# NAAQS Regulatory Review & Rulemaking Coalition

## Comments of the NAAQS Regulatory Review & Rulemaking Coalition on EPA's Reconsideration of the National Ambient Air Quality Standards for Particulate Matter

### Docket No. EPA-HQ-OAR-2015-0072

American Chemistry Council
American Coke and Coal Chemicals Institute
American Forest & Paper Association
American Fuel & Petrochemical Manufacturers
American Iron and Steel Institute
American Petroleum Institute
American Wood Council
National Lime Association
National Mining Association
National Stone, Sand & Gravel Association
Oilseed Processors Coalition
- Corn Refiners Association
- National Cotton Council
- National Cotton Ginners Association
- National Cottonseed Processors Association
- National Oilseed Processors Association
- Texas Cotton Ginners' Association

Portland Cement Association
The Aluminum Association
The Fertilizer Institute

March 28, 2023

# NAAQS Regulatory Review & Rulemaking Coalition

## COMMENTS OF THE NAAQS REGULATORY REVIEW & RULEMAKING COALITION ON EPA'S RECONSIDERATION OF THE NATIONAL AMBIENT AIR QUALITY STANDARDS FOR PARTICULATE MATTER

## DOCKET NO. EPA–HQ–OAR-2015-0072

### Executive Summary

Under the Clean Air Act ("CAA" or "Act"),[1] primary National Ambient Air Quality Standards ("NAAQS") are set at a level that, in the judgment of the Administrator of the United States Environmental Protection Agency ( "EPA" or "Agency"), is requisite to protect the public health, allowing an adequate margin of safety.[2] Secondary NAAQS are set at a level that, in his judgment, is requisite to protect the public welfare from known or anticipated adverse effects.[3] In December 2020, EPA completed a review of its NAAQS for particulate matter ("PM") and decided to retain the existing standards without revision.[4] Those standards include an annual primary NAAQS for fine PM (measured as $PM_{2.5}$) of 12.0 $\mu g/m^3$, annual primary and secondary $PM_{2.5}$ NAAQS of 15.0 $\mu g/m^3$, 24-hour primary and secondary NAAQS of 35 $\mu g/m^3$ and 65 $\mu g/m^3$, and 24-hour primary and secondary NAAQS for coarse PM (measured as $PM_{10}$) of 150 $\mu g/m^3$.[5] That

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[1] 42 U.S.C. §§ 7401-7671q.

[2] CAA § 109(b)(1). The Act does not require the Administrator to set NAAQS at a zero-risk level. *See Mississippi v. EPA*, 744 F.3d 1334, 1351 (D.C. Cir. 2013) (per curiam).

[3] CAA § 109(b)(2).

[4] 85 Fed. Reg. 82,684 (Dec. 18, 2020) (hereinafter "2020 PM NAAQS Rule").

[5] 40 C.F.R. §§ 50.6, 50.7, 50.13, & 50.18 (2021). The 15.0 $\mu g/m^3$ annual primary $PM_{2.5}$ NAAQS has been revoked except for areas designated nonattainment for it. 40 C.F.R. § 50.13(d).

decision was based on an Integrated Science Assessment ("ISA"),[6] a Policy Assessment ("PA"),[7] advice from the Clean Air Scientific Advisory Committee ("CASAC") on drafts of both of the documents and on whether revision of the PM NAAQS was appropriate,[8] and on over 1100 public comments.[9]

In June 2021, EPA announced that it would reconsider its December 2020 decision.[10] As part of that reconsideration, the Agency's career staff prepared a supplement to the 2019 ISA[11] and a new PA.[12] EPA also replaced many of CASAC's members[13] and obtained review of drafts of both the new documents by its new CASAC.[14] On January 28, 2023, the Administrator

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[6] EPA, EPA/600/R-19/188, Integrated Science Assessment for Particulate Matter (Dec. 2019), Doc. ID EPA-HQ-OAR-2015-0072-0212, https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=347534 (hereinafter "2019 ISA"). An ISA serves as the air quality criteria on which the Administrator bases his decision on appropriate NAAQS and must "accurately reflect the latest scientific knowledge useful in indicating the kind and extent of all identifiable effects on public health or welfare which may be expected from the presence of [the pollutant in question] in the ambient air in varying quantities." CAA § 108(a)(s); *see also id*. § 109(b).

[7] EPA, EPA-452/R-20-002, Policy Assessment for the Review of the National Ambient Air Quality Standards for Particulate Matter (Jan. 2020), Doc. ID EPA-HQ-OAR-2015-0072-0237, https://www.epa.gov/naaqs/particulate-matter-pm-standards-policy-assessments-current-review-0 (hereinafter "2020 Policy Assessment").

[8] Letter from Dr. Louis Anthony Cox, Jr., Chair, CASAC, to the Hon. Andrew R. Wheeler, Administrator, EPA (Apr. 11, 2019), EPA-CASAC-19-002, https://casac.epa.gov/ords/sab/f?p=113:0:9863628038368:APPLICATION_PROCESS=REPORT_DOC:::REPORT_ID:1069; Letter from Dr. Louis Anthony Cox, Jr., Chair, CASAC, to the Hon. Andrew R. Wheeler, Administrator, EPA, No. EPA-CASAC-20-001 (Dec. 16, 2019) (hereinafter "2019 Cox Letter"), https://casac.epa.gov/ords/sab/f?p=113:0:3827699310090:APPLICATION_PROCESS=REPORT_DOC:::REPORT_ID:1073.

[9] *See* EPA, Review of the National Ambient Air Quality Standards for Particulate Matter, EPA-HQ-OAR-2015-0072, https://www.regulations.gov/docket/EPA-HQ-OAR-2015-0072/comments?postedDateFrom=2016-04-20&postedDateTo=2020-12-18&sortBy=postedDate&sortDirection=desc.

[10] Press Release, EPA, *EPA to Reexamine Health Standards for Harmful Soot that the Previous Administration Left Unchanged* (June 10, 2021), https://www.epa.gov/newsreleases/epa-reexamine-health-standards-harmful-soot-previous-administration-left-unchanged.

[11] EPA, EPA/600/R-22/028, Supplement to the 2019 Integrated Science Assessment for Particulate Matter (May 2022), https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=354490 (hereinafter "ISA Supplement").

[12] EPA, EPA-452/R-22-004, Policy Assessment for the Reconsideration of the National Ambient Air Quality Standards for Particulate Matter (May 2022), https://www.epa.gov/system/files/documents/2022-05/Final%20Policy%20Assessment%20for%20the%20Reconsideration%20of%20the%20PM%20NAAQS_May2022_0.pdf (hereinafter "2022 Policy Assessment").

[13] *See* Press Release, EPA, *EPA Announces Selections of Charter Members to the Clean Air Scientific Advisory Committee* (June 17, 2021), https://www.epa.gov/newsreleases/epa-announces-selections-charter-members-clean-air-scientific-advisory-committee.

[14] Letter from Dr. Elizabeth A. (Lianne) Sheppard, Chair, CASAC, to the Hon. Michael S. Regan, Administrator, EPA (Mar. 18, 2022), EPA-CASAC-22-002, https://casac.epa.gov/ords/sab/f?p=113:0:13970452662844:APPLICATION_PROCESS=REPORT_DOC:::REPOR

published a Reconsideration Proposal in the *Federal Register* soliciting comments on the action he intends to take at the end of this reconsideration.[15] In that proposal, the Administrator announced his proposed decision "to revise the level of the primary annual $PM_{2.5}$ standard from 12.0 µg/m$^3$ to within the range of 9.0 to 10.0 µg/m$^3$."[16] The Administrator proposed to retain the current secondary annual $PM_{2.5}$ NAAQS, primary and secondary 24-hour $PM_{2.5}$ NAAQS, and primary and secondary $PM_{10}$ NAAQS.

These are the comments of the NAAQS Regulatory Review & Rulemaking Coalition (hereinafter "NR3 Coalition" or "Coalition") on the Reconsideration Proposal. The NR3 Coalition is an ad hoc association of industry groups and companies supportive of NAAQS that provide the requisite protection of public health and welfare and that are implemented in ways that provide protection consistent with the economic health of the country.

Briefly, the NR3 Coalition concludes:

- In determining whether or not revisions to the PM NAAQS are "appropriate," the Administrator must consider costs and burdens to state, local, and tribal regulators and on stakeholders and base his decision on review of the entire record, including that of the 2020 proceeding. These considerations apply to EPA's discretionary reconsideration of the Agency's reconsideration of its 2020 decision to retain the current PM NAAQS. Based on both procedural and factual grounds, the Administrator must withdraw this reconsideration.

- The Administrator has not justified revision of the current primary $PM_{2.5}$ standards. Specifically, while he has "display[ed] awareness" that he is making a change from the prior Administrator's 2020 decision that revision was not appropriate, the current Administrator has not offered "good reasons" why a more stringent annual primary $PM_{2.5}$ NAAQS is warranted, based on the entire rulemaking record and in the absence of evidence

T_ID:1094 ("2022 Sheppard Letter"); Letter from Dr. Elizabeth A. (Lianne) Sheppard, Chair, CASAC, to the Hon. Michael S. Regan, Administrator, EPA (Mar. 18, 2022), EPA-CASAC-22-001, https://casac.epa.gov/ords/sab/f?p=113:0:13970452662844:APPLICATION_PROCESS=REPORT_DOC:::REPORT_ID:1093.

[15] 88 Fed. Reg. 5558 (Jan. 28, 2023).

[16] 88 Fed. Reg. at 5629. Although the Administrator refers to this as a revision of the current 12.0 µg/m$^3$ annual standard, he is actually proposing the *addition* of such a standard. The proposed regulatory language would add a new 40 C.F.R. § 50.20 to the *Code of Federal Regulations* but would make no change to the existing standards. Should EPA finalize a decision to establish a more stringent annual primary $PM_{2.5}$ NAAQS, the Agency should provide that the current annual primary $PM_{2.5}$ NAAQS will not longer apply after EPA promulgates designations for the new NAAQS.

of different health effects, greater health risk, or different "at-risk" populations. *Cf. FCC v. Fox Television Stations*, 556 U.S. 502, 129 S. Ct, 1800, 1811 (2009). On the other hand, the Administrator's conclusions, consistent with those of his predecessor, that the current primary 24-hour $PM_{2.5}$ and $PM_{10}$ NAAQS and the secondary NAAQS provide the requisite protection of public health and welfare are supported by the record.

- The Administrator has the statutory authority to set the effective date of a revised NAAQS two years after notice of that NAAQS revision is published in the *Federal Register*. If he revises a NAAQS at the conclusion of this reconsideration, he should exercise that option in this case. Doing so would not impair the timeline for area designations and state plan submissions. Moreover, given the significant implementation issues associated with EPA's proposed levels for an annual $PM_{2.5}$ NAAQS, and EPA's own schedule to complete ongoing implementation-related improvements, a sooner effective date would be arbitrary and capricious.

- As NAAQS become increasingly stringent – whether as a result of this proceeding or in future NAAQS reviews – EPA should encourage opportunities for flexible approaches to implementation. For example, EPA should encourage states to use emissions trading to achieve required PM air quality improvements, should support and promote exclusion of air quality data significantly impacted by international emissions or due to exceptional events, and should update its permitting and modeling requirements and guidance to eliminate excessive conservatism.

- EPA's draft Regulatory Impact Analysis ("RIA") is seriously deficient in that it fails to account for the significant uncertainty in the data on public health benefits that might result from a more stringent annual $PM_{2.5}$ NAAQS and does not attempt to estimate the full costs and economic impacts of attaining any such revised standard. As a result, the costs and economic impacts of a more stringent standard are understated, and therefore EPA has not adequately considered the consequences of its proposed action.

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## I. Introduction.

Members of the NR3 Coalition and their member companies are committed to reducing emissions, consistent with the requirements of the Act, to provide air quality protective of public health and welfare, while continuing to facilitate economic growth in the United States. We, and they, have worked for many years with EPA, states, and local authorities to lower concentrations of PM and other criteria pollutants in ambient air. As a result, between 1970 and 2020, air quality throughout the nation improved dramatically, while both the US gross domestic product and population grew steadily.[17]

With regard to PM specifically, 24-hour average $PM_{10}$ concentrations declined 60 percent nationally between 1990 and 2021.[18] Annual average $PM_{2.5}$ levels fell 29 percent, and 24-hour $PM_{2.5}$ levels fell 34 percent between 2000 and 2021.[19] These reductions of PM in ambient air are, in part, a result of reductions in emissions of direct (primary) PM and of PM precursors made by NR3 Coalition members. Direct emissions of $PM_{10}$ declined by 33 percent, and those of $PM_{2.5}$ declined by 40 percent over this period.[20] Emissions of most PM precursors have also declined: sulfur dioxide ("$SO_2$") by 92 percent, nitrogen oxides ("NOx") by 70 percent, and volatile organic compounds (" VOCs") by 49 percent.[21] Emissions of these pollutants will certainly continue to decline as a result of private sector innovation; existing federal, state, and local programs aimed at reducing emissions; and improvements in energy efficiency.

Efforts at reducing air pollution in the United States have led to much better PM air quality than is experienced by most of the rest of the world. According to the Organisation for Economic

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[17] *See* EPA, Our Nation's Air: Trends Through 2021, https://gispub.epa.gov/air/trendsreport/2022/#growth_w_cleaner_air (last visited Mar. 5, 2023).
[18] https://gispub.epa.gov/air/trendsreport/2022/#introduction (last visited Mar. 5, 2023).
[19] *Id*.
[20] *Id*.
[21] *Id*.

Co-operation and Development ("OECD"), worldwide average exposure to $PM_{2.5}$ annually in 2018 to 2019 was 42 $\mu g/m^3$, compared to a US average of 7.7 $\mu g/m^3$.[22] Average $PM_{2.5}$ exposures are lower in the US than in France, Germany, Japan, and the United Kingdom.[23]

It is against this backdrop that EPA, barely two years after the most recent PM NAAQS review – completed consistent with the timeline specified in § 109(d)(1) of the Act – is conducting a discretionary proceeding to reconsider the adequacy of the existing NAAQS to protect public health and welfare. We believe that, given the discretionary nature of this proceeding, and in the context of historical American air quality and current global air quality, EPA must, for the reasons discussed below, determine that no new, more stringent PM NAAQS is appropriate.

## II. Under Section 109(d)(1), Costs Must Be Considered in Determining Whether To Revise a NAAQS.

The gateway to a revision of a NAAQS is CAA § 109(d)(1). Under that section, EPA must complete a review of NAAQS at least once every five years and determine whether revisions to an existing standard "in accordance with" CAA § 109(b) "*may be appropriate*."[24] In reviewing an existing standard, the Administrator must consider the "latest scientific knowledge" on health effects contained in CAA § 108 criteria and consider advice from CASAC regarding standard revisions, including information on any "adverse health, welfare, social, economic or energy effects which may result from … strategies for attainment and maintenance of such" NAAQS. In determining whether, based on this record, revisions to the standard "may be appropriate," EPA

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[22] *See* Air Pollution Exposure, Organisation for Economic Co-operation and Development, 2000-2019, https://data.oecd.org/air/air-pollution-exposure.htm (last visited Mar. 5, 2023).

[23] *Id*.

[24] Section 109(d)(1) establishes a duty to complete an review at least every five years, whereas the "appropriate" language gives the Administrator discretion to decide whether or not to revise a NAAQS. As the Second Circuit held in *EDF v. Thomas*, 870 F.2d 892, 898 (2d Cir. 1989), "as may be appropriate" is "nonmandatory language." That language, according to the court, "clearly suggests that the Administrator must exercise judgment . . . to make some formal decision whether to revise the NAAQS, the content of that decision being within the Administrator's discretion . . . ." *Id.*

must evaluate, and weigh, a broad range of factors that include the adverse consequences associated with implementing a more stringent standard. The Supreme Court's decision in *Michigan v. EPA*,[25] interpreting CAA § 112(n), confirms this reading of CAA § 109(d).

CAA § 112(n) uses an "appropriateness" test to determine whether to regulate hazardous air emissions from power plants, as does § 109(d)(1).[26] And just like CAA § 109(d), the record on which that CAA § 112(n) "appropriateness" determination must be based includes information on "technologies … to control … emissions, *and the cost of such technologies*."[27] In *Michigan*, the Court, quoting then Judge Kavanaugh's dissent below, noted that "'appropriate' is 'the classic broad and all-encompassing term that naturally and traditionally includes consideration of all the relevant factors.'"[28] As a result, according to the Court, "[a]gencies have long treated costs as centrally relevant factors when deciding whether to regulate."[29] This is because "cost includes more than just the expense of complying with regulations; any disadvantage ... [can be] a cost."[30] And "[n]o regulation is 'appropriate' if it does significantly more harm than good."[31]

In this rulemaking, EPA is reconsidering the determination of the prior Administrator that, under CAA § 109(d)(1), revisions were not "appropriate." To reconsider that "appropriateness" determination, and conclude that revised standards are "appropriate," the current Administrator must consider all costs that would result from implementation of the revisions he would propose.[32] EPA attempts to circumvent the requirements of CAA § 109(d)(1) by styling the rulemaking a

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[25] *Michigan v. EPA*, 576 U.S. 743 (2015).
[26] An appropriateness finding under CAA § 109(d)(1) is required to undertake a NAAQS standard revision under § 109(b). An "appropriate and necessary" finding under § 112(n) is required to undertake regulation of electric generating units under §§ 112(d) and (f).
[27] *Michigan*, 576 U.S. at 753.
[28] *Id.* at 752.
[29] *Id.*
[30] *Id.*
[31] *Id.*; *see* Paul R. Noe & John D. Graham, *The Ascendancy of the Cost-Benefits State?*, 5 Admin. L. Rev. 85, 109-11 (2020).
[32] *See* Section III.A.

"reconsideration proposal." As discussed in the following section, EPA cannot evade consideration of costs in determining whether or not to revise a NAAQS by invoking an unprecedented procedure.

## III. The Reconsideration Proposal Is Procedurally Unique; the Administrator Must Consider Costs and Burdens; and the Administrator Must Justify Policy Changes After Reconsidering the Entire Record.

If the Administrator finalizes this rulemaking, he will do what no other Administrator has done before – complete reconsideration of a promulgated NAAQS. This reconsideration is entirely discretionary, and the Administrator has substantial flexibility to consider many factors, including costs and burdens, when determining whether to proceed to a final rule. Those factors should compel him to withdraw this reconsideration. Should the Administrator nevertheless proceed with this Reconsideration Proposal, then he must do more than is required under a regular NAAQS rulemaking. He must not only provide a reasonable explanation of his proposed decisions, but also justify changes to existing policy established in the 2020 PM NAAQS Rule. He must do so considering the entire record, including the contrary decisions of his predecessor and the CASAC he disbanded.

Simply put, the Reconsideration Proposal must "reconsider." It does not. Left unaddressed, this oversight renders any final rule emerging from the Reconsideration Proposal arbitrary and capricious. However, EPA cannot wait until preparing that final rule to address these fatal flaws. It first must issue a supplemental proposal to allow the public opportunity to comment meaningfully on EPA's changes.

### A. The Administrator Must Consider Costs and Burdens When Deciding Whether To Proceed with a Discretionary Reconsideration.

The Reconsideration Proposal would add inflationary pressures and increase risk of recession for a post-pandemic economy struggling to recover. It would impose significant new burdens on states and local governments already facing numerous new requirements under the $PM_{2.5}$ NAAQS and other environmental programs. EPA claims that it may not consider implementation costs and burdens when setting a NAAQS.[33] Yet this overlooks the Administrator's first-order decision – whether to move forward with reconsideration at all.

### 1. The Administrator Must Consider Whether the Asserted Benefits Attributable to Reconsidering the Former Administrator's Determination in December 2020 Not To Revise the Current $PM_{2.5}$ Annual Standard Justify the Costs Associated with Revising that Standard.

As was noted previously, the setting of this proceeding to revise the $PM_{2.5}$ annual standard is rather unusual, insofar as it is taking place outside of (*i.e.*, some two years earlier than) the statutorily prescribed five-year review cycle set forth in CAA § 109(d).[34] EPA styles it as a "reconsideration" proceeding, a procedure to which the Agency has resorted to only once before in the last 50 years.[35] Given the all-but-unprecedented nature of EPA's approach here, it bears noting at the outset that nothing on the face of CAA § 109 actually authorizes the Agency to

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[33] 88 Fed. Reg. at 5563.

[34] It is notable, too, that EPA had rarely, if ever, been able to meet the statutorily prescribed schedule for reviewing NAAQS at least every five years, until meeting that deadline, for both the PM NAAQS and the Ozone NAAQS, in December 2020. Up until then, EPA had "routinely tak[en] twice that time before finalizing a review and any accompanying revision." *See* Memorandum from E. Scott Pruitt, Administrator, EPA, to Assistant Administrators, (May 9, 2018), https://www.epa.gov/sites/default/files/2018-05/documents/image2018-05-09-173219.pdf, at 3 (hereinafter "Back-to-Basics"). Under this "Back-to-Basics" memorandum, the Agency announced its "intention to conduct the review of the PM NAAQS in such a manner as to ensure that any necessary revisions were finalized by December 2020," consistent with the provisions of CAA § 109(d)(1). *See* 88 Fed. Reg. 5567. Given unease among some former (and current) EPA career staff concerning the newly-accelerated – if statutorily mandated – review process, contrary to the more deliberate pace of work with which they were accustomed, *see e.g.,* Oral Comments of John Bachmann on behalf of the Environmental Protection Network to EPA Acting Administrator Andrew Wheeler and the Clean Air Scientific Advisory Committee ("CASAC") (Dec. 12, 2018), https://casac.epa.gov/ords/sab/f?p=113:0:10526369326702:APPLICATION_PROCESS=MEETING_FILE:::MM_ID:5314, it is perhaps surprising that EPA now professes such confidence in the output of the current process, and one undertaken in a hyper-abbreviated fashion, comparatively speaking.

[35] History repeats itself. EPA's acknowledged motive in January 2010 for "reconsidering" the Ozone NAAQS it promulgated in March 2008 was an intervening change in presidential administrations. *See* 75 Fed. Reg. 2938, 2943 (Jan. 19, 2010) ("Consistent with a directive of the new Administration regarding the review of new and pending regulations . . . the Administrator reviewed a number of actions that were taken in the last year by the previous Administration," with the "2008 final rule [being] included in this review."); *see also* 88 Fed. Reg. at 5567 ("On January 20, 2021, President Biden issued an 'Executive Order on Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis' . . . which directed review of certain agency actions" including the 2020 "Particulate Matter NAAQS Decision.").

"reconsider" a decision by the Administrator not to revise a previously established NAAQS, made in conjunction with an earlier statutorily prescribed NAAQS review. EPA is simply assuming that it has some sort of inherent authority to act in this fashion, since it otherwise points to no statutory provision expressly granting it such authority.[36]

To be sure, the last sentence of CAA § 109(d)(1) provides that the Administrator "may review and revise criteria or promulgate new standards . . . more frequently" than the "five-year intervals" that are "required under this paragraph." But that is not what EPA says it is doing here.[37] Again, EPA purports to be "reconsidering" the decision made by the Administrator in December 2020 to, among other things, leave the $PM_{2.5}$ annual standard unchanged.[38] Based on this "reconsidering," EPA says that the Administrator has now "reached his provisional judgment to propose revising the annual standard level from 12.0 $\mu g/m^3$ to within a range of 9.0 $\mu g/m^3$ to 10.0 $\mu g/m^3$."[39] All this bespeaks a process for revising a NAAQS that is nowhere described on the face of CAA § 109. While this ad hoc approach on EPA's part may be convenient for policy purposes, it is nevertheless problematic statutorily speaking, particularly given that CAA § 109, in providing that both the primary and secondary standards "may be revised" subsequent to their initial promulgation, expressly states that any such revision should be effectuated "*in the same manner*" in which those standards were first "promulgated."[40] That is not what is happening in this instance. The proposal to revise the $PM_{2.5}$ annual standard is not the product of the Agency having initiated

[36] Nor, for that matter, did EPA identify such statutory "reconsideration" authority back in January 2021.

[37] Nowhere in the January 27, 2023, *Federal Register* notice does EPA even mention the last sentence of CAA § 109(d)(1).

[38] *See*, *e.g.*, 88 Fed Reg. at 5560 ("The EPA is *reconsidering* the December 2020 decision because the available scientific evidence and technical information indicate that the current standards may not be adequate to protect public health and welfare, as required by the Clean Air Act.").

[39] 88 Fed. Reg. at 5629.

[40] *See* CAA § 109(b)(1), (2) (emphasis added).

and completed a "thorough review of . . . the national ambient air quality standards" pursuant to CAA § 109(d)(1), and EPA nowhere claims that it is.

A rulemaking proceeding for the "promulgation *or revision* of any national ambient air quality standard" is governed by the provisions of CAA § 307(d)(1)(A). The *only* sort of "proceeding for reconsideration" contemplated under CAA § 307(d) is that described in subparagraph (B) of CAA § 307(d)(7).[41] Such a proceeding is not in view here.

Meanwhile, any assertion by EPA that it possesses some sort of inherent authority to act outside the statutorily prescribed "review" and "determine whether or not to revise" procedures of CAA § 109(d)(1) in reconsidering the former Administrator's December 2020 determination to leave unchanged the $PM_{2.5}$ annual standard must be assessed in light of such precedents as *American Methyl Corp. v. EPA*,[42] where the U.S. Court of Appeals for the D.C. Circuit observed that, "when Congress has provided a mechanism capable of rectifying mistaken actions . . . it is not reasonable to infer authority to reconsider agency action."[43] Here, while EPA is not exactly claiming that the former Administrator's December 2020 determination was "mistaken,"[44] to the extent the Agency now takes issue with the former Administrator's judgment in finding that the current $PM_{2.5}$ annual standard was "requisite to protect the public health," while allowing for an "adequate margin of safety," Congress has provided an express "mechanism" by which EPA is

[41] Subparagraph (B) provides that "the Administrator shall convene a *proceeding for reconsideration* of the rule" in those circumstances where a person who seeks to challenge a final rule on the basis of an objection not raised during the public comment period "can demonstrate to the Administrator that it was impracticable to raise such objection within such time or if the grounds for such objection arose after the period for public comment (but within the time specified for judicial review) and if such objection is of central relevance to the outcome of the rule." CAA § 307(d)(7)(B) (emphasis added). Although petitions were filed seeking reconsideration of the 2020 decision retaining the PM NAAQS, the Administrator did not refer to those petitions when he announced he would reconsider that decision. *See* Press Release, EPA, *EPA to Reexamine Health Standards for Harmful Soot that Previous Administration Left Unchanged* (June 10, 2021).

[42] *American Methyl Corp. v. EPA*, 749 F.2d 826 (D.C. Cir. 1984).

[43] *See id.*, 749 F.2d at 835; *accord New Jersey v. EPA*, 517 F.3d 574, 583 (D.C. Cir. 2008).

[44] Specifically, EPA states that it is "reconsidering the December 2020 decision because the available scientific evidence and technical information indicate that the current standards may not be adequate to protect public health and welfare." 88 Fed. Reg. at 5560.

authorized to "review" and determine whether or not to "revise" that determination – *i.e.*, the procedures set forth expressly in CAA § 109(d)(1). It was incumbent on EPA to avail itself of those carefully crafted procedures, not to embark on an abbreviated "reconsideration" proceeding nowhere contemplated under CAA § 109 that is not constrained by those procedures.

In any event, assuming, for the sake of argument, that EPA is authorized under the Act to take the specific action at issue here – *i.e.*, the current Administrator's proposal to revise the $PM_{2.5}$ annual standard on the basis of his ad hoc "reconsideration" of the prior Administrator's decision in December 2020 to leave that standard unchanged[45] – the Agency remains obligated to engage in reasoned decision making. In the specific context here, this requires the Administrator to take account of the full range of costs associated with any decision on his part to "reconsider," and then depart from, his predecessor's determination to leave the current $PM_{2.5}$ annual standard unchanged. Failure to do so would render any such final action on the Administrator's part arbitrary and capricious, in that the costs associated with moving forward to promulgate a more stringent standard is obviously a "relevant factor" that the Administrator must consider, an "important aspect of the problem" that the Administrator cannot reasonably ignore.[46]

EPA gives no indication that it understands its obligations in this regard. In the January 27 *Federal Register* notice, EPA states that, "[i]n setting the NAAQS, the EPA may not consider the costs of implementing the standards," something that "was confirmed by the Supreme Court in *Whitman v. American Trucking Associations*, 531 U.S. 457, 465-472, 475-76 (2001)."[47] EPA's

[45] The NR3 Coalition does not concede that such is the case. Should EPA proceed to take final action in this matter and promulgate a more stringent $PM_{2.5}$ annual standard, the Agency must, at a minimum, identify the statutory basis upon which it is relying for conducting this "reconsideration" proceeding.

[46] *See Motor Vehicle Mfrs. Ass'n v. State Farm Mut. Auto. Ins. Co.*, 463 U.S. 29, 43 (1983) (hereinafter "*State Farm*").

[47] *See* 88 Fed. Reg. at 5563; *see also id.* at 5564 ("In setting primary and secondary standards that are 'requisite' to protect public health and welfare, respectively, as provided in section 109(b), the EPA's task is to establish standards that are neither more nor less stringent than necessary. In so doing, the EPA may not consider the costs of implementing the standards. *See generally Whitman v. American Trucking Associations*, 531 U.S. 457,

repeated, reflexive invocation of *Whitman* suggests that the Agency has missed the point. In the present context – where the threshold issue is whether EPA should proceed to regulate at this time at all – *Whitman* does not control.

More pertinent to this threshold issue are observations made by the Supreme Court in *Michigan*, where the majority took note of the reality that "[a]gencies have long treated cost as a centrally relevant factor when deciding *whether to regulate*."[48] Further, the majority explained, the "[c]onsideration of cost reflects the understanding that reasonable regulation ordinarily requires paying attention to the advantages *and* the disadvantages of agency decisions."[49]

Notably, the dissenters in *Michigan* themselves raised no objection to the majority's observation that the "consideration of cost" should ordinarily weigh heavily on an agency's decision *whether* to regulate. "Cost is almost always a relevant – and usually, a highly important – factor in regulation," the dissent acknowledged, and "[u]nless Congress provides otherwise, an agency acts unreasonably in establishing 'a standard-setting process that ignore[s] economic considerations.'"[50] "That is because," the dissent continued, "at a minimum," such a process "would 'threaten[] to impose massive costs far in excess of any benefit.'"[51] "[A]bsent contrary indication from Congress," the dissent concluded, "an agency *must* take costs into account in some manner before imposing significant regulatory burdens."[52]

465-472, 475-76 (2001)."); *id.* ("As previously noted, the Supreme Court has held that section 109(b) 'unambiguously bars cost considerations from the NAAQS-setting process.' *Whitman v. Am. Trucking Associations*, 531 U.S. 457, 471 (2001)."); *id.* n.7 ("Indeed, were the EPA to consider costs of implementation when reviewing and revising the standards 'it would be grounds for vacating the NAAQS.' *Whitman*, 531 U.S. at 471 n.4.").

[48] *Michigan*, 576 U.S. at 753 (2015) (emphasis added).

[49] *Id*. (emphasis in original).

[50] 576 U.S. at 769 (Kagan, J., dissenting) quoting *Indus. Union Dep't, AFL-CIO v. Am. Petrol. Inst.*, 448 U.S. 607, 670 (1980) (Powell, J., concurring in part and concurring in judgment).

[51] 576 U.S. at 769 (Kagan, J., dissenting), quoting *Entergy Corp. v. Riverkeeper, Inc.*, 556 U. S. 208, 234 (2009) (Breyer, J., concurring in part and dissenting in part).

[52] 576 U.S. at 769 (Kagan, J., dissenting).

In the present case, where EPA is choosing to act outside the statutorily prescribed procedure for reviewing an existing NAAQS, it cannot be plausibly asserted that Congress has precluded EPA from taking costs into consideration in proceeding to regulate. Before EPA can address the matter of how the current $PM_{2.5}$ annual standard might be revised, the Agency must first confront the threshold consideration *whether* to disturb the former Administrator's December 2020 determination that revisions to that standard were not appropriate. In deciding *that* question, EPA *must* take costs into consideration.

Finally, in this "reconsideration" setting, should EPA proceed to promulgate revisions to the $PM_{2.5}$ annual standard, as it is proposing to do, the Administrator must consider the broader social and economic impacts of the revised NAAQS in determining an acceptable level of risk. Here, where the threshold question is *whether* to regulate at all, or leave the current $PM_{2.5}$ annual standard unchanged, it is incumbent on EPA to bear in mind that, in summarizing its holding in *Whitman*, the Supreme Court has said "EPA may not consider *implementation costs* in setting primary and secondary NAAQS under § 109(b) of the CAA."[53] The Court did not otherwise construe CAA § 109(b) as imposing any sort of blanket prohibition on EPA's taking account of *other* types of costs – *i.e.*, those which, in current parlance, are typically labeled "disbenefits" – in setting a NAAQS. In this context, among the disbenefits that EPA would have to consider in any reasonable exercise of its decision making authority would, at a minimum, be those that, as it so happens, are specifically listed in CAA § 109 itself – *i.e.*, adverse "public health," "welfare," "social," "economic," and "energy" effects. [54]

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[53] *See Whitman*, 531 U.S. at 486 (emphasis added).

[54] *See* CAA § 109(d)(2)(C)(iv). In a *per curiam* opinion issued some 18 years after *Whitman*, a D.C. Circuit panel rejected an argument advanced by certain industry petitioners who, as the court then characterized it, had "argue[d] that . . . consideration" by EPA "of other 'adverse economic, social, and energy impacts' is required" in the NAAQS-setting process. *See Murray Energy Corp. v. EPA*, 936 F.3d 597, 621 (D.C. Cir. 2019). "[A]t bottom," the panel believed, "this is the same argument rejected in *Whitman*, with the 'costs' of the revised and more stringent NAAQS merely reframed as 'impacts.'" *Id.* at 621. Such "impacts," the court said, were really "no

With this as a backdrop, the observation of Justice Breyer, writing separately in *Whitman* to the effect that the "statute . . . permits the Administrator to take account of *comparative health risks*," can be seen in a fuller context. *See Whitman*, 531 U.S. at 495 (Breyer, J. concurring in part and concurring in the judgment) (emphasis added). The Administrator, Justice Breyer said, "may consider whether a proposed rule promotes safety overall," given that a "rule likely to cause more harm to health than it prevents is not a rule that is 'requisite to protect the public health.'" *Id.*

Justice Breyer emphasized, in particular, that it bore noting that the very phrase in CAA § 109(b)(1) – "in the judgment of the Administrator" – operates to "grant[] the Administrator considerable discretionary standard-setting authority." 531 U.S. at 595.[55] "The statute's words,"

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different than the 'economic costs' that the petitioners in *Whitman* worried 'might produce health losses sufficient to offset the health gains achieved in cleaning the air – for example, by closing down whole industries and thereby impoverishing the workers and consumers dependent upon those industries.'" 936 F.3d at 621-22, *quoting Whitman*, 531 U.S. at 466. The court said that "*Whitman* forbids EPA from taking these considerations into account, however denominated." *Id.*, 936 F.3d at 622. Writing nearly two decades removed from *Whitman*, the panel failed to appreciate that the Supreme Court's holding was expressly, and exclusively, focused on "*implementation* costs," as a more careful reading of the decision on its part would have made clear. Indeed, at the very outset of his *Whitman* opinion, Justice Scalia had so framed the matter: "These cases present the following questions: ". . . (2) Whether the Administrator may consider the *costs of implementation* in setting national ambient air quality standards (NAAQS) under § 109(b)(1)." 531 U.S. at 462. Then, writing some 15 years after *Whitman*, Justice Scalia observed in *Michigan* that "'cost' includes more than the expense of complying with regulations; *any disadvantage could be termed a cost*." 576 U.S. at 752 (emphasis added). In this specific context, the *Michigan* majority had taken issue with "EPA's interpretation" of the statutory provision at issue in that case, in that it "precludes the Agency from considering *any* type of cost – including, for instance, harms that regulation might do to human health or the environment." *Id.* (emphasis in original). While the panel in *Murray Energy* otherwise discussed the Supreme Court's *Michigan* decision, it did not address this part of the opinion.

[55] Justice Breyer's acknowledgment of the fact that CAA § 109 affords the EPA Administrator "considerable standard-setting authority" is particularly significant, in that it was made even though neither he, writing separately, nor Justice Scalia, writing for the Court in *Whitman*, had discussed the specific language of CAA § 109(d)(1), which, as was noted previously, indicates that, in the course of the mandatory five-year statutory review process, NAAQS are to be revised only "as may be appropriate," language that speaks directly to the broad scope of the Administrator's discretion. It is difficult to account for the *Whitman* Court's failure to interact with this critically important statutory language, particularly since industry respondents had in their own brief pointed to that same language in arguing that, in order to "establish that standard revision is 'appropriate' in accordance with §§ 108 and 109(b), the Agency must explain why a change in the status quo is 'requisite' to protect public health." *See* Brief for Respondents Appalachian Power Company, et al., in Support of Petitioners 39-40, *Am. Trucking Ass'ns v. Browner*, 530 U.S. 1259 (2000). "In other words," the industry respondents had further argued, the Administrator was required to "explain why the existing standard is no longer 'appropriate' in accordance with §§ 108 and 109(b) and the revised standard is." *Id.* at 40. Whatever the explanation, insofar as the *Whitman* Court failed to come to grips with this key bit of statutory language, this necessarily raises some doubts as to the continued vitality of the Court's holding even as to the consideration of "implementation costs," given the Court's subsequent elaboration, in *Michigan*, that "'appropriate' is 'the classic broad and all-encompassing term that naturally and traditionally includes consideration of all the relevant factors.'" *Michigan*, 576 U.S. at 752, *quoting White Stallion Energy Ctr.,*

he continued, "authorize the Administrator to consider" a wide range of relevant factors, including "the severity of a pollutant's potential adverse health effects, the number of those likely to be affected, the distribution of the adverse effects, and the uncertainties surrounding each estimate." *Id.* Further, the plain language of the statute "permits the Administrator to take account of comparative health consequences," while at the same time allowing him to "take account of context when determining the acceptability of small risks to health." *Id.* In the particular context of a "reconsideration" proceeding, where the Administrator is under no statutory obligation to act, he must embrace the comprehensive range of discretion that is afforded him, lest any decision he may make fail to reflect reasoned decision making.[56]

### 2. The Administrator Should Withdraw the Reconsideration Proposal Because it Creates Regulatory Uncertainty and Burdens in Economically Challenging Times.

The Administrator would not be the first to consider costs and burdens when withdrawing a NAAQS reconsideration. On September 2, 2011, the Obama Administration's Office of Information and Regulatory Affairs ("OIRA") sent EPA a letter directing it to withdraw a reconsideration of the Ozone NAAQS similar to the current reconsideration proceeding. Recognizing the need to "minimize regulatory *costs and burdens*, particularly in this economically

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*LLC v. EPA*, 748 F.3d 1222, 1266 (D.C. Cir. 2014) (opinion of Kavanaugh, J.). When confronted by this very assertion in *Murray Energy*, the D.C. Circuit had to concede that the *Whitman* Court had nowhere addressed the "as may be appropriate" language of CAA § 109(d)(1), as is evidenced by the fact that the D.C. Circuit could but cite to its *own* decision in the case below in replying that "[w]e have already rejected the idea that 'appropriate' in section 109(d) requires consideration of economic costs." *Murray Energy*, 936 F.3d at 622, *citing Am. Trucking Ass'ns, Inc. v. EPA*, 175 F.3d 1027, 1040-41 (D.C. Cir. 1999). In the case below, however, the D.C. Circuit had done little more than point out that the "clause immediately following 'appropriate' . . . incorporates § 109(b) and thereby affirmatively precludes consideration of costs in revising NAAQS." *See* 175 F.3d at 1040. Apart from the seeming circularity of the D.C. Circuit's reasoning here, it must again be pointed out that nowhere in its *Whitman* decision did the Supreme Court discuss the "as may be appropriate" language in CAA § 109(d)(1), nor indicate that the D.C. Circuit's earlier take on the matter was correct as a matter of statutory interpretation.

[56] *See*, *e.g.*, *American Lung Ass'n v. EPA*, 985 F.3d 914, 944 (D.C. Cir. 2021), *rev'd on other grounds sub nom*, *West Virginia v. EPA*, 142 S. Ct. 2587 (2022) (A "regulation must be declared invalid, even though the agency might be able to adopt the regulation in the exercise of its discretion, if it 'was not based on the agency's own judgment but rather on the unjustified assumption that it was Congress' judgment that such a regulation is desirable' or required."), *quoting Prill v. NLRB*, 755 F.2d 941, 948 (D.C. Cir. 1985).

challenging time," the OIRA letter stated that "finalizing a new standard now is not mandatory and could produce needless uncertainty."[57] Notably, OIRA relied on this rationale despite explicitly "recogniz[ing] that the relevant provisions of the Clean Air Act forbid EPA to consider costs in deciding on the stringency of [NAAQS]"[58] – implying that CAA § 109(b)'s prohibition of the consideration of costs and burdens does not apply to the decision to move forward on a discretionary reconsideration under CAA § 109(d)(1). President Obama was even more direct in an accompanying press statement, stating that he requested the withdrawal due to "the importance of reducing regulatory burdens and regulatory uncertainty, particularly as our economy continues to recover."[59]

The country is, once again, facing economically challenging times. Similarly to twelve years ago, quarterly gross domestic product hovers at or just above recession levels, and today there is the added burden of high prices for consumer goods driven by historic inflationary pressure and challenges for the banking system. President Obama's concern that a reconsideration could create regulatory burdens and uncertainty for the economy was understandable at the time, and holds true today. Taken together, costs arising from the Reconsideration Proposal, if finalized, would undermine the competitiveness of American manufacturing and the businesses that support critical infrastructure and electricity needs of the U.S. The Reconsideration Proposal would drive business to countries with weaker environmental standards and less stringent worker safety laws.

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[57] Letter from Cass Sunstein, OIRA Administrator, to Lisa Jackson, EPA Administrator (Sep. 2, 2011) (hereinafter "OIRA Letter") (emphasis added).

[58] OIRA Letter at 1 (emphasis added). Notably, the D.C. Circuit declined to rule on this withdrawal, finding that it "lacks jurisdiction" over a "non-final decision" on a "voluntary revision" of NAAQS. Order # 1359125, *Am. Lung Assoc. v. EPA*, No. 11-1396 (D.C. Cir. Feb. 17, 2012).

[59] Press Release, Statement by the President on the Ozone National Ambient Air Quality Standards (Sep. 2, 2011) ("Obama Ozone Reconsideration Statement").

**a. Even When Considering Statutory Provisions To Address Background Concentrations, EPA's Analysis Shows the Proposed Standards Will Be Unattainable.**

Congress intended for NAAQS to be "*national*" ambient air quality standards; thus, EPA is not required to tailor these national regulations for a specific region or locality.[60] Instead, EPA should account for background levels of air pollution during enforcement, not when setting standards.[61] It is for this reason, among others, that the CAA addresses high background levels–with the exclusion of exceptional events under CAA § 319(b), and ozone-specific provisions addressing international pollution and rural transport under CAA §§ 179B and 182(h)–outside of the standard setting process.

It is therefore surprising that EPA's PM NAAQS reconsideration side steps legal precedent and loosely interprets statutory criteria to provide for little to no interest balancing against on the ground constraints of cost and technical feasibility. For example, EPA's PM NAAQS reconsideration provides extensive evidence that questions concerning high background levels and attainability are not isolated in nature nor ones that can be addressed through the existing CAA exceptional event provision. Such actions by EPA would place a heavy burden on the States, who remain subject to the imposition of sanctions for failure to achieve unrealistic benchmarks which the Agency should not be considering as a topic in this rulemaking in the first instance.[62]

EPA's draft RIA demonstrates the magnitude of the attainment challenge. Despite developing a menu of known $PM_{2.5}$ controls[63] and excluding EPA-concurred exceptional events

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[60] *See Am. Petrol. Inst. v. Costle*, 665 F.2d 1176, 1186 (D.C. Cir. 1981) ("[T]he agency need not tailor national regulations to fit each region or locale.").

[61] *Murray Energy*, 936 F.3d at 624 ("[E]ven if, as the states claim, it is more difficult to meet the terms of these exceptions than EPA asserts . . . the fact remains that Congress decided that EPA should account for background ozone during enforcement, not when setting standards.")

[62] See *supra*, discussion on *Am. Petrol. Inst. v. Costle*, 665 F.2d at 1186, and *Murray Energy*, 936 F.3d at 624.

[63] *See* US EPA, *Important Information Concerning the Menu of Control Measures* (Sept. 2022), https://www.epa.gov/sites/default/files/2016-02/documents/menuofcontrolmeasures.pdf.

and air quality deemed "atypical, extreme, or unrepresentative,"[64] EPA's own analysis could not identify or assess the cost of controls necessary for all areas of the country to attain the *current* $PM_{2.5}$ standards (12µg/m$^3$ annual standard/35µg/m$^3$ 24-hour standard). In fact, seven counties in California exhaust all of the candidate controls available to them without attaining the *current* annual standard, while Fresno County, California, and another nine counties in the RIA's West region are projected to still fail to meet the current *daily* standard of 35 µg/m$^3$.[65] As NERA's analysis of the draft RIA notes:

> Several of the major counties for which this RIA projects only partial attainment with the alternative standards actually enter the RIA's cost analysis with zero remaining options in the CoST [Control Strategy Tool] input data set. The RIA's partial cost analysis therefore estimates that these counties' costs for getting to 10/35, 9/35, or 8/35 are *zero* (*i.e.*, $0 per year). This is a remarkable example of this RIA's incompleteness, given that the RIA's analysis is actually finding that these counties face a huge remaining challenge (and compliance cost) even if the current standard is not tightened at all.[66]

Given that the draft RIA already excludes agreed-to Exception Events and atypical air quality events which could be considered exceptional, these counties face sanctions and perpetual nonattainment under the CAA for the $PM_{2.5}$ standards – outcomes not envisioned by Congress. Nor is California suffering from a lack of commitment or enforcement. In fact, the RIA assumes an additional 75 percent reduction in California $NO_x$ emissions projected to remain by 2032 before estimating the number of tons of direct $PM_{2.5}$ reduction still needed for these California

[64] 2022 Draft RIA at 2A-21.

[65] NERA Economic Consulting, Estimating the Costs of Fully Attaining Proposed Alternative $PM_{2.5}$ NAAQS Standards: Technical Comments on the Costs Estimates in the Regulatory Impact Analysis for the Proposed $PM_{2.5}$ NAAQS Rule at 41 n.70 (Mar. 22, 2023) ("NERA Report"), Attachment 3. This report has been submitted to Docket EPA-HQ-OAR-2015-0072, but has not yet been assigned a docket number.

[66] *Id*. at 15 (noting that when developing its lists of identifiable control measures and their associated annual costs for attaining each of the alternative standards that the RIA addresses, EPA uses the CoST module, and associated datasets generally referred to as the Control Measures Database (CMDB)).

nonattainment areas to attain the current $PM_{2.5}$ standard.[67] Even with this optimistic assumption, EPA could not identify controls for significant portions of the still-needed reductions.

**Table A-1. California Counties in Partial Attainment of Current 12/35 Standard**

| California County Not Attaining Annual Standard of 12 ug/m³ by 2032 | Emissions Reductions in Direct $PM_{2.5}$ Needed to Attain 12/35 (tons) | Direct $PM_{2.5}$ Reductions Identified by CoST Model Before Reaching Its Limit (tons and % of tons needed) | Direct $PM_{2.5}$ Emissions Reductions Still Needed for Attaining 12/35 in the "Partial" Analytical Baseline (tons) |
|---|---|---|---|
| Imperial | 349 | 92 (26%) | 257 (74%) |
| Kern | 791 | 563 (71%) | 228 (29%) |
| Kings | 104 | 43 (41%) | 61 (59%) |
| Los Angeles | 313 | 313 (100%) | 0 (0%) |
| Plumas | 1,244 | 108 (9%) | 1,136 (91%) |
| Riverside | 1,478 | 192 (13%) | 1,286 (87%) |
| San Bernadino | 2,209 | 2,139 (97%) | 70 (3%) |
| Tulare | 230 | 177 (77%) | 53 (23%) |

EPA's October 2022 proposed decision to disapprove the San Joaquin Valley's state implementation plan for the 2012 $PM_{2.5}$ standards confirms the dire nature of this attainability challenge.[68] Backstopped by a decision of the U.S. Court of Appeals for the Ninth Circuit on the 2006 24-hour $PM_{2.5}$ standard for the San Joaquin Valley, EPA's proposed disapproval of the 2012 SIP cites the court's opinion with regard to the speculative nature of the proposed SIP controls: "[b]ecause these speculative assertions are unsupported by the evidence, they fail to ensure that California and the District have a plausible strategy for achieving this portion of the attainment strategy, and therefore do not collectively satisfy the second factor of the EPA's three-factor test." The court concluded that the EPA's analysis with respect to the second factor for evaluating enforceable commitments was arbitrary and capricious, vacated the final rule with respect to this factor, and remanded this matter to EPA for further consideration.[69]

[67] NERA Report at 41.
[68] 87 Fed Reg. 60,494 (Oct. 5, 2022).
[69] *Med. Advocs. for Healthy Air v. EPA,* Case No. 20-72780, 2022 WL 1109656 (9th Cir. 2022).

Notably, EPA's draft RIA does not offer California a remedy in the form of new technologies or ways to attain the existing standard. Instead, the draft RIA simply moves on to offer an expanded analysis of partial attainment of the newly proposed more stringent standards, demonstrating that this attainment gap only widens as EPA lowers the proposed standards. In evaluating an alternative annual standard of 10.0 $\mu g/m^3$ (while holding the daily standard at 35.0 $\mu g/m^3$) EPA is only able to identify 3,591 tons to reduce (*i.e.*, 29 percent) of the 12,491 tons needed to bring all areas into attainment. Roughly 71 percent or 8,930 tons of the needed reductions remain unidentified. At an alternative standard of 8.0 $\mu g/m^3$, only 80 of the initial 141 counties reach attainment.[70]

This is clear evidence of a breaking point having been reached, born of the statutory interpretations previously embraced by the courts. Despite its significant resources and history overseeing the implementation of the CAA, EPA is unable to propose a path by which States can achieve its newly proposed standards, assuring that more States will be subject to sanctions for failing to submit approvable plans. There is no evidence that Congress anticipated this degree of challenge or sustained likelihood of failure, much less intended such a result. Accordingly, EPA should defer any revision to the current standards pending development of strategies to attain any revised standard throughout the nation.

**b. The Reconsideration Proposal's Impact on Nonattainment Areas Would Be Substantially More Than Estimated by EPA.**

The breadth of this present reconsideration is likely unprecedented. EPA's own data indicate that nearly half of the country's population would live in counties that could not attain an annual $PM_{2.5}$ NAAQS at the lower end of the range for which the Reconsideration Proposal

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[70] NERA Report at 16.

requests comment.[71] A nonattainment designation under the Act would directly affect the economic vitality of these communities by making it difficult to attract and develop business.

Existing business operations would be required to install more restrictive emission control technology than is used for similar operations in attainment areas (*i.e.*, reasonably available control technology ("RACT"))[72] and may be required to do even more if necessary to attain the NAAQS.[73] As evidenced by the fact that EPA's RIA cannot identify controls that attain the potential range of standards, it could be significantly more challenging to identify controls to reach a revised $PM_{2.5}$ NAAQS than was the case with the withdrawn 2011 Ozone NAAQS reconsideration.

With many traditional sources of $PM_{2.5}$ already well-controlled, states would increasingly be required to look to control novel source categories that, unlike major sources, lack consolidated ownership, such as small businesses or residential wood combustors, or sources of emissions with no owner at all, such as non-point sources and forest fires, impacting local and state government budgets. Lacking a history of NAAQS regulation, many of these smaller sources potentially impacted by the Reconsideration Proposal likely remain unaware of the potential impacts of this reconsideration and, as a result, are not likely to participate in the rulemaking process without further outreach of the variety EPA has proposed in some of its most recent and economically significant rulemakings.

Moreover, companies building new facilities or performing major modifications to existing facilities in a nonattainment area that result in increased emissions of $PM_{2.5}$ or its precursors would be required to install emission reduction technology that produces the lowest achievable emission

[71] *See* Section XII.F., *infra*.

[72] CAA § 172(c)(1).

[73] *Id.* § 188(e) (requiring the most stringent measures that are included in the implementation plan of any State or are achieved in practice in any State for areas seeking extension of the attainment deadline for a Serious nonattainment area).

rate, without consideration of cost.[74] These companies would also be required to obtain offsets for such emissions by reducing emissions from other existing sources in a nonattainment area.[75] Available offsets have become more difficult, if not impossible, to find in many parts of the country. If no party is willing or able to provide offsets, then the project simply cannot go forward.

