Nov. 2, 2026

EPA Office of Air and Radiation (Docket ID No. EPA-HQ-OAR-2025-0124)

Re: Supplemental notice of proposed rulemaking: Rescission of the Greenhouse Gas Findings for Fossil Fuel-Fired Power Plants and Repeal of Regulations for Power Plant Greenhouse Gas Emissions Under Clean Air Act Section 111

Administrator Zeldin:

Please find attached joint legal comments from the Clean Air Task Force, Center for Biological Diversity, Earthjustice, Environmental Defense Fund, Environmental Law & Policy Center, Natural Resources Defense Council, Union of Concerned Scientists, and Sierra Club on the proposed supplemental rulemaking entitled "Rescission of the Greenhouse Gas Findings for Fossil Fuel-Fired Power Plants and Repeal of Regulations for Power Plant Greenhouse Gas Emissions Under Clean Air Act Section 111," 91 Fed. Reg. 59002 (Sept. 17, 2026). These comments are also endorsed by Clean Air Council, Clean Wisconsin, and Friends of the Earth.

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INCORPORATIONS

We incorporate by reference all sources cited in this comment. We have also submitted copies of referenced sources and damages calculations on two thumb drives delivered to the EPA Docket Center. We are uploading via regulations.gov an index of the files contained on the thumb drives along with proof of delivery by Sam Dilley, Earthjustice, to the Docket Center on November 2, 2026 at 2:50PM.

We also incorporate by reference all comments previously submitted to the Agency on this docket, EPA-HQ-OAR-2025-0124, concerning the primary proposal in EPA's proposed rule, "Repeal of Greenhouse Gas Emissions Standards for Fossil Fuel-Fired Electric Generating Units," 90 Fed. Reg. 25752 (June 17, 2025); and all comments previously submitted to the Agency concerning EPA's original 2015 endangerment finding for fossil fuel-fired electric generating units, "Standards of Performance for Greenhouse Gas Emissions From New, Modified, and Reconstructed Stationary Sources: Electric Utility Generating Units," 80 Fed. Reg. 64510 (Oct. 23, 2015).

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I. INTRODUCTION

As the nonpartisan National Academies of Sciences, Engineering, and Medicine recently declared in a consensus report, the evidence that greenhouse gas emissions and their attendant contribution to global climate change and evidence of the lived effects of that change is "beyond scientific dispute."[1] As millions of Americans know from living with the increasingly dangerous effects of that climate change – from extreme heat, drought, wildfire, tropical cyclones, and convective storms – we now "face[] a future in which climate-induced harm continues to worsen and today's extremes become tomorrow's norms."[2]

In the face of the scientific and lived reality of those effects, EPA now proposes to abdicate its congressionally delegated authority and responsibility to regulate the greenhouse gas emissions that are putting public health and safety at risk. In this Supplemental Proposal, EPA once again ignores the science and instead attempts to rewrite the Clean Air Act, inventing a novel, categorical limitation on its Section 111 regulatory authority: an atextual and ahistorical interpretation of dangerous "air pollution" to mean only pollution which endangers human health and welfare solely through local or regional exposure.

First, EPA is simply wrong about its authority to regulate greenhouse gases based on their contribution to climate change under Section 111 of the Clean Air Act. The Supreme Court found in 2007 that EPA has authority to regulate greenhouse gases under the plain text of the Act, and stated that that authority includes the authority to issue standards under Section 111 just a few years later. EPA lacks authority to reinterpret those holdings to read extra-statutory constraints into the Clean Air Act where none exist: EPA cannot simply make up a category of "local/regional" pollution and then claim greenhouse gases fall outside of its arbitrary categorization. Instead, EPA must follow the law as Congress enacted it and the Court has interpreted it. And the major-questions doctrine and *Loper Bright* overturning *Chevron* deference has no bearing on EPA's authority here: the Supreme Court found in 2007 – and reconfirmed in 2011 – that the text of the Act is *unambiguous*. There is no question left open for the major-questions doctrine to answer.

Second, EPA's proposal that regulating greenhouse gas emissions from power plants is "futile" is flawed as a factual matter and legally irrelevant. At the point of making a threshold determination under Section 111(b) as to whether to regulate a given source category, the statute asks EPA to consider whether a source category "contributes significantly" to dangerous air pollution, not whether performance standards – which are set at a later point in the regulatory process – significantly ameliorate the effects of such pollution. In all events, even if the agency were required to assess futility, the proposed analysis is critically flawed. As the undersigned organizations documented extensively in comments submitted to the agency under this docket in

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[1] National Academies of Sciences, Engineering, and Medicine. 2025. Effects of Human-Caused Greenhouse Gas Emissions on U.S. Climate, Health, and Welfare. Washington, DC: The National Academies Press. https://doi.org/10.17226/29239. (Summary) [hereinafter "NASEM 2025 Climate Report"]

[2] NASEM 2025 Climate Report.

2025, U.S. fossil fuel-fired power plants unquestionably significantly contribute to dangerous air pollution, and regulating them will materially ameliorate the domestic effects of climate change. The modeling submitted with this Comment projects that the monetized value of health and welfare dangers from U.S. power-plant CO_2 emissions by 2100, *even assuming EPA's own flawed modeling results*, is between $11.7-37.1 trillion – a sum that cannot reasonably be considered *de minimis*.

And, ***finally***, EPA's action is arbitrary and capricious. The Supplemental Proposal rests on factual assumptions that EPA has failed to justify, and reverses the agency's prior factual and legal assessment without offering a sufficiently reasoned basis for changing positions. And while making this tectonic and unreasoned policy shift, EPA has declined to provide adequate time for meaningful public comment or for necessary Tribal consultation. EPA fails to consider the health and environmental costs of its action or to meaningfully weigh alternatives. For these reasons and more, EPA's Supplemental Proposal is fundamentally unlawful and should be abandoned.

* * *

As we explain in more detail in the subsequent pages, EPA's Supplemental Proposal is fundamentally flawed. It misinterprets the Clean Air Act, ignores scientific evidence, and entirely misunderstands its own duty as the agency responsible for protecting public health and the environment.

EPA must withdraw the Supplemental Proposal in its entirety.

II. SECTION 111 APPLIES TO GREENHOUSE GAS POLLUTION.

In its Supplemental Proposal, EPA proposes to interpret Section 111 to deprive EPA of the authority to regulate greenhouse gas emissions from stationary sources. That proposal is contrary to law. The Supreme Court has already held that greenhouse gases are "air pollutants" and that the Clean Air Act "unambiguous[ly]" confers authority to regulate them based on their contribution to global climate change. *Massachusetts v. EPA*, 549 U.S. 497, 528-29 (2007) (having "little trouble concluding" that the Clean Air Act "authorizes EPA to regulate greenhouse gas emissions from new motor vehicles in the event that it forms a 'judgment' that such emissions contribute to climate change"); *see also Am. Elec. Power Co., Inc. v. Connecticut*, 564 U.S. 410, 424 (2011) (finding that the Clean Air Act "'speaks directly' to emissions of carbon dioxide" from power plants). EPA cannot get around this direct precedent, which remains binding.

In all events, EPA's proposed interpretation is contrary to the statutory text, structure, history, and practice. EPA's proposed interpretation that "air pollution which may reasonably be anticipated to endanger public health or welfare" refers only to "local or regional exposure to dangerous air pollution" has no basis in the Act and does not reflect the "best reading" of Section 111. 91 Fed. Reg. 59002 (Sept. 17, 2026).

A. EPA has no authority to reinterpret the scope of Section 111.

In the Supplemental Proposal, EPA proposes to abandon the longstanding construction of Section 111, which has been settled by binding Supreme Court precedent. EPA now proposes that

when Congress directed EPA (1) to list categories of stationary sources if those sources "cause[], or contribute[] significantly to, air pollution which may reasonably be anticipated to endanger public health or welfare," 42 U.S.C. § 7411(b)(1)(A), and then (2) to "establish[] standards of performance for any existing source for any air pollutant," *id.* § 7411(d)(1), emitted by those sources (which is not a criteria pollutant or regulated under Section 112), that Congress only intended EPA to regulate air pollutants that contribute to "local or regional exposure to dangerous air pollution." 90 Fed. Reg. 36288, 36290 (Aug. 1, 2025). No text in the statute supports EPA's proposed interpretation (nor does EPA identify any). Binding Supreme Court precedent also ties the Agency's hands, depriving it of authority to reinterpret Section 111's scope.

EPA cannot lawfully finalize the Supplemental Proposal because the question of whether EPA has authority to regulate greenhouse gases for their effects on global climate change was decided in the first instance by *Massachusetts v. EPA*, 549 U.S. 497 (2007). There, the Supreme Court held that Section 202 of the Act, which, like Section 111, authorizes EPA to regulate air pollutant emissions that contribute to "air pollution which may reasonably be anticipated to endanger public health or welfare," authorizes EPA to regulate greenhouse gases. That opinion remains good law and EPA is bound by it. What's more, the Supreme Court subsequently held in *American Electric Power Co., Inc. v. Connecticut*, 564 U.S. 410, 424 (2011), that it is "equally plain" that the Clean Air Act authorizes EPA to regulate greenhouse gas emissions from power plants. EPA's attempt to reinterpret the statutory text to suit its current policy preferences is thus beyond its lawful authority. The proposal must accordingly be withdrawn.

1. The Court in *Massachusetts* held that Section 202 unambiguously covers greenhouse gas emissions.

Under review in *Massachusetts* was EPA's denial of a petition to regulate greenhouse gases under Section 202(a). In the *Massachusetts* opinion, the Supreme Court articulated the question under consideration as "whether § 202(a)(1) of the Clean Air Act authorizes EPA to regulate greenhouse gas emissions from new motor vehicles in the event that it forms a 'judgment' that such emissions contribute to climate change." *Id.* at 528. The Court then answered that question: "We have little trouble concluding that it does." *Id.* Those statements alone foreclose EPA's proposed interpretation here.

As EPA acknowledges in the Supplemental Proposal, the Court ruled that the plain language of "'[t]he Clean Air Act's sweeping definition of 'air pollutant' . . . embraces all airborne compounds of whatever stripe' and provided no textual basis for excluding CO_2 or the three other GHGs raised in the petitions for rulemaking." 91 Fed. Reg. at 59012 (quoting *Massachusetts*, 549 U.S. at 528-29). In reaching that conclusion, the Court rejected EPA's arguments that Congress never intended the Agency to regulate greenhouse gas emissions, 549 U.S. at 529-30; that regulating vehicles' greenhouse gas emission under Section 202(a) would conflict with the regulation of fuel economy, *id.* at 531-32; and that regulating greenhouse gases under Section 202(a) was contrary to the principles laid out in *FDA v. Brown & Williamson* (principles we now know as the major-questions doctrine), *id.* at 530-31. The Court also rejected EPA's suggestion that even if it had authority to regulate greenhouse gases, it could decline to exercise it for policy reasons unrelated to the science, *id.* at 532-34.

The Court's holding was clear: "Because greenhouse gases fit well within the Clean Air Act's capacious definition of 'air pollutant,' we hold that EPA has the statutory authority to regulate the emission of such gases from new motor vehicles." *Id.* at 532. The Court left EPA to decide the ultimate *scientific* question: "whether greenhouse gas emissions contribute to climate change" and so declined to reach the question of "whether on remand EPA must make an endangerment finding," *id.* at 533-34.

Although EPA acknowledges that *Massachusetts* held that greenhouse gases fell within the definition of "air pollutant," EPA implies that the clear holding and plain implications of *Massachusetts* have been eroded by the subsequent decisions in *Utility Air Regulatory Group v. EPA*, 573 U.S. 302 (2014) ("*UARG*") and *West Virginia v. EPA*, 597 U.S. 697 (2022). *Id*. at 59020. EPA's interpretation of *Massachusetts* and subsequent cases on its ability to re-interpret its authority reflects a tortured misreading of the case law.

First, *Massachusetts* leaves no room to interpret "air pollution which may reasonably be anticipated to endanger public health or welfare" radically differently from "air pollutant." First, as the Court observed , "[t]he Act defines 'air pollutant' to include 'any air pollution agent or combination of such agents, including any physical, chemical, biological, radioactive . . . substance or matter which is emitted into or otherwise enters the ambient air.'" 549 U.S. at 506 (citing 42 U.S.C. § 7602(g)). The Court then held that greenhouse gases are "unquestionably agents of air pollution," rejecting the dissent's theory that "air pollution agent" was an ambiguous term that EPA could define (relying on Chevron) more narrowly than "air pollutant" itself, *id.* at n.26 (quotations removed). It is remarkably telling, then, that, in the preamble for the Proposed Rule, EPA misquotes the Section 302(g) definition, erroneously stating that it refers to "'any . . . air *pollutant* agent or combination of such agents, including any physical [or] chemical . . . substance.'" 91 Fed. Reg. at 59029 (emphasis added).

Furthermore, from a functional standpoint, even a cursory read of the *Massachusetts* opinion shows that the Court was not merely deciding the meaning of "air pollutant" as an isolated term, but was affirmatively deciding that EPA has authority *to regulate* those air pollutants under Section 202(a)(1) *because* of greenhouse gases' impact on climate change. The Court said exactly that:

> On the merits, the first question is whether § 202(a)(1) of the Clean Air Act authorizes EPA to regulate greenhouse gas emissions from new motor vehicles in the event that it forms a "judgment" that such emissions contribute to climate change. We have little trouble concluding that it does.

549 U.S. at 528. In other words, the Court concluded that EPA *can* regulate greenhouse gas emissions *if* the Agency determines that they "contribute to *climate change*" – not to "local or regional" exposure. The proposal asserts that the *Massachusetts* Court overlooked the term "air pollution" as it appears in Section 202(a)(1). That the Court emphasized the definition of "air pollutant" in Section 302(g) reflects only that the Court saw no conflict with the term "air pollution" in Section 202. The Court saw air pollutant and air pollution as referring to the same thing – the former focusing on emissions of the greenhouse gases from sources and the latter on concentrations of the same gases in the atmosphere. If that had not been the case, the Court surely would have articulated a different holding. Instead, it concluded: "Because greenhouse

gases fit well within the Clean Air Act's capacious definition of 'air pollutant,' *we hold that EPA has the statutory authority to regulate the emission of such gases from new motor vehicles*." *Massachusetts*, 549 U.S. at 532 (emphasis added). This same logic extends to Section 111: as with Section 202, nothing whatsoever in the text, structure, history, or application of that provision indicates that "air pollution" has a narrower scope than in Section 202.

Likewise, EPA's stilted view of *Massachusetts* elides the Court's reliance on the statutory definition of not only of "air pollutant," but also of "welfare": "Welfare," the Court explained, "is also defined broadly: among other things, it includes 'effects on . . . weather . . . and climate." *Massachusetts*, 549 U.S. at 506 (quoting 42 U.S.C. § 7602(h)). The conclusion that Section 111 does not reach harms from global climate change is in direct opposition to Congress's direction to regulate air pollution "which may endanger human health and *welfare*" – which both the statute and the *Massachusetts* Court make clear encompasses climate change.

For these reasons, EPA is wrong to propose that *Massachusetts* leaves space to construe "air pollution" as narrowing the scope of authority under Section 202 or Section 111, notwithstanding the Court's interpretation of the interrelated term "air pollutant." As discussed *infra*, the two terms have different functions in the provision, but it would be absurd to conclude that the Clean Air Act's definition of "air pollutant" unambiguously encompasses greenhouse gases, but that "air pollu*tion*" – the condition arising from the emission of air pollu*tants* – does not. Indeed, the point is made abundantly clear in the present context by the language and structure of Section 111. Under the statute, EPA must list categories of stationary sources that contribute to "air pollution," 42 U.S.C. § 7411(b)(1)(A), and then issue "standards of performance" – defined as "standard[s] for emissions of air pollu*tants*" – for new source in each category. *Id.* § 7411(b)(1)(B), (a)(1). Likewise for existing sources, where EPA's emission guidelines direct the establishment (by the states or EPA) of "standards of performance for any existing source for any air pollu*tant*" emitted by the listed source category (which is not a criteria air pollutant or regulated under Section 112). *Id*. § 7411(d)(1).

Furthermore, the Court's statement that EPA "can avoid taking further action" to regulate greenhouse gas pollution "only if it determines that greenhouse gases *do not contribute to climate change*," 549 U.S. at 533 (emphasis added), would be strange indeed if the Court was undecided on whether climate change could *ever* constitute dangerous air pollution. The judgment *Massachusetts* left to EPA of "whether" to regulate greenhouse gas emissions was explicitly the "*scientific* judgment" to determine whether climate change endangers human health and welfare, and whether greenhouse gas emissions contribute to climate change. *Id.* at 533-34 (emphasis added). It was not an invitation to retread whether greenhouse gases fell within the *legal* ambit of Section 202, as EPA proposes to do now in the context of Section 111.

Nor did the Court leave any space for the Agency to decide that the type of dangerous air pollution to which greenhouse gases contribute is, categorically, not a type of air pollution with which Section 202 – and now Section 111 – is concerned. To the contrary, the Court clearly understood that petitioners were arguing that greenhouse gases contribute to dangerous air pollution *because* they contribute to climate change; there was no suggestion of any other basis for an endangerment finding on remand. Not only did the Court indicate no reservation about finding endangerment on that basis, it expressly recognized that EPA would have authority to regulate greenhouse gas emissions from vehicles under Section 202 so long as EPA concluded

that such vehicles "contribute to climate change." *Id.* at 528. EPA's new position that contribution to climate change is not a contribution to dangerous pollution within the meaning of Section 202 (and, as we discuss below, within the meaning of Section 111 as well) – cannot be reconciled with *Massachusetts*.

Indeed, EPA fails to explain how a decision determining only that greenhouse gases were "air pollutants" under the first half of the first sentence of Section 202, but leaving open the possibility that the remaining text of that sentence could be read to exclude them again, would have resolved the question put to the Court (let alone constituted a reasonable pass at statutory interpretation). The Supreme Court granted certiorari on two questions in *Massachusetts*, one of which specifically asked the Court to resolve the scope of EPA's authority under Section 202: "Whether the EPA Administrator has authority to regulate carbon dioxide and other air pollutants associated with climate change under section 202(a)(1)." *Massachusetts v. EPA*, 548 U.S. 903 (2006) (granting writ of certiorari); *see* Petition for Writ of Certiorari, 2006 WL 558353 (Mar. 2, 2006); *see also, e.g.*, Resp't. All. of Auto. Mfrs. Br., *Massachusetts v. EPA*, 2006 WL 3023028 (second question presented). If the Court had stopped where EPA now claims it did – opining only on the meaning of "air pollutant" but otherwise leaving undecided whether the text of Section 202 forecloses regulation of greenhouse gases – it would not have actually answered the central question: whether EPA "*has authority* to *regulate*" greenhouse gas emissions. But, of course, the Court did not stop there; it reasoned, *including* from the definition of "air pollutant," that "EPA has the statutory authority [under Section 202(a)(1)] to regulate the emission of such gases from new motor vehicles." *Massachusetts*, 549 U.S. at 532.

Notably, the briefs filed in the Supreme Court in *Massachusetts* show that EPA and other parties made many of the same arguments that EPA now advances in this Supplemental Proposal. The Court rejected those arguments. EPA's brief claimed that it had reasonably determined that it "lacks authority to address the threat of global climate change by regulating greenhouse gas emissions from new motor vehicles," EPA Br., *Massachusetts v. EPA*, 2006 WL 3043970, at *22, because, *inter alia*, the presumption that "air pollutant" had a consistent meaning between sections was "not rigid," allowing EPA to conclude greenhouse gases could be a pollutant for purposes of non-regulatory provisions while also falling beyond the scope of Section 202(a)(1), *id.* at *34-35; *compare* 91 Fed. Reg. at 59021-22.

Similarly, States siding with EPA in *Massachusetts* argued that Section 202 authorizes standards for emissions that cause or contribute to dangerous air pollution only "where U.S. emission reductions will measurably and meaningfully address such air pollution," excluding 202 regulation where "sources primarily generating the air pollution are outside the United States and where emission reductions from within the United States will have no meaningful effect on protecting public health and welfare." State Resp't-Intervenors Br., *Massachusetts v. EPA*, 2006 WL 3095443, at *9; *compare* 91 Fed. Reg. at 59024.

Industry parties, meanwhile, advanced arguments that Section 202 could not be used to regulate greenhouse gas pollution because "[t]he ordinary meaning of 'pollution" is the '*[c]ontamination* of air, soil, or water by the discharge of harmful substances'" and, therefore, "Congress vested the agency with authority to implement controls over emissions of chemicals and substances that *contaminate* the air by making it impure or dirty." Resp't. All. of Auto. Mfrs. Br., *Massachusetts v. EPA*, 2006 WL 3023028, at *20 (emphasis in original); *see also* CO2

Litigation Group Br., *Massachusetts v. EPA*, 2006 WL 3043971, at *9 (suggesting EPA's authority should be limited to "harmful or poisonous substances"); *compare* 91 Fed. Reg. at 59022. This reading, they asserted, "is further reinforced by the various substances expressly identified as pollutants pursuant to section 302, such as carbon monoxide, hydrocarbons, nitrogen oxides, and particulate matter," which "dirty the air and, at excessive levels, pose substantial health problems for humans." Resp't. All. of Auto. Mfrs. Br., *Massachusetts v. EPA*, 2006 WL 3023028, at *20; *see also id.* at *23-24; *compare* 91 Fed. Reg. at 59022.

The Supreme Court was not swayed by any of those arguments. Had the Court accepted any of them as accurate readings of the text of Section 202 – and therefore determinative of Congressional intent that Section 202 reach only locally or regionally dangerous pollution – the Court would have been compelled to uphold EPA's denial of the petition to regulate. But it did not. *See Massachusetts*, 549 U.S. at 529 n.26 (rejecting the dissent's conception of the "ambient air"). EPA cannot now plausibly assert that the Supreme Court "did not address whether 'air *pollution*' can be interpreted to include elevated concentrations of GHGs in the atmosphere," 91 Fed. Reg. at 59029 (emphasis in original).

In fact, the opinion rejected any suggestion that the distinctions in the geographic impact of pollution were relevant to the authority question. The Court was fully aware of EPA's belief that "Congress designed the original Clean Air Act to address *local* air pollutants rather than a substance that 'is fairly consistent in its concentration throughout the *world's* atmosphere.'" *Massachusetts*, 549 U.S. at 512 (emphasis in original) (quoting EPA's denial of the petition for rulemaking). It nevertheless rejected the relevance of such potential distinctions, explaining that whether or not Congress anticipated a problem like climate change, "[t]he broad language of § 202(a)(1) reflects an intentional effort to confer the flexibility necessary to forestall [the provision's] obsolescence." *Id.* at 532; *see also id*. at 506 (noting that the definition of "welfare" "is also defined broadly: among other things, it includes 'effects on . . . weather . . . and climate.'"). Accordingly, the Court rejected the Agency's belief that the statute was not intended to reach "substances that contribute to climate change" and thus that "carbon dioxide is not an 'air pollutant' within the meaning of the [Section 202(a)(1)]." Per the Court, "[t]he statutory text forecloses EPA's reading." *Id.* at 528.

Because EPA's proposal relies on an erroneous reading of *Massachusetts*, it is unreasonable and unlawful and must be withdrawn.

2. *AEP* confirmed the holding in *Massachusetts* and extended it to regulation of power plants under Section 111.

The holding in *Massachusetts* was confirmed and extended to Section 111 in *American Electric Power Co., Inc. v. Connecticut*, 564 U.S. 410, 428 (2011) ("*AEP*"). There, the Supreme Court found that Section 111 of the Clean Air Act authorizes EPA to regulate greenhouse gas emissions from power plants. *AEP*, 564 U.S. at 424; *see id.* ("Most relevant here, § 7411(d) then requires regulation of existing sources" within a source category that contributes significantly to dangerous air pollution). In the Court's words: "*Massachusetts* made plain that emissions of carbon dioxide qualify as *air pollution subject to regulation under the Act*. (citations omitted) And we think it equally plain that the Act 'speaks directly' to emissions of carbon dioxide from the defendants' plants." *Id*. (emphasis added).

The *AEP* Court explained that power plants are subject to Section 111 and emit greenhouse gases which may contribute to climate change, bringing them within Section 111's regulatory ambit. Moreover, the Court explained that if EPA fails to set Section 111 standards for a source category like power plants, the Clean Air Act "provides a means to seek limits on emissions of carbon dioxide from domestic powerplants": petitioning for a Section 111 rulemaking. *Id*. at 425. It would be passing strange for the Court to have held that a petition for a Section 111 rulemaking could result in standards to abate greenhouse gas emissions if Section 111 did not authorize such standards.

Following *AEP* and *Massachusetts*, the D.C. Circuit explained in *Coalition for Responsible Regulation v. EPA*, 684 F.3d 102, 119 (D.C. Cir. 2012): "EPA indeed wields the authority to regulate greenhouse gases under the CAA." Later, in *American Lung Association v. EPA*, 985 F.3d 914, 934 (D.C. Cir. 2021), the court stated that "the Supreme Court ruled that the significant greenhouse gas pollution caused by fossil-fuel-fired power plants is subject to regulation under Section [111] of the Clean Air Act."

To wriggle out of the vise grip of these precedents, EPA's Supplemental Proposal makes much of the *AEP's* statement that "Congress delegated to EPA the decision whether and how to regulate carbon-dioxide emissions from power plants." *See* 91 Fed. Reg. at 59014. But *AEP* (and *Massachusetts* before it) makes clear that the only discretion conveyed by "whether" is to apply EPA's scientific expertise to the scientific question on which the statutory authority hinges: in this instance whether power plants meet Section 111's contribution requirement *See also supra* Comment Part III.1. That question asks for a technical and scientific determination of whether the air pollution to which a source category contributes "endangers human health or welfare." As relevant here, then, the question is whether the climate change to which power plants' greenhouse gas emissions contribute endangers human health and welfare. That climate change *does* endanger human health and welfare is beyond scientific doubt that even EPA cannot and does not dispute. *See* 91 Fed. Reg. at 59019 (acknowledging recent National Academy of Sciences Report on the attribution of extreme weather events such as heat waves, wildfires, and convective storms to global climate change); *id*. at 59020 ("GHG emissions may endanger public health and welfare only by virtue of elevated global concentrations of GHGs in the atmosphere and the impacts of second- and third-order phenomena attributed to global climate change[.]"); *see also* 91 Fed. Reg. 7686, 7734-35 (Feb. 18, 2026) ("Vehicle Endangerment Repeal") (declining to finalize proposed scientific alternative rationale for rescinding the 2009 vehicles endangerment finding).

