevant evidence in the record regarding additional proven systems of emission reduction

a. EPA grounded its analysis of potential best systems on assertions about the nation's electrical grid that are not supported by evidence

As discussed in Section III.C of our Comments, EPA's revised Best System of Emission Reduction (BSER) determination for coal plants failed to consider relevant evidence in the record. *See* Comments at 29-34. The Assessment's findings in the "Energy" chapter are particularly relevant to our argument in III.C.1.a that the agency's analysis of potential BSERs is flawed because it is founded on erroneous assumptions about the electrical grid. Those findings include:

- **Clean energy resources and energy efficiency programs have many economic and system benefits beyond emissions reduction.** "[T]he growing adoption of energy efficiency programs, demand response programs, transmission capacity increases, and

[43] *Assessment* at 1116-17.

[44] *Id.* at 1127.

[45] *Id.* at 1129.

[46] *Id.* at 1104.

microgrids with energy storage technologies is enhancing system flexibility, reliability, and resilience." "Energy efficiency has been remarkably successful over several decades in helping control energy costs to homes, buildings, and industry, while also contributing to enhanced resilience through reduced energy demand."[47]

- **Coal plants are *not* inherently more "secure."** "[M]ost electric service disruptions are caused by transmission and distribution outages . . . . Most generation technologies have experienced fuel deliverability challenges in the past. Coal facilities typically store enough fuel onsite to last for 30 days or more, but extreme cold can lead to frozen fuel stockpiles and disruptions in train deliveries."[48]

V. Pollution Impacts of the Proposed Rule

A. EPA Admits that Air Pollution Under the Proposed Rule Would Be Higher Compared to Under the Clean Power Plan

In Section V.A of our Comments, we argued that the proposed rule's emission guidelines are unlawful under section 111 of the Clean Air Act in light of, *inter alia*, the fact that EPA now has more compelling scientific evidence than it had when it promulgated the Clean Power Plan that prompt and aggressive reductions are necessary to avoid catastrophic harm to public health and welfare. Comments at 83. Several findings in the Assessment further support this argument:

- "Unless counteracting efforts to improve air quality are implemented, climate change will worsen existing air pollution levels," which "would increase the incidence of adverse respiratory and cardiovascular health effects, including premature death."[49] There is robust evidence from models and observations that climate change is worsening ozone pollution.[50] Moreover, the prevailing evidence "strongly suggests" a "climate penalty," i.e., an increase in air pollution resulting from climate change alone, for ozone from warmer temperatures and increases in natural emissions over most of the United States.[51]

- With respect to $PM_{2.5}$, certain studies indicate that even without considering increased wildfire frequency, "climate change will cause a small but important increase in $PM_{2.5}$ over North America."[52] Accounting for increased wildfires amplifies the amount of $PM_{2.5}$ particles resulting from climate change, since wildfires are a major source of $PM_{2.5}$, especially in the western United States during the summer and in the Southeast.[53] And, "[m]ore frequent and severe wildfires due to climate change would further diminish air

---

[47] *Assessment* at 184.

[48] *Id.* at 184-85.

[49] *Id.*, Ch. 13, Key Message 1.

[50] *Id.* at 516.

[51] *Id.* at 518.

[52] *Id.* at 520.

[53] *Id.* at 519.

quality, increase incidences of respiratory illness from exposure to wildfire smoke, impair visibility, and disrupt outdoor recreational activities."[54] Wildfires also emit gases that contribute to ozone formation.[55]

- Rising temperatures and increased CO_2 concentrations can also influence plant-based allergens, hay fever and asthma by increasing the duration of the pollen season, by increasing the amount of pollen produced by plants, and by altering the degree of allergic reactions to pollen.[56]

- Mitigating carbon dioxide and other greenhouse gas emissions can lower emissions of PM, ozone, and other hazardous pollutants, reducing the risks to human health from air pollution.[57]

D. Increased Air Pollution Will Result in Numerous Harms to the States and Cities

2. More pollution will cause disproportionate harm to environmental justice communities

As previously discussed, in the proposed rule EPA improperly ignored the disproportionate harm that climate change causes vulnerable populations, and unlike in the Clean Power Plan, the agency did not require states to engage with vulnerable and overburdened communities when developing state plans. *See* Comments at 87. The Assessment underscores the implications for this failure, finding that low-income communities, communities of color, the elderly, and children are particularly vulnerable to health-related climate impacts and that "these groups are among the most exposed, most sensitive, and have the least individual and community resources to prepare for and respond to health threats."[58]

3. More pollution will harm public welfare in the States and Cities in myriad ways

Section V.D of our Comments discusses the numerous harms the States and Cities will experience as a result of the increased pollution the proposed rule would allow. The Assessment's findings support our contention in V.D.3 that additional carbon pollution from power plants will harm our public welfare in myriad ways, including:

- ***Harms from sea level rise.*** The States and Cities, representing the entire West Coast and most of the east cost of the continental United States, as well as Hawaii, face a disproportionate burden from sea level rise and related impacts. Comments at 88-89. The Assessment provides further support for the current and escalating effects of sea level rise caused by climate change. Relevant findings in the Assessment include that storms,

---

[54] *Assessment* at 521, Key Message 2.

[55] *Id.* at 519.

[56] *Id.* at 522; *see also* Key Message 3.

[57] *Id.* at 522-23.

[58] *Id.* at 542, 546-48, 555-56.

floods, and erosion, exacerbated by rising sea levels, threaten approximately $1 trillion in national wealth held in coastal real estate and the continued viability of coastal communities that depend on coastal water, land, and other resources for economic health and cultural integrity.[59] Flooding from rising sea levels and storms is likely to destroy, or make unsuitable for use, billions of dollars of property by the middle of this century, with the Atlantic and Gulf coasts facing greater-than-average risk compared to other regions of the country.[60] High tide flooding is forcing some East Coast cities to install costly pump stations to frequently clear floodwaters from the streets (such as Miami Beach) and to mobilize emergency responders to routinely close flooded streets.[61] For example, low-lying Norfolk—Virginia's second-largest city—is enduring serious physical, financial, and social impacts as the frequency of high tide flooding accelerates due to rising local sea level.[62] Sea level rise might reshape the U.S. population distribution, with 13.1 million people potentially at risk of needing to migrate due to a sea level rise of 6 feet (about 2 feet less than the Extreme scenario) by the year 2100.[63]

- ***Spread of infectious diseases.*** In our Comments, we explained that by expanding the habitat of disease-carrying insects, climate change has increased and will continue to increase the incidence and spread of infectious diseases in our States and Cities. Comments at 91. Similarly, the Assessment notes that "[c]limate change is expected to alter the geographic range, seasonal distribution, and abundance of disease vectors, exposing more people in North America to ticks that carry Lyme disease or other bacterial and viral agents, and to mosquitoes that transmit West Nile, chikungunya, dengue, and Zika viruses."[64]

- ***Undermining the reliability of the electrical grid.*** "[E]xtreme weather impacts are expected to continue growing in frequency and severity over the coming century, affecting all elements of the Nation's complex energy supply system."[65] "Repairs to electricity generation, transmission, and distribution systems from recent hurricane events are costing billions of dollars. Con Edison and Public Service Electric and Gas invested over $2 billion (in 2014 dollars) in response to Superstorm Sandy. An estimate to build back Puerto Rico's electricity systems in response to Hurricanes Irma and Maria is approximately $17 billion (in 2017 dollars)."[66] "Unless other mitigation strategies are implemented, more frequent, severe, and longer-lasting extreme heat events are expected to make blackouts and power disruptions more common, increase the potential for

---

[59] *Assessment* at 324.

[60] *Id.* at 330.

[61] *Id.* at 329-30.

[62] *Id.* at 336-37.

[63] *Id.* at 335.

[64] *Id.* at 545.

[65] *Id.* at 179.

[66] *Id.*

electricity infrastructure to malfunction, and result in increased risks to public health and safety."[67] In addition, "[e]nergy infrastructure is long-lived and, as a result, today's decisions about how to locate, expand, and modify the Nation's energy system will influence system reliability, resilience, and economic security for decades."[68]

- ***Increased costs of electricity.*** "[H]igher temperatures are projected to drive up electricity costs not only by increasing demand but also by reducing the efficiency of power generation and delivery, and by requiring new generation capacity costing residential and commercial ratepayers by some estimates up to $30 billion per year by mid-century." "By the end of the century, an increase in average annual energy expenditures from increased energy demand under the higher [emissions] scenario is estimated at $32–$87 billion . . . . Nationwide, electricity demand is projected to increase by 3%–9% by 2040 under the higher scenario."[69]

- ***Damage to transportation systems.*** Climate change is projected to increase the costs of maintaining, repairing, and replacing infrastructure, with regional differences proportional to the magnitude and severity of impacts. Nationally, the total annual damages from temperature- and precipitation-related damages to paved roads are estimated at up to $20 billion under RCP8.5 in 2090 (in 2015 dollars, undiscounted, five-model average). Inland flooding, projected to increase over the coming century, threatens approximately 2,500 to 4,600 bridges across the United States and is anticipated to result in average annual damages of $1.2 to $1.4 billion each year by 2050 (in 2015 dollars, undiscounted, five-model average).[70] Combined sewer and storm sewer systems used in many cities are often not designed to withstand the capacity demand currently experienced during heavy rainfall events or rising high tides. This situation is becoming increasingly problematic with more frequent localized flooding, leading to more frequent travel disruptions for commuters, travelers, and freight. The effect is compounded in cities with older infrastructure, such as Philadelphia, Miami, Chicago, and Charleston.[71] Higher temperatures, combined with increased salinity and humidity, accelerates deterioration in bridges and roads constructed with concrete.[72] Similarly, sea level rise poses a major threat to functional performance of low-elevation roadways, rail and bridges. On the East Coast alone, more than 7,500 miles of roadway are located in high tide flooding zones.[73]

---

[67] *Assessment* at 181.

[68] *Id.* at 189.

[69] *Id.* at 181.

[70] *Id.* at 485.

[71] *Id.* at 490.

[72] *Id.* at 489.

[73] *Id.* at 487.

- ***Multisector impacts.*** EPA's analysis in the proposed rule failed to engage with multi-sector impacts to the States and Cities, despite the fact it considered those impacts in the Clean Power Plan. Comments at 87-92 (summarizing direct and indirect effects of climate change that the States and Cities are already experiencing). By contrast, the Assessment concludes that climate change risk assessments should "encompass[] interactions among sectors," and should not stop at describing "first order direct . . . impacts" only.[74] Although acknowledging that it is "hard to quantify all the ways in which climate-related stressors might lead to severe or widespread consequences for natural, built and social systems," the Assessment faults analyses that "fail[] to recognize indirect and cascading consequences" of climate-related phenomena.[75]

4. The paltry emission reductions (if any) from implementation of the proposed rule cannot be squared with EPA's findings in the Clean Power Plan and other current EPA rulemakings regarding the urgent threat climate change poses and the need to demonstrate international leadership to facilitate other countries' commitments to reduce greenhouse gas emissions

In our Comments, we noted that EPA had not retracted or rebutted its findings in the Clean Power Plan rulemaking that climate change poses an existential threat that requires prompt action. Comments at 92-93. The Assessment's chapter on "Mitigation" confirms the importance of significantly cutting greenhouse gases now in order to avoid more severe harms in the future:

- "Many climate change impacts in the United States can be substantially reduced over the course of the 21st century through global-scale reductions in GHG emissions."[76] Reducing greenhouse gases could avoid "thousands to tens of thousands of deaths per year from extreme temperatures, hundreds to thousands of deaths per year from poor air quality, and the annual loss of hundreds of millions of labor hours from extreme temperatures."[77] These impacts also have significant economic impacts: each "represents domestic economic benefits of tens to hundreds of billions of dollars per year."[78]

- The Assessment reinforces the urgency of mitigation, finding that "early and substantial mitigation offers a greater chance of avoiding increasingly adverse impacts."[79] Failing to act will lead to harmful and unpredictable effects, even if later action is taken to mitigate climate change: "delayed and much steeper emissions reductions jeopardize achieving any long-term goal given uncertainties in the physical response of the climate system to changing atmospheric CO_2, mitigation deployment uncertainties, and the potential for

---

[74] *Assessment* at 639, 641.

[75] *Id.* at 640-41.

[76] *Id.* at 1359.

[77] *Id.*

[78] *Id.*

[79] *Id.* at 1348.

> abrupt consequences."[80] Similarly, the Assessment's authors warn that "[d]ecisions that decrease or increase emissions over the next few decades will set into motion the degree of impacts that will likely last throughout the rest of this century, with some impacts (such as sea level rise) lasting for thousands of years, or even longer."[81]

In addition, the Assessment's Frequently Asked Questions section further underscores the need for meaningful reduction of greenhouse gases now. For example, in response to the question "**Is timing important for climate mitigation?**" the Assessment answers:

> Yes. The choices made today largely determine what impacts may occur in the future…. The sooner greenhouse gas emissions are reduced, the easier it may be to limit the long-term costs and damages due to climate change. Waiting to begin reducing emissions is likely to increase the damages from climate-related extreme events (such as heat waves, droughts, wildfires, flash floods, and stronger storm surges due to higher sea levels and more powerful hurricanes).[82]

The Assessment further describes "**The Risks of Inaction**" as follows:

> In the absence of more significant global mitigation efforts, climate change is projected to impose substantial damages on the U.S. economy, human health, and the environment. Under scenarios with high emissions and limited or no adaptation, annual losses in some sectors are estimated to grow to hundreds of billions of dollars by the end of the century. It is very likely that some physical and ecological impacts will be irreversible for thousands of years, while others will be permanent.[83]

VII. Economic Impacts of the Proposal

A. The RIA Underestimates the Foregone Benefits of Reducing Carbon Pollution

1. EPA erroneously failed to consider international costs of climate change in calculating the social cost of carbon

In our Comments (pp. 128-32), the States and Cities explained how EPA's RIA for the proposed rule underestimated the foregone benefits of reducing carbon pollution by taking an unduly narrow view of the Social Cost of Carbon. The Assessment further bolsters that argument, including:

---

[80] *Assessment* at 1351.

[81] *Id.*

[82] *Id.* at 1488.

[83] *Id.* at 1347.

- The Assessment identifies numerous public health impacts of climate change—including extreme weather events, elevated heat, droughts, vector borne diseases, water related illnesses, food availability and nutrition, and mental health—that EPA should have separately considered in evaluating the Social Cost of Carbon.[84] The RIA for the Proposed Rule merely states that EPA considered "net changes in agricultural productivity and human health" in the Social Costs of Carbon, without specifically defining what human health impacts were included and how EPA ensured it properly accounted for them.

- The Assessment's key message that climate change impacts will have widespread, often unpredictable but costly downstream effects on many sectors and systems exposed to climate change further refutes EPA's outdated and very low Social Cost of Carbon range of $1 to $7 per ton.[85] Even if EPA could lawfully limit its analysis to domestic costs only, its cost range fails to consider up-to-date, peer-reviewed findings that recent multi-sector research into the domestic costs of climate change on the agricultural and energy sectors, and on domestic economic output generally, are much higher than estimated by EPA.

- The Assessment supports our point that EPA ignored the Department of Defense's finding that "climate change is an urgent and growing threat to our national security." *See* Comments at 130 (citing 2015 Department of Defense report). Specifically, the Assessment explains that "[c]limate change and extremes increase risks to national security through direct impacts on U.S. military infrastructure and by affecting factors, including food and water availability, that can exacerbate conflict outside U.S. borders."[86]

- In our comments, we noted that in adopting a "domestic only" estimate of the cost of carbon, EPA "implicitly assumes that U.S. citizens and residents derive no utility from the welfare of citizens of other countries." Comments at 129. The Assessment directly contradicts that assumption, stating that "U.S. citizens have long been concerned about the welfare of those living beyond U.S. borders and their vulnerability to the global impacts of climate."[87]

- We previously noted that EPA "fails to account for climate change impacts on foreign trading partners and the resulting impacts to domestic welfare," and "ignores the fact that lower economic growth in other regions could reduce demand for U.S. exports, and lower productivity could increase the prices of U.S. imports." Comments at 129. Similarly, the Assessment observes that "[t]he impacts of climate change, variability, and extreme events outside the United States are affecting and are virtually certain to increasingly affect U.S.

---

[84] *See Assessment* at 543-46, 551-52.

[85] *See id.* at 636, Key Message 1.

[86] *Id.* at 612.

[87] *Id.* at 608; *see also id.* at 611 ("The impacts of climate change … [can] undermin[e] international aid and investments made by the United States and increas[e] the need for humanitarian assistance and disaster relief.").

trade and economy, including import and export prices and businesses with overseas operations and supply chains."[88]

3. EPA failed to meaningfully consider the non-monetized costs of climate change that are not incorporated in the social cost of carbon models, as required by OMB Circular A-4 and Supreme Court precedent

The States and Cities faulted EPA for ignoring the complexity of climate impacts by wholly disregarding non-monetized costs of climate change in the proposed rule. *See* Comments at 136-38. Similarly, the Assessment provides that rather than ignoring complexity that is difficult to quantify, EPA should "integrate diverse evidence, combining quantitative and qualitative results," and drawing on multidisciplinary "forms of analysis" to fill the gap.[89] The Assessment further highlights the importance of specific examples of non-monetized costs of carbon that we had previously referenced. In our comments, we mentioned "damages caused by ocean acidification and wildfires" as among the non-monetized costs of climate change. Comments at 137. The Assessment similarly states: "Marine fisheries and fishing communities are at high risk from climate-driven changes in the distribution, timing, and productivity of fishery-related species. Ocean warming, acidification, and deoxygenation are projected to increase these changes in fishery-related species, reduce catches in some areas, and challenge effective management of marine fisheries and protected species."[90] The Assessment also states: "Wildfire smoke degrades air quality, increasing the health risks to tens of millions of people in the United States. More frequent and severe wildfires due to climate change would further diminish air quality, increase incidences of respiratory illness from exposure to wildfire smoke, impair visibility, and disrupt outdoor recreational activities."[91]

In addition, the Assessment supports the States' and Cities' argument that EPA ignored the dictates of OMB Circular A-4 by not using its professional judgment to highlight, categorize, or rank non-quantifiable impacts. Comments at 136 (quoting Circular A-4). The Assessment explains that "numerical estimates" should be "complemented by methods quantifying expert judgment in order to consider uncertainties not well represented by" existing models.[92] EPA's failure to grapple with the "diverse evidence" of climate harms[93] in the manner described by

---

[88] *Assessment* at 608 (noting that in 2010-11, "drought in Russia, Ukraine and the United States and damaging precipitation in Australia" resulted in "reduction in wheat production," which "contributed to a spike in global wheat prices … increasing the cost of flour and bread in the United States.").

[89] *Id.* at 640.

[90] *Id.* at 361.

[91] *Id.* at 513.

[92] *Id.* at 640.

[93] *Id.* at 639.

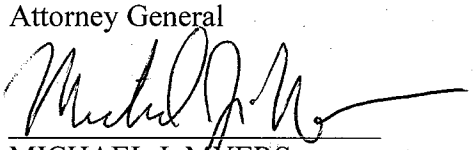
Circular A-4 and the Assessment, means it has arbitrarily limited its consideration of costs and benefits in a manner prescribed in these guidance documents for federal agencies.