A nonattainment designation also gives EPA authority to intervene in and revise any state permitting decision affecting the nonattainment area, even if EPA has delegated permitting authority to the state.[76] A nonattainment designation can even profoundly affect infrastructure development vital to the business community. Beginning one year from the date of the nonattainment designation, federally supported highway and transit projects cannot proceed without a state demonstration that the project will not cause an increase in emissions.[77]

Nonattainment areas do not escape regulatory burden even if so-designated only briefly. Even after achieving attainment, these areas face a lasting legacy of EPA regulatory oversight. Before a nonattainment area can be redesignated to attainment, EPA must receive and approve an enforceable maintenance plan for the area that specifies measures providing continued maintenance of the NAAQS.[78]

EPA estimates that controls under this reconsideration could cost as much as $1.8 billion per year[79] but admits that amount "may be underestimated."[80] It is a gross underestimation. As explained further in Section XII of these comments, *infra*, EPA clearly underestimated that amount by only calculating costs for partial attainment. Indeed, control costs resulting from the

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[74] *Id.* § 173(a)(2).
[75] *Id.* § 173(a)(1)(A).
[76] *Id.* § 505(b).
[77] *Id.* § 176(c).
[78] *Id.* § 107(e)(iv).
[79] Regulatory Impact Analysis for the Proposed Reconsideration of the National Ambient Air Quality Standards for Particulate Matter, ES-14, tbl. ES-5 (hereinafter "RIA").
[80] *Id.* at 4-11.

reconsideration proposal could reach $23 billion per year.[81] Even that does not reflect all of the Reconsideration Proposal's economic burdens, including lost business opportunities from the stigma of nonattainment. Ignoring exponentially increasing costs of unknown controls does not change the heavy price Americans living in nonattainment areas would pay if EPA finalized the Reconsideration Proposal.

**c. The Reconsideration Proposal, if Finalized, Could Result in Vast Economic Impacts to Attainment Areas that EPA Does Not Estimate.**

Growing implementation challenges for Prevention of Significant Deterioration ("PSD") permitting extend the Reconsideration Proposal's impact to attainment and unclassifiable areas, as well. Before a major source can be built, modified, or expanded in an attainment or unclassifiable area, the source's proponent must obtain a permit, a condition of which is a modeling demonstration that the source will not cause or contribute to a $PM_{2.5}$ NAAQS or increment violation.[82] In addition, the source must make use of the best available control technology.[83]

Companies seeking to build or modify such projects and support development in local communities already face numerous challenges in making the necessary demonstrations under current NAAQS. These challenges include the layers of conservatism built into the required modeling analysis and the fact that truly representative monitored background air quality to be added to modeled concentrations may be unavailable.[84] These challenges would be amplified if the level of the standard were lowered close to background concentration. As a result, communities across the country would face increasing, expensive delays and difficulties in permitting new or expanded facilities, including for manufacturing, for new, state-of-the-art

[81] NERA Report at 3.
[82] Id. § 165(a)(3).
[83] *Id.* § 165(a)(4).
[84] *See* Section V.A., *infra*.

projects that create jobs and bring much-needed tax revenue to local communities in critical need of economic development.

### 3. The Administrator Should Withdraw the Reconsideration Proposal Because it Would Burden State Officials with Inconsistent, Incompatible, and Duplicative Requirements.

Beyond consequences for local economies, the Reconsideration Proposal would impose additional administrative burdens on state and local officials already working to implement multiple existing NAAQS. OIRA's comments on these concerns in 2011 are equally applicable today. Reminding EPA that President Obama's E.O. 13563 required agency actions to "avoid regulations that are inconsistent, incompatible, or duplicative with its other regulations,"[85] OIRA pointed out that the "Act explicitly sets out a five-year cycle for review of [NAAQS]."[86] With this schedule in mind, OIRA warned that finalizing an out-of-cycle ozone NAAQS reconsideration "would be problematic in view of the fact that a new assessment, and potentially new standards, will be developed in the relatively near future."[87] President Obama put a finer point on the issue, saying that "ultimately, I did not support asking state and local governments to begin implementing a new standard that will soon be reconsidered."[88]

On its current schedule, EPA would finalize this PM NAAQS reconsideration with potentially stringent new $PM_{2.5}$ standards this year. EPA would require states to implement not only the new $PM_{2.5}$ NAAQS but also the 2012 and 2006 $PM_{2.5}$ NAAQS, the $PM_{10}$ NAAQS, and, in some cases, aspects of the 1997 $PM_{2.5}$ NAAQS. This redundancy poses challenges for states, as the timelines for implementing these standards do not coincide.

[85] OIRA Letter at 2.
[86] *Id.* at 1.
[87] *Id*.
[88] Obama Ozone Reconsideration Statement.

Section 110(a)(2) lists numerous requirements state, local, and tribal agencies must meet as part of developing state implementation plans ("SIPs") for each NAAQS. These requirements include setting up and operating ambient air quality monitors and collecting and reporting the resulting data;[89] providing for enforcement of measures and regulation of new and modified sources;[90] prohibiting activity that would contribute significantly to nonattainment or interfere with measures to prevent significant deterioration of air quality or protect visibility in another state;[91] providing assurances of adequate resources and legal authority to implement SIPs;[92] requiring emissions monitoring for certain stationary sources;[93] establishing authority for emergency actions to protect public health;[94] providing for future SIP revisions in response to changing NAAQS or findings of SIP inadequacy;[95] meeting nonattainment planning requirements, if applicable;[96] meeting requirements related to consultation and public notification;[97] performing air quality modeling, if requested, to predict effects on air quality from pollutant emissions;[98] establishing a program of permitting fees to cover costs of permits required under the SIP;[99] and providing for consultation and participation by local political subdivisions affected by the SIP.[100] States with $PM_{2.5}$ nonattainment areas face additional requirements depending on the area's nonattainment classification.[101]

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[89] CAA § 110(a)(2)(B).
[90] *Id.* § 110(a)(2)(C).
[91] *Id.* § 110(a)(2)(D).
[92] *Id.* § 110(a)(2)(E).
[93] *Id.* § 110(a)(2)(F).
[94] *Id.* § 110(a)(2)(G).
[95] *Id.* § 110(a)(2)(H).
[96] *Id.* § 110(a)(2)(I).
[97] *Id.* § 110(a)(2)(J).
[98] *Id.* § 110(a)(2)(K).
[99] *Id.* § 110(a)(2)(L).
[100] *Id.* § 110(a)(2)(M).
[101] *Id.* § 189.

Given the changing nature of $PM_{2.5}$ sources, EPA and states lack adequate information on local emissions sources, international emissions, exceptional events, appropriate controls, and air quality modeling needed to identify attainment strategies and effectively accomplish these tasks. EPA information on emissions estimates and control costs is often based on outdated and inconsistent data, confirming a lack of preparedness to implement any new $PM_{2.5}$ NAAQS. Compounding these challenges for state agencies, EPA has not issued adequate guidance on appropriate ways to estimate and control non-traditional sources, the emissions of which will be increasingly necessary to control under more stringent $PM_{2.5}$ NAAQS.

These requirements would be layered on top of numerous other administrative demands created by recently promulgated environmental regulations. Taken together, these requirements impose enormous, potentially inconsistent, incompatible, and duplicative burdens on state regulators. EPA should withdraw this reconsideration so it does not ask state and local governments to begin implementing an unnecessary and unjustified new NAAQS.

**B. The Reconsideration Proposal Is Arbitrary and Capricious Because it Does Not Reconsider the Entire Record and Justify Changes to Existing Policy.**

The Reconsideration Proposal states the basis for the Administrator's proposed decisions: "key aspects of the available health effects evidence[] and conclusions contained in the 2019 ISA and ISA Supplement, quantitative exposure/risk analyses and policy evaluations presented in the PA, advice from the CASAC, and public comment received as part of this reconsideration."[102] While explaining what the Administrator considered in making a NAAQS decision might ordinarily suffice, a reconsideration requires more. To reconsider something, one must "discuss or take up (a matter) *again*"[103] or "consider *again* especially with a view to changing or

[102] 88 Fed. Reg. at 5560.
[103] *Reconsider*, BLACK'S LAW DICTIONARY 1300 (8th ed. 2004) (emphasis added).

reversing."[104] In other words, a reconsideration must "reconsider," and not simply replace, a previous agency decision. Otherwise, it is inherently arbitrary and capricious.

This is not simply a matter of logic and linguistics; it is the law. When an agency changes policy, it must provide a "reasoned explanation" for "disregarding facts and circumstances that underlay . . . the prior policy" and, in doing so, provide a "more detailed justification" than it would for a new policy.[105] As the Northern District of California explained when overturning the Department of the Interior's 2018 recission of the 2016 Waste Prevention Rule, "an agency cannot flip-flop regulations on the whims of each new administration."[106] Instead, reasoned decision-making requires that, when departing from precedents or practices, an agency must "offer a reason to distinguish them or explain its apparent rejection of their approach."[107] "[H]owever the agency justifies its new position, what it may not do is 'gloss[] over or swerve[] from prior precedents without discussion.'"[108] Regardless how an agency chooses to characterize its action, its earlier determination is "clearly a 'relevant factor' the agency had to consider."[109]

The question is "whether [EPA] has provided a rational explanation of how it treated the evidence before it."[110] The universe of evidence now before EPA is that contained in the docket listed in the *Federal Register* for the Reconsideration Proposal, the same one established in 2015 for the review that culminated in the 2020 PM NAAQS Rule now under reconsideration: EPA-

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[104] *Reconsider*, MERRIAM-WEBSTER.COM, https://www.merriam-webster.com/dictionary/reconsider (emphasis added).

[105] *FCC v. Fox*, 556 U.S. at 515 (2009).

[106] *California. v. Bernhardt,* 472 F. Supp.3d 573, 600-601 (N.D. Cal. 2020) (explaining further that agencies must use reasoning, deliberation, and process when reconsidering existing policy "because markets and industries rely on stable regulations.").

[107] *Physicians for Soc. Resp. v. Wheeler*, 956 F. 3d 634, 644 (D.C. Cir. 2020) (quoting *Southwest Airlines v. FERC*, 926 F.3d 851, 852 (D.C. Cir. 2019)).

[108] *Id.* (*quoting Southwest Airlines*, 926 F.3d at 856).

[109] *Id.* (*quoting State Farm*, 463 U.S. at 42).

[110] *Mississippi v. EPA*, 744 F.3d at 1351.

HQ-OAR-2015-0072. EPA may not be bound to past reviews,[111] but the Reconsideration Proposal is bound to its docket.

EPA must provide a complete justification for reversing the previous Administrator's decision to retain all the current PM NAAQS. In doing so, the Agency must distinguish and explain its new policy without glossing over or swerving from the previous Administrator's decision to retain the current standard.

The Administrator does none of this in EPA's Reconsideration Proposal. It is therefore arbitrary and capricious.

**1. The Administrator Fails To Justify Disregarding His Predecessor's Decisions.**

The Reconsideration Proposal notes that EPA completed a previous review of the PM NAAQS in 2020;[112] that the former Administrator emphasized uncertainties and limitations in several studies in the 2020 review;[113] and that based on these and other considerations the former Administrator decided to retain the existing standards.[114] The Reconsideration Proposal engages in no further substantive discussion of the former Administrator's decisions and certainly does not reconsider those decisions in a manner that considers all aspects of the problem, as required by basic administrative law principles.

The Reconsideration Proposal considers largely the same scientific evidence as did the 2020 PM NAAQS Rule.[115] The Administrator reviewed this evidence and determined it warranted proposing revisions to the $PM_{2.5}$ NAAQS. His predecessor came to the opposite conclusion.

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[111] *See id*. at 1333-34.

[112] 88 Fed. Reg. at 5566-67.

[113] *Id*.

[114] *Id*.

[115] As discussed at Section VI.D., *supra*, the Reconsideration Proposal notes that the conclusions concerning health effects that have a causal or likely causal relationship with $PM_{2.5}$ remain consistent with those in the 2019 ISA. Furthermore, as noted at Section VII.B.1., risks estimated in the 2022 Policy Assessment are lower than those that were estimated in the 2020 Policy Assessment.

The Administrator not only must provide a reasoned explanation for his belief that the science is certain enough to revise the $PM_{2.5}$ NAAQS but also must justify that belief by distinguishing it from the contrary conclusions of his predecessor. In this reconsideration, the Administrator must make both positive and negative arguments – he must explain why it is reasonable to find the evidence certain enough to revise the NAAQS as proposed and why it is reasonable to conclude that his predecessor was wrong in finding the evidence too uncertain to support a revision.

Instead, the Reconsideration Proposal glosses over and swerves from past, contrary determinations without explanation. It is arbitrary and capricious.

**2. The Administrator Fails To Address the Advice of the CASAC he Disbanded.**

The Reconsideration Proposal states that the Administrator's determinations are informed, by, among other things, the advice of the CASAC.[116] The Administrator, however, considered only the advice of CASAC offered after he had "reestablished" its membership by "select[ing] seven members to serve on the chartered CASAC."[117] The Reconsideration Proposal later cites an EPA press release announcing the Administrator's decision to "reestablish," "reset," and "reorient" CASAC, which notes that the Administrator directed EPA to "initiate the release of current members of . . . the CASAC, to reconstitute, restore and create new committees to better address EPA priorities."[118]

Buried deeper in the Reconsideration Proposal, EPA states that "some members"[119] of the CASAC whose members had been "released" recommended retaining the existing $PM_{2.5}$ NAAQS

[116] 88 Fed. Reg. at 5560.
[117] *Id.* at 5719, n.2.
[118] *Id.* at 5568 (citing Press Release, *Administrator Regan Directs EPA to Reset Critical Science-Focused Federal Agency Committees* (March 21, 2021), https://www.epa.gov/newsreleases/administrator-regan-directs-epa-reset-critical-science-focused-federal-advisory (hereinafter "CASAC Reset Press Release")).
[119] In fact, all but one member of the disbanded CASAC expressed this opinion.

based on uncertainties in the underlying science.[120] The Reconsideration Proposal does not further address these views in a meaningful way. In other words, the Administrator's proposed decisions were informed by the views of the CASAC that he "reconstitute[ed], restore[d], and create[d] . . . to better address EPA priorities,"[121] but not the contrary views of the CASAC that he directed be "release[d]," "reestablish[ed]," "reset," and "reorient[ed]."[122] The Act does not permit the Administrator to pick the advice of his favored CASAC in this way, while ignoring contrary CASAC advice. At a minimum, the Administrator must explain why the uncertainties identified by released members of CASAC have been adequately resolved so as to warrant a change in the outcome of the PM NAAQS review.

The Administrator does not have to agree with the disbanded CASAC, but he cannot ignore it. The Act requires that any NAAQS proposal be accompanied by a statement setting forth "*any* pertinent findings, recommendations, and comments" of CASAC and that, "if the proposal differs in any important respect from *any* of these recommendations, an explanation of the reasons for such differences."[123] While it is unprecedented that one NAAQS rulemaking docket includes recommendations from two differently constituted CASACs with contrary views, that does not change the Administrator's duty under the Act. He is to respond to "any" pertinent findings, recommendations, and comments of CASAC, not just the most recent ones. EPA cannot evade this requirement by claiming that the findings, recommendations, and comments of the disbanded CASAC are not "pertinent." They are in the docket for this rulemaking.[124] Furthermore, the findings, recommendations, and comments of the disbanded CASAC are pertinent because the

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[120] 88 Fed. Reg. at 5578.
[121] *See* CASAC Reset Press Release.
[122] *See id.*
[123] CAA § 307(d)(3) (emphasis added).
[124] *See* CASAC Reset Press Release.

prior Administrator's reliance on them means they are "clearly a 'relevant factor'" that EPA must take into account in its reconsideration.[125]

The Administrator must explain why he differs from any pertinent findings, recommendations, and comments by CASAC that are in the docket, whether or not he selected the members of that CASAC.

#### 3. The Administrator Must Justify New Positions Taken in a Revised "Response to Significant Comments" Document.

The Act further specifies that a final NAAQS rulemaking be "accompanied by a response to each of the significant comments, criticisms, and new data submitted in written or oral presentations during the comment period."[126] Such a response to comments document already exists in the docket in response to comments filed before the Administrator embarked on this reconsideration.[127] Should EPA issue another such document, then that document must distinguish or explain any apparent rejection of a position taken in the existing response to comments document.[128] If EPA does not do so, then it is being arbitrary and capricious. Where EPA does not address a contrary position, then EPA retains it.

#### 4. The Public Must Have an Opportunity To Comment Meaningfully on Any Changes EPA Makes To Cure the Reconsideration Proposal's Flaws.

The Reconsideration Proposal does not comply with EPA's obligation to reconsider the entire record, including prior contrary decisions, and justify changes to existing EPA policy. Longstanding jurisprudence, as well as recent cases involving policy reversals, makes clear that

[125] *See Physicians for Soc. Resp.*, 956 F. 3d at 644 (quoting *State Farm*, 463 U.S. at 42); *see also Bernhardt*, 472 F.Supp.3d at 601 (finding that the Department of the Interior was arbitrary and capricious for disregarding independent reviews upon which the Department relied when establishing the Waste Prevention Rule).

[126] *Id.* § 307(d)(6)(B).

[127] *Responses to Significant Comments on the 2020 Proposed Rule on the National Ambient Air Quality Standards for Particulate Matter* (Dec. 2020), Docket No. EPA-HQ-OAR-2015-0072-1239.

[128] *See Physicians for Soc. Resp.*, 956 F. 3d at 644.

past determinations are "clearly a 'relevant factor' the agency had to consider"[129] in a reconsideration. Left unaddressed, the Reconsideration Proposal's failure to meaningfully reconsider the 2020 PM NAAQS Rule renders any resulting final rule arbitrary and capricious.

EPA cannot cure these fatal flaws by simply addressing them in a preamble to a final rule. That would deny commenters due process because EPA would be justifying its action on analysis not presented in the Reconsideration Proposal, unknown to stakeholders at the time comments were filed. Every part of the final rule must be a logical outgrowth of the Reconsideration Proposal. "A final rule is the 'logical outgrowth' of a proposed rule if 'interested parties should have anticipated that the change was possible, and thus reasonably should have filed their comments on the subject during the notice-and-comment period.'"[130] That is not the case here. Commenters have no way of anticipating the Administrator's justifications for swerving from his predecessor's reasoning.

The public can anticipate that EPA must change the final rule so that its is not arbitrary and capricious. That does not mean the change is a logical outgrowth of the Reconsideration Proposal. Rewriting the *Reconsideration* Proposal to meaningfully *reconsider* the policy it seeks to change exceeds the "certain degree of change" between a proposal and final rule "inherent" to the rulemaking process.[131] Indeed, the Reconsideration Proposal does not "expressly ask[] for comments on [the] particular issue" of justifying its changes to existing EPA policy, nor does it "[make] clear that the agency [is] contemplating" such a justification in the final rule.[132] Generally soliciting comments on the "array of issues associated with the reconsideration of these

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[129] *Id.* (quoting *State Farm*, 463 U.S. at 42, 103 S. Ct. 2856).
[130] *Clean Air Council v. Pruitt*, 862 F.3d 1, 10 (D.C. Cir. 2017) (internal citation omitted).
[131] *See Int'l Harvester Co. v. Ruckelshaus*, 478 F.2d 615, 632 n.51 (D.C. Cir. 1973).
[132] *See CSX Transp., Inc. v. Surface Transp. Bd.*, 584 F.3d 1076, 1081 (D.C. Cir. 2009).

standards"[133] does not convert the Agency's "unexpressed intentions" to justify changes to existing policy into a logical outgrowth the public should have anticipated.[134] A supplemental proposal is imperative for stakeholders to comment meaningfully on the Reconsideration Proposal before its finalization. Interested parties should not be left to "divine the EPA's unspoken thoughts" on how it will make its rulemakings comply with the law.[135]

EPA must issue a supplemental proposal that satisfies its legal obligation to provide a reasonable explanation for the Reconsideration Proposal's changes to policy established in the 2020 PM NAAQS Rule. At a minimum, this supplemental proposal must: (1) justify rejecting the previous Administrator's decision to retain the $PM_{2.5}$ NAAQS and instead to propose more stringent standards; (2) explain the reasons why the Reconsideration Proposal differs from any pertinent findings, recommendations, and comments of CASAC; and (3) distinguish or explain any apparent rejection of a position taken in the "response to significant comments" document already in the docket.

## IV. Should EPA Proceed with Revising the Standard, an Effective Date of Two Years Following Promulgation Is Necessary To Avoid Disruptions in PSD Permitting and Is Consistent with the Designation and SIP Development Schedule.

The Reconsideration Proposal notes that EPA has "historically interpreted the requirement for an air quality impact analysis under CAA section 165(a)(3) and the implementing regulations" to "include a requirement to demonstrate that emissions from the proposed facility will not cause or contribute to a violation of any NAAQS" that is "in effect" as of the date a PSD permit is issued, "except to the extent that a pending permit application was subject to grandfathering provisions

[133] 88 Fed. Reg. at 5560.

[134] *See Shell Oil Co. v. EPA*, 950 F.2d 741, 751 (D.C. Cir. 1991) ("[A]n unexpressed intention cannot convert a final rule into a 'logical outgrowth' that the public should have anticipated. Interested parties cannot be expected to divine EPA's unspoken thoughts.").

[135] *See CSX Transp., Inc.*, 584 F.3d at 1080 (*citing Shell Oil Co.*, 950 F.2d at 751 (D.C. Cir. 1991)).

that the EPA had established through rulemaking."[136] Specifically, the preamble points to the "2012 $PM_{2.5}$ NAAQS (78 FR 3086, January 15, 2013) and 2015 Ozone NAAQS (80 FR 65292, October 26, 2015)" as examples of prior NAAQS revisions where the Agency had "included limited grandfathering provisions that exempted certain pending PSD permit actions" – i.e., those that had "reached a particular stage in the permitting process at the time the revised NAAQS was promulgated or became effective" – from the requirement to "demonstrate that the proposed emissions increases would not cause or contribute to a violation of the revised NAAQS."[137] Here, however, EPA proposed no such grandfathering provisions.[138]

EPA states that it changed its approach regarding grandfathering due to the decision of the U.S. Court of Appeals for the D.C. Circuit in *Murray Energy.* In that case, the preamble notes, the court "vacated the grandfathering provision in the PSD rules applicable to the 2015 Ozone NAAQS" because it found that the provision "contradicted 'Congress's 'express policy choice' not to allow construction which will 'cause or contribute to' nonattainment of 'any' effective NAAQS, regardless of when they are adopted or when a permit was completed.'"[139] Because EPA is "not proposing any grandfathering provision for this proposed $PM_{2.5}$ NAAQS revision, if finalized," "PSD permits issued on or after the *effective date* of any final revised $PM_{2.5}$ NAAQS" would require a "demonstration that the proposed emissions increases would not cause or contribute to a violation of the revised $PM_{2.5}$ NAAQS."[140]

While *Murray Energy* prohibits a grandfathering provision exempting PSD applicants from demonstrating compliance with "'any' effective NAAQS," the Agency can achieve the policy ends

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[136] 88 Fed. Reg. at 5686-87.
[137] *Id.* at 5687.
[138] *Id*.
[139] *Id.*, *quoting Murray Energy*, 936 F.3d at 627.
[140] *Id*. at 5687 (emphasis added).

of grandfathering by establishing a later effective date for any revised standard. As explained below, EPA, like other agencies,[141] has clear authority to establish an effective date greater than 60 days after the date of publication. In the case of any revised PM NAAQS, a two-year effective date would avoid a suspension in PSD permitting without prejudicing any subsequent action a state may take to implement the revised standard. Failure to adopt this later effective date would be arbitrary and capricious and an abuse of discretion.

EPA's past practice with respect to NAAQS rulemakings has been to set a new standard's effective date at 60 days after *Federal Register* publication. This 60-day timeline is not itself required by law and, if imposed in this rulemaking, would require the reopening and amendment of pending applications and thereby significantly delay the processing of dozens of permit applications under development and in review. This reopening of applications would have to be undertaken at the same time that EPA, state staff, and industry applicants would be required to develop new modeling and other information needed to conform applications with any tightened standard. At best, the construction of needed facilities would be delayed, and many projects would likely be abandoned.

An effective moratorium on PSD permitting would have severe adverse consequences for the public interest and the regulated community. Over the last two years, Congress has enacted several statutes, including the Infrastructure, Investment and Jobs Act (P.L. 117-58), the CHIPS and Science Act (P.L. 117-167), and the Inflation Reduction Act (P.L. 117–169), to improve existing infrastructure and to provide public and private-sector funding for new businesses needed to expedite the United States' transition towards a less-polluting future. This funding promises

[141] *See* Debt Collection Practices, 85 Fed. Reg. 76,734, 76,863 (Nov. 30, 2020) ("The Bureau proposed that the final rule take effect one year after publication in the Federal Register . . . [we] received several comments on this aspect of the proposal . . . [and] determined that, as proposed, the final rule will become effective one year after publication in the Federal Register.").

much needed upgrades to the United States' aging infrastructure as well as the development of new technologies in the field of batteries, renewable energy, and semiconductors that are key to energy transition and a more competitive economy. Delay in permitting would disrupt financing and postpone construction of these needed infrastructure projects.

In a time of rising global tension, these issues have national security and supply chain implications. Preparing for an uncertain future requires the United States to move deftly and quickly to address supply chain weakness and to build the production capacity needed. Forcing new modeling and the submission of new applications could delay construction by months to years and threaten expected investments. EPA, consistent with the Clean Air Act's dual goals "to promote the public health and welfare *and* the productive capacity" of the United States,[142] must take lawful action to avoid disruptions in PSD permitting following promulgation of revised standards.

As noted above, historically, EPA has recognized the public interest in limiting NAAQS permitting delays following publication of a revised NAAQS by administratively grandfathering PSD applications. Under such grandfathering rules, a source was required to demonstrate compliance with the standard that was in effect when the application was filed, not a new, tighter standard that became effective 60 days after publication. Because PSD permitting is time- and resource-intensive, often requiring extensive legal, engineering, and air quality analysis, grandfathering avoided the unfairness caused by disruption of a process that had already consumed months, or even years. Establishment of a two-year effective date would accomplish the fairness and clean air policy objectives that grandfathering sought to achieve, but do so consistent with *Murray Energy*. [143]

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[142] CAA § 101(b)(1) (emphasis added).
[143] *Murray Energy,* 936 F. 3d at 627; *see also* 42 U.S.C. § 7475.

A final rule's effective date establishes when that rule becomes a binding, enforceable legal requirement that supersedes prior rules. In the Administrative Procedure Act ("APA"), Congress required that the effective date of any substantive rule be "not less than 30 days" after publication in the *Federal Register*. 5 U.S.C. § 553(d). Subsequently, Executive Order 12866 extended this minimal period to "not less than 60 days" for "major" rules such as NAAQS. In the APA, the 30-day deferred effective date cannot be shortened except for "good cause," and Congress cautioned that "the specification of a 30-day deferred effective date is not to be taken as a maximum since there may be cases in which good administration or the convenience and necessity of the person subject to the rule reasonably requires a longer period."[144] As a result, EPA is authorized to adopt a later effective date for any revised PM NAAQS.

Setting a two-year effective date for any NAAQS revisions would prevent unnecessary disruptions and delays in the granting of PSD permits *without* impeding progress by states and EPA in implementing a new standard. The suggested two-year period would allow states and permit applicants preparing PSD air quality analyses to rely on the latest air quality information for modeling purposes. A two-year effective date for this rule would align the PSD permitting program with the first key deadline for developing new SIPs: EPA's promulgation of "the [attainment/nonattainment/unclassifiable] designation of areas" within each state.[145] Moreover, due to the conservatism of the modeling that EPA requires before a PSD permit can issue, a source issued a permit based on modeling that predicts air quality meeting the 12.0 μg/m$^3$ annual NAAQS, but not a new one in the proposed range of 9.0 to 10.0 μg/m$^3$ would be unlikely to be responsible for an actual violation of such a more stringent NAAQS.

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[144] SENATE REP. NO. 752, at 201 (1945).

[145] *See* CAA § 107(d)(1)(B)(i) ("[T]he Administrator shall promulgate the designations . . . [within] 2 years from the date of [NAAQS] promulgation.").

Coordinating the effective date of any revised NAAQS with the two-year deadline for EPA's promulgation of designations creates a natural pivot and reset point for subjecting new PSD applications to a tightened standard. In the absence of a two-year effective date, state-level and EPA officials are operating with regulatory uncertainty with respect to their modeling and likely New Source Review ("NSR") obligations for areas within a state.[146] That said, the proposed two-year effective date would not disrupt the development of future SIPs and the deployment of new air quality controls, which do not have to be submitted until three years after the NAAQS *promulgation date*, which, as noted, EPA equates to the publication date.

A two-year effective date for any revised NAAQS: (1) would be consistent with the policies underlying Executive Orders, the APA, and the CAA provisions regarding rule effective dates; (2) would conform to recent case law in *Murray Energy*; (3) would not delay the CAA's schedule for § 107 designations and § 110 SIP preparation, submittal, and approval, which are tied to *promulgation date* rather than *effective date*; (4) would promote fairness to pending permit applicants; (5) would avoid disruption to permitting of important projects necessary for modernizing the nation's infrastructure and diversifying our production and energy sources; (6) would advance the public interest by assisting with the implementation of policies recently enacted by this Administration through Congress; and (7) would allow EPA time to develop new modeling and permitting tools, as discussed in Section V below.

In carrying out a congressional authorization, EPA must implement the Act consistent with its purpose section, *cf. Sierra Club v. Ruckelhaus,* 343 F. Supp. 253 (D.D.C. 1972), and adopt authorized measures needed to avoid unreasonable and unfair results. A two-year effective date is just such a measure. As is explained above, there are no adverse environmental consequences

[146] If more than two years are needed to develop modeling and other guidance, EPA has discretion to extend the effective date following notice and comment rulemaking.

associated with EPA's setting a two-year effective date, whereas EPA's refusal to do so would inflict considerable harm on the regulated community specifically and society generally. Nothing in *Murray Energy* can be read as precluding a two-year effective date. In these circumstances, the path forward is clear and compelled by the Act.

## V. EPA Must Develop an Effective and Feasible Implementation Strategy and Related Tools that States Can Use for Any More Stringent NAAQS.

A more stringent primary $PM_{2.5}$ NAAQS like those on which the Administrator has solicited comment would pose serious implementation challenges for attainment, unclassifiable, and future nonattainment areas. If EPA adopts its proposed revised NAAQS, the Agency must develop an effective and feasible implementation strategy and ensure the availability of appropriate tools to implement that strategy prior to the effective date of any more stringent NAAQS. An effective date for any new NAAQS that follows its promulgation by two years, as discussed above,[147] would provide the Agency with time to address current implementation challenges. In particular, it would allow EPA time to specify approaches to air quality modeling that provide more realistic, less conservative predictions for both permitting and SIP development purposes; issue updated permitting policies; and, implement model improvements. It would also allow the Agency to provide states with guidance on use of more flexible control strategies.

### A. EPA Needs To Ensure its Recommended Models and Requirements for Using Models Yield Realistic Air Quality Predictions.

The Act requires use of air quality modeling for both permitting and SIP development.[148] EPA's Guideline on Air Quality Models, commonly known as Appendix W, identifies EPA's preferred models and how those models should be used, including specifying inputs to them.[149]

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[147] *See* Section IV, *supra*.
[148] *See, e.g.,* CAA §§ 165(e)(3)(D), 189(b)(i)(B).
[149] 40 C.F.R. pt. 51, app. W.

Although Appendix W recognizes that an alternative model or technique may sometimes be appropriate, use of such an alternative requires approval by EPA and evaluation of the model "from both a theoretical and a performance perspective."[150] The models that EPA recommends generally err on the side of conservatism, i.e., they are likely to predict concentrations higher than those measured in ambient air.

**1. EPA Needs To Correct its Conservative Approach to Air Quality Modeling To Facilitate the Permitting of New or Modified Sources in Areas Attaining the PM NAAQS.**

As the stringency of NAAQS has increased over time, use of EPA's preferred models, all of which are conservative, has significantly increased the challenges of permitting major new sources or major modifications to existing ones.[151] Such sources are essential for US economic growth and to provide new jobs.[152] When locating in an area designated attainment or unclassifiable for a NAAQS, an economically important source of this nature must receive a PSD permit based on its use of the Best Available Control Technology ("BACT") and a modeled demonstration that it will not cause or contribute to a violation of the NAAQS or an increment.[153] Such a demonstration is increasingly difficult in the face of ever-more-stringent NAAQS.

The table below, which was prepared by the environmental consulting firm ALL4, illustrates how a more stringent annual primary $PM_{2.5}$ NAAQS, if promulgated, would increase the already challenging process of obtaining the required PSD permit. The table summarizes modeled annual average $PM_{2.5}$ concentrations associated with recent permit applications for projects by members of several industries. These projects were permitted based on modeling in

[150] 40 C.F.R. pt. 51, app. W 3.2.2.

[151] It can also make obtaining minor source permits more difficult in a state that requires modeling to support issuance of such permits.

[152] One purpose of the Act is "promoting the productive capacity" of the US population. CAA § 101(b)(1). The purpose of the Act's PSD program is "to *ensure economic growth will occur* in a manner consistent with the preservation of existing clean air resources." CAA § 160(3) (emphasis added).

[153] CAA § 165(a).

accordance with Appendix W. None of them had an annual average modeled design concentration ("MDC") of greater than 6.0 μg/$m^3$. All of them were able to demonstrate that they would not cause or contribute to a violation of the current 12.0 μg/$m^3$ annual primary $PM_{2.5}$ NAAQS. However, 25 of these 32 projects would have been modeled to cause or contribute to a violation of an annual $PM_{2.5}$ NAAQS of 9.0 μg/$m^3$, the lower end of EPA's proposed range for an annual primary standard. Moreover, almost half of the projects were modeled as causing or contributing to an violation of a hypothetical annual $PM_{2.5}$ standard of 10.0 μg/$m^3$, the top of the Agency's proposed range.

| Facility | State | Annual Average $PM_{2.5}$ (micrograms per cubic meter) | | |
|---|---|---|---|---|
| | | MDC (1) | Background (2) | Total (3) |
| Pulp & Paper Mill | Florida | 6.0 | 5.9 | 11.9 |
| Steel | Arkansas | 2.5 | 9.4 | 11.9 |
| Steel | Arkansas | 4.4 | 7.3 | 11.7 |
| Recycled Paper Mill | Oklahoma | 3.4 | 8.2 | 11.6 |
| Brick | Iowa | 3.5 | 8.0 | 11.5 |
| Steel | Illinois | 3.7 | 7.8 | 11.5 |
| Paper | Texas | 2.8 | 8.5 | 11.3 |
| Cement | Pennsylvania | 2.2 | 9.0 | 11.2 |
| Power | Wisconsin | 3.9 | 7.3 | 11.2 |
| Paper | Louisiana | 3.7 | 7.4 | 11.1 |
| Power | Pennsylvania | 3.0 | 8.1 | 11.1 |
| Cement | Georgia | 2.3 | 8.3 | 10.6 |
| Wood Products Panels | South Carolina | 3.1 | 7.1 | 10.2 |
| Steel | North Carolina | 1.2 | 8.9 | 10.1 |
| Lumber | Washington | 6.0 | 4.0 | 10.0 |
| Automotive | Georgia | 2.5 | 7.3 | 9.8 |
| Manufacturing | Washington | 3.3 | 6.5 | 9.8 |
| Aluminum | Kentucky | 1.5 | 8.1 | 9.6 |
| Steel | Kentucky | 1.7 | 7.8 | 9.5 |
| Paper | Texas | 0.9 | 8.5 | 9.4 |
| Gas-fired EGU | Georgia | 0.9 | 8.4 | 9.3 |
| Paper | Michigan | 4.6 | 4.7 | 9.3 |
| Steel | Kentucky | 1.9 | 7.4 | 9.3 |
| Feed & Grain | Idaho | 4.3 | 4.9 | 9.2 |
| Pharmaceutical | New York | 0.4 | 8.7 | 9.1 |
| Power | Wisconsin | 1.3 | 7.6 | 8.9 |
| Gas-fired EGU | Georgia | 0.9 | 7.9 | 8.8 |
| Gas-fired EGU | New York | 1.8 | 6.5 | 8.3 |
| Paper | Maine | 3.5 | 4.0 | 7.5 |
| Steel | Florida | 0.9 | 6.5 | 7.4 |
| Wood Products Panels | Michigan | 1.4 | 5.6 | 7.0 |
| LNG Storage | Massachusetts | 1.6 | 5.1 | 6.7 |
| **Count** | | **32** | **32** | **32** |
| **90th Percentile** | | **4.4** | **8.7** | **11.6** |
| **75th Percentile** | | **3.6** | **8.2** | **11.2** |
| **Average** | | **2.7** | **7.2** | **9.9** |
| **Median** | | **2.5** | **7.5** | **9.8** |
| **25th Percentile** | | **1.5** | **6.5** | **9.2** |
| **10th Percentile** | | **0.9** | **4.9** | **7.6** |

1. "MDC" denotes the **modeled design concentration** computed by AERMOD (i.e., the maximum 5-year average annual mean concentration) simulating cumulative impacts from applicant facility and nearby sources. Includes secondary $PM_{2.5}$ screening concentration from precursor emissions of $NO_X$ and $SO_2$ estimated using EPA's MERPs and related guidance.

2. "Background" denotes the background concentration accounting for all sources not explicitly simulated in AERMOD, typically quantified as the design value (3-year average) from a representative (usually nearest) Federal Reference Method or Federal Equivalent Method ambient monitor. Color coding denotes relatively higher (hotter) and lower (cooler) background concentrations among sampled analyses.

3. "Total" denotes the sum of the MDC and background, which is compared to the level of the NAAQS to demonstrate that the total ambient $PM_{2.5}$ concentration simulated in the cumulative impact analysis would not exceed the standard. Color coding dinstguishes total modeled annual average $PM_{2.5}$ concentrations from 11-12 (red), 10-11 (orange), 9-10 (yellow), 8-9 (blue), and less than 8 (green).

Based on the experience of NR3 Coalition member companies, most projects requiring a PSD permit need headroom of up to about 3.0 µg/m$^3$ between background and the standard level to demonstrate, in accordance with Appendix W's modeling requirements, that they will not cause or contribute to a violation of the annual $PM_{2.5}$ NAAQS.

As shown in green on Figure 1 below, such headroom is available under the current NAAQS in most of the country.[154]

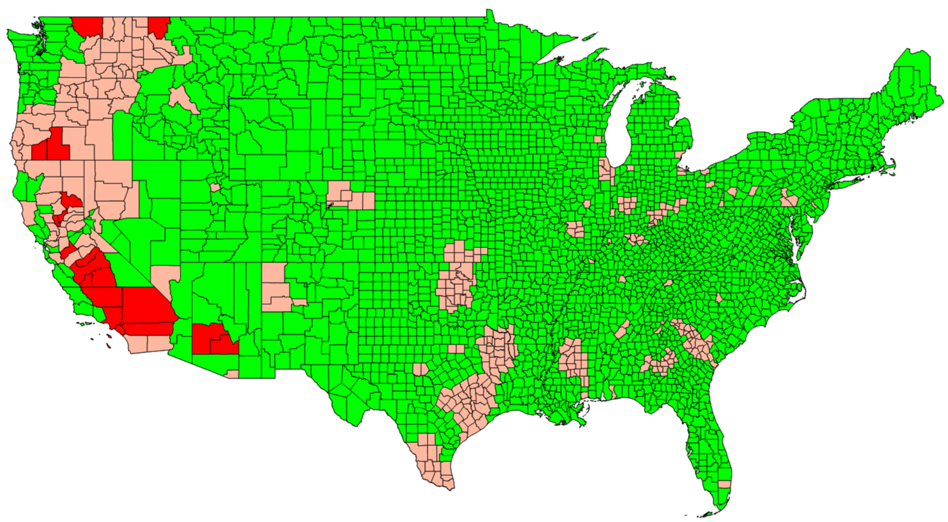

Figure 1: Headroom Below a 12.0 µg/m$^3$ Annual NAAQS

Far less of the country would have sufficient headroom under a more stringent NAAQS. Figure 2 shows how much less of the United States would have 3.0 µg/m$^3$ of headroom if the NAAQS were reduced to 9.0 µg/m$^3$.

[154] Areas shown in red on Figures 1 and 2 are nonattainment for the 12.0 µg/m$^3$ NAAQS. Those shown in pink have less than 3.0 µg/m$^3$ of headroom. These figures were prepared by Alpine Geophysics using air quality data from 2019 to 2021. Maximum $PM_{2.5}$ Design Values ("DVs") were used for each monitored county. For counties without monitors, design values were estimated using geospatial statistical interpolation ("kriging") fill-in estimates. The five closest monitored values were used to estimate non-monitored county values using an inverse-distance weighted averaging method.

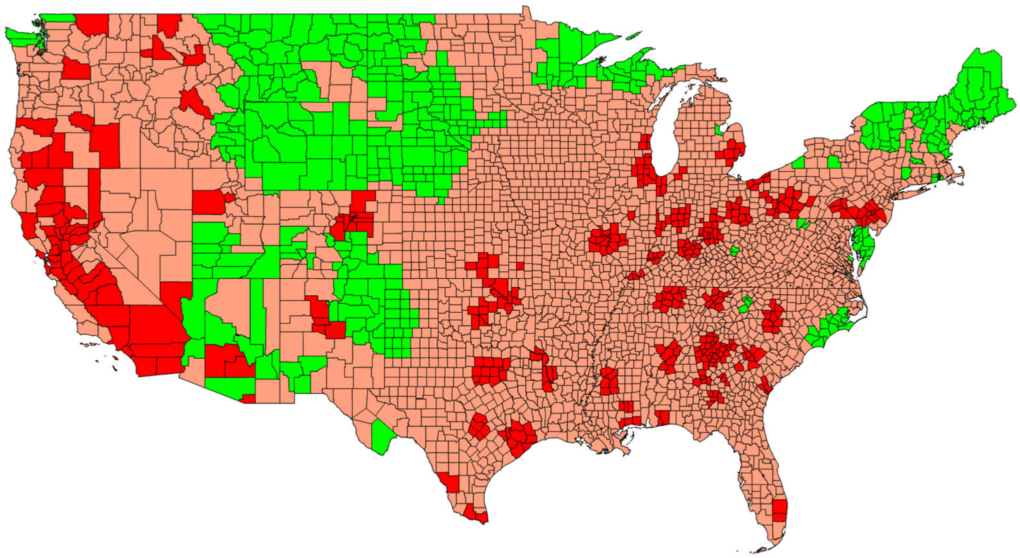

Figure 2: Headroom below a 9.0 μg/m$^3$ Annual NAAQS

Instead of allowing overly conservative modeling requirements to hamper economic growth in this country, EPA should revise those requirements to predict air quality more realistically. This would involve updating both Appendix W, including the preferred models identified in it, and related permitting and modeling guidance.

The Agency is currently planning to propose revisions to Appendix W this fall,[155] including updates to its preferred AERMOD model, and to finalize Appendix W updates in 2024.[156] The NR3 Coalition appreciates EPA's plans to update mobile source modeling, characterization of building downwash, conversion of nitrogen oxide emissions to nitrogen dioxide in ambient air, and representation of area source plume meander in AERMOD. We look forward to reviewing these proposed updates to the model, but additional model improvements are necessary to address

[155] *See* Tillerson, C.; G. Bridgers; R. C, Owen; D. Heist; J. Thurman; A. Piliero; C. Misenis & M. Porter, EPA's Near-Future Development Priorities for the AERMOD Model System, *EM* (Feb. 2023), https://www.awma.org/em.

[156] Should EPA defer the effective date of a new NAAQS for two years, as proposed above, *see* Section IV, *supra*, that would coincide with EPA's planned updates to its modeling requirements.

sources of $PM_{2.5}$ such as fugitive emissions that significantly affect model outputs. We urge the Agency also to consider further improvements to AERMOD's performance related to area and volume sources, including characterization of building shapes, of moist, buoyant plumes, and of ambient pollutant levels under low wind speed conditions.

In addition to updating AERMOD, EPA should consider updates to requirements for information to be input into the models. Specifically, Table 8-2 of Appendix W requires, for purposes of evaluating compliance with an annual or quarterly NAAQS, that the source seeking a permit be modeled as if it continually emits at its design capacity or its permit limit (unless a different operating capacity would lead to a higher predicted ambient impact). Moreover, the source and nearby sources must be modeled as emitting at their maximum allowable emission limit or their federally enforceable permit limit. The chance of these emission rates and operating conditions occurring simultaneously for a full year are vanishingly small, so the resulting air quality predictions are highly conservative.

EPA needs to provide an approach that lessens this conservatism. In some cases, data on a source's actual operating schedule, capacity, and emission rate may be available. In that case, modeling those conditions would be appropriate. If such data are unavailable for the specific source, but are available for a similar source, those data could be used to inform more realistic predictions. Ultimately, EPA should develop probabilistic approaches that could be used more generally instead of assuming continuous operation of multiple sources under the operating conditions that provide the highest estimated impacts and assuming the highest allowable rate of emissions at all times, as is often required currently.

Another aspect of modeling in which EPA's approach leads to unrealistically high concentrations is characterization of background for modeling the 24-hour NAAQS. Citing "the many factors that contribute to the temporal and spatial variability of ambient concentrations across a typical modeling domain on an hourly basis," Appendix W rejects the pairing of monitored background with modeled air quality on an hourly or daily basis.[157] Predictions using EPA's approach fail, however, to capture the inherent variability of background. The result is predicted ambient concentrations that are biased high. EPA should either allow hourly or daily pairing of monitored and modeled values or should develop another approach that captures the variability of background. Furthermore, EPA should assist the states to leverage inherent flexibility in the Act. For characterization of background air quality, EPA should develop estimates of the contribution of international emissions and exceptional events to background at every Federal Reference Method ("FRM") monitor. EPA should permit the exclusion of these contributions from background for any source modeling impact analyses, as well as any SIP or compliance demonstration modeling.

EPA's approach to modeling $PM_{2.5}$ in particular, adds another unique factor into the general conservatism of its approved modeling approaches. Ambient $PM_{2.5}$ results from both primary emissions and secondarily formed particles. EPA's current approach requires modeling of primary and secondary $PM_{2.5}$ separately and then combining the highest $PM_{2.5}$ levels predicted by each model.[158] Because primary PM tends to have ambient impacts that are greatest close to a source, and secondary $PM_{2.5}$ impacts are generally greater farther from a source, combining these two predictions overstates ambient $PM_{2.5}$ concentrations. EPA should instead direct (or allow) combining predictions from the two models on a receptor-by-receptor basis.

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[157] 40 C.F.R. pt. 51, app. W 8.3.2(e) and 8.3.3(d).

[158] EPA, *Guidance for Ozone and Fine Particulate Matter Permit Modeling,* EPA-454/R-22-005, at 52 (July 2022), https://www.epa.gov/system/files/documents/2022-07/Guidance_for_O3_PM25_Permit_Modeling.pdf.

EPA's interpretation of the spaces that are to be modeled adds further conservatism to modeling with regard to the risk of exposure of people to levels above a NAAQS. For example, EPA's approach requires that areas such as a sheer cliff, a river adjacent to a facility, a road beside a plant site, or a railroad line passing through such a site be treated as areas to which the public has access. Although it is true that the public may have access to these sites, there is very little probability of anyone spending a year – or 24 hours straight – at one of these locations represented as a receptor in a PSD modeling analysis. Modeling pollutant impacts in these locations as if people could be there adds yet another level of conservatism to the modeling EPA requires by those seeking a PSD permit.[159] EPA should revise its policy related to the definition of ambient air further to acknowledge that the probability of human exposure is a relevant factor.

Finally, EPA should retain project emissions accounting ("PEA") regulatory provisions in the NSR rules and consider further improvements to permitting guidance that would reduce the number of projects that are considered modifications of major sources that trigger air dispersion modeling. Such guidance improvements could include expansion of those activities that are considered to be routine maintenance, repair, and replacement ("RMRR"), debottlenecking guidance, and additional guidance on demand growth/accommodated emissions.

#### 2. EPA Must Also Ensure its Requirements and Guidance for SIP Modeling Produce Realistic Air Quality Predictions.

Appendix W also specifies modeling requirements appliable to SIP submittals and revisions.[160] The excessive and unnecessary conservatism of Appendix W requirements discussed

[159] In 2019, EPA revised its policy on areas that need not be considered ambient air to acknowledge that barriers other than physical ones can exclude access to a property, and that, in such situations, air above the site should not be considered ambient air. *See* Memorandum from Andrew R. Wheeler, Administrator, EPA, to Regional Administrators (Dec. 2, 2019), https://www.epa.gov/sites/default/files/2019-12/documents/ambient_air2019.pdf. This clarification of what must be modeled as ambient air is inadequate, however, to reflect the reality of where people are potentially exposed to NAAQS violations. Further flexibility is needed to capture that reality when performing air quality modeling.

[160] 40 C.F.R. pt. 51, app. W 1.0(a).

above is equally a concern for SIP-related modeling. Reducing this conservatism would also provide more realistic information for SIP development.

For SIP submittals addressing $PM_{2.5}$, in particular, additional guidance on modeling is provided by EPA's Modeling Guidance for Demonstrating Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze.[161] Although this guidance, which focuses on photochemical grid modeling of large numbers of sources across broad regions, largely avoids the overly conservative assumptions of Appendix W, combining predictions of a photochemical grid model with a dispersion model used to characterize ambient impacts of primary $PM_{2.5}$ emissions remains a concern. Furthermore, requiring modeling of areas where people are unlikely to be exposed for as long as the averaging time of the NAAQS addressed by the SIP is conservative and may drive unnecessary and costly emission reduction requirements.[162]

In short, EPA needs to reduce the conservatism in those aspects of its modeling requirements and guidance discussed above. Unless the Agency does so, it will be thwarting optimal economic development that could be achieved in this country, consistent with the protection of air quality as envisioned by Congress.

### B. EPA Should Develop and Encourage States To Use Flexible and Cost-Effective Tools for Developing Control Strategies.

If EPA promulgates a new PM NAAQS, the responsibility for ensuring that areas attain it will fall to the states.[163] Although EPA previously promulgated rules for implementing $PM_{2.5}$

[161] Air Quality Assessment Div., Office of Air Quality Planning and Standards, EPA, Doc. EPA 454/R-18-009, Modeling Guidance for Demonstrating Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze (Nov. 2018), https://www.epa.gov/sites/default/files/2020-10/documents/o3-pm-rh-modeling_guidance-2018.pdf.

[162] When modeling was used in the absence of monitoring to determine nonattainment areas for the 1-hour NAAQS for $SO_2$, EPA instructed states to use several inputs that provided more realistic assessment of possible NAAQS violations, including placing receptors only in locations where a monitor could be placed and using actual emissions data. *See* Memorandum from Stephan D. Page, Director, Office of Air Quality and Standards, to Regional Air Directors, at 5 (Mar. 20, 2015), https://www.epa.gov/sites/default/files/2016-06/documents/20150320so2designations.pdf. This guidance illustrates EPA's flexibility to use realistic modeling.

[163] CAA §§ 110, 189.

NAAQS,[164] it should offer states guidance, either formally or informally, concerning flexible options for strategies to obtain the emission reductions necessary to attain any new, more stringent $PM_{2.5}$ NAAQS in a cost-effective manner. We present suggestions below for providing such flexibility.

Historically, PM NAAQS, including $PM_{2.5}$ NAAQS, have been implemented principally through reduction of emissions of $PM_{2.5}$ precursors from major stationary sources and motor vehicles. If EPA adopts a more stringent $PM_{2.5}$ NAAQS, however, it may be necessary to go beyond controls on those sources to control emissions from non-traditional sources such as area sources and sources of primary (direct) $PM_{2.5}$ that are not as well-controlled. EPA should advise states that it will look favorably on SIPs that use flexible approaches such as emissions trading or offsets to bring areas into attainment in a cost-effective manner.

A program allowing the use of offsets and/or trading can be designed to reduce health risks, particularly in disadvantaged communities, while also reducing costs. Such an approach is consistent with the intent of the Act "to protect and enhance the quality of the Nation's air resources so as to promote the public health and welfare and the productive capacity of its population"[165] and with the direction of Section 110(a)(2)(A) of the Act to use "control measures, means, or techniques (including economic incentives such as fees, marketable permits, and auctions of emissions rights)."[166]

Consistent with these statutory provisions, courts have recognized that RACT and other controls required for nonattainment areas can often be satisfied by averaging emissions, an approach that can be implemented through an emission offset or trading program. The D.C. Circuit

[164] *See* 81 Fed. Reg. 58,010 (Aug. 24, 2016).
[165] 42 U.S.C. § 7401(b)(1).
[166] CAA § 110(a)(2)(A).

has acknowledged that it is permissible "to meet RACT-level emissions through averaging within a nonattainment area."[167] The Sixth Circuit, in the context of reviewing SIP provisions for a redesignation to attainment, has found "EPA can plausibly and rationally interpret the statute to allow a wider purview than individual sources" and "do[es] not believe EPA must be limited to reductions within the nonattainment area."[168]

EPA has a history of using regional emissions trading to address air pollutant transport and to bring nonattainment areas into attainment. Most recently, these EPA programs have focused on attaining ozone NAAQS. The 2005 Clean Air Interstate Rule (CAIR), however, addressed both ozone and $PM_{2.5}$ NAAQS.[169] Although these were EPA trading programs, they can inform how a state-driven program to offset or trade emissions might work. The NR3 Coalition would be willing to work with EPA on strategies for scoping and undertaking these steps.