"Whether" does not convey discretion to interpret the statutory terms "air pollutant" or "air pollution" differently than in *Massachusetts*. Indeed, the Court studiously emphasized that the "judgment" that is left to the EPA administrator "is not a roving license to ignore the statutory text." *AEP*, 564 U.S. at 427 (quoting *Massachusetts*). Underscoring that the question is one of scientific judgment, not statutory interpretation, *AEP* emphasized that "EPA may not decline to regulate carbon-dioxide emissions from power plants if refusal to act would be 'arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law.'" *Id*. (quoting 42 U.S.C. § 7607(d)(9)(A). That standard applies to the reasonable exercise conferred authority within statutory boundaries, not to the question of statutory interpretation. *See, e.g.*, *Seven County Infrastructure Coal. v. Eagle County*, 605 U.S. 168, 179-80 (2025) ("As a general matter, when an agency interprets a statute, judicial review of the agency's interpretation is *de novo*.

. . . But when an agency exercises discretion granted by a statute, judicial review is typically conducted under the [APA's] deferential arbitrary-and-capricious standard." (citing *Loper Bright Enters. v. Raimondo*, 603 U.S. 369, 392-93 (2024)); *Judulang v. Holder*, 565 U.S. 42, 52 n.7 (2011) (observing that when the challenged agency action "is not an interpretation of any statutory language," "the more apt analytic framework . . . is standard 'arbitrary [or] capricious' review under the APA").

In other words, *AEP* does *not* leave any room for EPA to reinterpret Section 111 to deprive itself of authority to regulate greenhouse gas emissions from listed source categories. *See* 91 Fed. Reg. at 59019.

3. Subsequent cases like *UARG*, *West Virginia*, and *Loper Bright* confirm, rather than undermine, the holdings in *Massachusetts* and *AEP*.

EPA cannot escape the binding Supreme Court precedent of *Massachusetts* and *AEP* by turning to the Court's later decisions. Notably, EPA does not claim (nor could it claim) that *Utility Air Regulatory Group v. EPA*, *West Virginia v. EPA*, or *Loper Bright Enterprises v. Raimondo*, or any other case overturned *Massachusetts* or *AEP*. EPA makes only the much weaker plea that *Massachusetts* and *AEP* should be read "in harmony with subsequent decisions bearing on the EPA's authority and statutory interpretation." 91 Fed. Reg. at 59021.

EPA is wrong to suggest that "harmonizing" these precedents would have the effect of narrowing *Massachusetts* and *AEP*; if anything, they affirm rather than cast doubt on those cases' conclusions. To begin with the obvious, the *UARG* Court affirmed that *Massachusetts* decided the authority question that EPA's Supplemental Proposal attempts to throw into question: "In 2007, the Court held that Title II of the Act 'authorize[d] EPA to regulate greenhouse gas emissions from new motor vehicles' if the Agency 'form[ed] a judgment that such emissions *contribute to climate change*.'" *Util. Air Regul. Grp. v. EPA*, 573 U.S. 302, 310 (2014) (emphasis added). The Court further reiterated that, in *AEP*, it had "held that the Act's authorization for EPA to establish *performance standards for powerplant greenhouse-gas emissions* displaced any federal-common-law right that might otherwise have existed to seek abatement of those emissions." *Id*. at 319 n.5 (emphasis added).

Though *UARG* went on to conclude that greenhouse gas emissions would not, on their own, trigger permitting obligations for new stationary sources under the Prevention of Significant Deterioration and Title V programs, the Court nowhere cast doubt on the *Massachusetts* or *AEP* holdings. On the contrary, the Court relied on EPA's regulation of greenhouse gases from vehicles to conclude that the agency *did* have authority to impose "best available control technology" requirements for greenhouse gases on new stationary sources that were already subject to permitting requirements based on their criteria pollutant emissions. *See id.* at 332-34 & n.9 (explaining that greenhouse gases are "indisputably" a "pollutant subject to regulation under this chapter" due to EPA's vehicle rules). Additionally, the Court affirmed that "[t]he authorization to which we referred" in *AEP* "was that given in the NSPS program of [Section 111], a part of the Act not at issue here." *Id*. at 319 n.5.

EPA grossly over-interprets *UARG's* statement that *Massachusetts* "'did not embrace EPA's [then] current, equally categorical position that greenhouse gases must be air pollutants for all purposes regardless of the statutory context,'" 91 Fed. Reg. at 59029 (quoting *UARG*, 573

U.S. at 319). What *UARG* did was uphold *Massachusetts* and *AEP* while carving out a context-driven exception for the Prevention of Significant Deterioration ("PSD") and Title V permit programs – one driven by the clash between those provisions' statutory emission thresholds and the obvious congressional intent as to the number and size of sources that should be subject to those permitting requirements. That is not a license to revisit the *Massachusetts* and *AEP* holdings that *UARG* reaffirmed.[3]

The Court's opinion in *West Virginia v. EPA*, 597 U.S. 697 (2022), also does not support EPA's position. The Court's rejection of a specific "system of emission reduction" chosen by EPA to reduce greenhouse gas emissions from power plants under Section 111 has no bearing on the type of pollutant and pollution that may be regulated under that section. Indeed, even while rejecting EPA's specific regulatory choices, the Court nonetheless affirmed that EPA has authority to regulate greenhouse gases from power plant sources under the Clean Air Act. *See id.* at 730 (distinguishing between the *fact* of EPA's underlying authority under Section 111 over power plants' greenhouse gas emissions and "the ways in which Congress intended EPA to exercise its power under that provision"). That conclusion cannot possibly be restyled as suggesting that EPA entirely *lacks* Section 111 authority.

Nor does the articulation of "major-questions doctrine" in *West Virginia* weaken the precedential strength of *Massachusetts*. The *Massachusetts* Court considered and rejected "major questions" concerns under the same line of case law applied in *West Virginia*, so the two cases are already in doctrinal "harmony." *See infra* Comment III.A. As noted above, the *Massachusetts* Court held that the plain text of the Clean Air Act unambiguously confers authority on EPA to regulate greenhouse gas pollution – leaving no room for the "major-questions doctrine" to point to a different interpretation. And in any event, the Court's application of the "major-questions doctrine" in *West Virginia* was narrowly addressed to the interpretation of the term "best system of emissions reduction" in Section 111, not the threshold question of which pollutants and pollution can be regulated under Section 111.

EPA errs as well in invoking *Loper Bright Enterprises v. Raimondo*, a case that demands that courts determine the "single, best meaning" of a statute, including by resolving statutory

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[3] Notably, in agreeing to hear the case that led to the *UARG* opinion, the Supreme Court *declined* to grant certiorari on questions concerning the validity of the 2009 Endangerment Finding. *See Chamber of Com. v. EPA*, 571 U.S. 951 (2013) (granting petition for a writ of certiorari only as to a question concerning the triggering of statutory source permitting requirements and denying as to questions concerning the validity of EPA's endangerment finding); *Texas v. EPA*, 571 U.S. 951 (2013) (same); *Se. Legal Found. v. EPA*, 571 U.S. 951 (2013) (same); *Virginia v. EPA*, 571 U.S. 951 (2013) (denying petition for a writ of certiorari as to questions concerning EPA's endangerment finding); *Pacific Legal Found. v. EPA*, 571 U.S. 951 (2013) (same); *Coal. for Responsible Regul., Inc. v. EPA*, 571 U.S. 951 (2013) (same). Amongst those denials, the Court specifically denied a request that it consider whether to overrule *Massachusetts*. *Texas v. EPA*, 571 U.S. 951 (2013). The Supreme Court's categorical denial of (diverse) questions concerning the validity of the vehicle Endangerment Finding left the *Coalition for Responsible Regulation* court's affirmation of that finding in place – and is definitive evidence that the Court considered the question of EPA's underlying authority settled.

ambiguities as to which courts previously extended deference to agency constructions. 603 U.S. 369, 398-400 (2024). *Massachusetts* held that the statute is "unambiguous." Thus, even under *Chevron*, EPA lacked discretion to interpret the statute differently. Under *Loper*, EPA is even less empowered to change the unambiguous meaning of the statute, *id.* at 397, which the *Massachusetts* Court decided. *Loper* thus cuts against, rather than for, EPA's claimed authority to (re)define the meaning of "pollutant."

Puzzlingly, EPA also points to *Sackett v. EPA*, 598 U.S. 651 (2023). 91 Fed. Reg. at 59029. EPA quotes *Sackett*'s statement that statutory interpretation is more than an exercise in "relying on 'the outer limits of [that] word's definitional possibilities,'" but should be construed in the context of "the rest of the law." *Id*. (quoting *Sackett*, 598 U.S. at 676). But EPA identifies nothing in the rest of the Clean Air Act that gainsays the holdings of *Massachusetts* and *AEP* – holdings followed in *UARG* and *West Virginia.*

Reading the Supreme Court's precedents concerning EPA's greenhouse gas authority "in harmony" thus tells a clear story: at every possible turn, the Supreme Court (like the lower courts) has affirmed that the Clean Air Act authorizes EPA to regulate emissions of greenhouse gases – including under Section 111 – because of their contribution to climate change. No further analysis of this question is necessary on EPA's part: the Supreme Court has decided the scope of the Agency's authority, and EPA cannot advance a new interpretation that would narrow it. The Supplemental Proposal must be withdrawn.

B. The best reading of Section 111 encompasses greenhouse gas pollution.

Even if applicable precedent were not dispositive, EPA's attempts to read greenhouse gases out of Section 111 are incorrect and unsupported. First, the statutory text is definitive: Section 111 gives EPA authority to regulate "air pollutants," a broad grant of authority that is defined in pertinent part by the Act itself and which plainly encompasses greenhouse gases and greenhouse gas pollution. Second, that broad definition is not susceptible to further contraction akin to *UARG*, so EPA's proposal is unreasonable and unlawful. Third, even if there were an open question as to Section 111's scope, EPA cannot plausibly assert that the text includes other (unstated) limitations on the regulated pollutants. Its attempt to claim that Section 111 applies only to pollution that endangers through local and regional exposure is contrary to the text and factually dubious, and would impose unwarranted limitations on EPA's execution of the Act. As such, EPA's suggestion that it lacks authority under Section 111 to regulate greenhouse gases is baseless and must be rejected.

1. EPA's Section 111 authority to set standards for "air pollutants," including greenhouse gases, is evident from the plain text and confirmed by context and practice.

Even if applicable precedent had not already disposed of this question, EPA cannot sustain an argument that the best reading of Section 111 excludes authority to regulate greenhouse gas emissions from power plants. To begin, the statutory text speaks otherwise. Section 111 authorizes EPA to list for regulation any category of stationary sources - defined as "*any* building, structure, facility, or installation which *emits or may emit any air pollutant*," *see* 42 U.S.C. § 7411(a)(3) (emphasis added) – that "causes, or contributes significantly to, air

pollution which may reasonably be anticipated to endanger public health or welfare." *Id.* § 7411(b)(1)(A). Upon listing, EPA must establish "standards of performance" for that source category, *id.* § 7411(b)(1)(B), which are "standard[s] for emissions of air pollutants" set by assessing the emission reduction capabilities, and other qualities, of adequately demonstrated emission control technologies. *Id.* § 7411(a)(1). Congress also defined "air pollutant":

> The term "air pollutant" means any air pollution agent or combination of such agents, including any physical, chemical, biological, radioactive (including source material, special nuclear material, and byproduct material) substance or matter which is emitted into or otherwise enters the ambient air. Such term includes any precursors to the formation of any air pollutant, to the extent the Administrator has identified such precursor or precursors for the particular purpose for which the term "air pollutant" is used.

42 U.S.C. § 7602(g). It likewise defined what constituted harm to public welfare:

> All language referring to effects on welfare includes, but is not limited to, effects on soils, water, crops, vegetation, manmade materials, animals, wildlife, weather, visibility, and climate, damage to and deterioration of property, and hazards to transportation, as well as effects on economic values and on personal comfort and well-being, whether caused by transformation, conversion, or combination with other air pollutants.

Id. § 7602(h).

Congress consistently used expansive terms in the text to reinforce the breadth of EPA's authority to regulate air pollutants: EPA may regulate the emissions of *"any air pollution agent or combination of such agents*" from "*any structure*" that "*may emit*" "*any air pollutant*," provided the source category significantly contributes to air pollution which "*may reasonably be anticipated*" to harm public health or welfare "*includ[ing] but not limited to*" more than a dozen types of specific harm, among them effects on "*weather, ... climate, ... economic values, and ... personal comfort and well-being.*" Even after sources have been built, they become subject to standards if modifications to the facility "increase[] the amount *any air pollutant emitted* by such source or … result[] in the emission of *any air pollutant not previously emitted*." *Id.* § 7411(4) (emphasis added). "In choosing such expansive terms … , modified by the comprehensive 'any,' Congress plainly contemplated that the [statutory provision] would be given wide scope." *J.E.M. Ag Supply, Inc. v. Pioneer Hi-Bred Int'l, Inc.*, 534 U.S. 124, 130 (2001) (citation modified). The word "any" alone, which Section 111 uses numerous times, "has an expansive meaning, that is, 'one or some indiscriminately of whatever kind.'" *Dep't of HUD v. Rucker*, 535 U.S. 125, 131 (2002) (citation modified). The Supreme Court has, of course, already called Section 302(g)'s definition of "air pollutant" an "unambiguous" and "sweeping" statutory provision that includes greenhouse gases, specifically objecting to a construction that would "confer on EPA the authority to narrow [the] definition" where Congress had chosen to define "'air pollutant' so carefully and so broadly." *Massachusetts*, 549 U.S. at 528-29 & n.26.

EPA's suggestion that its authority under Section 111 should be read narrowly is, thus, anomalous from the start. To be sure, Section 111 does not grant EPA unfettered discretion.

Rather, it limits EPA's authority to source categories the Agency determines are "caus[ing], or contribut[ing] significantly" to air pollution. But that defined limitation does not alter the statute's overall thrust: it grants EPA comprehensive authority to address any type of air pollution problem arising from those high-emitting sources.[4]

That Section 111's unmistakably broad terms encompass greenhouse gases should be obvious (they are unquestionably physical and chemical substances emitted into the ambient air that cause or contribute to air pollution), but is further reinforced by context and past practice. The Act's definition of "welfare," which EPA agrees applies here, 91 Fed. Reg. at 59022, is particularly instructive. That definition, which appears in Section 302(h), defines (along with "public health") the types of harm that Section 111 was intended to address and explicitly includes "effects on … weather … and climate." *Id.* § 7602(g). The only sensible conclusion drawn from this plain language is that "climate" means "climate": as the legislative history confirms, *see infra*, Congress intended air pollution, like greenhouse gases, that have effects on the climate to fall squarely within the Act's, and Section 111's, purview.

The Act also repeatedly refers to carbon dioxide and other greenhouse gases as "air pollutants," with no indication that the usage of that term was intended to be distinct from its other appearances in the Act. For example, Section 132 states that "[t]he term 'greenhouse gas' means *the air pollutants* carbon dioxide, hydrofluorocarbons, methane, nitrous oxide, perfluorocarbons, and sulfur hexafluoride." 42 U.S.C. § 7432(d)(4) (emphasis added); *accord id.* §§ 7435(c), 7436(i), 7438(d), 7545(o)(1)(G). Section 133 concerns grants "to reduce air pollution" and directs consideration of strategies to reduce, among other things, greenhouse gases – defined as "the air pollutants carbon dioxide, hydrofluorocarbons, methane, nitrous oxide, perfluorocarbons, and sulfur hexafluoride." *Id.* § 7433(d)(2). Section 137 refers to "Greenhouse Gas Air Pollution Plans and Implementation Grants," and establishes funding for states to "develop[] a plan for the reduction of greenhouse gas air pollution." *Id.* § 7437(b); *see also id.* § 7437(d)(2) (defining the "air pollutants" comprising greenhouse gas).[5]

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[4] As further discussed below, *see infra* Comment Part II.B.2.b.i, the reference to "air pollution agents" in 302(g) does not alter either the breadth of 302(g) or the operation of 111. *See Massachusetts*, 549 U.S. at 529 n.26. Air pollutants create air pollution, with the latter reflecting instances where the former have been released or have accumulated in the environment in concentrations that can lead to harm to human health or welfare. *Cf.* 90 Fed. Reg. at 36300 (describing a pollutant as the "substance" and pollution as the "harmful addition" of that substance "into [the] environment"). While not every emission of an air pollutant creates dangerous air pollution in fact, the Act provides that all substances *capable* of creating air pollution are air pollution agents and that EPA may regulate when that air pollution has the prospect of endangering the public.

[5] The fact that some of those provisions provided definitions "[f]or purposes of" the given section does not change their value as evidence of Congressional ratification. *See, e.g.*, 42 U.S.C. § 7432(d). Chapeau text confirms a provision-specific meaning of the term "greenhouse gas," *i.e.*, which *particular air pollutants* are considered greenhouse gases under the given provision. It does not alter the meaning of the term "air pollutants" as Congress used it in that definition (which would include all of the various air pollutants EPA has called greenhouse gases). Recent

Of particular relevance here, Congress added Section 135, titled "Low emissions electricity program," to address "domestic electricity generation and use." 42 U.S.C. § 7435. This provision reinforces EPA's existing authority to regulate carbon dioxide emissions from existing power plants under Section 111. Subsection (a) provides funding to EPA, among other things, "to ensure that reductions in greenhouse gas emissions are achieved through the use of the existing authorities of this Act." *Id.* § 7435(a)(6). That subsection also directed EPA to incorporate anticipated changes in generation, which are influenced by incentives established by Congress, when regulating.[6] Congress enacted this provision shortly after the Supreme Court interpreted Section 111 as allowing standards that "improve the pollution performance of individual sources" and "caus[e] plants to operate more cleanly." *West Virginia*, 597 U.S. at 734, 706.[7] Importantly, Section 135 of the Clean Air Act directs EPA to achieve greenhouse gas emissions reductions under its "existing authorities," 42 U.S.C. § 7435(a)(6), which include Section 111.

The Supplemental Proposal's description of changes to the text of Inflation Reduction Act between the House and Senate is both misleading and irrelevant. The Supplemental Proposal cannot avoid the fact that Section 135 of the Clean Air Act enacted in the Inflation Reduction Act, known as the "Low Emissions Electricity Program," provides funding to ensure that greenhouse gas emissions reductions "are achieved through use of the existing authorities" in the Clean Air Act. *See* 91 Fed. Reg. at 59018 (quoting 42 U.S.C. § 7435(a)(6)). And in the Low Emissions Electricity Program, the provision states for that "section, the term 'greenhouse gas'" includes "the air pollutant[] carbon dioxide." 42 U.S.C. § 7435(c). Those provisions remain in the United States Code, and the text indicates that Congress understood that existing Clean Air Act authorities covered regulation of carbon dioxide – an air pollutant – from electricity generation and use under existing Clean Air Act authorities, like Section 111. Furthermore, this text in Section 135 remained constant, other than changing its section number in the Inflation Reduction Act, from the House Budget committee through ultimate passage. *See* H.R. 5376, § 30108 (Engrossed in House, Nov. 19, 2021); H. Rept. 117-130, Book 2 (Sept. 21, 2021) (House Budget Committee Report); Pub. L. No. 117-169, § 60107.

Congressional action to revoke some of the funding provided under those provisions is also irrelevant. Regardless of the total size of those grant programs at this moment, Congress did not amend the statutory text or its understanding of the definitions applicable to pollutants that would fall within the program's purview.

[6] *See* 42 U.S.C. § 7435(a)(5)-(6) (instructing EPA to "assess" the projected emission reductions from anticipated changes in electricity generation following enactment of the Inflation Reduction Act and to issue new standards that "ensure" reductions and that incorporate that assessment); *see also* EPA, Electricity Sector Emissions Impacts of the Inflation Reduction Act: Assessment of Projected CO2 Emission Reductions From Changes in Electricity Generation and Use, EPA 430-R-23-004 (September 2023), https://perma.cc/RA8S-Z3J9 (EPA's report prepared in response to the Inflation Reduction Act).

[7] *See* Inflation Reduction Act, Pub. L. No. 117-169, § 60107, 136 Stat. 2069 (2022) (Low Emissions Electricity Program).

Rather than engage with the substance of that congressional direction, the Supplemental Proposal misleads by referencing a change to the Inflation Reduction Act that happened in the Senate where an explicit reference to Section 111, in addition to eight other sections of the Clean Air Act, was ultimately dropped under a point of order. *See* 91 Fed. Reg. at 59018. The Supplemental Proposal does not provide a citation indicating what specific provision changed, but it implies that change was relevant to the Section 135, which it references in the immediate prior sentence. However, what the Supplemental Proposal references is an entirely different section, what passed the House in Section 30106 and ultimately became Section 60105 in the Inflation Reduction Act. That a *different* section of the bill changed under a point of order has no bearing on what Congress directed in the Low Emissions Electricity Program.[8] And even more so, even if EPA's implication that this change somehow affected the Low Emissions Electricity Program were given credence, the Supplemental Proposal gives no reason to suppose why a change from listing sections by number to simply stating "existing authorities" would be meaningful. That is especially so given that key members of Congress indicated Section 111 was specifically intended as one of the authorities under the Low Emissions Electricity Program, with the relevant House Committee chair stating that "CAA Section 111 is one of the 'existing authorities' funded by section 60107 of this Act."[9]

And in Section 135 and several other provisions, the Act lists greenhouse gases alongside other regulated "air pollutants," reinforcing that Congress intended and treated these pollutants as similar for purposes of the Clean Air Act. *See McDonnell v. United States*, 579 U.S. 550, 568-69 (2016) ("Under the familiar interpretive canon *noscitur a sociis*, a word is known by the company it keeps." (citation modified)). Section 103(g), for example, which was enacted decades before either the 2009 or 2015 Endangerment Findings,[10] authorizes research and development programs for "pollution prevention and emissions control" focused on "[i]mprovements in nonregulatory strategies and technologies for preventing or reducing multiple air pollutants, including sulfur oxides, nitrogen oxides, heavy metals, PM-10 (particulate matter), carbon monoxide, and carbon dioxide." 42 U.S.C. § 7403(g); *see also id.* § 7433(d)(3)(A) (directing the formulation of strategies to reduce emissions of greenhouse gases, air pollutants listed under Section 108(a), and hazardous air pollutants); *id.* § 7438(b)(2) & (d) (referring to grants for activities that help reduce "greenhouse gas emissions and other air pollutants," including to mitigate "climate and health risks," promote "climate resiliency," and "reduc[e] indoor toxics and indoor air pollution").

Section 136 of the Clean Air Act goes even further, confirming that Congress specifically intended and ratified EPA's exercise of its Section 111 authority to regulate greenhouse gases from stationary source categories. Section 136 sets a "waste emission charge" on methane

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[8] In any event, that change was struck by a point of order under the Byrd Rule. *See* Dotson & Maghamfar (2023) at 10019 n.26.

[9] 168 Cong. Rec. E869 (daily ed. Aug. 23, 2022) (statement of Rep. Frank Pallone Jr.).

[10] Congress added this provision as part of the Clean Air Act Amendments of 1990. Pub. L. No. 101-549, title IX, § 901(c), 104 Stat. 2399, 2703 (codified as amended at 42 U.S.C. § 7403(g) (1990)).

emissions in excess of certain thresholds from oil and gas facilities "that report[] more than 25,000 metric tons of carbon dioxide equivalent of greenhouse gases." 42 U.S.C. § 7436(c). But the statute specifies that "[c]harges shall not be imposed" if the facility is in compliance with "methane emissions requirements pursuant to" Section 111 – so long as those requirements "will result in equivalent or greater emissions reductions as would be achieved by" a 2021 proposed rule to regulate greenhouse gas under Section 111 (which was later finalized as 89 Fed. Reg. 16820 (March 8, 2024)). 42 U.S.C. § 7436(f)(6)(A).[11] This provision would make no sense if EPA lacked authority under Section 111 to determine that greenhouse gases constitute dangerous pollution and thus to regulate their emissions. Coming well after *Massachusetts* and after EPA's regulation of greenhouse gases under Section 111 specifically, these provisions provide not only useful statutory context but explicit Congressional ratification of the then-EPA's understanding of Section 111.[12]

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[11] While the Supplemental Proposal asserts that its interpretations "would not impact regulations for source categories other than fossil fuel-fired EGUs under CAA section 111," EPA does not provide a reasoned explanation as to how the same statutory text – "air pollution which may reasonably be anticipated to endanger public health or welfare" – could be read two different ways depending on the source category. EPA's alleged "best reading" of that text depends exclusively on the (supposed) attributes of greenhouse gases themselves, which it argues do not "impact public health or welfare through local or regional exposure," 91 Fed. Reg. at 59020, not on particular attributes of fossil fuel-fired *power plants*.

Furthermore, despite EPA's claim that its Section 111 methane standards for the oil and gas industry "have their own regulatory history and relevant considerations," 91 Fed. Reg. at 59043, the Agency has now confirmed in a proposed rule published just four days ago, which seeks to significantly roll back the oil and gas standards, that it intends to weigh "concerns about the Agency's underlying statutory authority to regulate GHG emissions from the Oil and Natural Gas source category under CAA section 111." 91 Fed. Reg. 68234, 68244 (Oct. 29, 2026). That proposal goes on to state that, "[p]ending completion of the separate rulemaking addressing the EPA's statutory authority with respect to GHG emissions from the fossil fuel-fired power plant source category [*i.e.*, the Supplemental Proposal that is the subject of these comments], the Agency would then address in a future rulemaking, as appropriate, the extent to which the conclusions in such action with respect to the Agency's statutory authority under CAA section 111 require revisions to the oil and gas regulations." *Id.* Thus, EPA appears to be taking inconsistent stances on whether or not the Supplemental Proposal will have some bearing on other source categories. Its discussion of this issue in the Supplemental Proposal is insufficient to establish that the Agency has considered this important aspect of the problem and underscores the fundamental error in EPA's proposed interpretation of its authority. In any event, none of this undercuts the evident relevance of Section 136 here.