Conclusion

The Assessment is of central relevance to the proposed rule and therefore EPA must include it in the rulemaking docket. The Assessment's findings confirm the States and Cities' grave concerns with EPA's proposed rule. We renew our request that the agency withdraw its flawed proposal and work to implement and strengthen the Clean Power Plan.

Respectfully Submitted,

FOR THE STATE OF NEW YORK
BARBARA D. UNDERWOOD
Attorney General



MICHAEL J. MYERS
Senior Counsel
MORGAN A. COSTELLO
Section Chief, Affirmative Litigation
ANDREW G. FRANK
BRIAN M. LUSIGNAN
CLAIBORNE WALTHALL
Assistant Attorneys General
ALAN BELENSZ
Chief Scientist
PETER MALASPINA
Chief Economist
ANDREA CATALFAMO
Legal Assistant
Environmental Protection Bureau
The Capitol
Albany, NY 12224
(518) 776-2400

FOR THE STATE OF CALIFORNIA

XAVIER BECERRA
ATTORNEY GENERAL
Robert W. Byrne
Sally Magnani
Senior Assistant Attorneys General
David A. Zonana
Supervising Deputy Attorney General
M. Elaine Meckenstock
Elizabeth B. Rumsey
Timothy E. Sullivan
Jonathan Wiener
Deputy Attorneys General
1515 Clay Street
Oakland, CA 94612
(510) 879-1300

FOR THE STATE OF CONNECTICUT

GEORGE JEPSEN
ATTORNEY GENERAL
Matthew I. Levine
Scott N. Koschwitz
Assistant Attorneys General
Office of the Attorney General
P.O. Box 120, 55 Elm Street
Hartford, CT 06141-0120
(860) 808-5250

FOR THE STATE OF DELAWARE

MATTHEW P. DENN
ATTORNEY GENERAL
Valerie S. Edge
Deputy Attorney General
Delaware Department of Justice
102 West Water Street, 3d Floor
Dover, DE 19904
(302) 739-4636

FOR THE STATE OF HAWAII

RUSSELL A. SUZUKI
ATTORNEY GENERAL
William F. Cooper
Deputy Attorney General
465 S. King Street, Room 200
Honolulu, HI 96813
(808) 586-4070

FOR THE STATE OF ILLINOIS

LISA MADIGAN
ATTORNEY GENERAL
Matthew J. Dunn
Gerald T. Karr
Daniel I. Rottenberg
Assistant Attorneys General
Jason James
Special Asst. Attorney General
69 W. Washington St., 18th Floor
Chicago, IL 60602
(312) 814-3816

FOR THE STATE OF IOWA

THOMAS J. MILLER
ATTORNEY GENERAL
Jacob Larson
Assistant Attorney General
Office of Iowa Attorney General
Hoover State Office Building
1305 E. Walnut Street, 2nd Floor
Des Moines, IA 50319
(515) 281-5341

FOR THE STATE OF MAINE

JANET T. MILLS
ATTORNEY GENERAL
Gerald D. Reid
Natural Resources Division Chief
6 State House Station
Augusta, ME 04333
(207) 626-8800

FOR THE COMMONWEALTH OF MASSACHUSETTS

MAURA HEALEY
ATTORNEY GENERAL
Melissa A. Hoffer
Christophe Courchesne
Assistant Attorneys General
Megan M. Herzog
Special Assistant Attorney General
Environmental Protection Division
One Ashburton Place, 18th Floor
Boston, MA 02108
(617) 963-2423

FOR THE STATE OF NEW MEXICO

HECTOR BALDERAS
ATTORNEY GENERAL
Anne Minard
Assistant Attorney General
Office of the Attorney General
408 Galisteo Street
Villagra Building
Santa Fe, NM 87501
(505) 490-4045

FOR THE STATE OF MARYLAND

BRIAN E. FROSH
ATTORNEY GENERAL
Joshua M. Segal
Assistant Attorney General
200 St. Paul Place, 20th Floor
Baltimore, MD 21202
(410) 576-6962

FOR THE STATE OF MINNESOTA, BY AND THROUGH ITS MINNESOTA POLLUTION CONTROL AGENCY

OFFICE OF THE ATTORNEY GENERAL
STATE OF MINNESOTA
Karen D. Olson
Deputy Attorney General
Max Kieley
Assistant Attorney General
445 Minnesota Street, Suite 900
St. Paul, MN 55101-2127
(651) 757-1244

FOR THE STATE OF NORTH CAROLINA

JOSHUA H. STEIN
ATTORNEY GENERAL
Daniel Hirschman
Senior Deputy Attorney General
Taylor Crabtree
Asher Spiller
Assistant Attorneys General
Environmental Division
North Carolina Department of Justice
P.O. Box 629
Raleigh, NC 27602-0629
(919) 716-6000

FOR THE STATE OF OREGON

ELLEN F. ROSENBLUM
ATTORNEY GENERAL
Paul Garrahan
Attorney-in-Charge
Steve Novick
Special Assistant Attorney General
Natural Resources Section
Oregon Department of Justice
1162 Court Street NE
Salem, OR 97301-4096
(503) 947-4593

FOR THE COMMONWEALTH OF PENNSYLVANIA

JOSH SHAPIRO
ATTORNEY GENERAL
Michael J. Fischer
Chief Deputy Attorney General
Aimee Thomson
Deputy Attorney General
Office of the Attorney General
Strawberry Square
Harrisburg, PA 17120
(215) 560-2171

FOR THE STATE OF RHODE ISLAND

PETER F. KILMARTIN
ATTORNEY GENERAL
Gregory S. Schultz
Special Assistant Attorney General
Rhode Island Department of Attorney General
150 South Main Street
Providence, RI 02903
(401) 274-4400

FOR THE STATE OF VERMONT

THOMAS J. DONOVAN, JR.
ATTORNEY GENERAL
Nicholas F. Persampieri
Assistant Attorney General
Office of the Attorney General
109 State Street
Montpelier, VT 05609-1001
(802) 828-3186

FOR THE COMMONWEALTH OF VIRGINIA

MARK HERRING
ATTORNEY GENERAL
Stephen A. Cobb
Deputy Attorney General
Donald D. Anderson
Sr. Asst. Attorney General and Chief
Matthew L. Gooch
Assistant Attorney General
Environmental Section
900 East Main Street
Richmond, VA 23219
(804) 225-3193

FOR THE STATE OF WASHINGTON

ROBERT W. FERGUSON
ATTORNEY GENERAL
Katharine G. Shirey
Assistant Attorney General
Office of the Attorney General
P.O. Box 40117
Olympia, WA 98504-0117
(360) 586-6769

FOR THE DISTRICT OF COLUMBIA

KARL A. RACINE
ATTORNEY GENERAL
Robyn R. Bender
Deputy Attorney General
David S. Hoffman
Assistant Attorney General
Office of the Attorney General
441 Fourth Street, NW
Suite 650 North
Washington, DC 20001
(202) 442-9889

FOR BROWARD COUNTY, FLORIDA

ANDREW J. MEYERS
COUNTY ATTORNEY
Mark A. Journey
Assistant County Attorney
Broward County Attorney's Office
115 S. Andrews Avenue, Room 423
Fort Lauderdale, FL 33301
(954) 357-7600

FOR THE CITY OF CHICAGO

EDWARD N. SISKEL
CORPORATION COUNSEL
BENNA RUTH SOLOMON
Deputy Corporation Counsel
30 N. LaSalle Street, Suite 800
Chicago, IL 60602
(312) 744-7764

FOR THE CITY OF NEW YORK

ZACHARY W. CARTER
CORPORATION COUNSEL
Susan E. Amron
Chief, Environmental Law Division
Kathleen C. Schmid
Senior Counsel
New York City Law Department
100 Church Street
New York, NY 10007
(212) 356-2319

FOR THE CITY OF BOULDER

TOM CARR
CITY ATTORNEY
Debra S. Kalish
City Attorney's Office
1777 Broadway, Second Floor
Boulder, CO 80302
(303) 441-3020

FOR THE CITY OF PHILADELPHIA

MARCEL S. PRATT
CITY SOLICITOR
Scott J. Schwarz
Patrick K. O'Neill
Divisional Deputy City Solicitors
The City of Philadelphia
Law Department
One Parkway Building
1515 Arch Street, 16th Floor
Philadelphia, PA 19102-1595
(215) 685-6135

FOR THE CITY OF SOUTH MIAMI

THOMAS F. PEPE
CITY ATTORNEY
City of South Miami
1450 Madruga Avenue, Suite 202
Coral Gables, Florida 33146
(305) 667-2564

FOR THE CITY OF LOS ANGELES

MICHAEL N. FEUER
CITY ATTORNEY
Michael J. Bostrom
Assistant City Attorney
Los Angeles City Attorney's Office
200 N. Spring Street, 14th Floor
Los Angeles, CA 90012
(213) 978-1882

Attorneys General of New York, California, Connecticut, Delaware, Hawaii, Illinois, Iowa, Maine, Maryland, Massachusetts, Minnesota (by and through its Minnesota Pollution Control Agency), New Jersey, New Mexico, North Carolina, Oregon, Pennsylvania, Vermont, Virginia, Washington, and the District of Columbia, the County Attorney of Broward (FL), and the City Attorneys/Corporation Counsel of Boulder (CO), Chicago, Los Angeles, New York, Oakland (CA), Philadelphia, San Francisco, and South Miami

December 11, 2018

Via Electronic Mail and First Class Mail
Andrew K. Wheeler
Acting Administrator
Environmental Protection Agency
Office of the Administrator Code 1101A
1200 Pennsylvania Avenue, NW
Washington, D.C. 20460

Re: Fourth National Climate Assessment and Proposed Rules Weakening Greenhouse Gas Emission Standards for Motor Vehicles and Power Plants

Dear Acting Administrator Wheeler:

The undersigned State Attorneys General and Local Government Attorneys (together "States and Cities") respectfully submit this letter concerning the recent national climate assessment report issued by the Environmental Protection Agency and twelve other U.S. government agencies.[1] The Assessment provides a thorough evaluation of the harmful impacts of climate change that different regions of the country are experiencing and the projected risks climate change poses to our health, environment, economy and national security.

Although the Assessment credits emission reduction strategies the States and Cities and others have already put into action, it concludes that current efforts "do not yet approach the scale considered necessary to avoid substantial damages to the economy, environment, and human health over the coming decades." *Assessment*, ch. 29. The sobering findings of the Assessment should serve as a call to action to EPA and other federal agencies to take prompt measures to require reductions in greenhouse gases. Yet EPA is proposing to move our nation backwards by rolling back current regulations that require greenhouse gas emission reductions from the transportation and electricity generation sectors, the two largest sources of those emissions in the United States. The combined effect of these two rollbacks would harm Americans by making climate change worse: Conservatively, based on EPA's own figures, the

[1] *See* U.S. Global Change Research Program, "Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II," (D.R. Reidmiller et al. eds., 2018), https://nca2018.globalchange.gov/ ("Assessment").

vehicle emissions rollback would result in increased emissions of 540 million metric tons of carbon dioxide equivalent just from model year 2022-25 motor vehicles (*i.e.*, not even counting the 2021 and 2026 model years),[2] and the rollback of the Clean Power Plan would cause an increase of up to 55 million metric tons (61 million short tons) of carbon dioxide equivalent in 2030. 83 Fed. Reg. 44,746, 44,784, tbl. 6 (Aug. 31, 2018). Added together, the emissions increases for those years alone would equal the annual emissions of 147 coal-fired power plants or 127 million gasoline-powered cars.

In light of the Assessment, we renew our request that you immediately withdraw the proposals to weaken the motor vehicle and power plant greenhouse gas emission standards. At a minimum, EPA should reopen the comment periods for each of the rollback proposals to allow for public input on and adequate consideration of the bearing of the Assessment's findings on both proposals.[3]

With respect to the numerous climate change harms documented in the Assessment, two are particularly important to highlight. Regarding human health, the Assessment states that "[i]mpacts from climate change on extreme weather and climate-related events, air quality, and the transmission of disease through insects and pests, food, and water increasingly threaten the health and well-being of the American people, particularly populations that are already vulnerable." *Assessment*, *Summary Findings*, ch. 6. Similarly, regarding infrastructure, the Assessment notes that "[o]ur aging and deteriorating infrastructure is further stressed by increases in heavy precipitation events, coastal flooding, wildfires, and other extreme events, as well as changes to average precipitation and temperature." *Id.*, ch. 10.

Moreover, the Assessment makes clear that we need to act now to reduce greenhouse gas emissions. It cautions that "[i]n the absence of significant global mitigation action and regional adaptation efforts, rising temperatures, sea level rise, and changes in extreme events are expected to increasingly disrupt and damage critical infrastructure and property, labor productivity, and the vitality of our communities." *Assessment*, *Summary Findings*, ch. 2. Furthermore, "[b]y the end of this century, thousands of American lives could be saved and hundreds of billions of dollars in health-related economic benefits gained each year under a pathway of lower greenhouse gas emissions."[4]

---

[2] U.S. EPA, *Final Determination on the Appropriateness of the Model Year 2022-2025 Light-Duty Vehicle Greenhouse Gas Emissions Standards Under the Midterm Evaluation* (Jan. 2017), at 6.

[3] Because we cannot assume that EPA will grant our request to withdraw the proposals or at least reopen the public comment period, the States and Cities intend to submit the Assessment to the dockets of the two rulemakings shortly, along with letters discussing how the Assessment supports our legal and policy concerns previously expressed in our rulemaking comments.

[4] U.S. Global Change Research Program, "Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II: Report-in-Brief," 102 (D.R. Reidmiller et al. eds., 2018), https://nca2018.globalchange.gov/downloads/NCA4_Report-in-Brief.pdf ("*Report-in-Brief*").

EPA and its sister agencies cannot ignore or downplay their own Assessment. The Assessment represents the federal government's authoritative analysis of climate science and the impacts of climate change on the United States. *See* Global Change Research Act of 1990, Pub. L. No. 101-606. It represents the work of more than 300 governmental and non-governmental experts, was externally peer-reviewed by a committee of the National Academy of Sciences, Engineering and Medicine, and underwent several rounds of technical and policy review by the thirteen federal member agencies of the U.S. Global Change Research Program. *Report-in-Brief* at 1–2. EPA and other federal agencies must give full weight to the scientific facts and findings presented in the Assessment, and consider the implications of the Assessment for its proposed actions.

Many of the States and Cities have already filed extensive comments objecting to the proposals to weaken the motor vehicle and power plant greenhouse gas emission standards and calling for their withdrawal.[5] We today renew our call for their withdrawal in light of the overwhelming evidence the Assessment presents of the need for prompt, meaningful action by the federal government to reduce greenhouse gas emissions.

Sincerely,

BARBARA D. UNDERWOOD
Attorney General of New York

XAVIER BECERRA
Attorney General for California

[5] *See, e.g.*, Comments of California Attorney General, et al. on the Proposed Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021-26 Passenger Cars and Light Duty Trucks (Oct. 26, 2018), *available at*: https://www.regulations.gov/document?D=NHTSA-2018-0067-11735; Comments of New York Attorney General, et al. on EPA Proposed Rule, Emission Guidelines for Greenhouse Gas Emissions from Existing Electric Utility Generating Units; Emission Guideline Implementing Regulations; New Source Review Program (Oct. 31, 2018), *available at*: https://www.regulations.gov/document?D=EPA-HQ-OAR-2017-0355-24817.

George Jepsen
Attorney General of Connecticut

Maura Healey
Attorney General of Massachusetts

Matthew Denn
Attorney General of Delaware

Lori Swanson
Attorney General of Minnesota for the State of Minnesota, by and through its Minnesota Pollution Control Agency

Russell Suzuki
Attorney General of Hawaii

Gurbir S. Grewal
Attorney General of New Jersey

Lisa Madigan
Attorney General of Illinois

Hector Balderas
Attorney General of New Mexico

Tom Miller
Attorney General of Iowa

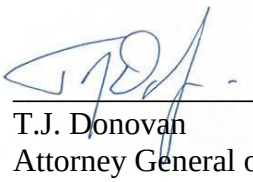
Josh Stein
Attorney General of North Carolina

Janet T. Mills
Attorney General of Maine

Ellen F. Rosenbaum
Attorney General of Oregon

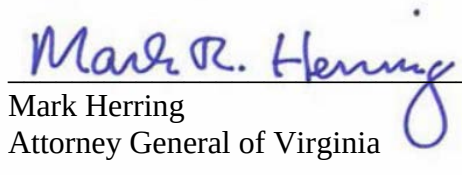
Brian Frosh
Attorney General of Maryland

Josh Shapiro
Attorney General of Pennsylvania

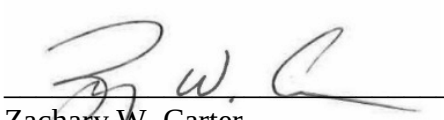


T.J. Donovan
Attorney General of Vermont

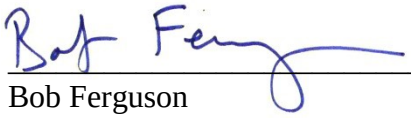
Michael N. Feuer
Los Angeles City Attorney



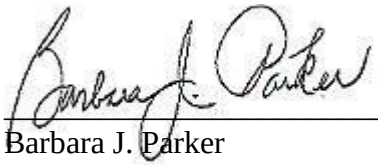
Mark Herring
Attorney General of Virginia



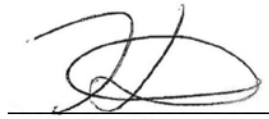
Zachary W. Carter
New York City Corporation Counsel



Bob Ferguson
Attorney General of Washington

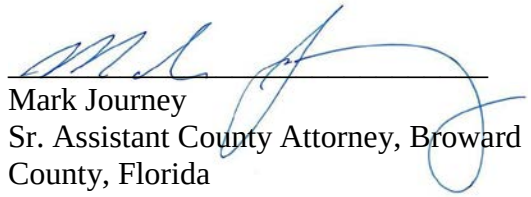


Barbara J. Parker
City Attorney, Oakland, California

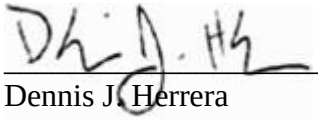


Karl A. Racine
Attorney General for the District of Columbia

/s/
Marcel S. Pratt
City Solicitor, City of Philadelphia, Pennsylvania

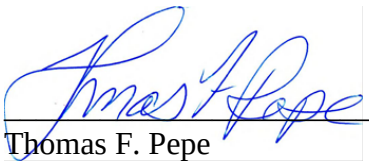


Mark Journey
Sr. Assistant County Attorney, Broward County, Florida



Dennis J. Herrera
City Attorney, San Francisco, California

Thomas A. Carr
City Attorney, Boulder, Colorado



Thomas F. Pepe
City Attorney, South Miami, Florida

Edward N. Siskel
City Attorney, Chicago, Illinois

Exhibit C:

Comment of Center for Biological Diversity, *et al.*, concerning United States Global Change Research Program, UNITED STATES GLOBAL CHANGE RESEARCH PROGRAM, FOURTH NATIONAL CLIMATE ASSESSMENT, VOLUME II: IMPACTS, RISKS AND ADAPTATION IN THE UNITED STATES (2018), submitted December 13, 2013, Docket ID No. EPA-HQ-OAR-2017-0355-26637

From: Benjamin Levitan <blevitan@edf.org>
Sent: Thursday, December 13, 2018 3:26 PM
To: A-AND-R-DOCKET
Subject: Docket ID No. EPA–HQ–OAR–2017-0355
Attachments: ACE Supplemental Comment Letter on NCA4.pdf

Attached please find supplemental comments pertaining to the Fourth National Climate Assessment, Vol. II for Docket ID No. EPA-HQ-OAR-2017-0355, submitted on behalf of Center for Biological Diversity, Clean Air Task Force, Earthjustice, Environmental Defense Fund, Environmental Law and Policy Center, National Parks Conservation Association, Natural Resources Defense Council, Sierra Club, and Union of Concerned Scientists.