Implementation of the existing PM NAAQS, particularly for $PM_{2.5}$, has been challenging for EPA and states charged with developing plans for such implementation. Certain areas have been unable to attain those NAAQS, the most recent of which was promulgated more than a decade ago. Implementation of any new, more stringent NAAQS, if EPA ultimately promulgates one, would be even more difficult.

EPA must recognize the challenges that any new NAAQS would pose for attainment and unclassifiable areas as well as for those designated nonattainment and, if it intends to promulgate a stringent new NAAQS, should begin now to prepare both itself and states for those implementation challenges. Elimination of excessive conservatism in air quality modeling requirements and planning for the implementation flexibility that could be provided by state

[167] *S. Coast Air Quality Mgmt., Dist. v. EPA*, 882 F.3d 1138, 1154 (D.C. Cir. 2018).

[168] *Sierra Club v. EPA*, 793 F.3d 656, 667 (6th Cir. 2015); *see also S. Coast*, 882 F.3d at 1146-47 (The D.C. Circuit suggested that measures to satisfy RACM, including RACT, must be applied within the nonattainment area.).

[169] 70 Fed. Reg. 25,161 (May 12, 2005).

offset/emissions trading programs would help to address these challenges. Establishing an effective date for any revised $PM_{2.5}$ NAAQS that follows its promulgation by two years would provide time for these efforts, mitigating harmful effects on economic growth and other unintended consequences of implementing a new NAAQS.

## VI. The Administrator Should Retain the 12.0 μg/m³ Annual Primary $PM_{2.5}$ NAAQS.

After proposing to conclude that the current primary $PM_{2.5}$ NAAQS do not provide the requisite degree of public health protection,[170] the Administrator seeks comment on revising the level of the annual primary NAAQS from 12.0 $\mu g/m^3$ to within the range of 9.0 $\mu g/m^3$ to 10.0 $\mu g/m^3$.[171] The Administrator also solicits comment on levels of up to 11.0 $\mu g/m^3$ and as low as 8.0 $\mu g/m^3$.[172] In particular, "EPA solicits comments on the uncertainties in the reported associations between daily or annual average $PM_{2.5}$ exposures and mortality and morbidity in the epidemiologic studies, the significance of the 25th percentile of ambient concentrations reported in studies, the relevance and limitations of international studies,"[173] among other issues. Any such more stringent standard would be intended to address health risks associated with both long-term and typical daily $PM_{2.5}$ exposures.[174] For the reasons explained below, however, the Administrator has not adequately justified his conclusion that the current suite of primary $PM_{2.5}$ NAAQS fails to protect public health with an adequate margin of safety. As a result, revision of the annual primary NAAQS is not appropriate, and the Administrator should withdraw or otherwise end reconsideration of this standard.[175]

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[170] 88 Fed. Reg. at 5624.
[171] *Id*. at 5629.
[172] *Id*.
[173] *Id*.
[174] *Id*. at 5617.
[175] In the absence of a revision to the NAAQS, there is no reason to revise the Air Quality Index ("AQI") as EPA has proposed. *See id*. at 5641-42. Should EPA proceed with revision of the AQI, however, the Agency must ensure that such a revision does not lead the public to believe, mistakenly, that air quality has declined, and that $PM_{2.5}$ concentrations are increasing.

### A. The Health Effects Evidence Is Consistent with that Considered in 2012 and 2020.

The substance of the scientific record concerning health effects associated with exposure to $PM_{2.5}$ in ambient air has not changed meaningfully since the current suite of primary $PM_{2.5}$ NAAQS was promulgated in 2012.[176] The decision at that time to reduce the level of the annual primary $PM_{2.5}$ standard from 15.0 µg/m$^3$ to 12.0 µg/m$^3$ while retaining a 24-hour primary standard of 35 µg/m$^3$ was based on the science reflected in an ISA dated 2009.[177] The decision in 2020 to retain that suite of NAAQS was based on science reflected in a 2019 ISA.

#### 1. This Reconsideration Does Not Add Any New Findings of Health Effects with a Causal or Likely Causal Association with $PM_{2.5}$ Exposure.

As discussed in the Reconsideration Proposal, many conclusions concerning effects caused by or likely caused by ambient $PM_{2.5}$ remain the same as they were in the 2009 ISA. Examples include:

- "In the 2012 review, the 2009 ISA reported that the evidence was 'sufficient to conclude that the relationship between long-term $PM_{2.5}$ exposures and mortality is causal.'" Newer studies "continue to provide consistent evidence of positive associations between long-term $PM_{2.5}$ exposures and mortality."[178]
- "The 2009 ISA concluded that 'a causal relationship exists between short-term exposure to $PM_{2.5}$ and mortality.' . . . Multicity studies evaluated in the 2019 ISA and the ISA Supplement provide evidence of primarily positive associations between daily $PM_{2.5}$ exposures and mortality . . . ."[179]
- "Consistent with the evidence assessed in the 2009 ISA, the 2019 ISA concludes that recent studies, together with evidence available in previous reviews, support a causal relationship between long-term exposure to $PM_{2.5}$ and cardiovascular effects. . . .

[176] *See id*. at 5618 ("The evidence available in this reconsideration . . . reaffirms, and in some cases, strengths the conclusions from the 2009 ISA regarding the health effects of $PM_{2.5}$ exposures.").
[177] EPA, Integrated Science Assessment for Particulate Matter, EPA/600/R-08/139F (Dec 2009), https://ordspub.epa.gov/ords/eims/eimscomm.getfile?p_download_id=494959 (hereinafter "2009 ISA").
[178] 88 Fed. Reg. at 5581.
[179] *Id*. at 5583.

[S]tudies published since the completion of the 2019 ISA and evaluated in the ISA Supplement . . . further support such a conclusion."[180]

- "The 2009 ISA concluded that 'a causal relationship exists between short-term exposure to $PM_{2.5}$ and cardiovascular effects.' . . . Studies evaluated in the 2019 ISA provide additional support for a causal relationship between short-term $PM_{2.5}$ exposure and cardiovascular effects. . . . Moreover, recent multicity studies . . . evaluated in the ISA Supplement are consistent with studies evaluated in the 2019 ISA."[181]

- "The 2009 ISA concluded that 'a causal relationship is likely to exist between long-term $PM_{2.5}$ exposure and respiratory effects.' . . . Cohort studies evaluated in the 2019 ISA provided additional support for the relationship."[182]

- "The 2009 ISA . . . concluded that a 'causal relationship is likely to exist' between short-term $PM_{2.5}$ exposure and respiratory effects. . . . Epidemiological studies evaluated in the 2019 ISA continue to provide strong evidence for a relationship between short-term $PM_{2.5}$ exposure and several respiratory-related endpoints."[183]

In other cases, the Reconsideration Proposal notes that the conclusions concerning health effects that have a causal or likely causal relationship with $PM_{2.5}$ remain consistent with those in the 2019 ISA. For example, "For cardiovascular-related mortality, the evidence evaluated in the ISA Supplement is consistent with the evidence evaluated in the 2019 ISA."[184] Findings of likely causal associations between $PM_{2.5}$ exposure and lung cancer and $PM_{2.5}$ and nervous system effects were first reached in the 2019 ISA.[185] The Administrator took them into account in deciding in 2020 to retain the existing suite of standards.[186] The Reconsideration Proposal fails to explain adequately why the current Administrator now finds that these same effects warrant a more stringent annual primary $PM_{2.5}$ NAAQS.[187]

[180] *Id*. at 5585.
[181] *Id*. at 5586.
[182] *Id*. at 5587.
[183] *Id*. at 5588.
[184] *Id*. at 5581.
[185] *Id*. at 5589-90.
[186] 85 Fed. Reg. at 82,701-03.
[187] *See* Section III.B.1., *supra*.

### 2. Substantial Uncertainties and Limitations Remain in the Health Effects Evidence.

In proposing to find that the current NAAQS do not provide the requisite public health protection and therefore proposing revisions to the annual primary $PM_{2.5}$ NAAQS, the Administrator does not give appropriate weight to the uncertainties and limitations of the health effects evidence. If he had done so, it should have been apparent that the evidence does not provide a basis for questioning the adequacy of the health protection provided by the existing NAAQS.

In 2020, the Administrator noted and weighed the "important uncertainties and limitations" in the epidemiological evidence which formed the primary basis for the $PM_{2.5}$ NAAQS in reaching his decision to retain the existing suite of standards.[188] He cited these uncertainties and limitations in support of his conclusion that the current suite of standards remains requisite to protect the public health.[189]

The Reconsideration Proposal acknowledges the continued existence of such uncertainties and limitations.[190] The Reconsideration Proposal specifically recognizes that these uncertainties include "some evidence of potential confounding of the $PM_{2.5}$-mortality association by co-pollutants in some of the studies.[191] In addition, it acknowledges the potential for exposure error.[192] It admits unexplained differences remain in $PM_{2.5}$-mortality relationships from city to city and from region to region.[193]

In fact, as recognized by Gradient, a risk science consulting firm, the key epidemiologic studies relied on in the Reconsideration Proposal "have substantial uncertainties and limitations (*e.g.,* exposure measurement error, confounding, irrelevant exposure windows), and do not provide

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[188] 85 Fed. Reg. at 82,714.
[189] *Id*. at 82,718.
[190] 88 Fed. Reg. at 5604, 5628.
[191] *Id*. at 5582.
[192] *Id*. at 5625.
[193] *Id*. at 5584.

adequate evidence of health effects occurring at $PM_{2.5}$ concentrations lower than the current primary annual standard of 12 μg/m$^3$."[194]

Similarly, the National Council for Air and Stream Improvement (NCASI), a research organization that addresses environmental topics relevant to the forest products industry, explains:

> While the current Particulate Matter Integrated Science Assessment (ISA) does compile a large swath of scientific literature related to the potential health effects from exposure to particulate matter, many, if not most of the critical features of systematic review are absent from the current process . . . . This leads to the reliance on studies that either have disqualifying amount of uncertainty inherent to their design or are not designed to address the policy relevant question at hand and, in some cases, exclusion of studies from consideration that may be extremely informative for evaluating cause-and-effect relationships between particulate matter and health outcomes.[195]

NCASI notes that because of "uncertainty, exposure misclassification, confounding, and other sources of risk of bias . . . the current evidence base does not support the need for an annual $PM_{2.5}$ standard of less than 12 μg/m$^3$ to protect public health."

One vital remaining uncertainty relates to the $PM_{2.5}$ levels associated with the health effects of concern. The Reconsideration Proposal recognizes that epidemiologic studies "do not identify particular $PM_{2.5}$ exposures that cause effects."[196] It indicates that more recent studies "continue to provide evidence" of linear, no-threshold concentration-response ("C-R") relationships between long- and short-term $PM_{2.5}$ exposure and mortality,[197] while indicating greater uncertainty about

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[194] Gradient, Comments on US EPA's Proposed Rule for the Reconsideration of the National Ambient Air Quality Standards for Particulate Matter 3 (Mar. 21, 2023) (hereinafter "Gradient Comments"); *see also id*. at 9-12 (discussing specific uncertainties). The Gradient comments have been submitted to Docket EPA-HQ-OAR-2015-0072, but do not yet have a docket number. Gradient's comments are Attachment 1 to these comments.

[195] Letter from Giffe Johnson, PhD, NCASI, to US EPA Docket Center, on Reconsideration of the National Ambient Air Quality Standards for Particulate Matter 2 (undated) (hereinafter "NCASI Comments"). This letter has been submitted to Docket EPA-HQ-OAR-2015-0072, but does not yet have a docket number.

[196] 88 Fed. Reg. at 5605.

[197] *Id*. at 5582, 5585.

the shape of the C-R relationship for effects of long-term exposures to less than 8.0 μg/m$^3$ and short-term exposures to less than 5.0 μg/m$^3$ $PM_{2.5}$.[198]

In its comments, Gradient explains that:

> Exposure measurement errors, ranging from instrument imprecision to the practice of serially averaging measured constituent values over time and space, are pervasive in observational air pollution studies. These errors preclude the ability of these studies to detect a $PM_{2.5}$ threshold , if one were to exist. Given that such errors make determining the true shape of the $PM_{2.5}$ concentration-response function difficult, assessment of risks at low $PM_{2.5}$ exposure levels based on these curves are of dubious reliability.[199]

The level of $PM_{2.5}$ causing health effects and the associated risks to public health are, of course, the key questions when it comes to the adequacy of the current NAAQS. Assuming a linear, no-threshold C-R relationship without accounting for other uncertainties like those mentioned above is misleading and "will always lead to proportional decreases in risk (i.e., each additional μg/m$^3$ reduction produces additional benefits with no clear stopping point)."[200] EPA has treated the C-R relationship as a linear (or log-linear) one without a threshold for the past two PM NAAQS reviews,[201] however, so the assumption of such a relationship here without consideration of uncertainties does not signify health risk at lower $PM_{2.5}$ levels than previously believed.

The Reconsideration Proposal simply does not explain why evidence of associations of PM exposure with the same health effects that EPA considered previously, with significant remaining uncertainties, and given the longstanding assumption of a no-threshold C-R relationship, now warrants a more stringent annual primary $PM_{2.5}$ NAAQS. In the absence of any such explanation

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[198] *Id.*
[199] Gradient Comments at 11.
[200] 88 Fed. Reg. at 5621.
[201] *See* 85 Fed. Reg. at 82,696; *see also* 78 Fed. Reg. at 3119.

and without a basis for such a conclusion, the Administrator should withdraw his reconsideration of the 2020 decision retaining this standard.

**3. Even if EPA Fails To Consider the Substantial Limitations in the Health Effects Evidence, Compliance with the Existing Standard Will Likely Achieve Average Exposure Levels that Fall within EPA's Proposed Range.**

While the Administrator draws on evidence-based and risk-based considerations in evaluating the need to revise the current PM standards, it is clear from his proposed stated rationale that evidenced-based considerations using mean values of key U.S. epidemiology studies are given the greatest weight:

> The Administrator provisionally concludes that a standard level within the range of 9.0 to 10.0 $\mu g/m^3$ would reflect appropriate approaches to placing the most weight on the strongest available evidence, while placing less weight on much more limited evidence and on more uncertain analyses of information available from a relatively small number of studies. He notes that a standard set at 9.0 to 10.0 $\mu g/m^3$ would be at or below the study-reported mean $PM_{2.5}$ concentrations in the key US epidemiologic studies, exposures for which we have the strongest support for adverse health effects occurring.[202]

EPA's implementation of the NAAQS, however, relies on *design values* instead of measurements which average the public's exposure. According to the 2022 Policy Assessment, the maximum annual $PM_{2.5}$ design values in U.S. CBSAs are often 10 to 20 percent *higher* than the annual average concentrations.[203] Thus, design values meeting the current $PM_{2.5}$ standard of 12.0 $\mu g/m^3$ are likely achieving equivalent average exposures of 9.6 to 10.8 $\mu g/m^3$ – a range that overlaps with EPA's proposed range of 9.0 to 10.0 $\mu g/m^3$ and which, according to the Administrator, provide the strongest support for adverse health effects.

Moreover, the 2022 Policy Assessment also notes that recent requirements for $PM_{2.5}$ monitoring at near-road locations in large urban areas may increase the ratios of maximum to

[202] 88 Fed. Reg. at 5,628.
[203] 2022 Policy Assessment at 2-45.

average annual design values.[204] To illustrate, a study cited by EPA in its 2022 Policy Assessment found that 52 percent of near-road monitors reported the highest annual $PM_{2.5}$ design value in the metropolitan statistical area; these design values were, on average, 0.8 μg/$m^3$ higher than the next highest measuring non-near-road monitors.[205] As states continue to install more near-road monitors in response to current EPA monitoring policy, the gap between design values and average exposure concentrations (most similar to study means in the key epidemiology studies) will widen such that compliance with an annual standard of 12.0 μg/$m^3$ is well within EPA's proposed range and the mean values of the key epidemiology studies cited by EPA as providing the strongest evidence.

Some observers may suggest the standard should be set in a manner to assure that no subgroup or even individual should be exposed to levels that approach the design value, shifting the focus from average exposure to a hypothetical exposure to the design value concentrations. This approach, however, is not supported by the key U.S. epidemiology studies on which the Administrator relies. Instead, these studies provide risk inferences that are based on average exposures of the study population that includes an exposure distribution. Simply put, within each study population, some individuals have higher exposures while others have less. Without further information, it is therefore inappropriate to make inferences about subgroup risks within these studies.

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[204] *Id.* at 2-45.

[205] *Id*. at 2-33 (citing Owen Gantt et al., *Characterizing Nitrogen Oxides and Fine Particulate Matter near Major Highways in the United States Using the National Near-Road Monitoring Network*, ENVIRONMENTAL SCIENCE & TECHNOLOGY 55(5): 2831-2838 (2021).

### B. CASAC's Comments Do Not Require Revision of the Annual Primary $PM_{2.5}$ NAAQS.

In the Reconsideration Proposal, the Administrator reports that "every member of the CASAC found that the information . . . supported revising the annual level to 10.0 µg/m$^3$," with a minority recommending a standard in the range of 10.0 µg/m$^3$ to 11.0 µg/m$^3$ and the majority favoring one in the range of 8.0 µg/m$^3$ to 10.0 µg/m$^3$.[206] This, however, does not, accurately and fully characterize the record for this reconsideration and is therefore inaccurate and misleading. The record for this proceeding contains recommendations from two CASAC panels for the Administrator's action on NAAQS. Although the Reconsideration Proposal accurately characterizes the recommendations in the 2022 Sheppard Letter, those in the 2019 Cox Letter are not considered.[207]

The 2019 CASAC Letter explained:

> Given the[] limitations in the underlying science basis for policy recommendations, and diverse opinions about what quantitative uncertainty analysis and further analysis of all relevant data using the best available scientific methods would show, some CASAC members conclude that the Draft PM PA does not establish that new scientific evidence and data reasonably call into question the public health protection afforded by the current 2012 $PM_{2.5}$ annual standard. Other members of CASAC conclude that the weight of the evidence, particularly reflecting recent epidemiology studies showing positive associations between $PM_{2.5}$ and health effects at estimated annual average $PM_{2.5}$ concentrations below the current standard, does reasonably call into question the adequacy of the 2012 annual $PM_{2.5}$ National Ambient Air Quality Standards (NAAQS) to protect public health with an adequate margin of safety.[208]

This 257-page letter provided significant detail explaining why six of the seven members of CASAC at that time concluded that the record did not call into question the adequacy of the 12.0 µg/m$^3$ primary $PM_{2.5}$ NAAQS to provide the requisite public health protection. The

[206] 88 Fed. Reg. at 5626.

[207] As explained in section III.B.1., *supra*, the record on reconsideration must address the conclusions, bases, and rational for EPA's 2020 decision.

[208] 2019 Cox Letter at 1.

Administrator considered all of this advice from CASAC in proposing to retain the PM NAAQS without revision.[209] He considered the view of both the CASAC majority and minority when he concluded that the current primary $PM_{2.5}$ standards "are requisite to protect the public health from fine particles with an adequate margin of safety, including the health of at-risk populations."[210] It is arbitrary and capricious for the current Administrator not to consider this critical part of the record.

### C. The Populations Identified as "At-Risk" Are Appropriately Protected by the Current NAAQS.

In setting NAAQS, EPA seeks to protect sensitive – or in EPA's terminology "at-risk" – populations.[211] The Reconsideration Proposal recognizes, "[t]he information available in this reconsideration has not altered our understanding of human populations at risk of health effects from $PM_{2.5}$ exposures."[212] Yet, despite indicating that the populations at greatest risk from exposure to ambient $PM_{2.5}$ have not changed, EPA asserts that evidence in the ISA Supplement shows that some of these "at-risk" groups are now recognized as being at greater risk from $PM_{2.5}$ due to higher exposures.[213] But EPA fails to address whether these higher exposures involve exposures that violate a NAAQS and, if so, to what extent. If a NAAQS is violated, that violation must be remedied. NAAQS must be attained in ambient air throughout the country. Lowering a NAAQS because of an existing NAAQS violation does not ensure that violation is remediated and would unnecessarily harm the nation's productivity.

Moreover, even if the higher exposures are unrelated to NAAQS violations, they do not provide the basis for a more stringent NAAQS. When revising the annual primary NAAQS from

[209] *See* 85 Fed. Reg. at 82,690.
[210] *Id*. at 82,718; s*ee also id*. at 82,706-07, 82,716.
[211] 88 Fed. Reg. at 5563 n.5.
[212] *Id*. at 5591.
[213] 88 Fed. Reg. at 5592.

15.0 μg/m$^3$ to 12.0 μg/m$^3$, EPA took the potential for higher exposures of "at-risk" groups into account. The Agency considered "potential impacts on low-income and minority populations" and modified the form of the standard "to avoid potential disproportionate impacts on" them.[214] The record does not indicate that this consideration of potential higher exposures of "at-risk" groups was inadequate.

The Reconsideration Proposal also refers to evidence for "health risk disparities" for these populations.[215] As an initial matter, many of the epidemiology studies on which the evaluation of the current standard is based involved populations from "at-risk" populations.[216] Moreover, the key studies on which EPA relies in assessing disparate health risk of mortality from long-term exposure to $PM_{2.5}$ do not support risk differences.[217] Thus, EPA lacks any meaningful evidence of differences in health risk on the basis of race or socioeconomic status.

**D. Risk Estimates Do Not Support the Need for a More Stringent NAAQS.**

The Reconsideration Proposal notes that the risk assessment in the 2022 Policy Assessment "includes updates and improvements to input data and modeling approaches" compared to the risk assessment in the 2020 Policy Assessment.[218] Importantly, the result of these updates and improvements is that the risks estimated in the 2022 Policy Assessment are *actually lower* than those that were estimated in the 2020 Policy Assessment on which the 2020 decision to retain the NAAQS was based. For estimates of mortality associated with long-term $PM_{2.5}$ exposure, the 2022 Policy Assessment relied on a hazard ratio of 1.073 (1.071-1.075) from Di, et al. (2017),[219]

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[214] 78 Fed. Reg. 3086, 3267 (Jan. 15, 2013).

[215] 88 Fed. Reg. at 5592.

[216] Gradient Comments at 18.

[217] *Id*. at 19 ("[N]one of the five studies cited in the ISA Supplement … that valuated the dose-response relationship between long-term $PM_{2.5}$ exposure and total mortality stratified by race/ethnicity … support the conclusion that there is a disparity in $PM_{2.5}$-related mortality risk associated with race/ethnicity.").

[218] 88 Fed. Reg. at 5615.

[219] 2022 Policy Assessment C-8, tbl. C-1.

which is lower than the 1.084 (1.081-1.086) hazard ratio used for the risk assessment in the 2020 Policy Assessment.[220] Moreover, the 2022 Policy Assessment indicates that, while the risk assessment used a single-pollutant model, the Di, et al. (2017) study also included a co-pollutant model which, if it had been used, would have reduced mortality estimates by approximately a further 13 percent.[221]

The Administrator, however, does not recognize that the estimated risks have decreased. Indeed, the Reconsideration Proposal states:

> Although the methodologies and data used to estimate risks in this reconsideration differ in several ways from what was used in the 2020 review, the findings and considerations summarized in the PA present a pattern of exposure and risk that is *generally similar to that considered in the 2020 review and indicate a level of protection generally consistent with that describer in the 2020 PA*.[222]

The Administrator simply does not explain why these lower risks (or even similar risks) warrant a more stringent standard than the 12 µg/m$^3$ one EPA found in 2020 provided the requisite public health protection. In fact, the updated and improved information on risk assessment adds support for EPA's December 2020 decision to retain the annual primary $PM_{2.5}$ standard without revision.

The varying hazard indices and resulting risk estimates serve to highlight uncertainties about the entire risk assessment. The Reconsideration Proposal itself acknowledges:

> Uncertainty in risk estimates (e.g., in the size of risk estimated) can result from a number of factors, including the assumptions about the shape of the C-R function with mortality at low ambient PM concentrations, the potential for confounding and/or exposure measurement error in the underlying epidemiological studies, and the methods used to adjust $PM_{2.5}$ air quality. More specifically, the use of air quality modeling to adjust $PM_{2.5}$ concentrations are limited as they rely on model predictions, are based on emission changes are scaled by fixed percentages, and use only two of the full set of possible emission scenarios and linear

[220] *Id*.
[221] *Id.*, tbl. C-1, n.5.
[222] 88 Fed. Reg. at 5616 (emphasis added).

> interpolation/extrapolation to adjust air quality that may not fully capture potential non-linearities associated with real-world changed in air quality.[223]

It also recognizes:

> [T]he at-risk analysis is also subject to many of these same uncertainties. Additionally, the at-risk analysis included C-R functions from only one study . . .as opposed to the multiple studies used in the overall risk assessment to convey risk estimates.[224]

Gradient points to yet another limitation of the risk assessment:

> The long-term exposure studies of $PM_{2.5}$ that US EPA evaluated did not assess the risks of lifetime exposures or determine how individuals' $PM_{2.5}$ exposures before the study period impact the interpretation of their results, even though it is hard to imagine these earlier exposures not playing a role if $PM_{2.5}$ exposure is indeed causal.[225]

These substantial uncertainties about and limitations of the risk assessment mean that it cannot provide meaningful insight into health risks associated with air quality associated with attainment of either the current or alternative annual $PM_{2.5}$ NAAQS. Thus, it does not provide a basis for a decision to increase the stringency of the NAAQS.

Finally, the risk assessment does not reflect risks associated with current air quality. Without information on those risks, it is impossible to assess whether lower NAAQS would lead to discernible public health improvement. Only five areas in the entire country do not meet the 12.0 $\mu g/m^3$ $PM_{2.5}$ NAAQS.[226] The 2022 Policy Assessment reports, "[a]t long-term monitoring sites in the U.S., annual $PM_{2.5}$ concentrations from 2017 to 2019 averaged 8.0 $\mu g/m^3$ (with the $10^{th}$ and $90^{th}$ percentiles at 5.9 and 10.0 $\mu g/m^3$, respectively)," even when days affected by episodic events such as wildfires and windstorms were included.[227] Information on the health risk posed

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[223] 88 Fed. Reg. at 5606.

[224] *Id*. at 5607.

[225] Gradient Comments at 12.

[226] *See* EPA, Green Book *PM-2.5 (2012) Nonattainment Areas* (Feb. 28, 2023), https://www3.epa.gov/airquality/greenbook/knc.html.

[227] 2022 Policy Assessment at 2-28.

by $PM_{2.5}$ in ambient air should reflect this reality. In its risk assessment, however, EPA virtually ignores information on current air quality. Instead, the Agency seeks to characterize risks in a fictional world in which the current $PM_{2.5}$ NAAQS are just attained everywhere.[228] For this purpose, in selecting sites to be considered for the risk assessment, the Agency first focused on those areas in which either the annual or the 24-hour $PM_{2.5}$ NAAQS, or both, had been exceeded during the 2014 to 2016 period, and then added consideration of areas that met, but were close to, those NAAQS.[229] For those areas that met the NAAQS, EPA used a modeling approach to adjust $PM_{2.5}$ air quality data from 2015 upward (i.e., added additional theoretical $PM_{2.5}$ to what was actually present) to reflect what air quality might have been had the area just attained the NAAQS.[230] The Agency also used modeling to estimate air quality in these areas in 2015 as if they just attained an alternative annual NAAQS of 10.0 $\mu g/m^3$ and an alternative 24-hour NAAQS of 30 $\mu g/m^3$.[231] The Agency modeled and reported risks associated with these alternative NAAQS levels compared to risks if the current standard were just attained.[232] This is simply not reflective of reality and leads to significantly overstated health benefits of any more stringent standard.

Although EPA has air quality data from 2015 for all of the areas it addressed in its risk assessment,[233] and predicted health risk associated with that air quality,[234] it nowhere provides information on the specific estimated health risks with this actual, monitored air quality. Appendix C to the 2022 Policy Assessment includes limited information on predicted $PM_{2.5}$-related mortality associated with these "recent conditions,"[235] but the body of that document only says, in a footnote,

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[228] *Id.* at 3-138.
[229] *Id.* at 3-141.
[230] *Id.* at 3-140 to 3-141.
[231] *Id.* at 3-140.
[232] *See id.* at 3-149, tbl. 3-14.
[233] *Id.* at 3-140, C-47, tbl. C-10.
[234] *Id.* at C-47, Fig. C-24.
[235] *Id.* at C-50, Fig. C-25; C-54, Fig. C-29; C-55, Fig. C-30. "Recent conditions" here is a bit of a misnomer. The monitored data are from eight years ago.

that "assumptions that PM concentrations would not increase would make results [of analyses of risks associated with recent conditions] difficult to interpret."[236] It is unrealistic to suggest that air quality in areas attaining the NAAQS will degrade. $PM_{2.5}$ concentrations have declined steadily since 1990.[237] States and localities have economic and other incentives to avoid air quality declines that could lead to a designation as nonattainment. Moreover, several CAA programs guard against such degradation. These programs include New Source Performance Standards,[238] Prevention of Significant Deterioration,[239] and emission standards for motor vehicles.[240]

Without information on health risks associated with current air quality, and given the uncertainty concerning attaining the current or alternative NAAQS, the risk assessment does not provide the Administrator with a rational basis for assessing the public health impact of a more stringent NAAQS. Any decision to revise the annual NAAQS that is based on this risk assessment would be arbitrary and capricious.

### E. The Administrator Must Consider Disbenefits of a More Stringent NAAQS.

Although courts have held that the Administrator may not consider the costs of attainment when promulgating a NAAQS,[241] as discussed above, costs are relevant when considering whether it is appropriate to continue with reconsideration of a NAAQS.[242] Moreover, the Administrator must also consider environmental disbenefits of a more stringent NAAQS.[243]

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[236] 2022 Policy Assessment at 3-146, n.58.

[237] *See* EPA, Our Nation's Air: Trends Through 2021, https://gispub.epa.gov/air/trendsreport/2022/#introduction. Despite the steady decrease in concentrations of $PM_{2.5}$, as EPA recognizes, small year-to-year variability can occur. *See id*.

[238] CAA § 111.

[239] *Id*. §§ 160-169.

[240] *Id*. § 202.

[241] *Whitman*, at 465.

[242] *See* Sections II & III.A., *supra*.

[243] The D.C. Circuit has held that EPA must evaluate the net adverse health effects of a pollutant in the ambient air, including considering the pollutant's beneficent effects, when deciding whether to revise a NAAQS. *Am. Trucking Ass'ns v. EPA*, 175 F.3d at 1052-53, *aff'd in part and modified in part on other grounds on rehearing*, 195 F.3d 4, 10 (D.C. Cir. 1999), *rev'd in part on other grounds sub nom Whitman v. Am. Trucking Assn's,* 531 U.S.

Should the Administrator lower the level of the annual $PM_{2.5}$ NAAQS despite our recommendation to the contrary, that action could result in actions that themselves would cause increases in PM in ambient air. For example, requiring the operation of fabric filters, electrostatic precipitators and venturi scrubbers on sources emitting as few as five tons of $PM_{2.5}$ annually, as is contemplated in EPA's draft RIA,[244] would require additional energy usage, and the production of this energy would itself likely increase emissions into ambient air.[245] So, too, paving roads and road shoulders, as contemplated in the RIA,[246] would entail energy usage and increased emissions. Moreover, promulgation of a more stringent NAAQS would likely shift economic activity and growth to parts of the world with less stringent standards, potentially leading to a worldwide increase in $PM_{2.5}$. The Administrator must take these environmental and related health disbenefits into account in deciding whether to continue with this reconsideration, and discuss those impacts in any re-proposal, prior to revising the NAAQS.

Environmental impacts associated with implementation of a more stringent NAAQS would not be limited to impacts on air resources. Water resources could also be adversely impacted. Dust suppression measures require the use of water, a resource that is severely limited in some Western areas,[247] where the greatest number of nonattainment areas are likely.[248] The

457 (2001). Similarly, the Administrator should weigh negative environmental effects of a revised NAAQS against its benefits.

[244] RIA at 3-3, 4-3, and 4-8.

[245] A control strategy that focused on precursor emissions would also require additional energy consumption, with resulting increases in emissions.

[246] *See* RIA at 3A-3.

[247] *See* Bill Weir, "Scientists fear a Great Toxic Dustbowl could soon emerge from the Great Salt Lake," CNN (Feb. 10, 2023), https://www.cnn.com/2023/02/10/us/utah-great-salt-lake-dust-pollution-weir-wxc/index.html; Joshua Partlow, "Officials fear 'complete doomsday scenario' for drought-stricken Colorado River, Washington Post (Dec. 1, 2022), https://www.washingtonpost.com/climate-environment/2022/12/01/drought-colorado-river-lake-powell/.

[248] *See* RIA at 2-27.

Administrator should also weigh these adverse effects on the environment in reaching his decision on NAAQS revision.

Moreover, given that he must consider economic costs in deciding whether to reconsider the NAAQS and if so, what revision would be appropriate, the Administrator should consider both the economic cost of potential new control measures and other economic impacts of a more stringent NAAQS. A more stringent NAAQS would lead to delay, uncertainty, and disapprovals of permits even in areas where the NAAQS are not violated. A recent analysis by the forest products industry, for example, estimated that reducing the annual $PM_{2.5}$ standard to 10.0 µg/m$^3$ would cost pulp, paper, and packaging facilities between $1 and $2 billion and wood products manufacturing facilities between $500 and $750 million for emission controls in order to obtain required permits.[249] The cost to pulp, paper, and packaging facilities is estimated to be between $3 and $4 billion and to wood products manufacturing facilities between $900 million and $1 billion if the standard were reduced to 8.0 µg/m$^3$.[250] Assuming that other manufacturing sectors are similarly affected, the cost to manufacturing interests *in areas not violating* a 8.0 µg/m$^3$ NAAQS "could be almost $20 billion for direct $PM_{2.5}$ emissions . . . and even more when precursor emissions such as NOx, $SO_2$, VOC, and ammonia . . . are considered."[251] These estimates do not account for unquantifiable costs due to forgone opportunities for new facilities or facility expansions.

In short, before reaching a decision on reconsideration of the NAAQS, the Administrator must consider both adverse environmental effects of a more stringent standard and control costs in areas that meet the standard. Neither is reflected in EPA's draft RIA. Both are substantial.

[249] *See* Impacts at 3-4.
[250] *Id.* at 3-4.
[251] *Id*. at 4.

### F. The Wide Range of Values for the Annual Primary $PM_{2.5}$ NAAQS on Which the Administrator Is Taking Comment Will Require him To Weigh Numerous Factors To Select an Appropriate Standard Level.

Under the CAA, only the Administrator has the authority to set, review, and revise NAAQS.[252] To reach a decision in this proceeding on whether to uphold the 2020 decision to retain the 12.0 µg/m$^3$ annual primary $PM_{2.5}$ NAAQS or to revise it, and, if the latter, what the level of the revised NAAQS should be, the Administrator must base his judgment on the entire record, including the record underlying the 2020 decision to retain the standards. This record includes, *inter alia*, the advice of his staff and of CASAC, as well as public comment. The scientific evidence concerning health effects associated with long-term exposure to low levels of $PM_{2.5}$ is highly uncertain. This can be seen from the virtually opposite views of two CASACs on whether NAAQS revision is warranted. It can also be seen from the wide range of options on which the Reconsideration Proposal seeks comment, everything from retaining a standard of 12.0 µg/m$^3$ to reducing the level of the standard by a third, to 8.0 µg/m$^3$.

In the face of this uncertainty, the Administrator should consider whether he can judge that a more stringent standard – even one of 11.0 µg/m$^3$, which is at the top of the range for a possible standard revision – can reasonably be expected to yield public health benefits. If it would not, then the Administrator should continue to retain the current 12.0 µg/m$^3$ NAAQS. That is the case here.

First, the scientific uncertainties are too great for the Administrator to have confidence that further reducing the level of $PM_{2.5}$ in ambient air would reduce the risk to public health. Second, a NAAQS will produce health benefits only if it produces improvements in air quality. As illustrated by EPA's recent proposal to disapprove California's $PM_{2.5}$ SIP for the San Joaquin

[252] CAA §§ 109(b), (d).

Valley,[253] an area currently classified as Serious nonattainment for the 12.0 μg/m$^3$ NAAQS,[254] parts of the country cannot attain even the current standard. EPA's proposed SIP disapproval is based in part on its conclusion that a plausible strategy has not been identified for achieving the necessary emission reductions.[255] If an area cannot attain the current 12.0 μg/m$^3$ standard, it surely cannot attain any health benefits postulated to result from a more stringent one. Indeed, EPA itself fails in its RIA to identify control measures sufficient to attain any more stringent standard throughout the country.[256] Third, as discussed above, measures required to attain a more stringent NAAQS could themselves have adverse health effects.[257] Fourth, as discussed above, control costs, other economic factors, and implementation feasibility are relevant to a decision on whether reconsideration of a properly promulgated NAAQS is appropriate.[258] Finally, as Justice Breyer pointed out, "[t]he [CAA] by its express terms, does not compel the elimination of all risk, and it grants the Administrator sufficient flexibility to avoid setting ambient air quality standards ruinous to industry."[259] For all these reasons, the Administrator should judge that revision of the annual primary $PM_{2.5}$ NAAQS is not appropriate at this time and should withdraw this reconsideration.

## VII. The Administrator's Proposal To Retain the 24-Hour Primary $PM_{2.5}$ NAAQS Is Appropriate.

The Administrator proposes to retain the 35 μg/m$^3$ 24-hour primary $PM_{2.5}$ NAAQS.[260] He does so "recogniz[ing] that the current annual standard . . . and 24-hour standard . . . together, are intended to provide public health protection against the full distribution of short- and long-term $PM_{2.5}$ exposures" and that "the 24-hour standard, with its 98th percentile form, is most effective

[253] 87 Fed. Reg. 60,494 (Oct, 5, 2022).
[254] https://www3.epa.gov/airquality/greenbook/knc.html.
[255] 87 Fed. Reg. at 60,514.
[256] NERA Report at 1.
[257] *See* Section VI.E., *supra*.
[258] *See* Section II, III.A., *supra.*
[259] *Whitman*, 531 U.S. at 494 (Breyer, J. concurring in part and dissenting in part).
[260] 88 Fed. Reg. at 5629.

at limiting peak daily or 24-hour concentrations."[261] Focusing first on the controlled human exposure studies, he notes that results of these studies, largely involving 2-hour exposures, "are inconsistent particularly at . . . $PM_{2.5}$ concentrations" lower than those found in ambient air.[262] He explains that, even at higher concentrations, the effects observed are "intermediate" ones that "typically, would not, by themselves, be judged as adverse."[263] Looking at monitored air quality in the United States, he "finds that the current suite of standards maintains sub-daily concentrations far below the current concentrations in controlled human exposure studies where consistent effects have been observed."[264] As to the epidemiologic evidence, the Administrator explains this evidence "does not help to inform questions on the adequacy of the current 24-hour standard given that the 24-hour standard focuses on reducing 'peak' exposures (with its 98th percentile form)."[265] Specifically, he notes difficulties in relating the air quality scenarios analyzed in the studies to the level and form of the current 24-hour standard.[266] With regard to the risk assessment, the Administrator recognizes it finds health benefits associated with a more stringent 24-hour standard only in a "more limited" population.[267] He also points out that neither the majority of CASAC members (who supported consideration of a more stringent 24-hour NAAQS) or the minority of CASAC members (who did not) indicated that the risk assessment justified a more stringent NAAQS.[268] The Administrator's proposal to retain the current 24-hour NAAQS is sound.

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[261] *Id*. at 5617.
[262] *Id*. at 5620.
[263] *Id*.
[264] *Id*. at 5621.
[265] *Id*.
[266] *Id*.
[267] *Id.* at 5622, 5623.
[268] *Id*. at 5623.

**A. Evaluation of the 24-Hour Standard in the Context of the Full Suite of Primary $PM_{2.5}$ Standards Is Appropriate.**

As a preliminary matter, the Administrator's evaluation of the adequacy of the 24-hour standard in the context of the protection provided by the suite of NAAQS follows a longstanding Agency practice. In 1997, when EPA first adopted NAAQS using a $PM_{2.5}$ indicator, the Administrator explained:

> [T]he suite of $PM_{2.5}$ standards could most effectively and efficiently be defined by treating the annual standard as the generally controlling standard for lowering both short- and long-term $PM_{2.5}$ concentrations. In conjunction with the annual standard, the 24-hour standard would serve to provide protection against days with high peak $PM_{2.5}$ concentrations, localized 'hot spots,' and risks arising from seasonal emissions that would not be well controlled by a national annual standard.[269]

EPA deviated from this approach in 2006, leading the D.C. Circuit to question whether the annual $PM_{2.5}$ standard would protect against short-term exposures.[270] Following the D.C. Circuit's remand of EPA's 2006 PM NAAQS rule, the Agency returned to its 1997 approach:

> [T]he Administrator conclude[d] that it is appropriate to set an annual standard that is generally controlling, which will lower the broad distribution of 24-hour average concentrations in an area as well as the annual average concentration, so as to provide protection from both long- and short-term $PM_{2.5}$ exposures. In conjunction with this, it is appropriate to set a 24-hour standard focused on providing supplemental protection, particularly for areas with high peak-to-mean ratios of 24-hour concentrations, possibly associated with strong local or seasonal sources, and for $PM_{2.5}$-related effects that may be associated with shorter-than-daily exposure periods.[271]

The Administrator is acting reasonably in continuing to follow this approach in the current proceedings. Moreover, recent air quality data show that peak $PM_{2.5}$ levels that the Administrator

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[269] 62 Fed. Reg. 38,652, 38,669 (July 18, 1997). Petitions for review of the standards promulgated under this rationale were denied by the D.C. Circuit. *Am. Trucking Assn's v. EPA*, 283 F.3d 355, 374, 379 (D.C. Cir. 2002).

[270] *See Am. Farm Bureau Fed'n. v. EPA*, 559 F.3d 512, 524 (D.C. Cir. 2009) (remanding to EPA the final rule on PM NAAQS published at 71 Fed. Reg. 61,144 (Oct. 17, 2006)).

[271] 78 Fed. Reg. 3099, 3158 (Jan. 15, 2013). Petitions for review of this rule were also denied. *Nat'l Ass'n. Mfrs. v. EPA,* 750 F.3d 921, 927 (D.C. Cir. 2014).

has identified as being of concern do not occur in areas where the current suite of standards is attained.[272]

**B. The Scientific Evidence Concerning Health Effects of Short-Term $PM_{2.5}$ Exposure Has Not Changed Significantly Since the Previous NAAQS Review.**

In fact, the Administrator's identification of effects of concern overstates the risks associated with short-term exposure to $PM_{2.5}$ in ambient air in light of the current suite of standards. The evidence for short-term effects is consistent with that at the time of the 2020 decision to retain the existing standards and is effectively consistent with the evidence considered in the previous review. This consistency extends not only to the level at which effects have been reported in studies but also to remaining uncertainties and limitations in the evidentiary database. Moreover, by ignoring these uncertainties and current air quality, EPA's risk assessment overstates the risk to public health that is associated with current air quality.

**1. The Effects Deemed To Have a Causal or Likely Causal Association with Short-Term $PM_{2.5}$ Exposure Have Not Changed.**

In each ISA, EPA characterizes the scientific evidence for a causal relationship between the pollutant that is the subject of the ISA and specific types of health effects into five categories: causal relationship; likely to be a causal relationship; suggestive of, but not sufficient to infer, a causal relationship; inadequate to infer a causal relationship; and not likely to be a causal relationship.[273] EPA bases NAAQS on evidence of effects that are causal or likely causal. In reviewing a NAAQS, EPA builds on the evidence base as summarized in earlier ISAs.

In the present review and reconsideration, EPA compares causal determinations in the 2019 ISA with those in the 2009 ISA from the previous (2012) PM NAAQS review. In no case does the 2019 ISA conclude that the evidence now supports a new and different finding of a "causal"

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[272] 2019 Policy Assessment at 3-221 to 3-222.
[273] EPA, Preamble to the Integrated Science Assessments 22-23 (2015).

or "likely causal" association between short-term exposure to $PM_{2.5}$ and a health effect of concern.[274] Specifically, the 2019 ISA continues to find evidence to support a causal association only between short-term $PM_{2.5}$ exposure and mortality and cardiovascular effects and a likely causal relationship between short-term $PM_{2.5}$ exposure and respiratory effects.[275] In fact, newer evidence supports, and is consistent with, earlier conclusions about causality:

- "In summary, recent evidence evaluated in the 2019 ISA and the ISA Supplement *further supports and extends the conclusions of the evidence base reported in the 2009 ISA*."[276]
- "*Consistent with the 2009 PM ISA*, the strongest evidence comes from epidemiologic studies that reported consistent positive associations between short-term $PM_{2.5}$ exposure and cardiovascular-related ED visits and hospital admissions."[277]
- "Taken together, the evidence described within the 2019 PM ISA *extends the consistency and coherence of the evidence base reported in the 2009 PM ISA* and 2004" Air Quality Criteria Document.[278]

### 2. Uncertainties in and Limitations of the Evidence Supporting EPA's Causality Determinations Remain.

Not only is evidence concerning the effects that EPA considers likely to be caused by short-term exposure to $PM_{2.5}$ consistent with that from prior NAAQS reviews, uncertainties and limitations of that evidence continue. One of the key limitations of the evidentiary database remains EPA's failure to have conducted a transparent, systematic review of the evidence.

NCASI points out that "a systematic process, with specific, measurable criteria to rank and weight studies is largely absent from the ISA."[279] Furthermore, "*Without a systematic process to select, rank, disqualify and weight studies with measurable features of study quality that are free*

[274] *See* 2019 ISA at 1-60, fig. 1-1. The ISA Supplement addresses "only the health effects evidence for which the 2019 PM ISA concluded a *causal relationship*." ISA Supplement at 1-3.

[275] 2019 ISA at 1-60, fig. 1-1. By citing to these EPA determinations, the NR3 Coalition is not indicating that it agrees with them. It is citing them solely for the purpose of showing that *EPA's* assessment of the effects associated with short-term exposure to $PM_{2.5}$ has not changed.

[276] 2022 Policy Assessment at 3-36 (emphasis added).

[277] ISA Supplement 2-7 (emphasis added).

[278] *Id*. at 3-7 (emphasis added).

[279] NCASI Comments at 12.

*from individual bias, the conclusions of the ISA are impaired and do not represent the best science available for policy decision-making.*"[280]

In addition to the problems posed by the lack of a systematic and transparent review of the scientific evidence, other acknowledged uncertainties and weaknesses remain in the evidentiary record. Gradient explains, "Considering the uncertainties in and limitations of the scientific evidence and qualitative information regarding short-term $PM_{2.5}$ exposure … we agree with the US EPA Administrator that the primary 24-hour $PM_{2.5}$ standard should be retained."[281]

### C. Risks Associated with Exposure to Short-Term $PM_{2.5}$ Exposures Are Overstated in EPA's Risk Assessment.

EPA's risk assessment overstates the health risks posed by exposure to 24-hour concentrations of $PM_{2.5}$ in ambient air and the potential health benefits of a more stringent standard for two fundamental reasons. First, the risk assessment does not address the uncertainties in the scientific evidence discussed above. By failing to do so, while at the same time providing statistical confidence intervals around the estimates, the risk assessment overstates the certainty that a more stringent 24-hour $PM_{2.5}$ NAAQS will produce the predicted benefits.

Second, the starting point for the risk assessment does not reflect current air quality. Only eleven areas in the entire country are designated nonattainment for the current 24-hour $PM_{2.5}$ NAAQS.[282] The 2022 Policy Assessment reports, "At long-term monitoring sites in the U.S., . . . the 98th percentiles of 24-hour concentrations [from 2017 to 2019] averaged 21.3 $\mu g/m^3$ (with the 10th and 90th percentiles at 14.0 and 29.7 $\mu g/m^3$ respectively)," even when days affected by

280 *Id.* (emphasis in original).
281 Gradient Comments at 17.
282 *See* EPA, Green Book, *PM-2.5 (2006) Nonattainment Areas* (Feb. 28, 2023), https://www3.epa.gov/airquality/greenbook/rnc.html.

episodic events such as wildfires and windstorms were included.[283] Information on the health risk posed by $PM_{2.5}$ in ambient air should reflect this reality.

But, as discussed above,[284] in its risk assessment, EPA virtually ignores information on current air quality. Building from air quality in 2015, the Agency seeks to characterize risks in a fictional world in which the current $PM_{2.5}$ NAAQS are just attained everywhere.[285] The Agency then uses modeling to estimate air quality in these areas as if they just attained an alternative annual NAAQS of 10.0 μg/m$^3$ and an alternative 24-hour NAAQS of 30 μg/m$^3$.[286] The Agency reports risks associated with these alternative NAAQS levels compared to risks if the current standard were just attained.[287] This is simply not reflective of reality and leads to significantly overstated health benefits of any more stringent standard.

It is unrealistic to suggest that air quality in areas attaining the NAAQS in 2015 – let alone those attaining today – will degrade. $PM_{2.5}$ concentrations and emissions contributing to them have declined steadily since 1990.[288] Even apart from the general incentive that areas have to avoid designation as a nonattainment area, several CAA programs serve to protect against such degradation, including programs establishing New Source Performance Standards,[289] Prevention of Significant Deterioration,[290] and emissions standards for motor vehicles standards.[291]

In fact, modeling air quality as just meeting the current standards in areas where the air quality is cleaner leads to mortality predictions that are significantly overestimated when compared

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[283] 2022 Policy Assessment at 2-28.
[284] *See* Section VI.C., *supra*.
[285] 2022 Policy Assessment at 3-138.
[286] *Id*. at 3-140.
[287] *See* 2022 Policy Assessment at 3-149, tbl. 3-14.
[288] *See* Section I, *supra*.
[289] CAA § 111.
[290] *Id*. §§ 160-169.
[291] *Id*. § 202.

to more realistic estimates using current air quality. As CASAC member Dr. James Boylan has explained:

> EPA's approach evaluates the change in risk associated with moving from $PM_{2.5}$ air quality "just meeting" the current standards (12/35) to "just meeting" alternative annual and/or 24-hour standards (10/30). While this approach is appropriate for CBSAs that are currently above the current standards, this approach is *not* appropriate for CBSAs that are currently below the current standards and results in estimated reductions in $PM_{2.5}$-a[ss]ociated mortality [risks] that are significantly overestimated compared to the actual number of prevented deaths. . . . *In order to accurately evaluate the number of* actual *deaths that will be prevented if the standard was lowered, the starting point for the risk analysis for each CBSA that is already below the current $PM_{2.5}$ NAAQS needs to be the 2018-2020 $PM_{2.5}$ design values, not the current NAAQS.*[292]

This overestimation of deaths avoided affects EPA's already small estimates of potential mortality benefits from lowering the existing 24-hour $PM_{2.5}$ standard. For example, the 24-hour $PM_{2.5}$ design value for Fulton County, Georgia, (home of Atlanta) for 2019-2021 was 21 $\mu g/m^3$ and that of New York-Newark-Jersey City Core-Based Statistical Area ("CBSA") was 22 $\mu g/m^3$,[293] both well below the 35 $\mu g/m^3$ level of the NAAQS. Accounting for current air quality in these cities would reduce the Agency's existing estimated 1 to 2 percent reduction in mortality from reducing the current 24-hour daily standard to 30 $\mu g/m^3$ to zero in each city. In other cities, the "corrected" estimate may well be within the margin of error of the analysis due to the many assumptions and uncertainties involved.

Given the significant overestimation of the benefits that might be anticipated from alternative NAAQS, the risk assessment cannot be relied upon as support for a more stringent 24-hour NAAQS. Instead, it supports the Administrator's proposal to retain the current 24-hour standard.

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[292] 2022 Sheppard Letter at A-22 (individual comments of Dr. Boylan) (emphasis in original). As illustrated in the text, this statement remains valid for 2019 to 2021 design values.

[293] EPA, Air Quality Design Values (Aug. 2022), https://www.epa.gov/air-trends/air-quality-design-values#report (scroll to $PM_{2.5}$ Design Values, 2021).

### D. Retention of the Current 24-Hour $PM_{2.5}$ NAAQS Is Consistent with the CASAC's Advice.

As explained above, the record for this reconsideration contains letters from two different CASACs expressing their recommendations for the Administrator's action on the suite of standards.[294] The 2019 Cox letter indicates that CASAC found "the available evidence does not reasonably call into question the adequacy of the current 24-hour $PM_{2.5}$ standard."[295] One member, in his individual comments, questioned the protection provided by the combination of the annual and 24-hour standards.[296] In contrast, the 2022 Sheppard letter states, "the majority of CASAC members find that the available evidence calls into question the adequacy of the current 24-hour standard."[297] A minority of CASAC members found that EPA had justified retention of the current standard.[298] Because two members were members of both CASACs,[299] the Administrator received the advice of twelve members of the two CASACs. Although some CASAC members questioned the adequacy of the current 24-hour primary NAAQS, this was not a majority opinion. Thus, retaining the current primary 24-hour $PM_{2.5}$ standard is consistent with the CASAC advice in the rulemaking record.