[12] Similar evidence (and, of course, the direct holding of *Massachusetts*) confirms that greenhouse gases were intended to be regulated under the nearly identical endangerment language in Section 202, which, in Section 202(a)(1) allows for regulation of vehicle emissions of "any air pollutant" that "cause, or contribute to, air pollution which may reasonably be anticipated to endanger public health or welfare." 42 U.S.C. § 7521(a)(1). Section 303 of the

Congress has also repeatedly declined to amend the Clean Air Act to remove EPA's authority over greenhouse gases or to nullify the 2009 Endangerment Finding. *See, e.g.*, Joint Resolution, S.J. Res. 26, 111th Congress (2010) (joint resolution of disapproval not enacted); Defending America's Affordable Energy and Jobs Act, S. 228, 112th Cong. (2011) (bill not enacted); Energy Tax Prevention Act, H.R. 910, 112th Cong. (2011) (bill not enacted); Stopping EPA Overreach Act of 2017, H.R. 637, 115th Cong. (2017) (bill not enacted). Congress also acted under the Congressional Review Act to disapprove a rule enacted by the first Trump Administration that would have *rescinded* certain Section 111 standards for greenhouse gases from the oil and natural gas sector and required EPA to make certain additional findings before it could regulate greenhouse gases under that section. *See* Pub. L. No. 117-23, 135 Stat. 295 (2021); 85 Fed. Reg. 57018, 57019-20 (Sept. 14, 2020).[13] And Congress has appropriated money to EPA in response to Agency budget requests specifically referencing the need for appropriations to fund the development and promulgation of greenhouse gas regulations under the Clean Air Act – in some cases, after rejecting the efforts of individual legislators to prohibit the use of funds for developing greenhouse gas emissions regulations.[14]

Looking backwards, the legislative history also reinforces that the best reading of Section 111 authorizes regulation of greenhouse gases. The definition of effects on "welfare" was added

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Energy Policy Act, as amended, governs the procurement of the federal vehicle fleet and states that EPA's guidance for federal fleet standards must account for "the most stringent standards for vehicle greenhouse gas emissions applicable to and enforceable against motor vehicle manufacturers for vehicles sold anywhere in the United States." 42 U.S.C. § 13212(f)(3)(B). Like Section 136, that provision would have no meaning if the endangerment language in Section 202 did not actually allow federal standards for vehicle greenhouse gas emissions. It is true that California also possesses the authority to set vehicle greenhouse gas standards under Clean Air Act Section 209. *See id.* § 7543(b). But the phrase "sold anywhere in the United States" would be surplusage if it did not reflect *both* California's *and* EPA's authorities to set such standards. *Fischer v. United States*, 603 U.S. 480, 496 (2024) (noting that "surplusage is … disfavored" and a "construction that creates substantially less of it is better than a construction that creates substantially more" (citation modified)).

[13] *See* H. Rept. 117-64 ("Passage of this resolution of disapproval will indicate Congress' disapproval of many aspects of the 2020 Rescission rule and specifically rejects… repealing standards for emissions of GHGs (in the form of limitations on methane emissions); negating the EPA's statutory obligation to regulate existing oil and gas sources under section 111(d); and creating new legal hurdles by requiring a pollutant-specific SCF before regulating a particular pollutant under section 111, despite no basis in the plain language of section 111 to do so.").

[14] *See, e.g.*, U.S. Environmental Protection Agency, Fiscal Year 2015, Justification of Appropriation Estimates for the Committee on Appropriations, at 12, 213-14, EPA-190-R-14-002 (2014); Continuing Appropriations Resolution, 2015, Pub. L. No. 113-164, 128 Stat. 1867 (2014); Consolidated and Further Continuing Appropriations Act, 2015, Pub. L. No. 113-235, 128 Stat. 2130 (2014); *see generally* Greg Dotson, *Looking for Your Friends at a Cocktail Party: the Dubious Role of Rejected Legislation and the Overlooked Potential of the Presidential Appropriations Process*, Harv. L. S. J. on Legis. Online (2024), https://perma.cc/3HW7-7G2J.

in 1970, before the present text of Section 111 was added, and included effects to both "weather … and climate." *See* Pub. L. No. 91-604, §§ 4, 15, 84 Stat. 1676, 1678, 1710 (1970). Congress's inclusion of "climate" in the Clean Air Act's definition of welfare reflected an understanding of climate as a global phenomenon, not merely local or regional weather conditions. As academic literature has explained, by 1970 scientists had already established that greenhouse gases emitted from fossil-fuel combustion could "alter the global climate with potentially serious and deleterious ensuing effects," and those concerns had been extensively communicated to Congress and Executive Branch officials.[15]

That was reflected in the statements of the legislators themselves. Senator Muskie, the leading Senate sponsor of the 1970 amendments, warned during floor debate that uncontrolled air pollution could "threaten irreversible atmospheric and climatic changes." 116 Cong. Rec. 32,901 (1970). Similarly, in congressional testimony on the 1970 amendments, Russell Train, Chairman, Council of Environmental Quality (CEQ), testified that "international dimensions of the air pollution problem should not be overlooked . . . [as] discharge of particulates and carbon dioxide to the atmosphere could have dramatic and long-term effects on the world's temperature with many major consequences."[16] *See also* 116 Cong. Rec. 32,907, 32,914 (1970) (statement of Sen. Boggs referring to the Council on Environmental Quality's conclusion that "[a]ir pollution alters [the] climate and may produce global changes in temperature"). These statements show that Congress in 1970 was aware that anthropogenic emissions had the potential to threaten the Earth's atmosphere and understood these problems as affecting the "climate" at the same moment Congress was adding that term to the definition of welfare effects in Section 302(h).[17]

Indeed, in the years leading up to the 1970 amendments, officials at the highest levels of government had been calling attention to the threat of climate-disrupting greenhouse gases, drawing attention to the global aspects of this problem. For instance, in a message to Congress in February 1965 on environmental degradation, President Lyndon Johnson observed that "[a]ir pollution is no longer confined to isolated places. This generation has altered the composition of the atmosphere *on a global scale* through … a steady increase in carbon dioxide from the burning of fossil fuels" and called for updates to the Clean Air Act as it then existed.[18] Later that

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[15] *See generally* Oreskes, N., Lanier-Christensen, C., Conway, H., & MacFarlane, R. A., *Climate Change and the Clean Air Act of 1970 Part I: the Scientific Basis*, 50 Ecology L. Quarterly 811 (2023), available at https://www.ecologylawquarterly.org/wp-content/uploads/archive/2024/08/50.3-Oreskes-et-al.pdf (hereinafter "Oreskes, et al.").

[16] *Report of the Council on Environmental Quality: Hearing Before the Senate Subcomm. on Air and Water Pollution of the S. Comm. On Pub. Works*, 91st Cong. 5 (1970).

[17] *See generally* Lanier-Christensen, C., MacFarlane, R. A., Conway, H., & Oreskes, N., *Congressional Knowledge of Climate Change before the Clean Air Act of 1970*, 37 Duke Env't L. & Pol'y F., no. 1 (forthcoming 2026) (hereinafter "Lanier-Christensen, et al.").

[18] Pres. Lyndon Johnson, *Special Message to the Congress on Conservation and Restoration of Natural Beauty*, 1 Pub. Papers 155, 161, 163 1965 WL 190123, at *7, *9 (Feb. 8. 1965), available at: https://www.presidency.ucsb.edu/documents/special-message-the-congress-

year, in November, the Environmental Pollution Panel of the President's Science Advisory Committee provided a far more extensive discussion of the topic in its report titled *Restoring the Quality of Our Environment*, which included a 23-page appendix dedicated to the effects of CO_2 on climate change.[19] The report's frequent references to "climate," "climatic effects," and "climatic change" center entirely on global rather than purely domestic factors: the panel evaluated *worldwide* changes in surface temperature, sea-level rise, carbon sinks, CO_2 concentrations, fossil fuel production, and energy requirements,[20] concluding that "[m]an is unwittingly conducting a vast geophysical experiment."[21]

Four years later, in September 1969, future Senator and Ambassador Daniel Patrick Moynihan – then an aide to President Nixon – circulated a memo to White House staff describing the mechanics of climate change and the "instability [caused by] the burning of fossil fuels," referencing the "worldwide" scale of the problem and urging the Administration to take action.[22] And in its 1970 Annual Report submitted to Congress as part of Chairman Train's testimony cited above, CEQ warned of future climate impacts from fossil-fuel combustion, noting that "in a period of a few decades, [it could] lead to the start of substantial melting of ice caps and flooding of coastal regions."[23] As with all other contemporaneous sources, the CEQ report addressed the global rather than local or regional aspect of climate change: while acknowledging that "[c]limate is much too complicated to be described by any single parameter," the report cites data pertaining to such disparate regions as North America, Eurasia, India, East Africa, Iceland and the North Atlantic, and focuses on the global "*average* surface temperature" rather than climate effects in just one region.[24]

In 1977, when Congress added the text of Section 111 as we now recognize it, it affirmed that provision's intended breadth (including by maintaining the term "climate" in the definition of welfare). The House Committee Report accompanying the draft text explains that the addition of the phrase "causes, or contributes significantly to, air pollution which may reasonably be

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conservation-and-restoration-natural-beauty (emphasis added) (hereinafter "Johnson Special Message to the Congress").

[19] Report of The Environmental Pollution Panel, President's Science Advisory Committee, *Restoring the Quality of Our Environment* (Nov. 1965) at 111-34, available at: https://legacy-assets.eenews.net/open_files/assets/2019/01/11/document_cw_01.pdf (hereinafter "*Restoring the Quality of Our Environment*")

[20] *Restoring the Quality of Our Environment* at 9, 26, 33, 38, 113-14, 121-24, 127.

[21] *Restoring the Quality of Our Environment* at 126.

[22] Memorandum from Daniel P. Moynihan, Urb. Aff. Advisor, White House, to John Ehrlichman, Couns., White House (Sept. 17, 1969), available at: https://nsarchive.gwu.edu/document/31936-document-1-memorandum-daniel-p-moynihan-john-ehrlichman-september-17-1969-folder-e.

[23] Council on Envtl. Quality, *First Annual Report* 95-97 (1970), https://www.slideshare.net/whitehouse/august-1970-environmental-quality-the-first-annual-report-of.

[24] Council on Envtl. Quality, *First Annual Report* at 95-97.

anticipated to endanger public health or welfare" in the 1977 Clean Air Act Amendments – which originated in the House – was intended to ensure EPA's regulatory authority was far-reaching, with a particular eye towards preventing problems that had not yet arise or may not yet be understood. Congress confirmed that the amendments were intended to effectuate the precautionary approach to pollution regulation described by the *en banc* court in *Ethyl Corp. v. EPA*, 541 F.2d 1 (D.C. Cir. 1976), which the Committee report discusses in detail. The *en banc* court there had rejected the assertion that then-applicable language requiring EPA to find that vehicle emissions "will endanger" public health should be understood to require "'conclusive proof of harm'" – relying on the Act's precautionary intent and the difficulty of foreseeing environmental problems. *See* H.R. Rep. 95-294 at 43-51, 1977 U.S.C.C.A.N. 1077, 1121-29 (1977) (citing *Ethyl Corp.*). The court's analysis had rested in particular on its assessment that "'[m]an's ability to alter his environment has developed far more rapidly than his ability to foresee with certainty the effects of his alterations. It is only recently that we have begun to appreciate the danger posed by unregulated modification of the world around us.'" *Id.* at 46-47 (quoting *Ethyl Corp.* 541 F.2d at 6).

In response, Congress redesigned a suite of pollution control authorities, including Section 111, to ensure EPA had sufficient authority to regulate potential pollution problems in the face of uncertainty or impacts that might be far in the future. *Id.* at 50-51. The D.C. Circuit has confirmed that the Act's "precautionary thrust" is relevant to interpretations of Section 111. *See Am. Lung Ass'n v. EPA*, 985 F.3d at 914, 976 (D.C. Cir. 2021), *rev'd on other grounds* by *West Virginia*, 597 U.S. at 734-35.[25] "In determining the legislative intent," the Agency, like the courts,

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[25] Amendments to other sections of Title I in the 1977 Clean Air Act Amendments provide continuing evidence of Congress's concern with potential pollutant impacts on global climate. For example, in the 1970 amendments, Congress tasked EPA with studying the health hazards and means of controlling particulate matter emissions for purposes of regulation, and Congress grew tired of EPA not completing these studies. Thus, in the 1977 Amendments, Congress imposed an 18-month deadline on EPA to finish its particulate matter study. Pub L. No. 95-95, § 403, 91 Stat. 685, 792, codified at 42 U.S.C. § 7548 note. Explaining its deadline, Congress stated:

> [T]he committee is aware of several articles and studies which have raised the possibility that fine particulate emissions could significantly modify the Earth's climate. It has been suggested that precipitation rates and distribution and temperature may be affected. The committee expects that special emphasis in this study will be placed on possible weather and climate modifications which may result from fine particulate emissions…. [T]here can be no higher mission for Government than assuring that man's activities will not threaten the life-sustaining conditions on which we all rely.

H.R. Rep. 95-294, at 339 (1977); *see also id.* at 339 n.350 (citing sources describing rising aerosol levels in the atmosphere that may "signal the beginning of global inadvertent weather modification").

The 1977 Amendments also created the modern Prevention of Significant Deterioration program, which was also motivated in part by concerns about "[w]orldwide weather

must "favor an interpretation which would render the statutory design effective in terms of the policies behind its enactment and to avoid an interpretation which would make such policies more difficult of fulfillment, particularly where, as here, that interpretation is consistent with the plain language of the statute." *Nat'l Petroleum Refiners Ass'n v. F.T.C.*, 482 F.2d 672, 689 (D.C. Cir. 1973) (citing *Bird v. United States*, 187 U.S. 118, 124 (1902)).

On top of these textual and contextual indications, EPA's authority to regulate power plant greenhouse gases is also confirmed by past practice. EPA's proposal suggests that the Agency first "took the unprecedented step of asserting authority to regulate GHG emissions" in 2009, when it issued an endangerment finding for vehicle greenhouse gases, and that its new interpretation "would effectively return" to the status quo before EPA made a comparable finding for power plants in 2015. 91 Fed. Reg. at 59005, 59043. But EPA announced its understanding that the Clean Air Act's definition of "air pollutant" extended to greenhouse gases well before 2009 and even before the Supreme Court's decision in *Massachusetts*. In a 1996 rulemaking under Section 111 concerning methane and other gases from municipal solid waste landfills, EPA described one of its "objectives" as "the reduction of methane emissions in order

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modification" and the possibility that "[f]ine particulates and aerosols emitted from polluting sources threaten to bring about major modifications in weather and climate." *Id.* at 138. Quoting a 1973 NOAA report, the House Report noted that "there can be little doubt that inadvertent weather modification on a scale large enough to affect man's well-being might soon become a reality." *Id*. The House Committee also quoted a 1974 National Academy of Sciences report stating: "It is not primarily the advance of a major ice sheet over our farms and cities that we must fear. Rather, it is persistent changes of the temperature and rainfall in areas committed to agriculture use which are of more immediate concern," and expressed concern about these "potential inadvertent weather changes." *Id*.

Other aspects of the legislative history demonstrate that Congress not only understood the Act's reference to "climate" to include concerns about global climate changes but that climate impacts were a motivating force behind Congress' actions. For example, the 1977 Amendments included a new section expanding the regulation of aircraft emissions; in doing so, the House Report noted that the preexisting authority to regulate aircraft emissions in the 1970 amendments already included the authority to regulate such emissions that "may thereby endanger public health or environment, including climate." *Id*. at 102 n.92. This indicates Congress understood its 1970 amendments to include regulation of air pollutants that may endanger the climate. Congress also ordered NOAA to "establish a continuing program of research and monitoring of the stratosphere for the purpose of early detection of changes in the stratosphere and climatic effects of such changes." Pub. L. No. 95-95, § 126, 91 Stat. 728 (originally codified at 42 U.S.C. § 7454 but repealed in 1990). "The ozone layer also helps to determine climate" and Congress was concerned that "depletion of the ozone layer would bring a worldwide decline in surface temperatures, damaging crop production." S. Rep. 95-127, at 61 (1977), *as reprinted in* 91st Cong., A Legislative History of the Clean Air Act Amendments of 1977, Vol. III, at 1435 (Comm. Print 1978). This report shows that Congress was aware of problems of climate change and the driving role pollution plays at the time it amended Section 111 in 1977.

to mitigate global warming." 61 Fed. Reg. 9905, 9909-10 (Mar. 12, 1996); *see infra* Comment Part II.B.2.b.ii.

Two years later, in a 1998 memorandum to the EPA Administrator, the Agency's general counsel confirmed that "CO_2 … [is] a 'physical [and] chemical … substance which is emitted into … the ambient air,' and hence, [it] is an air pollutant within the meaning of the Clean Air Act."[26] EPA reiterated that view again a year later in Congressional testimony, explaining that "[g]iven the clarity of the statutory provisions defining 'air pollutant' and providing authority to regulate air pollutants, there is no statutory ambiguity" about greenhouse gases' status as air pollutants under the Act.[27] While both pronouncements were clear that EPA had not yet made the "factual and scientific" conclusions on endangerment that were the predicates to *regulating* under that authority, both were equally clear that EPA did not lack for legal authority over greenhouse gases. The 1998 Cannon memorandum did not mark any sort of official change of position. EPA did not propose a limiting construction applicable to the Clean Air Act's standard-setting provisions until the early 2000s, nearly 40 years after the statute was enacted. In fact, in the more than 50 years between Section 111's enactment and the present proposal, only five years (2003-2008) have passed where EPA has purported to constrain its understanding of the term "pollutant" in Section 111 to exclude globally-distributed pollutants like greenhouse gases. And that brief period ended, of course, following the Supreme Court's definitive rejection of EPA's approach in *Massachusetts*.

Moreover, the rebuke of EPA's current position did not come only from the Supreme Court. At every possible juncture in the nearly two decades since the Supreme Court's ruling in *Massachusetts*, EPA itself has consistently affirmed its authority to regulate greenhouse gas emissions from power plants under Section 111. EPA has set standards under that authority in the last three presidential administrations, including in the first Trump Administration. *See* 80 Fed. Reg. 64510 (Oct. 23, 2015); 80 Fed. Reg. 64662 (Oct. 23, 2015); 84 Fed. Reg. 32520 (July 8, 2019); 89 Fed. Reg. 39798 (May 9, 2024). (While not all of those rules survived substantive judicial review, at no time has either EPA or the courts suggested the Agency lacked authority to pursue such standards in the first place.) Likewise, EPA has rejected petitions to reconsider its related endangerment finding for greenhouse gas pollution under Section 202 on three separate occasions, once again including during the first Trump Administration. 75 Fed. Reg. 49556 (Aug. 13, 2010); 87 Fed. Reg. 25412 (Apr. 29, 2022).[28] EPA's post-*Massachusetts* understanding of how greenhouse gas pollution endangers public health or welfare has been repeatedly considered

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[26] Memorandum from Jonathan Z. Cannon, General Counsel, U.S. EPA, to Carol Browner, Administrator, U.S. EPA (Apr. 10, 1998) at 2, available at: https://perma.cc/R3Q2-B4EP.

[27] Testimony of Gary S. Guzy, General Counsel, U.S. EPA, Before a Joint Hearing of the Subcommittee on National Economic Growth, Natural Resources and Regulatory Affairs of the Committee on Government Reform and the Subcommittee on Energy and Environment of the Committee on Science, U.S. House of Representatives (October 6, 1999), available at: https://perma.cc/3S6R-6QP4.

[28] *See also* U.S. EPA, 2021 Denial of Petitions to Reconsider the EPA's Greenhouse Gas Endangerment Finding (Jan. 19, 2021) (withdrawn and replaced by 87 Fed. Reg. at 25412), available at: https://perma.cc/MVM3-KKVB.

by the courts and never overturned. *Coal. for Responsible Regulation, Inc. v. EPA*, 684 F.3d 102, 120-26 (D.C. Cir. 2012), *certiorari denied in pertinent part*, 571 U.S. 951 (2013); *cf. Concerned Household Elec. Consumers Council v. EPA*, 2023 WL 3643436 (D.C. Cir. May 25, 2023), *certiorari denied*, 114 S. Ct. 497 (Mem.) (2023).

Accordingly, even if the term "air pollutant" may carry a narrower meaning where a broader reading would "conflict" with the statute, *see supra* Comment Part II.B.2.a, the text, context, and history of both Section 111 and the Clean Air Act disprove any suggestion that Congress sought to grant only narrow authority in Section 111 even as it used broad terms. The best reading of the statute thus affirms EPA's authority to set Section 111 standards for source categories' emissions of greenhouse gases.

2. EPA's effort to narrow Section 111 to address only "pollution that itself endangers … through local or regional exposure" is baseless.

Even if *Massachusetts*'s and *AEP*'s understanding of the plain text were not dispositive, EPA fails to demonstrate that "air pollutant" must have a narrower meaning in Section 111 than in Section 302. Regulating greenhouse gases under Section 111 does not raise any intrinsic workability concerns or transform the scope of the provision (as the *UARG* court found with respect to the Prevention of Significant Deterioration program), and EPA fails to identify any plausible basis for concluding that either air pollutants or air pollution under Section 111 must be limited to either "local or regional" pollutants or those pollutants that endanger through direct exposure, words that appear nowhere in the text of either 111(b)(1)(A) or (B). As such, EPA's interpretation is unreasonable, arbitrary, capricious, and contrary to law.

a. UARG is inapposite here, so EPA's claim that the definition of "air pollutant" in Section 302 should not govern the use of that phrase in Section 111 must fail.

It is a "standard principle of statutory construction" that "identical words and phrases within the same statute should normally be given the same meaning." *Powerex Corp. v. Reliant Energy Servs., Inc.*, 551 U.S. 224, 232 (2007). While courts have occasionally found cause to vary from that presumption in circumstances where demanded by context – for example, because applying a consistent meaning would "render [statutory provisions] unworkable as written," *UARG*, 573 U.S. at 320 – EPA cannot reasonably assert that the Act's definitions do not govern Section 111. When Congress defines the terms it uses, both the agency and the courts must respect its definitions as "virtually conclusive." *Sturgeon v. Frost*, 587 U.S. 28, 56 (2019). Courts "will deviate from a statutory definition only when applying the definition would be 'incompatible with Congress['s] regulatory scheme' or would 'destro[y] one of the statute's major purposes.'" *Dep't of Agric. Rural Dev. Rural Hous. Serv. v. Kirtz*, 601 U.S. 42, 60 (2024) (quoting *Digital Realty Trust, Inc. v. Somers*, 583 U.S. 149, 163-164 (2018) (citation modified)); *cf. Pulsifer v. United States*, 601 U.S. 124, 149 (2024) (explaining that the principle that "the same term usually has the same meaning" is "generally useful" and "mostly applied to terms with some heft and distinctiveness, whose use drafters are likely to keep track of and standardize").

Unlike the context presented by *UARG*, there is no textual basis for carving greenhouse gases out of Section 111. *See* 91 Fed. Reg. at 59022, 59029. First, *UARG* itself explained that its

holding did not disturb EPA's authority to regulate greenhouse gases under Section 111. The Court specifically acknowledged the Court's conclusion in *AEP* that the Act "authoriz[es] … EPA to establish performance standards for powerplant greenhouse-gas emissions" under "the NSPS program of § 7411," explaining that its specific holding as to Section 111 was not in conflict with its general statement that greenhouse gases may not be pollutants "for all purposes" under the Act. *See* 573 U.S. at 319 & n.5.[29]

Second, carving greenhouse gases out of EPA's Section 111 authority would be contrary to *Massachusetts*. That case rejected arguments that, under *FDA v. Brown & Williamson Tobacco Corp.*, 529 U.S. 120 (2000), the apparently broad meaning of "air pollutant" should take a narrower construction in the context of similar "endangerment" language in Clean Air Act Section 202. *Massachusetts*, 549 U.S. at 530-31. Instead, as discussed in detail above, the *Massachusetts* Court held that Congress unambiguously defined "air pollutant" in Section 302 and that this definition unambiguously applies to EPA's authority in Section 202 to "prescribe … standards applicable to the emission of any air pollutant" that causes or contributes to dangerous air pollution. *Id.* at 528-29. In *UARG*, the Court considered whether the definition in Section 302 was similarly determinative of the use of "air pollutant" in the Act's "prevention of significant deterioration" and Title V permitting provisions. But the holding in that case – that greenhouse gas emissions do not trigger permitting obligations under those specific statutory programs – in no way overruled or even limited *Massachusetts*'s consideration of the scope of the term of "air pollutant" in a directly apposite provision, nor *AEP*'s affirmation – specifically noted in *UARG* – that Section 111 authorizes greenhouse gas regulation. *See* Comment Part II.A. Accordingly, *UARG*'s general instructions regarding context do not reopen a definitional question that has already been settled by the Supreme Court.

The conclusion reached in *UARG* is also easily distinguishable from the context here. In that case, all parties, including EPA, recognized that the plain text of the statute commanded specific regulatory steps at numeric pollution thresholds that, if applied to greenhouse gases, "would be inconsistent with – in fact, would overthrow – the Act's structure and design," by increasing the number of sources subject to air permitting requirements, as well as program costs, by multiple orders of magnitude. *UARG*, 573 U.S. at 321-322. The fact that Congress had not intended EPA to require major source permits for any entity emitting more than 100 or 250 tons of greenhouse gases per year was thus "beyond reasonable debate," *id.*, as was the fact that EPA had "no power" to fashion a workaround – as it had attempted to do – "by rewriting [those]

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[29] Notably, *UARG* also upheld as proper most of EPA's regulation of greenhouse gases under the PSD program, allowing EPA to continue to require best available control technology for greenhouse gases from sources already subject to the PSD program (so-called "anyway" sources). 573 U.S. at 331-32. This meant the vast majority of greenhouse gas emissions remained subject to regulation, even after *UARG* – dispelling any suggestion that that case's general aim or effect was to limit the Clean Air Act's reach with respect to greenhouse gases. *See id.* at 315 ("The Solicitor General … informs us that 'anyway' sources account for roughly 83% of American stationary-sources greenhouse-gas emissions, compared to just 3% for the additional, non-'anyway' sources EPA sought to regulate.").

unambiguous statutory terms" in order to avoid extending the program's reach far beyond any reasonable limits. *Id.* at 325-26.