Please contact me with any questions about this submission.

With best regards,
Ben Levitan

Ben Levitan
Attorney, U.S. Clean Air

Environmental Defense Fund
1875 Connecticut Ave., NW
Washington, DC 20009
(202) 572-3318
blevitan@edf.org
edf.org

December 13, 2018

VIA EMAIL TO A-AND-R-DOCKET@EPA.GOV AND U.S. MAIL

Andrew R. Wheeler
Acting Administrator
Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460

Attn: Docket No. EPA-HQ-OAR-2017-0355

Re: Supplemental Comments of Environmental and Public Health Organizations on EPA's Proposed Emission Guidelines for Greenhouse Gas Emissions From Existing Electric Utility Generating Units; Revisions to Emission Guideline Implementing Regulations; Revisions to New Source Review Program, 83 Fed. Reg. 44,746 (Aug. 31, 2018)

The undersigned organizations ("Environmental and Public Health Commenters") hereby submit these supplemental comments concerning the United States Global Change Research Program's ("USGCRP's") FOURTH NATIONAL CLIMATE ASSESSMENT, VOLUME II: IMPACTS, RISKS, AND ADAPTATION IN THE UNITED STATES ("NCA4-II" or "Report"), which was published on November 23, 2018, after the closing of the period for public comment on EPA's above-referenced proposal ("ACE" or "Proposal").[1] We are submitting these comments and the Report to the U.S. Environmental Protection Agency's ("EPA's" or "Agency's") docket for the Proposal.

The NCA4-II is a comprehensive, interdisciplinary assessment that represents the federal government's best understanding of the consequences of climate change for the United States. It compiles compelling new evidence of the serious damages to public health, the economy, and natural resources climate change has already caused throughout the United States, and the gravity of risks of even more costly and disruptive damage yet to come. The Report emphasizes that the degree of future harm society will experience from climate change depends upon whether effective efforts are taken now to mitigate emissions of climate-destabilizing greenhouse gases. The Report is thus of "central relevance" to this rulemaking,[2] which would significantly increase allowable greenhouse gas emissions from existing power plants, compared to the rule it would replace.

[1] The Report is available at https://www.globalchange.gov/nca4. The hard copy of these supplemental comments, which is being transmitted to the EPA Docket Center via the United States Postal Service, is accompanied by an electronic copy of the Report. Volume I of the Fourth National Climate Assessment was published in 2017, and focused on the physical scientific basis for climate change. USGCRP, FOURTH NATIONAL CLIMATE ASSESSMENT, VOL. I: CLIMATE SCIENCE SPECIAL REPORT (2017), https://science2017.globalchange.gov/downloads/CSSR2017_FullReport.pdf.

[2] 42 U.S.C. § 7607(d)(4)(B).

In prior comments, Environmental and Public Health Commenters showed that the Proposal flatly violates EPA's statutory obligation to reduce harmful climate pollution; among other flaws, it fails to ensure *any* pollution reductions.[3] The Agency's cursory and dismissive treatment of climate impacts in the context of a rule that is statutorily mandated to address climate pollution also violates the agency's legal obligation, as a basic requirement of reasoned decision-making, to demonstrate a "rational connection" between the record facts and the agency's policy choice.[4] As Environmental and Public Health Commenters explained, "[t]he reasonableness of any given policy response (such as strengthening or weakening limits on climate-altering emissions) necessarily depends upon the severity, imminence, and remediability of the harm."[5] Yet the Proposal scarcely discusses climate change at all, and the regulatory impact analysis gives the topic a mere two sentences. The Agency fails to reconcile the Proposal with the Administration's own conclusions about the threat that climate change poses. This shortcoming is not just unconscionable; it is unlawful.

The Report is further proof that the Proposal cannot plausibly stand as an adequate or even rational response to the problem it is required to address. NCA4-II thoroughly details the impacts of climate change and its sweeping implications for the country and the world. Yet even as the effects of climate change have already become increasingly prevalent, severe, and well-documented, the Agency's proposed approach would do little or nothing to address the crisis—and could well make it worse. The Proposal fails to achieve the statutory mandate to protect the public from dangerous pollution, and the stark disconnect between the evidence before the Agency and the proposed response is arbitrary, irrational, and unlawful.

* * * * *

Issued pursuant to Section 106 of the Global Change Research Act of 1990,[6] the NCA4-II embodies the work of experts at the 13 federal agencies of the USGCRP, including the Environmental Protection Agency.[7] Resulting from an exhaustive and exacting peer review and public review processes, the NCA4-II reflects the work of the federal government's foremost

[3] Center for Biological Diversity, Clean Air Task Force, Coalition to Protect America's National Parks, Earthjustice, Environmental Defense Fund, Environmental Law & Policy Center, National Parks Conservation Association, Natural Resources Defense Council, Sierra Club, and Union of Concerned, "Comments of Environmental and Public Health Organizations Concerning Climate Science and Climate Change," at 1, Docket No. EPA-HQ-OAR-2017-0355-24415 (Oct. 31, 2018) [hereinafter Envtl. and Pub. Health Comments].
[4] *Id.* at 9 (citing *Motor Vehicles Mfrs. Ass'n v. State Farm Mut. Auto Ins. Co*., 463 U.S. 29, 43 (1983)).
[5] *Id.*
[6] 15 U.S.C. § 2936. The Act requires that the USGCRP prepare a report every four years that "'1) integrates, evaluates, and interprets the findings of the Program . . .; 2) analyzes the effects of global change on the natural environment, agriculture, energy production and use, land and water resources, transportation, human health and welfare, human social systems, and biological diversity; and 3) analyzes current trends in global change, both human-induced and natural, and projects major trends for the subsequent 25 to 100 years.'" NCA4-II at 1 (quoting the Global Change Research Act of 1990 (codified at 15 U.S.C. § 2936)).
[7] The following federal agencies are member agencies of the USGCRP: the Department of Agriculture, the Department of Commerce, the Department of Defense, the Department of Energy, the Department of Health and Human Services, the Department of the Interior, the Department of State, the Department of Transportation, the Environmental Protection Agency, the National Aeronautics & Space Administration, the National Science Foundation, the Smithsonian Institution, and the U.S. Agency for International Development.

experts on climate change and its consequences.[8] It provides voluminous, detailed, and specific evidence of climate change's current and future harms and costs to the United States as a whole and as experienced on a regional and state-wide basis, highlighting the necessity of steep and immediate emission reductions to avoid some of these consequences.

The NCA4-II describes the multiple and diverse harms that the United States is already suffering from climate change and explains that risks will become more severe absent effective and timely action to reduce greenhouse gas emissions. As the authors explain, the NCA4-II

> draws a direct connection between the warming atmosphere and the resulting changes that affect Americans' lives, communities, and livelihoods, now and in the future. It documents vulnerabilities, risks, and impacts associated with natural climate variability and human-caused climate change across the United States and provides examples of response actions underway in many communities. It concludes that *the evidence of human-caused climate change is overwhelming and continues to strengthen, that the impacts of climate change are intensifying across the country, and that climate-related threats to Americans' physical, social, and economic well-being are rising*. These impacts are projected to intensify—but how much they intensify will depend on actions taken to reduce global greenhouse gas emissions and to adapt to the risks from climate change now and in the coming decades.

NCA4-II at 36 (emphasis in original). Among other harms driven by anthropogenic climate change,

> [h]igher temperatures, increasing air quality risks, more frequent and intense extreme weather and climate-related events, increases in coastal flooding, disruption of ecosystem services, and other changes increasingly threaten the health and well-being of the American people, particularly populations that are already vulnerable. Future climate change is expected to further disrupt many areas of life, exacerbating existing challenges and revealing new risks to health and prosperity.

NCA4-II at 55.

[8] "NCA4 Volume II was thoroughly reviewed by external experts and the general public, as well as the Federal Government (that is, the NCA4 Federal Steering Committee and several rounds of technical and policy review by the 13 federal agencies of the USGCRP). An expert external peer review of the whole report was performed by an ad hoc committee of the National Academies of Sciences, Engineering, and Medicine (NASEM)." NCA4-II at 2. Accompanying the Report, USGCRP published a volume consisting of authors' responses to public comments and questions on a draft version, *available at* https://nca2018.globalchange.gov/downloads/NCA4_Public_Comments_Author_Responses_with_Names.pdf. As EPA previously explained, the USGCRP reports "provide exactly the kind of information required" under the Clean Air Act by "bring[ing] together and synthesiz[ing] the numerous individual studies in the scientific literature" through a "rigorous and transparent peer-review process." EPA's Denial of the Petitions To Reconsider the Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act," 75 Fed. Reg. 49,556, 49,581 (Aug. 13, 2010).

The NCA4-II's twelve summary findings affirm the sweeping and profound implications of climate change for the United States:

> 1. **Communities**. Climate change creates new risks and exacerbates existing vulnerabilities in communities across the United States, presenting growing challenges to human health and safety, quality of life, and the rate of economic growth.
>
> 2. **Economy**. Without substantial and sustained global mitigation and regional adaptation efforts, climate change is expected to cause growing losses to American infrastructure and property and impede the rate of economic growth over this century.
>
> 3. **Interconnected Impacts**. Climate change affects the natural, built, and social systems we rely on individually and through their connections to one another. These interconnected systems are increasingly vulnerable to cascading impacts that are often difficult to predict, threatening essential services within and beyond the Nation's borders.
>
> 4. **Actions to Reduce Risks**. Communities, governments, and businesses are working to reduce risks from and costs associated with climate change by taking action to lower greenhouse gas emissions and implement adaptation strategies. While mitigation and adaptation efforts have expanded substantially in the last four years, they do not yet approach the scale considered necessary to avoid substantial damages to the economy, environment, and human health over the coming decades.
>
> 5. **Water**. The quality and quantity of water available for use by people and ecosystems across the country are being affected by climate change, increasing risks and costs to agriculture, energy production, industry, recreation, and the environment.
>
> 6. **Health**. Impacts from climate change on extreme weather and climate-related events, air quality, and the transmission of disease through insects and pests, food, and water increasingly threaten the health and well-being of the American people, particularly populations that are already vulnerable.
>
> 7. **Indigenous Peoples**. Climate change increasingly threatens Indigenous communities' livelihoods, economies, health, and cultural identities by disrupting interconnected social, physical, and ecological systems.
>
> 8. **Ecosystems and Ecosystem Services**. Ecosystems and the benefits they provide to society are being altered by climate change, and these impacts are projected to continue. Without substantial and sustained reductions in global greenhouse gas emissions, transformative impacts on some ecosystems will

> occur; some coral reef and sea ice ecosystems are already experiencing such transformational changes.
>
> 9. **Agriculture and Food**. Rising temperatures, extreme heat, drought, wildfire on rangelands, and heavy downpours are expected to increasingly disrupt agricultural productivity in the United States. Expected increases in challenges to livestock health, declines in crop yields and quality, and changes in extreme events in the United States and abroad threaten rural livelihoods, sustainable food security, and price stability.
>
> 10. **Infrastructure**. Our Nation's aging and deteriorating infrastructure is further stressed by increases in heavy precipitation events, coastal flooding, heat, wildfires, and other extreme events, as well as changes to average precipitation and temperature. Without adaptation, climate change will continue to degrade infrastructure performance over the rest of the century, with the potential for cascading impacts that threaten our economy, national security, essential services, and health and well-being.
>
> 11. **Oceans and Coasts**. Coastal communities and the ecosystems that support them are increasingly threatened by the impacts of climate change. Without significant reductions in global greenhouse gas emissions and regional adaptation measures, many coastal regions will be transformed by the latter part of this century, with impacts affecting other regions and sectors. Even in a future with lower greenhouse gas emissions, many communities are expected to suffer financial impacts as chronic high-tide flooding leads to higher costs and lower property values.[9]
>
> 12. **Tourism and Recreation**. Outdoor recreation, tourist economies, and quality of life are reliant on benefits provided by our natural environment that will be degraded by the impacts of climate change in many ways.

NCA4-II at 25-31.

Spanning hundreds of pages, the NCA4-II paints a panorama of how climate change is already contributing to massive harms throughout the United States. The Report finds, for example, that "[c]limate change is altering the characteristics of many extreme weather and climate-related events. Some extreme events have already become more frequent, intense, widespread, or of longer duration, and many are expected to continue to increase or worsen, presenting substantial challenges for built, agricultural, and natural systems." NCA4-II at 66. The Report notes that:

- The National Oceanic and Atmospheric Administration estimates that the United States has experienced 44 billion-dollar weather and climate disasters since 2015 (through April 6, 2018), incurring costs of nearly $400 billion (https://www.ncdc.noaa.gov/billions/). . . .

[9] Coastal communities are also economically vulnerable to impacts of climate change on fisheries. NCA4-II at 25.

- The 2017 Atlantic Hurricane season alone is estimated to have caused more than $250 billion in damages and over 250 deaths throughout the U.S. Caribbean, Southeast, and Southern Great Plains. . . .[10]

- In 2015, drought conditions caused about $5 billion in damages across the Southwest and Northwest, as well as parts of the Northern Great Plains. California experienced the most severe drought conditions. Hundreds of thousands of acres of farmland remained fallow, and excess groundwater pumping was required to irrigate existing agricultural interests. Two years later, in 2017, extreme drought caused $2.5 billion in agricultural damages across the Northern Great Plains. Field crops, including wheat, were severely damaged, and the lack of feed for cattle forced ranchers to sell off livestock. . . .

- During the summer of 2015, over 10.1 million acres—an area larger than the entire state of Maryland—burned across the United States, surpassing 2006 for the highest annual total of U.S. acreage burned since record keeping began in 1960. These wildfire conditions were exacerbated by the preceding drought conditions in several states. The most extensive wildfires occurred in Alaska, where 5 million acres burned within the state. In Montana, wildfires burned in excess of 1 million acres. The costliest wildfires occurred in California, where more than 2,500 structures were destroyed by the Valley and Butte Fires; insured losses alone exceeded $1 billion. In October 2017, a historic firestorm damaged or destroyed more than 15,000 homes, businesses, and other structures across California . . . . The Tubbs, Atlas, Nuns, and Redwood Valley Fires caused a total of 44 deaths and their combined destruction represents the costliest wildfire event on record.[11]

Id. at 66-68. The Report's volumes set out detailed descriptions of the distinctive ways in which climate change is imperiling the societies and resources of the various regions of the continental United States, Alaska, Hawai'i, and the U.S. Caribbean.

Of great relevance to the current rulemaking, the NCA4-II emphasizes that the nature and degree of harm caused by climate change depends critically on whether we take action in the near term to reduce greenhouse gas emissions:

> Climate-related risks will continue to grow without additional action. Decisions made today determine risk exposure for current and future generations and will either broaden or limit options to reduce the negative consequences of climate

[10] In August 2018, the government of Puerto Rico raised the death toll from Hurricane Maria, which struck in September 2017, to 2,975. *See* Josh Hoyos & Alexander Mallin, *Death Toll in Puerto Rico from Hurricane Maria Officially Raised to 2,975 from 64*, ABC News (Aug. 29, 2018), https://abcnews.go.com/US/death-toll-hurricane-maria-3000-puerto-rico-study/story?id=57179291.

[11] The Camp Fire, which struck California in November 2018, killed 85 people, making it the deadliest wildfire in the state's history. *See* Cleve R. Wootson Jr., *The Deadliest, Most Destructive Wildfire in California's History Has Finally Been Contained*, Washington Post (Nov. 26, 2018), https://www.washingtonpost.com/nation/2018/11/25/camp-fire-deadliest-wildfire-californias-history-has-been-contained.

> change. While Americans are responding in ways that can bolster resilience and improve livelihoods, neither global efforts to mitigate the causes of climate change nor regional efforts to adapt to the impacts currently approach the scales needed to avoid substantial damages to the U.S. economy, environment, and human health and well-being over the coming decades.

NCA4-II at 34.

As the Report also explains: "Many climate change impacts and associated economic damages in the United States can be substantially reduced over the course of the 21st century through global-scale reductions in greenhouse gas emissions, though the magnitude and timing of avoided risks vary by sector and region. The effect of near-term emissions mitigation on reducing risks is expected to become apparent by mid-century and grow substantially thereafter." NCA4-II at 1347. "Acting sooner rather than later generally results in lower costs overall for both adaptation and mitigation efforts and can offer other benefits in the near term." NCA4-II at 60; *see also id.* at 43 ("The severity of these projected impacts, and the risks they present to society, is greater under futures with higher greenhouse gas emissions, especially if limited or no adaptation occurs."); *id.* at 42 ("With substantial and sustained reductions in greenhouse gas emissions (e.g., consistent with the very low scenario [RCP2.6]), the increase in global annual average temperature relative to preindustrial times could be limited to less than 3.6°F (2°C). Without significant greenhouse gas mitigation, the increase in global annual average temperature could reach 9°F or more by the end of this century.") (citations omitted).[12]

Indeed, one of the "key messages" from the NCA4-II's mitigation chapter is the following:

> In the absence of more significant global mitigation efforts, climate change is projected to impose substantial damages on the U.S. economy, human health, and the environment. Under scenarios with high emissions and limited or no adaptation, annual losses in some sectors are estimated to grow to hundreds of billions of dollars by the end of the century. It is very likely that some physical and ecological impacts will be irreversible for thousands of years, while others will be permanent.

NCA4-II at 1347. As noted in comments submitted on October 31, 2018, the United States' actions to reduce greenhouse gas emissions are essential to contributing to and prompting the global mitigation efforts that the NCA4-II indicates are needed.[13]

Given the gravity of the harms described in the NCA4-II, the necessity of near-term emission reductions to avoid the worst harms, and the large quantity of greenhouse gas emissions from

---

[12] To take a concrete example of how reducing emissions could lessen harms from climate change, the Report finds that deaths from extreme temperatures are projected to inflict annual damages valued at $141 billion per year in 2090, but mitigating climate change could reduce that figure by 58 percent. NCA4-II at 1358.