Moreover, the diversity of CASAC member opinions in the face of scientific evidence that has not materially changed illustrates that the decision on whether standard revision is warranted is not a scientific question. Instead, it is one of science policy. As such, even if a majority of CASAC members had recommended revision of the NAAQS, the Administrator could reach a

[294] *See* Section III.B.2., *supra*.

[295] 2019 Cox Letter at 2 and Consensus Responses at 11.

[296] 2019 Cox Letter, Comments of Dr. Mark Frampton at 3.

[297] 2022 Sheppard Letter at 3. To the extent that CASAC members recommending a lower 24-hour $PM_{2.5}$ standard are concerned about exposure to $PM_{2.5}$ caused by wildfires, *see, e.g.*, *id*., Consensus Responses at 13, it should be noted that the Clean Air Act directs EPA's program to exclude exceptional events, including natural events such as wildfires, from consideration when determining whether an area attains a NAAQS. Thus, a more stringent NAAQS would not reduce exposure to wildfire-generated $PM_{2.5}$.

[298] *Id*. at 4.

[299] *Compare* 2019 Cox Letter at ii (CASAC membership in 2019), *with* 2022 CASAC Letter at ii (CASAC membership in 2022).

different public health policy judgment.[300] Given the split among CASAC members, however, the Administrator public health policy judgment that revision of the NAAQS is not appropriate is consistent with CASAC's advice,[301] and is warranted for the reasons discussed above.

### E. Disbenefits Support the Administrator's Preliminary Judgment that a More Stringent 24-Hour Primary $PM_{2.5}$ NAAQS Would Not Be Appropriate.

For reasons discussed above, the Administrator would need to take costs into account before deciding during this reconsideration proceeding that a more stringent 24-hour primary NAAQS would be appropriate.[302] In addition, as explained above, he would need to weigh health and environmental disbenefits of such a NAAQS against its possible benefits.[303] The potential disbenefits of a more stringent 24-hour NAAQS would likely be similar to those of a more stringent annual standard. Once again, the control measures to reduce PM emissions could lead to increased energy usage, which would likely result in increases in emissions into the air. Such emissions could produce health and environmental harms. In addition, again water resources could be adversely impacted. Furthermore, a tighter 24-hour NAAQS could again impose significant costs on sources in and outside of nonattainment areas.[304] These disbenefits further support the Administrator's conclusion that increasing the stringency of the 24-hour primary $PM_{2.5}$ NAAQS is not appropriate.

[300] *See Mississippi*, 744 F.3d at 1357-58 n.6 (D.C. Cir. 2013) (explaining that when CASAC and EPA both exercise policy judgment, EPA's policy judgment is determinative).

[301] EPA points out that the 2022 CASAC, although questioning the form of the 24-hour standard, recommended retaining the current form at this time. 88 Fed. Reg. at 5619.

[302] *See* Sections II, III.A., *supra*.

[303] *See* Section VI.E., *supra*.

[304] *See generally*, Impacts.

## VIII. The Administrator Properly Recognizes There Is No Basis for Increasing the Stringency of the Primary $PM_{10}$ NAAQS.

Since 1987, EPA has enforced a 24-hour primary standard for $PM_{10}$ at a level of 150 µg/m$^3$, allowing an average of one exceedance of that level every three years.[305] That standard was retained by the 2020 rulemaking that the Agency is now reconsidering.[306] In the current reconsideration, the Administrator again proposes to retain the primary $PM_{10}$ standard.[307] This proposal is both appropriate and reasonable.

EPA now considers the $PM_{10}$ NAAQS a surrogate indicator for coarse PM – particles with a nominal mean aerodynamic diameter between 2.5 µg and 10.0 µg, denominated $PM_{10-2.5}$.[308] As both the 2019 ISA and the Reconsideration Proposal recognize, the scientific evidence does not support a causal or likely causal determination for any adverse health outcomes for short- or long-term exposure to $PM_{10-2.5}$.[309] In particular, the 2019 ISA concludes that the causality determinations for all health outcome categories for short- and long-term $PM_{10-2.5}$ exposure are "either suggestive of, but not sufficient to infer, a causal relationship or inadequate to infer the presence or absence of a causal relationship."[310] Although the 2022 Policy Assessment notes that the evidence for some $PM_{10-2.5}$-related health effects has "been strengthened," it recognizes that this evidence still suffers from significant uncertainties identified as long ago as the 2012 PM NAAQS review.[311] These uncertainties include questions about the $PM_{10-2.5}$ exposure estimates used in epidemiologic studies, about the potential for confounding by co-occurring pollutants,

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[305] 52 Fed. Reg. 24,634 (July 1, 1987).

[306] 85 Fed. Reg. 82,687, 82,727 (Dec. 18, 2020).

[307] 88 Fed. Reg. at 5637.

[308] 2020 Policy Assessment at 4-18.

[309] 2019 ISA at 1-66 to 1-68, Tbl. 1-4; 88 Fed. Reg. at 5630. The ISA Supplement does not address $PM_{10-2.5}$ because it addresses only health effect relationships for which the 2019 ISA found a causal or likely causal relationship. 88 Fed. Reg. at 5630.

[310] 2019 ISA at ES-23 (emphasis omitted).

[311] 2022 Policy Assessment at 4-9.

about the independence of $PM_{10-2.5}$ health effect associations, and about the biological plausibility of the $PM_{10-2.5}$-related effects.[312] In 2022, CASAC concurred with this discussion of the uncertainties and noted "the difficulty in extracting the sole contribution of coarse PM to observed adverse health effects, in light of the causal evidence for $PM_{2.5}$ which can be a confounder in studies of $PM_{10}$ health effects."[313] Indeed, in 2019, then-CASAC Chair Tony Cox pointed out that studies reporting positive associations between health effects and $PM_{10-2.5}$ should not be used to assess causality because "positive associations that are not free from confounding, coincident historical trends, and other non-causal explanations, do not provide valid evidence for making or strengthening causal determinations. Using them for this purpose amounts to drawing causal conclusions from non-causal evidence, and is not scientifically valid."[314]

Recognizing the limitations in the scientific database, EPA staff conclude "the available evidence in this reconsideration of the 2020 final decision supports retaining the current standard."[315] The 2019 CASAC determined that the available evidence did not call into question the adequacy of the public health protection afforded by the existing primary $PM_{10}$ standard and expressed support for retaining the current standard.[316] The 2022 CASAC supported the recommendation to retain the primary $PM_{10}$ NAAQS without revision.[317] For these reasons, the Administrator's proposal to retain the primary $PM_{10}$ NAAQS is both appropriate and reasonable.[318]

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[312] *Id*. at 4-9 to 4-10.
[313] 2022 Sheppard Letter, Consensus Responses at 19.
[314] Individual Comments of Dr. Tony Cox, 2019 Cox Letter at B-26.
[315] 2022 Policy Assessment at 4-19.
[316] 2019 Cox Letter, Consensus Responses at 13.
[317] 2022 Sheppard Letter, Consensus Responses at 19.
[318] One member of the NR3 Coalition, the National Mining Association, is filing separate comments that address the substantial uncertainties that continue to plague research into health effects of coarse PM that prevent promulgation of any more stringent NAAQS for coarse PM and the importance of accounting for the effect of crustal PM on judging compliance with the $PM_{2.5}$ NAAQS.

## IX. The Administrator's Proposal Not To Revise the Secondary NAAQS Is Reasonable and Consistent with the Scientific Evidence.

The Act directs EPA to set secondary NAAQS that specify a level of air quality that, "in the judgment of the Administrator," is requisite to protect the public welfare from "known or anticipated" risks of "adverse" effects.[319] As with the primary NAAQS, the Act does not require the Administrator to set secondary NAAQS at a zero-risk level.[320] Rather, secondary NAAQS are to be set at a level that limits risk sufficiently to protect the public welfare, but not at a level more stringent than necessary to provide this protection.[321]

The current secondary NAAQS for PM are equal to the primary NAAQS, with the exception that the secondary annual $PM_{2.5}$ standard is 15.0 $\mu g/m^3$ instead of 12.0 $\mu g/m^3$.[322] These standards are based on protection of visibility, taking into account effects on other welfare values, including climate change and materials damage. Consistent with the decision the Agency reached in 2020 that "the current secondary standards are requisite to protect the public welfare from known or anticipated adverse effects,"[323] the Administrator's proposal to determine "that no change to the current secondary PM standards is required at this time to provide requisite protection against the public welfare effects of PM within the scope of this reconsideration" is a reasonable exercise of his public welfare policy judgment authority under the Act.[324]

### A. The Current Secondary NAAQS Provide the Requisite Protection of Visibility.

In reaching his conclusion to propose retaining the current secondary NAAQS, the Administrator focuses first on the protection of visibility provided by the 24-hour $PM_{2.5}$ standard. He recognizes that the information on acceptable visibility "is largely the same as [it] was in the

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[319] CAA § 109(b)(2).
[320] 88 Fed. Reg. at 5644.
[321] *Id*.
[322] *Id*.
[323] 85 Fed. Reg. 82,684, 82,744 (Dec. 18, 2020).
[324] *See* 88 Fed. Reg. at 5643.

[2012 and 2020] reviews."[325] The one new study of visibility preference in the United States is Malm, et al., (2019), which the Administrator recognizes cannot readily be compared to the earlier studies.[326] Further, the Administrator notes that the Malm study examined visibility in Grand Canyon National Park. He concludes that Congress intended that visibility protection for a Class I Area such as the Grand Canyon would be provided by the CAA's regional haze program rather than a secondary NAAQS.[327] As a result, he concludes that this study should not be the basis for his decision on whether the secondary NAAQS require revision.

Given the lack of new relevant scientific information, it is not surprising that the Administrator concludes that the current standards continue to protect public welfare with regard to visibility. The Administrator proposes to conclude that the indicator, form, and averaging time of that standard remain appropriate.[328] These conclusions are all rational, given that neither his career staff nor CASAC identified any alternatives for these aspects of the secondary NAAQS.[329]

Turning to the level of the standard, he, as have his predecessors, identifies a 30 deciview (dv) visibility as the level requisite to protect public welfare.[330] In doing so and responding to a request from the 2022 CASAC for better justification of the 30 dv level, the Administrator explains at some length the "substantial uncertainties and limitations" in the visibility preference studies that provide the basis for the secondary NAAQS.[331] He reasons that, given the uncertain nature of

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[325] *Id*. at 5659.

[326] *Id*. at 5649-50; s*ee also* 2022 Policy Assessment at 5-24 to 5-25.

[327] 88 Fed. Reg. at 5658, 5660.

[328] *See* 88 Fed. Reg, at 5658-59; *see also* 2022 Policy Assessment at 5-27 to 5-29 (recommending retention of the present indicator, form, and averaging time for the standard).

[329] *See* 2022 Policy Assessment at 5-27 to 5-28; 2019 Cox Letter at 3. The 2022 CASAC suggests, "*For future reviews*, . . . a more extensive technical evaluation of the alternative measures to provide the basis for a secondary standard protective of visibility." 2022 Sheppard Letter at 4 (emphasis added). By tying this recommendation to future reviews, CASAC tacitly acknowledges that the current record does not support consideration of such alternatives.

[330] 88 Fed. Reg. at 5660; 85 Fed. Reg. at 82,741; 78 Fed. Reg. at 3226-27.

[331] 88 Fed. Reg. at 5660; *see also* 2022 Policy Assessment at 5-26, 5-29 (identifying remaining scientific uncertainties and limitations and expressing continued support for use of a 30 dv visibility index).

the data and recognizing that the Regional Haze Program works with the secondary NAAQS to protect visibility, "it is appropriate to establish a target level of protection based on the upper end of the range of [studied] levels."[332] He notes that these judgments are "consistent with similar judgments in past reviews,"[333] when the same underlying data were available. Citing analyses by his staff "demonstrat[ing] that the 3-year visibility metric is at or below 28 dv in all areas meeting the current 24-hour $PM_{2.5}$,"[334] and noting that the 2022 CASAC did not recommend any alternative level for the NAAQS,[335] he "proposes to conclude that the current secondary standards provide requisite protection against PM-related visibility effects."[336] This conclusion is well-grounded in the science and is appropriate.

**B. Revision of the NAAQS To Protect Materials and Climate Is Not Appropriate.**

The Administrator also considers evidence that PM causes impacts on materials and climate. He concludes that uncertainties and limitations of significance remain concerning the relationships between PM and damage to materials and changes in climate such that "it is not appropriate to establish any distinct secondary PM standards to address" them.[337] This conclusion is consistent with the advice of both CASAC panels and of his staff.[338]

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[332] 88 Fed. Reg. at 5660.

[333] *Id*.

[334] *Id*.; *see also* 2022 Policy Assessment at 5-30 to 5-33.

[335] 88 Fed. Reg. at 5660. The 2019 CASAC explicitly concluded that "the available evidence does not call into question the protection afforded by the current secondary PM standards." 2019 Cox Letter, Consensus Responses to Charge Questions at 14.

[336] 88 Fed. Reg. at 5661. Noting the request of the 2022 CASAC for better justification for the determination that a 30 dv visual range is protective of public welfare, the Administrator solicits comment on a 24-hour $PM_{2.5}$ standard as low as 25 $\mu g/m^3$, noting the need for justification for any such comments. 88 Fed. Reg. at 5662. No such more stringent standard is justified in light of the uncertainties and limitations in the evidence concerning PM effects on visibility, as discussed in the proposal and in the 2022 PA.

[337] 88 Fed. Reg. at 5661.

[338] 2022 Sheppard Letter at 22-23 ("large uncertainties" remain concerning the relationship between PM and climate change, and quantitative information on the relationship between PM and materials damage "is lacking"); 2019 Cox Letter, Consensus Responses to Charge Questions at 13-14 (recognizing "uncertainties" about concerning the PM/materials damage and PM-climate relationships); 2022 Policy Assessment at 5-50 (recognizing "significant uncertainties" remain related to quantifying the relationship of PM to climate and materials).

With regard to PM effects on materials, EPA staff explain:

> While there are a number of studies in the 2019 ISA that investigate the effect of PM on newly studied materials and further characterize the effects of PM on previously studied materials, there remains insufficient evidence to relate soiling or damage to specific PM levels or to establish a quantitative relationship between PM in ambient air and materials degradation. Uncertainties that were identified in the 2012 review still largely remain with respect to quantitative relationships between particle size, concentration, chemical concentrations, and frequency of repainting and repair. No new studies are assessed in the 2019 ISA that link perceptions of reduced aesthetic appeal of buildings and other objects to PM-related materials effects. Moreover, uncertainties about the deposition rates of airborne PM to surfaces and the interaction of co-pollutants still remain.[339]

With regard to PM and climate, they state:

> [S]ignificant uncertainties remain that make it difficult to quantify the climate effects of PM. Such uncertainties include those related to our understanding of:
>
> - The magnitude of PM radiative forcing and the portion of that associated with anthropogenic emissions;
> - The contribution of regional differences in PM concentrations, and of individual components, to radiative forcing;
> - The mechanisms of climate responses and feedbacks resulting from PM-related radiative forcing; and,
> - The process by which PM interacts with clouds and how to represent such interactions in climate models.[340]

Declining to set a standard in the face of these uncertainties is appropriate. Revising a NAAQS in the face of uncertainties of this nature would be inappropriate. When an EPA Administrator lacks an adequate scientific basis to make a reasonable judgment on an appropriate standard to protect public welfare, any standard would be arbitrary and capricious, *per se*.[341]

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[339] 2022 Policy Assessment at 5-46 to 5-47.
[340] *Id*. at 5-41.
[341] *Ctr. Biological Diversity v. EPA*, 749 F.3d 1079, 1087 (D.C. Cir. 2014).

## X. Even if EPA Were Conducting a Review of the PM NAAQS, the Appropriate Action Would Be Retention of the Existing Standards.

EPA has characterized the current proceeding as a reconsideration of its 2020 decision to retain the existing PM NAAQS.[342] That characterization is accurate. As the Agency recognizes, this proceeding is not based on a completely updated ISA,[343] which would be required before a review of the NAAQS would be appropriate. Instead, it builds on the record compiled by the prior administration, including the 2019 ISA.

Even if EPA instead considers the present proceeding to be a review of the NAAQS, retention of *all* the current PM NAAQS would remain the appropriate decision. A revision is not required each time a NAAQS is reviewed. The decision in 2020 that revision of the PM NAAQS was not then appropriate is consistent with this statutory scheme. Indeed, under both Democratic and Republican administrations, EPA has a history of concluding against revision of the NAAQS at the end of a review.[344]

As discussed above, the uncertainty about possible health effects below the level of the current annual and 24-hour primary $PM_{2.5}$ NAAQS is too great for revision of those standards to be appropriate now. Similarly, uncertainty about the benefit of any more stringent primary $PM_{10}$ NAAQS makes increasing the stringency of that standard inappropriate.[345] Furthermore, the evidence points to the adequacy of the present secondary NAAQS to protect visibility.[346] Finally, the science does not permit quantification of a level at which PM adversely affects materials and

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[342] *See* 88 Fed. Reg. at 5560.

[343] *See id*. at 5568.

[344] *See, e.g.*, Review of the National Ambient Air Quality Standards for Oxides of Nitrogen, 83 Fed. Reg. 17,226 (Apr. 18, 2018); Review of the National Ambient Air Quality Standards for Lead, 81 Fed. Reg. 71,906 (Oct. 18, 2016); Secondary National Ambient Air Quality Standards for Oxides of Nitrogen and Sulfur, 77 Fed. Reg. 20,218 (Apr. 3, 2012); National Ambient Air Quality Standards for Ozone – Final Decision, 58 Fed. Reg. 13,008 (Mar. 9, 1993).

[345] *See* Section IX.A., *supra*.

[346] *See* Section IX.B., *supra*.

climate that would warrant consideration of a revision to the secondary NAAQS.[347] In short, given the nature of the scientific evidence, revision of *any* PM NAAQS at this time to increase its stringency is inappropriate.

## XI. EPA Should Follow the Suggestions of State, Local, and Tribal Agencies and Their Representatives in Revising Requirements for $PM_{2.5}$ Monitoring.

EPA is proposing numerous revisions to its requirements for $PM_{2.5}$ monitors, use of data from different types of $PM_{2.5}$ monitors, and monitor siting.[348] Some of these revisions appear ministerial.[349] Others are more significant and could affect determinations of whether NAAQS are attained.[350] As a preliminary matter, we agree with EPA that data that are not from a FRM or a FEM must not be used for regulatory purposes.[351]

EPA notes that it is using American Rescue Plan funds to upgrade FRM-only monitoring sites.[352] This is a reasonable use of those funds. When considering how to upgrade the $PM_{2.5}$ monitoring network, EPA should also consider providing funds to states to locate monitors in rural areas. Placing monitors in such areas could help address the PSD permitting challenges addressed in Sections V.A.1. above by providing more realistic values for background air quality. Alabama has sited such rural monitors and is finding that the data they provide indicate that background air quality is better than was previously assumed.

[347] *See* Section VI, VII, *supra*.

[348] 88 Fed. Reg. at 5662-5680.

[349] For example, EPA proposes to update references and codify existing practices for combining data from nearby sites. *Id*. at 5663.

[350] For example, EPA proposes to modify specifications for calibration of FEMs to address recognized biases in the comparability of certain Federal Equivalent Method ("FEM") monitors to FRMs. *Id*. at 5670.

[351] *Id*. at 5679-80 (explaining that satellite-based measurements and those from low cost, portable air sensors are not usable for regulatory uses). Because these data are not suitable for regulatory use, they should not be relied upon to make decisions about the boundaries of a nonattainment area, as EPA indicates has been done in the past. *See id*. at 5678.

[352] *Id*. at 5679.

For other aspects of the proposed rules, EPA must work with the state, local, and tribal agencies that are responsible for establishing monitoring networks, collecting air quality data, and reporting those data to EPA. EPA clearly recognizes the importance of these groups, having discussed the question of FEM bias with them.[353] It is less clear that EPA is following their recommendations.

For example, the Association of Air Pollution Control Agencies ("AAPCA") – not one state, as the Reconsideration Proposal says[354] – asked EPA to "Consider the use of correction factors developed for collocated FRMs and FEMs."[355] As EPA recognizes, CASAC also suggested this approach.[356] Yet EPA appears to dismiss this suggestion in favor of "a national solution in factory calibrations of approved FEMs through a firmware update."[357] Without taking a position on EPA's proposed solution, the NR3 Coalition urges EPA to give greater weight to the reactions of their state, local, and tribal partners to this proposal. Furthermore, EPA should give serious consideration to other recommendations by these partners.

## XII. EPA Should Provide a More Realistic Picture of Costs and Benefits of Revised $PM_{2.5}$ NAAQS Under the Reconsideration Proposal.

The RIA states that "[t]he prohibition against considering cost in the setting of the primary air quality standards does not mean that costs, benefits, or other economic consequences are unimportant."[358] These factors are even more important here since, as noted above, the Administrator can consider costs and burdens in deciding whether to move forward with this

[353] *Id*. at 5672.
[354] *Id*.
[355] Letter from Jason E Sloan, Executive Director, AAPCA, to Mr. Peter Tsirigotis, Director, Office of Air Quality Planning and Standards (OAQPS), at 2 (Nov. 23. 2022) (addressing particulate matter monitoring method comparability).
[356] 88 Fed. Reg. at 5682.
[357] 88 Fed. Reg. at 5670.
[358] RIA at ES-2.

reconsideration.[359] Thus, unlike in the normal five-year review cycle, this RIA is not simply for "informational purposes only."[360] The RIA must present a clear picture of the Reconsideration Proposal's benefits as well as its costs and burdens so that the Administrator can make an informed decision as to the appropriateness of finalizing reconsideration of the 2020 PM NAAQS and changing the existing EPA policy therein.

The RIA falls well short of providing such clarity. First, it fails to present a path toward attaining the Reconsideration Proposal's proposed and alternative standards. In doing so, it substantially underestimates costs to apply controls in and around nonattainment areas to meet those standards. As have RIAs in the past, this RIA completely excludes the substantial costs that sources in attainment areas would face due to permitting gridlock caused by more stringent $PM_{2.5}$ NAAQS. Second. it claims benefits of the Reconsideration Proposal that are premised on highly uncertain and subjective inputs. Fueled not by new risks but rather the substantial population residing in potential nonattainment areas, many of which would be nonattainment for the first time, the RIA projects significantly higher benefits for the Reconsideration Proposal than were found in past analyses. However, by failing to do economy-wide modeling, the RIA does not equally capture the sensitivities that such a large population base would have on costs arising from the Reconsideration Proposal.

The RIA is not just informational. It is critical to this reconsideration. EPA should revisit the RIA and work to provide a more realistic cost-benefit analysis of the Reconsideration Proposal – one that leads the Administrator to the sound public policy conclusion that this reconsideration should be withdrawn.

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[359] *See* Section II, III.A., *supra*.
[360] *See* 88 Fed. Reg. at 5563.

### A. EPA Cannot Identify a Path Toward Complying with the Reconsideration Proposal's Stringent Standards.

The Reconsideration Proposal's executive summary includes EPA's boilerplate RIA description, "As has *traditionally* been done in NAAQS rulemaking, the EPA prepared a Regulatory Impact Analysis (RIA) to provide the public with information on the potential costs and benefits of *attaining* several alternative $PM_{2.5}$ standard levels."[361] EPA should have been more careful when reproducing this language. This RIA is not traditional. Rather, for the first time in a NAAQS rulemaking, this RIA does not even attempt to provide the public with potential costs for fully attaining proposed or alternative standards.

This RIA is not the first to be unable to identify known controls necessary to achieve the range of revised standards discussed in the Reconsideration Proposal. While EPA's citation of unknown controls is not unique to the Reconsideration Proposal,[362] however, the scale of this reliance is. As seen in the table below, the percentage of unknown controls has grown substantially from the RIA for the Final 2012 PM NAAQS Rule to this RIA. In 2012, EPA projected that reducing the annual $PM_{2.5}$ NAAQS from the then-existing standard of 15.0 $\mu g/m^3$ down to 13.0 $\mu g/m^3$ would have required a reduction of 674 tons of emissions beyond those that could be obtained through application of known controls. An equivalent 2 $\mu g/m^3$ reduction from the current standard down to 10 $\mu g/m^3$ in this RIA yields an estimate that 8,330 tons of emissions would be required in addition to those obtainable through use of known controls – an astounding 1,136 percent increase in tons for which controls were not identified over the 2012 PM NAAQS Final RIA.

[361] *Id.* (emphasis added); *see also National Ambient Air Quality Standards for Particulate Matter, Proposed Rule*, 77 Fed. Reg. 38,889, 39,984 (June 29, 2012) (2012 $PM_{2.5}$ NAAQS proposal containing identical language).

[362] RIAs for both the 2012 PM NAAQS and 2015 Ozone NAAQS could model only partial attainment after applying known controls.

| Emissions Remaining After Application of Known Controls: 2012 PM NAAQS Final RIA and 2022 Reconsideration Proposal RIA | | | |
|---|---|---|---|
| Reduction from Existing Standard | 2012 PM NAAQS Final RIA[363] | 2022 Reconsideration Proposal RIA[364] | Increase in Unknown Controls |
| 2 µg/m$^3$ | 674 tons | 8,330 tons | 1,136% |
| 3 µg/m$^3$ | 3,190 tons | 18,157 tons | 469% |
| 4 µg/m$^3$ | 1,500 tons | 39,912 tons | 2,561% |

It is here where the RIA sharply breaks from past practice. So substantial is the issue of unknown controls in the Reconsideration Proposal that EPA does not even attempt to quantify the cost of such controls. In the past, EPA addressed unknown controls in NAAQS RIAs by assigning them a general cost per ton based on varied extrapolation assumptions.[365] While this approach almost certainly underestimated the rapidly increasing control costs, it was at least an attempt to calculate costs of all controls necessary to attain a more stringent standards.

In contrast, this RIA introduces the novel nomenclature of "*estimated* emissions reductions" (i.e., reductions that can be accomplished through known controls) and "*needed* emissions reductions" (i.e., reductions needed for compliance), abruptly stopping its analysis at the assumption that *estimated* emissions reductions "do not fully account" for *needed* emissions reductions.[366] The RIA admits that, with all known controls applied, "there are remaining air quality challenges in the northeast and southeast, as well as in the west and California."[367] In other words, the RIA concedes that the best that can be achieved is partial attainment of the Reconsideration Proposal's proposed and alternative standards.

The infeasibility of meeting a more stringent $PM_{2.5}$ NAAQS is illustrated by EPA's inability to project attainment at any of the standard levels on which the Agency has solicited

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[363] Regulatory Impact Analysis for the Final Revisions to the National Ambient Air Quality Standards for Particulate Matter (undated) ("2012 PM NAAQS Final RIA"), 4-14 tbl. 4-4, EPA-452/R-12-005.
[364] Reconsideration Proposal RIA at ES-12 tbl. ES-4.
[365] NERA Report at 8-10.
[366] RIA at 3-25 (emphases in original).
[367] *Id.* at 4-10.

comment. The RIA highlights some of these concerns, noting that challenges inhibiting compliance include local source-to-monitor impacts, cross-border transport, effects of complex terrain in the West and California, and wildfire influence.[368] EPA effectively admits that the Reconsideration Proposal would create new, potentially permanent, nonattainment areas, in addition to those areas that have struggled for decades to attain NAAQS.

The RIA's inability to project a pathway toward complying with more stringent standards raises broader concerns about the Reconsideration Proposal's reasonableness. This is particularly the case in light of the substantial uncertainty in the science underlying the Administrator's proposed decision to revise the $PM_{2.5}$ NAAQS – including uncertainty identified by his predecessor and not properly reconsidered in the Reconsideration Proposal.[369]

### B. EPA's Failure to Estimate the Full Costs of Compliance Conflicts with its Statutory Obligation Under Section 312 of the CAA to Conduct a Comprehensive Analysis of the Impacts of EPA Regulations.

Under CAA § 312, the Administrator is required to conduct a "comprehensive analysis" of the "costs, benefits and other effects associated with compliance with each standard." In performing this analysis, CAA § 312(c) further requires the Administrator specifically to address the effects of such standards on "employment, productivity, cost of living, economic growth, and the overall economy of the United States." EPA's failure to estimate the full costs of compliance with any of the proposed $PM_{2.5}$ alternative standards, let alone compliance with the current standard, will prevent the Agency from fulfilling its statutory obligation under CAA § 312. It will also undermine Congress' intent that such information be made available to the public. Further, EPA's failure to conduct a full cost analysis will impede the ability of the Office of Management and Budget to fulfill its obligations under the Regulatory Right-to-Know Act to issue "an

[368] RIA at 4-11.
[369] *See* Section VI.A.2., VII.B.2.

accounting statement and associated report" to Congress each year that includes an estimate of the total annual costs and benefits of federal rules and paperwork.[370] EPA cannot thwart Congress' clear intent for transparency with regard to costs and benefits by attempting to hide the true cost of regulations by deciding not to estimate them. Any decision to do so would be arbitrary and capricious.

### C. EPA Grossly Underestimates the Cost of Controls To Comply with the Reconsideration Proposal's Stringent Standards.

The RIA concedes that, "[t]o the extent that additional $PM_{2.5}$ emissions reductions are required that were not identified in our analysis of these areas, the annualized control costs *may be* underestimated."[371] Yet, the RIA projects only partial attainment of revised $PM_{2.5}$ NAAQS, arbitrarily capping control costs at $160,000 per ton and failing to monetize unknown controls beyond that point.[372] Accordingly, the only way control costs *may be*, rather than *are*, underestimated is if EPA believes it is possible that (1) areas will elect not to install additional controls in the face of the Reconsideration Proposal's stringent standards and instead accept long-term nonattainment, or (2) current businesses in the area will cease to operate. Otherwise, it is undisputable that the RIA underestimates the costs of complying with the Reconsideration Proposal's proposed and alternative standards – by a wide margin. EPA should acknowledge that it cannot provide the public with a reasonably accurate estimate of the cost of attaining NAAQS if EPA cannot actually specify measures to bring all areas into attainment.

NERA Economic Consulting analyzed EPA's partial attainment approach, concluding that it leaves the RIA's cost estimates "incomplete to the point of having very limited usefulness to

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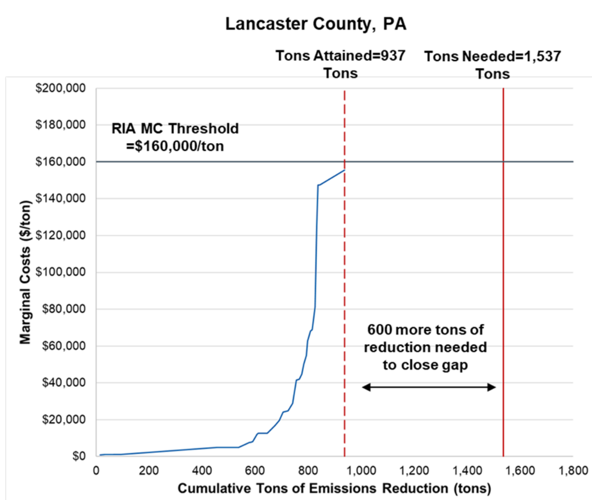
[370] 31 U.S.C. § 1105 note. The Regulatory Right-to-Know Act was enacted as part of the of Treasury and General Government Appropriations Act, 2001, Pub. L. No. 106-554 (2000), https://www.govinfo.gov/content/pkg/PLAW-106publ554/html/PLAW-106publ554.htm.

[371] RIA at 4-11 (emphasis added).

[372] *Id*. at ES-10.

decision making or public understanding of the full potential impacts of any of the alternative standards."[373] Excluding unknown controls costs above $160,000 effectively cuts marginal costs off as they increase at their fastest pace. For example, EPA projects that Lancaster County, Pennsylvania, needs 1,537 tons of emissions reductions to attain an 8 μg/m$^3$ $PM_{2.5}$ NAAQS.[374] The RIA can identify only 937 tons of emissions reductions within the constraints of its modeling because control measures after that point cost more than $160,000 per ton.[375] As can be seen in the below graph reproduced from the NERA Comments,[376] this effectively masks the price of controls at the point marginal costs grow exponentially. The impact is astounding. EPA projects partial attainment will result in annual control costs for Lancaster County of $27.2 million.[377] When accounting for growing costs as controls become more scarce, NERA projects full attainment costs for just Lancaster Country to be $96 million – 450 percent greater than the RIA's reported partial attainment costs.[378]




County that is in partial attainment in RIA

373 NERA Report at 6.
374 *Id*. at 18.
375 *Id*. at 19.
376 *Id*. at 18, fig. 2.
377 *Id*. at 19.
378 *Id*.

NERA extrapolated full attainment costs for all counties modeled to partial attainment in the RIA (15 counties at an annual $PM_{2.5}$ NAAQS of 10.0 μg/m$^3$, 22 at a standard of 9.0 μg/m$^3$, and 61 at a standard of 8.0 μg/m$^3$).[379] The results show the astonishing gap in the RIA's cost analysis. While the RIA projects partial attainment of a 10.0 μg/m$^3$ annual $PM_{2.5}$ NAAQS would result in just $95 million in annual control costs, NERA finds that full attainment could cost as much as $4.3 billion per year.[380] The RIA projects partial attainment costs for a 9.0 μg/m$^3$ standard at $393 million and an 8.0 μg/m$^3$ standard at $1.8 billion, while NERA calculates full attainment costs at as much as $9.2 billion and $23.7 billion respectively.[381] As NERA concludes, "partial attainment costs provide no indication of either the absolute or relative costs of any of the alternative standards considered. Their presence in the RIA's executive summary is therefore misleading."[382]

The RIA caps Reconsideration Proposal control costs as they rapidly increase. The Agency should instead provide a full accounting of the Reconsideration Proposal's costs acknowledging that control option costs rise as states exhaust compliance options. Indeed, EPA should provide better information on the basis of its cost estimates in general. This includes providing a clearer picture of its cost analysis by specifically delineating costs and impacts to municipalities and small business through independent analyses.

### D. EPA Should Quantify Increased Permitting Costs in Attainment and Unclassifiable Areas Under the Reconsideration Proposal's Stringent Standards.

Even if the RIA were to more accurately portray control costs, it would capture only part of the Reconsideration Proposal's effect on nonattainment areas. Indeed, the Reconsideration

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[379] *Id.* at 20 tbl. 2. NERA's methodology for deriving estimates of full attainment costs is explained at pages 21 to 27 of their comments.
[380] *Id*. at 31 tbl. 4.
[381] *Id*.
[382] *Id*. at 3, 38.

Proposal's impact would be still greater when considering the impact across the country on permitting necessary for economic development in local communities that are *in attainment or unclassifiable*. These costs grow every time EPA revises a NAAQS. Yet in the RIA, EPA once again fails to calculate the economic impact of more stringent NAAQS on PSD permitting. EPA should acknowledge the costly impact of any new NAAQS on permitting sources in areas attaining the NAAQS.

As discussed in Section V, *supra*, and Attachment 3, as NAAQS have become more stringent, the costs of permitting major sources and modifications in attainment and unclassifiable areas have increased over time and the Reconsideration Proposal's revised $PM_{2.5}$ NAAQS, if promulgated, would exacerbate this problem. Permitting obstacles undermine efforts to grow the economy and have a real-world impact on construction of projects with state-of-the-art pollution controls.[383]

This is not what Congress intended when it stated in the Act that PSD permitting should "insure that economic growth will occur in a manner consistent with the preservation of existing clean air resources."[384] And yet this is exactly what would happen under the more stringent $PM_{2.5}$ NAAQS suggested in the Reconsideration Proposal. Such a NAAQS would prevent companies from receiving needed permits, foreclose proposed projects, and ultimately inhibit job creation. EPA should provide a fuller picture of the Reconsideration Proposal's economic impacts by revising the RIA to address effects on PSD permitting within attainment areas.

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[383] *See e.g., The American Energy Initiative: A Focus on the New Proposal to Tighten National Standards for Fine Particulate Matter: Hearing before the H. Comm. on Energy and Commerce, Subcomm. on Energy and Power* (June 28, 2012) (testimony from Charlotte Pipe and Foundry Company noting that $PM_{2.5}$ NAAQS permitting modeling requirements forced the company to abandon efforts to replace an aging foundry with a new, state-of-the-art, high-efficiency green facility).

[384] CAA §160(3).

### E. Benefits Cited in the Reconsideration Proposal Are Subjective and Highly Uncertain.

The RIA is deficient on both sides of the ledger, not only underestimating costs that will have certain impact, but also treating benefits of any more stringent NAAQS as more certain than is justified. At a fundamental level, the epidemiological associations on which those benefits are based suffer from substantial uncertainty.[385] Although EPA recognizes that the uncertainties about possible health benefits from improved air quality increase at lower $PM_{2.5}$ exposure levels,[386] the RIA fails to reflect the increasing uncertainty about benefits at the lowest levels of $PM_{2.5}$ exposure. Continuing disagreements over causality and the concentration-response relationship in benefit estimations raise questions as to the level of benefits, or whether those benefits should be counted at all. It was uncertainties like these that caused the former Administrator and prior CASAC to conclude that the $PM_{2.5}$ NAAQS should be retained – findings in this docket that are central to reconsidering the 2020 PM NAAQS.

The uncertainty underlying the science on which the Reconsideration Proposal relies is compounded by the manner in which benefits are monetized by the RIA. Reconsideration Proposal benefit estimations are overwhelmingly driven by the "value of statistical life" (VSL) metric. The higher the VSL, the higher the value of benefits attributed to a regulation – and EPA uses one of the highest VSLs used by government agencies to calculate benefits for its regulations.[387]

It is important to note that the VSL estimate upon which EPA relies in the RIA is not based on a single, comprehensive valuation analysis. Rather, it is a mean of a Weibull distribution fitted to 26 different VSL estimates identified in economics literature.[388] The data was highly dispersed,

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[385] *See* discussion herein at Section II.A.1.a.

[386] 88 Fed. Reg. at 5627.

[387] Dave Merrill, *No One Values Your Life More Than the Federal Government*, Bloomberg.com (Oct. 19, 2017), https://www.bloomberg.com/graphics/2017-value-of-life/.

[388] EPA, *Mortality Risk Valuation Estimates* in GUIDELINES FOR PREPARING ECONOMIC ANALYSIS App. B (2014).

with VSL estimates ranging from as little as $850,000 ($2006) to as much as $19.8 million ($2006).[389] As such, EPA's central VSL estimate of $7.4 million ($2006) is subject to substantial variability, with a significantly high standard deviation of $4.7 million ($2006).[390]

Indeed, in his 1976 paper setting the foundation for VSL estimates, Robert Thaler, 2017 winner of the Nobel Prize for Economics and father of behavioral economics, suggested a VSL estimate that, if applied to the RIA, would reduce benefits in the Reconsideration Proposal by 80 percent.[391] Recent analysis building on Thaler's work raises questions as to whether a single VSL exists at all, noting that "[a] better understanding of how consumers value a wide range of non-market goods and services, including clean air, public transportation, school quality, and a host of other issues, will result in better policies going forward and have a positive impact on social welfare."[392]

This is not to argue that EPA has necessarily selected the wrong VSL. Rather, the discussion highlights the extent to which benefits in the Reconsideration Proposal are highly dependent on subjective VSL estimates. Accordingly, there is substantial quantitative uncertainty regarding benefits claimed in the Reconsideration Proposal, yet the costs remain highly certain – and significantly understated.

### F. The Sensitivity of EPA's Benefits Calculations to Population Size Highlights the Need To Quantify Economy-Wide Impacts of More Stringent Standards.

The uncertainty and subjectivity pervading the RIA's benefits calculation is particularly relevant when accounting for the sheer size of those benefits. This is not due to newly identified

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389 *Id*.

390 *Id*.

391 Richard Thaler & Sherwin Rosen, *The Value of Saving a Life: Evidence from the Labor Market*, in HOUSEHOLD PRODUCTION AND CONSUMPTION 294 (Nestor E. Terleckyj ed. 1976).

392 Kyle Greenberg, Michael Greenstone, Stephen P. Ryan, & Michael Yankovich, The Heterogeneous Value of a Statistical Life: Evidence from U.S. Army Reenlistment Decisions (Sep. 30, 2021), https://bfi.uchicago.edu/working-paper/2021-75/.

risk, but rather the significant portion of U.S. population that would be affected by the Reconsideration Proposal. While the RIA's benefits estimate accounts for the base of population regulated, its cost projections do not reflect this same sensitivity.

EPA claims substantially more benefits in the RIA then it did in the 2012 PM NAAQS RIA[393] for the same incremental $PM_{2.5}$ NAAQS reduction. For example, the RIA estimates between 1,054 percent and 1,131 percent more benefits for full attainment of a 2.0 µg/m$^3$ drop in $PM_{2.5}$ annual NAAQS as compared to the 2012 PM NAAQS RIA. Overall C?R functions used in the two RIAs are similar,[394] and EPA maintains the same VSL estimate accounting for inflation. The primary difference is population affected.

**Benefits Claimed for Full Attainment in the 2012 PM NAAQS RIA and Reconsideration Proposal RIA[395]**

| Reduction of Annual $PM_{2.5}$ NAAQS | Estimate/ Discount | Benefits ($ Billions) | | | Increase |
|---|---|---|---|---|---|
| | | 2012 RIA | 2022 RIA | Difference | |
| 2 µg/m$^3$ | Low, 3% | 1.3 | 16 | 14.7 | 1.131% |
| | Low, 7% | 1.2 | 14 | 12.8 | 1.067% |
| | High, 3% | 2.9 | 33 | 30.1 | 1.038% |
| | High, 7% | 2.6 | 30 | 27.4 | 1.054% |
| 3 µg/m$^3$ | Low, 3% | 4.0 | 36 | 32.0 | 800% |
| | Low, 7% | 3.6 | 33 | 29.4 | 817% |
| | High, 3% | 9.1 | 76 | 66.9 | 735% |
| | High, 7% | 8.2 | 68 | 59.8 | 729% |
| 4 µg/m$^3$ | Low, 3% | 13.0 | 77 | 64.0 | 492% |
| | Low, 7% | 23.0 | 69 | 46.0 | 200% |
| | High, 3% | 29.0 | 160 | 131.0 | 452% |
| | High, 7% | 26.0 | 140 | 114.0 | 438% |

The RIA hints at the correlation between benefits claimed for the Reconsideration Proposal and the population living in areas above the level of the possible NAAQS, noting that

[393] EPA, Regulatory Impact Analysis for the Final Revisions to the National Ambient Air Quality Standards for Particulate Matter (Feb. 28, 2013), EPA-452/R-12-005.

[394] The 2012 PM NAAQS RIA utilizes $PM_{2.5}$ all-cause mortality risk estimates with a low value of 1.06 (Krewski et al., 2009) and high value of 1.14 (Lepeule et al., 2012). The Reconsideration Proposal relies on different studies with similar risk estimates of 1.066 (Wu et al., 2020) and 1.12 (Pope III et al., 2019).

[395] 2012 PM NAAQS RIA at 5-71; RIA at 5A-4.

approximately 25 percent of the U.S. population lives in areas that would see $PM_{2.5}$ concentration reductions at a 9.0 µg/m$^3$ standard.[396] Indeed, according to EPA $PM_{2.5}$ air quality data, 27 percent of the population live in counties that would not have attained an annual $PM_{2.5}$ NAAQS of 9.0 µg/m$^3$ in 2021. Revising the annual $PM_{2.5}$ NAAQS to just 10 µg/m$^3$ would still pull Chicago and Houston, the country's third and fourth largest cities, as well other counties that together comprise 16 percent of the U.S. population, into nonattainment. An 8.0 µg/m$^3$ standard would cause counties with populations comprising 43 percent -- nearly half – of Americans be nonattainment. Actual nonattainment would likely be even higher because counties surrounding a county out of attainment would also likely be pulled into a nonattainment area, even if their air quality otherwise attains the $PM_{2.5}$ NAAQS.

| Population in Nonattainment Counties Under Reconsideration Proposal[397] | | | |
|---|---|---|---|
| **Annual $PM_{2.5}$ NAAQS Standard** | **Population** | | |
| | **Counties With 2019-2021 Design Value Above Standard** | **Increase from Current Standard** | **Portion of U.S.** |
| **12.0 µg/m$^3$** | 19,749,096 | n/a | 6% |
| **10.0 µg/m$^3$** | 53,481,243 | 171% | 16% |
| **9.0 µg/m$^3$** | 90,801,113 | 360% | 27% |
| **8.0 µg/m$^3$** | 141,528,251 | 617% | 43% |

It is not necessarily surprising that RIA benefits increase as more people live in areas that do not attain a NAAQS. However, the RIA is not equally sensitive to the effect of population on cost. While the RIA finds benefits for the many people that the Reconsideration Proposal would regulate, it does not fully account for their hardship.

The RIA only measures the costs of controls associated with the Reconsideration Proposal's proposed and alternative standards. Even if the RIA were to properly assess those costs, which is does not, that would only cover the Reconsideration Proposal's impact on sources. Left

396 RIA at 6-34.

397 Design values from EPA's $PM_{2.5}$ Design Value Report, 2021. Population data from U.S. Census Bureau's Annual Resident Population Estimates, April 1, 2020 to July 1 2021.

out is the impact of those costs as they trickle down to increased consumer expenses, lost business opportunities, and reduced job growth in nonattainment areas due to stigmatization and in attainment areas from permitting gridlock, and other economy-wide impacts. As the RIA notes, "[i]t is not possible to estimate the magnitude and direction of all these potential effects outside of the regulated sector(s) without an economy-wide modeling approach."[398]

Fortunately, Computable General Equilibrium ("CGE") models "are a tool for evaluating the impacts of a regulation on the broader economy."[399] CGE models can fill gaps in the RIA's control-centric cost assessment because "a CGE model captures the effects of behavioral responses on the part of consumers or other producer to changes in price *that are missed by an engineering estimate of costs*."[400]

In 2017, the Science Advisory Board ("SAB") "recommended that EPA integrate CGE modeling into regulatory analysis to offer a more comprehensive assessment of the effects of air regulation."[401] In response, EPA developed a CGE model called SAGE that the SAB peer-reviewed in 2020. As noted in the RIA, "EPA now has a peer-reviewed CGE model for analyzing the potential for economy-wide effects of regulations" and is "committed to the use of CGE models to evaluate the economy-wide effects of its regulations."[402] Unfortunately, "we did not use the model in the RIA for this proposal."[403]

The Agency's explanation for failing to use its SAGE model for the Reconsideration Proposal is insufficient. EPA claims, with no further explanation, that the SAGE model "does not have the resolution needed to accurately model the emissions inventory sectors being controlled

[398] RIA at 4-14.
[399] *Id*.
[400] *Id*. (emphasis added).
[401] *Id*. (citing *SAB Advice on Use of Economy-Wide Models in Evaluating the Social Costs, Benefits, and Economic Impacts of Air Regulations*, EPA-SAB-17-2017).
[402] *Id*. at 4-16.
[403] *Id*.

(e.g. area fugitive dust inventory sector, residential wood combustion inventor sector)."[404] Yet the SAB's 2020 final peer review report did not raise this as a concern about the model. Rather, the SAB described SAGE as "a dynamic intertemporal model of the U.S. economy *with subnational resolution* across both regions and households and can be used to estimate the welfare effects of an environmental policy."[405]

EPA went through the effort of developing and peer reviewing a tool specifically to address a major gap in the RIA's cost analysis. The Agency's reticence to now use that tool is puzzling. On one hand, the absence of known control data did not stop EPA from modelling control costs in the RIA, even if only to partial attainment. On the other, the lack of data on dust and home ovens makes EPA suddenly unwilling to model economy-wide costs. Indeed, this incongruity goes to the heart of this reconsideration. EPA refuses to use the SAGE model citing certain limited uncertainties, while at the same time proposes to lower the $PM_{2.5}$ NAAQS based on a scientific record that both an Administrator and a CASAC concluded *in this docket* is too uncertain to warrant revising standards.

As was the case in the 2012 PM NAAQS RIA, the RIA applies highly uncertain and subjective assumptions to calculate benefits. That those benefits are so much higher in the current RIA results predominately from the significantly larger affected population base. The RIA's benefits estimates are sensitive to population size. Because EPA failed to engage in economy-wide modeling, the RIA's costs estimates are not. EPA should either conduct economy-wide modeling, or clearly articulate why it cannot do so with the SAGE model. That way, the SAGE model can be quickly improved to at least be used in other near-term NAAQS rulemakings and environmental regulations.

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[404] *Id*. at 4-13.

[405] EPA SAB, *Technical Review of EPA's Computable General Equilibrium Model, SAGE* (Aug. 28, 2020), EPA-SAB-02-010 (emphasis added).

## XIII. Conclusion.

For the foregoing reasons, EPA should withdraw or otherwise end this voluntary reconsideration proceeding regarding its 2020 decision to retain the existing PM NAAQS, leaving the existing standards in place. Any additional consideration of the 2020 PM NAAQS should be undertaken during the Agency's next statutorily mandated review of those standards. At this time, however, EPA should focus on developing approaches and tools for effective implementation of the NAAQS in a manner consistent with protecting the US economy and minimizing burdens to states and stakeholders.

# NAAQS Regulatory Review & Rulemaking Coalition

# ATTACHMENT 1
# TO
## COMMENTS OF THE NAAQS REGULATORY REVIEW & RULEMAKING COALITION ON EPA'S RECONSIDERATION OF THE NATIONAL AMBIENT AIR QUALITY STANDARDS FOR PARTICULATE MATTER

### DOCKET NO. EPA–HQ–OAR-2015-0072

American Chemistry Council

American Coke and Coal Chemicals Institute

American Forest & Paper Association

American Fuel & Petrochemical Manufacturers

American Iron and Steel Institute

American Petroleum Institute

American Wood Council

National Lime Association

National Mining Association

National Stone, Sand & Gravel Association

Oilseed Processors Coalition

- Corn Refiners Association
- National Cotton Council
- National Cotton Ginners Association
- National Cottonseed Processors Association
- National Oilseed Processors Association
- Texas Cotton Ginners' Association

Portland Cement Association

The Aluminum Association

The Fertilizer Institute

March 28, 2023

# Comments on US EPA's Proposed Rule for the Reconsideration of the National Ambient Air Quality Standards for Particulate Matter

# Docket No. EPA-HQ-OAR-2015-0072

March 21, 2023

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# Abbreviations

| | |
|---|---|
| AOD | Aerosol Optical Depth |
| ATS | American Thoracic Society |
| CASAC | Clean Air Scientific Advisory Committee |
| CI | Confidence Interval |
| C-R | Concentration-Response |
| ERS | European Respiratory Society |
| HR | Hazard Ratio |
| ISA | Integrated Science Assessment |
| NAAQS | National Ambient Air Quality Standards |
| PA | Policy Assessment |
| PM | Particulate Matter |
| $PM_{10}$ | Particulate Matter with Particles 10 µm in Diameter or Less |
| $PM_{2.5}$ | Particulate Matter with Particles 2.5 µm in Diameter or Less |
| SES | Socioeconomic Status |
| US | United States |
| US EPA | United States Environmental Protection Agency |

# Executive Summary

On January 27, 2023, the United States Environmental Protection Agency (US EPA) released the Proposed Rule on the "Reconsideration of the National Ambient Air Quality Standards for Particulate Matter" (hereafter referred to as the Proposed Rule) (US EPA, 2023). The US EPA Administrator proposes to lower the primary annual fine particulate matter (PM) (*i.e.*, particulate matter with particles 2.5 µm in diameter or less [$PM_{2.5}$]) standard from 12 µg/$m^3$ to 9-10 µg/$m^3$ (US EPA, 2023). The Administrator also proposes retaining the current primary and secondary 24-hour $PM_{2.5}$ standard of 35 µg/$m^3$, the primary and secondary 24-hour coarse PM (*i.e.*, particulate matter with particles 10 µm in diameter or less [$PM_{10}$]) standard of 150 µg/$m^3$, and the secondary annual $PM_{2.5}$ standard of 15 µg/$m^3$ (US EPA, 2023).

The Administrator concluded that, supported by the results of recent accountability studies with starting $PM_{2.5}$ concentrations that are relevant to the current primary annual standard and studies that restricted their analyses to $PM_{2.5}$ concentrations below the current standard, the key US epidemiology studies provide evidence of adverse health effects occurring at concentrations below the current standard of 12 µg/$m^3$ (US EPA, 2023). However, US EPA did not review these key epidemiology studies in a systematic, unbiased, or transparent manner, and inappropriately discounted the substantial uncertainties in and limitations of these studies (*e.g.*, exposure measurement error, confounding, irrelevant exposure windows). Therefore, these studies do not provide adequate evidence of health effects occurring at concentrations lower than the current standard of 12 µg/$m^3$.

Even if such evidence were certain, US EPA also failed to acknowledge that the area annual design values are generally higher than the mean concentrations in these key studies, such that the lowest mean concentration reported in the monitor-based studies (*i.e.*, 9.9 µg/$m^3$) and hybrid model-based studies with population weighting (*i.e.*, 9.3 µg/$m^3$) are associated with a range of annual $PM_{2.5}$ design values of 10.9-11.9 µg/$m^3$ and 10.6-11.0 µg/$m^3$, respectively. These values exceed design values reflected in US EPA's proposed range (9-10 µg/$m^3$) for the annual standard. Similarly, as noted in the 2022 Policy Assessment (PA) for the reconsideration of the PM National Ambient Air Quality Standards (NAAQS) (hereafter referred to as the 2022 PA), the recommended increase in near-road monitoring will further increase the ratios of maximum annual design values to averaged concentrations. In turn, this will increase the potential that continued implementation of the current standard could effectively achieve average concentration levels in many areas that approach US EPA's proposed range for what is required to protect public health.