The essentially irreconcilable statutory problem created by the PSD and Title V programs' binding numeric pollution thresholds – which the Court found to be definitive evidence that Congress had excluded greenhouse gases from the meaning of "air pollutant" in the subject sections – has no analogue in Section 111. Including greenhouse gases within the covered "air pollutants" in Section 111 follows, rather than rewrites, the statutory terms. As described above, Congress consistently used capacious language to describe the pollutants falling within EPA's Section 111 authority. *See also* 42 U.S.C. § 7411(a)(3) (defining a stationary source as any structure "which emits or may emit any air pollutant"). And no part of Section 111 is rendered inoperable or absurd if applied to greenhouse gases. *See Massachusetts*, 549 U.S. at 531 (explaining that unlike FDA regulation of tobacco products, "there is nothing counterintuitive to the notion that EPA can curtail the emission of substances that are putting the global climate out of kilter"). To the contrary, EPA can and has set standards of performance for greenhouse gases reflecting the degree of emission limitation achievable, taking into account costs and other specified factors.

In particular, Section 111 also differs from the provisions at issue in *UARG* because including greenhouse gases in the group of "air pollutants" regulated under Section 111(b)(1)(B) does not *de facto* trigger the type of absurd regulatory consequences for which a narrower interpretation of "air pollutant" is the only remedy. Rather, the Supreme Court's review of past standards in *West Virginia* shows that it is entirely equipped to police the unreasonable exercise of EPA's development of standards under Section 111 without having to strip "air pollutant" of its meaning or EPA of its underlying authority. *See* 597 U.S. at 697. *West Virginia* is thus direct evidence that while individual assessments of the "best system of emission reduction" might reach too far, there is nothing inherent in the text of that Act that would prevent EPA from assessing available systems of emission control for greenhouse gases that "reduce pollution by causing plants to operate more cleanly," *id.* at 706, and then setting emission limitations for that pollutant based on the best of those systems (considering the statutory factors).

Indeed, the Clean Air Act standard-setting provisions, like Section 111, are the very places where the broad definition of "air pollutant" in Section 302 fits most naturally. Those technology-based limits do not depend on specific regulatory thresholds, as with the PSD program, or on the ability of specific geographic areas to meet predetermined health- or welfare-based pollutant concentrations, as with the NAAQS program. In those other contexts, the obligations of the emitting sources are highly reliant on the volume or nature of the pollutant in question, since those characteristics make compliance with the Act's requirements more or less difficult. But that is not the case with standard-setting provisions like Section 111, where the standard reflects, among other things, what reductions available technology makes feasible for the emitting source. Such technology-based standards operate by the same criteria, and operate equally well, whether the source emits a small amount of acutely harmful pollution or large amounts of dispersed pollution. EPA cannot explain why, if the Agency identifies a risk to public health or welfare and can identify an available technology for reducing that risk consistent with the factors outlined in Section 111, Congress would have sought to limit its authority to do so to only a subset of pollutants without saying so.

EPA's interpretation here is thus a solution in search of a problem. There is simply no reason why the definition of the pollutants subject to regulation under a technology-based standard like Section 111 would need to be narrowed (to either local/regional pollution or pollution that harms by direct exposure) for that provision to function. Section 111 can be applied just as naturally to greenhouse gases (a globally-dispersed pollutant) as to nitrogen oxides (a regionally-dispersed pollutant), and just as naturally to pollutants that endanger by creating extreme weather (among other things) as to those that are harmful to inhale. Because the application of Section 111 to greenhouse gases requires no legislative rewriting, the principles articulated in *UARG* affirm, rather than undercut, EPA's longstanding assertion of Section 111 authority over power plant greenhouse gas emissions.[30]

Lacking any basis in text or purpose, EPA claims such narrowing is necessary to prevent Section 111 from granting EPA sweeping regulatory authority. But EPA's purported concern about a "limiting construction" begs the question of what it is the Agency's believes its present interpretation would serve to limit. EPA cites *West Virginia* as supporting the need for a limiting construction, claiming that it "provides an example of the potential result of an unbounded construction of CAA section 111(b)(1)(A)," and that "[h]ad EPA limited its approach to regulating fossil fuel-fired power plants to circumstances in which there is a closer connection between the emissions and the identified harm, it would have been clear that generation shifting did not achieve a purpose within the scope of CAA section 111 and was thus an impermissible use of its authority." 91 Fed. Reg. at 59027.

This retelling of *West Virginia* fails on two counts. First, as noted above and discussed further below, *see* Comment Part III, *West Virginia* in fact dispels the suggestion that a further limiting principle is required beyond the tools already at courts' disposal. If reading Section 111 to grant EPA *any* authority over greenhouse gas pollution was contrary to the statute or presented a major question, *West Virginia* would have been resolved on different grounds. But the Court pointedly did not read such a limitation into Section 111, explaining instead that the Congress's intent was effectuated by ensuring that EPA consider only "best system[s]" that "caus[e] plants to operate more cleanly," while finding no fault in EPA's attempt to do so for this particular pollutant. 597 U.S. at 706. Second, EPA's argument that requiring "a closer connection between the [greenhouse gas] emissions and the identified harm" would have made it "clear" to the Agency in 2015 that the "generation shifting" approach adopted in the Clean Power Plan was not permissible is pure concoction. Power plants' emissions of criteria pollutants – which EPA confirms have a suitably close connection to health and welfare impacts as to qualify as "air pollution" under Section 111 – could just as easily and rapidly be reduced through the same

[30] It does not matter whether "statute's application in these cases reaches 'beyond the principal evil' legislators may have intended or expected to address." *Bostock v. Clayton Cnty., Georgia*, 590 U.S. 644, 674 (2020) (quoting *Oncale v. Sundowner Offshore Servs., Inc.*, 523 U.S. 75, 79 (1998)). "[T]he fact that a statute has been applied in situations not expressly anticipated by Congress does not demonstrate ambiguity; instead, it simply demonstrates the breadth of a legislative command." *Id.* (citation modified). In any event, in this case, Congress *expressly* referred to "effects on . . . weather . . . and climate" in defining "welfare" under the Act, 42 U.S.C. § 7602(h), and has subsequently ratified EPA's exercise of this authority. *See supra*.

"generation shifting" system, as renewable resources like wind and solar also emit no criteria pollutants. Altering the scope of pollutants subject to regulation under Section 111 would thus not have prevented EPA from choosing to read "best system" capaciously for other (clearly authorized) pollutants if it so chose.

EPA further claims that "[w]ithout a limiting interpretation of the air pollution addressed by CAA section 111," EPA could regulate "based on a global concern when there is little or no connection between a source category's emissions and the identified harm" and then "promulgate standards … for any reason so long as the standards also reduce emissions, even if those standards would do nothing to meaningfully address the harm." 91 Fed. Reg. at 59027. But nothing in EPA's stated concern relates to whether a pollutant is "global" or not. A local pollutant might also lack a sufficient connection between the emissions and the identified harm, in which case EPA might promulgate standards "so long as" they "reduce emissions." Such circumstances are not prevented by rewriting Section 111 to exclude supposedly "global" pollutants; rather, Congress *already* prevented unreasonable exercises of authority under Section 111 by requiring that EPA establish, with a suitable record, that the pollutant in question is a (significant) contributor to the pollution in question, that the pollution can be reasonably expected to work real harm, and that standards to reduce those emissions have taken reasonable account of the costs and other non-air quality effects of those reductions. *See* 42 U.S.C. § 7411(a)(1), (b)(1)(A).[31]

The claim that Section 111 can be lawfully applied only if limited in the manner EPA suggests is thus fallacious. EPA's atextual limits on which pollutants can be regulated under Section 111 would not resolve any practical issues with implementing this provision of the statute. And they ignore the multiple limiting principles that Congress *did* write into Section 111: it constrains EPA's exercise of authority to substances that fall within the definition of air pollutant and to source categories that are significant emitters of dangerous substances. And it limits EPA to establishing regulations based on what is achievable with adequately demonstrated technology, giving due consideration to cost, lead time, and other statutory factors.

These constraints are already sufficient to prevent absurd results, *see* 91 Fed. Reg. at 59031 (arguing that authority would lead to absurd results), and they remain, as always, policed by the courts. By way of example: EPA suggests that the present interpretation must be unlawful because it would allow EPA to regulate water vapor (because, EPA says, water vapor "is also considered a GHG" and because rain can cause slip-and-fall injuries and flooding). *Id.* As it so happens, in the case of water vapor, EPA grossly misunderstands or misrepresents the hydrologic cycle; anthropogenic water vapor emissions do not increase the amount of water held in the atmosphere, and so could not be understood to "'contribute significantly' to elevated H_2O concentrations in the atmosphere from all anthropogenic sources," *id.* at 59032. *See infra* Comment Part VI.B.1.c. No doubt this is why EPA has never attempted to regulate it. *Cf.* 74 Fed. Reg. 66496, 66520 (Dec. 15, 2009) (explaining in the 2009 Finding why EPA was not addressing water vapor). Plus, if water vapor could somehow pass the "significant contribution"

[31] Of course, EPA here has explicitly disclaimed that it is making (or, rather, remaking) those record-based findings. 91 Fed. Reg. at 59019. So it has not proposed to repeal the 2015 finding on the basis of the limitations the Act actually imposes.

test, EPA's own limiting principle would not exclude it, as water vapor would be a "local or regional" pollutant[32] and one that, in EPA's telling, harms through direct exposure, 91 Fed. Reg. at 59031 (citing harms like "slip-and-fall injuries"). Indeed, the *Massachusetts* dissent's hypothetical about a profusion of frisbees (which would be both local and dangerous in themselves if tossed about by sources in sufficient quantities) would fall *within* the new lines EPA proposes to draw around Section 111. *See Massachusetts*, 549 U.S. at 558 n.2 (Scalia, J., dissenting). So EPA's proposed construction of "air pollutant" in Section 111 is hardly a bulwark against absurd results.

Rather, as the frisbee example shows, it is possible to draw out absurd hypotheticals from nearly any statutory construction. The ability to generate such hypotheticals – like the specter of regulating water vapor – does not mean a statute's terms lack adequate specificity to prevent unreasonable applications. In such cases, EPA would still have to show that its regulatory choices were reasonable. Like "frisbees or flatulence," *see Massachusetts*, 549 U.S. at 558 n.2 (Scalia, J., dissenting), water vapor or any other theoretical pollutant from stationary sources could not be regulated unless emitted from a source category that satisfied the requisite significant contribution and endangerment findings and unless standards of performance were justifiable, considering the quantity of emissions reductions, cost, energy requirements, and other impacts.[33] At that point, like NO_X or SO_2 or greenhouse gases, EPA would be complying with the will of Congress by ensuring that power plants deployed available technology to help prevent public harms. And EPA's choices in doing so would be subject to judicial review.

As such, Section 111's construction is easily distinguished from instances where the law fails to sufficiently "guide the agency's exercise of authority." *Whitman v. Am. Trucking Ass'ns*, 531 U.S. 457, 463 (2001); *see id.* at 474 ("In the history of the Court we have found the requisite

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[32] *See, e.g.*, NASA, *Steamy Relationships: How Atmospheric Water Vapor Amplifies Earth's Greenhouse Effect* (Feb. 8, 2022), https://perma.cc/3CGV-V6RF (explaining that "a molecule of water vapor stays in the atmosphere just nine days, on average" rather than accumulating, and depicting localized changes in water cycling). The state of water (liquid, snow, ice, or vapor) depends on temperature, and thus local concentrations of water vapor are constantly changing; moreover, because of the nature of water on our planet, "even large additions of water vapor would have negligible warming effects on climate" and "added water vapor [added at the Earth's surface] rains out before it can reach the altitudes required to significantly contribute to Earth's greenhouse effect." Steven C. Sherwood, et al., *The global warming potential of near-surface emitted water vapour*, 2018 Environ. Res. Lett. 13 104006, https://iopscience.iop.org/article/10.1088/1748-9326/aae018.

[33] Nor could such standards be set, in EPA's current view, unless and until EPA listed a source category for that particular pollutant, 90 Fed. Reg. at 25762 (hereinafter "Significant Contribution Proposal"), or at least concluded in parallel that the pollutant in question was the type that significantly contributes to an actual pollution problem that, as a scientific matter, endangers health or welfare, 91 Fed. Reg. at 59021. As noted above, EPA would quickly run into a wall attempting to find an elevated concentration of water vapor attributable to anthropogenic sources. But even if that were not a constraint, EPA's proposed limiting construction would not fill the breach, as water vapor endangers through local or regional exposure.

'intelligible principle' lacking in only two statutes, one of which provided literally no guidance for the exercise of discretion, and the other of which conferred authority to regulate the entire economy on the basis of no more precise a standard than stimulating the economy by assuring 'fair competition.'"); *see* 90 Fed. Reg. at 36301 n.59 (discussing nondelegation cases). The standards for finding an intelligible principle "are not demanding." *Gundy v. United States*, 588 U.S. 128, 146 (2019). Courts have rarely found Congress to have fallen short and only where it has "failed to articulate *any* policy or standard" to confine an Agency's discretion, *id.* (quoting *Mistretta v. U.S.*, 488 U.S. 361, 373 n. 7 (1989)). That is a far cry from the circumstances here, where Section 111 includes constraints on both what emissions can be regulated and how they can be regulated.

To the extent EPA's complaint is really that Section 111 allows regulation of sources' contributions to pollution without asking whether the emissions contribute significantly to the *harm*, and not just the pollution, 91 Fed. Reg. at 59027, that was Congress's choice, reflecting an understanding that harm was the product of the "cumulative impact of all sources." H.R. Rep. 95-294 at 49-50. Plus, that complaint would be true regardless of the pollutant in question. *See also* Comment Part VIII.C. In fact, EPA recognizes that interpreting Section 111 to require a finding of significant contribution to the harm itself would be a change in the meaning of that section and so is specifically taking comment on that new interpretation. 91 Fed. Reg. at 59024 (proposing that Section 111(b)(1)(A) be read "as requiring the Agency to consider a source category's contribution to the *endangerment* caused by air pollution, rather than to just the air pollution itself"). That interpretation is wrong for reasons commenters have already addressed at length in prior comments.[34]

If anything, it is EPA's proposed interpretation that raises concerns about limiting principles. EPA bases its exclusion of greenhouse gases from Section 111 on general arguments that are not unique to that provision, namely dictionary definitions of pollutant and pollution, general causation principles, the relative recency of greenhouse gas regulation, and non-delegation concerns associated with such regulation. If the appearance of these general elements were adequate to establish that Congress intended some tacit, provision-specific definitions of "air pollutant" – and the resulting air pollution – to supplant its chosen definition in Section 302, it is unclear what purpose would still be served by Section 302. EPA does not explain how its proposed reading could be duly limited to the specific context of this provision without swallowing the Act as a whole, or how it would avoid rendering Section 302 a nullity. Indeed, EPA is now making identical arguments to categorically exclude greenhouse gases from multiple Clean Air Act sections, *see* 91 Fed. Reg. at 7686, raising the question of what, exactly, EPA

[34] *See* Comment of Center for Biological Diversity, Clean Air Task Force, Earthjustice, Environmental Defense Council, Natural Resources Defense Council, and Sierra Club at III.B.1.i (Aug. 7, 2025), EPA-HQ-OAR-2025-0124-0648 (hereinafter "Significant Contribution Comment") ("[T]he text, on its face, does not ask EPA to determine whether sources contribute 'to' that endangerment, it asks whether the sources contribute 'to air pollution' and then explains what kind of air pollution that must be."). We incorporate those comments here by reference as demonstrating why EPA's additional proposed interpretation is invalid and incorrect.

thinks is left.[35] EPA cannot advance a reading that would do such fundamental and far-reaching damage to the statutory text, and it certainly cannot do so in the face of Supreme Court precedent with which it is bound to comply.[36]

b. In any event, EPA's attempt to narrow the plain language of Section 111 is unsupported and unreasonable.

EPA's attempts to manufacture a textual basis to exclude greenhouse gases from Section 111, like its arguments concerning *UARG*, never get off the ground. The Agency fails to locate any genuine support – let alone support adequate to overcome the plain text – for the proposition that Section 111 was actually intended to apply only to local and regional pollutants, and only to those that harm through direct exposure. EPA's arguments not only lack a basis in statutory text, they fail basic tests of logic. As such, they must be rejected.

i. The term "air pollution" does not impose limits that "air pollutant" does not.

In an apparent attempt to escape the clear precedential effect of *Massachusetts* and its treatment of the term "air pollutant," EPA argues that "the scope of the EPA's authority to list source categories under CAA Section 111(b)(1)(A) informs the overall regulatory scope of CAA

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[35] EPA disingenuously asserts that its proposed statutory interpretation "would not impact" other source categories regulated under Section 111. 91 Fed. Reg. at 59043. But EPA has not explained how its construction of the language "air pollution which may reasonably be anticipated to endanger public health or welfare" would be confined to the power plant source category. Indeed, EPA itself suggests otherwise in a proposal published just four days ago that proposes to amend Section 111 standards for the oil and gas sector. In that proposal, EPA confirms that it plans to "address in a future rulemaking, as appropriate, the extent to which the conclusions in [the Supplemental Proposal] with respect to the Agency's statutory authority under CAA section 111 require revisions to the oil and gas regulations." 91 Fed. Reg. at 68244. And EPA has, of course, already taken the view that this construction applies to motor vehicles under Section 202 – once again without explaining how its supposed "best reading" would not reach other provisions where it has exercised greenhouse gas regulatory authority, such as Section 231(a)(2) on aircraft emissions. EPA has thus failed to adequately consider an important aspect of the problem and failed to take proper account of that aspect of its past practice. As we have shown, however, EPA's "local or regional exposure" construction has no textual, contextual, or historical support. So it is wrong for the power plant category, wrong for other Section 111 categories, and wrong for other Clean Air Act provisions.

[36] EPA's remaining contention that a limiting principle is necessitated by *Loper Bright* is unpersuasive because it is circular. If Section 111's authority over "air pollutants" includes greenhouse gases – the question *Loper Bright* requires that we answer – then applying that text without a further limiting principle is consistent with, not contrary to, *Loper Bright*. Conversely, claiming that a limiting principle is necessary because EPA's interpretive "discretion does not extend to redefining 'air pollution' from the local and regional exposure problems understood at the time of enactment" begs the question at the heart of the *Loper* inquiry here: whether Section 111 is in fact confined to pollutants that harm through local and regional exposure.

Section 111. That is, the Agency's authority to regulate a given air pollutant from a given source category under CAA Section 111 is cabined by whether the associated air *pollution* is the type that Congress intended the EPA to address." 91 Fed. Reg. at 59021. But EPA is incorrect to conclude that the term "air pollution" serves some narrowing function distinct from the Act's definition of the term "air pollutant." *See id.* ("The Act does not define the term 'air pollution.' The EPA proposes to interpret 'air pollution' as that which itself endangers public health or welfare through local or regional exposure."); *id.* at 59027.

Once again, the plain language does not express the limitation EPA claims to find there, though it surely could have – for example, by stating that Section 111 applies to "air pollution that endangers health or welfare *at the local or regional scale*." Congress could easily have included such modifiers – or others serving that function like "in an air quality control region," *cf.* 42 U.S.C. § 7407 – to limit the kind of endangerment that it meant EPA to address, but did not do so. Nor, notably, did Congress see the need to define "air pollution" as something with a more particular shape or geography than simply being a concentration of the "air pollutants" it had already defined.[37] The omission itself is telling.

Indeed, the statutory text of Section 111 belies any suggestion that Congress meant "pollutant" and "pollution" to be fundamentally different things. For instance, Section 111(a)(7)(B) refers to "a technological system for continuous reduction of the *pollution* [not *pollutants*] generated by a source before such *pollution is* [not *pollutants are*] emitted into the ambient air." 42 U.S.C. § 7411(a)(7)(B). Referring to pollution "before [it] is emitted into the ambient air" undermines any suggestion of EPA's that "air pollution" has some inherent meaning related to how pollutants accumulate across geographic areas.

Elsewhere in Title I, the Act refers also specifically to "greenhouse gas pollution." 42 U.S.C. § 7437 (grant provisions concerning "the costs of developing a plan for the reduction of greenhouse gas air pollution"). And EPA cannot claim this is merely a recent phenomenon: Congress referred directly to greenhouse gases as air pollution in a 1987 statute directing EPA to develop and propose to Congress "a coordinated national policy on global climate change": "The Congress finds as follows: (1) There exists evidence that manmade pollution – the release of carbon dioxide, chlorofluorocarbons, methane, and other trace gases into the atmosphere – may be producing a long-term and substantial increase in the average temperature on Earth, a phenomenon known as global warming through the greenhouse effect." *See* Pub. L. 100-204, § 1102, 101 Stat. 1331, 1408 (1987).

In any event, the Supreme Court has left no doubt that the distinction is immaterial, explaining that the linguistic and practical move from air pollut*ant* to air pollut*ion* does not exclude greenhouse gases from the Act's coverage. In *Massachusetts*, the dissent had asserted that EPA could decline to regulate greenhouse gases notwithstanding that they were a "substance or matter [being] emitted into … the ambient air" because they were not "agents" of "air

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[37] Dictionaries in 1970 also did not see the need for distinction. *See, e.g.*, Am. Heritage Dictionary 547 (1970) (defining "pollutant" and "pollute," but noting "pollution" only as the noun form of "to pollute"), available at: https://archive.org/details/amerheritagedict00amer/page/546/mode/2up.

pollution." 549 U.S. at 557-58 (Scalia, J., dissenting) (citing the definition in Section 302(g)). That argument relied on nearly identical arguments as those EPA raises here. But the Court's majority disagreed, rejecting the dissent's effort to distinguish the meaning of pollution and confirming that greenhouse gases are "unquestionably 'agent[s]' of air pollution." 549 U.S. at 529 n.26.

The scope of the *Massachusetts* Court's holding has been reinforced by the Court itself. Four years later, the Court in *AEP* explained in its holding that "*Massachusetts* made plain that emissions of carbon dioxide qualify as air pollution subject to regulation under the Act." 564 U.S. at 424. And courts have continued to refer to greenhouse gases as causing "pollution" in the context of Section 111 and the Clean Air Act. *See, e.g.*, *West Virginia v. EPA*, 597 U.S. 697, 711, 713 (2022) (referring to "carbon dioxide pollution from power plants," "carbon pollution"); Oral Argument Transcript, *Suncor Energy (U.S.A.), Inc. v. County Comm'rs of Boulder Cty.*, No. 25-170 (S. Ct. Oct. 5, 2026) (in a case concerning harms from greenhouse gases, repeatedly describing the issue as concerning interstate air "pollution").[38] EPA's suggestion that the separate term "air pollution" in Section 111(b)(1)(A) has some narrowing effect is unsupportable in the face of these precedents – as well as the further evidence offered above.

EPA's attempt to locate supportive evidence in lay dictionaries is thus irrelevant but, in any case, unsuccessful. The definitions EPA cites do not suggest a distinction between the scope of the term pollutant and the scope of the term pollution. To the contrary, EPA's own logic relies on the premise that air pollution is simply the collective environmental result of emissions of air pollutants. *See* 91 Fed. Reg. at 59021-22 (defining "pollutant" as "anything that pollutes; especially, any gaseous, chemical, or organic waste that contaminates air, soil, or water" and defining pollution as the resulting "contamination of soil, water or the atmosphere" resulting from the "discharge" of such "noxious substance[s]"). Indeed, as noted above, Section 302(g) defines "air pollutant" to include "any air pollution agent," leaving no doubt that these cannot diverge in the way EPA now claims. Accordingly, as "air pollutant" is defined in the Act, the scope of "air pollution" – its collective result – is determined by the same.[39]

EPA also relies on the "[c]ontemporaneous usage of the term 'air pollution' in the 1960s and 1970s." 91 Fed. Reg. at 59022. But the two 70s-era judicial opinions it cites do not explore, let alone explain, the scope of the term "air pollution." *See* 91 Fed. Reg. at 59022 n.132. It is entirely uncontroversial that local and regional geophysical characteristics are "often" significant factors to consider when abating pollution, and that remains true today, even as EPA also regulates greenhouse gases, *see Washington v. General Motors Corp.*, 406 U.S. 109, 115

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[38] Available at: https://www.supremecourt.gov/oral_arguments/argument_transcripts/2026/25-170_8m58.pdf.

[39] EPA's suggestion that those definitions' reference to "contamination" or "noxious substances" are relevant to the Act because they inform the meaning of *both* air pollutant and air pollution is incorrect, as discussed below. *See infra* Comment Part II.B.2.b.iii. But regardless, the definitions do not establish that "air pollution" is a term that carries connotations distinct from "air pollutant."

(1972).[40] Yet simply because pollution "often" has local or regional impacts does not mean that this is a definitional characteristic of pollution; indeed, the very use of the word "often" inherently means that there are *some* cases in which pollution has impacts that are *not* primarily local or regional.