[13] Environmental Defense Fund, Institute for Policy Integrity at New York University School of Law, Montana Environmental Information Center, Natural Resources Defense Council, Sierra Club, Union of Concerned Scientists, Western Environmental Law Center, and WildEarth Guardians, "Comments on Flawed Estimates of the Social Cost of Carbon in the Proposed Emission Guidelines for Greenhouse Gas Emissions from Existing Electric Utility Generating Units," at 12-13, Docket No. EPA-HQ-OAR-2017-0355-24812 (Oct. 31, 2018).

electric generating units, the Agency's Proposal, which would at most result in minimal reductions of climate pollution, is indefensible. As noted in the comments submitted on October 31, 2018, EPA makes no serious attempt to link the Proposal to the known facts about climate change, even as it implements a Clean Air Act provision that "speaks directly" to greenhouse gas emissions from the very sources at issue.[14] Nor has EPA explained why it has discarded—or simply ignored—its prior, well-supported conclusion that climate change is "the United States' most important and urgent environmental challenge," and that delaying action would come at an enormous cost.[15]

By meticulously detailing the harms of climate change and the overpowering need for near-term action, the NCA4-II shines a glaring spotlight on the illegality and arbitrariness of EPA's Proposal. It highlights the extreme costs that climate change is already imposing on the United States, and the much greater harm that will occur if emissions are not sharply curtailed. And it supplies further proof that EPA is well aware of the massive and urgent risks that climate change poses. EPA's Proposal, which blatantly fails to grapple with the overwhelming evidence in the administrative record, is thus patently unlawful.

Please contact Ben Levitan at (202) 572-3318 or blevitan@edf.org if you have any questions regarding these comments.

Sincerely,

CENTER FOR BIOLOGICAL DIVERSITY
CLEAN AIR TASK FORCE
EARTHJUSTICE
ENVIRONMENTAL DEFENSE FUND
ENVIRONMENTAL LAW AND POLICY CENTER
NATIONAL PARKS CONSERVATION ASSOCIATION
NATURAL RESOURCES DEFENSE COUNCIL
SIERRA CLUB
UNION OF CONCERNED SCIENTISTS

[14] Envtl. & Pub. Health Comments at 4 (quoting *American Electric Power Co. v. Connecticut*, 564 U.S. 410, 424 (2011)).
[15] *Id.* at 8 (quoting EPA, Basis for Denial of Petitions to Reconsider and Petitions to Stay the CAA section 111(d) Emission Guidelines for Greenhouse Gas Emissions and Compliance Times for Electric Utility Generating Units at 1 (Jan. 11, 2017) [hereinafter Reconsideration Denial]). *See also* Reconsideration Denial at 17, 21.

Exhibit D:

Comment of Center for Biological Diversity, *et al*., concerning Rhodium Group, Energy & Climate Staff, *Preliminary US Emissions Estimates for 2018* (Jan. 8, 2019) [without attachments], submitted January 31, 2019, Docket ID No. EPA-HQ-OAR-2017-0355-26647

January 31, 2019

VIA ELECTRONIC SUBMISSION

Andrew R. Wheeler
Acting Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460

Attn: Docket No. EPA-HQ-OAR-2017-0355

Re: Supplemental Comment of Environmental and Public Health Organizations on EPA's Proposed Emission Guidelines for Greenhouse Gas Emissions From Existing Electric Utility Generating Units; Revisions to Emission Guideline Implementing Regulations; Revisions to New Source Review Program, 83 Fed. Reg. 44,746 (Aug. 31, 2018)

The undersigned organizations ("Environmental and Public Health Commenters") hereby submit this supplemental comment concerning the Rhodium Group's Note entitled "Preliminary US Emissions Estimates for 2018," which was published on January 8, 2019, after the closing of the period for public comment on the U.S. Environmental Protection Agency's ("EPA's") proposal to revise the Emission Guidelines for Greenhouse Gas Emissions From Existing Electric Utility Generating Units ("the Proposal").[1] We are submitting this letter and the Note to the above-captioned docket. Under the Clean Air Act, the Note must be included in the rulemaking docket because it is of "central relevance" to the proposed rule.[2]

In the Proposal, EPA states that "[c]arbon dioxide emissions in the power sector have steadily declined in recent years due to a variety of power industry trends, which are expected to continue."[3] It notes that these trends "have been driven by market factors, reduced electricity demand, and policy and regulatory efforts," and that they are "expected to result in declining power sector [carbon dioxide] emissions."[4] Thus, the Agency suggests that any requirements under Clean Air Act section 111(d) for existing power plants could "quickly be overtaken by external market forces which could make those efforts redundant,"[5] implying that regulations might not be necessary.

---

[1] Rhodium Group, Energy & Climate Staff, Preliminary US Emissions Estimates for 2018 (Jan. 8, 2019), https://rhg.com/research/preliminary-us-emissions-estimates-for-2018/ ("Note").
[2] *See* 42 U.S.C. § 7607(d)(4)(B)(i) ("All documents which become available after the proposed rule has been published and which the Administrator determines are of central relevance to the rulemaking shall be placed in the docket as soon as possible after their availability.").
[3] 83 Fed. Reg. 44,746, 44,750 (Aug. 31, 2018).
[4] *Id.* at 44,750, 44,751.
[5] *Id.* at 44,751.

As many of us have explained in detail in previous comments on the Proposal, this statement is misguided.[6] EPA may not lawfully conclude that factors such as current market trends or reduced electricity demand excuse it from regulating existing power plants, collectively the largest stationary source of greenhouse gas emissions in the U.S.[7] The agency cannot leave the prevention of such enormous amounts of harmful pollution up to volatile market forces. EPA's obligation under the Clean Air Act is to require emission reductions that reflect the *best* system of emission reduction.[8] As such, EPA's rule must address the urgent need to mitigate the impacts of climate change through rapid and deep reductions in emissions from the power sector.

In any event, the Rhodium Group's Note indicates that power sector emission trends in fact contradict EPA's factual assumption and directly refutes the Proposal's implication that no—or only partial—regulation of existing fossil fuel-fired power plants is necessary to mitigate greenhouse gas emissions. Although U.S. power sector carbon dioxide (CO_2) emissions had previously been declining, the annual rates of decline have been shrinking since 2016, and in 2018, the Note estimates, emissions *increased* by 34 million metric tons.[9] Recently released data from the U.S. Energy Information Administration ("EIA") for the first ten months of 2018 support these findings, as power sector CO_2 emissions rose by 27 million metric tons compared to the same time period in 2017.[10] Market trends in isolation from pollution standards cannot be relied upon to prevent the increase of, let alone effectively mitigate and reduce, the greenhouse gas emissions that endanger public health and welfare, even if such an approach were lawful under the Clean Air Act.

The Rhodium Group's Note shows that the significant rise in emissions was driven by a 166 million MWh increase in natural gas-fired generation in the first ten months of 2018, more than triple the decreases in coal-fired generation over that same period of time.[11] EIA data similarly show that CO_2 emissions from natural gas-fired generation rose by 73 million metric tons in the first ten months of 2018, compared to the same time period in 2017.[12] Yet the Proposal would do nothing to address CO_2 emissions from natural gas-fired power plants, other than to redirect some natural gas-fired generation back to higher-emitting coal-fired generation.[13] An analysis of

---

[6] Appalachian Mountain Club, Center for Biological Diversity, Clean Air Council, Clean Air Task Force, Clean Wisconsin, Coalition to Protect America's National Parks, Conservation Law Foundation, Earthjustice, Environmental Defense Fund, Environmental Law & Policy Center, Minnesota Center for Environmental Advocacy, National Parks Conservation Association, National Wildlife Federation, Natural Resources Defense Council, Sierra Club, and Union of Concerned Scientists, "Joint Comments of Environmental and Public Health Organizations on the Best System of Emission Reduction and Other Issues in EPA's Proposed Emission Guidelines for Greenhouse Gas Emissions From Existing Electric Utility Generating Units; Revisions to Emission Guideline Implementing Regulations; Revisions to New Source Review Program," at 32, 36-38, Docket No. EPA-HQ-OAR-2017-0355-24260 (Oct. 31, 2018) ("Joint Environmental and Public Health Organizations' BSER Comments").

[7] EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016, at 2-3 to 2-5, Table 2-1 (2018).

[8] 42 U.S.C. § 7411(a)(1), (d).

[9] Note at 4.

[10] EIA, January 2019 Monthly Energy Review at 207, Table 12.6 (Jan. 28, 2019) ("January 2019 Monthly Energy Review"). We are submitting this document to the rulemaking docket, and EPA must include it because it is of "central relevance" to the above-captioned rulemaking. *See* 42 U.S.C. § 7607(d)(4)(B)(i).

[11] Note at 4 & Figure 2.

[12] January 2019 Monthly Energy Review at 207, Table 12.6.

[13] *See* EPA, Regulatory Impact Analysis for the Proposed Emission Guidelines for Greenhouse Gas Emissions from Existing Electric Utility Generating Units; Revisions to Emission Guideline Implementing Regulations; Revisions to New Source Review Program, at 3-23, Table 3-17 (Aug. 2018) (showing slightly lower generation at existing

EPA's modeling—which did not account for the emissions increases under way—indicates that the Proposal itself would *increase* power sector emissions in some states as compared to results absent regulations.[14] Moreover, in some states, this increase would be driven by higher natural gas-fired generation.[15]

The 2018 power sector emissions data clearly indicate that EPA must develop and enforce regulations that sharply reduce greenhouse gas emissions from existing fossil fuel-fired power plants, and any approach that fails to cut emissions from natural gas-fired power plants will be ineffective and unlawful. EPA claims that it lacks the information it needs to determine the best system of emission reduction for natural gas combined cycle units ("NGCCs").[16] This is simply false: in prior comments, Environmental and Public Health Commenters have documented that, in addition to unlawfully rejecting the approach taken in the Clean Power Plan, the agency has ignored detailed information on adequately demonstrated measures to reduce emissions at NGCCs that meet the agency's proposed new statutory interpretation, including heat rate improvements, reduced utilization, carbon capture and storage, and on-site renewable energy integration.[17] The Rhodium Group's new analysis further demonstrates the substantial role of natural gas-fired generation in contributing to total greenhouse gas emissions from existing electric utility generating units; a failure to regulate NGCCs would violate Clean Air Act section 111 and be arbitrary and capricious.[18]

Any final rule issued by EPA must address these data and their implications for the Proposal.[19] We urge the agency to abandon its Proposal to repeal and replace the Clean Power Plan, as the Proposal is inadequate to mitigate the danger to human health and welfare posed by greenhouse gas pollution from existing power plants and is unlawful under the Clean Air Act.

Please contact Ben Levitan at (202) 572-3318 or blevitan@edf.org if you have any questions regarding this comment.

---

natural gas combined cycle (NGCC) units and higher generation from coal in 2025, 2030, and 2035, as compared to a scenario without any regulation of existing power plants under CAA section 111(d)).

[14] *See* A. T. Keyes *et al.*, *The Affordable Clean Energy Rule and the Impact of Emissions Rebound on Carbon Dioxide and Criteria Air Pollutant Emissions*, 2019 Envtl. Res. Letters, accepted manuscript at 6 (noting that decomposition of EPA's modeling results reveals that CO_2 emissions increase in 18 states as well as the District of Columbia in 2030 under the Proposal).

[15] *See id.* (noting that CO_2 emissions increases in California, Georgia, Massachusetts, and Oregon in 2030 under the Proposal are mainly due to natural gas-fired generation).

[16] 83 Fed. Reg. at 44,755; *see also id.* at 44,761 ("[N]o commenters provided specific information on the availability, applicability, or cost of [heat rate improvement] opportunities for NGCC units—nor did any commenters provide any information on the magnitude of expected heat rate reductions.").

[17] Joint Environmental and Public Health Organizations' BSER Comments at 61-64; *see also* Environmental Defense Fund, Comments on EPA's Proposed Emission Guidelines for Greenhouse Gas Emissions from Existing Electric Utility Generating Units; Revisions to Emission Guideline Implementing Regulations; Revisions to New Source Review Program, at 40-43, 46-47, Docket No. EPA-HQ-OAR-2017-0355-24419 (Oct. 31, 2018); Sierra Club, Comments on Emission Guidelines for Greenhouse Gas Emissions From Existing Electric Utility Generating Units; Revisions to Emission Guideline Implementing Regulations; Revisions to New Source Review Program, at 19-27 & App. A at 16-32, Docket No. EPA-HQ-OAR-2017-0355-26581 (Oct. 31, 2018, corrected Nov. 9, 2018).

[18] *See* Joint Environmental and Public Health Organizations' BSER Comments at 61-64.

[19] *Motor Vehicle Mfrs. Ass'n v. State Farm Mut. Auto. Ins. Co.*, 463 U.S. 29, 43 (1983) ("Normally, an agency rule would be arbitrary and capricious if the agency has . . . entirely failed to consider an important aspect of the problem [or] offered an explanation for its decision that runs counter to the evidence before the agency.").

Sincerely,

CENTER FOR BIOLOGICAL DIVERSITY
CLEAN AIR TASK FORCE
EARTHJUSTICE
ENVIRONMENTAL DEFENSE FUND
ENVIRONMENTAL LAW & POLICY CENTER
NATIONAL PARKS CONSERVATION ASSOCIATION
NATURAL RESOURCES DEFENSE COUNCIL
SIERRA CLUB
UNION OF CONCERNED SCIENTISTS

Exhibit E:

Comment of Sierra Club concerning Energy Innovation: Policy and Technology, LLC and Vibrant Clean Energy, LLC, *The Coal Cost Crossover: Economic Viability of Existing Coal Compared to New Local Wind and Solar Resources* (March 2019), submitted April 12, 2019, Docket ID No. EPA-HQ-OAR-2017-0355-26650

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Repeal of Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units	)	
and	)	**Docket No. EPA–HQ–OAR–2017–0355**
Emission Guidelines for Greenhouse Gas Emissions From Existing Electric Utility Generating Units; Revisions to Emission Guideline Implementing Regulations; Revisions to New Source Review Program	)	*Via email* *April 12, 2019*

Submission to the Docket of *The Coal Cost Crossover: Economic Viability of Existing Coal Compared to New Local Wind and Solar Resources*

Sierra Club hereby submits to the docket a report titled *The Coal Cost Crossover: Economic Viability of Existing Coal Compared to New Local Wind and Solar Resources*, published in March 2019 by Energy Innovation: Policy and Technology, LLC and Vibrant Clean Energy, LLC. Via separate emails, we are also submitting the data files used in this report. While the public comment period for this docket has closed, section 307(d)(4)(B)(i) of the Clean Air Act provides that "*[a]ll documents* which become available after the proposed rule has been published and which the Administrator determines are of central relevance to the rulemaking shall be placed in the docket as soon as possible after their availability." 42 U.S.C. § 7607(d)(4)(B)(i) (emphasis added). This includes documents that are published or otherwise become available after the close of the public comment period. *Am. Petroleum Inst. v. Costle*, 609 F.2d 20, 22 (D.C. Cir. 1979) ("EPA may supplement the docket with any public comments received *after the comment period* or other document that becomes available after publication of the proposed rule . . . if the Administrator determines they are 'of central relevance to the rulemaking.'") (emphasis added).

The Coal Cost Crossover analyzes the marginal costs of operating and maintaining the existing coal-fired power plants in the United States, as well as the levelized cost of electricity of new wind and solar resources throughout the country. The report concludes that in 2018, approximately 74 percent of existing coal-fired generation could be replaced with new, cheaper wind or solar resources within a 35-mile range, and nearly 33 percent of coal units could be replaced with proximately-located new wind or solar resources that are at least 25 percent cheaper. *Coast Cost Crossover* at 2–3. By 2025, even as federal renewable energy tax credits phase out, these figures increase to 86 percent of generation and 49 percent of existing coal units, respectively. *Id.*

This report is of central relevance to EPA's proposal to repeal the Clean Power Plan (CPP) and replace it with the Affordable Clean Energy (ACE) rule. Building Block 3 of the CPP's best system of emission reduction (BSER) is premised on the opportunity for affected sources to shift generation from higher-emitting fossil fuel-fired units to new, zero-emitting wind and solar resources. Indeed, a significant portion of the rule's environmental benefits are based on shifting generation from existing coal plants in particular to new wind and solar units. By contrast, the ACE rule's BSER includes no

measures similar to Block 3 or any other generation-shifting components, but is based solely on a limited number of heat rate improvements at existing coal plants.

Among the agency's primary rationales for withdrawing the CPP and replacing it with ACE is its argument that there could be "serious economic and political implications arising from the CPP's reliance on . . . generation shifting," which may require "a clear statement from Congress assigning the agency that authority." 82 Fed. Reg. 48,035, 48,032 (Oct. 16, 2017). As a corollary, EPA suggests that a rule that does not include generation-shifting measures in its BSER "has the advantage of . . . avoid[ing] potentially transformative economic, policy, and political significance in the absence of a clear Congressional statement of intent to confer such authority on the Agency." *Id.*[1] Accordingly, in its ACE proposal, EPA abandons generation-shifting measures entirely while calling into question whether "recent . . . advances in renewable cost and performance . . . will be sustained" into the future, especially in light of the eventual expiration of federal tax subsidies for wind and solar resources. 83 Fed. Reg. 44,746, 44,754 (Aug. 31, 2018).

The Coal Cost Crossover refutes each of these assertions by EPA. As the report demonstrates, rather than effectuate a "transformat[ion]" of the nation's electric sector that would have "serious economic and political implications," the CPP would capitalize on trends that are already in the economic interest of both the electric power sector and the country as a whole, a trend that will only increase in the coming years. While this fact has already been apparent for several years, *The Coal Cost Crossover* provides a much more granular and up-to-date portrait than has been available thus far of the economic benefits that would accrue from replacing existing coal-fired generation with new renewable generation, *even despite the anticipated phase out of federal tax credits for wind and solar*. The report also seriously undermines EPA's projections of the avoided compliance costs from repealing the CPP and replacing it with ACE, *see* CPP Repeal RIA at 170–73 and ACE RIA at 6-4–6-5, as it indicates that shifting generation from existing coal to new wind and solar resources—the heart of Building Block 3—is not only cheaper than previously anticipated, but is likely to *save* plant operators money in the coming years.

The Coal Cost Crossover's analysis also suggests that the following concern expressed by EPA in ACE rulemaking is unfounded:

> Because of the rapid pace of . . . power sector changes, it is difficult for sector analysts to fully account for these changing trends in near-term and long-term sector-wide projections. This means that regulatory decisions made today could be based on information that may very well be outdated within the next several years. If that is the case, work put in by federal and state regulatory agencies—as well as by the affected sources themselves—to address section 111(d) requirements could quickly be overtaken by external market forces which could make those efforts redundant or, even worse, put them in conflict with industry trends that are already reducing CO_2 emissions.

[1] Even apart from the *The Coal Cost Crossover*'s findings, EPA's rationale on this point is unfounded. Congress has expressly delegated to the agency the determination of what is the "best" system of emission reduction. 42 U.S.C. § 7411(a)(1). Where there is such an express delegation, the so-called "major questions doctrine" is not applicable. *See U.S. Telecom Ass'n v. FCC*, 855 F.3d 381, 386-87 (D.C. Cir. 2017) (Srinivasan, J., concurring in denial of reh'g en banc) ("The statute itself might be ambiguous about whether ISPs are to be treated as common carriers, but still be clear in authorizing the agency to resolve the question.").

83 Fed. Reg. at 44,751. The report indicates that the power sector is likely to continue its current trend of replacing existing coal-fired generation resources with new renewable capacity, removing much of the uncertainty EPA worries might compromise the effectiveness of standards under section 111(d). As such, the report further reinforces that EPA's regulatory standards can effectively reduce pollution by accelerating this trend. Indeed, EPA notes that power-sector trends have been driven by the combination of "market factors" and "policy and regulatory efforts." *Id.* at 44,750. *The Coal Cost Crossover* underscores the need for robust emission guidelines and standards under section 111(d) that would secure and strengthen the emission reductions that economic factors will promote.