US EPA evaluated controlled human exposure studies and experimental animal studies of $PM_{2.5}$ in the 2019 Integrated Science Assessment (ISA) of PM (hereafter referred to as the 2019 ISA), the 2022 Supplement to the 2019 ISA (hereafter referred to as the 2022 ISA Supplement), the 2022 PA, and the Proposed Rule (US EPA, 2019, 2022a,b, 2023). The Agency acknowledged that these studies mostly evaluated $PM_{2.5}$ exposure levels much higher than ambient PM concentrations. In addition, some of the health outcomes observed in the controlled human exposure studies may not be adverse. These are also studies of small populations that may not be representative of the larger United States (US) population that the NAAQS are intended to protect. Regarding the experimental animal studies, there is inherent uncertainty in extrapolating results from animal models to humans. We agree with US EPA that the available controlled human exposure studies and experimental animal studies do not provide evidence regarding exposures to ambient levels of $PM_{2.5}$. We also conclude that these studies support the existence of thresholds for health outcomes associated with $PM_{2.5}$ exposure.

In the Proposed Rule, the Administrator concluded that the available literature did not call into question the adequacy of the current primary 24-hour $PM_{2.5}$ standard of 35 $\mu g/m^3$ and proposed retaining that standard for now. In support of that decision, the Administrator noted that "the air quality concentrations in areas meeting the current standards are well below the $PM_{2.5}$ concentrations shown to elicit effects" (US EPA, 2023). Considering the uncertainties in and limitations of the scientific evidence and quantitative information on $PM_{2.5}$ exposure, we agree with the US EPA Administrator's current decision that the primary 24-hour $PM_{2.5}$ standard should be retained.

# 1 Introduction

In December 2020, based on the United States Environmental Protection Agency's (US EPA) review of the air quality criteria and the National Ambient Air Quality Standards (NAAQS) for particulate matter (PM), US EPA Administrator Andrew Wheeler retained the primary and secondary NAAQS for fine and coarse PM (*i.e*., particulate matter with particles 2.5 and 10 µm in diameter or less [$PM_{2.5}$ and $PM_{10}$], respectively) without revision (US EPA, 2020a).

In June 2021, US EPA announced that it would reconsider the 2020 decision to retain the PM NAAQS (US EPA, 2023). As part of the reconsideration process, in May 2022, US EPA released the Supplement to the 2019 Integrated Science Assessment (ISA) for PM (hereafter referred to as the 2022 ISA Supplement) and the Policy Assessment (PA) for the reconsideration of the PM NAAQS (hereafter referred to as the 2022 PA) (US EPA, 2019, 2022a,b).

On January 27, 2023, US EPA released the Proposed Rule on the "Reconsideration of the National Ambient Air Quality Standards for Particulate Matter" (hereafter referred to as the Proposed Rule) (US EPA, 2023). The Administrator proposes to lower the primary annual $PM_{2.5}$ standard from 12 µg/$m^3$ to 9-10 µg/$m^3$ and to retain the primary and secondary 24-hour $PM_{2.5}$ standard at 35 µg/$m^3$, the current primary and secondary 24-hour $PM_{10}$ standard at 150 µg/$m^3$, and the current secondary annual $PM_{2.5}$ standard at 15 µg/$m^3$ (US EPA, 2023).

To evaluate the adequacy of the current primary PM NAAQS, the Administrator considered the scientific evidence evaluated in the 2019 ISA and the 2022 ISA Supplement, as well as evaluations presented in the 2022 PA (US EPA, 2023). The Administrator considered the key epidemiology studies (including the key accountability studies), the available experimental animal and controlled human exposure studies, and air quality analyses, including the important strengths and limitations of these lines of evidence. In his evaluation, the Administrator placed the greatest weight on evidence regarding health effects that were determined to be causally or likely causally associated with short- and long-term $PM_{2.5}$ exposure in the 2019 ISA (US EPA, 2023).

Regarding the adequacy of the current primary annual $PM_{2.5}$ standard, the Administrator noted that "the evidence available in this reconsideration provides support for adverse health effect associations at lower ambient $PM_{2.5}$ concentrations than in previous reviews" (US EPA, 2023). He also stated that "a large number of key U.S. epidemiologic studies report positive and statistically significant associations for air quality distributions with overall mean $PM_{2.5}$ concentrations that are well below the current level of the annual standard of 12 µg/$m^3$… with concentrations ranging down as low as 9.9 µg/$m^3$ in U.S.-based monitor-based studies and 9.3 µg/$m^3$ in U.S.-based hybrid model-based studies" (US EPA, 2023). The Administrator acknowledged that the experimental studies (*i.e*., controlled human exposure studies and experimental animal studies) mostly evaluate exposures well above ambient concentrations, and may measure outcomes that are not clinically significant. There are also issues with extrapolating results from animals or small human sample populations to the larger human population.

In the Proposed Rule, the Administrator concluded that the new literature did not call into question the adequacy of the current primary 24-hour $PM_{2.5}$ standard of 35 µg/$m^3$ and proposed retaining that standard. In support of that decision, the Administrator noted that "the air quality concentrations in areas meeting the current standards are well below the $PM_{2.5}$ concentrations shown to elicit effects" (US EPA, 2023).

As discussed below, the available scientific evidence and risk-based information do not call into question the adequacy of the public health protection provided by the current primary annual and 24-hour $PM_{2.5}$ standards or indicate that lower standards will increase public health protection against adverse health effects associated with $PM_{2.5}$ exposure.

# 2 Primary Annual $PM_{2.5}$ Standard – Epidemiology Evidence

To evaluate the adequacy of the current primary annual $PM_{2.5}$ standard, the Administrator cited all available lines of scientific evidence, the previous US EPA risk assessments of $PM_{2.5}$ in the 2019 ISA and the 2022 ISA Supplement, and the analysis of the available evidence in the 2022 PA (US EPA, 2023). This approach is consistent with those of previous NAAQS reviews. However, the Administrator's decision regarding the adequacy of the current standard and his proposal to lower the standard are driven primarily by a review of the study-reported means and lower values (*i.e.*, the 25$^{th}$ and 10$^{th}$ percentiles of estimated exposures or health events) from the key epidemiology studies of $PM_{2.5}$. The key epidemiology studies included studies that used monitors to estimate $PM_{2.5}$ exposures, as well as studies that used hybrid modeling approaches and applied population weighting in calculating $PM_{2.5}$ exposure levels (US EPA, 2023).

In the Proposed Rule, the Administrator noted that "the evidence available in this reconsideration provides support for adverse health effect associations at lower ambient $PM_{2.5}$ concentrations than in previous reviews" (US EPA, 2023). He also stated that "a large number of key U.S. epidemiologic studies report positive and statistically significant associations for air quality distributions with overall mean $PM_{2.5}$ concentrations that are well below the current level of the annual standard of 12 μg/m$^3$… with concentrations ranging down as low as 9.9 μg/m$^3$ in U.S.-based monitor-based studies and 9.3 μg/m$^3$ in U.S.-based hybrid model-based studies" (US EPA, 2023). The Administrator noted that, supported by the results of recent accountability studies with starting $PM_{2.5}$ concentrations that are more relevant to the current primary annual standard and studies that restricted their analyses to $PM_{2.5}$ concentrations below the current standard, the key US epidemiology studies provide evidence of health effects occurring at $PM_{2.5}$ concentrations lower than the current standard of 12 μg/m$^3$ (US EPA, 2023).

However, as noted below, these studies have substantial uncertainties and limitations (*e.g.*, exposure measurement error, confounding, irrelevant exposure windows), and do not provide adequate evidence of health effects occurring at $PM_{2.5}$ concentrations lower than the current primary annual standard of 12 μg/m$^3$.

## 2.1 Key Monitor-Based Studies

In the Proposed Rule, US EPA focused on 21 key monitor-based studies that were conducted in the US that evaluated both short-term and long-term $PM_{2.5}$ exposures and their associations with morbidity and mortality (US EPA, 2023). These studies reported overall mean $PM_{2.5}$ exposure concentrations between 9.9 and 16.5 μg/m$^3$ (US EPA, 2023). As discussed below, US EPA also considered key studies that reported mean $PM_{2.5}$ concentrations corresponding to the 25$^{th}$ and 10$^{th}$ percentiles of exposures or health events.

### 2.1.1 Mean $PM_{2.5}$ Levels

The key US monitor-based epidemiology studies considered in the Proposed Rule reported mean $PM_{2.5}$ exposure concentrations between 9.9 and 16.5 μg/m$^3$ (US EPA, 2023).

As noted in the Proposed Rule, the area annual design values for $PM_{2.5}$ are generally higher than the mean concentrations reported in the monitor-based studies by 10-20% (US EPA, 2023). Therefore, the range of area annual design values associated with the lowest mean concentration (*i.e.*, 9.9 $\mu g/m^3$) reported in these studies would be 10.9-11.9 $\mu g/m^3$. These levels are higher than the Administrator's proposed primary annual $PM_{2.5}$ standard of 9-10 $\mu g/m^3$. CASAC member Dr. James Boylan also discussed this issue in his comments on the draft of the 2022 PA (Sheppard, 2022; US EPA, 2021a).

In addition, there are major limitations to relying on mean $PM_{2.5}$ concentrations to evaluate the adequacy of the current primary annual standard. US EPA justifies this approach in the 2022 PA by stating that there is the most confidence in the reported magnitude of $PM_{2.5}$ exposure-response associations around the center of the distribution, which corresponds to the bulk of the underlying data (as indicated by narrow confidence intervals [CIs]). However, statistically, influential points for an exposure-response association tend to be located at the data extremes (*i.e.*, outliers), where data are sparse and each data point is given a disproportionately large weight in a least square fitting (Bollen and Jackman, 1985). Considering that the incidence of health effects increases with increasing $PM_{2.5}$ exposure concentrations in cohort studies (as demonstrated by positive associations in linear models), the observed associations at the center of the data are more likely to be at least partially driven by the upper portion of the air quality distribution than observations found lower on the distribution. In other words, while cohort studies report health effects that occurred in *study populations*, for which the average $PM_{2.5}$ exposure concentrations are below the current primary annual standard, they do not necessarily reflect health effects that occur in *individuals* who live in areas with $PM_{2.5}$ concentrations below the current standard.

The key monitor-based studies also have major uncertainties and methodological limitations (*e.g.*, exposure measurement error, confounding, irrelevant exposure windows). In the Proposed Rule, US EPA noted:

> [T]he PA recognizes that uncertainties associated with the epidemiologic evidence (e.g., the potential for copollutant confounding and exposure measurement error) remain, although new studies evaluated in the ISA Supplement employ statistical methods such as alternative methods for confounder control, to more extensively account for confounders, which are more robust to model misspecification. (US EPA, 2023).

As discussed below in Section 2.5, these uncertainties and limitations call into question the basis for moving towards a more stringent primary annual $PM_{2.5}$ standard.

### 2.1.2 Mean $PM_{2.5}$ Concentrations Corresponding to the 25th and 10th Percentiles of Health Events

As part of the PM NAAQS reconsideration process US EPA also considered the mean $PM_{2.5}$ concentrations corresponding to the 25th and 10th percentiles of estimated exposures or health events, when these values were available in the key epidemiology studies, in the 2022 PA (US EPA, 2022b).

As shown in Figure 1 of the Proposed Rule (US EPA, 2023), none of the long-term monitor-based epidemiology studies reported mean $PM_{2.5}$ concentrations corresponding to the 25th and 10th percentiles of estimated exposures or health events. Three short-term $PM_{2.5}$ exposure studies reported both of these values: Franklin *et al*. (2007), Zanobetti and Schwartz (2009), and Bell *et al*. (2008). The lowest mean $PM_{2.5}$ concentrations (*i.e.*, averaged over the study period for each study city) corresponding to the 25th and 10th percentiles of health events reported in these studies are 11.5 and 9.8 $\mu g/m^3$, respectively, both of which are reported by Bell *et al*. (2008). While US EPA (2023) noted that these small number of studies can be "considered to provide insight into the concentrations that comprise the lower quartiles of the air quality distributions," any direct comparisons of the $PM_{2.5}$ concentrations corresponding to lower percentiles (*i.e.*, 25th and/or 10th) with the annual design values is more uncertain than comparisons with the mean concentrations. As noted in the Proposed Rule:

> As such, the PA concludes that focusing on concentrations somewhat below the means (*e.g.*, 25th and 10th percentiles), when such information is available from epidemiologic studies, is a reasonable approach for considering lower portions of the air quality distribution. However, the PA recognizes that the health data are appreciably more sparse and an understanding of the magnitude and significance of the associations correspondingly become more uncertain in the lower part of the air quality distribution. While health effects can occur over the entire distribution of ambient $PM_{2.5}$ concentrations evaluated, and epidemiologic studies do not identify a population-level threshold below which it can be concluded with confidence that PM-associated health effects do not occur (U.S. EPA, 2019a, section 1.5.3), using values below the 10th percentile would lead to even greater uncertainties and diminished confidence in the magnitude and significance of the associations. (US EPA, 2023)

We concur with these points made by the Administrator and conclude that the mean $PM_{2.5}$ concentrations corresponding to the 25th and 10th percentiles of health events from the monitor-based studies should not be considered in setting the $PM_{2.5}$ NAAQS.

## 2.2 Key Hybrid Model-Based Studies

The 2019 ISA and the 2022 ISA Supplement included a substantial number of hybrid model-based studies that had been conducted since the 2012 PM NAAQS review (US EPA, 2023). These studies "employ various fusion techniques that combine ground-based monitor data with air quality modeled estimates and/or information from satellites to estimate $PM_{2.5}$ exposures" (US EPA, 2023). In the current Proposed Rule, US EPA focused on 11 key epidemiology studies that used hybrid model-predicted $PM_{2.5}$ concentrations and that also applied aspects of population weighting. Similar to the monitor-based studies, US EPA also focused on these studies' reported mean $PM_{2.5}$ concentrations and concentrations lower than the mean (*i.e.*, concentrations corresponding to the 25th and 10th percentiles of estimated exposures or health events). As discussed below, while the hybrid model-based studies overcome certain limitations found in the monitor-based studies, these studies also have limitations that are similar to those of the monitor-based studies.

### 2.2.1 Mean $PM_{2.5}$ Levels

Overall, the key US epidemiology studies considered in the Proposed Rule that used hybrid model-predicted $PM_{2.5}$ concentrations and that applied aspects of population weighting reported mean $PM_{2.5}$ exposure concentrations between 9.3 and 12.2 $\mu g/m^3$ (US EPA, 2023).

As noted in the Proposed Rule, area annual design values for $PM_{2.5}$ are generally higher than the mean concentrations reported in the hybrid model-based studies with population weighting by 14-18% (US EPA, 2023). Therefore, the range of area annual design values associated with the lowest mean concentration reported in these studies (*i.e.*, 9.3 $\mu g/m^3$) would be 10.6-11.0 $\mu g/m^3$. These levels are higher than the Administrator's proposed primary annual $PM_{2.5}$ standard of 9-10 $\mu g/m^3$. In his comment on the draft of the 2022 PA (US EPA, 2021a), CASAC member Dr. Boylan also calculated the potential range of area annual $PM_{2.5}$ design values based on the mean $PM_{2.5}$ concentrations reported in the hybrid model-based studies with population weighting.

Dr. Boylan concluded:

> Based on this information, an annual standard in the range of 10.6-12.2 μg/m$^3$ is appropriate. In order to protect public health with an adequate margin of safety, an annual standard in the range of 10.0-11.0 μg/m$^3$ is recommended. In addition, many accountability studies that report public health improvements have starting concentrations within that range. (Sheppard, 2022)

The key hybrid model-based studies also have major methodological limitations (*e.g.*, exposure measurement error, confounding, irrelevant exposure windows). For instance, Di *et al*. (2017a) evaluated the relationship between long-term $PM_{2.5}$ exposure and total mortality in Medicare enrollees in the continental US from 2000 to 2012. While this study used a model that was validated and more flexible regarding complex nonlinear relationships than the models used in many other studies, it is limited by the quality of the input variables, such as the aerosol optical depth (AOD) data, as satellite-based AOD measurements can be biased by unresolved clouds, water vapor, and smoke. In addition, because the study used Medicare records as the source of data regarding cohort members, residential mobility was not accounted for and deaths from unnatural causes were not excluded, resulting in errors in the study's exposure and outcome assessments. Annual average $PM_{2.5}$ concentrations in the year prior to cohort members' deaths or censoring were evaluated in the study's concentration-response (C-R) analysis, but this was likely was not the relevant exposure window, due to the lack of latency time. Regarding adjustment for confounders, while Di *et al*. (2017a) included several individual-level covariates, important confounders such as smoking and body mass index were not available for the Medicare enrollee cohort. Other key hybrid model-based studies have similar limitations.

## Restricted Analyses

The Proposed Rule stated that, consistent with advice from CASAC, US EPA examined epidemiology studies that included "analyses that restrict annual average $PM_{2.5}$ concentrations" to concentrations that are lower than the current annual $PM_{2.5}$ standard, in order to assess the adequacy of the current standard (US EPA, 2023). The current Proposed Rule considered two key studies (Di *et al*., 2017b; Dominici *et al*., 2019) that both used hybrid model-based exposure assessments with population weighting. Regarding these two studies, the Proposed Rule noted:

> These restricted analyses report positive and statistically significant associations with all-cause mortality and report mean $PM_{2.5}$ concentrations of 9.6 μg/m$^3$. Thus, these two epidemiologic studies provide support for positive and statistically significant associations at lower mean $PM_{2.5}$ concentrations. The Administrator does note that uncertainties exist in these analyses (described in more detail in sections II.B.3.b and II.D.2.a above), including uncertainty in how studies exclude concentrations (e.g., at what spatial resolution are concentrations being excluded), which would make any comparisons of concentrations in restricted analyses difficult to compare directly to design values. (US EPA, 2023)

Furthermore, as stated by Papadogeorgou *et al*. (2019):

> [R]estricting the analysis to a subset of the data has some interpretational limitations. Considering a subgroup of the data effectively changes the population of interest. Specifically, it is likely that the subpopulation exposed to low levels of $PM_{2.5}$ does not have the same characteristics as the full study population. If the distribution of certain modifiers of the association between $PM_{2.5}$ and the outcome of interest is different among participants living in lower exposure levels (e.g., rural vs. urban residence, age, socioeconomic status,

etc.) compared to the characteristics in the full population, then the effect estimates from the restricted analysis are not necessarily directly comparable to those of the full analysis.

In other words, just because statistically significantly positive associations remained in analyses restricted to subpopulations exposed to lower $PM_{2.5}$ concentrations, this does not necessarily mean that the upper portion of the air quality distribution was not the driver for the observed associations in the full analyses. In addition, the distributions of potential confounders and effect modifiers in the subpopulation and the full study population could differ, undermining the direct comparability of the results from restricted analyses and those of the full analyses.

### 2.2.2 Mean $PM_{2.5}$ Concentrations Corresponding to the 25th and 10th Percentiles of Estimated Exposures or Health Events

Similar to the monitor-based studies, only three hybrid model-based studies reported the mean $PM_{2.5}$ concentrations corresponding to the 25th and/or 10th percentiles of estimated exposures or health events. However, while all three of the monitor-based studies reporting these values were studies of short-term $PM_{2.5}$ exposure, two of the three hybrid model-based studies reporting at least one of these values studied long-term $PM_{2.5}$ exposure, as shown in Figure 2 of the Proposed Rule (US EPA, 2023). Wang *et al*. (2017) reported a mean $PM_{2.5}$ concentration corresponding to the 25th percentile of estimated exposure of 9.1 $\mu g/m^3$, and Di *et al*. (2017a) reported mean $PM_{2.5}$ concentrations corresponding to the 25th and 10th percentiles of exposure estimates of 9.1 and 7.3 $\mu g/m^3$, respectively. Di *et al*. (2017b), who conducted a study of short-term $PM_{2.5}$ exposure, reported mean $PM_{2.5}$ concentrations corresponding to the 25th and 10th percentiles of health events of 6.7 and 4.7 $\mu g/m^3$, respectively.

As discussed in Section 2.1.2, US EPA noted that considering the small number of available studies reporting these values and the uncertainties related to the $PM_{2.5}$ concentrations lower than the overall mean concentrations, these studies do not provide adequate evidence regarding associations between $PM_{2.5}$ exposure and morbidity/mortality at lower concentrations. In addition, as discussed above, the hybrid model-based studies have several limitations, such as exposure misclassification, the use of an irrelevant exposure window, a lack of consideration of residential mobility, and issues with residual confounding. As such, the mean $PM_{2.5}$ concentrations corresponding to the 25th and 10th percentiles of estimated exposures or health events should not be considered in setting the primary annual $PM_{2.5}$ standard.

## 2.3 Accountability Studies

As part of US EPA's evaluation of the adequacy of the current primary annual $PM_{2.5}$ standard, the Administrator also considered evidence from $PM_{2.5}$ accountability studies, which examine "past reductions in ambient $PM_{2.5}$ and the degree to which those reductions resulted in public health improvements" (US EPA, 2022b). The Administrator specifically noted what he considered to be three key accountability studies that present analyses with starting $PM_{2.5}$ concentrations (*i.e.*, concentrations prior to the policy change or intervention) below the current primary annual standard of 12.0 $\mu g/m^3$: Corrigan *et al*. (2018), Henneman *et al*. (2019), and Sanders *et al*. (2020). The Administrator concluded that these three studies "indicate positive and significant associations with mortality and morbidity and reductions in ambient $PM_{2.5}$" and "suggest public health improvements may occur at concentrations below 12 $\mu g/m^3$" (US EPA, 2023).

We agree with the Administrator that these three accountability studies have made methodological improvements in terms of focusing on $PM_{2.5}$ and starting from a mean $PM_{2.5}$ concentration of 12 $\mu g/m^3$ (*i.e.*, the current primary annual standard) or lower, and can further inform the relationship between $PM_{2.5}$

exposure and health effects. However, accountability studies can have crucial methodological limitations that undermine their findings. Some of these methodological limitations are the same as those commonly found in more traditional epidemiology studies, and others are unique to this specific study design and the statistical approaches these studies use. In addition, some of the significant methodological limitations that remain in these studies were also noted in the previous PA for the PM NAAQS from 2020 (hereafter referred to as the 2020 PA), including the fact that they were not able to "attribute changes in ambient $PM_{2.5}$ concentrations to the interventions under evaluation" and/or "disentangle health impacts of the intervention from background trends in health" (US EPA, 2020b). As a result, the association between a reduction in $PM_{2.5}$ concentrations below the current standard and improvement in health outcomes observed in these studies is not fully supported. Unless all of the aforementioned methodological limitations can be sufficiently addressed, we conclude that accountability studies do not provide adequate evidence to support a lower primary annual $PM_{2.5}$ standard.

## 2.4 US Studies *vs*. Canadian Studies

While the 2019 ISA considered and included epidemiology studies of $PM_{2.5}$ conducted globally (US EPA, 2019), the 2020 PA focused on epidemiology studies of $PM_{2.5}$ conducted in the US and Canada (US EPA, 2020b), because these studies were considered "most relevant to informing the level, form, averaging time, and indicator of the NAAQS for PM" (US EPA, 2022a). Following this approach, the 2022 ISA Supplement was also limited to studies of $PM_{2.5}$ conducted in the US and Canada (US EPA, 2022a).

In the 2022 PA and the Proposed Rule, US EPA noted the differences in exposure environments and population characteristics in the US and Canada (US EPA, 2022b, 2023). As stated in the Proposed Rule:

> [W]hile information from Canadian studies can be useful in assessing the adequacy of the annual standard, differences in the exposure environments and population characteristics between the U.S. and other countries can affect the study-reported mean value and its relationship with the annual standard level. Sources and pollutant mixtures, as well as $PM_{2.5}$ concentration gradients, may be different between countries, and the exposure environments in other countries may differ from those observed in the U.S. Furthermore, differences in population characteristics and population densities can also make it challenging to directly compare studies from countries outside of the U.S. to a design value in the U.S. (US EPA, 2023)

Therefore, US EPA concluded that "interpreting the data (*e.g.*, mean concentrations) from the Canadian studies in the context of a U.S.-based standard may present challenges in directly and quantitatively informing questions regarding the adequacy of the current or potential alternative [to] the levels of the annual standard" (US EPA, 2023). The Agency further noted that while both US and Canadian studies were considered in reaching conclusions, it considered that "the U.S.-based epidemiologic studies are most informative for comparisons with the annual standard metric and for reaching conclusions on the current standard and for informing potential alternative levels of the standard" (US EPA, 2023).

In the comments on the 2022 ISA Supplement, CASAC consultant Dr. Clougherty also recommended removing the Canadian studies from the evaluation of exposure disparities and dose-response relationships between $PM_{2.5}$ and health effects, for the following reasons: "different social & economic context, context of health disparities very different, different patterns of historical discrimination by race and ethnic group, universal access to healthcare and education alter interpretability of SES [socioeconomic status] indicators for US regulatory context" (Sheppard, 2022).

Considering the differences in exposure environments, demographics, and access to healthcare and education between the US and Canada, we concur with Dr. Clougherty that the Canadian studies should be excluded from consideration in the Agency's evaluation of the adequacy of the current primary annual $PM_{2.5}$ NAAQS.

## 2.5 Uncertainties and Limitations

A relatively recent industry-sponsored workshop focused on bridging the gap between epidemiologists and risk assessors in an effort to improve the value of epidemiology research for use in decision-making. It included a diverse group of US EPA researchers, industry scientists, national and international academics, and government scientists. Following this workshop, Burns *et al.* (2019) and LaKind *et al*. (2020) developed a matrix for communicating risk assessment "asks" of epidemiology research that describes the characteristics of epidemiology studies that should be considered when using them for hazard identification, dose-response assessment, and exposure assessment in a risk assessment setting (Table 2.1). By extension, these "asks" are equally important to US EPA's reliance on epidemiology studies when determining whether the existing standards are adequate to protect public health. The key characteristics of epidemiology studies include confirming exposure levels and outcomes and determining the direction and magnitude of error surrounding exposure and dose-response assessments, among others. The epidemiology studies reviewed in the Proposed Rule do not fully meet the risk assessment "asks" outlined by Burns *et al.* (2019) and LaKind *et al*. (2020) or appreciably reduce uncertainty regarding the associations between $PM_{2.5}$ exposure and morbidity or mortality, particularly at exposure concentrations below the current primary annual $PM_{2.5}$ standard. Compared to the studies reviewed in the 2009 ISA (US EPA, 2009), the more recent cohort studies evaluated in the 2019 ISA (US EPA, 2019) and the 2022 ISA Supplement (US EPA, 2022a) are subject to similar methodological limitations, and thus do not meaningfully reduce the uncertainty of the evidence; this prevents causal inference at exposures below the current NAAQS. These methodological limitations and sources of uncertainty are discussed further below.

**Table 2.1 The Nine "Asks" of Epidemiology Research[a]**

| Step of Risk Assessment | "Asks" | | |
|---|---|---|---|
| Hazard Identification | Confirm outcome? | Confirm exposure? | Report methods fully and transparently? |
| Dose-Response | Include information on shape of the curve? | Harmonize exposure categories (definitions)? | Describe direction/ magnitude of error? |
| Exposure Assessment | Evaluate source-to-intake pathways? | Provide complete exposure data? | Report on quality assurance/quality control? |

Note:
(a) Adapted from Table 3 in LaKind *et al*. (2020).

### 2.5.1 Measurement Error

Exposure measurement error is a key source of uncertainty, not only because it affects the reported $PM_{2.5}$ concentrations at which associations with morbidity or mortality are observed, but it can also introduce bias to the observed associations if the direction or magnitude of error is associated with the outcome status. The assessment of $PM_{2.5}$ concentrations in epidemiology studies can be subject to considerable measurement error due to unaccounted-for residential mobility, temporal variation, or poor prediction model performance.

Another important source of exposure measurement error is the placement of the $PM_{2.5}$ monitors from which measurements are taken. As noted in the 2022 PA, in response to a key change in US EPA's monitoring requirements, "the addition of $PM_{2.5}$ monitoring at near-road locations was phased in from 2015 to 2017"

(US EPA, 2022b), largely after the study periods covered by the key epidemiology studies. Since near-road monitoring sites tend to capture higher $PM_{2.5}$ concentrations than those in surrounding areas, had the near-road monitors been placed during the study periods, the study-reported mean $PM_{2.5}$ concentrations would have been higher.

In addition, long-term cohort studies of all-cause or nonaccidental mortality often do not assess exposure timing or duration during etiologically relevant periods within individuals' lifetimes. In most of these studies, ambient $PM_{2.5}$ exposure is only measured for a few years, often contemporaneously with follow-up, leading to innumerable misalignments between exposures and disease processes that inevitably result in death. In effect, these exposure measurement periods are only small parts of individuals' lifetimes that are not contemporaneous with the natural history of any particular health condition that leads to death. Because different causes of death have different etiologies, they also have very different relevant exposure windows. In addition, some causes of death are also more likely due to acute, rather than chronic, conditions.

Given the potential existence of multiple sources of exposure measurement error, assuming the association is causal at higher $PM_{2.5}$ concentrations, it is possible that the observed associations with mortality or morbidity at lower mean $PM_{2.5}$ concentrations simply reflect true associations at higher $PM_{2.5}$ concentrations that were substantially underestimated in the studies. This is particularly important when considering there is limited evidence regarding health effects at lower mean $PM_{2.5}$ concentrations.

In addition, the Proposed Rule noted that the 2022 PA "emphasize[d] multicity/multistate studies that examine health effect associations, as such studies are more encompassing of the diverse atmospheric conditions and population demographic in the U.S. than studies focus on a single city or state" (US EPA, 2023). However, these studies also have limitations, as noted by CASAC consultant Dr. Jane Clougherty in her comments on the draft of the 2022 PA (US EPA, 2021a). Dr. Clougherty noted that she had "some hesitance regarding *co-pollutant adjustment* and *spatial scale* in the $PM_{2.5}$ epidemiology literature to date" (Sheppard, 2022 [emphasis in original]). She explained that:

> There is an assumption throughout the document [*i.e.*, the draft of the 2022 PA] that *larger studies constitute better epidemiology*, though this is not necessarily the case, as larger studies often have greater exposure misclassification, as compromises are made in estimating exposures across larger populations/regions.
>
> Further, these studies are often implemented at larger spatial scales (e.g., 1 km x 1 km or larger), which is much larger than the scale of variance for many important co-pollutants (i.e., NOx [nitrogen oxides] can vary at 100 m or less); as such, studies at larger almost necessarily imperfectly adjust for co-pollutants…. Though larger scales may reasonably capture spatial variation in $PM_{2.5}$ concentrations, they do not fully capture variation in important co-pollutants, so these studies may well not accurately adjust for co-pollutant exposures. (Sheppard, 2022 [emphasis in original])

### 2.5.2 Confounding

Although some of the recent studies have considered potential confounding by copollutants, others have not, which may render the observed associations between $PM_{2.5}$ exposure and health effects in such studies uncertain. However, copollutant evaluations are themselves subject to methodological issues, such as mismatching the copollutant exposure window and mortality, failing to account for collinearity or a nonlinear relationship with $PM_{2.5}$ exposure, and failing to account for temporal variation. In fact, the 2022 ISA Supplement found that there is some evidence of potential confounding by copollutants in some studies

(US EPA, 2022a), which is inconsistent with the studies evaluated in the 2019 ISA that showed statistically significant results in both single and copollutant models, indicating that confounding by copollutants was not a significant source of uncertainty in the associations between $PM_{2.5}$ exposure and health effects observed in these studies (US EPA, 2019).

Three assessments by different researchers (Janes *et al*., 2007; Greven *et al*., 2011; Pun *et al*., 2017) using Medicare cohort data from different time periods have each detected confounding in their datasets, conferring doubt on the reliability/validity of national-level effect estimates derived from this cohort and similar cohorts. Each study observed remarkable differences between their temporal (global) effect estimates and their spatiotemporal (local) effect estimates. In the absence of confounding by variables trending on the national level, these decomposed estimates would be approximately equal. Local effect estimates, which are not confounded by national trends such as healthcare and economic changes, have shown little to no evidence of an association between $PM_{2.5}$ exposure and mortality. While these studies suggested the presence of some unmeasured confounding from epidemiology studies, US EPA did not take these findings into consideration in its causal determinations for $PM_{2.5}$ exposure and health outcomes in the 2019 ISA and 2022 ISA Supplement (US EPA, 2019, 2022a), which provided the scientific basis for the 2022 PA and the Proposed Rule (US EPA, 2022b, 2023).

### 2.5.3 Statistical Model

The Cox proportional hazards model used in cohort studies cannot adequately control for strong time-varying confounding. A recent simulation, based on a realistic cohort of 500,000 adults constructed using the National Cancer Institute Smoking History Generator, indicates that the Cox model poorly controls for a time-dependent strong risk factor (*e.g*., smoking, which was used in this simulation), yielding unreliable relative risk estimates unless detailed, time-varying information is incorporated into the modeling. None of the studies identified as key in the 2022 PA incorporated these parameters in their modeling (US EPA, 2022b). As a result, the effect estimates from these studies are of questionable reliability, given the relatively modest association between $PM_{2.5}$ exposure and mortality (Moolgavkar *et al.*, 2018).

### 2.5.4 $PM_{2.5}$ Exposure Threshold

In the Proposed Rule, US EPA noted:

> Studies evaluated in the 2019 ISA and the ISA Supplement examine this issue, and continue to provide evidence of linear, no-threshold relationships between long-term $PM_{2.5}$ exposures and all-cause and cause-specific mortality…. Generally, the evidence remains consistent in supporting a no-threshold relationship, and in supporting a linear relationship for $PM_{2.5}$ concentrations > 8 $\mu g/m^3$. However, uncertainties remain about the shape of the C-R [concentration-response] curve at $PM_{2.5}$ concentrations < 8 $\mu g/m^3$, with some recent studies providing evidence for either a sublinear, linear, or supralinear relationship at these lower concentrations (U.S. EPA, 2019a, section 11.2.4; U.S. EPA, 2022a, section 2.2.3.2). (US EPA, 2023)

Rhomberg *et al.* (2011) showed that exposure measurement error can lead to the underestimation of risks at higher exposure levels and the overestimation of risk at lower exposure levels. Exposure measurement errors, ranging from instrument imprecision to the practice of serially averaging measured constituent values over time and space, are pervasive in observational air pollution studies. These errors preclude the ability of these studies to detect a $PM_{2.5}$ threshold, if one were to exist. Given that such errors make determining the true shape of the $PM_{2.5}$ concentration-response function difficult, assessments of risks at low $PM_{2.5}$ exposure levels based on these curves are of dubious reliability.

Similarly, in his comments on the draft of the 2022 ISA Supplement (US EPA, 2022a), CASAC member Dr. Jeremy Sarnat noted:

> A theoretical question related to the shape of C-R curves (for mainly long-term exposure and mortality) is whether we might expect to see differential measurement error at lower observed PM concentrations. For studies based primarily on measured estimates of population exposure I could hypothesize why differential error may exist and lead to differences in the shape of the curve along its full observed range. (US EPA, 2021b)

Furthermore, in her comments on the same document, CASAC member Dr. Deborah Corey-Slechta stated:

> One topic that does come to mind, although not necessarily related to the current document or its ultimate purpose and which may be included in the 2019 PM ISA is the fact that exposure to air pollution is lifelong, beginning in utero. Obviously, this cannot be accommodated in terms of data or specific calculations but may be an important reminder with respect to the problem itself, given that right now we're not even focused on lifetime exposures. (US EPA, 2021b)

This is an important point. The long-term exposure studies of $PM_{2.5}$ that US EPA evaluated did not assess the risks of lifetime $PM_{2.5}$ exposures or determine how individuals' $PM_{2.5}$ exposures before the study period impact the interpretation of their results, even though it is hard to imagine these earlier exposures not playing a role if $PM_{2.5}$ exposure is indeed causal. Not only can this impact the detection of a threshold, but these earlier exposures may be confounders that impact the interpretation of associations between $PM_{2.5}$ exposure and health effects at lower exposure concentrations.

Taken together, there is a high degree of uncertainty at long-term $PM_{2.5}$ concentrations below the current annual standard in epidemiology studies that evaluated concentration-response relationships.

## 2.6 Conclusion

In the Proposed Rule, US EPA (2023) concluded:

> Regardless of whether an epidemiologic study uses monitoring data or a hybrid modeling approach when estimating $PM_{2.5}$ exposures, the PA recognizes that it is challenging to interpret the study-reported mean $PM_{2.5}$ concentrations and how they compare to design values. This is particularly true given the variability that exists across the various approaches to estimate exposure and to calculate the study-reported mean.

We concur with US EPA that comparing the mean $PM_{2.5}$ concentrations reported from the key epidemiology studies to the annual design values is challenging. In addition, we recognize that the key epidemiology studies on which the Administrator based his proposal to lower the current standard were not reviewed in a systematic, unbiased, or transparent manner. These studies have substantial uncertainties and limitations (*e.g.*, exposure measurement error, confounding, irrelevant exposure windows) that were not adequately taken into account in the Administrator's evaluation of the current standard. Therefore, these studies do not provide adequate evidence for health effects occurring at $PM_{2.5}$ concentrations lower than the current standard of 12 $\mu g/m^3$.

# 3 Primary Annual $PM_{2.5}$ Standard – Experimental Evidence

US EPA described experimental studies in the 2019 ISA, 2022 ISA Supplement, 2022 PA, and Proposed Rule (US EPA, 2019, 2022a,b, 2023). The Agency acknowledged that these studies mostly evaluated exposures well above ambient $PM_{2.5}$ concentrations. We agree with US EPA that these studies do not provide evidence regarding ambient $PM_{2.5}$ exposures. We also conclude that these studies provide evidence that there are thresholds for health outcomes associated with $PM_{2.5}$ exposure.

## 3.1 Controlled Human Exposure Studies

Regarding the available controlled human exposure studies of $PM_{2.5}$, the 2022 PA stated:

> Taken together, these controlled human exposure studies support biological plausibility for the serious cardiovascular and respiratory effects that have been linked with ambient $PM_{2.5}$ exposures and seen in epidemiologic studies (U.S. EPA, 2019, Chapter 6). However, while these studies are important in establishing biological plausibility, it is unclear how the results alone and the importance of the effects observed in these studies, particularly in studies conducted at near-ambient $PM_{2.5}$ concentrations, should be interpreted with respect to adversity to public health. (US EPA, 2022b)

We disagree with the Agency's conclusion that these studies' results provide support for the biological plausibility of the health effects observed at ambient $PM_{2.5}$ concentrations in the epidemiology studies. Only a few such studies are available, and they mostly evaluated exposure concentrations well above ambient concentrations. In addition, the exposure concentrations these studies evaluated and the health outcomes they observed are not consistent or coherent. They also all had very small samples sizes and do not represent the larger population of people in the US that the NAAQS is intended to protect.

In addition, some of the effects observed in these studies are either not adverse themselves or are not necessarily indicative of potential adverse effects. US EPA acknowledged and discussed this in the Proposed Rule:

> [I]mpaired vascular function can signal an intermediate effect along the potential biological pathways for cardiovascular effects following short-term exposure to $PM_{2.5}$ and show a role for exposure to $PM_{2.5}$ leading to potential worsening of IHD [ischemic heart disease] and heart failure followed potentially by ED [emergency department] visits, hospital admissions, or mortality (U.S. EPA, 2019, section 6.1 and Figure 6-1). **However, just observing the occurrence of impaired vascular function alone does not clearly suggest an adverse health outcome.** (US EPA, 2023 [emphasis added])

Regarding this issue, US EPA also referenced the American Thoracic Society (ATS) and European Respiratory Society (ERS) statement on the adverse effects of air pollutants (Thurston *et al.*, 2017) in the Proposed Rule, stating:

> While the ATS/ERS statement concluded that chronic endothelial and vascular dysfunction can be judged to be a biomarker of an adverse health effect from air pollution, they also conclude that "the health relevance of acute reductions in endothelial function induced by air pollution is less certain" (Thurston et al., 2017). This is particularly informative to our consideration of the controlled human exposure studies which are short-term in nature (*i.e.*, ranging from 2- to 5-hours), including those studies that are conducted at near-ambient $PM_{2.5}$ concentrations. (US EPA, 2023)

Many of the cardiovascular and respiratory effects assessed in the controlled human exposure studies have threshold modes of action and do not occur at lower $PM_{2.5}$ concentrations. If the threshold is above ambient concentrations, then these studies do not provide support for these effects at ambient concentrations.

In light of these issues, US EPA should not consider the results of the controlled human exposure studies of $PM_{2.5}$ to support the biological plausibility of health effects reported in epidemiology studies at near-ambient or lower $PM_{2.5}$ concentrations.

## 3.2 Experimental Animal Studies

With respect to the available experimental animal studies of $PM_{2.5}$, the 2022 PA noted that, except for two studies that examined $PM_{2.5}$ concentrations close to ambient concentrations, most of the studies examined short-term exposures to concentrations ranging from 100 to >1,000 $\mu g/m^3$ and long-term exposures to concentrations ranging from 66 to >400 $\mu g/m^3$, which are far above ambient levels in the US (US EPA, 2022b). Of the two exceptions, one study reported impaired lung development in mice following exposure to an average concentration of 16.8 $\mu g/m^3$ of $PM_{2.5}$ for 24 hours/day for several months (Mauad *et al.*, 2008), and the other study reported increased carcinogenic potential following exposure to an average concentration of 17.7 $\mu g/m^3$ $PM_{2.5}$ for 2 months (Cangerana Pereira *et al.*, 2011, as cited in US EPA, 2022b). The 2022 PA noted that while these two studies reported "serious effects following long-term exposures to $PM_{2.5}$ concentrations close to the ambient concentrations reported in some $PM_{2.5}$ epidemiologic studies (U.S. EPA, 2019, Table 1-2), [these concentrations are] still above the ambient concentrations likely to occur in areas meeting the current primary standards" (US EPA, 2022b).

The Administrator noted in the Proposed Rule:

> With regard to the animal toxicological studies, the PA recognizes that, unlike the controlled human exposure studies that provide insight on the exposure concentrations that directly elicit health effects in humans, there is uncertainty associated with translating the observations in the animal toxicological studies to potential adverse health effects in humans. The PA notes that the interpretation of these studies is complicated by the fact that $PM_{2.5}$ concentrations in animal toxicological studies are much higher than those shown to elicit effects in human populations. Moreover, the PA recognizes that there are also significant anatomical and physiological difference[s] between animal models and humans. (US EPA, 2023)

The Administrator concluded, "noting uncertainty in extrapolating the effects seen in animals, and the $PM_{2.5}$ exposures and doses that cause those effects to human populations, animal toxicological studies are of limited utility in informing decisions on the public health protection provided by the current or alternative primary $PM_{2.5}$ standards" (US EPA, 2023). We agree with the Administrator's judgment regarding the overall evidence from the experimental animal studies of $PM_{2.5}$.

# 4 Primary 24-Hour $PM_{2.5}$ Standard

In the Proposed Rule, the Administrator concluded that the available literature did not call into question the adequacy of the current primary 24-hour $PM_{2.5}$ standard of 35 μg/$m^3$ and proposed retaining that standard for now. In support of that decision, the Administrator noted that "the observations that the air quality concentrations in areas meeting the current standards are well below the $PM_{2.5}$ concentrations shown to elicit effects" (US EPA, 2023). However, because some CASAC members have proposed lowering the current primary 24-hour standard to between 25 and 30 μg/$m^3$, the Administrator will also take public comments on that proposal (US EPA, 2023).

Regarding the available epidemiology studies of short-term $PM_{2.5}$ exposure, the Administrator noted:

> While there are three studies available in this reconsideration that restricted 24-hour concentrations to concentrations below 25 μg/$m^3$ and while some members of CASAC pointed to these studies as the basis for their recommendation to revise the 24-hour standard, the Administrator preliminarily concludes that the results from these studies, particularly in light of the uncertainties associated with these studies… are an inadequate basis for revising the level of the 24-hour $PM_{2.5}$ standard. (US EPA, 2023)

The Administrator also noted that the risk assessment of long- and short-term $PM_{2.5}$ exposures and all-cause or nonaccidental mortality shows that:

> [E]stimated reduction in $PM_{2.5}$-associated risks is across a more limited population and is largely confined to a small number of areas located in the western U.S. Other areas included in the risk assessment were shown to experience risk reductions that were driven primarily by meeting a lower annual standard level (though the associated change in air quality also resulted in lower 24-hour standard concentrations). (US EPA, 2023)

In their review of the draft of the 2022 PA, some CASAC members recommended retaining the primary 24-hour $PM_{2.5}$ standard, primarily based on the US EPA risk assessment and evidence from controlled human exposure studies of $PM_{2.5}$. For example, in his comments on the draft of the 2022 PA, Dr. Boylan noted:

> EPA provides sufficient rationale to retain the current primary 24-hour $PM_{2.5}$ standard, without revision. The risk assessment not only accounts for the level of the standard, but also accounts for the form of the standard and the way attainment with the standard is determined (i.e., highest design value in the CBSA [core-based statistical areas]). The risk assessment indicates that the annual standard is the controlling standard across most of the urban study areas evaluated and revising the level of the 24-hour standard is estimated to have minimal impact on the $PM_{2.5}$-associated risks. Therefore, the annual standard can be used to limit both long- and short-term $PM_{2.5}$ concentrations.
>
> Epidemiologic studies provide the strongest support for reported health effect associations for the overall mean concentrations rather than near the upper end of the concentration distribution; therefore, there is limited epidemiologic evidence to determine the adequacy of the level of the 24-hour standard. The epidemiologic studies included in this document

> do not indicate that the reported health effect associations are strongly influenced by exposures to the peak concentrations in the air quality distribution.
>
> Finally, the $PM_{2.5}$ concentrations used in human clinical studies to show short-term exposure effects are well above those typically measured in areas meeting the current standards, suggesting that the current standards are providing adequate protection against these exposures. (Sheppard, 2022)

Considering the uncertainties in and limitations of the scientific evidence and quantitative information regarding short-term $PM_{2.5}$ exposure noted by both the Administrator and CASAC member Dr. Boylan, we agree with the US EPA Administrator that the primary 24-hour $PM_{2.5}$ standard should be retained.

# 5 At-Risk Populations

The Proposed Rule noted that at-risk populations "represent a substantial portion of the total U.S. population" and "[t]he information available in this reconsideration has not altered our understanding of human populations at risk of health effects from $PM_{2.5}$ exposures" (US EPA, 2023). These populations include children, older adults, individuals with pre-existing cardiovascular and/or respiratory diseases, individuals of Black and Hispanic race/ethnicity, and individuals of lower socioeconomic status (SES) (US EPA, 2023). However, the 2019 ISA indicates that "children and race were the only factors for which it was concluded that '*adequate evidence*' was available indicating that people of a specific lifestage and race are at increased risk of $PM_{2.5}$-related health effects" (US EPA, 2019 [emphasis in original]). For all the other risk factors, US EPA found the evidence to be suggestive of an association with an increased risk of $PM_{2.5}$-related health effects[1] (*e.g.*, pre-existing cardiovascular disease or respiratory disease, low SES) or inadequate to be able to assess that association (*e.g.*, older age) (US EPA, 2019). Highlighting environmental justice issues, the 2022 ISA Supplement focused on reviewing studies published since the 2019 ISA that examined disparities in $PM_{2.5}$ exposure or $PM_{2.5}$-related health risks based on SES and race/ethnicity (US EPA, 2022a). US EPA concluded in the 2022 ISA Supplement that the evidence from those studies "support the conclusions of the 2019 PM ISA," specifically that there is "suggestive" evidence that low SES is associated with an increased risk of $PM_{2.5}$-related health effects and "adequate" evidence that "race and ethnicity, specifically minority populations including Black populations, are at increased risk of $PM_{2.5}$-related health effects, in part due to disparities in exposure" (US EPA, 2022a).

With respect to children, the 2019 ISA stated that "[a]lthough stratified analyses do not indicate a difference in the risk of PM-related health effects between children and adults, there is strong evidence from studies focusing on children that demonstrate health effects only observable in growing children that [can be] attributed to $PM_{2.5}$ exposure" (US EPA, 2019). That is, while children may be susceptible to health outcomes that would not affect adults (*e.g.*, lung function growth), there is no evidence that the $PM_{2.5}$ exposure levels at which these effects occur are lower than the exposure levels at which other health effects can occur in children and adults. This indicates that the current primary annual and 24-hour $PM_{2.5}$ standards are adequate to protect children.

It is also notable that many of the epidemiology studies on which the evaluation of the current standard is based involved populations that the 2019 ISA indicated have suggestive evidence of being susceptible to $PM_{2.5}$ (US EPA, 2019). For example, studies of children, older adults, and people with pre-existing cardiovascular and respiratory diseases form the basis of causal conclusions in the 2019 ISA. In addition, three of the eight studies on which the $PM_{2.5}$ risk assessment presented in the 2022 PA was based (US EPA, 2022b) evaluated mortality risks in people over the age of 55 (*i.e.*, Thurston *et al*., 2016) and 65 (*i.e.*, Di *et al*., 2017a; Zanobetti *et al*., 2014). Although the remaining five studies on which this risk assessment was based evaluated all ages (Baxter *et al*., 2017; Ito *et al*., 2013) and ages 30 and over (Jerrett *et al*., 2017; Pope *et al*., 2015; Turner *et al*., 2016), the majority of the deaths observed in these studies occurred in older individuals.

In addition, while environmental justice issues are important and should continue to be studied, and there is clear evidence for disparities in $PM_{2.5}$ exposure associated with race and SES, the evidence to date regarding disparities in the risk of $PM_{2.5}$-related health effects associated with these factors does not support

[1] *i.e.*, "[The] evidence is limited due to some inconsistency within a discipline or, where applicable, a lack of coherence across disciplines" (US EPA, 2019)

a similar conclusion. Specifically, none of the five studies included in the 2022 ISA Supplement (US EPA, 2022a) that evaluated the dose-response relationship between long-term $PM_{2.5}$ exposure and total mortality stratified by race/ethnicity (*i.e.*, Awad *et al*., 2019; Lipfert and Wyzga, 2020; Parker *et al*., 2018; Son *et al*., 2020; Wang *et al*., 2020) support the conclusion that there is a disparity in $PM_{2.5}$-related mortality risk associated with race/ethnicity. Both Awad *et al*. (2019) and Lipfert and Wyzga (2020) reported stronger associations between long-term $PM_{2.5}$ exposure and mortality among Whites than among Blacks, while Son *et al*. (2020) and Wang *et al*. (2020) both reported associations of equal magnitude among Whites and Blacks (US EPA, 2022a). Regarding the fifth study by Parker *et al*. (2018), while the 2022 ISA Supplement stated that the "study reported a larger association, in terms of magnitude, among Black (HR: 1.05 [95% CI: 1.03, 1.09]) and White (HR: 1.02 [95% CI: 1.00, 1.05]) individuals and a null association among Hispanic individuals (HR: 0.98 [95% CI: 0.94, 1.03])" for all-cause mortality[2] (US EPA, 2022a), these hazard ratios (HRs) and CIs are not consistent with those reported in the study publication. Rather, Parker *et al*. (2018) reported no association between long-term $PM_{2.5}$ exposure and all-cause mortality among White (HR = 1.05, 95% CI: 1.00-1.11), Black (HR = 1.11, 95% CI: 0.97-1.28), or Hispanic individuals (HR = 0.97, 95% CI: 0.88-1.06). The results suggest that there were no statistically significant differences in the associations between long-term $PM_{2.5}$ exposure and all-cause mortality among different racial groups.

As with the key epidemiology studies of $PM_{2.5}$ exposure discussed in Section 2, US EPA did not systematically evaluate the quality of the studies evaluating $PM_{2.5}$ exposure and at-risk populations that the Agency reviewed in the 2022 ISA Supplement (US EPA, 2022a). For example, the study by Wang *et al*. (2020) is subject to several methodological limitations, primarily the potential for exposure measurement error, model misspecification, and multiple comparisons being performed, all of which could have biased the study's findings on racial disparities in mortality rates. Further, all five of the studies discussed above had very large sample sizes, ranging from approximately 660,000 to 53,000,000 (Awad *et al*., 2019; Lipfert and Wyzga, 2020; Parker *et al*., 2018; Son *et al*., 2020; Wang *et al*., 2020). As a result, any observed differences in the association between long-term $PM_{2.5}$ exposure and mortality across racial groups could have been due to overly sensitive statistical testing, rather than reflecting true underlying racial disparities in mortality associated with $PM_{2.5}$ exposure. Finally, there are few studies (maximum of two) available for each particular health outcome (*e.g.*, overall cardiovascular mortality, hypertension, diabetes mortality), raising question about the certainty of the existing evidence.