Meanwhile, the summary of "relevant history" EPA cites from a dissent from rehearing *en banc* in *Coalition for Responsible Regulation*, like EPA's preamble itself, ignores the contemporaneous Congressional record, where legislators referred to climate change in terms of "air pollution." *See, e.g.,* 116 Cong. Rec. 32,914 (1970) (statement of Sen. Boggs referring to the Council on Environmental Quality's conclusion that "[a]ir pollution alters climate and may produce global changes in temperature"); Report of the Council on Environmental Quality: Hearing Before the Senate Subcomm. on Air and Water Pollution of the S. Comm. on Pub. Works, 91st Cong. 5 (1970) (statement of Russell Train, Chairman of the Council, testifying that the "international dimensions of the air pollution problem should not be overlooked . . . [as] discharge of particulates and carbon dioxide to the atmosphere could have dramatic and long-term effects on the world's temperature with many major consequences"). EPA can hardly be ignorant of these references, some of which were quoted in *Massachusetts*. EPA likewise ignores relevant Presidential history, including President Johnson's call in 1965 for new air pollution legislation because "[l]arge-scale pollution of air … is no respecter of political boundaries, and its effects extend far beyond those who cause it" and because "[t]his generation has altered the composition of the atmosphere on a global scale through radioactive materials and a steady increase in carbon dioxide from the burning of fossil fuels."[41]

Academic literature has also extensively documented the public and governmental understanding of climate change, concluding that by the late 1960s the perception that carbon dioxide was not causing air pollution had "largely drop[ped] away."[42] As that literature documents:

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[40] Suitably ironic, too, that EPA seeks support in a case that found polluting vehicles akin to cigarettes, *see* 91 Fed. Reg. at 59022 n.132 (citing *Friends of the Earth v. FCC*, 449 F.2d 1164 (D.C. Cir. 1971)), given the effort both industries went to to hide the dangers of their products from the public. *See* Hiroko Tabuchi, *Exxon Scientists Predicted Global Warming, Even as Company Cast Doubt, Study Finds*, New York Times (Jan. 12, 2023), available at: https://www.nytimes.com/2023/01/12/climate/exxon-mobil-global-warming-climate-change.html.

[41] Johnson Special Message to the Congress at 161.

[42] Oreskes, et al. at 843; *id.* at 815 (summarizing the research as showing, "The [impact of CO_2 on climate] was the subject of a wide variety of scientific papers and reports, several of which were transmitted to the Executive Branch and communicated to Congress in the 1960s and in 1970, particularly but not only in the context of urban air pollution. Concern about CO_2 pollution also made its way into film and television, including during an interview with President Nixon's Science Advisor, Lee DuBridge, on *Meet the Press* in 1969."); *see also* Richard L. Revesz, *Bostock and the End of the Climate Change Double Standard*, 46 Colum. J. Env't L. 1, 28 (2020).

> [T]he hearings [for the Clean Air Act of 1970] before the House and the Senate reveal significant public understanding of both the connection between air pollutants and global climate change, and of how greenhouse gases, including carbon dioxide, could cause global warming. Many witnesses, including distinguished scientists, testified on both matters. In their testimony, they discussed significant academic literature on these questions. Moreover, the two agencies with responsibility for regulating air pollution expressed concern about the problem, with one of them preparing an extensive report documenting the problem. Perhaps most tellingly, the principal government witness at the hearings, who expressed serious concern about climate change, testified in favor of the bill.[43]

The literature cites dozens of further examples, including:

- A 1958 statement of a coal industry representative at the first National Conference on Air Pollution (sponsored by a federal agency, the U.S. Public Health Services) that "'[o]xides of nitrogen, hydrocarbons, moisture, and carbon dioxide play a large part in air pollution, and many people are concerned about them.'"[44]

- A 1967 report of the Panel on Electrically Powered Vehicles convened by the Department of Commerce and provided to Senator Muskie, which in a section on "'Weather modification'" described the greenhouse effect, noted existing attention on "'the effects of rising levels of carbon dioxide in the atmosphere due to increasing rates of combustion of fossil fuels'," and stated the "'the interrelationships between pollution in the atmosphere and the basic meteorological processes which govern weather'" "'could have extremely significant implications upon the welfare of the world's population and a start should be made as soon as possible to learn more about this potentially important aspect of air pollution.'"[45]

- A 1969 speech given by Senator Randolph, "chair of the Senate Public Works Committee, where the 1970 Clean Air Act originated" before the International Clean Air Congress that "spoke at length about carbon dioxide from burning fossil fuels, its character as a global problem, and the need for global monitoring," and noted that "'coordinated worldwide system to monitor pollution in the total environment'" "'would be invaluable in adding to our knowledge of the worldwide increase in carbon dioxide resulting from the burning of fossil fuels.'"[46]

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[43] Richard L. Revesz, *Bostock and the End of the Climate Change Double Standard*, 46 Colum. J. Env't L. at 55.

[44] Oreskes, et al. at 846.

[45] Oreskes, et al. at 852-54.

[46] Oreskes, et al. at 858-59.

- A report from Nixon's Task Force on Air Pollution that was "transmitted to the President in June 1970 and publicly released in August" and that "proclaimed, 'the greatest consequences of air pollution for man's continued life on earth are its effects on the earth's climate.'"[47]

EPA's claim that greenhouse gas concentrations were not considered air pollution in the 1960s and 1970s is thus baseless.

EPA is incorrect, in any case, that it cannot regulate emissions from a listed source under Section 111(b)(1)(B) unless the "concerns used to justify regulation satisfy the statutory prerequisite" for listing in Section 111(b)(1)(A). *See* 91 Fed. Reg. at 59018. As explained in our comments on the Significant Contribution Proposal, *see* Significant Contribution Comment at IV, the decision about what sources are sufficiently major emitters to warrant regulation under Section 111(b)(1)(A) and the subsequent decision of what standards of performance for particular pollutants are appropriate pursuant to 111(b)(1)(B) (in consideration, among other things, of the Act's precautionary approach to regulating new sources) are distinct. And EPA's contemporaneous practice in the 1970s – a factor it considers important elsewhere in its proposal – at no time included assessing whether every pollutant for which a standard was imposed "satisf[ied] the statutory prerequisite" for listing in 111(b)(1)(A). *See id.* (in particular notes 187 and 190, describing EPA's historical practice and noting that certain fossil fuel-fired steam generators were regulated for PM, SO_2 and NO_X without ever determining that the source category contributed significantly to dangerous concentrations of those pollutants); *cf.* 90 Fed. Reg. at 59023 (acknowledging that under EPA's traditional practice, "[o]nce a source category was listed, pursuant to CAA section 111(b)(1)(A), the EPA exercised judgment as to which air pollutant(s) emitted from each source category to regulate").[48]

EPA's argument is no more functional because the Agency starts to distance itself from an assertion that it must actually make a pollutant-specific endangerment finding before every exercise of Section 111(b)(1)(B). *See* 91 Fed. Reg. at 59019 (saying that its interpretation applies "[r]egardless whether CAA section 111(b)(1)(A) requires the EPA to have only a rational basis for regulating air pollutants from an already listed source category or whether the Agency must make a pollutant-specific significant contribution finding"); *see also* Significant Contribution Proposal, 90 Fed. Reg. at 25762 (seeking comment on whether Section 111 requires "or at least authorizes EPA to require" a pollutant-specific endangerment finding before regulating any pollutant). EPA's reading is not rehabilitated by simply reimagining it from something explicit (EPA *must* make an endangerment finding for each specific pollutant) to something implicit (EPA cannot regulate unless it finds that it *could* make an endangerment finding for each specific pollutant). *See* Significant Contribution Comment at IV. EPA's new version of this argument is a

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[47] Oreskes, et al. at 863.

[48] Curiously, EPA simultaneously deploys the distinct steps Congress created in Section 111(b)(1)(A) and (b)(1)(B) as a basis for distinguishing *Massachusetts*. 91 Fed. Reg. at 50029. EPA does not explain how that distinction would relevantly distinguish the two cases if, as EPA proposes, the "statutory prerequisite" of 111(b)(1)(A) governs the threshold for "prescrib[ing] standards applicable to the emissions" in (b)(1)(B) as well. *See id.* at 59018.

pretextual attempt to evade the meaning of the plain text; Commenters accordingly incorporate by reference their comments on the Significant Contribution Proposal, which explain the flaws in EPA's view of pollutant-specific endangerment findings and address its claim that such a reading is necessary to avoid unreasonable consequences. *See generally* Significant Contribution Comment; *see also supra* Comment Part II.B.2.a.

ii. Nothing in Section 111 limits its scope to local and regional pollution.

The statute does not support EPA's assertion that the broader context of Section 111 implicitly limits EPA's authority to regulating pollution that adversely impacts health or welfare at the "local or regional level." *E.g.*, 91 Fed. Reg. at 59027.

As described above, the text of Section 111 explicitly signals its breadth. The section governs EPA's authority to regulate stationary sources, defined as "*any* building, structure, facility, or installation which emits or may emit *any air pollutant*," and to set performance standards for those sources, defined, *inter alia*, as "a standard for emissions of *air pollutants*." *See* 42 U.S.C. § 7411(a)(1), (3) (emphasis added); *see also id.* § 7411(a)(4) (defining "modifications" that require compliance with new source standards as those that "increase[] the amount *any air pollutant emitted* by such source or which results in the emission of *any air pollutant not previously emitted*" (emphasis added)). The Act in turn defines "air pollutant" with comparable breadth. *Id.* § 7602(g); *see supra* Comment Part II.B.1. Even where it uses some limiting terms, like requiring that source categories be found to contribute "significantly" to air pollution before being listed for regulation, the language of Section 111 signals broad applicability, allowing that significant contributions need only be to air pollution that "may reasonably be anticipated" to endanger the public, *id.* § 7411(b)(1)(A), "includ[ing], but … not limited to, effects on soils, water, crops, vegetation, manmade materials, animals, wildlife, weather, visibility, and climate, damage to and deterioration of property, and hazards to transportation, as well as effects on economic values and on personal comfort and well-being, whether caused by transformation, conversion, or combination with other air pollutants." *Id.* § 7602(h).

The Act nowhere narrows any of that expansive phrasing with the modifiers "local" or "regional," or with any other modifiers that confine geography or proximity. *See generally* 42 U.S.C. § 7411. Congress could have imposed such a limitation in Section 111 or in the applicable definitions in Section 302, but it never did – a meaningful omission when Congress was indisputably attentive to such defining terms where it wished to be. *See, e.g.*, 42 U.S.C. § 7412(f)(1)(C) (requiring reporting on health effects on "persons living in the vicinity of sources"), (k)(2) & (4) (addressing pollution specific to urban areas); *id.* § 7407 (establishing "air quality control regions"); *id.* § 7423(c) (requiring that EPA "insure that emissions from the stack do not result in excessive concentrations of any air pollutant in the immediate vicinity of the source"); *id.* §§ 7472, 7475(d)(2)(C), 7473(b)(1) & 7491 (defining and setting area-specific rules for "Class I" areas); *cf. id.* § 7412(b)(2) (including under Section 112 pollutants which operate "through inhalation or other routes of exposure," including substances that are "carcinogenic, mutagenic, teratogenic, neurotoxic, which cause reproductive dysfunction, or which are acutely or chronically toxic"). Rather, those invisible modifiers have been concocted by EPA here as an atextual gloss on a provision the Agency hopes to narrow, as EPA's Administrator has openly

declared, due to a general hostility to regulatory action to address climate change.[49] *See* 91 Fed. Reg. at 59019 (describing "the Nation's policy response to global climate change concerns" as "a major issue in the 2024 election" where voters "elected a candidate promising a change in policy," and asserting that "the election of a new Administration is an independent and sufficient basis" for reconsidering prior Agency interpretations). But elections do not change the meaning of laws already on the books. Only Congress can do that, by passing a new law.

Nor is EPA's argument consistent with the structure of the Clean Air Act. The Agency posits that Section 111's alleged "local/regional" limitation is implied by its proximity to Sections 107-110 and 112, which, respectively, cover criteria and hazardous air pollutants. *See* 91 Fed. Reg. at 59025-27. In fact, the exact opposite is true: the text of Sections 107-110 and 112 highlight the *lack* of limitations that Congress placed on the kinds of pollutants covered under Section 111. As for the NAAQS program, Section 108 includes language parallel to Section 111 in that it covers each air pollutant "emissions of which … cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare." 42 U.S.C. § 7408(a)(1)(A). However, it further qualifies that a regulated pollutant must be such that its "presence … in the ambient air results from numerous or diverse mobile or stationary sources," and thus affects "air quality." *Id.* §§ 7408(a)(1)(A)-(C). Section 112 is even more specific, covering "pollutants which present, or may present, through inhalation or other routes of exposure, a threat of adverse human health effects (including, but not limited to, substances which are known to be, or may reasonably be anticipated to be, carcinogenic, mutagenic, teratogenic, neurotoxic, which cause reproductive dysfunction, or which are acutely or chronically toxic) or adverse environmental effects whether through ambient concentrations, bioaccumulation, deposition, or otherwise." *Id.* § 7412(b)(2).

By contrast, Section 111 requires only that a regulated source category "cause[], or contribute[] significantly to, air pollution which may reasonably be anticipated to endanger public health or welfare." *Id.* § 7411(b)(1)(A). To the extent that this phrase extends not just to source categories but to regulated pollutants themselves, it includes no further limitations as to emissions from new sources, despite the fact that Congress clearly knew how to include such limitations, as evidenced by Sections 107 and 112. Section 111(d)(1) does impose further limitations on *existing* source emissions subject to regulations, but that language further highlights the absence of any "local/regional" condition: it permits EPA to regulate only those pollutants "for which air quality criteria have not been issued or which is not included on a list published under section 7408(a) of this title or emitted from a source category which is regulated under section 7412 of this title but (ii) to which a standard of performance under this section would apply if such existing source were a new source." *Id.* § 7411(d)(1). Congress could have easily excluded existing sources' emissions non-local/regional pollutants from coverage under Section 111(d) along with NAAQS and HAP pollutants, but again, did not do so.

It is thus quite puzzling that EPA supports its argument by drawing attention in the Supplemental Proposal to "the structural relationship between CAA sections 107-110, section

[49] U.S. EPA, Press Release: EPA Launches Biggest Deregulatory Action in U.S. History (Mar. 12, 2025), available at: https://perma.cc/SS6J-4G9C (describing EPA's intent to "driv[e] a dagger straight into the heart of the climate religion").

111, and section 112." 91 Fed. Reg. at 59025. As the agency points out, "Congress designed sections 107-110 and section 112 to address air pollutants and air pollution that adversely impact health or welfare through direct exposure at the local or regional levels." *Id.* at 59026. But the statute is explicit in that the Section 111, in turn, extends to pollutants *not* covered under the NAAQS and HAP programs – and, in the case of existing sources, extends *only* to those additional pollutants. Thus, rather than highlight the supposed convergence of these three regulatory schemes with regard to local/regional pollutants, the structural relationship between Sections 107-110, 112, and 112 fatally undermines EPA's claim that Congress meant to limit Section 111 to the particular pollutants or types of pollutants regulated under Sections 107-110 and 112.

EPA's suggestion that Section 111 applies only to harm on the local or regional "scale" is also directly contrary to the harms the statute itself defines as falling within the ambit of Section 111. And as noted above, "welfare" as defined under Section 302(h) explicitly covers "effects on … weather … and climate," terms that can clearly encompass harms happening at a global scale. 42 U.S.C. § 7602(g); *see, e.g.*, *Massachusetts,* 549 U.S. at 531 ("[T]here is nothing counterintuitive to the notion that EPA can curtail the emission of substances that are putting the global climate out of kilter.") (emphasis added). EPA disputes this, claiming that "weather" and "climate" should both be read as referring to "things and mechanisms of action that occur in a particular place or under regionally bounded conditions." 91 Fed. Reg. at 59022. But EPA's arguments are unsustainable.

First, EPA cites a dictionary definition from the 1970 printing of the American Heritage Dictionary defining "climate" as "[t]he prevailing weather in a particular region" or "[a] region manifesting particular meteorological conditions."[50] *Id*. It is worth noting at the outset that other dictionaries from the 1970s, including another EPA cites for the meaning of other terms in the proposal, are not so singularly wedded to the idea that climate refers only to particular "regions," defining "climate" to include, *e.g.*, "the prevailing set of conditions (as of temperature, humidity, or freshness of atmosphere) in any place" or "the average course or condition of the weather at a particular place over a period of many years … ."[51]

But even more telling is that the 2022 version of the American Heritage Dictionary actually defines "climate" the same way it did 1977: "1. The meteorological conditions, including temperature, precipitation, and wind, that characteristically prevail in a particular

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[50] Climate, Am. Heritage Dictionary 136 (1970), *available at* https://archive.org/details/amerheritagedict00amer/page/136/mode/2up

[51] Climate, Webster's 3d New Int'l Dictionary, Unabridged 423 (1966), available at: https://archive.org/details/websthirdnew0000phil_l0b1/page/422/mode/2up; *see also* Climate, Webster's New Twentieth Century Dictionary, 2d Ed. 339 (1970) (emphasis added), *available at* https://archive.org/details/webstersnewtwent00webs/page/338/mode/2up (defining climate to include "the prevailing or average weather conditions of a *place*, as determined by the temperature and meteorological changes over a period of years").

region. 2. A region of the earth having particular meteorological conditions."[52] And yet no one would claim that we have all been misspeaking when referring to the "earth's climate" or to "climate change." That is because the natural understanding of phrases like the "earth's climate" or "climate change" is that we are referring to the *collective* prevailing conditions on earth: no one would say that the Louisiana Bayou, the American West, and the Arctic have the same climate, nor that they are being affected by climate change the *same way*. But we would naturally say that "climate change" is affecting all three regions – and that the "earth's climate" includes both warm, wet regions and cold, dry regions. EPA's effort to impose some confining geographic scope on the word "climate" is thus totally misplaced. On its face, all EPA's definition shows is that there was nothing particular to the way "climate" was used in the 1970s that distinguishes it from how "climate" is used today, when describing "effects on climate" would decidedly *not* exclude the effects of climate change. But more significantly it reveals a larger flaw in EPA's best reading: the assertion that pollution from air pollutants like greenhouse gases – where emissions are so enormous and so long-lived that pollutant concentrations are rising *everywhere* at the same time – somehow is not present or inflicting harm at the "regional" (or "local") level. Congress in Section 111 asks EPA to assess whether pollution endangers the public. Even if that question asked "the scale" at which the pollution impacts health or welfare, *see* 91 Fed. Reg. at 59026, no person could say greenhouse gas pollution is not endangering local and regional "climate" – even if it is doing so in many (indeed, most) regions simultaneously. So too with "weather." *See* 91 Fed. Reg. at 59022. And there is nothing in EPA's chosen definitions that suggests air pollution only endangers climate or weather when it does so in a single place or the place that it is emitted (conditions that would exclude criteria pollutants as well).

That these terms, weather and climate, were flexible enough to include narrower and broader instances of harm is also apparent. The definition of welfare did not need to use the words "global" or "change" to ensure "climate" reached to the collective global climate, just as it did not need to use the words "bodies of" to ensure that "effects on … water" reached to not just molecules but lakes. *See* 91 Fed. Reg. at 59022 (arguing that Congress did not add "terms like 'global' or 'change' that would have expanded the scope of the effects on welfare encompassed within the definition").[53] To that point, Congress itself was using the (unmodified) term "climate" only a few years later in its discussion of the 1977 Amendments to reach the collective global, not merely local or regional, "climate." For example, the first sentence of a section titled "Worldwide weather modification" discusses Congress's concern that "[f]ine particulates and aerosols emitted from polluting sources threaten to bring about major modifications in weather

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[52] Climate, Am. Heritage Dictionary 5th Edition (2022), *available at* https://www.ahdictionary.com/word/search.html?q=climate.

[53] EPA's argument to this effect is also poorly reasoned and poorly supported. Listing "effects … on climate change" would make no sense: EPA has not been regulating greenhouse gases to date because it is worried about "air pollution which may reasonably be anticipated to *endanger climate change*." Both citations EPA provides are also inapposite: one sets a duty to perform an "analysis of … the impact of … renewable fuels on … climate change" (where the syntax makes sense) and the other allows EPA to include in the definition of greenhouse gas other gases it determines "contribute to global warming" (a specific question, not a broad grant of authority over "effects on … climate"). *See id.* at 59022 n.138.

and climate." H.R. Rep. 95-294 at 138; *see also id.* at 339 (noting the Committee's awareness of several studies on the potential for fine particulates to "significantly modify the Earth's climate," and then expressing its expectation that the study required in Section 312 of the bill (42 U.S.C. § 7548 note) will place "special emphasis" on "possible weather and climate modification which may result from fine particulate emissions"). It is nonsensical to engage in a war of dictionary definitions when Congress itself left a record of what it understood that term to mean.

Second, EPA claims weather and climate must be read like their fellows. 91 Fed. Reg. at 59022. But EPA's resort to the *noscitur* canon ignores that most of the terms in the definition of welfare are expansive. Effects on water or vegetation may be on a particular river or forest, but there is no reason they could not also be nation- or planet-wide (greenhouse gas pollution has effects on both). The asteroid that killed the dinosaurs undoubtedly affected the welfare of "wildlife." And that is before considering terms like "effects on economic values" and "personal comfort and well-being" that are not locational terms at all: effects on "economic values" cannot naturally be understood to "occur in a particular place or under regionally bounded conditions" and yet EPA says nothing about it.[54] What is more, the definition specifies that the breadth of the term "welfare" "is not limited to" the things Congress enumerated, another unmissable signal that Congress was seeking an all-inclusive list. 42 U.S.C. 7602(h). Yet EPA misses it. EPA's proposal does not explain how its reading is consistent with these additional elements of the welfare definition and commenters cannot guess. EPA has thus failed to consider an important aspect of the problem.

Notably, EPA's proposed interpretation of the welfare definition cites to the legislative history from the 1970 Clean Air Act Amendments, 91 Fed. Reg. at 59022, but takes the wrong lesson. Congress there described its efforts to expand research into welfare effects, describing its concerns in broad terms ("Research efforts also must be directed toward improving knowledge of the causal relationships involving impacts [of air pollution] on socio-economic conditions") and as pertaining to many second- and third-order phenomena (directing attention to "[t]he influence of air pollution agents on impairment of human functions, increased accidents or absenteeism"). S. Rep. 91-1196 at 7, 91st Cong., 2d Sess. (1970); *cf.* 91 Fed. Reg. at 59020 (rejecting harms from "second- and third-order phenomena"). Congress specifically expressed that, "This research effort should extend into welfare effects and aesthetics *in their broadest definition*, including the economy, visibility, weather, and climate." S. Rep. 91-1196 at 7 (emphasis added); *see also id.* at 53 (describing efforts to "improve knowledge of … the short- and long-term effects of [air pollution] agents on the total human environment"). EPA's narrow reading of Section 302(h) is a poor fit where Congress was simultaneously expressing concerns about welfare effects on

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[54] EPA also repeats its claim that "global climate change concerns" (the shorthand EPA uses to avoid the awkwardness of having to describe the long list of harms from climate pollution that are decidedly regional and local) are excluded from "[t]he terms Congress used" in its definition of welfare because these harms "entail a very different and much longer causal chain." *See* 91 Fed. Reg. at 59022. But EPA does not and cannot explain how the pollution it believes *can* be regulated under the Act would have effects on "economic values" or "personal well-being" without different, and less direct, causal chains than those applying to, say, soils.

climate "in their broadest definition" and endeavoring to capture that breadth in its regulatory delegations.[55]

And, as noted above, these definitions came at a time when the potential for anthropogenic emissions of greenhouse gases to change the climate was already a subject of both significant scientific discourse and direct government engagement in both the federal and legislative branches. *See* Comment Part II.B.1. Given this text and context, only a tortured reading of the term "welfare" would endorse EPA's suggestion that it can ignore the primary pollutant threatening the climate when assessing whether power plant pollution has negative effects on "climate."

EPA's claim that the nature of the pollutants it has regulated in the past supports its interpretation that air pollutants include only those that impact at a "local or regional scale" is likewise incorrect. EPA's argument purports to draw lines between greenhouse gases and other supposedly "local" and "regional" pollutants (or pollution), but fails to provide any factual or logical basis to do so. Two problems are apparent immediately, one narrow, one broad. First the narrow: EPA is incorrect that greenhouse gases have no direct local impacts. Greenhouse gas pollution harms directly through increases in heat. *See, e.g.*, 74 Fed. Reg. at 66524-25 (discussing "direct temperature effects"). And as EPA has previously acknowledged, "locally elevated carbon dioxide concentrations" "can have local impacts on, for instance, the extent of ocean acidification." 87 Fed. Reg. at 14365-66 & n.317.[56] That alone defeats EPA's reading.

As for the broad problem in EPA's interpretation: other than enabling the Agency to evade its regulatory responsibilities concerning greenhouse gases, EPA does not articulate any reason why the Act would advance regulation of pollutants that endanger health and welfare across smaller areas but not those that cause harm both within the United States and across the globe. *Cf. Massachusetts*, 549 U.S. at 535 (holding that when assessing endangerment, "EPA must ground its reasons for action or inaction in the statute"). Although greenhouse gases mix evenly in the atmosphere, the on-the-ground impacts they create are very much not evenly or equally distributed, but vary tremendously based on local and regional characteristics and geographies. *See infra* Comment Part VII. The effects of greenhouse gas-driven climate change will have very different manifestations in Alaska, California, Missouri, and New Jersey. Those impacts do not become harmless, or illusory, simply because they have a common cause, or because the impacts may occur quite a distance from the emissions themselves (as do harms from NO_X, PM, or mercury, which may be hundreds or even thousands of miles away from where the pollutants were emitted). Plus, as EPA acknowledges, the standards themselves are national, not particularized to individual areas – yet more evidence that they were not intended to be set for problems that only endanger public health or welfare at a single location where the pollutant is emitted or has been transported. *See* 91 Fed. Reg. at 59022.

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[55] *See generally* Lanier-Christensen, et al.

[56] *See also* U.S. EPA, *Climate Change Indicators: Ocean Acidity*, available at: https://perma.cc/3RP7-V77K; NASEM 2025 Climate Report, *supra* note **Error! Bookmark not defined.**, at 29-30.

On top of that, the design and effect of Section 111's standard-setting provision operates equally well regardless of whether a pollutant is local, regional, or global. In each instance, there is no *practical* barrier to EPA assessing contribution and endangerment, or determining performance standards based on the level of emission limitation achievable with adequately demonstrated technologies. EPA cannot explain why, if cost-effective technologies can reduce power plants' emissions of pollutants that are contributing to harm, Congress would have intended EPA to impose some of those technologies (to reduce supposedly local or regional pollutants) but not others (to reduce supposedly global pollutants). Limiting EPA in that manner is decidedly contrary to the Act's purpose, which is "pollution prevention" writ large. *See* 42 U.S.C. § 7401(c), (b)(1) (announcing that one of the purposes of the Act is "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"). EPA's reading should fail on that ground too.