Thus, *The Coal Cost Crossover* relates to issues that are of central relevance to EPA's proposals to repeal the CPP and propose the ACE rule, and it must be submitted to the rulemaking dockets for both proposals pursuant to 42 U.S.C. § 7607(d)(4)(B)(i).

Respectfully submitted,

Andres Restrepo
Sierra Club
50 F St. NW
8th Floor
Washington, DC 20001
Email: andres.restrepo@sierraclub.org
Phone: (215) 298-0335

VCE VIBRANT CLEAN ENERGY
ENERGY INNOVATION POLICY & TECHNOLOGY LLC
www.energyinnovation.org
98 Battery Street; San Francisco, CA 94111
power@energyinnovation.org

THE COAL COST CROSSOVER: ECONOMIC VIABILITY OF EXISTING COAL COMPARED TO NEW LOCAL WIND AND SOLAR RESOURCES

ERIC GIMON AND MIKE O'BOYLE, ENERGY INNOVATION[1]
CHRISTOPHER T.M. CLACK AND SARAH MCKEE, VIBRANT CLEAN ENERGY ● MARCH 2019

America has officially entered the "coal cost crossover" – where existing coal is increasingly more expensive than cleaner alternatives. Today, local wind and solar could replace approximately 74 percent of the U.S. coal fleet at an immediate savings to customers. By 2025, this number grows to 86 percent of the coal fleet.

This analysis complements existing research[2] into the costs of clean energy undercutting coal costs, by focusing on which coal plants could be replaced locally (within 35 miles of the existing coal plant) at a saving.

It suggests local decision-makers should consider plans for a smooth shut-down of these old plants—assessing their options for reliable replacement of that electricity[3], as well as financial options for

TABLE OF CONTENTS

INTRODUCTION AND RESULTS	**2**
CORE DATASETS	**5**
COAL TO RENEWABLES COST CROSSOVER	**8**
FINDINGS – COAL AT RISK NUMBERS	**9**
DISCUSSION	**11**
CONCLUSION	**13**
APPENDIX A – SOLAR PV DATASET	**15**
APPENDIX B – WIND DATASET	**19**
APPENDIX C – COAL PLANT DATASET	**23**

[1] The authors would like to thank Joe Daniel, Harriet Moyer Aptekar, Jeremy Fisher, Uday Varadarajan, Ric O'Connell, Taylor McNair, and Sonia Aggarwal for their helpful feedback on this report. Any remaining errors are the responsibility of the authors.

[2] Carbon Tracker Institute, *No Country for Coal Gen – Below 2° C and Regulatory Risk for US Coal Power Owners*, September 2017, https://www.carbontracker.org/reports/no-country-for-coal-gen-below-2c-and-regulatory-risk-for-us-coal-power-owners/; Pacificorp, *2019 Integrated Resource Plan (IRP) Public Input Meeting*, December 2018, https://www.eenews.net/assets/2018/12/05/document_cw_01.pdf.

[3] Joshua Novacheck, Greg Brinkman, and Gian Porro, *Operational Analysis of the Eastern Interconnection at Very High Renewable Penetrations*, National Renewable Energy Laboratory, September 2018, https://www.nrel.gov/docs/fy18osti/71465.pdf; Mark Dyson and Alex Engel, A Low-Cost Energy Future for Western Cooperatives, Rocky Mountain Institute, 2018, https://www.rmi.org/wp-content/uploads/2018/08/RMI_Low_Cost_Energy_Future_for_Western_Cooperatives_2018.pdf.

communities dependent on those plants[4].

Ultimately, this report begins a longer conversation about the most cost-effective replacement for coal, which may include combinations of local or remote wind, solar, transmission, storage, and demand response.

INTRODUCTION & RESULTS

Coal generation is at a crossroads in the United States, or more precisely at a "cost crossover." Due to the rapid recent cost decline of wind and solar,[5] the combined fuel, maintenance, and other going-forward costs of coal-fired power from many existing coal plants is now more expensive than the all-in costs of new wind or solar projects. This cost crossover raises substantial questions for regulators and utilities as to why these coal plants should keep running instead of new renewable power plants.

To determine which coal plants are facing this cost crossover with renewables, Energy Innovation partnered with Vibrant Clean Energy (VCE) to compile a dataset of coal, wind, and solar costs.[6] For simplicity, the modeling compares each coal plant's marginal cost of energy (MCOE) to the lowest levelized cost of energy (LCOE) for wind or solar resource localized around that coal plant. Restricting replacement to local resources makes this analysis conservative, considering most coal, wind, and solar all travel from more remote locations to load centers via transmission.

Our research finds that in 2018, 211 gigawatts (GW) of existing (end of 2017) U.S. coal capacity, or 74 percent of the national fleet, was at risk from local wind or solar that could provide the same amount of electricity more cheaply. By 2025, at-risk coal increases to 246 GW – nearly the entire U.S. fleet.[7]

Definitions in this analysis:

"Local" means within 35 miles.

"At risk" coal means local wind or solar could replace the coal plant's total output (on a kilowatt-hour basis) at an all-in cost lower than the existing coal plant's ongoing marginal costs.

"Substantially at risk" coal means local wind or solar could replace the coal plant's total output at an all-in cost >25% lower than the existing coal plant's ongoing marginal costs.

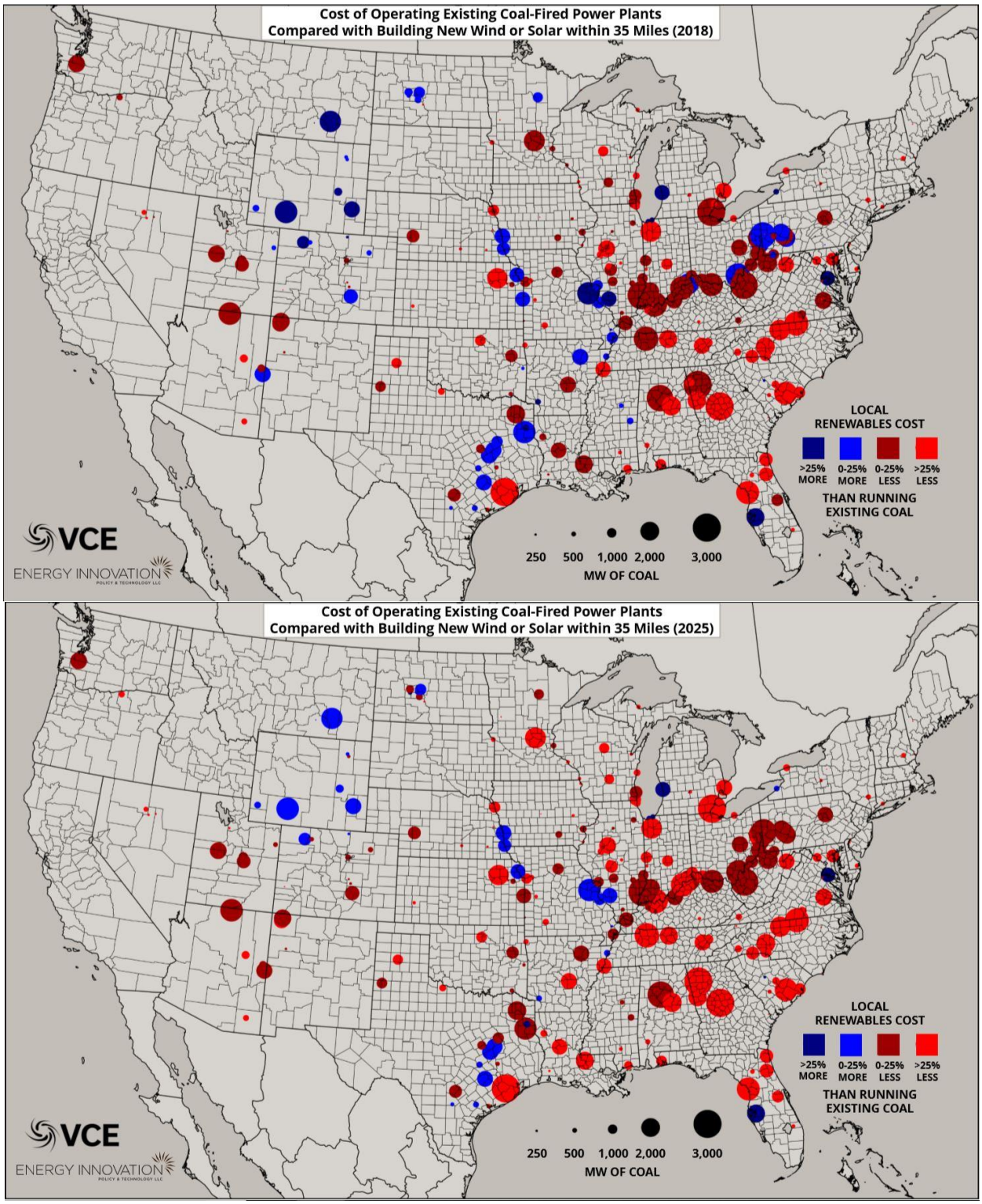
[4] Sonia Aggarwal, "Billions At Stake: Should We Invest In Struggling Power Plants Or Communities Facing Closures?" *Forbes*, August 23, 2018, https://www.forbes.com/sites/energyinnovation/2018/08/23/billions-at-stake-should-we-invest-in-struggling-power-plants-or-communities-facing-closures/#b62238a1f687.

[5] Megan Mahajan, "Plunging Prices Mean Building New Renewable Energy Is Cheaper Than Running Existing Coal," *Forbes*, December 3, 2018, https://www.forbes.com/sites/energyinnovation/2018/12/03/plunging-prices-mean-building-new-renewable-energy-is-cheaper-than-running-existing-coal/.

[6] VCE's WIS:dom model uses granular wind speed and solar irradiance data for nine-square-kilometer (3-km x 3-km) cells across the entire U.S. to paint an accurate picture of LCOE, making this a uniquely granular analysis.

[7] The VCE compiled dataset computes approximately 286 GW of coal-fired power plants as of January 1st, 2018. Since that date, rapid retirements and re-firing with natural gas has occurred, in part, due to the cost pressure that we identify in this study.

Furthermore in 2018, 94 GW of existing U.S. coal capacity was deemed substantially at risk from new local wind and solar that could undercut ongoing costs of existing coal by at least 25 percent. By 2025, substantially at risk coal increases to 140 GW – almost half the U.S. fleet – even as federal renewable energy tax credits phase out. Given uncertainties in publicly available coal cost data, the tier of coal plants "*substantially at risk*" could, with high confidence, be



replaced with renewable energy at an immediate cost savings. State-by-state data detailing these findings are available as a companion to this report.

The VCE dataset reveals the going-forward costs for the vast majority of coal plants fall between $33 – 111 / megawatt-hours (MWh). Costs in 2018 for solar are more tightly clustered, between $28 – 52 / MWh, while wind costs vary more widely based on locational resource quality, falling between $13 – 88 / MWh, with a high number of very costly outliers in windless regions.

The crossover between new renewable and coal running costs is just one important part of shutting down existing coal plants – replacing coal plants with new wind and solar energy is much more complex in practice. The purpose of this report is to act as a conversation primer for stakeholders and policymakers where the math points to cheaper options that could replace coal plants at a savings to customers. Any decision on how to proceed will require further modeling of grid impacts and alternative sources of reliability services, as well as the possibility for even cheaper renewable replacements further away than the 35-mile maximum radius considered in this report.[8]

Regardless, any coal plant failing the cost crossover test should be a wake-up call for policymakers and local stakeholders that an opportunity for productive change exists in the immediate vicinity of that plant.

Building local renewables in the immediate vicinity of coal plants implies wind and solar could replace local jobs, expand the tax base, reuse existing transmission, and locate in the same utility service territory. But these constraints are quite restrictive. Utility planners, regulators, and customers could save additional money by looking further afield. For example, Colorado plans to replace its coal fleet with strategically located wind and solar resources around the state.[9] The VCE WIS:dom model and others can accurately analyze the viability of transitioning from dispatchable power sources like coal to variable resources like wind and solar.

The unpaid capital balance owed to investors in coal plants falls outside a coal plant's MCOE. Though this balance should not factor into the economic viability of the plant (after all, it's easier to repay debt if utilities are meeting current obligations more cheaply), potential stranded asset value of at-risk coal plants reaches into the tens of billions. A recent series of America's Power Plan policy briefs[10] highlight different financial tools policymakers can consider to retire uneconomic coal-fired generation while balancing consumer, community, and investor concerns.

---

[8] VCE's algorithm selected wind or solar resources immediately adjacent to the coal plant, and moved outward until renewable energy replaced the output of the coal plant. 35 miles is the furthest away from the coal plant the model had to go to fill this need. The algorithm is described in Appendix C.

[9] "Colorado Energy Plan," Xcel Energy, https://www.xcelenergy.com/company/rates_and_regulations/resource_plans/colorado_energy_plan.

[10] "Managing The Utility Financial Transition From Coal to Clean," Energy Innovation: Policy and Technology LLC, https://energyinnovation.org/publication/managing-the-utility-financial-transition-from-coal-to-clean-2/.

CORE DATASETS

This report uses two data sources to construct its unique plant-by-plant analysis: LCOE and MCOE. Current and future LCOE data for wind and solar projects are on a fine resolution scale, allowing policymakers to directly see wind and solar opportunities in their geography. VCE has created several high-resolution wind and solar LCOE maps across the U.S. using detailed weather models for power production at a nine-km^2 geographic resolution, multiple wind hub-heights, and a five-minute temporal resolution. Modeling details are provided in Appendices A & B.

The wind and solar LCOE maps in this report include 2018 LCOE estimates by VCE for each technology, including current tax benefits and regional cost modifiers. They clearly show attractive pricing for both technologies across the U.S. as low as $15 per MWh for wind and $28/MWh for solar in 2018. Note that wind LCOEs have more geographic variation and hence the color scales differ from the solar color scales.

We also include the VCE 2025 estimates of wind and solar LCOE using the low-case NREL Annual Technology Baseline (ATB)11 cost projections. In 2025, despite the loss of federal tax incentives,12 future cost declines mean that future pricing continues to be attractive. High-resolution images of the wind and solar LCOE maps are available for download, allowing users to zoom in at a fine-scale.

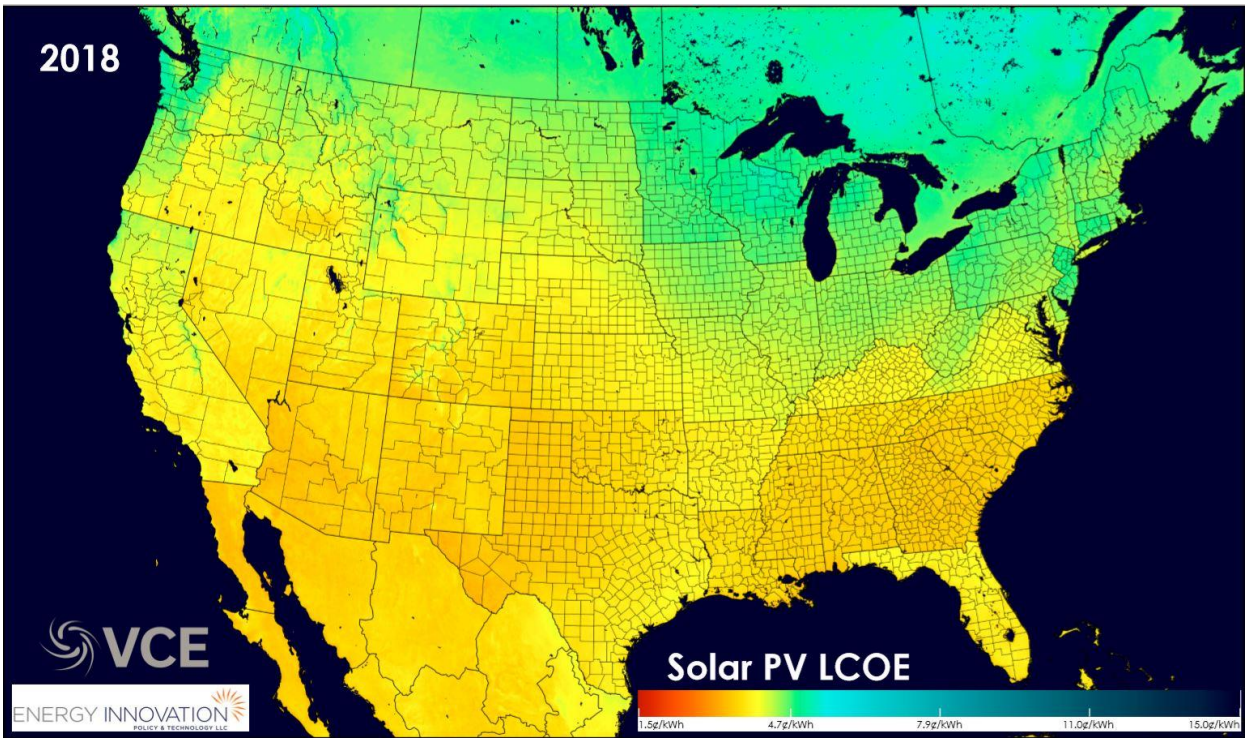
VCE also provided plant-by-plant estimates of the current MCOE for U.S. coal plants. This dataset was created for existing U.S. coal-fired power plants by combining publicly available information. Data was collected from FERC Form 1, EIA Form 860, and EIA Form 923 for the calendar year 2017. The extracted information includes amount of fuel burned, average power plant heat rate, emission factors, capital investments, pollution controls, fixed operations and maintenance (O&M) costs, and variable O&M costs.

The MCOE combines fuel and variable costs based on the operation and maintenance (O&M) of power plants, as well as the fixed O&M and the ongoing capital spending for pollution controls and other upgrades to the power plant. Those later fixed costs were converted to $/MWh, using plant-specific capacity factors. For plants in regular use (capacity factors over 33%) this analysis shows a wide range of MCOEs, from $25 / MWh to $104 / MWh. For smaller capacity factors, the MCOE values quickly climb even higher, as O&M expenses are spread over fewer and fewer hours, and efficiency plummets. High-resolution images of the maps showing coal operational costs compared new renewables.