[2] In addition, in Table A-16 of the 2022 ISA Supplement, US EPA reported a different risk estimate for all-cause mortality for white individuals (HR = 1.03, 95% CI: 1.02-1.03) (US EPA, 2022a). The risk estimates for the other two populations are the same as those provided in the main text.

# 6 Conclusions

Based on our review of the Proposed Rule, we conclude the following:

- The evidence does not support lowering the primary annual $PM_{2.5}$ standard.
  - The key epidemiology studies on which the Administrator based his proposal to lower the current standard were not reviewed in a systematic, unbiased, or transparent manner. These studies have substantial uncertainties and limitations (*e.g.*, exposure measurement error, confounding, irrelevant exposure windows) that were not adequately taken into account in the Administrator's evaluation of the current standard. Therefore, these studies do not provide adequate evidence for health effects occurring at $PM_{2.5}$ concentrations lower than the current standard of 12 $\mu g/m^3$.
  - The area annual $PM_{2.5}$ design values are generally higher than the mean concentrations reported in the monitor-based studies and the hybrid model-based studies that incorporated population weighting. The range of the area annual design values associated with the lowest reported mean $PM_{2.5}$ concentrations reported in these studies (*i.e.*, 9.9 $\mu g/m^3$ for the monitor-based studies and 9.3 $\mu g/m^3$ for the hybrid model-based studies with population weighting) would be 10.9-11.9 $\mu g/m^3$ and 10.6-11.0 $\mu g/m^3$, respectively. These levels are higher than the Administrator's proposed primary annual $PM_{2.5}$ standard of 9-10 $\mu g/m^3$.
  - Further, the recommended increase in near-road monitoring will further increase the ratios of maximum annual design values to averaged concentrations. In turn, this will increase the potential that continued implementation of the current standard could effectively achieve average concentration levels in many areas that approach US EPA's proposed range for what is required to protect public health.
  - While accountability studies can inform the relationship between $PM_{2.5}$ exposure and health effects, they can have crucial methodological limitations that undermine their findings, including some that are unique to this study design and the statistical approaches these studies use, and some common to epidemiology studies with a more-traditional study design (*e.g.*, exposure measurement error).
  - The experimental animal studies and controlled human exposure studies of $PM_{2.5}$ do not provide evidence regarding ambient $PM_{2.5}$ exposures.
- Considering the uncertainties in and limitations of the scientific evidence and quantitative information regarding short-term $PM_{2.5}$ exposure, we agree with the US EPA Administrator's current decision that the primary 24-hour $PM_{2.5}$ standard should be retained.

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**NAAQS Regulatory Review & Rulemaking Coalition**

# ATTACHMENT 2

# TO

## COMMENTS OF THE NAAQS REGULATORY REVIEW & RULEMAKING COALITION ON EPA'S RECONSIDERATION OF THE NATIONAL AMBIENT AIR QUALITY STANDARDS FOR PARTICULATE MATTER

## DOCKET NO. EPA–HQ–OAR-2015-0072

American Chemistry Council
American Coke and Coal Chemicals Institute
American Forest & Paper Association
American Fuel & Petrochemical Manufacturers
American Iron and Steel Institute
American Petroleum Institute
American Wood Council
National Lime Association
National Mining Association
National Stone, Sand & Gravel Association
Oilseed Processors Coalition
- Corn Refiners Association
- National Cotton Council
- National Cotton Ginners Association
- National Cottonseed Processors Association
- National Oilseed Processors Association
- Texas Cotton Ginners' Association

Portland Cement Association
The Aluminum Association
The Fertilizer Institute

March 28, 2023

**Impacts of a Lower Annual $PM_{2.5}$ Ambient Air Quality Standard on the Forest Products Industry**

American Forest and Paper Association/American Wood Council
February 2023

The Clean Air Act (CAA) requires the U.S. Environmental Protection Agency (EPA) to set National Ambient Air Quality Standards (NAAQS) for certain pollutants, termed "criteria pollutants." There are currently NAAQS for the following pollutants: ozone, nitrogen dioxide ($NO_2$), sulfur dioxide ($SO_2$), carbon monoxide (CO), particulate matter (PM) less than 10 microns in diameter ($PM_{10}$), particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), and lead. The CAA directs EPA to review the NAAQS every five years. EPA is currently reconsidering its most recent review of the PM NAAQS.

Implementation of NAAQS poses challenges, even in areas that attain the NAAQS. Before a new major source can be built in such an area or an existing source be expanded, a demonstration is required to show that this activity will not cause or contribute to a NAAQS violation. Many factors contribute to the challenges of demonstrating compliance with the $PM_{2.5}$ NAAQS, including the layers of conservatism built into the modeling analysis, uncertainty related to $PM_{2.5}$ emission rates, and the fact that the monitored background concentration EPA requires be added to modeled concentrations is often not representative of true background. This discussion focuses on the background concentration issue.

The assigned background $PM_{2.5}$ concentrations in many areas where forest products facilities are located approach the current annual primary NAAQS of 12 $\mu g/m^3$. Because of this, the American Forest and Paper Association (AF&PA) and the American Wood Council (AWC) with the assistance of All4 Inc and Fisher International evaluated the potential impacts of a lower annual $PM_{2.5}$ NAAQS on the forest products industry. Although some forest products facilities are in locations that would transition to designation as a nonattainment area with a lower annual standard, for those locations that continue to attain the NAAQS, the difference between the background and the NAAQS would get smaller and make air quality modeling demonstrations more difficult. The lack of "headroom" between the background annual $PM_{2.5}$ concentration and a lower standard would increase the burden on facilities that would like to expand operations or renew air permits. AF&PA and AWC evaluated the impact of lowering the annual $PM_{2.5}$ NAAQS from 12 $\mu g/m^3$ to between 8 and 10 $\mu g/m^3$. Even reducing the standard from 12 to 10 $\mu g/m^3$ would be a decrease that is 10 times EPA's 0.2 $\mu g/m^3$ ambient $PM_{2.5}$ significant impact level.

AF&PA/AWC developed a list of forest products facilities (wood products manufacturing facilities and pulp, paper, and packaging manufacturing facilities) and their locations. Next, current publicly available EPA $PM_{2.5}$ monitoring data were used to assign a monitored or interpolated background value for the annual $PM_{2.5}$ standard to each facility's county. Then, the difference between the annual standard and the assigned background value was calculated for each facility (this value represents the headroom). The headroom was calculated for both the current annual NAAQS and hypothetical revised levels of the standard of 10, 9, and 8 $\mu g/m^3$.

In order to determine the headroom typically required by forest products facilities, AF&PA/AWC reviewed several recent permit applications for both greenfield facilities and modifications to existing facilities. For example, a permit application for a state of the art, greenfield pulp and paper mill was submitted in the southern U.S in 2018. The modeling submitted with the air permit application indicates that the facility's $PM_{2.5}$ emissions consumed approximately 3 µg/m$^3$ of headroom. This mill was ultimately not constructed, but it was to be located on a large property in flat terrain, equipped with state-of-the-art PM emissions controls, and have exhaust stacks sized to optimize dispersion. Other recent air permit applications for pulp and paper mills that triggered PSD review and modeling for $PM_{2.5}$ required at least 3 µg/m$^3$ of headroom in order to model the mill's $PM_{2.5}$ emissions.

In a second example, a state-of-the-art, greenfield wood products manufacturing facility was constructed in the northern U.S in 2018. The modeling submitted with the permit application indicates that the facility's $PM_{2.5}$ emissions consumed approximately 1 µg/m$^3$ of headroom. Again, the new mill is located on a large property in flat terrain and has state of the art PM emissions controls. Other recent air permit applications for wood products mills that triggered PSD review and modeling for $PM_{2.5}$ required up to 3 µg/m$^3$ of headroom in order to model the mill's $PM_{2.5}$ emissions.

Currently, only seven pulp, paper, and packaging facilities and seven wood products mills are in areas that do not attain the annual $PM_{2.5}$ NAAQS. The following table shows the impacts on headroom for forest products facilities if the annual standard is reduced to 10, 9. or 8 µg/m$^3$. Of the 300 pulp, paper, and packaging facilities evaluated, 212 (about 71 percent) will have less than 3 µg/m$^3$ of headroom between the background and the standard (including 17 mills in nonattainment areas and 44 mills that already have less than 3 ug/m$^3$) if the annual $PM_{2.5}$ NAAQS is reduced to 10 ug/m$^3$ or less. And, of the 223 wood products facilities evaluated, 199 (about 89 percent) will have less than 3 µg/m$^3$ of headroom between the background and the standard (including 24 mills in nonattainment areas and 58 mills that already have less than 3 ug/m$^3$) if the annual $PM_{2.5}$ NAAQS is reduced to 10 µg/m$^3$ or less.

| Type of Facility | Total Facilities Evaluated | Mills with headroom less than 3 at 12 µg/m$^3$ | Mills with headroom less than 3 at 10 µg/m$^3$ | Mills with headroom less than 3 at 9 µg/m$^3$ | Mills with headroom less than 3 at 8 µg/m$^3$ |
|---|---|---|---|---|---|
| **Pulp, Paper, and Packaging** | 300 | 44 | 212 | 266 | 281 |
| **Wood Products** | 223 | 58 | 199 | 217 | 221 |

Less headroom between the background and the NAAQS will translate into capital expenditures related to conducting a successful air dispersion modeling analysis for $PM_{2.5}$ for addition of controls, stack modifications, etc. In some cases, a modeling demonstration will only be required for facilities that must submit modeling as part of a permit application for a modification that significantly increases $PM_{2.5}$ emissions. However, some permitting agencies require modeling demonstrations as part of the Title V renewal process or as part of minor permit applications. Achieving successful modeling analysis results for a project could force the facility to control emissions beyond what a Best Available Control Technology (BACT) analysis would require for modified sources and could require controls or modifications for sources that the facility was not modifying as part of an expansion project (and that were not required to apply BACT).

Unquantifiable costs are those of lost opportunities (e.g., a facility might not bother to proceed with a beneficial expansion project because of the cost of making modifications to the facility in order to successfully model below the NAAQS, or because offsets are not available, or because it would take too much time to set up a monitoring station and collect ambient data).

The majority (85%) of pulp, paper, and packaging facilities currently have a headroom of at least 3 ug/m$^3$. A headroom of 3 ug/m$^3$ is likely the minimum amount of headroom required to model a complex manufacturing facility like a pulp and paper mill, but a value of at least 5 ug/m$^3$ could be necessary based on recent permit applications with modeling. If the standard is lowered to 10 ug/m$^3$, an estimated 168 more mills than today will have headroom of less than 3 ug/m$^3$ and will likely need to implement improved emissions controls and make changes to exhaust stacks. The improved controls could include installation of polishing fabric filters or wet electrostatic precipitators (WESP) on solid-fuel boilers; electrostatic precipitators (ESP) on lime kilns currently controlled with wet scrubbers; improving ESP control efficiency on recovery furnaces; adding exhaust stacks to paper machines to improve dispersion; paving roads; increasing stack heights; moving stacks or sources that are close to the facility's fenceline; enclosing sources; or some combination of these. A complex mill (about 100 of the 300 mills) with at least one solid-fuel boiler, lime kiln, and recovery furnace might spend $20 million in capital[1] on these changes. A simpler recycle or converting mill may need to spend $2 to 4 million to reduce emissions and/or take steps to improve the dispersion characteristics of the $PM_{2.5}$ sources. Because the configuration of each mill is different and because we have interpolated design values in many locations, we developed a range of estimated costs at each level of the standard being contemplated by the proposal, based on a basic knowledge of the types of equipment at each mill and the types of projects that might need to be performed to improve a mill's ambient impacts.

- If the standard is reduced to 10 ug/m$^3$, the total cost to the pulp, paper, and packaging industry would be between $1 and 2 billion in capital.
- If the standard is reduced to 9 ug/m$^3$, the total cost to the pulp, paper, and packaging industry would be between $2 and 3 billion in capital.
- If the standard is reduced to 8 ug/m$^3$, the total cost to the pulp, paper, and packaging industry would be between $3 and 4 billion in capital.

The majority (74%) of wood products manufacturing facilities currently have a headroom of at least 3 ug/m$^3$ and 94% of wood products manufacturing facilities have a headroom of at least 1 ug/m$^3$. If the standard is lowered to 10 ug/m$^3$, an estimated 141 more facilities than today will have headroom less than 3 ug/m$^3$ and will likely need to implement improved emissions controls and make changes to exhaust stacks. The improved controls could include installation of wet electrostatic precipitators (WESP) on solid-fuel boilers; addition of or improvements to fabric filters on material handling sources; control of fugitive sources; moving stack or source locations; increasing stack heights; paving roads; or some combination of these. A complex

[1] Improving ESP controls on recovery furnaces would cost an estimated $3 million of capital for each project, on average. Adding fabric filter, ESP, or WESP controls on solid-fuel boilers, recovery furnaces, and lime kilns would cost between $4 million and $7 million of capital for each project, on average. Increasing stack height, moving stacks, or installing new stacks would cost an estimated at $1 million for each project, with multiple projects per mill.

wood products facility could spend $5 to 10 million in capital[2] on these changes. Because the configuration of each mill is different and because we have interpolated design values in many locations, we developed a range of estimated costs at each level of the standard being contemplated by the proposal, based on a basic knowledge of the types of equipment at each mill and the types of projects that might need to be performed to improve a mill's ambient impacts.

- If the standard is reduced to 10 $ug/m^3$, the total cost to the wood products manufacturing industry would be between $500 and 750 million in capital.
- If the standard is reduced to 9 $ug/m^3$, the total cost to the wood products manufacturing industry would be between $800 and 900 million in capital.
- If the standard is reduced to 8 $ug/m^3$, the total cost to the wood products manufacturing industry would be between $900 million and $1 billion in capital.

Based on EPA's 2017 National Emissions Inventory, forest products facilities contribute approximately 22 percent of total reported manufacturing industry direct (primary) $PM_{2.5}$ emissions. Therefore, although our study indicates that lowering the annual $PM_{2.5}$ NAAQS could have an impact on the forest products industry of $4 billion, the impact on the manufacturing sector could be almost $20 billion for direct $PM_{2.5}$ emissions assuming a similar level of additional controls and/or emissions reductions are required at facilities in other sectors, and even more when precursor emissions such as $NO_X$, $SO_2$, VOC, and ammonia, which form secondary $PM_{2.5}$, are considered.

[2] Improved fabric filter controls at wood products mills would cost an estimated $1 million for each upgrade. Adding or improving solid-fuel boiler controls would cost an estimated $3 million of capital per upgrade. Controlling additional sources of fine particulate would cost an estimated $3 million per control, on average. Increasing stack height, moving stacks, or installing new stacks could cost up to $3 million per mill.

**NAAQS Regulatory Review & Rulemaking Coalition**

# ATTACHMENT 3
# TO
## COMMENTS OF THE NAAQS REGULATORY REVIEW & RULEMAKING COALITION ON EPA'S RECONSIDERATION OF THE NATIONAL AMBIENT AIR QUALITY STANDARDS FOR PARTICULATE MATTER

### DOCKET NO. EPA–HQ–OAR-2015-0072

American Chemistry Council

American Coke and Coal Chemicals Institute

American Forest & Paper Association

American Fuel & Petrochemical Manufacturers

American Iron and Steel Institute

American Petroleum Institute

American Wood Council

National Lime Association

National Mining Association

National Stone, Sand & Gravel Association

Oilseed Processors Coalition

- Corn Refiners Association
- National Cotton Council
- National Cotton Ginners Association
- National Cottonseed Processors Association
- National Oilseed Processors Association
- Texas Cotton Ginners' Association

Portland Cement Association

The Aluminum Association

The Fertilizer Institute

March 28, 2023

NERA
ECONOMIC CONSULTING

# POTENTIAL COSTS OF FULLY ATTAINING PROPOSED LOWER $PM_{2.5}$ NAAQS STANDARDS

## Technical Comments on the Cost Estimates in the Regulatory Impact Analysis for the Proposed $PM_{2.5}$ NAAQS Reconsideration Rule

Prepared for:
American Petroleum Institute

For Submission to Docket ID No. EPA-HQ-OAR-2019-0587

March 25, 2023

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### *About NERA*

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# EXECUTIVE SUMMARY

On January 27, 2023, the *Federal Register* published a Notice of Proposed Rulemaking (NPRM) from the Environmental Protection Agency (EPA), seeking comment on a reconsideration of the Agency's 2020 rulemaking on the current annual National Ambient Air Quality Standards (NAAQS) for fine particulate matter ($PM_{2.5}$).[1] The current NAAQS for $PM_{2.5}$ are 12 μg/m$^3$ for the annual average and 35 μg/m$^3$ for the daily (24-hour) average.[2] For simplicity of exposition, this combination of annual and daily standards will be referred to herein as "12/35." Upon reconsideration, EPA is proposing to tighten the current annual standard (without modification of the daily standard of 35 μg/m$^3$) to some level between 10 ug/m$^3$ and 9 ug/m$^3$, and is taking comment on a standard of 8 μg/m$^3$ and of up to 11 ug/m$^3$.[3] Hereafter, we refer to these three alternative standards by the labels "10/35," "9/35," "8/35," and "11/35." Simultaneously with the NPRM, EPA also publicly released its Regulatory Impact Analysis (RIA) for the proposed revisions.[4] This RIA contains, *inter alia*, estimates of the costs of control measures that form part of the illustrative control strategies intended to meet more stringent standards and the public health benefits of their associated ambient $PM_{2.5}$ reductions. The comment period for both the NRPM and the RIA ends on March 28, 2023.

The technical comments in this report address the RIA's estimates of the potential costs of attaining three of the four alternative annual standards listed above: 10/35, 9/35, and 8/35.[5] Key findings of this report are summarized below, and fully detailed in the main sections and appendices of this report.

Most generally, we find that the RIA's cost estimates are incomplete to the point of having very limited usefulness to decision making or public understanding of the full potential impacts of any of the alternative standards. Specifically, the RIA's cost estimates reflect control measures that produce only a fraction of the emissions reductions that it estimates will be needed for all counties in the U.S. to achieve full attainment of each of the alternative standards (*i.e.,* only 29% to 53% of the required emissions reductions nationally, and as little as 0% for some individual counties). In essence, the cost estimates reported in the RIA are only for "partial attainment."

Partial attainment is not a concept with any basis in economic practice or theory. It is simply the point at which a list of candidate control measures that EPA prepared prior to initiating its cost analysis is

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[1] 88 *Federal Register* 5558, "Reconsideration of the National Ambient Air Quality Standards for Particulate Matter," January 27, 2023.

[2] These are the values that monitor-specific design values may not exceed. The annual average considers 3-year averages of the annual design values. The daily average standard must not be exceeded by the 3-year average of the 98$^{th}$ percentile of a monitor's 24-hour average values.

[3] The NPRM also solicits comments on a possible tightening of the daily standard to 30 μg/m$^3$ but the focus of these comments is only on analyses related to alternative annual standards discussed in the NPRM.

[4] EPA, 2022, *Regulatory Impact Analysis for the Proposed Reconsideration of the National Ambient Air Quality Standards for Particulate Matter*, EPA-452/P-22-001, December, available at https://www.epa.gov/system/files/documents/2023-01/naaqs-pm_ria_proposed_2022-12.pdf.

[5] The RIA does not explain why it has not provided an evaluation of 11/35 even though it does evaluate 8/35 and a daily standard of 30 μg/m$^3$ (*i.e.*, 10/30). Lacking any RIA analysis for 11/35, we do not attempt to comment on its costs in this report. While we do not quantitatively evaluate the RIA's cost estimates for 10/30, the comments and concerns we identify for the three alternative annual standards apply equally well to the RIA's estimates of 10/30.

completely used up, or contains only measures that are of a higher cost per ton than EPA has decided to consider,[6] or would be applied to emissions sources that emit fewer tons per year than EPA has decided to consider.[7] The constraints themselves have no foundation in the Clean Air Act nor in states' practices for developing NAAQS implementation plans, and may be unrealistic, given that states face sanctions if they cannot identify and impose controls sufficient to achieve attainment. These cost and size constraints likely play a role in why the RIA produces only partial attainment, but we also find that the list of candidate control measures does not even contain measures that would address a very large fraction of the baseline emissions that need to be reduced in order to achieve full attainment. The omitted potential control measures are inherently more costly than those included. The overall result of the RIA's cost analysis is significant understatement of the full attainment cost of each alternative standard.

There also is no basis in sound RIA practice for reporting only partial attainment costs. In fact, when EPA has run into the problem of partial attainment in its prior RIAs for both $PM_{2.5}$ and ozone NAAQS rulemakings (*e.g.*, EPA, 2012 and 2015), it provided estimates of only full attainment costs in those RIA's executive summaries. EPA treated its partial cost estimates as merely an initial step in the full cost analysis, relegating them to mere analytical details in later chapters of the RIAs. Inspection of the details in those prior RIAs finds that partial attainment costs were most often between 1% and 15% of EPA's respective full attainment cost estimates, and only one case reached as high as 50%.

These two prior NAAQS RIAs show — even by EPA's own calculations — that partial attainment costs are not at all indicative of the likely potential costs of attaining any of the alternative standards. Despite this, the current RIA for the $PM_{2.5}$ NAAQS reconsideration makes no attempt at all to develop cost estimates beyond those of its partial set of illustrative controls and does not even discuss why it has failed to develop full attainment cost estimates.

In this report, we carefully review the modeling inputs and outputs that were used to produce the RIA's partial cost estimates and we demonstrate how to provide a *range* of estimates for the potential cost of full attainment. In developing those full attainment cost estimates, we rely as much as possible on the data and general cost concepts used by EPA despite the fact that many of the cited references for control costs are often small in number and outdated.[8] We explain our approach and assumptions in the main body of this report. The resulting full attainment cost estimates are reported in Table ES-1, which compares them to the RIA's partial attainment costs (from the RIA's Table ES-5).[9]

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[6] In this RIA, the limit allowed is $160,000 per ton removed.

[7] In this RIA, the minimum allowed is 5 tons per year of baseline emissions.

[8] The quality of the available emissions data that must be relied upon is particularly weak for non-point sources of emissions, as EPA has generally conducted less analysis for this category of emissions than for larger point sources. Given the high degree of reliance on non-point source primary $PM_{2.5}$ controls in the RIA for this NAAQS reconsideration, and the high degree of partial attainment that EPA then finds, EPA is effectively considering requiring states to embark on a major regulatory program with significantly less data and more uncertainty on both costs and effectiveness than is typical of past NAAQS RIAs.

[9] The ranges for our estimates of the full cost of attainment of each alternative standard reflect uncertainties in the various input assumptions used in the full attainment portion of the analysis. These ranges do not represent confidence intervals with a probabilistic interpretation. It is our professional judgment, as explained in the main body of this report, that the assumptions defining the lower and upper ends of the range stretch the boundaries of

**Table ES-1. Comparison of NERA's Range of Estimates of Annual Cost of Full Attainment to Partial Cost Estimates Reported in RIA (Annual in 2032, millions of 2017$)**

| Area | 10/35 | | | 9/35 | | | 8/35 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Partial (RIA) | Full (NERA) | | Partial (RIA) | Full (NERA) | | Partial (RIA) | Full (NERA) | |
| | | Low | High | | Low | High | | Low | High |
| Northeast | $7 | $7 | $7 | $206 | $226 | $335 | $1,100 | $2,147 | $6,271 |
| Southeast | $4 | $4 | $4 | $69 | $202 | $605 | $437 | $1,219 | $3,388 |
| West | $19 | $74 | $238 | $34 | $272 | $905 | $122 | $769 | $2,378 |
| California | $64 | $957 | $4,055 | $85 | $1,830 | $7,322 | $163 | $3,097 | $11,704 |
| Total | $95 | $1,042 | $4,305 | $393 | $2,529 | $9,167 | $1,822 | $7,232 | $23,741 |

As the table shows, the estimated potential full attainment costs, even at the low end, are vastly larger than the partial attainment costs that the RIA has reported. It shows that for the 8/35 standard, the potential full attainment will cost between about $7 billion and $24 billion, which is 4 to 13 times more than the RIA's partial cost estimate of less than $2 billion. Full attainment of 9/35 is projected to potentially cost 6 to 23 times more than the RIA's partial estimate. As for the least stringent alternative standard considered, 10/35, the potential full attainment cost is estimated to be between $1 billion and $4 billion per year, 11 to 45 times more than the RIA's partial estimate.[10]

These comparisons illustrate one of the most important reasons that partial attainment costs are inappropriate to report in an RIA executive summary: partial attainment costs provide no indication of either the absolute or relative costs of any of the alternative standards considered. Their presence in the RIA's executive summary is therefore misleading.

Even if fraught with enormous uncertainty, a concerted effort to characterize the full attainment costs is what is needed. It is not the role of an RIA to determine whether such actions will actually be undertaken, but only what potential types of action and associated costs would be necessary if an alternative standard is to be attained. To the extent that some of the additional control measures we identify as needed to achieve full attainment (as detailed in the main body of this report) might be considered technically, economically, or administratively nonviable, our analysis indicates a situation of long-term extensive nonattainment, nationally in the case of the 8/35 standard, and regionally in the case of the other two alternative standards (serving only to exacerbate a regional situation of perpetual nonattainment). This

reasonable expectation and thus the true costs of full attainment have a robust chance of falling within the ranges of potential costs that these input assumption sets project.

[10] We note that the ratios of the RIA's partial to their respective full attainment costs are generally similar to those found in the prior $PM_{2.5}$ and ozone NAAQS RIAs (EPA, 2012 and EPA, 2015). This should be viewed as coincidental but perhaps unsurprising. It is coincidental because the approach taken in this study did not follow the extrapolation procedures relied upon in the prior RIAs. As explained in the main body, our approach was more bottom-up in nature, relying on county-specific estimates of remaining tons of primary $PM_{2.5}$ that could still be controlled after adoption of all the allowed control measures in the EPA cost modeling database; in contrast, EPA used more abstract extrapolation formulas. Additionally, the illustrative control strategies in this RIA are based on reductions in primary $PM_{2.5}$ measures, whereas prior RIAs focused on reductions in $PM_{2.5}$ and ozone precursor gases. However, it is perhaps unsurprising given that EPA used the same basic cost modeling tool and an input list of candidate control measures that were inherently among the lowest-cost of the universe of all potential controls to determine its partial attainment costs.

insight from our full attainment cost assessment calls into question the wisdom of setting the annual $PM_{2.5}$ NAAQS at any of the alternative levels, no matter what may appear to be the net benefits of the first few "partial" steps in the direction of attainment identified in the RIA.

Thus, this full attainment cost analysis provides readers with some understanding of the regulatory challenges that the various alternative standards may entail. By failing to even explain the extent of regulatory challenge that is implicit in the analysis and data behind this RIA, EPA does a disservice to the public and policymakers. This report therefore provides important policy-relevant information and insights that the RIA does not. This report also describes some other important anomalies in this RIA compared to established RIA practice, such as EPA's failure to identify sufficient control measures for several areas of the U.S. to attain even the current $PM_{2.5}$ NAAQS of 12/35.

We have focused our analysis on the costs of full attainment as contrasted to "partial attainment" cost estimates. However, readers should be aware of how narrow even a full attainment cost estimate is. For example, RIAs' full attainment cost estimates omit or may otherwise be limited by the following issues:

(1) Costs and/or economic growth losses in *attainment* areas because of heightened difficulties for potential new plants or plant expansions in those clean air areas to demonstrate that they will not cause "significant deterioration" of air quality already meeting the NAAQS.[11]

(2) The economy-wide costs from the ripple effects on related businesses and employment that could be picked up though macroeconomic modeling of the attainment cost estimates (*e.g.*, using computable general equilibrium models);

(3) Administrative costs to states, which are likely to be amplified when addressing controls for many smaller sources that have never been regulated;

(4) Potential costs of sanctions — transportation and/or conformity freezes if states cannot submit approvable plans;[12]

(5) The cost of all nonattainment stationary source obligations (*e.g.*, NSR, RACM/BACM);

(6) The potential for significant increases in the costs of controls for many source categories given the outdated nature of the referenced source material for the control cost estimates;

(7) EPA's decision to include in its annualized control cost estimates only costs incurred starting in 2032, whereas the technology investments needed to reach attainment by 2032 will need to be incurred well before 2032;

(8) The cost of offsetting emission increases that may perversely occur as the result of the lower standards, such as the recent concerns expressed by the USFS and the Interior Department over

[11] This is more commonly known as the requirement for prevention of significant deterioration (PSD) demonstrations before a proposed new facility can obtain its emissions permit(s).

[12] *See, e.g.*: 87 *Federal Register* 60494, "Clean Air Plans; 2012 Fine Particulate Matter Serious Nonattainment Area Requirements; San Joaquin Valley, California," October 5, 2022, at 60528.

the effect of the new standards in limiting prescribed fires to manage and prevent higher $PM_{2.5}$ emissions from wildfires.[13]

Item (1) of the above list is becoming a heightened concern as the $PM_{2.5}$ NAAQS starts to near levels typical of most of the attaining U.S. As the Discussion section of this report explains, RIAs' traditional estimates of the costs of implementing emissions control measures in projected nonattainment areas may be becoming a smaller and smaller part of the overall burden that NAAQS rules may entail on the U.S. economy. Specifically, concerns are being expressed that a lowered $PM_{2.5}$ NAAQS may create substantially greater challenges for businesses seeking to pass demonstrations of prevention of significant deterioration (PSD) in order to be allowed to expand even in areas that face no risk of falling into nonattainment with a tightened NAAQS. This issue is explained in more depth in the Discussion section of this report because it suggests that heightened emissions control requirements even in attainment areas could become a substantial new compliance cost that a traditional NAAQS RIA does not consider. This RIA (and future RIAs for tighter NAAQS) should consider expanding their notion of NAAQS compliance costs to include incremental costs likely to be incurred in attaining areas across the U.S. Complicating this issue, however, is the possibility that heightened challenges in passing a PSD demonstration could lead businesses to reduce or forego otherwise desired capacity growth, and thus could hinder the economic growth prospects of attainment areas without any actual dollar expenditures ever being incurred. And in that sense, benefit-cost analyses for NAAQS that are based solely on concepts of spending on control equipment or changes in operational processes may be losing their originally intended policy relevance.

Finally, we note that the fact that these comments evaluate only the RIA's cost estimates does not mean that we do not have significant concerns with the numerical validity of its benefits estimates as well. Those benefits estimates are far more uncertain than any cost estimate because they are the subject of on-going questions regarding both their causal and quantitative interpretation. The epistemological issues for benefits calculations are well documented in the record for the proposed rule;[14] the debate is easily summed up as uncertainty over whether such benefits will be realized. In contrast, there is no debate about the existence of actual compliance costs, and it is important and relevant to policy deliberation to understand their potential full attainment cost — and the associated implied practical or technical challenges — even if that requires acknowledgement of a wide range of numerical uncertainty.

[13] *See, e.g.*: General Accounting Office, 2023, *Wildfire Smoke Opportunities to Strengthen Federal Efforts to Manage Growing Risk,* March. Available at https://www.gao.gov/assets/gao-23-104723.pdf#page=48&zoom=100,0,789.

[14] *See*, *e.g.*: NCASI (2023); Smith (2019a, 2019b); Smith and Chang (2020); and Gradient (2023).

## 1. INTRODUCTION

On January 27, 2023, the *Federal Register* published a Notice of Proposed Rulemaking (NPRM) from the Environmental Protection Agency (EPA), seeking comment on a reconsideration of the Agency's 2020 rulemaking on the current annual National Ambient Air Quality Standards (NAAQS) for fine particulate matter ($PM_{2.5}$).[15] The current NAAQS for $PM_{2.5}$ are 12 μg/m$^3$ for the annual average and 35 μg/m$^3$ for the daily (24-hour) average.[16] For simplicity of exposition, this combination of annual and daily standards will be referred to herein as "12/35." Upon reconsideration, EPA is proposing to tighten the current annual standard (without modification of the daily standard of 35 μg/m$^3$) to some level between 10 ug/m$^3$ and 9 ug/m$^3$, and is taking comment on a standard of 8 μg/m$^3$ and of up to 11 ug/m$^3$.[17] Hereafter, we refer to these three alternative standards by the labels "10/35," "9/35," "8/35," and "11/35." Simultaneously with the NPRM, EPA also publicly released its Regulatory Impact Analysis (RIA) for the proposed revisions.[18] This RIA contains, *inter alia*, estimates of the costs of control measures that form part of the illustrative control strategies intended to meet more stringent standards and the public health benefits of their associated ambient $PM_{2.5}$ reductions. The comment period for both the NRPM and the RIA ends on March 28, 2023.

The technical comments in this report address the RIA's estimates of the potential costs of attaining three of the four alternative annual standards listed above: 10/35, 9/35, and 8/35.[19] In brief, we conclude that the RIA's cost estimates are incomplete to the point of having very limited usefulness to decision making or public understanding of the full potential impacts of any of the alternative standards. We demonstrate how to provide a range of estimates for the potential cost of full attainment, relying as much as possible on the data and general cost concepts used by EPA.

Our analysis does not attempt to alter the RIA's assumptions about the costs of candidate control measures that the RIA does identify as a potential portion of state attainment strategies, despite the substantial uncertainties that are inevitably associated with such assumptions.[20] Rather, we focus on

[15] 88 *Federal Register* 5558, "Reconsideration of the National Ambient Air Quality Standards for Particulate Matter," January 27, 2023.

[16] These are the values that monitor-specific design values may not exceed. The annual average considers 3-year averages of the annual design values. The daily average standard must not be exceeded by the 3-year average of the 98$^{th}$ percentile of a monitor's 24-hour average values.

[17] The NPRM also solicits comments on a possible tightening of the daily standard to 30 μg/m$^3$ but the focus of these comments is only on analyses related to alternative annual standards discussed in the NPRM.

[18] EPA, 2022, *Regulatory Impact Analysis for the Proposed Reconsideration of the National Ambient Air Quality Standards for Particulate Matter*, EPA-452/P-22-001, December, available at https://www.epa.gov/system/files/documents/2023-01/naaqs-pm_ria_proposed_2022-12.pdf.

[19] The RIA does not explain why it has not provided an evaluation of 11/35 even though it does evaluate 8/35 and a daily standard of 30 μg/m3 (*i.e.*, 10/30). Lacking any RIA analysis for 11/35, we do not attempt to comment on its costs in this report. While we do not quantitatively evaluate the RIA's cost estimates for 10/30, the comments and concerns we identify for the three alternative annual standards apply equally well to the RIA's estimates of 10/30.

[20] The quality of the available emissions data that must be relied upon is particularly weak for non-point sources of emissions, as EPA has generally conducted less analysis for this category of emissions than for larger point sources. In general, the data are supported by a small number of references that are relatively old, and the cost assumptions in the EPA model lack of consideration of location-specific factors. Nevertheless, it is out of NERA's

documenting how profoundly incomplete (and hence understated) are the cost estimates that the RIA reports, and on demonstrating how EPA could have used its own data and evidence to provide readers with a proper and complete understanding of the potential costs of fully attaining each of the alternative standards. Recognizing that computing the cost estimates for full attainment involves some highly uncertain input assumptions about how to make use of the remaining evidence in the EPA control measures data sets, we provide a range of potential cost estimates for fully attaining each alternative standard. This is a more appropriate way to communicate about analytical uncertainties than to simply assume that the most difficult aspects of identifying illustrative attainment strategies will cost nothing, as the RIA has implicitly done.

Although we provide wide ranges of uncertainty in order to produce numerical cost estimates for full attainment, our analysis to develop those estimates indicates that finding sufficient control measures would pose a significant practical challenge for many of the RIA's areas of projected nonattainment. Although our analysis does identify a sufficient number of additional reductions in primary $PM_{2.5}$ emissions for almost all areas to reach full attainment without resorting to "unknown" or "unidentified" control measures, the evidence in EPA's data sets is that they will likely be very costly per ton and in total for the affected nonattainment areas.

It is not the role of an RIA to determine whether such actions will actually be undertaken, but only what types of action and associated costs would be necessary if an alternative standard is to be attained. Nevertheless, to the extent that some of the additional control measures we identify as needed for full attainment might be considered technically, economically, or administratively nonviable, our analysis indicates a situation of long-term extensive nonattainment, nationally in the case of the 8/35 standard, and regionally in the case of the other two alternative standards (serving only to exacerbate a regional situation of perpetual nonattainment). This insight from our full attainment cost assessment calls into question the wisdom of setting the annual $PM_{2.5}$ NAAQS at any of the alternative levels, no matter what may appear to be the net benefits of the first few "partial" steps in the direction of attainment identified in the RIA.

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scope to attempt to remedy weaknesses in the emissions inventory or control technology cost data that the RIA uses. Our analysis also does not attempt to alter the RIA's assumption that attainment strategies will rely entirely on reductions in primary $PM_{2.5}$ emissions that account for the "urban increment" of consistently higher $PM_{2.5}$ concentrations over urban than surrounding areas, which the RIA suggests is the primary driver of the projected areas of nonattainment for annual standards lower than the current standard of 12 $\mu g/m^3$ (RIA, p. 1-2).

## 2. BACKGROUND ON RIA COST ESTIMATION REQUIREMENTS

Preparation of an RIA is required under executive order of the President for all proposed and final rulemakings of the federal government anticipated to have an annual effect of $100 million or more per year. The expected and required contents of RIAs are varied, but the most central requirement is to provide a thorough evaluation of the costs and benefits of a proposed or final rule, including for alternatives other than the specifically proposed or selected final rule.[21] Even for standards that, by law, cannot directly use evidence on costs or benefit-cost trade-offs in the selection of a standard level, providing this information to both policy makers and the interested public is an important part of creating a transparent understanding of the implications to society of the statutes that such regulations implement. As Professor Kenneth Arrow and other distinguished economists noted:

> *Although formal benefit-cost analysis should not be viewed as either necessary or sufficient for designing sensible public policy, it can provide an exceptionally useful framework for consistently organizing disparate information, and in this way, it can greatly improve the process and, hence, the outcome of policy analysis. If properly done, benefit-cost analysis can be of great help to agencies participating in the development of environment, health, and safety regulations, and it can likewise be useful in evaluating agency decision-making and in shaping statutes.*[22]

In cases where costs and economic impacts can, in fact, be a relevant factor in the regulatory decision, (as in the case of a reconsideration of a NAAQS[23]), it becomes particularly important that the RIA provide a balanced and complete understanding of the potential benefits and potential costs.

NAAQS rules for both $PM_{2.5}$ and ozone have traditionally presented special challenges for the development of robust cost estimates. One complication has been that states that find themselves to have one or more areas that do not attain a NAAQS are responsible for developing their own strategies (to be approved by the EPA) for reducing emissions sufficiently to get into attainment. Known as state implementation plans (SIPs), these documents account for location-specific air quality determinants to identify a set of control measures and other actions that a nonattainment state plans to adopt to achieve attainment. Thus, any RIA prepared by the federal government must attempt to simulate hypothetical or "illustrative" control strategies that are not guaranteed to be the most likely least-cost strategy or SIP

[21] For background on federal requirements for RIAs and a good synopsis of their additional merits beyond mere estimation of net benefits, *see* Office of the Assistant Secretary for Planning and Evaluation, U.S. Department of Health and Human Services, 2016, *Guidelines for Regulatory Impact Analysis*, available at https://aspe.hhs.gov/sites/default/files/private/pdf/242926/HHS_RIAGuidance.pdf. (For example, it states that an RIA "reflects a well-established and widely-used approach for collecting, organizing, and analyzing data on the impacts of policy options, to promote evidence-based decision-making. It provides an objective, unbiased assessment that is an essential component of policy development, considering both quantifiable and unquantifiable impacts.")

[22] K. J. Arrow, M. L. Cropper, *et al*. 1996. "Is There a Role for Benefit-Cost Analysis in Environmental, Health, and Safety Regulation," *Science*, Vol. 272:221-2.

[23] The relevance of costs and economic impacts to a NAAQS reconsideration is expressed in Sunstein (2011).

approach. Heightened lack of precision and accuracy of cost and benefit estimates in federal RIAs for NAAQS is thus an unavoidable and acknowledged feature of results reported in NAAQS RIAs.[24]

Whether "illustrative" or not, a significant complication that EPA has routinely encountered in evaluating attainment strategies in its past $PM_{2.5}$ and ozone NAAQS RIAs is that the Agency has routinely failed to assemble information on a sufficient set of candidate emissions control options to be able to produce a list of control measures that would provide sufficient emissions reductions for all projected nonattainment areas to reach attainment with a specific alternative NAAQS level. Thus, once the maximum set of control measures in the EPA cost analysis datasets are selected, EPA's analyses project that one or more areas of the country will still fail to attain a given standard. This condition is called "partial attainment" in RIAs, and the sum of all the costs associated with the specifically identified list of control measures is reported in the RIAs as the costs of *partial* attainment.

A partial attainment cost estimate is not an analytically proper estimate of the cost of the alternative standard in question, because one or more of the projected nonattainment areas would still need to make emissions reductions (at some cost) to fill the gap between the tons of reduction achieved by the partial list of measures and the total tons of reduction estimated by the air quality modeling to be *needed*. Without a thoughtfully structured effort to estimate that cost of the remaining tons of reduction still needed, the partial cost estimates, on their own, are uninformative regarding total costs and provide only limited insight on the nature of the controls that may be required. Indeed, these partial cost estimates should not even be presented in the RIA's executive summary or other comparisons of costs and benefits, as they completely misrepresent the absolute and relative difficulties of meeting alternative standards. Prior ozone and $PM_{2.5}$ NAAQS RIAs have been careful not to report partial attainment cost estimates in such ways.

Unfortunately, the current RIA for the $PM_{2.5}$ reconsideration not only runs into this common limitation seen in other NAAQS RIAs, but it then reports only the partial attainment costs. This represents its most prominent flaw and is significant enough that this RIA falls well short of meeting the objectives of the federal RIA requirement.[25]

## How EPA Has Addressed the Problem of Partial Attainment in Prior RIAs

The past record of NAAQS RIAs makes it clear that EPA has long understood that additional cost estimation is necessary to reflect the cost of filling the gap between tons of emissions reduced under the partial attainment limit of its set of candidate cost measures and the tons of emission reductions needed for full attainment. An estimate of the cost of the still-needed emissions reductions can be added to the

[24] It should be noted that the need to rely on illustrative control strategies creates inaccuracy in the benefits estimates of the RIA as well as in the cost estimates, as benefits estimates depend on the specific locations of emissions reductions that will be implemented, and this will vary the spatial pattern of ambient pollutant reductions that drives the benefits estimates.

[25] EPA's failure to conduct a broader analysis of costs and benefits also thwarts the Agency's ability to fulfill its nondiscretionary statutory obligation under Section 312 of the Clean Air Act to conduct "a comprehensive analysis" of the impact of this chapter (Chapter 85 Air Pollution Prevention and Control) which specifically references, as part of this analysis, 312(a)(1) the issuance of a NAAQS under 109. Additionally, it fails to provide any ranges reflecting the general uncertainty in its estimates, even though OMB's Circular A-4 (OMB, 2004) actually requires a full uncertainty analysis.

partial attainment cost estimate to provide the RIA's estimate of the "full attainment" cost for each alternative standard therein considered. Extrapolation from the costs of a technically detailed but partial list of controls in order to fill the still-needed gap with as-yet unidentified control measures is naturally fraught with even more uncertainty than those associated with estimating the costs of partial attainment. An appropriate analytical response to this uncertainty is to make a range of assumptions, and to represent full attainment costs in the RIA with the resulting wide range of costs for the extrapolated portion of the estimates.

Evidence of EPA's awareness of the need to roughly approximate the control costs for the still-needed tons is directly available in prior RIAs, such as the RIA for the 2015 ozone NAAQS decision (EPA, 2015)[26] and that for the 2012 $PM_{2.5}$ NAAQS decision (EPA, 2012).[27] Those RIAs also ran into the problem of partial attainment, but nevertheless provided a range of estimates for the cost of full attainment by making a range of assumptions about the marginal costs of control measures for filling the gap of still-needed emission reductions. For example, Figure 1 below provides a copy of the first figure in the executive summary of EPA (2012) — the last $PM_{2.5}$ NAAQS RIA before the current one — which shows the analytical steps in the RIA. It describes the distinction between partial and full attainment costs thus:

> *The partial attainment cost analysis reflects the costs associated with applying known controls. Costs for full attainment include estimates for the engineering costs of the additional tons of emissions reductions that are needed beyond identified controls, referred to as extrapolated costs. By definition, no cost data currently exist for the additional emissions reductions needed beyond known controls. We employ two methodologies for estimating the costs of unidentified future controls: a fixed-cost methodology and a hybrid methodology; both approaches assume either that existing technologies can be applied in particular combinations or to specific sources that we currently can't predict or that innovative strategies and new control options make possible the emissions reductions needed for attainment by 2020.*[28]

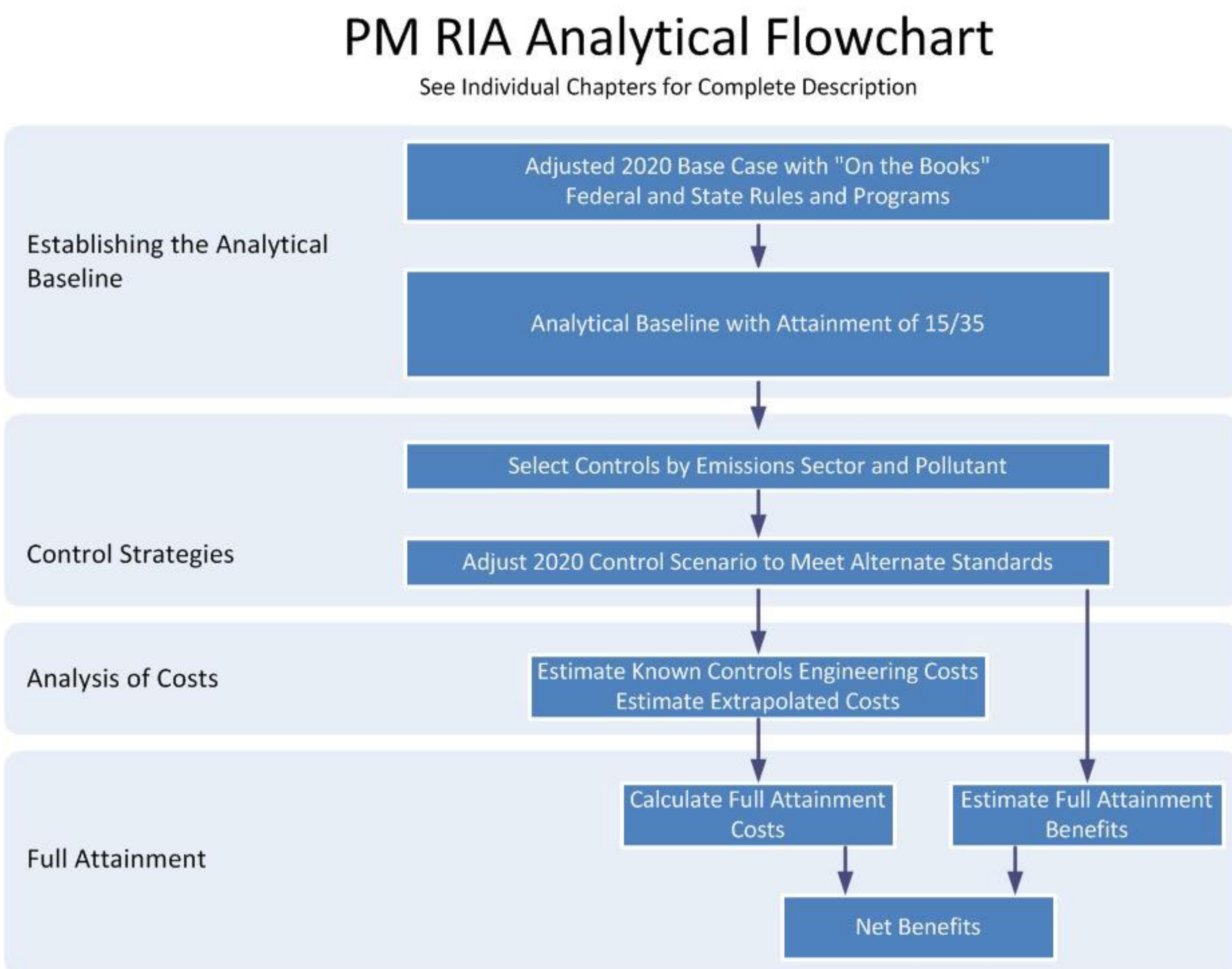
[26] EPA, 2015, *Regulatory Impact Analysis of the Final Revisions to the National Ambient Air Quality Standards for Ground-Level Ozone*, EPA-452/R-15-007, September, available at: https://www3.epa.gov/ttnecas1/docs/20151001ria.pdf.

[27] EPA, 2012, *Regulatory Impact Analysis for the Final Revisions to the National Ambient Air Quality Standards for Particulate Matter*, EPA-452/R-12-005, December, available at: https://www.epa.gov/sites/default/files/2020-07/documents/naaqs-pm_ria_final_2012-12.pdf.

[28] EPA (2012), p. ES-13.

**Figure 1. Copy of Figure in 2012 $PM_{2.5}$ RIA Showing Steps Needed to Develop Estimates of Full Attainment Costs**

Source: EPA (2012), p. ES-3.




The 2012 RIA's executive summary reports only its estimates of full attainment costs, which include the extrapolated estimates of costs to fill the gap of still-needed emissions reductions after exhausting EPA's list of "known" control measures and getting only a partial attainment cost estimate. And that RIA also makes at least two alternative sets of assumptions for the extrapolation. The result is a range of costs in the executive summary for each of the alternative standards selected. The high end of the range differs from the low end by a factor of 5 to 10, depending on the alternative standard, reflecting the inherent uncertainty in making such extrapolations.[29]

The executive summary of that 2012 RIA for $PM_{2.5}$ does not report its partial attainment costs, but they can be found in the detailed Chapter 7 of that RIA. Notably, it shows that its partial attainment costs are

[29] EPA (2012), Table ES-2, p. ES-15.

only 1% to 10% of the full attainment cost estimates, except for one of the estimated total costs, in which partial attainment accounted for 31% of the full attainment costs.[30]

The 2015 ozone RIA (EPA, 2015) also ran into the problem of achieving only partial attainment; it also estimated full attainment costs using varied extrapolation assumptions. While the methods of extrapolation are different and some of the terminology is different,[31] the key point is that this 2015 RIA also eschewed reporting partial attainment costs in its executive summary.[32] Based on details in that RIA's cost analysis chapters, it can be seen that partial attainment costs accounted for about 50% of the full attainment cost estimate for the less stringent 70 ppb standard evaluated and about 15% for the more stringent 65 ppb alternative standard evaluated.[33]

## The Current RIA Deviates from EPA's Past Practices

These two prior NAAQS RIAs show — even by EPA's own calculations — that partial attainment costs are not at all indicative of the likely potential costs of attaining any of the alternative standards. Despite this, the current RIA for the $PM_{2.5}$ NAAQS makes no attempt at all to develop cost estimates beyond those of its partial set of illustrative controls and does not even discuss why it has failed to develop full attainment cost estimates. States do have some flexibility in how they will choose to attain a standard that can differ from an RIA's illustrative strategies, but an RIA should at least identify a justifiable path to get there; this RIA does not. It compounds this flaw by using its executive summary to compare the partial cost estimates to partial benefit estimates. In the logic of benefit-cost analysis, this is a misleading comparison, because the degree of difference between full and partial costs cannot be expected to be similar to the degree of difference between full and partial benefits estimates. This is because marginal costs are expected be rising at greater degrees of control, while the benefits are expected to be rising linearly (under EPA's linear, no-threshold benefits calculation assumptions).

Given the prior evidence that using an extrapolation approach to estimate a range of full attainment costs can completely alter the understanding of the absolute and relative difficulties of meeting alternative NAAQS standards, we consider it paramount to provide our own range of extrapolated cost estimates in response to this RIA.[34]

[30] EPA (2012), Tables 7-4 and 7-5, pp. 7-14 and 7-15.

[31] For example, EPA (2015) uses the term "identified" and "unidentified" controls to mean the same thing as "known" and "unknown" controls in EPA (2012). Also, EPA (2015) uses the term "total costs" in lieu of "full attainment."

[32] EPA (2015), pp. ES-15 to ES-19. Specifically, the total (full) attainment costs are $1.4b and $16b, respectively, for non-California U.S. in 2025; and $0.8b and $1.5b, respectively, for California "post-2025".

[33] EPA (2015), Table 4-1, p. 4-11.

[34] We also note that OMB Circular A-4, providing guidelines for conducting RIAs, expects Agencies to conduct an uncertainty analysis in addition to an accounting of fully meeting a standard. Specifically, OMB Circular A-4 states: "For rules that exceed the $1 billion annual threshold, a formal quantitative analysis of uncertainty is required. For rules with annual benefits and/or costs in the range from 100 million to $1 billion, you should seek to use more rigorous approaches with higher consequence rules." The RIA should have but does not provide any analysis of uncertainty surrounding its cost estimates. The full attainment cost estimates that we provide in these comments come in the form of ranges that reflect uncertainties in several key input assumptions.