Further examination reveals additional flaws. EPA fails to demonstrate that being a "local" or "regional" pollutant denotes a set of distinguishing traits that make some pollutants appropriate for regulation while excluding global pollutants. On the contrary, pollutants EPA concedes fall under Section 111 bear relevant similarities to greenhouse gases, including in terms of having effects across a range of "scales," from local to global. For example, pollutants like NO_X affect areas hundreds of miles distant from their point of emission, cause harm because of their interaction with solar radiation (and VOCs), and mix with emissions from international sources. *EPA v. EME Homer City Generation, LP*, 572 U.S. 489, 496 (2014) (noting NO_X transport over "hundreds of miles"); 86 Fed. Reg. 23054, 23063, 23083 (Apr. 30, 2021).[57] As illustration, EPA recently waived certain NAAQS requirements in an Arizona nonattainment area because of the impact of ozone-precursor emissions blowing in from Asia. 90 Fed. Reg. 52019 (Nov. 19, 2025). Mercury, meanwhile, is emitted in different chemical forms, is "persistent" in its elemental form, and is part of a "global [mercury] cycle," 70 Fed. Reg. 15994, 16011, 16012 (Mar. 29, 2005); *see* 65 Fed. Reg. 79825, 79827 (2000) (recognizing the contribution of international mercury emissions to the total of mercury deposited in the U.S.).[58] Like greenhouse gases and NO_X, mercury can also travel hundreds or even thousands of miles – one reason why EPA is a party to an international convention on "global mercury pollution."[59]

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[57] *See also* U.S. EPA, EPA/600/R-20/012, Integrated Science Assessment for Ozone and Related Photochemical Oxidants at ES-3 ("Major contributors [U.S. background] ozone concentrations are stratospheric exchange, international transport, wildfires, lightning, global methane emissions, and natural biogenic and geogenic precursor emissions."), available at: https://perma.cc/T8SJ-8MTQ.

[58] Although EPA does not mention mercury in the Supplemental Proposal, mercury emissions for municipal waste combustors are regulated under Section 111. *See, e.g.*, 91 Fed. Reg. 11802 (Mar. 10, 2026).

[59] U.S. EPA, Minamata Convention on Mercury, https://perma.cc/MJ68-6MG4 (January 7, 2026) (explaining that the U.S. is a party to this international agreement because "[m]ercury pollution is a global problem that requires global action," because it "transcends political borders, and can be transported thousands of miles in the atmosphere," and because "domestic efforts alone are not sufficient to address the effects of global mercury pollution on the U.S. population" where,

The Supplemental Proposal also points to EPA's website to assert that acid rain operates "locally and regionally," *see* 91 Fed. Reg. at 59026 & n.169, but that source explains "Winds can blow SO_2 and NO_X over long distances and across borders making acid rain a problem for everyone and not just those who live close to these sources."[60] EPA's own rulemakings explain that "acid rain[] occurs when emissions of SO_2 and NO_X react in the atmosphere (with water, oxygen, and oxidants) to form various acidic compounds. … Prevailing winds can transport [these] acidic compounds hundreds of miles, across state borders" where they are "deposited onto terrestrial and aquatic ecosystems across the U.S." 76 Fed. Reg. 48208, 48316 (Aug. 8, 2011). EPA fails to explain why the distance traveled by these pollutants falls within the scope of the Act while the distance traveled by greenhouse gases does not.

Focusing on "the scale" at which the impacts operate is a particular misfire on EPA's part, as greenhouse gas pollution plainly *does* impact the American public at the regional and local levels. *See* 91 Fed. Reg. at 59026 (asserting that pollutants like lead or acid rain-forming SO_2 fall within Section 111 because "the scale at which emissions of, and exposure to, each of these air pollutants adversely impacts health or welfare is local or regional"). While the persistence and accumulation of greenhouse gases in the ambient air means adverse impacts of public health and welfare are occurring across the United States and, indeed, across the globe, those problems are, themselves, occurring "at the local or regional scale." *See* 91 Fed. Reg. at 59024. Individual states, cities, and regions are seeing changes in their local weather patterns and in their regional climate. They are experiencing heatwaves or droughts, even as neighboring areas experience wildfires or floods. Across regions of the U.S., these effects are neither evenly distributed nor the same in kind. *See* Comment Part VII. They are the consequence of a pollutant that, like EPA's examples, accumulates in the air and "then threatens harm on a local or regional scale, or both." *Id.* at 59026.[61]

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by some estimates, "global sources contribute about 70 percent of the mercury deposited in the contiguous United States"); *see also* U.S. EPA, Basic Information About Mercury, https://perma.cc/5UR4-KNAF (explaining that "mercury in the atmosphere can be transported over a range of distances – anywhere from a few feet from its source, to halfway around the globe").

[60] U.S. EPA, What is Acid Rain?, available at: https://perma.cc/7PBU-CXP4.

[61] Notably, EPA says at one point, "we use the phrase 'local or regional exposure' to distinguish air pollution that impacts public health or welfare by its presence in the ambient air from 'air pollution' consisting of six well-mixed GHGs that … impacts public health and welfare only indirectly and not by exposure to its presence in the ambient air." 91 Fed. Reg. at 59025. By that explanation, the words "local or regional" appear to be irrelevant to EPA's supposed best reading, with the operative questions instead being only the directness of the harm and whether the harm results from "exposure to [the pollution's] presence." If so, EPA misleads commenters by repeatedly suggesting that the geographic "scale at which emissions … impact[] health or welfare" – global, regional, or local – is essential to its reading. *Id.* at 59026. The proposal thus fails to adequately explain the "the major legal interpretations … underlying the proposed rule," in violation of 42 U.S.C. § 7607(d)(3)(C). But EPA's reading would remain untenable either way.

Likewise, EPA suggests that greenhouse gases are distinct from other regulated pollutants because the associated harm originates from "GHGs becoming well mixed in the upper atmosphere, resulting in elevated global GHG concentrations," 91 Fed. Reg. at 59023, but that distinction is wrong on multiple counts. First, EPA is incorrect about the nature of greenhouse gas pollution, which primarily accumulates in the lower atmosphere (the troposphere).[62] Indeed, despite EPA's claim that the 2015 Findings adopted the "same approach" as the 2009 finding of "defin[ing] [the air pollution] as the combined global concentrations in the upper atmosphere of six 'well-mixed GHGs,'" *see, e.g.*, 91 Fed. Reg. at 59021, EPA never once in the 2009 Finding limits its finding to greenhouse gas concentrations in the "upper atmosphere" or defined the pollution in that manner. *See, e.g.*, 74 Fed. Reg. at 66496, 66497, 66499 (defining the pollution).[63]

Second, the attempt to limit "air pollution" subject to regulation under Section 111 to substances that accumulate in the part of the atmosphere that is closer to the earth's surface was specifically rejected in *Massachusetts*. In that case, the Court considered EPA's conclusion that greenhouse gases should fall outside Section 202 because they "permeate the world's atmosphere rather than a limited area near the earth's surface," but rejected that argument – and the dissent's suggestion that it deserved *Chevron* deference – because, among other things, the text of the Act's definition section "uses the phrase 'the ambient air' without distinguishing between atmospheric layers." *Massachusetts*, 549 U.S. at 529 n.26. That reasoning applies equally to Section 111.

As described below, neither "exposure" nor the causal "directness" of the harm would reasonably preclude greenhouse gases and not other regulated pollutants.

[62] *See, e.g.*, NASA, *Carbon Dioxide: Direct Measurements: 1958-Present*, available at: https://perma.cc/5PZZ-YP5D (tracking the concentrations of greenhouse gas pollution in the "mid-troposphere, the layer of the Earth's atmosphere that is 8 to 12 kilometers (about 5 to 7 miles) above the ground"). EPA also appears to be misusing the term "upper atmosphere," which NOAA defines as the "thermosphere" lying between 53 miles and 375 miles above the earth's surface. Below the thermosphere lies the mesosphere, then the stratosphere, and then the troposphere, which is closest to earth. *See* NOAA, *Layers of the Atmosphere*, available at: https://perma.cc/7EGZ-LVWW.

[63] EPA also suggests in passing that the 2015 Finding diverged from the "contemporaneous understandings" of "air pollution" because, in part, EPA "treated the six long-lived and directly emitted GHGs as the relevant air pollution." 91 Fed. Reg. at 59022. As further discussed *infra* Comment Part VI.B.2, proposing to exclude greenhouse gases from regulation on this basis is entirely unjustified. Numerous other pollutants EPA regulates (and affirms it has authority to regulate) are a pollutant group defined by its similar qualities and effects rather than a single compound, including particulate matter ("PM"), volatile organic compounds ("VOCs"), and nitrogen oxides ("NO_X"). *See infra id.*; 91 Fed. Reg. at 59011 (describing EPA's 1979 source category listings under Section 111 as based on "nine air pollutants," including VOC, NO_X, and PM); 42 U.S.C. § 7602(g) (defining "air pollutant" as "any air pollution agent *or combination of such agents*") (emphasis added).

Third, mercury transport in the stratosphere (not just the troposphere) is "a major driver of mercury pollution,"[64] belying any suggestion that accumulation of a pollutant in the upper atmosphere inherently disqualifies it from being "air pollution" under Section 111 or would separate greenhouse gases from other pollutants over which no one disputes EPA's regulatory authority. *See, e.g.*, 42 U.S.C. § 7429(a)(4) (specifying that "performance standards promulgated under Section 7411" for solid waste incineration units "shall" set limits for mercury).

Fourth, EPA's suggestion that the nature of the impacts differs because greenhouse gases "*need* [to] become globally well-mixed in the atmosphere" to impact the public overstates the relevance of their global dispersal. *See* 91 Fed. Reg. at 59026 (emphasis added). Like other pollutants, greenhouse gases harm public health and welfare by unfavorably altering the characteristics of the surrounding environment in which they are dispersed (in particular, by "interacting with other … environmental factors such as sunlight," *see* 90 Fed. Reg. at 59025, to trap excess heat, 74 Fed. Reg. at 66517). Even if confined to a localized area, elevated concentrations of greenhouse gases would still cause harm by absorbing and then re-emitting infrared radiation as excess heat. That is the basic function of the greenhouse effect – not something that depends on these gases becoming globally well-mixed (which occurs "because their atmospheric lifetimes are much greater than the time scale of a few years for atmospheric mixing"[65]). The global dispersal of greenhouse gas pollution has thus made that pollution more dangerous – because global concentrations have risen enough to trigger disastrous system-wide climatic effects – but EPA is incorrect to suggest that without global dispersal, greenhouse gas pollution would cause no harm.[66]

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[64] Sahana Ghosh, *Mercury pollution driven by stratospheric forces*, Nature India (Jan. 31, 2025), available at: https://perma.cc/76JM-CQBX (reporting on research showing that "[n]early 52% of the mercury transported from the Northern Hemisphere to the Southern Hemisphere occurs through the stratosphere" which "work[s] as a global conveyor belt through which large quantities of gaseous mercury are picked up from industrial regions in the northern hemisphere and dropped off in remote areas regions like such as the Arctic and Antarctic").

[65] Myhre, G., et al., *Anthropogenic and Natural Radiative Forcing*, in Climate Change 2013: The Physical Science Basis, Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change at 668 (Stocker, T.F., et al., eds.), Cambridge University Press (2013).

[66] In fact, if U.S. greenhouse gas emissions (around 20 percent of the world's cumulative historical emissions, *see* Simon Evans, Analysis: Which countries are historically responsible for climate change? CarbonBrief, https://perma.cc/HV2U-WPK5) had been trapped in U.S. airspace alone (with the U.S. comprising less than 2 percent of the earth's surface area, *see Countries and dependencies by area*, Wikipedia, available at: https://perma.cc/YY99-UJHT), greenhouse gas concentrations in our airspace would be substantially higher and direct heat impacts across the United States would (in theory) be worse. *Cf., e.g.*, Myhre, G., et al., *Anthropogenic and Natural Radiative Forcing* at 684 (explaining that climate forcing pollutants with shorter lifespans, like aerosols, "can force local or regional perturbations to climate").

As these facts show, applying general labels to pollutants based on their supposed scope is insufficient to demonstrate that those pollutants actually have distinct and relevant qualities that warrant including some and excluding others for the purposes of Section 111. EPA has failed to demonstrate that its labels "local," "regional," or "global" reflect any meaningful distinctions that would allow for line-drawing between those categories, serve to rationally group the pollutants, or actually bear on the scope of pollutants covered by Section 111. The proposal is thus arbitrary, capricious, and unreasonable.

The Proposal's reference to EPA's supposed past practice additionally fails to fill these gaps. EPA claims that the Agency departed from "forty years of precedent" when it regulated greenhouse gases in 2015. 91 Fed. Reg. at 59024. But EPA in the Supplemental Proposal acknowledges that thirty years ago, in 1996, it set standards for methane from municipal solid waste landfills (which were updated again in 2016). *Id.* at 59012. In attempting to explain away that precedent, EPA suggests the 1996 rule's treatment of methane was based on "well-documented danger of fires and explosions" and described the effects on "global emissions of methane" as only an "ancillary benefit," so it was "not contingent on global climate change concerns." 91 Fed. Reg. at 59012 (citing 61 Fed. Reg. 9905 (Mar. 12, 1996)). But EPA misrepresents its own rule. To begin, EPA described *all* methane reductions – not only those associated with climate change – as "ancillary" to its regulation of non-methane organic compounds (NMOC): "[EPA] considered reductions of NMOC directly and methane reductions as an ancillary benefit." [67]

Indeed, climate change is cited as a basis for the rule in the first paragraph on the first page of the final preamble, on equal footing with the concern about "fires and explosions": "Methane emissions contribute to global climate change and can result in fires or explosions when they accumulate in structures on or off the landfill site." 61 Fed. Reg. at 9905. The two-paragraph section describing the purpose of the rule likewise states that "methane emissions present a well-documented danger of fire and explosion on-site and off-site, and contribute to global climate change as a major greenhouse gas." *Id.* at 9906.[68] And elsewhere, the preamble describes "the reduction of methane emissions in order to mitigate global warming" as one of the rule's "objectives." *Id.* at 9909-10.

More significantly, notwithstanding that EPA set the "best demonstrated technology" based primarily on NMOC reductions, the Agency considered and explicitly relied on "global climate change" to justify the source category's listing and regulation. In the "Background Information Document," cited in the rule as supplying the "further rationale" for its

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[67] U.S. EPA, *Air Emissions from Municipal Solid Waste Landfills – Background Information for Final Standards and Guidelines*, EPA-453/R-94-021 at 2-166 (December 1995) (hereinafter "Landfill Background Document").

[68] *See also* Landfill Background Document at 2-25 – 2-26 (noting that no quantitative assessment was performed for *either* methane's climate change impacts *or* its link to the risk of fire or explosion, but confirming that "landfills emit methane, which has been identified as a greenhouse gas contributing to global climate change," and the rule "will reduce methane emissions by over 47 million Mg").

endangerment finding for landfills, EPA listed the "specific health and welfare effect[s] of concern" that justified the endangerment finding,[69] identifying as "a welfare concern" the contribution of municipal solid waste emissions to "global methane emissions, a major greenhouse gas."[70] The same document again described the "adverse health and welfare effects" in a section responding to comments: "Methane was also a concern, due to the potential it poses for explosions and fire and global climate change impacts."[71]

Methane's impact on climate change was also cited as a reason for the chosen stringency of the rule. EPA explained in response to comments on the stringency of its "emission rate cutoff" that "[t]he Climate Change Action Plan, signed by the President in October 1993, calls for EPA to promulgate a 'tough' landfill gas rule as soon as possible. This initiative also supports a more stringent emission rate cutoff that will achieve greater emission reduction." 61 Fed. Reg. at 9911. It also explained that although the "cost effectiveness is much higher than is typical for NMOC (or VOC) controls in NSPSs," the "chosen alternative is the most cost-effective to achieve the objectives of section 111" due in part to the fact that the "additional methane reductions achieved by this option are … an important part of the total carbon reductions identified under the Administration's 1993 Climate Change Action Plan." *Id.* at 9914.

The rule and its supporting documentation are replete with other indicia that EPA intended to address climate change impacts. The proposal specifically sought comment on "incorporating climate change considerations in the cost analysis and proposals."[72] It considered and responded to multiple comments concerning greenhouse gas regulation and the need for a technology determination for methane alone due, in part, to "the serious health and welfare effects, including global climate change impacts, of methane emissions."[73] It acknowledged that common operations of landfill owners and operators would now need to be harmonized with the rule's objectives, including "the reduction of methane emissions in order to mitigate global warming." 61 Fed. Reg. at 9909-10. And it explained in detail that, "[a]lthough the methane reductions achieved by these rules were considered as ancillary benefits in the analysis, these reductions do have positive global climate change impacts," explaining the potency of methane as a greenhouse gas and the fact that landfills "are the largest anthropogenic source of methane emissions in the U.S., constituting about 40 percent of total emissions." Accordingly, "[t]he MSW landfills NSPS and EG are an important component of the Climate Change Action Plan because of the significant greenhouse gas reductions they provide."[74]

EPA cannot reasonably assert that its reading is consistent with past practice where that practice overtly involved regulating greenhouse gases based on their climate effects. Nor is EPA

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[69] Landfill Background Document at 1-2.

[70] Landfill Background Document at 1-3.

[71] Landfill Background Document at 2-54.

[72] Landfill Background Document at 2-170.

[73] Landfill Background Document at 1-25, 1-31, 2-53, 2-58 - 2-59, 2-163 - 2-166, 2-169, 2-174

[74] Landfill Background Document at 1-57.

taking part in "reasoned decisionmaking" where it fails to accurately characterize the practice on which it relies.

Of course, Section 111 standards for greenhouse gas emissions from power plants and from the oil and gas industry have now been in place for a decade or more. EPA has also committed to greenhouse gas standards for other industries regulated under Section 111. In 2009, it granted a petition for administrative reconsideration seeking Section 111 standards for greenhouse gas pollution from refineries,[75] which it followed with a 2010 settlement agreement, signed with a number of states, that committed to issue a proposed rule to set those greenhouse gas standards.[76] EPA cannot cherry-pick what constitutes past practice by simply backdating the cut-off point to a time before it began regulating other types of pollutants (ignoring, of course, the 1996 landfill methane rule).

But even assuming the pollutants EPA regulated in the 1970s could be understood as different in kind from greenhouse gases, the pollutants EPA chose to regulate in some period of its history are not determinative of the full scope of pollutants authorized for regulation. The definition of "air pollutant" is. Indeed, Section 111's internal definition of stationary sources as buildings that emit "*any* air pollutant" would be an anomalous if by "any" Congress had actually meant "only air pollutants akin to those that EPA chose to regulate in 1979." *See* 91 Fed. Reg. at 59024 & n.151. That remains true whether or not Congress anticipated or identified greenhouse gas regulation specifically. *See Bostock*, 590 U.S. at 674 (noting that "unexpected applications of broad language reflect only Congress's presumed point to produce general coverage – not to

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[75] *See* Letter to Timothy Ballo, et al., from Gina McCarthy, U.S. EPA (Dec. 29, 2009), EPA-HQ-OAR-2007-0011-0318; Petition for Reconsideration (August 25, 2008), EPA-HQ-OAR-2007-0011-0243.

[76] *See* Settlement Agreement (executed by the United States on Dec. 21, 2010), available at: https://perma.cc/Q69N-H9SG. The underlying rule those parties had challenged had declined to set such standards as part of EPA's 8-year review of the existing Section 111 standards for refineries (citing, *inter alia*, EPA's discretion over the timing of standards; the potential impacts on the PSD program, which were later resolved in *UARG*; that fact that *Massachusetts* had been decided only a few months before the proposal was issued; and EPA's belief that regulated greenhouse gases "present issues" that warrant "proceeding initially through a more deliberate process" like an advanced notice of proposed rulemaking, *see* 73 Fed. Reg. 35838, 35858-60 (June 24, 2008)). But the grant of reconsideration reopened those questions and the settlement agreement acknowledged that "based on current knowledge, EPA believes that it is appropriate for it to set standards of performance for GHGs from refineries," Settlement Agreement at 2. *See also* Response to Comment, EPA-HQ-OAR-2008-0260-0150 at 64 (explaining EPA's decision not to set greenhouse gas standards for coal preparation and processing plans, *see* 74 Fed. Reg. 51950 (Oct. 8, 2009), but confirming that should information from the "GHG Mandatory Reporting Rule indicate that it is a more significant source of GHG, then EPA will consider whether to revisit the issue").

leave room for courts to recognize ad hoc exceptions" (citation modified)[77]); *cf. Ethyl Corp. v. EPA*, 541 F.2d 1, 6 (D.C. Cir. 1976) (calling EPA a "watchdog agenc[y] whose task it is to warn us, and protect us, when technological 'advances' present dangers unappreciated or unrevealed by their supporters" and to "evaluat[e] the effects of unprecedented environmental modifications, often made on a massive scale").[78] That is what *Massachusetts* meant when it concluded that "[t]he broad language of § 202(a)(1)['s endangerment provision] reflects an intentional effort to confer the flexibility necessary to forestall [the provision's] obsolescence." 549 U.S. at 532. To understand a defined term like "air pollutant" as confined by the incidental choices EPA made in applying it would also be inviting regulatory manipulation: EPA, or any other agency, could then rewrite the meaning of statutory terms through selective implementation. But that would replace Congress's intent with EPA's. As EPA itself notes, "the statute controls regardless of policy preferences." 91 Fed. Reg. at 59020. Here, it is a broad grant of authority, rather than a narrow one, that effectuates Congress's choice in Section 111.[79]

iii. Nothing in Section 111 limits its scope to pollution that endangers through direct exposure.

The other half of EPA's "best reading" of Section 111 proposes that the term "air pollution" must be read as endangering the public "through local or regional *exposure*." *See* 91 Fed. Reg. at 59022 (emphasis added). EPA defines this as both "exposure to emissions" that "directly affect[] public health or welfare" and also "exposure … to air pollution created through

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[77] *See generally* Richard L. Revesz, *Bostock and the End of the Climate Change Double Standard*, 46 Colum. J. of Env't L. 1 (2020).

[78] As addressed *supra*, however, the Congressional record shows that Congress was not ignorant of greenhouse gases or climate change harms when it wrote expansive language into Section 111 – yet more evidence that Congress was cognizant of what the breadth of its word choices could mean for future regulation of pollutants including greenhouse gases. *See, e.g.*, 116 Cong. Rec. 32,914 (1970) (statement by Sen. Boggs that "[a]ir pollution alters the climate and may produce global changes in temperature"); Johnson Special Message to the Congress at 161 (message from President Johnson to Congress noting that, "Air pollution is no longer confined to isolated places. This generation has altered the composition of the atmosphere on a global scale through … a steady increase in carbon dioxide from the burning of fossil fuels.").

[79] EPA's proposed reading also relies on definitions in lay dictionaries. 91 Fed. Reg. at 59021-22; *see supra*; *see also infra* Comment II.B.2.b.iii. But none of cited definitions would confine the "scale" of pollution so as to exclude greenhouse gases on the basis of not harming locally or regionally, as EPA seeks to do. Neither contamination nor toxicity, *see id.* at 59022, are terms with inherent geographic limitations. For example, the atmosphere on Venus is 95 percent carbon dioxide, which would be toxic to humans at those concentrations, rendering Venus's greenhouse gas concentrations both toxic and global. *See* Marcel Snels, et al., *Carbon dioxide opacity of the Venus' atmosphere*, 103 Planetary and Space Science 347, 347 (2014), available at: https://www.sciencedirect.com/science/article/pii/S0032063314002268; Kris Permentier, et al., *Carbon dioxide poisoning: a literature review of an often forgotten cause of intoxication in the emergency department*, 10 Int J Emerg. Med. at 1 (2017), available at: https://pmc.ncbi.nlm.nih.gov/articles/PMC5380556/.

the reaction of those emissions with other airborne chemicals or conditions." *Id.* at 59024.[80] This reading, EPA suggests, accords with the fact that previously regulated pollutants (and pollutants elsewhere in Title I, *see infra* Comment Part II.B.2.b.iv) caused problems like "smog and health and welfare impacts related to inhalation and physical contact," *id.* at 59022; and with contemporaneous use of these terms in dictionaries and other public sources, *id.* at 59021-22. These sources are inadequate to support EPA's conjured new meaning.

As with EPA's arguments about local and regional pollutants, EPA attempts to magic into being terms that do not appear in the text. Nowhere in Section 111 does Congress refer to "exposure" (or, for that matter, "directly affect," "contamination," "toxicity," "smog," "inhalation," or "physical contact," *see infra*). Congress could have used a phrase like "harm through exposure" to expressly narrow the pollutants covered by Section 111 (assuming, *arguendo*, that demanding harm through exposure would in fact exclude greenhouse gases), but it did not. The omission of any terms to that effect must be presumed to be intentional – especially where the Act uses the term "exposure" dozens of times in numerous other provisions but not this one. *See Russello v. United States*, 464 U.S. 16, 23 (1983) ("Where Congress includes particular language in one section of a statute but omits it in another section of the same Act, it is generally presumed that Congress acts intentionally and purposely in the disparate inclusion or exclusion." (citation modified)); *see also, e.g.*, 42 U.S.C. §§ 7403(d)(2)(B) ("The evaluation shall be based on reasonably anticipated toxicity to humans and exposure factors such as frequency of occurrence as an air pollutant and volume of emissions in populated areas."), 7403(d)(2)(C) (assessments shall include, "where appropriate, an identification of additional activities, including toxicological and inhalation testing, needed to identify the types or levels of exposure which may present significant risk of adverse health effects in humans"), 7412(b)(2) (EPA shall "where appropriate, revise such list by rule, adding pollutants which present, or may present, through inhalation or other routes of exposure, a threat of adverse human health effects"), 7412(m)(6) (requiring EPA to promulgate "such further emission standards or control

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[80] It is not clear from the proposal where EPA derives two separate categories in the Act: one covering pollutants that harm through exposure and one covering pollutants that contribute to air pollution that harms through exposure. To the extent EPA believes the distinction reflects the statutory text's references to pollutants that "cause or contribute," that reading of the text ignores clear evidence that Congress did not intend "cause or contribute" to refer to different kinds of pollutants but to ensure instead that the Act addressed both sources solely responsible for particular air pollution problems and those who were responsible for only a share of those problems. H.R. Rep. 95-294 at 51 (describing Congress's intent that "cause or contribute" provisions "require the Administrator to consider all sources of the contaminant which contribute to air pollution"); *see also* Significant Contribution Proposal, 90 Fed. Reg. at 25763 n.91 (confirming that the present EPA believes "'causes' generally refers to emissions that are the sole part of the air pollution problem," while "[t]he use of the term 'contribute' clearly indicates a lower threshold than the sole or major cause" – a potential contradiction between EPA's proposals that it arbitrarily ignores). But no matter the origin, both purported categories of pollutants EPA describes rely on the presumption that Congress believed "exposure" to be a key feature of Section 111 pollution, despite any text to that effect.

measures as may be necessary and appropriate to prevent such effects, including effects due to bioaccumulation and indirect exposure pathways").