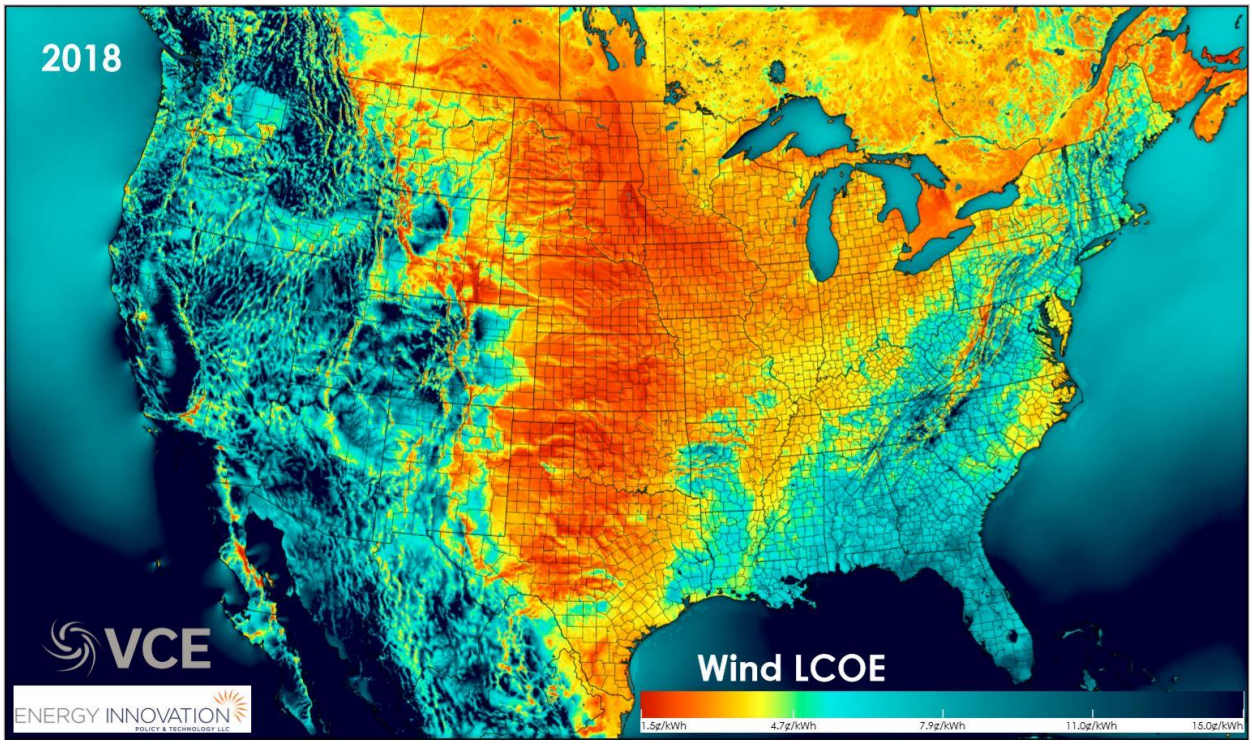
---

[11] "Annual Technology Baseline," National Renewable Energy Laboratory, August 2018, https://atb.nrel.gov/. These estimates are justifiable due to cost declines today that indicate we're already reaching the NREL ATB mid-case numbers. 2018-vintage contracts for wind and solar are available from Level 10.

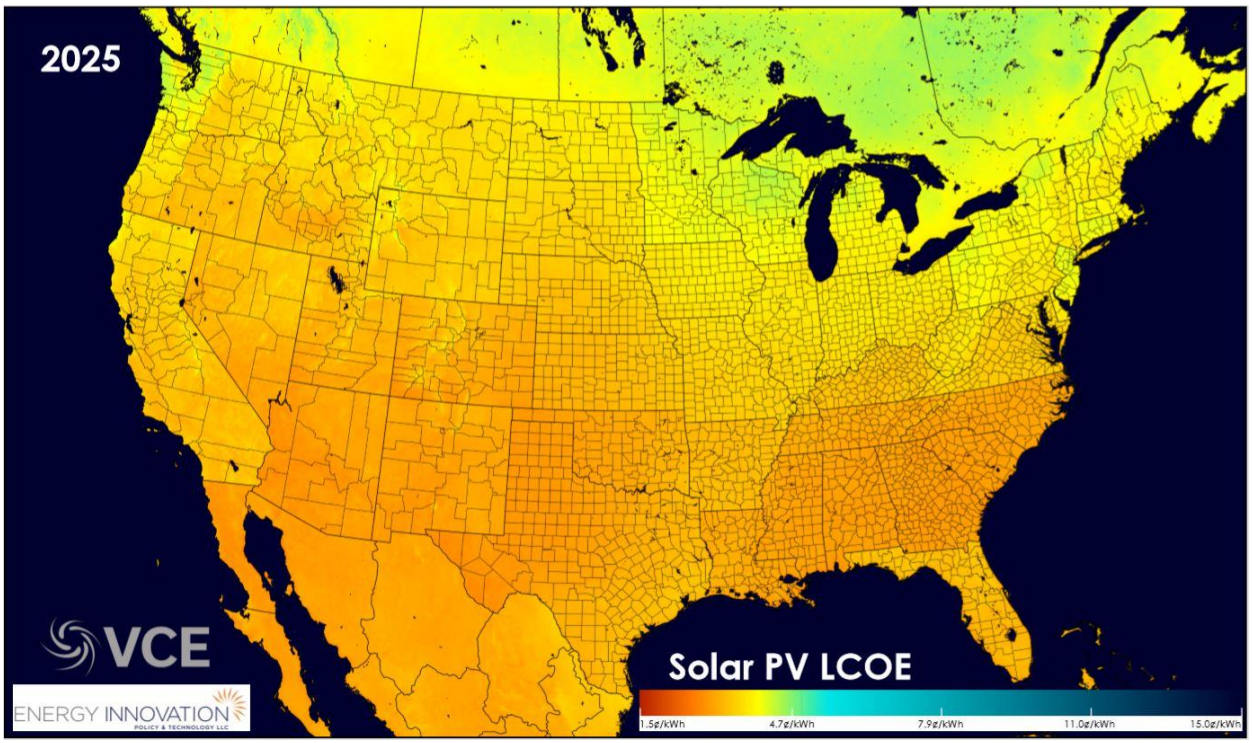
[12] "Renewable Electricity Production Tax Credit (PTC)," United States Department of Energy, https://www.energy.gov/savings/renewable-electricity-production-tax-credit-ptc



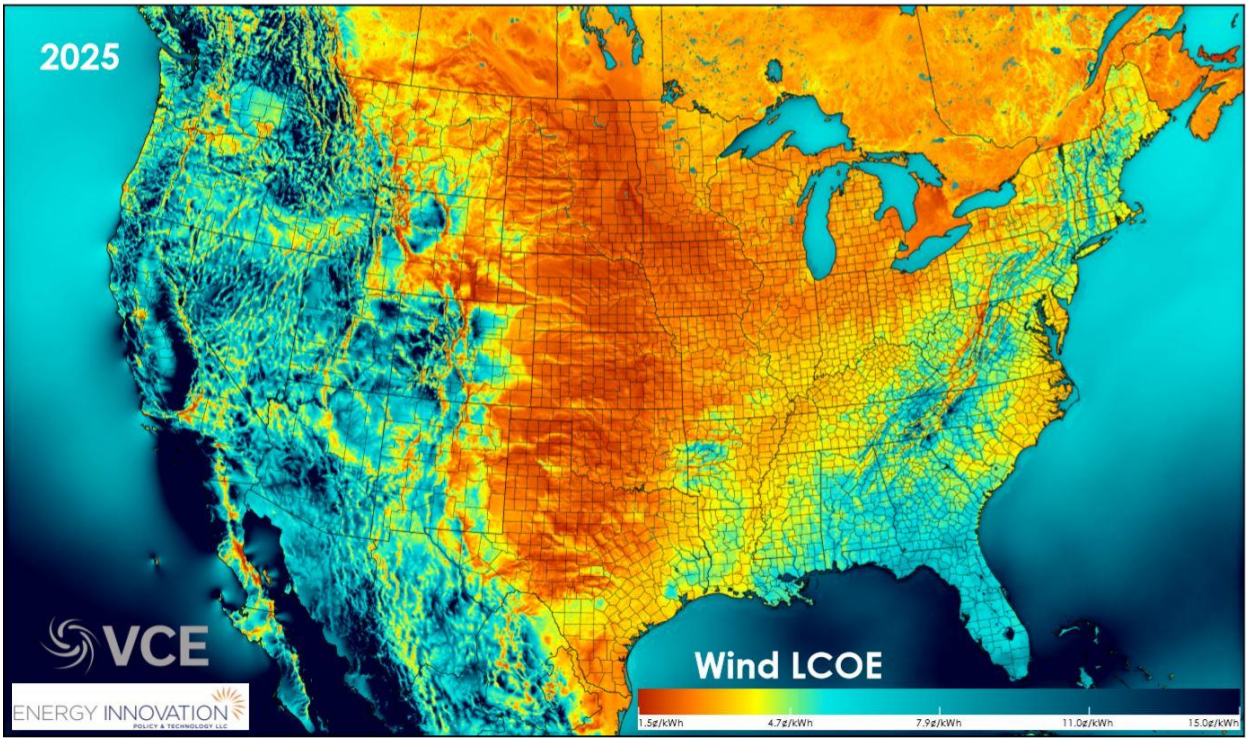
Map of the levelized cost of energy for U.S. solar photovoltaic projects in 2018 using VCE dataset



Map of the levelized cost of energy for U.S. wind projects in 2018 using VCE dataset



Map of the levelized cost of energy for U.S. solar photovoltaic projects in 2025 using VCE dataset



Map of the levelized cost of energy for U.S. wind projects in 2025 using VCE dataset

The coal plant dataset provides additional information that can be used for further analysis. First, it includes location and installed capacity of each coal-fired power plant. Second, it includes the heat rates, capacity factors, ages, and plant names for ease of reference on the MCOE construction.

COAL TO RENEWABLES COST CROSSOVER

In order to compare the costs of building new renewables with the ongoing costs of running coal plants, this report combines the two datasets above to present simplified cost crossover math. Examining each coal-fired power plant in the dataset, VCE determined how nearby wind and solar could be used to replace that coal plant. To determine the risk profile of the coal generation to wind and solar replacement, we compared the MCOE of the coal-fired power plant with the LCOE of the total wind or solar output required to replace all the coal megawatt hours (VCE looked only at either all wind or all solar replacement).

The VCE algorithm logic is explained in Appendix C. In short, it replaces all the MWhs generated from each coal plant annually using local wind or local solar in a search pattern for sites that are available for deployment[13] steadily increasing in distance. The maximum distance the algorithm required to identify replacement wind or solar resources for any given power plant was 35 miles, with a resulting average of 16 miles; these are very local replacements on the scale of the national maps being presented with this report. Sites deemed unsuitable for development by the VCE site screening algorithm were excluded from the assessment. The algorithm did not look further afield for cheaper combinations of distant resources and transmission. Its output is strictly the LCOE of local wind or solar required to replace each coal plant, transformed into a percentage difference between the MCOE of the existing coal generation and new local wind and solar.

Any plant with a negative percentage difference for solar or wind replacement was deemed at risk, and "*substantially at risk*" if the differential was less than -25% with local resources.

The quantity of energy replacement is only compared in terms of annual generation and doesn't capture the time-based value of energy and grid services from a dispatchable (if not always so flexible) coal plant. Further useful analysis could compare a coal plant with a "virtual power plant," combining wind, solar, storage and demand-side resources to more closely mimic or improve on the dispatch of the coal plant and reliability services.

But, as mentioned above, while the VCE analysis includes the cost of interconnecting new local wind and solar, the search algorithm does not look further afield for even cheaper resources once it has replaced the required MWhs. In Colorado, for example, no coal plant is at risk from local wind in this analysis, but we know that wind in the eastern part of the state easily competes

[13] Suitability is determined using the VCE site screening algorithms that remove all protected areas, urban areas, critical flora and fauna, as well as topographical constraints on construction. Further, the algorithm provides buffer space for habitation and other land uses around the potential resource candidate technology.

with coal and is accessible via in-state transmission. In light of these factors, cost crossover would likely be more common if transmission expansion were taken into account.

FINDINGS – COAL AT RISK NUMBERS

Using the cost crossover algorithm, VCE determined that in 2018 more than 49 GW of coal were substantially at risk from local wind and more than 69 GW are substantially at risk from local solar, meaning they could be replaced with local renewable energy resources at least 25 percent cheaper than the running costs of the coal.

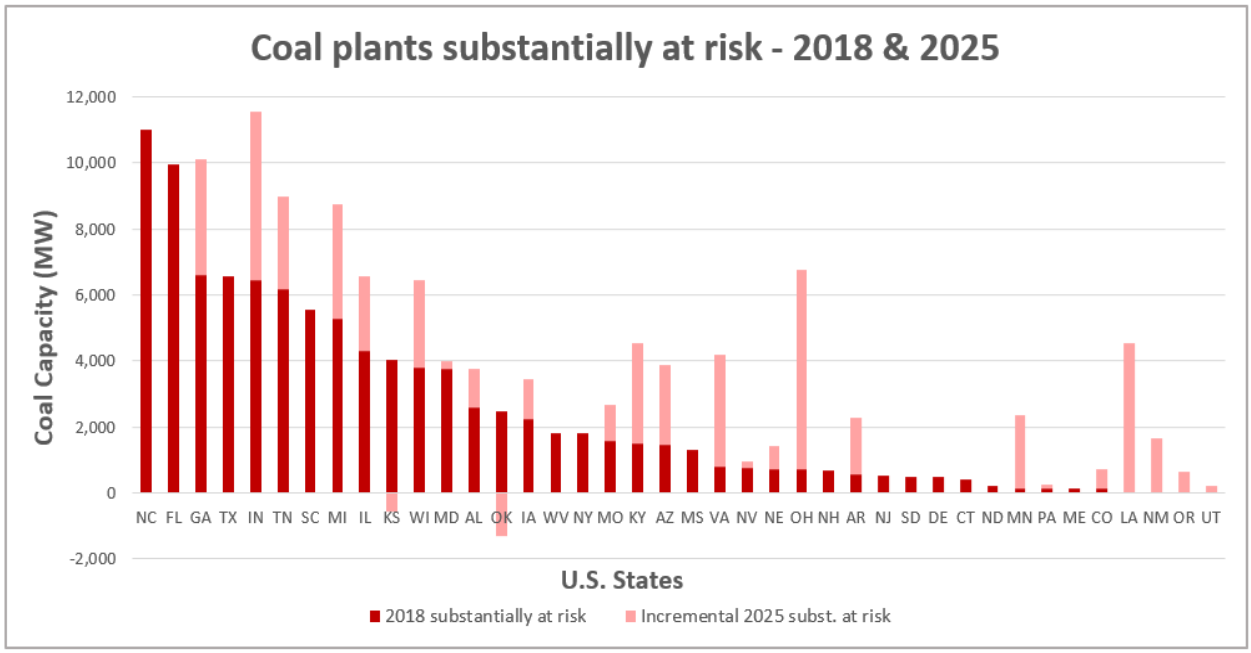
By 2025, local wind and solar could respectively replace roughly 76 GW and 111 GW of coal generation at 25 percent lower costs than running the coal-fired power plants.[14] Combining the wind and solar datasets, VCE finds that 211 GW of coal capacity, or 74 percent, is at risk with **94 GW substantially at risk** from 2018 possible local wind and solar. Assuming the NREL lower cost technology baseline case for 2025, substantially at-risk coal increases to 140 GW (with sunset tax support), or almost half of the U.S. fleet.

MW	RE Cost	Wind (2018)	Solar (2018)	Wind (2025)	Solar (2025)	Combined (2018)	Combined (2025)
Coal substantially at risk	*>25% less than coal*	*49,165*	*69,117*	*75,778*	*111,077*	*93,812*	*140,073*
Coal at risk	*0-25% less than coal*	*118,085*	*178,871*	*167,201*	*229,001*	*210,842*	*246,306*
Coal potentially at risk	*0-25% more than coal*	*168,563*	*107,777*	*119,447*	*57,647*	*75,806*	*40,342*
Coal deemed safe	*>25% more than coal*	*101,792*	*49,620*	*46,289*	*15,706*	*21,608*	*7,866*

We also report the substantially at-risk coal by state, as this is often the most relevant jurisdiction for the future of any at-risk coal plant[15]:

[14] Using NREL ATB low.

[15] There are two states where the MW of coal in the substantially at-risk categories falls from 2018 to 2025. This is because those plants are right on the cusp (-25%) of that category and a slight increase in local costs, due to PTC sunset causes them to move the less risky category.



Note that many Midwestern states see a significant increase in substantially at-risk coal by 2025, reflecting the continuing drop in price for local solar and the high marginal costs of these coal plants. Solar costs have less geographic variation and are therefore projected to become locally accessible in more places than wind, but Midwestern states could also readily access rich wind resources to the west with more transmission.

The sharpest patterns are regional. Almost all coal plants in the PJM footprint are at risk to coal replacement on a straight energy value comparison by 2025. Of course, coal plants in PJM garner a large fraction of their revenue from capacity markets that are unfriendly to solar[16] (in part because they make no allowances for seasonal performance or time-of-day value). This keeps them afloat, with a huge opportunity cost to customers. Another strong regional trend is in the Southeast, where almost all coal plants are substantially at risk to replacement by local solar in 2025 (solar energy is often available there at half the cost of coal power using the NREL lowest-cost scenario). The trend is so strong that it is hard to imagine Southeastern utilities not relying heavily on solar and complementary load shifting resources to replace the coal and save customers money.

The overall conclusion is clear: Much of the U.S. coal fleet is simply becoming uneconomic and analysts, utilities, other stakeholders, regulators, and policymakers need to take a critical look at

[16] Jacob Mays, David Morton, and Richard P. O'Neill, "Asymmetric Risk and Fuel Neutrality in Capacity Markets," United States Association for Energy Economics Working Paper No. 19-385 (February 8, 2019), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3330932; Robbie Orvis and Eric Gimon, "The State of Wholesale Power Markets: What's Wrong With Proposed Changes in Eastern RTOs?" Utility Dive, June 20, 2017, https://www.utilitydive.com/news/the-state-of-wholesale-power-markets-whats-wrong-with-proposed-changes-in/445417/.

each and every coal plant in their jurisdiction.

In this analysis, wind and solar replace all coal-fired generation solely on an annual basis, but as previously stated, a limitation of this analysis is that replacing annual generation does not capture coal generation dispatch timing. Despite its notorious inflexibility, coal is mostly dispatchable, while wind and solar are variable sources of energy whose output, even in aggregate, does not necessarily match demand. But so-called "baseload" coal economics typically require high capacity factors, limiting their use as flexibility resources (high capacity factors require avoiding frequent ramping up and down) and creating a premium for what flexibility they offer, as consumers must pay the costs of running higher-cost energy sources year-round to access that flexibility.

The wider the gap becomes between the marginal economics of coal versus wind and solar, the more coal plants will have to depend on their perceived capacity value to recover costs. Their capacity factors may drop even more, widening the gap, and opening a window for dedicated resources like demand response, storage, and existing flexible resources to fill their niche.

DISCUSSION

This report suggests a sunset scenario for coal power. Not all plants will retire immediately —a steady flow of exits is more likely, especially where capacity markets and monopoly utilities support uneconomic coal generation at the expense of new renewables — but all stakeholders must prepare for the looming economic reality.

The first step for merchant owners, utilities, regulators, and other stakeholders is taking a hard look at coal retirement. For regulated utility assets, integrated resource plans (IRP) and other long-term planning analytical efforts should always include coal retirement scenarios. Indiana utility NIPSCO has shown how smart analysis can flip planning directions: Their most recent planning effort recommended replacing all their coal in the next decade with renewable energy, including wind and solar, along with battery storage[17]. Consumer advocates elsewhere should be asking whether coal plants receiving state-regulated cost recovery but operating in transparent competitive regional energy markets[18] should be allowed to run at loss to the detriment of consumers' pocketbooks[19].