The amount by which full attainment cost estimates can be expected to exceed the Agency's partial attainment cost estimates will depend on the size of the gap, or the number of still-needed tons of emission reductions relative to the number of tons of emissions reduced with the controls selected by EPA in its partial cost modeling. This gap gets larger as the alternative standard under consideration becomes more stringent. Similarly, the range of uncertainty in the extrapolated portion of the cost estimate will widen as the alternative standard under consideration becomes more stringent, but RIAs are not required to present only narrow ranges of cost estimates, if doing so makes them incomplete or not a meaningful indication of regulatory impact. However, the wider the range of the full attainment cost, the more an RIA is suggesting that attainment may not be economically viable. This is policy-relevant information, even if the quantitative values of the cost estimates are speculative and no one knows if the more likely outcome will be towards the higher or lower end of the provided range.

## 3. THIS RIA'S COST ANALYSIS METHODS AND RESULTING DEGREE OF PARTIAL ATTAINMENT

In developing its lists of identifiable control measures (and their associated annual costs) for attaining each of the alternative standards that the RIA addresses, EPA uses a model called the Control Strategy Tool (CoST), and associated datasets generally referred to as the Control Measures Database (CMDB).[35] Briefly, CoST identifies the least-cost set of control measures to meet a given target of emissions from an input file that identifies a fuller list of candidate control measures by U.S. county. Runs of the CoST model can include additional user-specified constraints on the control measures that can be considered from a full list of candidate measures. Two specific constraints on the CoST model's optimization are explicitly identified in the RIA. These are a ceiling on the estimated cost per ton reduced for a candidate control measure, and a minimum number of tons per year emitted by emissions sources that have candidate control measures listed for them in the main "all controls" input data file. As we discuss below, these are largely arbitrary constraints (whatever value is selected) and may not be supportable even for an illustrative assessment of control strategies, given that states face sanctions if they cannot identify and impose controls sufficient to achieve attainment. However, we also have determined that there are other, more quantitatively significant constraints embedded in the CoST modeling framework that affect its ability to identify full attainment strategies. These too are discussed below. For now, the important point is that the CoST modeling framework has some basic features that cause it to have difficulty in identifying a full attainment illustrative control strategy for many of the projected nonattainment areas.

The RIA finds that full attainment occurs (in a given county projected to otherwise be in nonattainment of the alternative standard of concern) if the CoST run can find a sufficient number of reductions of the targeted emissions species in that county to meet the RIA's specified reduction target for that county. Partial attainment occurs when the entire list of control measures that CoST identifies would produce fewer emissions reductions than the target value. Because the analysis of attainment in this RIA is performed on a county-specific basis, the RIA's summary of partial attainment cost estimates for each alternative standard are a sum of full attainment cost estimates for some of the nonattainment counties and partial cost estimates from others. Because of the latter fact, the aggregate cost estimates reported in the RIA are, by definition, incomplete, and clearly understated.

Specifically, the RIA reports that its partial attainment costs for the 10/35, 9/35, and 8/35 standards are, respectively, $94 million, $393 million, and $1.82 billion (annually).[36] Based on past experience with estimating full attainment costs after first estimating partial attainment costs, those RIA cost estimates cannot be relied upon as an indication of either the absolute or relative cost of the alternative standards. One only knows that they are too low.

### The RIA Fails to Identify Sufficient Controls to Attain Even the Current 12/35 Standard

It should be noted before going further that an RIA's estimates of costs for any alternative standard are traditionally reflective of the additional costs of emissions control *incremental* to whatever costs must be incurred to reach full attainment of the existing standards (*i.e.*, 12/35 in this case). Another important

[35] *See* EPA, "Cost Analysis Models/Tools for Air Pollution Regulations," available at https://www.epa.gov/economic-and-cost-analysis-air-pollution-regulations/cost-analysis-modelstools-air-pollution.

[36] RIA Table ES-5, p. ES-14.

anomaly in this RIA versus traditional RIA practice is that EPA cannot find sufficient control measures in its CoST model for several areas of the U.S. to attain even the current $PM_{2.5}$ NAAQS of 12/35. Thus, even its starting point for estimating incremental costs of standards tighter than the current one of 12/35 is one of partial attainment in this RIA. This very unusual situation is detailed in Appendix A. Its primary significance for the remainder of this report is:

(1) Several of the major counties for which this RIA projects only partial attainment with the alternative standards actually enter the RIA's cost analysis with zero remaining options in the CoST input data set. The RIA's partial cost analysis therefore estimates that these counties' costs for getting to 10/35, 9/35, or 8/35 are *zero* (*i.e.*, $0 per year). This is a remarkable example of this RIA's incompleteness, given that the RIA's analysis is actually finding that these counties face a huge remaining challenge (and compliance cost) even if the current standard is not tightened at all.

(2) The cost of them first fully attaining 12/35 ought to be estimated and reported in this RIA as well, because it would provide important policy-relevant context regarding how much more difficult it will be for those counties to reach any degree of attainment of standards tighter than 12/35. We provide such cost estimates in Section 5, although these are not included in our ranges of full attainment costs and are provided solely for context.

### Evidence of Significant Degree of Partial Attainment in RIA's Set of Identified Control Measures for Alternative Standards

Focusing for the moment on the RIA's evaluation of the 8/35 alternative standard, the RIA identifies 141 counties that will require at least some reductions of primary $PM_{2.5}$ to attain 8/35,[37] for an aggregate reduction need of 86,869 tons.[38] It then runs its CoST model to identify controls of local primary $PM_{2.5}$ emissions sources that are reported to be available and estimated to be cost-effective in meeting each of the 141 counties' emissions reduction needs.[39] In running the CoST model, the RIA applies the following two constraints: (1) that any source undertaking a control measure have at least 5 tons per year of baseline emissions; and (2) that no control measure estimated by CoST input data to cost more than $160,000 per ton reduced will be required. While a total of 86,869 tons of reduction are needed for all these counties to

[37] RIA, Table 2A-14, pp. 2A-60 through 2A-64. The specific number of tons of reduction needed by each county is also shown in this table. This information is also provided in Appendix B of this report.

[38] This is three tons less than the value of 86,872 reported in RIA Table ES-2 at p. ES-9. NERA has confirmed that it is the result of rounding error in the way Table ES-2 was constructed. We will use the more precise values of emissions targets based on the target emissions input files to the CoST model. Discrepancies between what NERA has found in the raw CoST files and what is summarized in the RIA have been frequent but are minor enough not to affect the full attainment cost estimation that we have conducted for this report.

[39] The CoST model also allows counties in the Northeast and Southeast regions to turn to control measures in counties adjacent to them (within their same state) once all of the non-attaining county's identifiable measures have been selected. EPA counts these adjacent-counties' tons of reduction as only one-fourth of a ton towards the direct county's needed tons of reduction. In the following, we will use the term "effective tons" to be equal to the tons from adjacent counties divided by 4, while every ton reduced in a directly nonattaining county is equal to one effective ton.

attain 8/35, the CoST model finds only 46,073 effective tons,[40] with full attainment in only 80 of the initial 141 counties. Thus, another 40,796 effective tons of reduction are needed (in aggregate) to reach full attainment in the remaining 61 of the initial 141 counties.[41] Table 1 summarizes the degree of partial attainment in the RIA for all three alternative standards, showing that partial attainment is also a significant issue even for the less stringent alternative standards of 9/35 and 10/35.[42]

**Table 1. Summary of Aggregate Degree of Partial Attainment (in Tons and as % of Total Tons Needed)**

| | 10/35 | 9/35 | 8/35 |
|---|---|---|---|
| Emissions Reductions Needed (see Note 1) | 12,491 | 31,911 | 86,869 |
| "Effective" Emissions Reductions in RIA Partial Attainment Analysis (see Note 2) | 3,561 (29%) | 13,762 (43%) | 46,073 (53%) |
| "Effective" Emissions Reductions Still Needed | 8,930 (71%) | 18,149 (57%) | 40,796 (47%) |

Note 1: RIA Table ES-2 reports slightly different estimates of tons needed than used in this table. NERA concludes that Table ES-2 is subject to rounding error and does not precisely reflect the actual values used in its cost estimation modeling.
Note 2: RIA Table ES-3 reports actual tons reduced in adjacent counties whereas effective tons need to be used when assessing additional tons still needed for full attainment. The values in this row reflect the effective tons reduced, which equals the adjacent actual tons of reduction divided by 4. In the directly nonattaining counties of each region, actual tons are the same as effective tons. Additionally, NERA has found discrepancies between the actual tons reduced reported in Table ES-3 and those in the raw RIA CoST output files. This table uses the values as reported in RIA Table ES-3, as the discrepancies are too small to be material to any full attainment cost estimate.

Appendix B documents the degree of partial attainment in the RIA's analysis on a county-by-county level. When summed, the data in the tables of Appendix B match the information provided in Table 1. We provide the county-specific information because an assessment of full attainment costs requires a county-by-county cost extrapolation. Appendix B's tables reveal how extensive and deep partial attainment is for many individual counties, even while many other counties in the analysis do reach full attainment. Those tables also show that the counties that do reach full attainment in the RIA's partial analysis require, on average, substantially fewer tons of reduction than those that only reach partial attainment. Thus, the control effort to get the RIA's partially attaining counties into full attainment can be expected to be much larger than the cost of full attainment for those counties that do get into attainment.

[40] RIA, Table ES-3, p. ES-11. This is computed by adding the actual tons in the direct counties plus the actual tons in the adjacent counties divided by 4. The total of *actual* tons reported in the table is 61,321, but in terms of effective tons to be compared to the tons needed, it is 46,073.

[41] To the extent that some of these effective tons may need to be obtained by control measures in adjacent counties, the number of *actual* tons still needed would be larger than 40,796.

[42] Although the *percentage* of aggregate tons needed that are found (row 2 of Table 1) increases as the alterative standard tightens, the number of tons still needed (row 3) also increases. This seemingly counterintuitive trend in the percentages occurs because a rapidly increasing number of counties are projected to fall into nonattainment as the standard tightens, but mostly quite marginally (because the added counties *can* attain the next looser alternative standards). Because these additional counties have not yet had to undertake any of the control measures in the CoST data, many of them can get into full attainment even with the RIA's very limited set of candidate control measures. However, the number of counties that remain in partial attainment also continues to grow, and for those that are in partial attainment with one of the looser standards, their *individual* degree of partial attainment gets increasingly large as the alternative standard is tightened. The county-specific attainment percentages can be seen in Appendix B.

The significant shortfall in emissions reductions that the CoST model produces is a highly problematic result for a NAAQS RIA, given that stopping its control efforts at partial attainment is not a viable alternative for a nonattaining state under the Clean Air Act. States must demonstrate a plan for full attainment of each NAAQS within a federally prescribed time period or face a range of sanctions that have economic costs of their own. To the extent that the RIA's partial attainment outcomes are due to the EPA's arbitrary constraints on its CoST model,[43] or due to the CoST model's input file including an insufficiently broad list of candidate control measures, the requirement on states to demonstrate and achieve attainment will force adoption of additional options that the RIA has not identified, many of which will likely violate the limitations that EPA has built into its CoST modeling effort. Given the depth of the shortfall in the RIA analysis, those additional control measures are likely to cost more per ton (on average) than the average cost per ton of the measures selected in the RIA's partial attainment analysis. Thus, the shortfalls in tons reduced in the RIA's partial analysis (summarized in Table 1) most likely understate the degree to which the RIA's partial cost estimates fall short of full attainment costs.

### Evidence that Cost of Full Attainment Will Exceed Partial Attainment Cost by Even More Than the Estimated Deficits in Tons of Needed Reductions

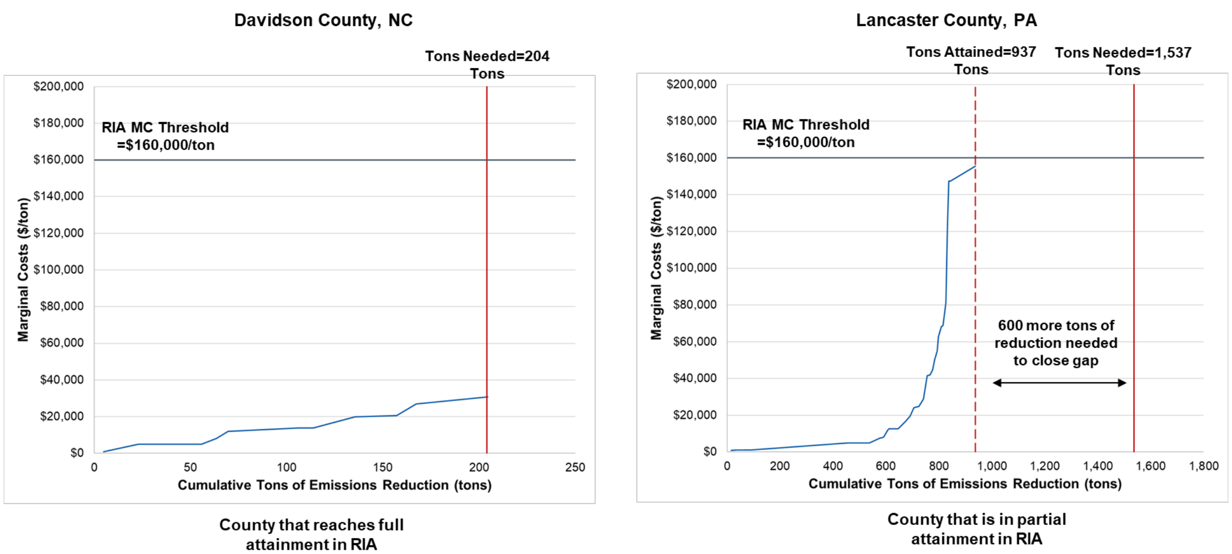
The above section has documented, relying on data that can be found in tables in various parts of the RIA, that the RIA has produced an incomplete evaluation of the costs of attaining each of the alternative standards, and that the deficit in tons of emission reductions that it has costed out is large, both in aggregate and county-specific terms. However, the central issue that this report addresses is how much it will *cost* to eliminate the deficit that we have so far stated only in terms of tons of emission reductions. The basic logic of least-cost analysis (including that reflected in the CoST model and its data) is that the cost per ton of emissions reduction will generally increase as regulators have to make deeper emissions cuts to meet more stringent standards. Thus, the cost of full attainment relative to that which a least-cost modeling exercise has found for partial attainment is likely to be proportionately more than the percentage of full attainment reductions relative to those achieved in the partial attainment analysis. More simply stated, if the tons of emission reductions needed for full attainment are double those reached in the partial attainment case, then the cost of full attainment likely will be more than double the partial attainment cost. The only ways that this basic logic might not hold when evaluating a strategy based solely on primary $PM_{2.5}$ control would be if the partial attainment analysis were either not least-cost in nature, or had failed to include in its list of identifiable candidate control measures some of the most cost-effective control options technically available. Based on an in-depth review of the data in the CoST model input files, we do not consider the latter possibility to have more than a marginal effect on the gap between CoST's project partial attainment and the RIA's projected total emissions reduction needs.[44]

[43] Specifically, these are a $160,000 per ton ceiling on control measures that CoST is allowed to select and a requirement that CoST not select any controls for emissions sources with less than 5 tons per year of baseline emissions.

[44] Another reason this logic might not hold would be if the illustrative strategies were to be broadened to consider more than just local primary $PM_{2.5}$ emissions reductions, such as more regional controls of $SO_2$, $NO_x$, and volatile organic gases. The RIA makes its case for assuming that control strategies for a tighter NAAQS will likely focus on primary $PM_{2.5}$ (RIA, p. 1-2). It is out of our scope to alter this RIA assumption but, given the apparent difficulties that states would face in reaching full attainment from primary $PM_{2.5}$ controls alone, the possibility that further controls on precursor emissions might be a necessary part of states' attainment strategies could be viewed as another insight arising from our full attainment cost analysis.

Figure 2 provides a visual summary of how the CoST model's county-specific marginal cost curve, relates to the RIA's county-specific estimate of tons needed for full attainment for two very different situations under the simulation of costs for meeting the 8/35 standard. On the left is the case of a county that is projected to be in nonattainment with 8/35 but which the RIA estimates will reach full attainment with measures available to it in the CoST model. This county (Davidson Co., NC) is projected to need 204 tons of reduction, indicated by the red vertical line.[45] The blue upward sloping line maps out the marginal cost curve in the CoST model for this county, up through the point of finding the full need of 204 tons of reduction.[46] This occurs well below the marginal cost limit of $160,000 per ton applied as a constraint in the CoST model run. The full cost of attainment for Davidson Co., NC is the area under the blue curve, left of the red line, down to the x-axis. It is, per NERA's review of the CoST output files, $3.3 million.[47]

**Figure 2. Examples of County-Specific Marginal Cost Curves in RIA (for 8/35) Compared to the Tons of Emissions Reduction Needed for Full Attainment**




On the right side of the figure is the case of a county that reaches only partial attainment in the RIA CoST analysis. This county (Lancaster Co., PA) needs 1,537 tons of emission reductions to attain 8/35,[48] but can find only 937 tons (61% of the full need) within the constraints of the CoST model data, resulting in a gap of 600 tons to reach full attainment.[49] Again, the blue line shows the marginal cost curve of the full

[45] RIA, p, 2A-62.

[46] NERA prepared this graph using the output of control measures selected for the 8/35 case in EPA's CoST run.

[47] It bears mentioning here that this is only the estimated cost (per the CoST model) of implementing the controls that will reduce that county's emissions by 204 tons. Even if it is taken as a sound estimate, it is probably dwarfed by the cost of developing or revising a SIP, much less meet all the additional requirements a state and businesses face under a nonattainment designation. We return to this question of the overall economic burdens of a tighter NAAQS in the Discussion section of this report.

[48] RIA, p. 2A-63.

[49] *See* for example, RIA Table 3-9, which shows 600 tons of emission reductions still needed for 8/35 in Lancaster Co., PA.

set of selected controls for this county in the CoST model output for 8/35. In this case it ends at 937 tons because that is where its control measures reach the RIA's marginal cost limit of $160,000 per ton, and where additional control measures in the CoST database all cost more than $160,000 per ton. The RIA's estimate of the cost incurred under 8/35 for Lancaster Co. is the area under the blue curve, to the left of the red dotted line, down to the x- axis. Per NERA's review of the CoST output file, this is $27.2 million — however, it is clearly only a part of the total costs that would be needed to keep adding more emissions reductions until the gap of 600 tons to full attainment is closed. Indeed, even if all the remaining 600 tons needed could be achieved at a flat $160,000 per ton, the cost of closing that 600-ton gap would be $96 million. In other words, the cost of meeting the first 61% of the attainment need would be only 28% of the full attainment cost, and the cost of full attainment for this county that gets to 100% of its need would be *4.5 times larger* than the reported partial attainment cost.

The big question for estimating the additional cost of full attainment of 8/35 is how much higher the cost per ton will be beyond the $160,000 per ton level for this county and the 60 other counties that reach only partial attainment in the RIA. That requires a county-by-county evaluation of the additional control opportunities in those 61 counties (and their adjacent counties for those in the Northeast and Southeast) individually. The approach we take is described in the next section of this report, and the results from applying that approach in the section thereafter.

However, as a prelude to that cost extrapolation section, we present Table 2 in which we have used EPA's CoST output files to replicate the U.S.-wide estimates of partial attainment costs in 2032 reported in the RIA.[50] Table 2 provides NERA's disaggregation of those costs into costs for all counties that do reach full attainment under the RIA CoST modeling, and costs for all counties that reach only partial attainment. We note that the RIA, when presenting these estimates of what it labels "annualized control costs" does not state clearly that these are only partial attainment costs — *i.e.*, that they are only the costs of control measures identified by the CoST model, with its limited set of candidate control measures and its marginal cost maximum of $160,000 per ton. However, NERA's table below, which was developed by NERA using the RIA's raw output files from the CoST modeling, shows the extent to which the U.S.-wide costs estimates provided in the RIA are predominantly in counties that do not reach full attainment in that RIA CoST analysis.

In our full cost estimation process, described in the next two sections, the cost estimate on the first row of the table will remain unchanged because they represent the portion of the RIA cost estimates that are consistent with full attainment in many of the counties projected to otherwise be in nonattainment, and our analysis makes no changes to the RIA's partial CoST analysis. However, the cost estimates in row 2 are patently incomplete and are subject to the type of cost increase illustrated for Lancaster Co., PA. To the extent that filling the gap of still-needed tons of reduction costs will cost more per ton than the limited set of control measures identified in CoST, Table 2 indicates that even a modest set of extrapolation assumptions can be expected to indicate that full attainment costs are likely substantially larger than the partial attainment costs reported in the RIA for each of the alternative standards.

[50] The RIA's U.S.-wide partial cost estimates are found in Table ES-5 on p. ES-14 of the RIA. They are $94.5 million, $393.3 million, and $1,821.7 million for 10/35, 9/35, and 8/35, respectively (2017$). Note that the RIA's caption to this control cost summary table does not state that these are only partial attainment costs; however, this fact is clear from the text.

**Table 2. Disaggregation of RIA's Partial Costs into Counties Reaching Full vs. Partial Attainment in the CoST Model.**

| | 10/35 | | 9/35 | | 8/35 | |
|---|---|---|---|---|---|---|
| | **Number of Counties** | **RIA Costs (million 2017$)** | **Number of Counties** | **RIA Costs (million 2017$)** | **Number of Counties** | **RIA Costs (million 2017$)** |
| Counties Reaching Full Attainment in RIA's CoST Modeling | 9 | $11.6 | 29 | $192.1 | 80 | $351.8 |
| Counties Remaining in Nonattainment in RIA's CoST Modeling | 15 | $82.9 | 22 | $201.2 | 61 | $1,469.9 |
| All Counties in RIA | 24 | $94.5 | 51 | $393.3 | 141 | $1,821.7 |

# 4. NERA'S METHOD FOR ESTIMATING COST OF FILLING THE FULL ATTAINMENT GAPS IN THE RIA'S ANALYSIS

## Constraints and Limitations of the CoST Modeling

As we have explained above, the RIA's analysis using the CoST model cannot identify a sufficient list of control measures to meet the estimated reductions in tons of primary $PM_{2.5}$ emissions required for a substantial portion of the counties that its air quality modeling indicates will otherwise fall into nonattainment with one or more of the alternative NAAQS standards. This partial attainment can be largely attributed by several important limitations of the CoST model's data base.

As we have noted in the prior section, EPA decided to limit the control measures that CoST could select to only sources with more than 5 tons per year of baseline emissions and to limit the cost of the selected control measures to not exceed $160,000 per ton relative to baseline controls in place. These are the most widely-discussed of the limitations imposed on the CoST analysis, and as we have noted, there is no basis for them in the Clean Air Act. They have thus received substantial comment and concern. NERA has reviewed the CoST model input and output files and performed several sensitivity runs of CoST in which these constraints are loosened. While projected reductions and costs do vary, it is only by a few percent and thus we conclude that these are not the keys to estimating anything close to full attainment. Appendix C provides more details on these findings.

On the other hand, our review of the CoST model found a much more significant limitation that is not widely known: after allowing for control of the first 25% non-point primary $PM_{2.5}$ sources in each county, the model does not allow any consideration of the possibility of applying control measures for any of the remaining 75%. We find that these remaining non-point source emissions sources are a primary route for identifying substantial quantities of additional needed reductions.

To explain in more detail, the CoST model's input file of candidate control measures contains control options for each of the emissions sources that are reported in the National Emissions Inventory (NEI) as aggregate county-wide sources (*i.e.*, primarily the non-point/area sources). That list of candidate control measures, however, is limited to either 10% or 25% "rule penetration" (RP). In the simplest terms, this means that if it is cost-effective to adopt a particular type of control (such as paving unpaved roads), CoST can only choose to control 10% of the unpaved road baseline emissions or (if more control is needed), to control 25% of that source category's baseline emissions. Options to apply controls addressing more than 25% of any county's road emissions are simply not in the CoST model's input file, even at a higher cost per ton (as higher rule penetration levels would almost certainly entail).[51] The above example is for the unpaved roads area source category, but applies to the majority of the non-point souce catgories in CoST.[52]

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[51] We note that the cost per ton for reducing up to 25% of the unpaved road dusts assumed in CoST is only about half of the RIA's limit of $160,000 per ton (*i.e.*, $89,103 per ton) and thus even if the likely escalation in cost per ton were to be included, at least some additional tons of reduction could have been identified in the RIA even without having to raise its *ad hoc* marginal cost limit of $160,000 per ton.

[52] A few non-point source categories in CoST have candidate controls for which the RP is effectively 100%. The main ones are household burning and open burning, for which the control measure "chipping" is applied to 100%

We consider the latter point to be quite important to the question of how to use evidence-based logic to start to estimate the cost of getting each of the partial-attaining counties into full attainment. It is important because the tons of emission reductions from primary $PM_{2.5}$ controls *remaining* in the non-point source categories such as unpaved roads, paved roads, *etc*., is very large even if one accounts for reductions applied to the first 25% of that county's emissions inventory. In fact, NERA has used the CoST-related data files to estimate that, among the 61 counties that still need tons of reduction to reach full attainment of the 8/35 standard, there *remain* (after accounting for all the controls selected by these counties in the CoST partial attainment modeling of 8/35): about 11,000 effective tons of unpaved road dusts, about 23,000 effective tons of paved road dusts, and about 36,000 effective tons of all other non-point sources in CoST's inventory. [53,54] In aggregate, these 61 counties still need about 40,000 tons to get to full attainment. Reducing even some of these remaining non-point source emissions will almost certainly cost more *per ton* than the first 25% that has already been selected in the partial attainment analysis, but they do represent an *identifiable* path towards full attainment for many of the counties even for the very stringent standard of 8/35.[55]

We recognize, at this point, that these remaining non-point source emissions may not occur close enough to nonattaining monitors to affect their reading. If some or all of these reductions are *ineffective* at the offending monitor's location, then states would be wasting money to control them in pursuit of full

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of the source category, if selected. A very small number of SCCs labelled "generic industrial processes" are treated as non-point in CoST, and the candidate measures for these (fabric filters, electrostatic precipitators, and venturi scrubbers) also would apply to the entire non-point source category, if selected.

[53] "Effective tons" means that remaining tons of emission reductions in counties adjacent to Northeast and Southeast directly nonattaining counties have been divided by four before adding them into the total.

[54] In estimating the remaining tons of emissions that can still be reduced in non-point source categories, we became aware that the CoST input file had not included *any* road or non-road dust emissions in quite a few counties that reach only partial attainment. We found estimates of these counties' road and/or unpaved road dusts with just existing controls in another EPA data file provided with the CoST input files (*see* 2032fj_from_2016_MY_from_afdust_2017NEI_NONPOINT_20200415_05aug2021_v0.csv). We note that the counties for which such emissions inventory data were not included in the CoST input file appear to be those that already report having controlled 25% or more of their road dusts; this implies the marginal cost of further reductions from roads in those counties would be higher than those assumed in CoST for the first 25% (and would likely exceed the *ad hoc* $160,000 per ton limit that the RIA has employed). Thus, if EPA *had* included these remaining inventories of paved and unpaved road dusts as candidate control measures, its CoST modeling results would likely not have selected them anyway. Nevertheless, for purposes of finding a set of control measures that provides the full need for attainment, without imposing an arbitrary cost per ton limit, we consider these additional tons of emission reductions important to our objective of estimating the complete cost of attaining the alternative standards. We therefore also extracted these NEI emission data for our county-by-county analysis, and they are included in the aggregate totals noted here.

[55] Aggregate comparisons can be misleading because the remaining tons that might be reduced in pursuit of full attainment need to be matched with the still-needed amount on a county-by-county basis. Upon performing the matching, we find that, if they were to be controlled to the maximum control effectiveness possible per the CoST model (*e.g*., 60% reduction of paved roads whose shoulders become paved) these remaining non-point source emissions could get all but eight of the 32 northeast and southeast partial attaining counties into full attainment. We find, however, that even more reductions would be still needed for 20 of the 29 partially attaining counties in California and the West.

attainment.[56] This is a significant remaining source of uncertainty in the analysis of full cost of attainment. If more effective control measures do exist closer to the monitor of concern, they will still have a cost, and that cost is at least proxied in our analysis by an assumption that there is no decline in the *effectiveness* of a ton of emissions reduced from a non-point source if it occurs within the same county as the offending monitor. Obviously, if one were to be able to refine the analysis to include location-specific effectiveness estimates, some of the non-point source emissions controls would not be selected on the basis of cost per *effective* ton — but then some other unidentified measure from another source category would have to be adopted instead, and there is no reason to expect that its cost per ton would be less, even if its cost per *effective* ton were less.

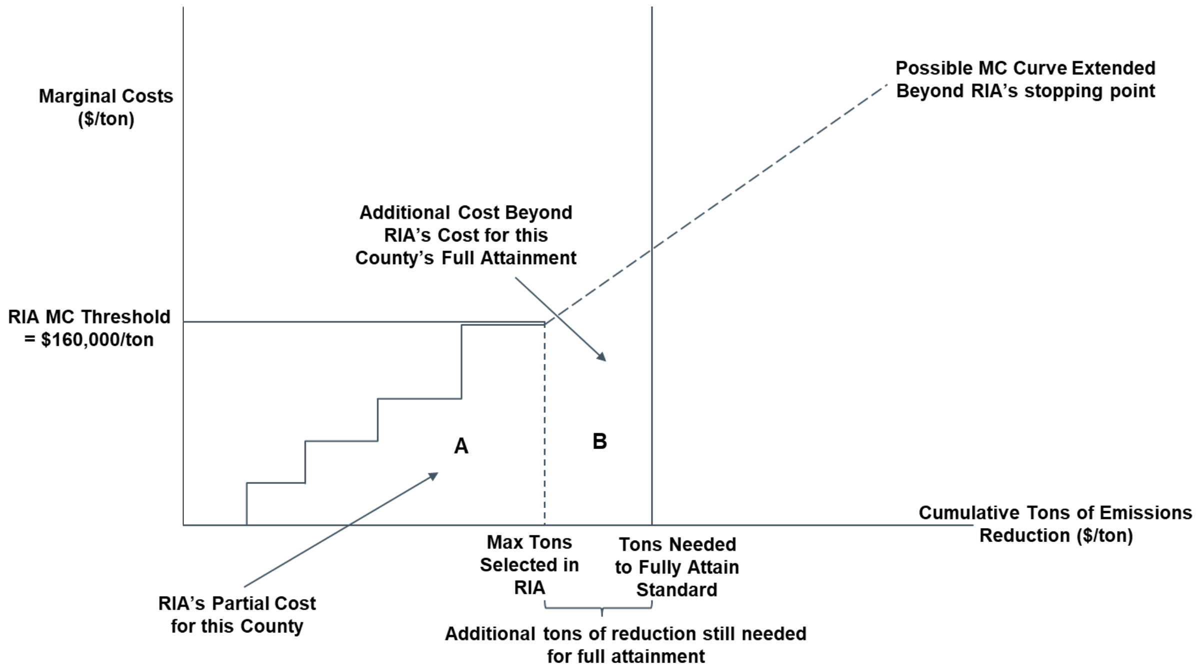
## NERA's Use of CoST Modeling Data to Estimate Options for Full Attainment

The basic construct that NERA employs to estimate the cost of filling the gap from partial to full attainment is illustrated in Figure 3. For each county that the RIA leaves in partial attainment with an alternative standard, the marginal costs of its selected identified controls are shown as a stairstep-like curve in the figure (this stairstep is analogous to the blue lines in Figure 2). The cost of partial attainment is equal to the area denoted A in Figure 3. Given an extrapolation of the CoST-derived marginal cost curve, shown as the dotted line sloping upwards, the additional cost of making the still-needed reductions would be equal to the area denoted B.

This figure shows only one point of tons needed (from the baseline of 12/35) to reach attainment. However, there are three lines to consider when evaluating full attainment for 8/35, 9/35, and 10/35. If the line shown in Figure 3 reflects the tons needed for this county to fully attain 10/35, the cost of fully attaining 10/35 would be A+B. However, the tons needed for 9/35 and 8/35 would lie farther to the right on the x-axis, and the equivalent of area B would become larger for 9/35 and larger still for 8/35. Thus, the cost of full attainment becomes larger as the standard being analyzed becomes more stringent, but the concept of developing an extension of the RIA's initial marginal cost curve and then estimating costs under it up to the point of full attainment is the same for all three alternative standards.

[56] Although this same problem could arise with RPs of 10% or 25%, one can safely assume that counties attempting to rely on controls of any non-point source category for an attainment strategy will attempt to identify the most effective subsets of each category in terms of location relative to the monitor(s) of concern, and intensity of emissions, thus the first few percentage points of RP are the least likely to run into this uncertainty of having effect. We do consider this a significant uncertainty our full attainment cost assumptions for counties that require the most significant amount of non-point source RP to project cost of full attainment. Nevertheless, any estimate of full attainment must make some assumptions about the nature of the sources that will be controlled. To the extent that some counties are projected to require large RPs for all the non-point source categories in its current emissions inventory, if those latter controls become literally ineffective (not just *cost*-ineffective), some other category of emissions that is not a typical target of regulatory controls may become the only effective alternative.

**Figure 3. Illustration of Concept in Full Attainment Cost Estimation**




The concept may seem simple, but the challenge is in how one might go about extending or extrapolating the first, lowest-cost portion of the marginal cost curve revealed by the CoST analysis (shown as the blue lines in Figure 2, and illustrated as the stairsteps in Figure 3). We take a two-stepped approach for doing this, both steps grounded on the basic approach of the CoST modeling while making use of additional information available in the CoST datasets.

## Step 1: Additional Point Source Controls

In the first step, we considered extensions of the constraints EPA selected for its CoST runs. We considered the separate and combined effect of both the 5 ton per year baseline emissions constraint and the $160,000 per ton control cost constraint. As we explain in Appendix C, the results of these sensitivity analyses generally had little impact to either reduction of partial attainment or estimates of attainment costs (either partial or full). At the same time, as we also explain in Appendix C, we concluded that loosening the constraint of 5 tons of baseline emissions per year appeared to tap into a specious portion of the CoST data, causing us to decide that the CoST model was being pressed beyond its range of usefulness. Ultimately, the only way in which we decided to use additional controls from within the CoST list of candidate measures was to identify and include point source controls that cost more than $160,000 per ton (while retaining the 5 ton per year constraint).

The result of our Step 1 identified 66 additional or more stringent control measures on point sources in the 61 counties still needing controls to fully attain 8/35. All of these additional controls were in the Northeast and Southeast regions; none were identified in the partially attaining counties in the West and California. The aggregate net increase in effective tons of control over the RIA was 465 tons at an additional aggregate annual cost of $205.6 million. Since none of the additional point source controls was found to cost more than $685,000 per ton, we did not elect to choose another (also *ad hoc*) cost limit below $685,000 per ton. This step produced no additional controls for the 10/35 standard and only 19 tons of control at an added cost of $5.3 million per year for the 9/35 standard. A listing of the additional point source controls included as a result of Step 1 is available on request.

Clearly, this effort to find more controls with a reasonable overall appearance of reliability by relaxing EPA's two explicit CoST modelling constraints made very little difference to the gap of about 40,000 additional tons of reduction needed. Thus, it is apparent that the only way to make a meaningful dent in the remaining 39,900, 18,160, and 8,930 tons of reductions needed to fully attain 8/35, 9/35, and 10/35, respectively, would be to include options for the partially attaining counties to resort to significant amounts of additional tons of reduction from their remaining non-point source emissions. As these deeper cuts were not even candidate control measures in the CoST data base, we incorporated them "off-line" as described in Step 2.

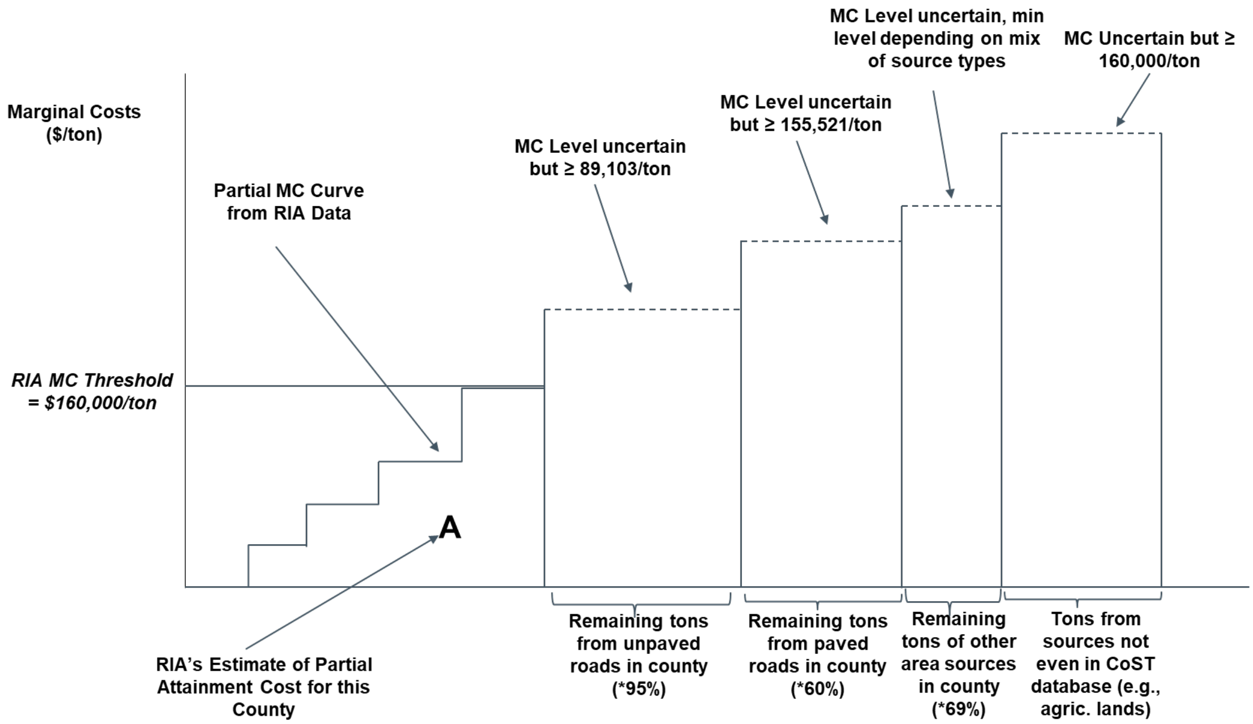
### Step 2: Additional Non-point Source Controls

Our second step for extension of the county-specific marginal cost curves is grounded in making deeper reductions in the non-point source controls than the maximal 25% control allowed for by the CoST model assumptions. Figure 4 illustrates the basic building blocks of this approach. Once the CoST controls have been exhausted (as they will have been in any partial-attainment county) and any additional controls from Step 1 are included, Step 2 starts to apply additional controls to the *remaining* tons in the county's database from three general source categories, represented by the next three "stairsteps" that start at the end of the partial marginal cost curve. These three steps are to be taken in their cost-effectiveness order until they have yielded the full amount of still-needed tons of reduction. Since the RIA's marginal cost for controlling 25% of each category is $89,103 per ton for unpaved roads, $155,521 per ton for shoulder paving, and starts at $471,406 for construction site water sprinkling, the figure shows that order for the stairsteps.

The total quantity of potential reduction from each category (*i.e.*, the width of each block) is 95% times the remaining tons of unpaved road dusts (which is the CoST model's assumption about the control effectiveness of paving a road), 60% times the remaining tons of paved road dusts (*i.e.*, the control effectiveness of paving shoulders in CoST) and 68.6% times the amount of other non-point source emissions (which is the control effectiveness for sprinkling water at construction sites). A listing of the remaining tons of non-point source emissions for the 61 partially-attaining counties is available on request.

The height of each of the three added stairsteps reflects an estimate of the cost per ton of controlling each category beyond the 25% RP level assumed in the CoST portion of the marginal cost curve. This is highly uncertain and we estimate alternative cost per ton levels for each of the three blocks, while not letting the paved and unpaved categories fall below the cost per ton levels used by CoST for the first 25% of controls. By varying these three categories' marginal costs, selecting from them in cost-effectiveness order, and stopping when a sufficient number of additional effective tons of reduction have been selected to reach full attainment in each affected county, we add the additional costs under that extended part of the curve to the costs from the RIA and Step 1 (*i.e.*, the area labelled A). For purposes of developing regional and national totals, we make no changes to the RIA's cost estimates for nonattaining counties that the RIA does project to reach full attainment (*i.e.,* for those counties identified in Appendix B as attaining "100%" of their emissions reduction need in the RIA CoST analysis).

**Figure 4. Illustration of Building Blocks for Extending Marginal Cost Curves Through Deeper Cuts in Remaining Primary $PM_{2.5}$ Emissions from Non-point Sources**




A fourth and last stairstep is applied only in the counties with the most extreme partial attainment situation, which occurs if even 100% RP for all of the first three blocks (that are rooted in CoST non-point source emissions inventory data) is insufficient to meet the full attainment needs of some counties.[57] Here is where the full cost analysis must rely on assumptions that cannot be traced to any of the data in the EPA RIA datasets. Since nearly maximal control has, by this point, been extracted from the sources listed in the CoST database, the controls that this block would account for would likely be from source categories not even listed in the CoST database – agricultural dusts would be an example. Here, any assumed marginal cost will have a wide range of uncertainty because this last block falls into the category that we might call "truly unidentifed" at this point.

One might take the reliance on this last block of the extrapolated cost curve in the 8/35 case as an indication that the 8/35 standard may be unattainable as a practical matter, rather than just very high cost. It could also be viewed as an indication that the decision to develop illustrative control strategies solely on controls of primary $PM_{2.5}$ was ill-advised, and that further controls of precursor emissions (which are

[57] Our analysis finds that eight of the 32 northeast and Southeast partial attaining counties and 20 of the 29 partially attaining counties in California and the West end up relying on Block 4 for the 8/35 standard.

widely understood to be increasingly expensive after decades of controls) will in fact become an essential part of full attainment.

## Key Attributes of Our Approach and Objectives

The approach we have described above was designed to rely as much as possible on data about controls and reduction potential in EPA's own databases. We are aware of many concerns various parties have raised about the reliability of the CoST control cost assumptions, their cost-effectiveness, emissions inventory, estimates of tons needed for attainment, *etc.*[58] In our own explorations of CoST sensitivity runs, some of these became apparent to us directly. We have noted how some of these data issues caused us not to rely heavily on adjustment of the two overt CoST model constraints in estimating costs of full attainment (see Appendix C). We choose not to engage in in-depth criticisms of specific numerical assumptions in the RIA, and we do not attempt to replace any numerical assumptions of the RIA analysis used in its partial portion of its calculations. However, we acknowledge here that some of these concerns are real and that, if they could be addressed better, might alter the results of our analysis (as well as those of the RIA).

Instead, our focus is on demonstrating that the partial attainment costs in the RIA are not informative about either the absolute or relative cost of the three alternative standards. Our approach relies on the standard economists' concepts of extrapolating the "identified" marginal cost curve that even EPA has used in its prior $PM_{2.5}$ and ozone NAAQS RIA rather that boldly report only partial attainment cost estimates. That is the fundamental criticism that we level at this RIA, and we consider it a very serious flaw for the utility of this RIA. We find it deeply concerning if its partial cost estimates should be allowed to stand as a precedent for bad practices in future RIAs.

[58] Uncertainties are not just inherent in the cost modeling efforts of the RIA; it also exists in the PM modeling itself, since the model performance evaluation criteria accept inaccuracies of as much as +/- 50 percent.

# 5. FULL ATTAINMENT COST RESULTS SUMMARY

## Input Assumptions Used to Define a Range of Full Attainment Costs for Each County

Our approach to assessing the full cost of attainment is to provide a range of cost estimates for each alternative standard to reflect the great degree of uncertainty in the underlying assumptions it requires. Table 3 presents the costs per ton that we assume for each of the four blocks illustrated in Figure 4 to estimate costs at the lowest and highest end of those full attainment cost ranges. The reasoning behind each value in the table is summarized below.

**Table 3. Range of Assumptions Used About the Average Cost per Ton of Reduction in Each of the Four Blocks of the Extrapolation Calculation**

| Block | Lowest | Highest |
|---|---|---|
| Block 1: Paving remaining unpaved roads after first 25% | $89,103 | $356,412 |
| Block 2: Paving shoulders of remaining paved roads after first 25% | $155,521 | $622,084 |
| Block 3: Controls on remaining emissions in all other non-point sources included in CoST database | $20,000 | $471,406 |
| Block 4: Truly unknown controls after exhausting 100% controls on all non-point sources in the CoST model | $166, 667 | $500,000 |

For the lowest assumptions for Blocks 1 and 2, we assume that the marginal cost assumed for the first 25% of rule penetration would not increase for the remaining 75% of rule penetration. We consider this to be an extremely low estimate, given that the source document for the non-point CoST assumptions provides graphs indicating very steep rises in those sources' costs per ton as the road segments being addressed are less intensively used.[59] A copy of one of those figures is provided in Figure 5. It shows a rapid increase in the estimated cost per ton reduced as the vehicle miles travelled (VMT) on a 1-mile segment of road to be paved falls below 30 miles per day (which is the VMT level assumed in the CoST model's cost per ton for RPs of 10% and 25%), and also as the speed of travel on that road falls below 25 mph (which is the approximate speed assumed in the CoST model's cost per ton for RPs of 10% and 25%). If equally well-located with respect to an offending monitor, a SIP planner would choose to pave road segments with the highest average VMT, mpg, and vehicle weights.[60] Based on figures in HARC (2015), such as the example provided in Figure 5, it would be entirely plausible to assume that the last percentiles of currently unpaved roads to be paved (*i.e.,* as a SIP planner needs to start paving roads with lower vehicle travelling attributes) could be at least ten times more costly per ton reduced than the CoST model assumes for the RPs of 10% and 25%. In contrast, our high-end assumptions are only four times

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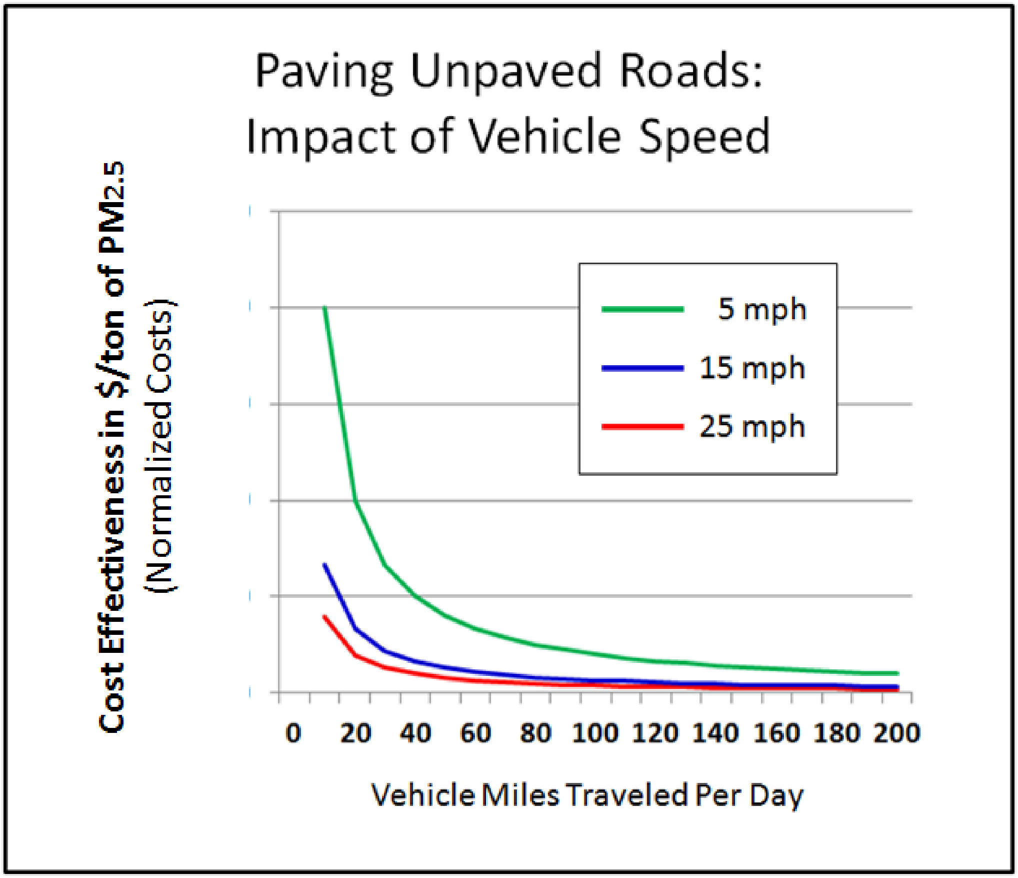
[59] Houston Advanced Research Center and Texas Environmental Research Consortium (HARC), 2015, *Fine Particulate Matter in Harris County*, report prepared for Harris County, April 30, Figures 4-7, pp. 18-21. Available at: https://pm25.harcresearch.org/assets/FinalReport.pdf.

[60] These are the three key road characteristics that are used in the HARC (2015) formula for estimating the cost per ton reduced from paving a 1-mile road segment. The estimate in CoST of $89,103 per ton for paving an unpaved road is taken from HARC (2015) and assumes, per Appendix C of HARC (2015) at p.2, a daily VMT per mile of road of 30 miles, vehicle speed of 25.9 mpg, and vehicle weight of 1.8 tons.

the CoST assumption, which we consider a quite modest assumption for a possible high end. The use of a multiple of only four is taken to recognize that this assumption is an *average* cost per ton over the entire range from the 26th percent to a 100% rule penetration of the most cost-effective of the CoST model's road control measures.

**Figure 5. Copy of Figure 7 from HARC (2015) Showing Cost per Ton Reduced by Paving Unpaved Roads as Function of Vehicle Miles Travelled per Day on a 1-Mile Segment to be Paved and the Speed (mpg) of Vehicles on the Segment.**[61]




For Block 3, we use an extremely wide range because this category of remaining tons is a combination of all the other non-point source categories' tons, which creates substantial uncertainty and county-to-county variation in the primary sources of emissions in the block. At the low end, we assume only $20,000 per ton, which is roughly consistent with assuming that most of the remaining tons are either from residential wood combustion or from commercial cooking, and that the remaining tons (after measures have been applied in CoST) will cost, on average, about two times the marginal cost assumed in CoST for the first 25% of rule penetration. On the high end, we use the marginal cost per ton for the most cost-effective of the construction dust control measures ("soil moisture/sprinkler") in CoST's candidate measures input file for the first 25% of that sector's emissions (*i.e.,* RP of 25%). Because even this control measure exceeds the $160,000 per ton limit EPA has applied to its CoST modeling, the RIA applies no construction dust

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[61] Note: The y-axis on this figure is for "normalized costs" and does not provide a numerical scale, so that a reader can only infer the *relative* cost impact of changing the assumptions on the graph.

controls at all in its partial attainment analysis. Thus, Block 3 effectively allows even some construction dust controls to start to be applied for full attainment.

For Block 4, there is no evidentiary basis in the EPA modeling data sets for estimating what these controls would be, what sources they would apply to, or what their average cost per ton might be. Clearly, not being even considered as candidates for control in CoST suggests these emissions come from sources that are either considered very high cost to control (or to control *further* than they might already be) or are considered uncontrollable for one or more possible reasons. Not knowing what they might, practically speaking, cost to control, but assuming they are inherently problematic to control, we have applied a wide range of costs per ton. We selected a high-end cost of $500,000 per ton, which is roughly consistent with the high-end cost of other blocks that are at least identifiable and thus somewhat evidence-based. For the low end, we took one-third of the high-end assumption, noting that it is approximately at the level of the cost limit that the RIA's CoST modeling chose to apply.

## Resulting Ranges of Estimates for Cost of Full Attainment

The full attainment cost estimates associated with simultaneously applying all four of the low-end cost per ton estimates in Table 3, and those associated with simultaneously applying all four of the high-end estimates are presented in Table 4. These ranges do not represent confidence intervals with a probabilistic interpretation. Rather, the lower ends of the ranges reflect the potential costs when one assumes the simultaneous combination of the lowest marginal cost estimates for the average cost per ton for reductions; the higher end values reflect the estimated costs when one assumes the simultaneous combination of our highest assumptions regarding the average cost per ton for the necessary number of tons of reduction in each of those four blocks. It is our professional judgment that both sets of input assumptions, *when taken simultaneously*, stretch the boundaries of reasonable expectation and thus the true costs for finding the RIA's estimated tons of reduction still needed have a robust chance of falling within the ranges of potential costs that these input assumption sets project. This judgment applies most strongly to the ranges for *total* full attainment costs (*i.e.*, the sum of costs estimated for all counties, shown in the bottom row of Table 4) than to ranges of cost estimates for any single county that lie beneath these totals.

The RIA's own estimates of costs for counties that it projects will reach full attainment are included in the "Full" cost ranges of Table 4 without any alteration by NERA. Because the RIA's cost estimates for those counties are just point estimates, the same values are included in the low and high ends for the "Full" cost ranges for each alternative standard, respectively.