The term "air pollution" does not provide a backdoor means of importing narrowing terms that Congress intentionally omitted from both the definition of "air pollutant" and the text of Section 111 itself. First, the Supreme Court after *Massachusetts* has described that case as determining the scope of the regulated "air pollution." *See supra* Comment II.A; *AEP*, 564 U.S. at 424 ("*Massachusetts* made plain that emissions of carbon dioxide qualify as air pollution subject to regulation under the Act."); *see also West Virginia v. EPA*, 597 U.S. at 711 ("Things changed in October 2015, when EPA promulgated two rules addressing carbon dioxide pollution from power plants."); *Coal. for Responsible Regul.*, 684 F.3d at 117 (describing the "particular 'air pollution'" at issue, "here, greenhouses gases," in a portion of the opinion on which certiorari was denied); Oral Argument Transcript, *Suncor Energy* (Justices repeatedly referring to greenhouse gases as "pollution").

Second, EPA has no business relying on how "pollutant" or "pollution" were defined by outside dictionaries "[a]t the time Congress added the terms 'air pollutant' and 'air pollution' to CAA section 111." 91 Fed. Reg. at 59021. *Congress* defined "air pollutant" itself and EPA does not get to redefine it in a manner contrary to the actual text (and *Massachusetts*). And as noted above, the reference to "air pollution" in Section 111(b)(1)(A) does not invite EPA to go fishing for "ordinary meaning" where Congress conveyed its intended meaning through the definition of "air pollutant." "When Congress takes the trouble to define the terms it uses, a court must respect its definitions as 'virtually conclusive.'" *Kirtz*, 601 U.S. at 59 (quoting *Sturgeon*, 587 U.S. at 56); *see also Stenberg v. Carhart,* 530 U.S. 914, 942 (2000). Even where not defined, "statutory terms can carry meanings that depart from their ordinary ones," because "Congress may … define a word or phrase in a specialized way or employ a term of art with long-encrusted connotations in a given field." *Feliciano v. Dep't of Transp.*, 605 U.S. 38, 45 (2025). As explained below, greenhouse gases fall within EPA's stab at ordinary meaning, but EPA need not get that far: because "air pollutant" is a defined term and "air pollution" is merely a variant of that defined term, EPA cannot use that phrase as the Trojan horse through which to introduce a whole new set of modifiers ("through local or regional exposure") that do not appear anywhere in the text. *Supra* Comment Part II.B.2.a & b.i.

Third, EPA does not actually explain how, if the statute includes greenhouse gases as "air pollutants," the meaning of "air pollution" could be understood to be something narrower. *See supra* Comment Part II.B.2.b.i. To the contrary, EPA's (re)interpretation examines alternative meanings of both "pollutant" and "pollution," 91 Fed. Reg. at 59021-22, and shows that lay dictionaries from before the 1970 Amendments likewise understood these terms as variants of each other. EPA's cited dictionary definitions – inapposite though they are – agree that pollution is the "the action of polluting," and a pollutant is "something that pollutes."[81] Indeed, Section

[81] Pollution, Pollutant, Webster's Third New Int'l Dictionary 1756 (1966); *see also* Pollute, Pollutant, Am. Heritage Dictionary 547 (1969) (defining "pollutant" as "[a]nything that pollutes" and "pollution" as the noun form of pollute). EPA cites the "1970" version of the American Heritage Dictionary, but both the 1969 and 1970 versions (published by Dell) do not have a separate definition for "pollution," as EPA suggests, and EPA's citation is insufficient to identify

302's definition of "air pollutant" directly incorporations "air pollution," defining the former term to include "any air pollution agent or combination of such agents. 42 U.S.C. § 7602(g). Accordingly, while the terms "air pollutant" and "air pollution" have different functions in the text of Section 111, their conceptual and linguistic relationship means that, as a scientific matter, EPA could not define one to include an entire class of compounds or molecules that the other one excluded. On top of that, Congress has referred specifically to "greenhouse gas air pollution" elsewhere in the Act, yet more evidence that it views greenhouse gases as contributing to "air pollution." *See, e.g.*, 42 U.S.C. § 7437 (titled "Greenhouse gas air pollution plans and implementation grants").

Fourth, even if "air pollution" could be understood differently than, simply, the resulting concentration of emitted "air pollutants," EPA's resort to lay dictionaries skips past how these terms were used in the context of pollution control specifically. "Pollution" is not defined in the Clean Air Act, but it *is* defined in the Clean Water Act, which is a more useful indicator of how that term is used in pollution control contexts than lay definitions applicable to common speech. That definition, added in 1972, states: "The term 'pollution' means the man-made or man-induced alteration of the chemical, physical, biological, and radiological integrity of water," 33 U.S.C. § 1362(19),[82] a definition that would fairly encompass greenhouse gas pollution if applied to air instead. Coming from a companion statute enacted at a comparable time in the same field, this is evidence of a "specialized" meaning or "term of art" that would take precedence over "ordinary meaning" if the two diverged. *See Feliciano*, 605 U.S. at 45. Indeed, it reflects a natural expression of EPA's purview in the case of both clean air and clean water: to address the "alteration" of the natural environment's "integrity."

Even if EPA's dictionary definitions had bearing here, however, the Agency's reliance on the "underlying concept of dangerousness and contamination" would not constitute a principled basis for writing greenhouse gases out of Section 111. 91 Fed. Reg. at 59022. Webster's Third New International Dictionary, which EPA relies on, *id.*, includes in its definition of "contaminate," "to render unfit for use by the introduction of unwholesome or undesirable elements," giving as an example "water contaminated by sewage."[83] Greenhouse gases, like other pollutants, are entering the ambient air ("the introduction of … [an] undesirable element[]") and altering its composition in a manner that is increasingly dangerous to the public and the environment ("render[ing]" it "unfit").[84] "Dangerousness and contamination" are, therefore, insufficient to exclude greenhouse gases from Section 111. If EPA means to rely on a further connotation of impurity or unnaturalness, 91 Fed. Reg. at 59022, then it is ignoring the

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what other document it might be citing. In any case, EPA's cited definition for "pollution" is also parallel to its definition to "pollutant," so the point remains the same.

[82] *See* Pub. L. No. 92-500, 86 Stat. 887 (1972).

[83] Contaminate, Webster's Third New Int'l Dictionary 491 (1966).

[84] Oddly, EPA also cites as supportive the definition in 302(g), which just defines air pollutants as "air pollution agents" that are "emitted into or otherwise enter[] the ambient air" – which greenhouse gases are by their nature alone and indisputably are by *Massachusetts* defining them so. *See supra* Comment Part II.A.

fact that other acknowledged air pollutants, like nitrogen oxides, that occur naturally in the environment.[85] If EPA means to rely instead on connotations of "toxicity" or "noxiousness," 91 Fed. Reg. at 59022, then it runs into the barrier that Section 111 protects against harm to components of "welfare" (such as "visibility") which occur by means other than either toxicity or noxiousness. Nor does it clarify how any of these terms actually relate to "local or regional exposure;" amongst its many proffered dictionary definitions, that is one term EPA does not actually define.[86]

On that, once again, the definition of "welfare" is instructive (and, indeed, determinative). As described at length above, Section 302(h) defines the "welfare" harms Section 111 was designed to address as including adverse effects on intangible concepts like "climate," "economic values," and "personal comfort and well-being," 42 U.S.C. § 7602(h), so claiming that Section 111 was intended to exclude consideration of climate harms is contrary to plain text and the height of arbitrariness and unreasonableness. EPA attempts to dispose of this problem by asserting (wrongly, as discussed above in Comment Part II.B.2.b.ii) that Congress intended to limit the scope of "climate" and "weather" to that "occurr[ing] in a particular place or under regionally bounded conditions." 91 Fed. Reg. at 59022. But even if those terms were narrower in geography (they are not, *see supra*), EPA's "best reading" is that the air pollution in question must endanger "through local or regional *exposure*." EPA is still short a reasoned explanation of how pollution could be understood to endanger *climate* through local or regional *exposure*. Suggesting that "the weather was harmed by *exposure* to pollution," or that "economic values were harmed by *exposure* to pollution," shows that this term does not match the statutory task. The question the statute actually asks – in this context, "does pollution endanger economic values" – makes far more sense without the constraint implied by "exposure" than it does with it.[87]

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[85] Not to mention pollutants regulated in other contexts, like "heat" or "sand." 33 U.S.C. § 1362(6).

[86] As noted below, the definitions of "exposure" in EPA's chosen sources would not help its cause – perhaps the reason they were omitted. But as noted here, EPA cannot just mean harm through "inhalation and physical contact," *see* 91 Fed. Reg. at 59022. Neither would match with harms like "hazards to transportation," "weather," or even "personal comfort and wellbeing" (as distinct from "health"), which are regulated harms under Section 111. *See* 74 Fed. Reg. at 66528 ("The inclusion of the phrase 'effects on * * * personal comfort and wellbeing' as an effect on welfare … would logically mean something other than the different term public health. The term 'wellbeing' is not defined, and generally has a broader and different connotation of positive physical, emotional, and mental status. The most straightforward meaning of this term, in a context where Congress used the different term public health in a wide variety of other provisions, would be to include effects on people that do not rise to the level of health effects, but otherwise impact their physical, emotional, and mental status. This gives full meaning to both terms.").

[87] EPA notes elsewhere that the 2009 vehicle finding explained that greenhouse gases differed from other pollutants regulated under Section 111 because the "human health effects" did not result from "direct exposure," and that the finding acknowledged that some effects were welfare

Other positive indicia point the same way: the definition of welfare incorporates harms resulting from "transformation, conversion, or combination with other air pollutants" – yet more capacious language indicating that Congress was not focused only on limited pathways of harm like direct exposure, but intended "welfare" to cover a much wider array of impacts. 42 U.S.C. § 7602(h). So too with Congress's choice of the term "endanger," which speaks to being in a state of risk or danger and is evidently more capacious than impacts from "smog[,] … inhalation and physical contact." 91 Fed. Reg. at 59022.

And as explained above, EPA is also incorrect about the contemporaneous understanding of the term "air pollution," which was used in scientific and federal government documents and testimony – including debates about the Clean Air Act – to refer to pollution changing the earth's climate and not just to pollutants causing "smog" or harming by "inhalation of physical contact." *Supra* Comment Part II.B.2.b.i.

Ultimately, it is not even evident that EPA's proffered interpretation would *include* the pollution EPA claims it may regulate and also *exclude* the regulation of greenhouse gases.[88] For

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effects as distinct from health effects, while others might be categorized either way. *See* 91 Fed. Reg. at 59013, 59023 (citing 74 Fed. Reg. at 66527). These statements do not bolster EPA's proposed interpretation, however, and if anything undercut it. Even if it is natural to call some health effects the result of "exposure," it does not follow that all health harms operate this way and, as noted above, it is incongruous to suggest all welfare effects do. *See* 74 Fed. Reg. at 66527 (noting that in the NAAQS context, EPA has considered "indirect health effect[s]" of ozone like its effect on "screening of harmful UVB rays" and noting that the term "public health" is undefined); *id.* at 66529 (considering as "health effects" the "injury and death from fires resulting from landfill gasses" even though they "did not result from direct exposure to the pollutant"). The examples from the NAAQS and landfills context also belie EPA's suggestion that the fact that specific harms from climate change might be considered either health or welfare harms showed "that the causal chain [for greenhouse gases] was different in kind from the type of 'air pollution'" typically addressed under the Act's endangerment provisions. *See* 91 Fed. Reg. at 59023 n.140.

[88] Both greenhouse gases and NO_X may be dangerous to breathe in high enough concentrations, *see* 91 Fed. Reg. at 59022 (describing the historical meaning of local or regional exposure as involving "impacts related to inhalation and physical contact"), but EPA has not limited itself to regulating NO_X on that basis: it regulates both pollutants for the secondary effects these chemical agents have once dispersed over broader distances (where they trap heat or create smog, respectively). EPA's interpretation fails to draw a rational line between them. So too with VOCs, which EPA regulates for their smog-forming potential alone – not for the harms that arise from direct exposure to VOCs (namely, inhalation), which, because they relate to indoor air quality, are beyond EPA's authority. *See Volatile Organic Compounds' Impact on Indoor Air Quality*, U.S. EPA (July 24, 2025), available at: https://perma.cc/9TRE-W928; *Does EPA Regulate Volatile Organic Compounds (VOCs) in Household Products?*, U.S. EPA (Feb. 24, 2025), available at: https://perma.cc/9W6N-2EDR ("While we do regulate VOCs in outdoor air, from an indoor air perspective, EPA has no authority to regulate household products (or any other aspect of indoor air quality.)").

example, greenhouse gases *do* contribute "to air pollution that harms health and the environment through exposure" – through public exposure to ozone attributable to increased methane emissions,[89] through ocean exposure to elevated carbon dioxide levels that trigger ocean acidification,[90] and through public and individual exposure to excess heat. 74 Fed. Reg. at 66524-25 (discussing "direct temperature effects"). Even tacking on a requirement that it be the "pollution that *itself* endangers," 90 Fed. Reg. at 36300 (emphasis added), greenhouse gases unequivocally accumulate into air pollution that "itself endangers" the "climate" under the terms of Section 302(h). Plus, EPA's chosen dictionary defines "exposure" as "a condition of being exposed to danger or loss" (where "exposed" means "la[id] open to (as to … danger)" or "subject to").[91] Restricting Section 111 to pollution that endangers by "lay[ing]" the public "open … to danger" on a local or regional scale would easily encompass all harms from climate change. The lack of logic, let alone clarity, in the operation of EPA's own terms here renders its interpretation arbitrary and capricious. *See Motor Vehicle Mfs. Ass'n v. State Farm Mutual Auto. Ins. Co.*, 463 U.S. 29, 43 (1983) ("*State Farm*") ("[T]he agency must examine the relevant data and articulate a satisfactory explanation for its action including a 'rational connection between the facts found and the choice made.'" (citation modified)); *cf. Evergreen Shipping Agency (Am.) Corp. v. Fed. Mar. Comm'n*, 106 F.4th 1113, 1118 (D.C. Cir. 2024) ("Certainly, if the result reached is illogical on its own terms, the agency's order is arbitrary and capricious." (citation modified)).

Like the terms "local or regional," EPA does not manage to explain precisely what "exposure" means. What EPA seems to come up with is that somewhere along the line, the public is supposed to be harmed by its encounter with the pollution itself or with its downstream consequences. But EPA's traditional understanding of both health and welfare harms quickly erodes this line. Excessive heat or wildfire smoke are downstream consequences of greenhouse gas concentrations just as acid rain is a downstream consequence of SO_2 concentrations or explosions are a downstream consequence of landfill gas concentrations. Drought is no less impactful on human welfare than impeded visibility. And harms to economic values or (non-

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[89] *See* 89 Fed. Reg. 16820, 16840 (Mar. 8, 2024) ("The tropospheric ozone produced by the reaction of methane in the atmosphere has harmful effects for human health and plant growth in addition to its climate effects."); U.S. EPA, *Integrated Science Assessment for Ozone and Related Photochemical Oxidant*s, EPA/600/R-20/012 at ES-3, available at: https://perma.cc/T8SJ-8MTQ ("Major contributors [U.S. background] ozone concentrations" include "global methane emissions.").

[90] *Climate Change Indicators: Ocean Acidity*, U.S. EPA (Jan. 15, 2025), available at: https://perma.cc/LN9D-V3FL ("Ocean chemistry is not uniform around the world, so local conditions can cause pH or aragonite saturation measurements to differ from the global average. For example, carbon dioxide dissolves more readily in cold water than in warm water, so colder regions could experience greater impacts from acidity than warmer regions. Air and water pollution also lead to increased acidity in some areas."); 87 Fed. Reg. 14332, 14365-66 & n.317 (Mar. 14, 2022); NASEM 2025 Climate Report at 29-30.

[91] Exposure, Webster's Third New Int'l Dictionary 802 (1966); *see also* Exposure, Expose, Am. Heritage Dictionary 253 (1970) (defining "exposure" as the "[a]n act or instance of … being exposed," where "expose" means "[t]o subject; lay open, as to an influence or danger").

health) impacts on personal well-being presume a broader net of consequences, not merely those resulting from some narrow view of direct contact. EPA's "best reading" is, thus, merely an expression of policy: harm under Section 111 is everything except whatever greenhouse gas pollution does. A results-oriented reading is inherently arbitrary and capricious, and this specific reading is contrary to both text and context.

iv. Title I's provisions were not designed for local/regional air pollution alone.

EPA asserts, incorrectly, that the text, purpose and history of Section 111 and of Title I as a whole demonstrate that Section 111 reaches only air pollutants that harm health or welfare through local or regional exposure. To the contrary, the history of Title I demonstrates that Section 111 has multiple purposes, not only the ones EPA asserts, and that Congress included many provisions in Title I that reach kinds of air pollution that disperse over intercontinental distances and harm human health and welfare without direct exposure.

This is EPA's claim:

> [T]he scope of the air pollutants addressed under CAA sections 107-110 and section 112 informs the EPA's authority to regulate under title I, including under CAA section 111. … [B]ecause CAA section 111 was designed to work in concert with these provisions by ensuring that new sources did not exacerbate existing air pollution problems and by preventing new sources from geographic forum shopping, it follows that Congress intended it to address the same types of air pollutants and air pollution.

91 Fed. Reg. at 59026. This is incorrect for many reasons.

First, while supporting attainment of the National Ambient Air Quality Standards (NAAQS) is *one* function Congress intended Section 111 to serve, EPA is wrong to assert this is the *only* function Congress intended it to have. It may be correct that "Section 111 was designed to work in concert with [Sections 107-110] by ensuring that new sources did not exacerbate existing air pollution problems and by preventing new sources from geographic forum shopping." 91 Fed. Reg. at 59026. But it does not "follow[] that Congress intended it to address [only] the same types of air pollutants and air pollution." *Id.*

EPA quotes Senator Edmund Muskie's statement in 1970 that Section 111 is intended to require all new sources to be well controlled to eliminate the economic incentive for new sources to locate outside polluted areas to the detriment of those areas' economies and the clean areas' superior air quality. 91 Fed. Reg. at 59010. True, that was *one* of Section 111's purposes, but not its only one. Senator Muskie also warned of air pollutants that "threaten irreversible atmospheric and climatic changes." 116 Cong. Rec. 32,901 (Sept. 21, 1970). And Section 111 provides authority to address pollutants from stationary sources in addition to NAAQS-related pollutants.

Textually, there is nothing in Section 111(b) or (f) that restricts performance standards for new and modified sources to only the NAAQS-related air pollutants. *See* 42 U.S.C. § 7411(b), (f). Many prior NSPSs address air pollutants that are not NAAQS-related. *See, e.g.*, 40 C.F.R. 60 Subpart H (sulfuric acid mist); *id.* Subpart T (fluorides); *id.* Subpart LLL (total reduced sulfur); *id.* Subpart XXX (landfill gas). There are also no words in the text of Section 111 that limit "air

pollution" to pollution that harms health or welfare through direct exposure, that mention "local or regional," or that limit the methods by which, or the distance over which, emissions may contribute to endangerment.

Indeed, the text of Section 111(d) *affirmatively refutes* the notion that it is limited to NAAQS-related emissions. Added as the 1970 Conference Committee reconciled the House and Senate bills, Section 111(d) is expressly aimed at dangerous pollutants that *are not* curbed under Section 110 or 112. 42 U.S.C. § 7411(d)(1). Congress adopted Section 111(d) in 1970 precisely to provide authority to curb emissions of non-NAAQS, non-NESHAPS pollutants that harm health and welfare. That provision reflected the congressional policy that "there should be no gaps in control activities pertaining to stationary source emissions that pose any significant danger to public health or welfare." S. Rep. No. 91-1196 at 20 (1970). Like the rest of Section 111, Section 111(d) contains no language limiting it to pollutants that harm health and welfare through local or regional exposure.

So, since Section 111(b) is not limited to NAAQS pollutants, and since Section 111(d) is affirmatively aimed at pollutants other than NAAQS pollutants, there is no basis for EPA's assertions that the section's only role is to support NAAQS attainment, and that it is limited to pollutants that harm health or welfare through local or regional exposure.

The proposal also asserts more broadly that *Title I as a whole* is limited in scope to pollutants that harm health or welfare through direct exposure and are local or regional in origin. *See* 91 Fed. Reg. 59023. This is plainly not true.

An obvious example is the ozone layer protection provisions that Congress enacted in 1977. The proposal appears unaware that the ozone layer provisions since amended and reorganized into Title VI *were originally part of Title I*. EPA says: "Most tellingly, Congress adopted a new regulatory regime in 1990 – title VI – in response to global concerns about depletion of the ozone layer, which contains its own findings, policies, and regulatory authorities that required the EPA to phase out domestic use of ozone-depleting substances." 91 Fed. Reg. at 59024. On this mistaken premise, EPA argues that their placement in Title VI signifies that Title I does not address pollutants with broader and more indirect pathways to harm. *Id.*

In fact, the Act's original provisions to regulate these substances were located *in Title I.* The 1977 amendments included Section 150-159 on ozone layer protection, in Title I. Pub. L. 95-95, 91 Stat. 685, 726-31 (1977). Contrary to EPA's suggestion that the statutory "findings, policies, and regulatory authorities" for ozone protection were adopted only in 1990, Congress adopted those findings, policies, and authorities in the 1977 amendments to Title I. Section 151(a) included congressional findings that:

> (1) halocarbon compounds introduced into the environment potentially threaten to reduce the concentration of ozone in the stratosphere;
>
> (2) ozone reduction will lead to increased incidence of solar ultraviolet radiation at the surface of the Earth;

> (3) increased incidence of solar ultraviolet radiation is likely to cause increased rates of disease in humans (including increased rates of skin cancer), threaten food crops, and otherwise damage the natural environment;
>
> (4) other substances, practices, processes, and activities may affect the ozone in the stratosphere, and should be investigated to give early warning of any potential problem and to develop the basis for possible future regulatory action; and
>
> (5) there is some authority under existing law, to regulate certain substances, practices, processes, and activities which may affect the ozone in the stratosphere.

91 Stat. 726. Section 157 provided new authority to regulate these compounds:

> If . . . in the Administrator's judgment, any substance, practice, process, or activity may reasonably be anticipated to affect the stratosphere, especially ozone in the stratosphere, and such effect may reasonably be anticipated to endanger public health or welfare, the Administrator shall promptly promulgate regulations respecting the control of such substance, practice, process, or activity, and shall simultaneously submit notice of the promulgation of such regulations to the Congress.

91 Stat. 729-30.

These provisions show that, contrary to EPA's current fictional vision, Congress did not limit Title I to only pollution that harms health and welfare through local and regional exposure. On the contrary, the 1970 Act provided authority within Title I to curb air pollution from stationary sources that mixes globally and harms health and welfare indirectly, in this case by destroying ozone miles overhead, leading to human and environmental exposure to increased ultraviolet radiation. As indicated by clause (5) above, the 1977 Amendments supplemented EPA's "authority under existing law," in this case not just permitting but *requiring* the agency to address *any* "substance, practice, process, or activity" that releases ozone-depleting substances, not just emissions from stationary sources.

As another example, before the enactment of Title IV in 1990, EPA had authority to curb acid rain-causing pollution in Title I's provisions to curb sulfur dioxide and oxides of nitrogen. Those authorities included Section 111. In contrast to Congress's 1990 decision to entirely move Title I's ozone protection provisions to Title VI, when Congress that same year adopted Title IV, it retained the original authorities to curb SO_2 and NO_X in Title I.

EPA has long interpreted the pre-1990, pre-Title IV provisions in Title I that authorize SO_2 and NO_X standards as applicable to curbing those pollutants' contribution to *long-range* transport of air pollution to Europe and beyond. Indeed, the U.S. became a party to the 1979 Convention on Long Range Transport of Air Pollution in 1981 on the basis that its requirements could be met by the then-extant Title I provisions of the Clean Air Act.[92] The EPA proposal never

[92] *See* Nigel Purvis, Resources for the Future, Paving the Way for U.S. Climate Leadership at 32 (April 2008), https://media.rff.org/documents/RFF-DP-08-09.pdf ("The Convention on Long

clearly defines the geographic limitations of "regional," but at these intercontinental distances, the distinction between regional and global pollution becomes meaningless.

The fact that Congress in 1990 supplemented the earlier Title I ozone protection and SO_2/NO_X provisions and located the new provisions in Titles IV and VI does not support EPA's mistaken view that the 1970 and 1977 provisions of Title I were *ever* limited only to addressing direct exposure to pollution originating locally or regionally. It simply represents a decision to give certain lengthy provisions their own titles for organizational clarity.