---

[17] Andrew Steele, "NIPSCO Plan Would Eliminate Coal-Fired Electricity Generation Within 10 Years," *The Times of Northwest Indiana*, September 19, 2018, https://www.nwitimes.com/business/local/nipsco-plan-would-eliminate-coal-fired-electricity-generation-within-years/article_269a1f6b-1a24-5180-976d-27a474d8ee47.html.

[18] United States Department of Energy, *Principles for Increasing the Accessibility and Transparency of Power System Planning*, January 2017, https://www.energy.gov/sites/prod/files/2017/01/f34/Principles%20for%20Increasing%20the%20Accessibility%20and%20Transparency%20of%20Power%20System%20Planning.pdf.

[19] Joseph Daniel, "The Coal Bailout Nobody is Talking About," *Union of Concerned Scientists* (blog), September 24, 2018, https://blog.ucsusa.org/joseph-daniel/the-coal-bailout-nobody-is-talking-about. A virtual power plant (VPP) is a cloud-based distributed power plant that aggregates the capacities of heterogeneous distributed energy

Consumer advocates faced with utility inertia, environmental advocates concerned about unpriced coal externalities, and advanced energy solutions providers eager to open opportunities can push back against reliability or dispatchability arguments by comparing the economics of any single coal plant with a combination of local (or distant but easily accessible) renewables with complementary demand-side and storage resources, or virtual power plants (VPP)[20]. If a VPP drop-in replacement also proves more economic than an at-risk coal plant, it can provide an estimate of the *minimum* savings available from coal plant retirement.

A more holistic approach leveraging other existing assets on the grid can prove to be even cheaper for integrating low-cost renewables. For example, a VCE study[21] showed how Colorado could replace all its aging coal plants with a mix of wind, solar, natural gas, and storage to save the state's electric customers more than $250 million annually without affecting reliability. This example is especially notable in the context of this report, because Colorado appears on the tail end of states with coal plants at risk from renewables within 35 miles.

Because coal plants in the central and eastern part of Colorado are most economically replaced with cheap wind from the eastern part of the state, not with local resources (although solar does start becoming a local option by 2025), our cost crossover analysis does not flag many of these plants as at risk (see 2025 LCOE wind map). In fact, this is true for most of the West, where high-quality wind resources in the $15 – 25 / MWh range are often only accessible through large transmission projects. Understanding the geographic dimensions of renewable costs – the opportunities visible in our maps – and proper modeling are therefore key to planning analysis and decision-making.

For coal plants in a vertically integrated jurisdiction like Colorado, and in hybrid setups where coal plants participate in wholesale markets but long-term costs are covered by ratepayers (e.g. many states in Southwest Power Pool and Midcontinent Independent System Operator), it is also useful to look not just at the MCOE of a given coal plant, but also at the remaining balance of long-term costs. Captive customers are on the hook for these costs. If an at-risk coal plant retires but is not paid off, significant incremental savings await ratepayers, especially if the remaining amortization balance can be refinanced at a lower cost than typical utility rates of return[22].

---

resources (DERs) for the purposes of enhancing power generation, as well as trading or selling power on the electricity market.

[20] Mark Dyson, Alexander Engel, and Jamil Farbes, *The Economics of Clean Energy Portfolios*, Rocky Mountain Institute, 2018, https://rmi.org/wp-content/uploads/2018/05/RMI_Economics_Of_Clean_Energy_Portfolios_2018.pdf.

[21] Vibrant Clean Energy, "New Study Finds That Replacing Aging Coal Plants With Wind and Solar Saves Colorado $2.5 Billion by 2040 While Sharply Slashing Emissions," January 8, 2019, https://www.vibrantcleanenergy.com/wp-content/uploads/2019/01/CEI-VCE_CO_CoalPlantRetireStudy(CRS).pdf.

[22] "Financial Transition," America's Power Plan, December 2018, https://americaspowerplan.com/power-transformation-solutions/financial-transition/.

When evaluating coal replacement by other long-term contracts, Colorado offers another interesting example because of its competitive IRP process where potential suppliers bid against each other to meet future needs. This kind of bidding transparently surfaced cost numbers that revealed some of the first signs that cost crossover was possible.

In competitive markets run by Independent System Operators (ISOs), cost crossover analysis indicates where markets are likely out of balance with current economic realities. Obviously, if plant owners are taking all the risk and wholesale prices remain below coal plant MCOE, coal plants will bow to economic pressure and retire. For example, in 2018, Texas' ERCOT system had at least five coal plants close or announce plans to close.[23] In PJM's most recent look at incorporating ambitious fractions of renewables[24], the largest amounts of solar generation considered are nowhere near the hundreds of terawatt-hours of coal to solar replacement implied in this report's analysis. With proper planning and more technology-agnostic rules, tremendous value can be unlocked for customers served by ISOs and utilities.

CONCLUSION

Coal is a dirty and expensive way to generate electricity. The National Academies estimated that in 2005, U.S. coal generation alone caused at least $62 billion in non-climate related damages.[25] Coal's remaining rationale was that it was cheap if externalities weren't included, but even that rationale is vanishing. Our report shows that coal is increasingly uneconomic against *new* local wind and solar resources.

The next refuge for those with an economic stake in coal generation is reliability, or claims that the grid cannot run reliably without it. This report cannot directly address that contention, but more holistic studies like the VCE Colorado or Minnesota studies[26] or the NREL[27] renewable integration studies do undercut this point.

---

[23] Miranda Green, "Texas Coal Plant Announces Plans to Shut Down," *The Hill*, September 25, 2018, https://thehill.com/policy/energy-environment/408369-texas-based-coal-fired-plant-announces-retirement.

[24] "Renewable Integration Study Reports," PJM Interconnection, https://www.pjm.com/committees-and-groups/subcommittees/irs/pris.aspx.

[25] The National Academies, *Hidden Costs of Energy*, 2009, https://www.nap.edu/resource/12794/Hidden_Costs_Key_Findings_final.pdf.

[26] Vibrant Clean Energy, "New Study Finds That Replacing Aging Coal Plants With Wind and Solar Saves Colorado $2.5 Billion by 2040 While Sharply Slashing Emissions," January 8, 2019, https://www.vibrantcleanenergy.com/wp-content/uploads/2019/01/CEI-VCE_CO_CoalPlantRetireStudy(CRS).pdf; Vibrant Clean Energy, Minnesota's Smarter Grid, July 31, 2018, https://www.mcknight.org/wp-content/uploads/Minnesotas-SmarterGrid_FullReport_NewFormat.pdf.

[27] Joshua Novacheck, Greg Brinkman, and Gian Porro, *Operational Analysis of the Eastern Interconnection at Very High Renewable Penetrations*, National Renewable Energy Laboratory, September 2018, https://www.nrel.gov/docs/fy18osti/71465.pdf; "Renewable Electricity Futures Study," National Renewable Energy Laboratory, https://www.nrel.gov/analysis/re-futures.html; "Interconnections Seam Study," National Renewable Energy Laboratory, https://www.nrel.gov/analysis/seams.html; "Eastern Renewable Generation Integration Study," National Renewable Energy Laboratory, https://www.nrel.gov/grid/ergis.html.

Other resources will be required to complement wind and solar and provide essential reliability services, but the increasingly attractive relative value proposition for the raw energy available from wind and solar versus more expensive coal generation can generate more and more money to directly address grid challenges. Steep declines in costs for resources like battery storage will stretch that money even more. Furthermore, it is becoming clear that wind and solar can become an asset rather than a liability when it comes to essential reliability services due to their highly responsive power electronics.[28]

Large majorities of Americans support increasing the use of solar and wind energy in their states[29]. The data in this report provide an economic rationale for a coal phase-out in the next decade led by wind and solar, happening a lot quicker than most had imagined. It's time to get on with the coal-to-clean transition.

[28] Energy and Environmental Economics, Inc., *Investigating the Economic Value of Flexible Solar Power Plant Operation*, October 2018, https://www.ethree.com/wp-content/uploads/2018/10/Investigating-the-Economic-Value-of-Flexible-Solar-Power-Plant-Operation.pdf.

[29] "Findings From the Fall 2018 NSEE," Gerald R. Ford School of Public Policy, http://closup.umich.edu/national-surveys-on-energy-and-environment/nsee-2018-fall/renewables.php.

APPENDIX A

SOLAR PV POWER DATASET

To create a high resolution levelized cost of electricity (LCOE) dataset a power dataset is required. Vibrant Clean Energy, LLC (VCE) has created such a power dataset for solar PV across the United States. The power dataset is at a geographic resolution of three km and a temporal resolution of five minutes. The solar PV power dataset spans five calendar years.

To construct the solar PV power dataset, VCE acquired the full three-dimensional (native) fields of the National Oceanic and Atmospheric Administration (NOAA) High Resolution Rapid Refresh (HRRR). VCE has continued to expand the only 3-D archive of the HRRR for both assimilation hours and forecast out to 36 hours. The numerical weather prediction (NWP) model data from NOAA is crucial because it includes 20 - 50,000 observations collected and quality controlled by the National Weather Service (NWS). The observations include ground-based measurements, satellites, aircraft, radar, balloon launches, and more. In addition, VCE acquired the GOES-East and GOES-West Satellite telemetry for the visible band, three Infrared bands, and the water vapor band. The temporal resolution of the satellite data is 15-minutes. The satellite dataset spans the same time period as the NOAA HRRR dataset. The satellite dataset has been collected because it is well understood that NWP are poorer at cloud resolving than satellites in terms of thickness and dispersion. Further, the dual satellite imagery facilitates stereographic projections of the clouds for computing the shading, reflection and absorption of solar irradiance in many grid cells. Finally, VCE collected the NOAA SURFRAD and SOLRAD high-precision ground-based measurements for solar irradiance. This will be used in the deep-learning AI algorithm contained in VCE's Solar Irradiance Model (SIM).

Not every variable in the HRRR dataset is used for the solar PV power estimates. For the proprietary algorithm created by VCE, the Solar Power Model (SPM), we extract: the wind speed at two meters, the incoming shortwave radiation, the incoming longwave radiation, the outgoing shortwave radiation, the outgoing longwave radiation, the clouds in the column above the ground resource sites, the hydrometeors in the column, the temperature, the clouds and hydrometeors in the beam direction, and the estimated aerosols.

In addition to collecting data from the HRRR, GOES, SURFRAD, and SOLRAD, VCE must compute some critical variables that have a significant influence on solar irradiance: The Earth-Sun distance, the declination angle, the hour angle, the azimuth angle, the zenith angle for every single site across the United States. An important addition is the Equation of Time that can disrupt accuracy at five-minute resolution if not included.

The HRRR dataset is at hourly resolution. It is at this stage that we convert the hourly data into five-minute data. We do this using the tendencies (derivatives) within the HRRR model as well as statistical methods to create a continuous function between hours. The five-minute resolution allows use of cloud scattering and other variables in the HRRR that can be useful to determining solar PV power at shorter-time periods than the hourly data.

The procedure to create the datasets is somewhat similar to that described in Clack, 2017[30]. We recap the major points here for completeness.

The first part of the procedure is to create the Direct Normal Irradiance (DNI), the Diffuse Horizontal Irradiance (DHI), and the Global Horizontal Irradiance (GHI). We require all components because the solar panels respond differently to the DNI and DHI; particularly with heating of the panels and the photoelectric effect. The SIM trains the learning algorithm (AI) with the ground-based observations from the SOLRAD and SURFRAD sites. These are considered the "truth" with their measurement errors incorporated. The GOES and NWP datasets are the components to be combined to produce the ground-based measurements. Of course, a small subset is held back from the training algorithm to validate the approach. The approach begins with a shallow-learning sequence (as in Clack, 2017); but then continues with deeper learning that recombines different variables in unconventional ways to increase the precision of the estimates. There are ~630,000 observations to train upon. The training is performed repeatedly with different data levels available. For example, one satellite only available; part of a satellite missing, all satellites missing, some hydrometeors missing, etc. It is important to note that the nearest one-minute average of the ground-based observation is used for the five-minute estimates. We combine errors of measurements and five-minute variance for the observations. This is a deliberate choice; the SIM is comparing a point to a grid cell average. We do not want to over-fit the learning. Note that the SURFRAD and SOLRAD sites span the U.S. and are in different urban/non-urban environments.

The conclusion of the SIM is where the deep learning algorithm applies the computed coefficients to all sites across the U.S. for all five-minute time periods. The outputs are GHI, DNI, DHI, hour angle, azimuth angle, zenith angle, declination angle, clouds, aerosols, temperature, and wind speed at two meters.

Once the SIM outputs are created, the procedure moves to the second stage, which is the SPM. The SPM include parameters for different solar PV types. The standard used is mono-crystalline. The SPM computes the power estimates based on the SIM outputs, the angle of the panels, the shading, the tracking assumed, and the terrain / elevation. The SIM outputs include temperature and wind speeds, that allows computation of the heating of the panels that influences the power production vastly. The Invert Loading Ratio (ILR) is assumed to be 1.2. The SPM has the ability to perform the computations with any level of ILR; but this would add too many degrees of freedom if it was not consistent across the U.S.

The SPM computes the instantaneous CF for each three-km site for each five-minute time step. The power can be above 100 percent rated power because of temperature dependency, cloud brightening, Inverter loading, and snow cover. The SPM is limited to only allowing 130 percent of

[30] Christopher T. M. Clack, "Modeling Solar Irradiance and Solar PV Power Output to Create a Resource Assessment Using Linear Multiple Multivariate Regression," *Journal of Applied Meteorology and Climatology*, (January 2017): 109-125, https://journals.ametsoc.org/doi/pdf/10.1175/JAMC-D-16-0175.1.

the rated capacity. This is to avoid overloading the inverters. The rated power is defined by the solar panels installed. This is because for costs later, we use the cost for installing at 1.0 ILR, so we require consistent definitions.

The solar PV power dataset is the final output of SPM. Currently, the dataset covers multiple tilts for fixed PV, one-axis tracking (North-South facing, tilted at latitude) and two-axis tracking. It does also include rooftop solar PV estimates, which is based on roof space, average tilt of roof, shading, and pitch of roof in each three-km grid cell. The one-axis tracking is the most widely adopted in the U.S., but the other versions allow comparison for production and optimal siting at a later date. For example, northern states would benefit from two-Axis tracking for higher solar production in the winter months, which would offset the additional cost of construction. However, the far south could use fixed axis tilted at an optimal angle and save on having tracker technologies. A short visualization of the solar PV dataset is available online.[31]

COSTS AND INCENTIVES

Once the solar PV power dataset is created, we can start to apply costs to the resource sites. In the previous section, we have only dealt with the physics of the solar irradiance and power; and not how economics alters the picture for site preference. To apply costs, we use the National Renewable Energy Laboratory (NREL) Annual Technology Baseline (ATB) 2018. The NREL ATB 2018 provide costs for numerous years and technologies. We have chosen to use the 2018 costs along with the 2025 (low and mid) projection. The solar cost is referenced to the one-axis tracking for each site across the U.S.

The economic life of the solar PV plant is estimated to be 25 years. The Weighted Average Cost of Capital is assumed to be 5.87 percent (real). The fixed and variable costs are also pulled from the NREL ATB 2018.

The federal incentives of the Production Tax Credit (PTC) and Investment Tax Credit (ITC) are applied with their current sunset dates. Only the ITC is applied to the solar sites.

The U.S. is extremely diverse in its costs for labor, materials and permitting. The algorithm used for the modeling includes a component that applies state-level multipliers to the cost of the solar PV construction. They are applied at the state-level because of data availability. The multipliers range from 87.5 percent to 105.0 percent. Further there is cost multipliers for the different technologies. For the one-axis tracker there is a 15 percent premium for building the tracker system compared with the fixed panels, with no tilt.

TRANSMISSION CONSIDERATIONS

The VCE WIS:dom optimization model includes detailed transmission datasets. The transmission datasets include the transmission lines, their voltage, the transmission substations and their capacities. For each three-km site from the solar PV power dataset, a geodesic is computed to

[31] "Solar Power For Day 10 of 2014 – Coincident With Winds," Christopher Clack, Youtube video (May 23, 2018), https://www.youtube.com/watch?v=d22m0KHy5Fs.

the nearest substation. The cost of the solar resource site is increased by the cost to construct the transmission line to the nearest substation. Further, if the WIS:dom model determines the substation is close to capacity, the solar site will incur a cost to upgrade the transmission substation as well. This is relaxed for the 2025 versions, because the grid topology is likely to change by that date.

LCOE MAPS AND DATA LINKS

With the costs and power datasets completed, the final step is to produce the LCOE mapping. The power dataset is converted to capacity factors for each three-km resource site. The capacity factor is combined with the costs to produce the LCOE. Essentially, total costs (capital, fixed, transmission, multipliers) divided by potential generation (CF * Size * 8760). We allowed only one-axis tracking tilted at latitude and orientated North-South.

VCE has created NetCDF files that include the LCOE data for 2018, 2025 Low, and 2025 Mid. Further, VCE has visualized the LCOE data in PDF. The images allow easy zoom capabilities into regions of the United States to be used by all. The data files allow more precise analysis using the LCOE mapping.

The location of the data files is:

https://www.vibrantcleanenergy.com/wp-content/uploads/2019/03/LCOE-Mapping/SolarLCOE_Data.zip

The locations of the images are:

https://vibrantcleanenergy.com/wp-content/uploads/2019/03/LCOE-Mapping/SolarPVLCOEMap_2018_cobrand_samescale.pdf

https://vibrantcleanenergy.com/wp-content/uploads/2019/03/LCOE-Mapping/SolarPVLCOEMap_2025L_cobrand_samescale.pdf

https://vibrantcleanenergy.com/wp-content/uploads/2019/03/LCOE-Mapping/SolarPVLCOEMap_2025M_cobrand_samescale.pdf

APPENDIX B

WIND POWER DATASET

To create a high resolution levelized cost of electricity (LCOE) dataset a power dataset is required. Vibrant Clean Energy, LLC has created such a power dataset for wind across the United States. The power dataset is at a geographic resolution of three km and a temporal resolution of five minutes. The wind power dataset spans five calendar years.

To construct the wind power dataset, VCE acquired the full three-dimensional (native) fields of the National Oceanic and Atmospheric Administration (NOAA) High Resolution Rapid Refresh (HRRR). VCE has continued to expand the only 3-D archive of the HRRR for both assimilation hours and forecast out to 36 hours. The numerical weather prediction (NWP) model data from NOAA is crucial because it includes 20 - 50,000 observations collected and quality controlled by the National Weather Service (NWS). The observations include ground-based measurements, satellites, aircraft, radar, balloon launches, and more.

Not every variable in the HRRR dataset are used for the wind power estimates. For the proprietary algorithm created by VCE, the Wind Power Model (WPM), we extract: he wind speeds from 20 m to 240 m above ground level in 10 meter increments, the wind direction at each height, the air density at each height, turbulent kinetic energy at each height, temperature at each height, hydrometeors at each height, and the clouds at each height. The HRRR model is in hybrid-sigma coordinates and these are interpolated to height above ground level using cubic spline interpolation.

The HRRR dataset is at hourly resolution. It is at this stage that we convert the hourly data into five-minute data. We do this using the tendencies (derivatives) within the HRRR model as well as statistical methods to create a continuous function between hours. The five-minute resolution allows use of wind gusts and other variables in the HRRR that can be useful to determining wind power at shorter-time periods than the hourly data.