The estimated potential full attainment costs, even at the low end, are vastly larger than the partial attainment costs that the RIA has reported (*e.g.*, in its Table ES-5). The RIA's partial attainment cost estimates are presented next to this study's range of full attainment cost estimates in the table. It shows that for the 8/35 standard, the potential full attainment will cost between about $7 billion and $24 billion, which is 4 to 13 times more than the RIA's partial cost estimate of less than $2 billion. Full attainment of 9/35 is projected to potentially cost 6 to 23 times more than the RIA's partial estimate. As for the least stringent alternative standard considered, 10/35, the potential full attainment cost is estimated to be between $1 billion and $4 billion per year, 11 to 45 times more than the RIA's partial estimate.

**Table 4. Comparison of NERA's Range of Estimates of Annual Cost of Full Attainment to Partial Cost Estimates Reported in RIA (Annual in 2032, millions of 2017$)**

| Area | 10/35 | | | 9/35 | | | 8/35 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Partial (RIA) | Full (NERA) | | Partial (RIA) | Full (NERA) | | Partial (RIA) | Full (NERA) | |
| | | Low | High | | Low | High | | Low | High |
| Northeast | $7 | $7 | $7 | $206 | $226 | $335 | $1,100 | $2,147 | $6,271 |
| Southeast | $4 | $4 | $4 | $69 | $202 | $605 | $437 | $1,219 | $3,388 |
| West | $19 | $74 | $238 | $34 | $272 | $905 | $122 | $769 | $2,378 |
| California | $64 | $957 | $4,055 | $85 | $1,830 | $7,322 | $163 | $3,097 | $11,704 |
| Total | $95 | $1,042 | $4,305 | $393 | $2,529 | $9,167 | $1,822 | $7,232 | $23,741 |

We also calculated full attainment cost estimates for all the possible combinations of the high and low average cost per ton assumptions for each block. This exercise produced a nearly uniform distribution of cost estimates between the low and high values, indicating that no single one of the four average cost per ton assumptions in Table 4 has a dominant effect on whether the full attainment cost estimate will be closer to the low end or to the high end.

For those who might view the above cost estimates as overstated, take note of the reasons they could be understated, especially at the lower end of the ranges.

- The low ends of the ranges assume that the marginal cost of obtaining additional reductions of non-point source controls is no higher than the CoST model assumes is the cost per ton from controlling the first 10% to 25% of emissions in each respective source category, despite extensive evidence in the reports that developed those costs per ton that costs per ton rapidly increase across the full source category. Review of EPA's CoST model input and related source data files indicate that EPA itself recognizes that as the fraction of road dusts already controlled increases, the marginal cost of reducing dusts on another fraction of the roads in that county increases. Apparently because this increased marginal cost estimate rises above $160,000 per ton, EPA elected to not include any candidate road dust control measures in counties indicating they have already controlled road dusts on 25% or more of their roads. Thus, our low-end assumption that all remaining 75% of the road dusts not controlled in the CoST run can be controlled at the CoST model's marginal cost for the first 25% appears to be lower than even EPA would have assumed, had it included such higher RP options in its CoST input file at all.

- The low ends of the ranges make no assumptions that the *effectiveness* of each incremental ton of reduction (with respect to reducing ambient concentrations at the specific location of offending monitors) declines as one reaches towards a 100% RP level in each partial-attaining county, even though this will almost certainly occur as well.

## California's Challenge in Meeting the *Current* $PM_{2.5}$ Standard Exceeds the Challenge That Most Other Counties Would Face Under an 8/35 Standard

The peculiar situation in this RIA of finding only partial attainment of the *current* standard of 12/35 in a number of counties further supports the notion that full attainment of any *tighter* standard will necessarily involve cost per ton assumptions higher than those assumed at the lower ends of each of our full attainment cost ranges. For example, most of the higher cost of full attainment in the case of the loosest of the alternative standards (*i.e.*, 10/35) is projected to occur in the California and the West. This reflects the fact that a number of the California and West region counties exhaust all of the candidate controls available to them in the CoST data even before attaining the current standard of 12/35 — and so the RIA's partial attainment costs for these counties is reported to be *zero* dollars per year, rather than a much higher cost per ton needed than is assumed for other counties that have not exhausted their available control options in CoST to attain 12/35. While Table 4 suggests that California's incremental costs of attaining 10/35 will be about \$1 billion to \$4 billion (compared to the \$0.06 billion reported in the RIA), we have used our extrapolation logic to estimate the cost of first getting the seven California counties that enter the analysis for 10/35 still in partial attainment of even 12/35 into full attainment with the *current* $PM_{2.5}$ NAAQS (*i.e.,* 12/35). The potential additional cost (above and beyond the point where the CoST-based control measures are exhausted) is estimated to be between \$0.4 billion and \$1.5 billion if those controls are to be based solely on local primary $PM_{2.5}$ controls, as the RIA has assumed.[62]

In undertaking these additional costs to first attain fully 12/35, the California counties would effectively be using up a large portion the remaining options for reducing non-point emissions that our estimates of full attainment costs presented in Table 4 have assumed would still be available once they have attained 12/35. Thus, our full attainment cost estimates for reaching any of the alternative standards in Table 4 should be viewed as understated in the case of the California region because we start the analysis of full attainment control options for meeting the alternative standards without first removing the portion of remaining tons that would need to be reduced to first attain 12/35; nor do we attempt to assign a higher cost per ton to reducing those remaining emissions to reflect that California counties will be well beyond the first 25% of rule penetration for those control measures.

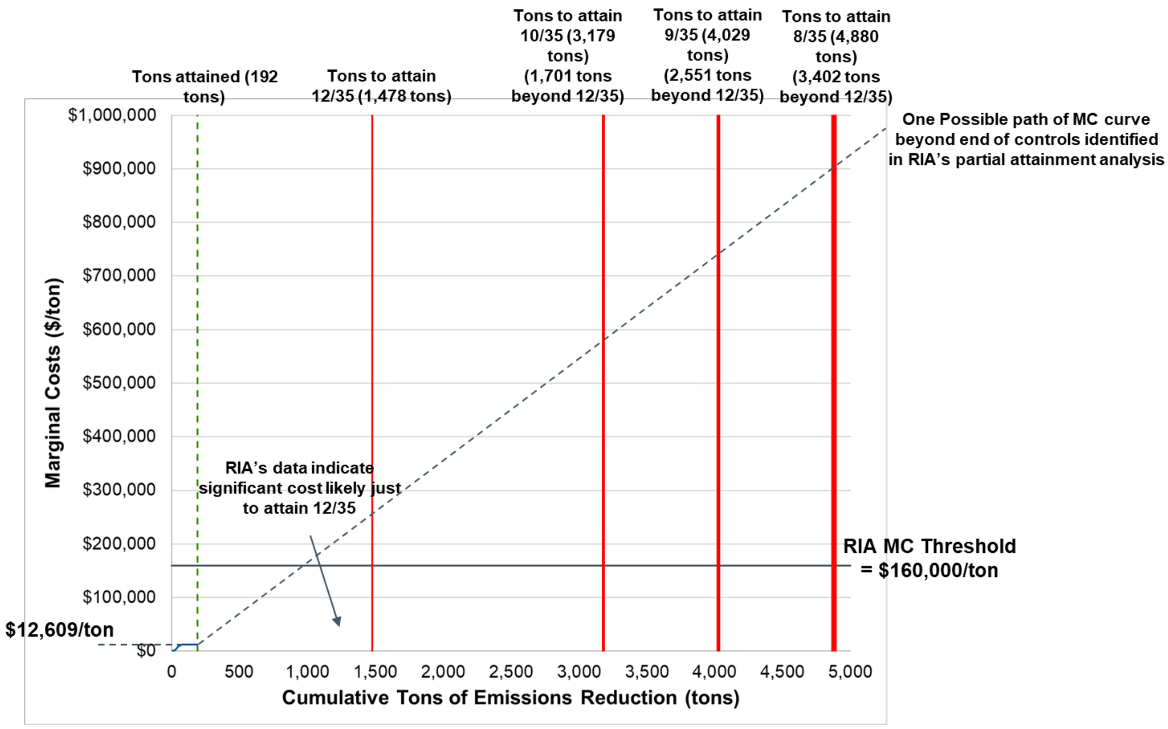
Although this analysis of first getting California into attainment of 12/35 indicates that our full attainment costs for California in Table 4 are systematically understated, they more broadly demonstrate the exceptional technical challenge that the current standard of 12/35 itself still presents. To visualize the degree of challenge that these California counties face in simply attaining the 12/35 standard, consider the information in Figure 6, which shows what the RIA's analysis finds for Riverside Co., CA. In the figure, the leftmost red vertical line shows the tons of primary $PM_{2.5}$ the RIA estimates Riverside Co. will need to reduce just to get to attainment with the current 12/35 standard.[63] The amount of reduction that the CoST model finds for this county is difficult to even see on this scale but ends at the dotted green line (192 tons). Relative to the 192 tons that the CoST modeling can identify for Riverside Co., the still-needed tons just to get to full attainment of 12/35 is 1,286 tons — a reduction larger than is required by most of the 141 counties needing to attain 8/35 (see Appendix B). Since the CoST model cannot find even those tons, this county (and another six counties identified in Appendix A) are projected in the RIA partial cost

[62] The cost of getting to full attainment of 12/35 for those California counties might be less if California has more cost-effective control measures available to it from precursor emissions sources, and/or more controls than assumed in the analytical baseline from mobile sources. It is out of NERA's scope to determine that, but it should be noted that the RIA analysis did control $NO_x$ emissions by an additional 75% relative to projected emissions in 2032 under all existing regulations before estimating the tons of primary $PM_{2.5}$ reductions still needed to reach 12/35 or any of the alternative standards (RIA, pp. 2A-50 to 2A-53).

[63] Note that these estimates of the requirements for full attainment using primary $PM_{2.5}$ emissions reductions are computed *after* the RIA modeling has imposed a 75% reduction in California $NO_x$ relative to the projected 2032 $NO_x$ levels in its 2032 all-measures CMAQ run (*i.e.*, the result of "Step 1" described on p. 2-1 of the RIA).

analysis to undertake zero additional measures to close the ever-growing gap to 10/35, 9/35, or 8/35 — the size of those gaps being illustrated by the three other vertical red bars.

**Figure 6. Illustration of the Full Attainment Challenge Faced by Riverside County, CA Based on Data from the RIA CoST Analysis.**




Additional reasons why the full attainment cost estimates in Table 4 should not be considered an overstatement of the overall economic burden of meeting the tighter NAAQS alternatives are discussed in the next section of this report.

## 6. DISCUSSION

This report has made the case that it is inappropriate and highly misleading for an RIA to provide only partial attainment cost estimates. The ranges of full attainment cost estimates in the prior section demonstrate just how misleading partial attainment estimates can be of either the absolute or relative costs of alternative tighter NAAQS standards.

- For example, the RIA's partial attainment costs for 8/35 are 19 times higher than those for 10/35, while the respective full attainment cost estimates are only 5 to 6 times higher. This tells us that the partial attainment cost estimates for the least stringent alternative standard appear to be understated even more than those for the most stringent alternative — a finding that is not possible to anticipate just by observing the way the partial attainment cost estimates differ.
- In absolute terms, one could readily anticipate that the full attainment cost estimates would be higher, but not how much higher based on the partial attainment cost estimate levels. In the case of this set of alternative NAAQS standards, we find that the partial attainment costs are only about 2% to 9% of the full attainment costs for 10/35, about 4% to 16% of full attainment costs for 9/35, and about 8% to 25% of full attainment costs for 8/35.

Such large differences between CoST-based partial attainment cost estimates and the full cost estimate range are completely consistent with EPA's own record of prior $PM_{2.5}$ and ozone NAAQS cost estimates. As noted in Section 2, CoST model-based partial attainment costs in the 2012 $PM_{2.5}$ NAAQS RIA were only 1% to 31% of EPA's own full attainment cost estimates.[64] It is not possible to simply apply a multiplier to any given set of partial attainment costs: there is no pattern observable in the past record of partial *versus* full attainment cost estimates to predict the magnitude of the understatement as a function of the type or stringency of the alternative standard. Nevertheless, this study, combined with past EPA RIA analyses, indicates that the difference can be very large — large enough to be of importance to policy deliberations, and thus essential information for a reliable RIA.

This report also makes the point that full attainment cost estimates must be provided as quantitative ranges to help communicate to readers of the RIA the degree of uncertainty about what types of options will be used to achieve attainment once the (very) short list of candidate control measures that EPA has assembled for its CoST model is used up. The more that one can base the extrapolation to full attainment on control actions that can at least be named and partially quantified, the more reliable the resulting full attainment cost estimates may be, but this does not necessarily help narrow the uncertainty range. For example, in this study, the full attainment cost estimates are at least based on named non-point sources and the set of known options for limiting their emissions. As they involve far greater rule penetration than the CoST model accounts for, the cost per ton of those additional measures is still a critical uncertainty. We suggest, however, that a full cost estimation process that broadly identifies the most likely types and sources of additional control measures can produce a more confidence-inspiring cost range than a process that simply assumes a particular shape of a marginal cost curve (*e.g.*, flat, rising linearly, or rising exponentially) of unknown, unnamed, unidentified control measures that might fill the gap after the end of the CoST model's marginal cost curves. This study has taken the former approach, whereas the EPA's prior RIAs containing full attainment cost estimates have taken the latter approach.

[64] EPA (2012), Tables 7-4 and 7-5, pp. 7-14 and 7-15.

We have focused our analysis on the costs of full attainment as contrasted to "partial attainment" cost estimates only. Readers should be aware of how narrow even the full attainment cost estimate is. For example, these cost estimates omit or may otherwise be limited by the following issues:

(1) Costs and/or economic growth losses in *attainment* areas because of heightened difficulties for potential new plants or plant expansions in those clean air areas to demonstrate that they will not cause "significant deterioration" of air quality already meeting the NAAQS; [65]

(2) The economy-wide costs from the ripple effects on related businesses and employment that could be picked up though macroeconomic modeling of the attainment cost estimates (*e.g*., using computable general equilibrium models);

(3) Administrative costs to states, which are likely to be amplified when addressing controls for many smaller sources that have never been regulated;

(4) Potential costs of sanctions — transportation and/or conformity freezes if states cannot submit approvable plans;[66]

(5) The cost of all nonattainment stationary source obligations (*e.g.*, NSR, RACM/BACM);

(6) The potential for significant increases in the costs of controls for many source categories given the outdated nature of the referenced source material for the control cost estimates;

(7) EPA's decision to include in its annualized control cost estimates only costs incurred starting in 2032, whereas the technology investments needed to reach attainment by 2032 will need to be incurred well before 2032;

(8) The cost of offsetting emission increases that may perversely occur as the result of the lower standards, such as the recent concerns expressed by the USFS and the Interior Department over the effect of the new standards in limiting prescribed fires to manage and prevent higher $PM_{2.5}$ emissions from wildfires.[67]

Item (1) in the list above merits some detailed discussion, as it raises the possibility of a tighter NAAQS resulting in incremental costs even in areas that remain in attainment with a tightened NAAQS. The numerical analyses in this report have focused solely on the costs of reducing criteria pollutant emissions to the degree estimated by the RIA to be needed to bring nonattainment areas into full attainment. That is the traditional focus of RIAs. However, as NAAQS regulations start to be driven down to levels close to those in relatively clean areas of the U.S. that do not face any risk of falling into nonattainment, RIA's estimates of the costs of implementing emissions control measures (even for full attainment) may be

[65] This is more commonly known as the requirement for prevention of significant deterioration (PSD) demonstrations before a proposed new facility can obtain its emissions permit(s).

[66] *See, e.g.*: 87 *Federal Register* 60494, "Clean Air Plans; 2012 Fine Particulate Matter Serious Nonattainment Area Requirements; San Joaquin Valley, California," October 5, 2022, at 60528.

[67] *See, e.g.*: General Accounting Office, 2023, *Wildfire Smoke Opportunities to Strengthen Federal Efforts to Manage Growing Risk,* March. Available at https://www.gao.gov/assets/gao-23-104723.pdf#page=48&zoom=100,0,789.

becoming a smaller and smaller part of the overall burden that NAAQS rules may entail on the U.S. economy at large, for reasons explained below.

Typically, RIAs acknowledge that there is an array of administrative costs for state governments to comply with SIPs and other implementation measures. Traditionally, it has been assumed that these costs are minor relative to the technical control measures themselves. That may still be the case. However, a tighter NAAQS also triggers increases in the challenges for businesses to demonstrate that any new or expanded major emissions source in attaining areas across the country will not result in new nonattainment or exacerbate any existing nonattainment. Known as the Clean Air Act's requirement for prevention of significant deterioration (PSD), "PSD demonstrations" are required of emitting manufacturing and industrial sources across the U.S. before they receive an air permit for a new or significantly expanded facility. There is nothing new about the PSD requirement, but as a NAAQS is tightened to levels increasingly close to the average ambient levels in areas that have no risk of nonattainment themselves, the chance that an increment in emissions from a new or expanded facility will exceed the allowable local air quality margin (called "headroom") becomes greater. If so, a detailed air quality modeling effort must be undertaken to demonstrate no significant deterioration would occur. To ensure passing that demonstration may require that proposed new sources agree to be built with emissions controls that are more expensive than is normally required outside of nonattainment areas.

Heightened emissions control requirements even in attainment areas could thus be an added cost that a traditional NAAQS RIA never considers, and could result in spending that is not insubstantial compared to the more narrowly defined costs of achieving attainment. For example, an analysis of additional costs due to additional controls on the wood and paper products industry that might become required in attaining areas if the PM2.5 NAAQS were tightened to 8/35 could cost over $4 billion in capital costs for that sector alone.[68] The paper suggests that if its analysis is representative of impacts to other U.S. manufacturing sectors, the overall increase in capital costs could be on the order of $20 billion. Although these costs are not directly comparable to the annualized costs estimated in the RIA, we estimate that, once annualized, they exceed the RIA's annual partial attainment costs for 8/35, and that they could be as much as 10% to 25% of our estimates of the full attainment costs of 8/35. Although these are rough estimates, they seem significant enough that this RIA (and future RIAs for tighter NAAQS) should start to consider expanding their notion of costs to include heightened costs in attaining areas across the U.S. in addition to the costs of eliminating projected nonattainment.

We also note that the PSD demonstration concern is not just that costs of manufacturing may increase more broadly than just in nonattainment areas. We also note that the heightened challenges in passing a PSD demonstration in many otherwise "clean" areas of the U.S. *could hinder their economic growth prospects without any actual dollar expenditures ever being incurred*. And in that sense in particular, benefit-cost analyses for NAAQS that are based solely on concepts of spending on control equipment or changes in operational processes may be losing their originally intended policy relevance. Consideration should be given to broadening the types of cost and economic impacts that future NAAQS RIAs should start to include.

[68] American Forest and Paper Association and American Wood Council, 2023, "Impacts of a Lower Annual $PM_{2.5}$ Ambient Air Quality Standard on the Forest Products Industry, February. To be submitted to the $PM_{2.5}$ Reconciliation docket EPA-HQ-OAR-2015-0072 as part of comments by the NR3 Coalition.

The analysis in this set of technical comments on the current $PM_{2.5}$ RIA is solely on the question of full attainment cost estimation to replace the misleading partial attainment costs in the RIA. The fact that we do not critique the RIA's estimates of benefits does not mean that we do not have significant concerns with their numerical validity as well. In fact, we note that those benefits estimates are far more uncertain than any cost estimate because they are the subject of on-going questions regarding both their causal and quantitative interpretation. Even if there is acceptance of a causal relationship reflected in the epidemiological associations on which RIA benefits are based, there is no evidence that the numerical values of those associations can be interpreted as unbiased quantitative predictors of the responses of public health to changes in concentrations in different locations, under different baseline exposures, and for different demographics than the original study. These epistemological issues for benefits calculations are well documented in comments on the rationale for the proposed rule;[69] the debate is easily summed up as uncertainty over whether such benefits will be realized. In contrast, there is no debate about the existence of actual compliance costs, and it is important and relevant to policy deliberation to understand their potential full attainment cost — and the associated implied practical or technical challenges — even if that requires acknowledgement of a wide range of numerical uncertainty.

[69] *See*, *e.g.*: NCASI (2023); Smith (2019a, 2019b); Smith and Chang (2020); and Gradient (2023).

# 7. CONCLUSION

In summary, the current RIA's cost estimates are inappropriately based on an undefined concept it calls "partial attainment." It is undefined because the "stopping point" at which control measures (and their costs) for getting closer to attainment stop being identified and are treated implicitly as zero cost; this is totally arbitrary and even differs in its degree of incompleteness with the location projected to be in nonattainment. Setting aside its ill-defined nature, partial attainment costs are inappropriate to report in an RIA executive summary because they bear no relationship whatsoever to the challenges, both technically and economically, of adopting a tighter standard or regulation, even though that sort of insight is one of the most important objectives of an RIA. Their presence in the executive summary is therefore misleading.

Even if fraught with enormous uncertainty, a concerted effort to characterize the full attainment costs is what is needed. If readers decide that the resulting cost ranges are too wide to be useful, the associated analysis to estimate those costs still provides readers with some understanding of the regulatory challenges that the various alternative standards may entail. By failing to even explain the extent of regulatory challenge that is implicit in the analysis and data behind this RIA, EPA does a disservice to the public and policymakers. This report provides important policy-relevant information and insights that the current RIA does not.

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# APPENDIX A. EVIDENCE IN THE RIA OF THE INABILITY OF SOME AREAS TO ATTAIN THE CURRENT STANDARD OF 12/35

Before evaluating any of the alternative standards, this RIA first makes estimates of design values in 2032 (the assumed first year of full attainment) at existing monitors across the U.S. based on an assumption of implementation of all existing regulations, plus assumptions about economic growth through 2032. In this RIA, this 2032 projection indicates that, after imposition of all those current and future regulatory requirements, eight counties (all in California) are projected to still fail to attain the current *annual* standard of 12 µg/m$^3$.[70] These eight counties are identified in Table A-1.

The RIA analysis then applies a 75% reduction in $NO_x$ emissions projected to remain by 2032 in South Coast and San Joaquin Valley counties.[71] (Plumas Co. is the only one in the table below that is not in either the South Coast or San Joaquin Valley.) After accounting for the effects on the 2032 design values of this large additional $NO_x$ reduction, the RIA estimates the number of tons of primary $PM_{2.5}$ reduction that those California counties will still need to first attain the current 12/35 standard. Those additional tons of primary $PM_{2.5}$ estimated to be needed, and the tons that EPA finds for them using its CoST model are shown in Table A-1. Only one of the eight counties (Los Angeles Co.) is projected by the CoST model to have sufficient control options available to it to reach full attainment of the current 12/35 standard.

**Table A-1. California Counties in Partial Attainment of Current 12/35 Standard**

| California County Not Attaining Annual Standard of 12 ug/m$^3$ by 2032 | Emissions Reductions in Primary $PM_{2.5}$ Needed to Attain 12/35 (tons) | Primary $PM_{2.5}$ Reductions Identified by CoST Model Before Reaching Its Limit (tons and % of tons needed) | Primary $PM_{2.5}$ Emissions Reductions Still Needed for Attaining 12/35 in the "Partial" Analytical Baseline (tons) |
|---|---|---|---|
| Imperial | 349 | 92 (26%) | 257 (74%) |
| Kern | 791 | 563 (71%) | 228 (29%) |
| Kings | 104 | 43 (41%) | 61 (59%) |
| Los Angeles | 313 | 313 (100%) | 0 (0%) |
| Plumas | 1,244 | 108 (9%) | 1,136 (91%) |
| Riverside | 1,478 | 192 (13%) | 1,286 (87%) |
| San Bernadino | 2,209 | 2,139 (97%) | 70 (3%) |
| Tulare | 230 | 177 (77%) | 53 (23%) |

The remaining seven counties in California enter the RIA's analysis of costs of meeting alternative standards (tighter than 12/35) still in partial attainment with 12/35 and lacking any further options in the CoST model to rely on. As one can infer from the last column of Table A-1, they still need a combined total of 3,091 tons. Clearly these are the counties of the U.S. that face the highest additional costs to attain even tighter standards than 12/35; but because they are already out of candidate control measures in

[70] RIA, Table 2A-13. Fresno Co., CA and another nine counties in the RIA's West region are projected to still fail to meet the current *daily* standard of 35 µg/m$^3$. These are not discussed here, as we are focused on attainment of alternative annual standards only.

[71] *See* RIA, pp. 2A-50 to 2A-53 for a description of its assumptions regarding additional $NO_x$ reductions prior to estimating the need for reductions in primary $PM_{2.5}$ emissions in California counties.

EPA's CoST dataset, the RIA analysis of partial attainment implies that these seven counties will do *nothing* as the standard tightens — and that their assessed partial attainment cost reported in the RIA is *zero* dollars.

Several of the counties not attaining the daily standard in the 2032 baseline also exhaust their full set of controls in the CoST model and enter the main cost analysis in partial attainment of the daily standard, as well as show no cost (because they have no identified controls left) when they face one or more of the tighter alternative annual standards. These are Lemhi Co., ID, Shoshone Co., ID, and Yakima Co., WA.

# APPENDIX B. COUNTY-BY-COUNTY ATTAINMENT OUTCOMES IN THE RIA PARTIAL ANALYSIS (TONS)

The tables below summarize the degree of severity of the partial attainment outcome of the RIA CoST analysis for every county that the RIA projects will have a nonattainment status under a given alternative standard. These tables also include the counties for which the RIA's CoST analysis does find sufficient control measures to get into full attainment (*i.e.*, for which the last column indicates "100%".) Table B-1 reflects the results for the 141 counties that are projected to be in nonattainment for the 8/35 standard. Table B-2 reflects the RIA's results for the 51 counties that are projected to be in nonattainment for the 9/35 standard. Table B-3 reflects the RIA's results for the 22 counties that are projected to be in nonattainment for the 9/35 standard. Obviously, the 22 counties are a subset of the 51 counties, which are in turn are a subset of the 141 counties. Also, any county that reaches only partial attainment of a less stringent standard will also be in partial attainment of any of the more stringent standards, and the depth of their partial attainment will increase with the tighter alternative standards.

**Table B-1. Degree of Attainment in RIA Analysis Results for 141 Counties Projected to Face Nonattainment for the Alternative Standard of 8/35 (continued next page)**

| | (1) **Reductions Needed (Tons)** (Source: RIA Table 2A-14) | (2) **Reductions Achieved (Tons)** (1)-(3) | (3) **Reductions Still Needed (Tons)** (Source: RIA Table 3-9) | (4) **Percent of Emissions Reductions Needed That Are Achieved in RIA CoST Analysis (%)** (2)/(1) |
|---|---|---|---|---|
| **Northeast** | | | | |
| Jefferson County, OH | 893 | 213 | 680 | 24% |
| Camden County, NJ | 856 | 248 | 608 | 29% |
| Delaware County, PA | 1,405 | 435 | 970 | 31% |
| Lebanon County, PA | 776 | 253 | 523 | 33% |
| Brooke County, WV | 271 | 152 | 119 | 56% |
| St. Joseph County, IN | 498 | 291 | 207 | 58% |
| Marshall County, WV | 307 | 183 | 124 | 60% |
| New York County, NY | 666 | 400 | 266 | 60% |
| Lancaster County, PA | 1,537 | 937 | 600 | 61% |
| Marion County, IN | 1,149 | 759 | 390 | 66% |
| St. Louis City County, MO | 234 | 157 | 77 | 67% |
| Armstrong County, PA | 907 | 613 | 294 | 68% |
| Butler County, OH | 1,303 | 893 | 410 | 69% |
| Cuyahoga County, OH | 1,603 | 1,167 | 436 | 73% |
| Vigo County, IN | 315 | 252 | 63 | 80% |
| Wayne County, MI | 1,478 | 1,192 | 286 | 81% |
| Union County, NJ | 424 | 348 | 76 | 82% |
| Cambria County, PA | 761 | 632 | 129 | 83% |
| Allegheny County, PA | 2,305 | 1,923 | 382 | 83% |
| Hamilton County, OH | 637 | 601 | 36 | 94% |

**Table B-1. (continued-2) Degree of Attainment in RIA Analysis Results for 141 Counties Projected to Face Nonattainment for the Alternative Standard of 8/35 (continued next page)**

| | (1) **Reductions Needed (Tons)** (Source: RIA Table 2A-14) | (2) **Reductions Achieved (Tons)** (1)-(3) | (3) **Reductions Still Needed (Tons)** (Source: RIA Table 3-9) | (4) **Percent of Emissions Reductions Needed That Are Achieved in RIA CoST Analysis (%)** (2)/(1) |
|---|---|---|---|---|
| Philadelphia County, PA | 1,251 | 1,200 | 51 | 96% |
| Saint Clair County, IL | 695 | 682 | 13 | 98% |
| New Castle County, DE | 73 | 73 | 0 | 100% |
| Cook County, IL | 1,017 | 1,017 | 0 | 100% |
| Madison County, IL | 724 | 724 | 0 | 100% |
| Allen County, IN | 44 | 44 | 0 | 100% |
| Clark County, IN | 395 | 395 | 0 | 100% |
| Elkhart County, IN | 241 | 241 | 0 | 100% |
| Floyd County, IN | 29 | 29 | 0 | 100% |
| Lake County, IN | 644 | 644 | 0 | 100% |
| Vanderburgh County, IN | 263 | 263 | 0 | 100% |
| Jefferson County, KY | 593 | 593 | 0 | 100% |
| Howard County, MD | 124 | 124 | 0 | 100% |
| Baltimore (City) County, MD | 95 | 95 | 0 | 100% |
| Kent County, MI | 329 | 329 | 0 | 100% |
| Buchanan County, MO | 80 | 80 | 0 | 100% |
| Jackson County, MO | 37 | 37 | 0 | 100% |
| Jefferson County, MO | 344 | 344 | 0 | 100% |
| Saint Louis County, MO | 571 | 571 | 0 | 100% |
| Franklin County, OH | 95 | 95 | 0 | 100% |
| Lucas County, OH | 483 | 483 | 0 | 100% |
| Mahoning County, OH | 117 | 117 | 0 | 100% |
| Stark County, OH | 644 | 644 | 0 | 100% |
| Summit County, OH | 498 | 498 | 0 | 100% |
| Beaver County, PA | 293 | 293 | 0 | 100% |
| Berks County, PA | 102 | 102 | 0 | 100% |
| Chester County, PA | 681 | 681 | 0 | 100% |
| Dauphin County, PA | 241 | 241 | 0 | 100% |
| Lackawanna County, PA | 22 | 22 | 0 | 100% |
| Lehigh County, PA | 95 | 95 | 0 | 100% |
| Mercer County, PA | 278 | 278 | 0 | 100% |
| Washington County, PA | 241 | 241 | 0 | 100% |
| York County, PA | 381 | 381 | 0 | 100% |
| Providence County, RI | 168 | 168 | 0 | 100% |
| Davidson County, TN | 95 | 95 | 0 | 100% |
| Knox County, TN | 410 | 410 | 0 | 100% |
| Berkeley County, WV | 124 | 124 | 0 | 100% |

**Table B-1. (continued-3) Degree of Attainment in RIA Analysis Results for 141 Counties Projected to Face Nonattainment for the Alternative Standard of 8/35 (continued next page)**

| | (1) **Reductions Needed (Tons)** (Source: RIA Table 2A-14) | (2) **Reductions Achieved (Tons)** (1)-(3) | (3) **Reductions Still Needed (Tons)** (Source: RIA Table 3-9) | (4) **Percent of Emissions Reductions Needed That Are Achieved in RIA CoST Analysis (%)** (2)/(1) |
|---|---|---|---|---|
| **Southeast** | | | | |
| Cameron County, TX | 1,398 | 154 | 1,244 | 11% |
| Hidalgo County, TX | 1,840 | 455 | 1,385 | 25% |
| El Paso County, TX | 850 | 247 | 603 | 29% |
| Clayton County, GA | 433 | 129 | 304 | 30% |
| Muscogee County, GA | 523 | 258 | 265 | 49% |
| Fulton County, GA | 1,161 | 765 | 396 | 66% |
| Caddo Parish, LA | 1,145 | 786 | 359 | 69% |
| Bibb County, GA | 621 | 467 | 154 | 75% |
| West Baton Rouge Parish, LA | 515 | 460 | 55 | 89% |
| Floyd County, GA | 556 | 541 | 15 | 97% |
| Jefferson County, AL | 1,488 | 1,488 | 0 | 100% |
| Talladega County, AL | 131 | 131 | 0 | 100% |
| Pulaski County, AR | 777 | 777 | 0 | 100% |
| Union County, AR | 65 | 65 | 0 | 100% |
| District of Columbia | 139 | 139 | 0 | 100% |
| Cobb County, GA | 41 | 41 | 0 | 100% |
| DeKalb County, GA | 33 | 33 | 0 | 100% |
| Dougherty County, GA | 278 | 278 | 0 | 100% |
| Gwinnett County, GA | 16 | 16 | 0 | 100% |
| Richmond County, GA | 409 | 409 | 0 | 100% |
| Wilkinson County, GA | 760 | 760 | 0 | 100% |
| Wyandotte County, KS | 90 | 90 | 0 | 100% |
| East Baton Rouge Parish, LA | 531 | 531 | 0 | 100% |
| Iberville Parish, LA | 16 | 16 | 0 | 100% |
| St. Bernard Parish, LA | 57 | 57 | 0 | 100% |
| Hinds County, MS | 33 | 33 | 0 | 100% |
| Davidson County, NC | 204 | 204 | 0 | 100% |
| Mecklenburg County, NC | 90 | 90 | 0 | 100% |
| Wake County, NC | 65 | 65 | 0 | 100% |
| Tulsa County, OK | 74 | 74 | 0 | 100% |
| Greenville County, SC | 98 | 98 | 0 | 100% |
| Dallas County, TX | 33 | 33 | 0 | 100% |
| Harris County, TX | 1,905 | 1,905 | 0 | 100% |
| Nueces County, TX | 809 | 809 | 0 | 100% |
| Travis County, TX | 842 | 842 | 0 | 100% |

**Table B-1. (continued-4) Degree of Attainment in RIA Analysis Results for 141 Counties Projected to Face Nonattainment for the Alternative Standard of 8/35 (continued next page)**

| | (1) **Reductions Needed (Tons)** (Source: RIA Table 2A-14) | (2) **Reductions Achieved (Tons)** (1)-(3) | (3) **Reductions Still Needed (Tons)** (Source: RIA Table 3-9) | (4) **Percent of Emissions Reductions Needed That Are Achieved in RIA CoST Analysis (%)** (2)/(1) |
|---|---|---|---|---|
| **West** | | | | |
| Lemhi County, ID | 939 | 0 | 939 | 0% |
| Shoshone County, ID | 1,265 | 0 | 1,265 | 0% |
| Santa Cruz County, AZ | 444 | 13 | 431 | 3% |
| Lincoln County, MT | 1,422 | 225 | 1,197 | 16% |
| Benewah County, ID | 734 | 133 | 601 | 18% |
| Denver County, CO | 468 | 145 | 323 | 31% |
| Silver Bow County, MT | 281 | 133 | 148 | 47% |
| Harney County, OR | 267 | 148 | 119 | 55% |
| Maricopa County, AZ | 669 | 669 | 0 | 100% |
| Pinal County, AZ | 56 | 56 | 0 | 100% |
| Weld County, CO | 47 | 47 | 0 | 100% |
| Canyon County, ID | 383 | 383 | 0 | 100% |
| Missoula County, MT | 697 | 697 | 0 | 100% |
| Ravalli County, MT | 33 | 33 | 0 | 100% |
| Douglas County, NE | 19 | 19 | 0 | 100% |
| Sarpy County, NE | 28 | 28 | 0 | 100% |
| Clark County, NV | 561 | 561 | 0 | 100% |
| Dona Ana County, NM | 248 | 248 | 0 | 100% |
| Crook County, OR | 105 | 105 | 0 | 100% |
| Jackson County, OR | 533 | 533 | 0 | 100% |
| Klamath County, OR | 281 | 281 | 0 | 100% |
| Lane County, OR | 37 | 37 | 0 | 100% |
| King County, WA | 126 | 126 | 0 | 100% |
| Spokane County, WA | 65 | 65 | 0 | 100% |
| **California** | | | | |
| Imperial County, CA | 3,402 | 0 | 3,402 | 0% |
| Kern County, CA | 1,268 | 0 | 1,268 | 0% |
| Kings County, CA | 1,268 | 0 | 1,268 | 0% |
| Plumas County, CA | 810 | 0 | 810 | 0% |
| Riverside County, CA | 3,402 | 0 | 3,402 | 0% |
| San Bernardino County, CA | 3,402 | 0 | 3,402 | 0% |
| Tulare County, CA | 1,268 | 0 | 1,268 | 0% |
| Napa County, CA | 650 | 33 | 617 | 5% |
| Merced County, CA | 871 | 101 | 770 | 12% |
| Stanislaus County, CA | 965 | 113 | 852 | 12% |
| Madera County, CA | 813 | 111 | 702 | 14% |

**Table B-1. (continued-5) Degree of Attainment in RIA Analysis Results for 141 Counties Projected to Face Nonattainment for the Alternative Standard of 8/35**

| | (1) **Reductions Needed (Tons)** (Source: RIA Table 2A-14) | (2) **Reductions Achieved (Tons)** (1)-(3) | (3) **Reductions Still Needed (Tons)** (Source: RIA Table 3-9) | (4) **Percent of Emissions Reductions Needed That Are Achieved in RIA CoST Analysis (%)** (2)/(1) |
|---|---|---|---|---|
| Ventura County, CA | 1,012 | 229 | 783 | 23% |
| Fresno County, CA | 1,074 | 248 | 826 | 23% |
| San Luis Obispo County, CA | 504 | 128 | 376 | 25% |
| San Joaquin County, CA | 646 | 168 | 478 | 26% |
| Los Angeles County, CA | 3,402 | 1,159 | 2,243 | 34% |
| Solano County, CA | 317 | 150 | 167 | 47% |
| Sacramento County, CA | 396 | 228 | 168 | 58% |
| San Diego County, CA | 953 | 616 | 337 | 65% |
| Alameda County, CA | 666 | 491 | 175 | 74% |
| Sutter County, CA | 247 | 191 | 56 | 77% |
| Butte County, CA | 76 | 76 | 0 | 100% |
| Contra Costa County, CA | 355 | 355 | 0 | 100% |
| Marin County, CA | 44 | 44 | 0 | 100% |
| Santa Clara County, CA | 482 | 482 | 0 | 100% |

**Table B-2. Degree of Attainment in RIA Analysis Results for 51 Counties Projected to Face Nonattainment for the Alternative Standard of 9/35 (continued next page)**

| | (1) **Reductions Needed (Tons)** (Source: RIA Table 2A-14) | (2) **Reductions Achieved (Tons)** (1)-(3) | (3) **Reductions Still Needed (Tons)** (Source: RIA Table 3-9) | (4) **Percent of Emissions Reductions Needed That Are Achieved in RIA CoST Analysis (%)** (2)/(1) |
|---|---|---|---|---|
| **Northeast** | | | | |
| Delaware County, PA | 673 | 435 | 238 | 65% |
| Jefferson County, OH | 161 | 161 | 0 | 100% |
| Camden County, NJ | 124 | 124 | 0 | 100% |
| Lebanon County, PA | 44 | 44 | 0 | 100% |
| Lancaster County, PA | 805 | 805 | 0 | 100% |
| Marion County, IN | 417 | 417 | 0 | 100% |
| Armstrong County, PA | 176 | 176 | 0 | 100% |
| Butler County, OH | 571 | 571 | 0 | 100% |
| Cuyahoga County, OH | 871 | 871 | 0 | 100% |
| Wayne County, MI | 746 | 746 | 0 | 100% |
| Cambria County, PA | 29 | 29 | 0 | 100% |
| Allegheny County, PA | 1,573 | 1,573 | 0 | 100% |
| Philadelphia County, PA | 520 | 520 | 0 | 100% |
| Cook County, IL | 285 | 285 | 0 | 100% |
| **Southeast** | | | | |
| Cameron County, TX | 581 | 154 | 427 | 27% |
| Hidalgo County, TX | 1,022 | 455 | 567 | 45% |
| El Paso County, TX | 33 | 33 | 0 | 100% |
| Fulton County, GA | 343 | 343 | 0 | 100% |
| Caddo Parish, LA | 327 | 327 | 0 | 100% |
| Jefferson County, AL | 670 | 670 | 0 | 100% |
| Harris County, TX | 1,087 | 1,087 | 0 | 100% |
| Travis County, TX | 25 | 25 | 0 | 100% |
| **West** | | | | |
| Lemhi County, ID | 471 | 0 | 471 | 0% |
| Shoshone County, ID | 797 | 0 | 797 | 0% |
| Lincoln County, MT | 954 | 224 | 730 | 23% |
| Benewah County, ID | 267 | 133 | 134 | 50% |
| Maricopa County, AZ | 201 | 201 | 0 | 100% |
| Missoula County, MT | 229 | 229 | 0 | 100% |
| Clark County, NV | 94 | 94 | 0 | 100% |
| Jackson County, OR | 65 | 65 | 0 | 100% |
| **California** | | | | |
| Imperial County, CA | 2,551 | 0 | 2,551 | 0% |
| Kern County, CA | 951 | 0 | 951 | 0% |
| Kings County, CA | 951 | 0 | 951 | 0% |

**Table B-2. (continued-2) Degree of Attainment in RIA Analysis Results for 51 Counties Projected to Face Nonattainment for the Alternative Standard of 9/35**

| | (1) **Reductions Needed (Tons)** (Source: RIA Table 2A-14) | (2) **Reductions Achieved (Tons)** (1)-(3) | (3) **Reductions Still Needed (Tons)** (Source: RIA Table 3-9) | (4) **Percent of Emissions Reductions Needed That Are Achieved in RIA CoST Analysis (%)** (2)/(1) |
|---|---|---|---|---|
| Plumas County, CA | 493 | 0 | 493 | 0% |
| Riverside County, CA | 2,551 | 0 | 2,551 | 0% |
| San Bernardino County, CA | 2,551 | 0 | 2,551 | 0% |
| Tulare County, CA | 951 | 0 | 951 | 0% |
| Napa County, CA | 333 | 33 | 300 | 10% |
| Stanislaus County, CA | 648 | 113 | 535 | 17% |
| Merced County, CA | 554 | 101 | 453 | 18% |
| Madera County, CA | 496 | 112 | 384 | 23% |
| Fresno County, CA | 757 | 248 | 509 | 33% |
| Los Angeles County, CA | 2,551 | 1,158 | 1,393 | 45% |
| San Joaquin County, CA | 329 | 168 | 161 | 51% |
| San Luis Obispo County, CA | 187 | 128 | 59 | 68% |
| Ventura County, CA | 162 | 162 | 0 | 100% |
| Sacramento County, CA | 79 | 79 | 0 | 100% |
| San Diego County, CA | 102 | 102 | 0 | 100% |
| Alameda County, CA | 349 | 349 | 0 | 100% |
| Contra Costa County, CA | 38 | 38 | 0 | 100% |
| Santa Clara County, CA | 165 | 165 | 0 | 100% |

**Table B-3. Degree of Attainment in RIA Analysis Results for 24 Counties Projected to Face Nonattainment for the Alternative Standard of 10/35**

| | (1) **Reductions Needed (Tons)** (Source: RIA Table 2A-14) | (2) **Reductions Achieved (Tons)** (1)-(3) | (3) **Reductions Still Needed (Tons)** (Source: RIA Table 3-9) | (4) **Percent of Emissions Reductions Needed That Are Achieved in RIA CoST Analysis (%)** (2)/(1) |
|---|---|---|---|---|
| **Northeast** | | | | |
| Lancaster County, PA | 73 | 73 | 0 | 100% |
| Cuyahoga County, OH | 139 | 139 | 0 | 100% |
| Wayne County, MI | 15 | 15 | 0 | 100% |
| Allegheny County, PA | 842 | 842 | 0 | 100% |
| **Southeast** | | | | |
| Hidalgo County, TX | 204 | 204 | 0 | 100% |
| Harris County, TX | 270 | 270 | 0 | 100% |
| **West** | | | 0 | |
| Lemhi County, ID | 3 | 0 | 3 | 0% |
| Shoshone County, ID | 330 | 0 | 330 | 0% |
| Lincoln County, MT | 486 | 224 | 262 | 46% |
| **California** | | | | |
| Imperial County, CA | 1,701 | 0 | 1,701 | 0% |
| Kern County, CA | 634 | 0 | 634 | 0% |
| Kings County, CA | 634 | 0 | 634 | 0% |
| Plumas County, CA | 176 | 0 | 176 | 0% |
| Riverside County, CA | 1,701 | 0 | 1,701 | 0% |
| San Bernardino County, CA | 1,701 | 0 | 1,701 | 0% |
| Tulare County, CA | 634 | 0 | 634 | 0% |
| Stanislaus County, CA | 331 | 113 | 218 | 34% |
| Merced County, CA | 237 | 101 | 136 | 43% |
| Fresno County, CA | 440 | 248 | 192 | 56% |
| Madera County, CA | 179 | 112 | 67 | 63% |
| Los Angeles County, CA | 1,701 | 1,159 | 542 | 68% |
| Napa County, CA | 16 | 16 | 0 | 100% |
| San Joaquin County, CA | 12 | 12 | 0 | 100% |
| Alameda County, CA | 32 | 32 | 0 | 100% |

# APPENDIX C. QUANTITATIVE IMPLICATIONS OF LOOSENING COST PER TON AND TON PER YEAR CONSTRAINTS

In this study, efforts were made to determine whether the two constraints that EPA applied to its CoST model runs could be a significant cause of the extensive degree of partial attainment in the RIA cost analysis. NERA re-ran the EPA CoST model with loosened constraint levels. As explained below, these sensitivity cases showed that few additional controls could be found within the CoST input data, and many of the additional controls identified in these runs appeared to be using unreliable cost assumptions. Below we summarize more details of these findings and explain why we decided not to rely on many of the resulting selected control measures for our estimates of full attainment costs.

<u>With regard to the 5 ton per year limit</u>:

We first note that the 5 ton per year limit has only minimal effect on CoST's ability to select control measures for *non-point* or area sources. Although area sources, such as restaurants, are individually likely to be smaller than 5 tons per year, they are not represented individually in the NEI, nor in the CoST model. Rather, for each separate category of area sources (defined in NEI by their SCC codes, such as types of commercial cooking equipment), NEI estimates the total emissions from all such sources within a county. This total emissions estimate is what CoST's constraint requires to be more than 5 tons per year. While some counties may have so few individual sources within an SCC that they do not aggregate to at least 5 tons per year, we find that this is not a widespread phenomenon. The CoST model run with the 5 ton per year limit does identify and select controls for the various categories of non-point sources in a large fraction of the counties analyzed.

Our sensitivity run of CoST that reduced the 5 ton per year constraint to 1 ton per year identified only 157 more net effective tons of control from *non-point* sources across all of the potential nonattainment areas compared to the EPA run.[72] In general, and *because* these were very small missing control options to start with, the reduction in the gap to full attainment was at most a few tons for a few of the partially attaining counties. Given the effort of tailoring a full attainment estimate to capture these few additional tons, we elected not to manually incorporate them into our analysis. We found that the more important constraint for non-point sources in CoST is that it only provides control measures for the first 10% or 25% of any non-point source category's estimated emissions. We do address this constraint in the main part of our full attainment cost estimation (called "Step 2" in Section 4).

The effect of reducing the 5 ton per year limit to 1 ton per year was somewhat larger in the case of *point* source controls. We found that lowering this constraint identifies additional net reductions of 1,727 effective tons in the 61 counties that only partially attain 8/35. While this is a more substantial reduction of those counties' gap than that for non-point sources, when we reviewed the additional set of control measures selected for the point sources, we became uncomfortable with relying upon them. We noticed

[72] By "net" we mean total effective tons of increased reduction, and by "effective" we mean that tons reduced in adjacent counties are counted only as 0.25 tons of control for purposes of comparison to the estimate of tons of reduction needed to reach full attainment. In gross terms, the model identified additional measures summing to 179 tons of reduction in the nonattaining counties, and 59 effective tons among the various adjacent counties. However, these 238 additional effective tons were offset by about 81 fewer effective tons when various less cost-effective measures in the original EPA CoST run were no longer needed. (such off-setting would only occur in counties that can reach full attainment without exhausting all of their available control options).

that about three-fourths of these extra reductions were assigned the same cost per ton regardless of the size of the point source. In other words, point sources with the same SCC code that emit, for example, 200 tons per year apply these control measures at the same cost *per ton* as point sources that emit only 1 or 2 tons per year. We do not know the size basis that was used to estimate that single cost per ton that could be applied to *any* point source of any annual emissions size, but it is extremely unlikely that the estimate would have been viewed as appropriate for point sources emitting less than 5 tons per year. In fact, we wonder whether these size-invariant marginal cost estimates in CoST may also be inappropriate for application to sources in the 5 ton per year range. (Any alterations to the assumptions in the CoST model that EPA did elect to rely on are beyond NERA's scope, and we make this statement only as an observation worthy of future study regarding the general reliability of the current CoST dataset.)

The other one-quarter of the added reductions did show a well-defined size-dependent marginal cost assumption that continued as the annual tons were reduced below 5 tons per year. For each of the various control measures that were in this category, the cost per ton for a source of about 5 tons per year averaged nine times higher than the cost per ton for the same type of control measure on a source with 50 tons per year.[73]

While the latter subset of the control measure cost data did not appear unreasonable, those measures consistently had very high marginal costs (*e.g.,* greater than $70,000 per ton), while contributing little overall to reduction in the gap towards full attainment. Rather than attempt to pick and choose which subset of control measures in the less than 5 ton per year segment could be deemed reliable and which not, we decided not to include any controls with less than 5 tons per year. This decision has little impact on the approximately 40,000 of additional tons of reduction needed, nor, therefore, to our ultimate full attainment cost estimate. The sensitivity analysis was useful in revealing some of the potentially problematic assumptions even in the RIA cost estimates of partial attainment; correcting those was out of our scope.

<u>With regard to the $160,000 per ton limit:</u>

The $160,000 per ton constraint might appear even more *ad hoc* than that of the size constraint, given that there is no obvious "limit" at which it implies a technical impracticality.[74] Indeed, the RIA indicates that EPA selected this cost constraint value just so that some paved road dust controls would become part of

[73] When the cost limit of $160,000 per ton is also removed, point source control measures' marginal costs for sources of 2 tons per year were on average about five times higher than the same respective measures applied to facilities with about 5 tons per year baseline emissions. Because of the marginal cost escalation, we also noticed that over 80% of the point source control measures that *do* have a size-dependent marginal cost estimate in CoST and which emit less than 5 tons per year already have marginal costs greater than $160,000. Thus, it appears that the 5 ton per year limit, on its own, has almost the same effect as setting a $160,000 per ton limit on point source control measures.

[74] Indeed, the RIA analysis does not even respect this limit in adjacent counties. That is, a ton of reduction in an adjacent county costs the same (*e.g*., $155,521 per ton for paving existing shoulders), but that ton of physical reduction counts towards the direct county's attainment need as only 0.25 tons. Thus, the marginal cost of control for any tons reduced in any adjacent county is four times higher per effective ton than in the directly nonattaining county that relies on such reductions. For example, the selection of paving shoulders in adjacent counties actually costs $622,084 per ton — and yet such controls are indeed selected in the RIA CoST modeling.

the identified control measures.[75] Notably, $160,000 is the nearest round number larger than the lowest cost-per-ton option for paved road controls, which is to pave existing shoulders at $155,521 per ton for the first 10% or 25% the paved road emissions of each county. We found that this cost limit had the merit of enabling the most cost-effective of the paved and unpaved road measures in the list of candidate control measures of CoST, while not allowing any further increase in controls from other sources, particularly point sources.

We realized, upon inspection of the control options available to non-point sources above the $160,000 per ton cost level, that it would likely be more cost-effective overall to allow counties to control the remaining tons in the various non-point source categories beyond the 25% RP mark using the most cost-effective control measures for those sources than to retain the 25% RP limit in CoST and force CoST to then adopt much higher cost-per-ton measures for just those first 25% of each source category's overall emissions. We therefore ran a sensitivity case in which the CoST limit of $160,000 per ton was lifted for point sources only. The initial sensitivity run raised the cost limit to $5 million, just to see how extreme the options might appear to be for point sources. That run (which retained the 5 ton per year limit) selected 66 additional control options within the 61 partial-attaining counties for 8/35. The average cost per ton of these additional measures was about $440,000 and the maximum cost per ton of the 66 extra controls was $685,000. As these additional point source controls did not appear to include any unreasonable-seeming outliers, we elected to include them in the set of control measures used as part of the effort of partial-attaining counties to reach full attainment. In aggregate, they have relatively little impact on closing that gap: an additional net reduction of 465 tons compared to the overall aggregate still-needed reductions of over 40,000 tons, adding $206 million to the RIA's original partial attainment cost for 8/35 of $1,822 million. These added control measures were found only in the Northeast and southeast regions.

[75] RIA, p. 3-11. ("We selected the $160,000/ton marginal cost threshold because it is around that cost level that (i) road paving controls get selected and applied (as seen by the slight uptick in the curves), and (ii) opportunities for additional emissions reductions diminish (as seen by the flattening of the curve around that cost threshold.")

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