The procedure to create the datasets is somewhat similar to that described in Clack et al., 2016[32] and Choukulkar et al., 2016[33]. We recap the major points here for completeness.

The first part to convert weather variables to power estimates is to create the Rotor Equivalent Wind Speed (REWS). The REWS is a scalar value that estimate the average wind speed across the entire rotor swept area. In Clack et al., 2016 the methods were expanded to include NWP models and the full power equation; which accounts for the discretization of the wind speed and derivatives for NWP. Further, in Choukulkar et al., 2016, the method was further expanded to

---

[32] Christopher T. M. Clack, et al., "Demonstrating The Effect of Vertical and Directional Shear for Resource Mapping of Wind Power," *Wind Energy* 19, (November 2015): 1687-1697, *https://www.vibrantcleanenergy.com/wp-content/uploads/2016/11/Demonstrating_the_effect_of_vertical_and.pdf.*

[33] Aditya Choukulkar, et al., "A New Formulation for Rotor Equivalent Wind Speed for Wind Resource Assessment and Wind Power Forecasting," *Wind Energy* 19, (September 2015): 1439-1452, *https://www.vibrantcleanenergy.com/wp-content/uploads/2016/11/Choukulkar_et_al-2016-Wind_Energy.pdf*

include the turbulent kinetic energy influence on the power equations. The REWS formulation can be found in those peer-reviewed papers. The REWS also takes into account the sheer and veer across the rotor swept area. A similar procedure is required for the temperature, clouds, and air density. Two video visualizations of the wind data set can be found online[34,35].

Once the REWS and other variables are created for the wind power dataset, the power estimates must be constructed. This is done using the wind power equations from Clack et al., 2016 and Choukulkar et al., 2016. The WPM uses a combination of wind turbines from each wind resource class to create a generic wind turbine for each. The generic wind turbine has a coefficient of power curve that is a function (rather than a data table). The coefficient of power (or C_P) is the efficiency of the wind turbine to extract power from the wind. It is used within the power equation. A more common tool is the power curve; however, this is more limited because it does not allow changes in air density, and is less sensitive to the cube of the wind speed (when using the REWS formulation). This is particularly important when considering the full power equation and turbulent kinetic energy.

Once the WPM has completed there is wind power for the optimal turbine class for each three-km across the United states for each five-minute interval for a five-year period. A visualization of the wind power (at 80m AGL) is available online.[36] The current iteration of the wind power dataset has power for 80 meters, 100 meters, 120 meters, 140 meters, and 160 meters. It includes terrestrial and offshore wind resources.

COSTS AND INCENTIVES

Once the wind power dataset is created, we can start to apply costs to the resource sites. In the previous section, we have only dealt with the physics of the wind; and not how economics alters the picture for site preference. To apply costs, we use the National Renewable Energy Laboratory (NREL) Annual Technology Baseline (ATB) 2018. The NREL ATB 2018 provide costs for numerous years and technologies. We have chosen to use the 2018 costs along with the 2025 (low and mid) projection. The wind cost is referenced to the optimal type for each site across the United States – including for offshore wind.

The economic life of the wind turbines is estimated to be 30 years for terrestrial and 25 years for offshore. The Weighted Average Cost of Capital is assumed to be 5.87 percent (real). The fixed and variable costs are also pulled from the NREL ATB 2018.

The federal incentives of the Production Tax Credit (PTC) and Investment Tax Credit (ITC) are applied with their current sunset dates. The PTC is applied to the terrestrial wind, while the ITC is

[34] "10m Winds For Day 10 of 2014," Christopher Clack, Youtube Video (May 23, 2018), https://www.youtube.com/watch?v=HU_m56X0FCM.

[35] "Hurricane Arthur in 2014 – 10m Wind Speeds," Christopher Clack, Youtube video (May 8, 2018), https://www.youtube.com/watch?v=VeTGnzg4ngs.

[36] "Wind Power Across United States (4 days)," Christopher Clack, Youtube video (November 29, 2018), https://www.youtube.com/watch?v=K5kqch2QNzU.

applied to the offshore wind sites. The algorithm used for the modeling takes into account that the PTC is only applied for 10 years after construction.

The U.S. is extremely diverse in its costs for labor, materials and permitting. The algorithm used for the modeling includes a component that applies state-level multipliers to the cost of the wind construction. They are applied at the state-level because of data availability. The multipliers range from 97.5 percent to 112.5 percent.

TRANSMISSION CONSIDERATIONS

The VCE WIS:dom optimization model includes detailed transmission datasets. The transmission datasets include the transmission lines, their voltage, the transmission substations and their capacities. For each three-km site from the wind power dataset, a geodesic is computed to the nearest substation. The cost of the wind resource site is increased by the cost to construct the transmission line to the nearest substation. Further, if the WIS:dom model determines the substation is close to capacity, the wind site will incur a cost to upgrade the transmission substation as well. This is relaxed for the 2025 versions, because the grid topology is likely to change by that date.

LCOE MAPS AND DATA LINKS

With the costs and power datasets completed, the final step is to produce the LCOE mapping. The power dataset is converted to capacity factors for each three-km resource site. The capacity factor is combined with the costs to produce the LCOE. Essentially, total costs (capital, fixed, transmission, multipliers) divided by potential generation (CF * Size * 8760). We allowed up to 100 meter AGL for 2018 and up to 120 meter for 2025. The algorithm selects the optimal height for the hub based on the reduction in the LCOE. It will increase the hub height from 80 meters to 100 meters if it reduces the LCOE by more than $7.50/MWh and from 100 meters to 120 meters if it reduces the LCOE by more than $12.50/MWh. Essentially, if it chooses a 120 meter hub height, the cost of wind power is estimated to be $20/MWh cheaper than at 80 meters.

VCE has created NetCDF files that include the LCOE data along with the optimal hub heights for 2018, 2025 Low, and 2025 Mid. Further, VCE has visualized the LCOE data in PDF. The images allow easy zoom capabilities into regions of the United States to be used by all. The data files allow more precise analysis using the LCOE mapping.

The location of the data files is:

https://www.vibrantcleanenergy.com/wp-content/uploads/2019/03/LCOE-Mapping/WindLCOE_Data.zip

The locations of the images are:

https://vibrantcleanenergy.com/wp-content/uploads/2019/03/LCOE-Mapping/WindLCOEMap_2018_cobrand.pdf

https://vibrantcleanenergy.com/wp-content/uploads/2019/03/LCOE-Mapping/WindLCOEMap_2025L_cobrand.pdf

https://vibrantcleanenergy.com/wp-content/uploads/2019/03/LCOE-Mapping/WindLCOEMap_2025M_cobrand.pdf

APPENDIX C

COAL-FIRED POWER PLANT DATASET

A marginal cost of electricity (MCOE) dataset can be created for the existing coal-fired power plants across the United States by combining publicly available information. The data collected from FERC Form 1[37], EIA Form 860[38] and EIA Form 923[39] for the calendar year 2017. The information extracted includes the amount of fuel burned, the average heat rate of the power plants, the emission factors, the capital investments, the pollution controls, the fixed operations and maintenance costs, and the variable operations and maintenance costs.

Due to the scale of the coal dataset as well as the frequency of update for public information, inevitably there are some inconsistencies that appear in the analysis when referencing other datasets. VCE has done its best to avoid such inconsistencies in the dataset, but some will likely remain. The highest occurrence of inconsistencies will be due to: retired plants after 2017, repowering of coal plants with natural gas, naming conventions between datasets, and nameplate capacity numbers.

The coal fuel cost for the construction of the MCOE dataset is taken from the National Renewable Energy Laboratory (NREL) Annual Technology Baseline (ATB) 2018. The national average for the 2018 calendar year is used. The fuel data collected from publicly available sources for 2017 was used to adjust the national coal price to the individual power plants. If there are multiple units at a coal-fired power plant, the data was combined into a single value for the entire plant. The coal-fired power plant fuel costs are multiplied by the annual average heat rates from the publicly available data. This results in a fuel cost for each power plant in $ / MWh.

In addition to fuel costs, there are variable costs based on the operations and maintenance (O&M) of the power plant. The variable O&M was extracted from the NREL ATB 2018 and applied regionally. The values were correlated to the publicly available data. The variable O&M was constructed in $ / MWh.

The final costs included in the MCOE are the fixed O&M costs and the ongoing capital spending for pollution controls and other upgrades to the power plant. These costs are applied to the coal-fired power plants based on estimates constructed from the publicly available data. To convert these fixed costs to $ / MWh, the capacity factors for each of the power plants were utilized.

The final MCOE dataset is in $ / MWh and is the addition of the fuel costs, the variable O&M costs and the fixed costs. The combined MCOE costs are dependent on the capacity factors. The MCOE dataset was constructed to compare the cost building new wind and solar to replace the

---

[37] "Form 1 – Electric Utility Annual Report," Federal Energy Regulatory Commission, https://www.ferc.gov/docs-filing/forms/form-1/data.asp.

[38] "Form EIA-860 Detailed Data With Previous Form Data," United States Energy Information Administration, https://www.eia.gov/electricity/data/eia860/.

[39] "Form EIA-923 Detailed Data With Previous Form Data," United States Energy Information Administration, https://www.eia.gov/electricity/data/eia923/.

generation from each of the coal-fired power plants. Since the MCOE is sensitive to the capacity factor of the coal-fired power plant, it should be noted that adding new wind and solar to replace the coal generation would lower the capacity factor, thereby increasing the MCOE.

The coal MCOE dataset comes with additional information that can be used for further analysis. First, the location and installed capacity of each coal-fired power plant is included. Second, the heat rates, capacity factors, age, and plant names are also included for ease of reference for the construction of the MCOE. Finally, the construction costs were estimated to compute the remaining debt for each coal-fired power plant. These debt costs were created using the publicly available data, the age of the power plants and the cumulative generation and revenue for that power plant. The debt costs were included in the LCOE, but not the MCOE.

COAL REPLACEMENT ALGORITHM

Once the coal-fired power plant dataset is created, it can be used to determine the ability for wind and solar to replace those coal plants. The LCOE for wind and solar were created previously. The LCOE calculation includes the transmission costs for interconnection, the resource potential and the localized costs for construction. The LCOE values were computed for 2018 and 2025.

The replacement of the coal generation with wind and solar is determined by comparing the MCOE of the coal-fired power plant with the LCOE of the total wind or solar required to replace all the coal megawatt hours.

The algorithm for replacing the coal generation has the following basic structure:

1. Select the coal-fired power plant to replace;
2. Find the closest wind or solar resource site;
3. Determine the generation from the wind or solar site and reduce the coal generation required to be replaced;
4. Save the installed capacity of wind or solar along with the LCOE;
5. Find the next closest wind or solar resource site;
6. Repeat steps 3–5 until the coal generation to replace becomes zero;
7. Compute the LCOE for the replacement wind or solar generation;
8. Repeat steps 1–7 until all the coal-fired power plants are replaced.

The algorithm continues until the entire generation for each coal-fired power plant is replaced with wind or solar. The output from the algorithm is the LCOE of the wind or solar required to replace the coal generation. That data is transformed into a percentage difference between the MCOE of the existing coal generation and the new wind and solar.

The algorithm could be expanded in the future to include the addition of storage and a limit to the amount of installed capacity allowed to replace the coal-fired power plants.

Exhibit F:

Letter from Benjamin Carlisle, U.S. Department of Justice, to Sean H. Donahue and Michael J. Myers (Sept. 27, 2019)

U.S. Department of Justice

Environment and Natural Resources Division

90-5-2-3-21520

Environmental Defense Section
P.O. Box 7611
Washington, DC 20044

Carlisle Telephone (202) 514-9771
Greenfield Telephone (202) 514-2795

September 27, 2019

VIA EMAIL

Sean H. Donahue
Donahue, Goldberg, Weaver & Littleton
1008 Pennsylvania Ave., SE
Washington, DC 20003
(202) 277-7085
sean@donahuegoldberg.com

Michael J. Myers
Senior Counsel
Environmental Protection Bureau
New York State Attorney General
The Capitol
Albany, NY 12224
(518) 776-2382
michael.myers@ag.ny.gov

Re: *American Lung Ass'n v. EPA*, No. 19-1140 (and consolidated cases).

Dear Mr. Donahue and Mr. Myers:

Thank you for your letter dated September 19, 2019. We appreciate the opportunity to attempt to resolve the issues you raise without the involvement of the Court.

I. Alleged Omissions from the Administrative Docket and/or Certified Index of Record.

A. Documents Filed After October 31, 2018.

In response to your request that EPA add to the docket certain materials available after the close of the public comment period, EPA agrees that the record should include the Fourth Annual National Climate Assessment Volume II: Impacts, Risks and Adaptation in the United States ("NCA4-II"). This document was prepared, in part, through the input of EPA personnel and published shortly after the close of the public comment period.

EPA, however, did not re-open the record in this case to consider late-submitted comments and, therefore, we cannot agree to add to the record in this case the remainder of the materials identified in Section 1.A of your letter, including the comments submitted on the NCA4-II. *See, e.g.*, *Appalachian Power Co. v. EPA*, 249 F.3d 1032, 1059 (D.C. Cir. 2001) (agencies need not consider untimely comments). Although Clean Air Act Section 307(d)(4)(B)(i) provides that the Administrator shall place documents "which the Administrator determines are of central relevance" in the rulemaking docket, EPA has broad discretion to make this decision. EPA has not determined these comments are of central relevance.

Moreover, Clean Air Act Section 307(d)(7)(B) provides that only those objections to a rule or procedure raised with reasonable specificity during the period for public comment are properly subject to judicial review. 42 U.S.C. § 7607(d)(7)(B). That provision, however, provides two exceptions to this rule, under which a person can seek mandatory reconsideration of a rule. These include when that person "can demonstrate to the Administrator that it was impracticable to raise such objection within [the period for public comment] or if the grounds for such objection arose after the period for public comment (but within the time specified for judicial review." *Id.* Under those circumstances, EPA must convene a proceeding for reconsideration. If the Administrator refuses to convene such a proceeding, that decision is subject to judicial review. *Id.* The statute thus sets forth the proper course for Petitioners to follow if they believe that EPA must consider the late-submitted materials identified in your letter.

B. Documentary Appendices and Other Documents Submitted by Petitioners.

Where voluminous documents are submitted to EPA, it is often not EPA's practice to upload those documents to the electronic docket in full. Rather, EPA may note in the docket the receipt of media and/or upload an index received associated with those documents. Although we believe this practice is appropriate, your letter identified concerns with the following submissions:

Petitioner Environmental Defense Fund's April 20, 2018, submission of a flash drive containing 289 documents. EPA hereby confirms that all of the documents provided in this submission, as reflected on Exhibit A of your letter, are considered to be part of docket entry EPA-HQ-OAR-2017-0355-20966 and, therefore, part of the certified record.

Petitioner Environmental Defense Fund's October 31, 2018, submission of a flash drive containing two additional compilations of documents—the ACE Joint Appendix (112 documents) and the ACE EDF Appendix (88 documents)—as well as EDF's comments on the December 2017 Advance Notice of Proposed Rulemaking, and 27 attachments. EPA hereby confirms that all of the documents provided in this submission, as reflected in Exhibits B-D of your letter, are considered to be part of docket entry EPA-HQ-OAR-2017-0355-24423 and, therefore, part of the certified record. To more particularly reflect the contents of this submission, EPA has updated this docket entry to include the indices associated with the ACE Joint Appendix and ACE EDF Appendix (Exhibits B and C to your letter).

Petitioner Sierra Club's October 31, 2018, submission of a flash drive containing documents and data. EPA hereby confirms that all of the documents and data provided in this submission, as reflected in Exhibits E and F of your letter, are considered to part of docket entry EPA-HQ-OAR-2017-0355-24422 and, therefore, part of the certified record. To more

particularly reflect the contents of this submission, EPA has updated this docket entry to include the list of files included on that flash drive (Exhibit F of your letter).

We believe this resolves Petitioners' requests to confirm that these materials are part of the certified record in this matter.

C. EPA's Review of the Clean Power Plan Pursuant to Executive Order 13,783.

EPA confirms that, consistent with Clean Air Act Section 307(d)(3), the docket includes all of the data, information, and non-deliberative documents referred to in that paragraph on which the proposed rule relies, including as pertaining to EPA's review under Executive Order 13,783. 42 U.S.C. § 7607(d)(3). The results of EPA's review under Executive Order 13,783 are reflected in the preamble to the proposed repeal of the Clean Power Plan. 82 Fed. Reg. 48,035 (October 16, 2017). We believe this resolves your request that EPA ensure that any records emanating from EPA's review under Executive Order 13,783 are reflected in the administrative record.

D. Documents Relating to Meetings With Former Assistant Administrator William Wehrum.

EPA has located sign-in sheets for the following meetings[1] identified in your letter:

- January 10, 2018: American Coalition for Clean Coal Electricity*
- March 30, 2018: National Rural Electric Cooperative Association
- May 30, 2018: Edison Electric Institute
- November 28, 2018: Lignite Energy Council*

Those sign-in sheets all reflect that no written materials were provided in these meetings.[2] EPA is unaware of any "significant new factual information" presented in these meetings and, accordingly, no memoranda summarizing those meetings were prepared.

EPA has located Microsoft Outlook meeting entries, containing information such as meeting invitees, for the following meetings identified in your letter:

- December 7, 2017: American Electric Power, Duke Energy, Dominion, and Southern Company*
- January 12, 2018: National Mining Association (discuss CPP)
- July 9, 2018: American Coalition for Clean Coal Electricity *
- December 11, 2018: National Rural Electric Cooperative Association*

For two of these meetings (December 7, 2017, with American Electric Power et. al., and December 11, 2018, with National Rural Electric Cooperative Association), EPA has also

[1] We note that for those meetings marked with a star, EPA does not have information indicating whether the Clean Power Plan or Affordable Clean Energy Rule were discussed.

[2] EPA agrees to add these sign-in sheets to the electronic docket and will include them in its update to the certified record.

located forms identifying further information regarding these meetings.[3]. EPA is currently unaware of any written materials provided in those meetings or any memoranda prepared summarizing those meetings. We believe this resolves Petitioners' concerns.

II. Request for Additional Information on Documents in the Certified Record.

We do not agree that the information that Petitioners request is "typically" included in the certified record in all cases. However, on September 24, 2019, we provided a searchable, sortable excel spreadsheet reflecting additional information to assist the parties in navigating the record. We believe this resolves Petitioners' concerns.

III. Status of Administrative Records for the Clean Power Plan Rulemaking and the Advance Notice of Proposed Rulemaking Preceding ACE Proposal.

EPA hereby confirms that, except as otherwise specifically provided in the certified index of record filed in this litigation, EPA does not consider the administrative record for this case to include the administrative records for the Clean Power Plan rulemaking (EPA-HQ-OAR-2013-0602) or the Advance Notice of Proposed Rulemaking (EPA-HQ-OAR-2017-0545).

Sincerely,

/s/ Benjamin Carlisle
Benjamin Carlisle
Meghan Greenfield
Trial Attorney
U.S. Department of Justice
Environment and Natural Resources Division
Environmental Defense Section
4 Constitution Sq., Room 4.1130
Washington, DC 20002
(202) 514-9771

Counsel for Respondents

[3] EPA agrees to add these Microsoft Outlook meeting entries and additional forms to the electronic docket and will include them in its update to the certified record.