These Title I authorities illustrate an additional point: that EPA has authority to control not just pollutants that harm health or environment in the form that they emerge from smokestacks or tailpipes, but also pollutants that undergo complex atmospheric transformations before causing harm. For instance, VOCs and NO_X transform into tropospheric ozone, the NAAQS pollutant, through complex chemical reactions in the presence of sunlight.[93] SO_2 and NO_X transform into sulfates and nitrates, forms of the NAAQS pollutant particulate matter, over long distances through similarly complex atmospheric chemistry pathways.[94] While VOCs, NO_X, and SO_2 can have negative impacts on their own through direct emissions, the vast majority of the harm they cause – and by far the main reason they are regulated – is their status as precursors to the other pollutants mentioned above. Yet EPA's authority over such pollutants is unquestioned. *See* Comment Part II.B.b.iii, *supra*.

EPA's insistence that it lacks authority over greenhouse gases because these pollutants do not harm health or the environment directly is wrong for at least two other reasons. First, greenhouse gases *do* have directly harmful effects, such as direct temperature effects and ocean acidification. *See* Comment Part VII.C, *infra*. Second, greenhouse gases operate very similarly to the ozone-depleting substances that the 1977 amendments included in Title I: chlorofluorocarbons (CFCs) are not directly toxic but they cause harm by depleting stratospheric ozone, increasing the dangerous UV radiation to which we are exposed.[95] Likewise, greenhouse gases are not directly toxic but harm health and welfare by increasing the temperatures and extreme weather events to which we are exposed. Thus, just as there was "some authority under existing law" to address ozone-depleting substances before 1977 (and the same for acid rain-

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Range Transboundary Air Pollution (LRTAP), a multilateral agreement that creates a framework to reduce the pollution its name describes, was entered into by the United States as a sole executive agreement precisely because the Clean Air Act provided sufficient authority for the President to comply with the agreement."); *see also* U.S. EPA, *Selected Multilateral Environmental Instruments In Force for the U.S.*, Convention on Long-range Transboundary Air Pollution (Dec. 16, 2025), https://perma.cc/ZRS5-3GDB (noting that the Convention "[f]or the United States, incorporates standards set under the Clean Air Act").

[93] U.S. EPA, Integrated Science Assessment for Ozone and Related Photochemical Oxidants at 1-9 (2020), https://www.epa.gov/system/files/documents/2026-06/isa_ozone_final-2020.PDF.

[94] U.S. EPA, Integrated Science Assessment for Particulate Matter at 2-13 (October 2019), https://www.epa.gov/system/files/documents/2026-06/isa_pm_final2019.PDF.

[95] U.S. EPA, Basic Ozone Layer Science (March 4, 2026), https://perma.cc/3F74-Q628.

causing pollutants before 1990), since 1970 there has always been authority under Title I – and Section 111 in particular – to curb greenhouse gas emissions.

In short, nothing about the design of Title I supports the erroneous claim that Section 111 is exclusively limited to a supporting role in achieving attainment of the NAAQS, limited to pollutants that harm health and welfare directly, or limited to pollutants that disperse only locally or regionally.

v. EPA's further assertions concerning "international" pollution problems are baseless.

EPA advances a further set of arguments based around the Section 111's supposed incompatibility with pollution problems where "most of the endangerment stems from international sources." 91 Fed. Reg. at 59024. But the tenuous connections drawn in these arguments are contrary to the text or otherwise unsupported.

First, the Supreme Court in *Massachusetts* rejected this logic, explaining in the context of a standing attack that the presence of even large or growing international contributions does not obviate EPA's duty to use its authorities to address emissions in the United States. 549 U.S. at 523-525. EPA's reasoning fails that test.

Second, Section 111 by its own terms does not ask whether source categories contribute to pollution "more than foreign emitters" or to pollution "whose sources are solely domestic." The text does not, in fact, engage at all with who the other contributors might be, asking only whether *this* source category is a significant contributor to a problem and so should bear some responsibility for that problem. *Cf. id.* at 524 ("Agencies, like legislatures, do not generally resolve massive problems in one fell regulatory swoop."). EPA notes the absence of modifiers like "international," but the absence of any modifiers at all signals the provision's breadth. Indeed, EPA's own references to provisions like Section 179B prove the point, as they show that Congress knew how to provide mechanisms to excuse sources from regulatory consequences on the basis of international contributions. But despite being attentive to such concerns, Congress pointedly chose not to include any such mechanism, or narrowing language, here. To the contrary, the legislative history shows that Congress was focused on ensuring individual contributors did not escape responsibility for their contributions to air pollution simply because they were just one among many sources. *See* H.R. Rep. 95-294 at 49-50.

Third, EPA suggests that global problems should be excluded from Section 111 because the section limits source category listing to "significant" contributors. But that term cannot be spun into a reason to exclude whole classes of pollution problems or pollutants. True, the term "significantly" sets a threshold for listing source categories, but like the text as a whole it is neutral as to who (and where) other contributors might be. Nor does the presence of international contributors establish that a U.S. source category will necessarily contribute insignificantly. That is a factual question, not a legal one, so the fact that *some* sources may not be significant to *some* problems on a case-by-case basis does not speak to the meaning of statutory terms applicable for all sources and all pollutants in all cases. EPA's proposed reading is especially anomalous given Congress's view of Section 111 as "precautionary or preventive," imposing a "duty to assess risks rather than wait for proof of actual harm" so that EPA can prevent problems that may not yet be known. H.R. Rep. 95-294 at 51; *see id.* at 46-47.

Importantly, this proposal disclaims that it is making new factual or scientific findings that the source category's contribution to greenhouse gas pollution is "insignificant." *See, e.g.*, 91 Fed. Reg. at 59019. So EPA's insinuation that "the threshold for a quantity of GHGs to comprise a 'significant' contribution to … to elevated atmospheric GHG concentrations … is well above the *likely* contributions of a single source category," *id.* at 59024 (emphasis added), is unsupported speculation, not a proposed finding that has been subject to proper notice and comment on the basis of a factual record (including, as would be necessary, a review of the 2015 record supporting a finding of significance). Accordingly, EPA cannot claim either logically or factually that greenhouse gases should be categorically excluded from Section 111 on the basis of the Agency's unsupported musings about the category's present significance – musings that, as this comment shows, are contrary to the facts.[96]

Fourth, EPA's attempt to leverage other statutory provisions (enacted and unenacted) is unpersuasive. As noted above, several of the cited provisions show Congress knew how to address the potential interaction of domestic and international emissions when setting statutory obligations, and yet it did not do so here. And EPA is wrong about the particular import of these provisions in any case.

EPA claims that Clean Air Act Sections 179B and 115 support its proposed interpretations that Section 111 does not permit domestic regulation when most emissions are from international sources. 91 Fed. Reg. at 59024. This assertion is plainly incorrect. Rather, these provisions support that Congress intended regulation of domestic sources impacting public health and welfare even when there is significant international contribution, and that such impact is not limited to local or regional exposure.

As described further below, there is nothing in the text or context of these two provisions suggesting that they are intended to exclude regulation of domestic pollution with international influences. Importantly, the Clean Air Act broadly does not support EPA's argument that Congress's specification of how it must consider international emissions under Sections 179B and 115 means that Congress did not presume other general authorities under the Act to encompass consideration of international emissions. There are many other instances under the Act where Congress specified when and how EPA must regulate as a complement to EPA's more general authorities, including when it wanted to force EPA to regulate. For example, as part of the 1990 Clean Air Act Amendments, Congress specified an initial list of hazardous air pollutants under Section 112(b)(1) that it expected EPA to regulate.[97] This did not mean that Section 112

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[96] EPA's citation to the legislative history, 91 Fed. Reg. at 59024 n.158, supports commenters rather than EPA. As that text shows, Congress was concerned about source categories with a "substantial" impact on the problem, whether because of "the nature or the amount of emissions." H.R. Rep. No. 91-1146, at 9-10 (1970). As discussed below, U.S. power plants are among the largest contributors of greenhouse gas emissions in the world and will have trillions of dollars in impacts, which is a "substantial" impact in both nature and amount.

[97] S. Rep. No. 101-228, 1990 U.S.C.C.A.N. 3385, 3517 (1989).

did not previously provide EPA the general authority to regulate these pollutants, only that Congress wanted to affirmatively require EPA to regulate them.

Turning to the two provisions related to international emissions that EPA cites, Section 179B allows EPA, upon a discretionary demonstration by a state, to waive certain statutory requirements regarding nonattainment state implementation plans (SIPs) and attainment determinations for nonattainment areas that are on the border and that would have achieved the relevant NAAQS "but for" emissions emanating from outside the United States. This provision demonstrates Congress's understanding that certain NAAQS pollutants and their precursors can travel through the ambient air without regard for international borders and adversely impact areas or states that do not originate such pollution. Importantly, Section 179B acknowledges the reality that international emissions can impact domestic air quality, but it does *not* excuse regulation of domestic air pollution that adversely impacts public health and welfare.

Section 179B(a) makes clear that a state seeking a prospective waiver is excused only from the attainment demonstration requirement (because an area that would attain but for international emissions cannot factually demonstrate attainment) must still meet all other nonattainment SIP requirements to reduce domestic pollution. These SIP requirements include control measures on domestic sources, such as implementation of Reasonably Available Control Technologies on major stationary sources in the nonattainment area. Similarly, Section 179B(b) plainly waives the requirement for EPA to reclassify areas that fail to attain to a more stringent level of nonattainment classification, but it does not waive the myriad nonattainment SIP and control requirements for domestic sources. This is true even when the proportion of international emissions to domestic emissions far outweigh contributions to violations of the NAAQS.[98] This provision thus reflects Congress's acknowledgment that international emissions outside of a state's control may impact a nonattainment area's ability to timely attain the NAAQS.

This is not the same as Congress prescribing the *only* circumstances under which EPA may address international emissions, nor does it in any way support the proposition "that Congress does not presume that general authorities in the CAA encompass international emissions." 91 Fed. Reg. at 59024. To the contrary, Section 179B, which leaves it to state discretion to seek relief, evinces Congress's expectation that harmful domestic emissions must be regulated to the extent possible even when international emissions are a significant contributor to the local or regional air pollution or public health or welfare problem. Notably, Section 179B does not provide a waiver for EPA's initial designation of an area as nonattainment, even when international emissions are most of the reason why air quality in the area is in violation of the NAAQS. The Clean Air Act requires that EPA must still designate such an area as nonattainment,

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[98] *See e.g.* 87 Fed. Reg. 50030 (Aug. 15, 2022). EPA proposed approval of a Section 179B waiver for the Imperial County, California 2015 ozone nonattainment area, in part based on EPA's finding that international anthropogenic contribution is four times higher than U.S. anthropogenic contribution to high ozone days in Imperial County. *Id.* at 50038. EPA also made clear that even if the waiver was finalized as proposed, the State would still be required to implement domestic control measures for the 2008 and 2015 ozone NAAQS as required by the area's nonattainment status. *Id.* at 50039.

and a state must do its part to reduce domestic emission impacts on the area. Therefore, Section 179B does not support a prohibition under Section 111 against regulating greenhouse gas emissions, but rather supports the principle that international contribution does not discharge EPA of its obligation to regulate harmful pollution that is within its purview to control.

EPA's citation to Clean Air Act Section 115 similarly does not support its proposed interpretation of Section 111, but instead merely underscores the agency's flawed reasoning. As with Section 179B, nothing in Section 115 suggests that a prohibition under Section 111 or any other provision of the Act against EPA regulating domestic air pollution that may also be impacted by international emissions. Rather, Section 115 specifies when EPA must take action to address domestic pollution with certain international impacts. There is no language or context in Section 115 suggesting Congress narrowly prescribed this provision as the means for regulating domestic pollution that is influenced by international pollution, to the exclusion of such regulation under other provisions of the Act. This provision specifies the circumstances under which EPA is required to address domestic pollution that has certain impacts in *other* countries. The context of this provision thus does not provide support for the proposition that EPA is precluded from regulating internationally influenced pollution that has impacts in *this* country.

Additionally, Section 115(a) requires that upon receipt of certain information or request from a country with reciprocal rights, EPA must give formal notification to a state originating "any air pollutant or pollutants" that "cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare" in the other country. This endangerment phrasing is almost identical to that under Section 111(b). As explained above, EPA's proposed interpretations regarding many of these same terms is fundamentally flawed.

Moreover, Section 115(a)'s use of this phrase demonstrates that it is *not* limited to endangerment of public health or welfare through local or regional exposure. There is no geographical limitation regarding which countries may make a request regarding endangerment from U.S. emissions under Section 115. By the terms of Section 115, a country with reciprocal rights and that is located thousands of miles from the U.S. could request a formal notification regarding pollution endangering that country's public health or welfare and that is originating in a particular American state. Such distance is by no means within a range of local or regional exposure. Therefore, the scale at which emissions of "any air pollutant or pollutants" that "cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare" cannot be limited to, as EPA claims, a local or regional scale. 91 Fed. Reg. at 59024.

Section 115(b) also further undermines EPA's claim that "air pollution" is best read as that which itself threatens health or welfare through local or regional exposure. 91 Fed. Reg. at 59006. This provision requires that when EPA formally notifies a state under Section 115(a) that emissions originating within that state are impacting public health or welfare in another country, the state must revise its applicable implementation plan to address such emissions. An applicable implementation plan includes the state's SIP for regulating criteria pollution under the NAAQS program.[99] As previously described, Section 115 clearly allows a geographically distant country to make an endangerment-related request. Section 115(b) further makes clear that such a request

[99] *See* Section 302(q), defining "applicable implementation plan."

could be made with respect to NAAQS pollutants. There is thus no basis for EPA's claim that Title I is designed to only address pollution that adversely impacts health or welfare through direct exposure at the local or regional levels. 91 Fed. Reg. at 59026.[100]

EPA's other passing references to "relevant legislative action," 91 Fed. Reg. at 59017-18, are also off-target. The provisions governing ozone-depleting substances in Title VI and the statutory structure contemplated in the American Clean Energy and Security Act have little in common with Section 111's technology-based standards for stationary sources. Title VI includes a broad array of requirements that go well beyond control of stationary source emissions – the pollution sources covered by Section 111. Title VI's requirements include provisions regulating the production, import, export, and destruction of ozone-depleting substances and that address a wide range of sources including refrigerators and air conditioners. 42 U.S.C. § 7671, *et seq.*[101] It is these activities and products that drive emissions of ozone depleting substances, and given that those activities and products fall outside the Title I regulatory framework, it is no wonder that Congress saw a need to enact different provisions to address those emissions. In other words, EPA errs in reasoning that Title VI's enactment shows that Congress acts separately to address global or international pollution problems; the correct inference is that Congress saw a need to provide additional and different tools for addressing them. The differences is *means*, not *ends*.

The American Clean Energy and Security Act likewise sought to establish an economy-wide policy related to climate change, touching building codes, technology subsidies, and job training, among many other things.[102] Congress's interest in comprehensive policies and different regulatory approaches to address important pollution problems (especially where such provisions are also necessary to comply with an international treaty[103]) does not conflict with the scope of EPA's specific authority to set technology-based standards for certain stationary sources elsewhere in the Act. Both general and specific statutory programs can exist at once, including under the Clean Air Act. *See., e.g.*, 42 U.S.C. § 7651 (providing specific authority to combat acid rain and precursor emissions of both SO_2 and NO_X notwithstanding these pollutants'

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[100] Notably, EPA's claim that neither Section 179B nor Section 115 encompasses greenhouse gases is conclusory, and therefore does not support EPA's conclusion that Section 111 cannot include regulation of greenhouse gas. 91 Fed. Reg. at 59024. EPA does not identify any limitation against regulating pollutants like greenhouse gases as a statutory matter under either provision and has never made a determination to that effect. Whether or not EPA could or should do so, EPA cannot rely on presumptions about whether and how these sections might operate as to pollutants like greenhouse gases when interpreting Section 111.

[101] *See* U.S. EPA, *Ozone Protection under Title VI of the Clean Air Act*, available at: https://perma.cc/G7WP-VEXD.

[102] H.R. 2454, 111th Cong. (2009).

[103] *See* U.S. EPA, *Ozone Protection under Title VI of the Clean Air Act*, available at: https://perma.cc/G7WP-VEXD.

simultaneous regulation under Section 111[104]); 42 U.S.C. § 7521 (providing both general authority to regulate emissions in Section 202(a)(1) and setting additional specifications for regulation of certain pollutants or vehicle classes in Section 202(a)(3), (b)(1), (g), (h), and (i)). The fact that Congress has considered or enacted specific, far-reaching statutory programs in the context of these supposedly global pollutants merely reflects the enormity of the danger associated with leaving these pollutants uncontrolled, not that they cannot *also* be addressed through the Act's general authorities.

vi. EPA's resort to "proximate cause" principles is misplaced and cannot create limitations the text lacks.

Recognizing the failure of its arguments from the text, EPA also claims that its interpretation is the best reading of the statute because Section 111 should be governed by "principles of causation and proximate cause" and power plant greenhouse gas emissions "do not have a sufficiently close connection to the harms identified in the 2015 Findings." 91 Fed. Reg. at 59023. EPA's argument is based on the premise that Congress meant to incorporate "background principles of causation and proximate cause" into the fabric of Section 111. In particular, the Agency resorts to cases involving federal statutes that establish a cause of action modeled on common law tort actions for plaintiffs to recover money damages for injuries to legally protected interests, *id.* & n.142, before suggesting that Congress specifically endorsed those same proximate cause principles when adding the phrase "may reasonably be anticipated" to Section 111 in 1977. *Id.* at 59023. Yet EPA provides little to show that Congress endorsed the same for the Clean Air Act or the Section 111 framework in particular. According to EPA, the 2009 Finding "on which the 2015 Findings are based" was improper because it asserted that greenhouse gas pollution "would *lead to* increases in global temperature and change to ocean pH that, in turn, would *lead to* environmental phenomena, in combination with an open-ended universe of additional factors, which would potentially have adverse health and welfare impacts of varying severity in certain regions." 91 Fed. Reg. at 59023 (emphasis original). From this, and in light of proximate cause, the Agency claims, the emissions in question lack the "sufficiently close connection" necessary to fit within the terms "cause," "contribute" and "reasonably be anticipated to endanger." *Id.*[105]

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[104] Notably, the acid rain provisions identifies the narrow circumstances where sources are exempt from simultaneous Section 111 regulation, confirming that they otherwise remain subject to it. 42 U.S.C. § 7651h(d); *see id*. § 7651*l* (savings clause).

[105] EPA asserts that the 2015 finding avoided these causation concerns by "severing" the endangerment and contribution portions of the finding. As we discuss in Comment Part VI.B.1 below, EPA's attempt to collapse the grammar of Section 111 and evade its meaning is unsupported. By its plain terms, Section 111 asks whether a source category "causes, or contributes significantly to, *air pollution*." It is that air pollution, in turn, that must "reasonably be anticipated to endanger public health or welfare." 42 U.S.C. § 7411(b)(1)(A) (emphasis added); *see Ethyl Corp. v EPA*, 541 F.2d 1, 15 (D.C. Cir. 1976) (explaining that nearly identical language in Clean Air Act Section 202 distinguishes between the "causal relationship between air pollution and health, [and the] relationship between automobile emissions and air pollution";

EPA's reasoning here founders because concepts associated with "proximate cause" have no place in Section 111's framework and EPA misreads the Act in an attempt to import them. First of all, the D.C. Circuit has already rejected similar attempts to impose proximate causation principles on contribution tests under the Clean Air Act. *See Catawba Cnty. v. EPA*, 571 F.3d 20, 38-39 (D.C. Cir. 2009) (rejecting arguments under Clean Air Act Section 107 that "contribute" should mean "strictly cause" or "necessarily connotes a significant causal relationship" because "contribution may simply exacerbate a problem rather than cause it" and does not require that "corrective measures" on contributors' emissions actually "address the problem"[106]). The proposal does not grapple with that precedent, let alone successfully distinguish it and the failure to do so ignores an important aspect of the problem.

Second, EPA's passing assertion that 111 incorporated "default rules" concerning proximate cause does not explain why principles of proximate cause flowing from tort – and tort-like claims under statutes like the Fair Housing Act and the Lanham Act's false advertising provisions, *see* 91 Fed. Reg. at 59023 n.142 – are appropriate "background principles" for interpreting the Clean Air Act. The three Supreme Court cases it cites in reference to proximate cause – *Bank of Am. Corp. v. City of Miami*, 581 U.S. 189, 201 (2017); *Lexmark Int'l, Inc. v. Static Control Components, Inc.*, 572 U.S. 118, 132 (2014) and *Univ. of Tex. Southwestern Med. Ctr. v. Nassar*, 570 U.S. 338, 347 (2013) – involved federal statutes (the Fair Housing Act, the Lanham Act, and Title VII of the Civil Rights Act of 1964, respectively) that established a cause of action for plaintiffs to recover money damages in compensation for injuries to legally

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while the language has since been amended, the distinction identified by that court remains). In any case, EPA's suggestion that greenhouse gases are not adequately linked to the dangers they cause is unfounded.

[106] As a factual matter, it is not true that regulations reducing greenhouse gases from power plants do nothing to "address the problem" of climate change. As discussed further in Comment Part VIII, regulation of this source category would prevent deaths and avoid substantial harm to human livelihoods, well-being, and the natural environment. What is more, the Supreme Court considered and discarded this very logic in *Massachusetts,* rejecting the premise that petitioners' climate-related injuries could find no remedy through EPA's regulations of greenhouse gases merely because that such standards would be an "incremental" step toward rectifying the larger problem. 549 U.S. at 524. "Agencies, like legislatures, do not generally resolve massive problems in one fell regulatory swoop … They instead whittle away at them over time, refining their preferred approach as circumstances change and as they develop a more nuanced understanding of how best to proceed. … And reducing domestic automobile emissions is hardly a tentative step." *Id.* (citation modified). The Court's conclusion as to U.S. vehicle emissions – which it noted were greater than emissions of all foreign contributors save the European Union and China – applies equally here, where U.S. power plant emissions comprise about a quarter of all U.S. emissions and continue to exceed the *total* national emissions of every country but China, India, and Russia.

protected interests.[107] While these monetary recovery provisions were modeled on common law tort actions, Section 111 was not.

The difference is no accident. Environmental statutes were enacted *for the purpose of* overcoming problems with torts, including potential difficulties of showing proximate or actual causation.[108] (Though, as noted below, advancing science can meet those tests as well.) Accordingly, Section 111 sets its own causal standards: whether the source category contributes significantly to air pollution and whether the air pollution "may be reasonably anticipated to endanger" the public. The statutory framework is not, therefore, a blank slate that EPA can fill with concepts of tort causation. It already articulates Congress's chosen view of the necessary relationship between the pollution and the harm – specific textual direction that EPA cannot override at will. *Montclair v. Ramsdell*, 107 U.S. 147, 152 (1883) ("It is the duty of the court to give effect, if possible, to every clause and word of a statute, avoiding, if it may be, any construction which implies that the legislature was ignorant of the meaning of the language it employed."). EPA's arguments notwithstanding, the plain text of a statute always controls over background principles of law. *Honeycutt v. United State*s, 581 U.S. 443, 453 (2017) ("The plain text and structure of § 853 leave no doubt that Congress did not incorporate those background principles."); *Arellano v. McDonough*, 1 F.4th 1059, 1085 (Fed. Cir. 2021) (Chen, J., concurring) ("[G]eneral background principles cannot override the unambiguous meaning of the statutory text."); *United States v. Hernandez*, 107 F.4th 965, 972 (11th Cir. 2024) ("'[B]ackground principles,' no matter how well established, can't control or contradict clear statutory text.").

To be sure, EPA may and must assess whether the air pollution in question, as a factual and scientific matter, "may be reasonably anticipated" to harm public health and welfare. Some air pollution will fail that test because no chain of causation reasonably connects the air pollution to anticipated harm. But that is an assessment conducted under the terms of the Act, not common law legal constructs designed to fairly assign civil liability.

Third, EPA is incorrect that the inclusion of the phrase "may reasonably be anticipated" in Section 111 – because it overlaps with the lay definition of "foreseeable" in a single dictionary – shows Congress "endorsed the incorporation of proximate cause principles." 91 Fed. Reg. at 59023. Both the D.C. Circuit and the Supreme Court have explained that while foreseeability may be one element of proximate cause, the two concepts are not inherently coterminous. *See, e.g.*, *Bank of Am. Corp. v. City of Miami*, 581 U.S. 189, 202 (2017) ("In the context of the FHA, foreseeability alone does not ensure the close connection that proximate cause requires."); *CSX*

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[107] EPA's fourth cited case, *City of Oakland v. Wells Fargo & Co.*, 14 F.4th 1030 (9th Cir. 2021) (*en banc*), likewise addressed claims under the Fair Housing Act.

[108] *See, e.g.*, Mark Latham, Victor E. Schwartz & Christopher E. Appel, *The Intersection of Tort and Environmental Law: Where the Twains Should Meet and Depart*, 80 Fordham L. Rev. 737, 754 (2011) (explaining the differences between torts and statutory environmental law, and explaining that "[t]he addition of statutory law allows for other policy objectives such as the precautionary principle to be included in the legal system."); *id.* at 759 ("[T]he CAA … set[s] forth required conduct with a specific environmental objective that does not involve the common law of torts.").

Transp., Inc. v. McBride, 564 U.S. 685, 701 (2011) ("Common-law formulations [of 'proximate cause'] include, *inter alia,* the 'immediate' or 'nearest' antecedent test; the 'efficient, producing cause' test; the 'substantial factor' test; and the 'probable,' or 'natural and probable,' or 'foreseeable' consequence test."); *Hemi Grp., LLC v. City of New York, N.Y.*, 559 U.S. 1, 12 (2010) (explaining that "the concepts of direct relationship and foreseeability are of course two of the many shapes proximate cause took at common law" but that "in the RICO context, the focus is on the directness of the relationship between the conduct and the harm" (citation modified)); *Keren Kayemeth LeIsrael - Jewish Nat'l Fund v. Educ. for a Just Peace in the Middle E.*, 66 F.4th 1007, 1015 (D.C. Cir. 2023) ("To establish proximate cause, appellants must allege that USCPR's actions were a substantial factor in, and had the reasonably foreseeable effect of, causing appellants' harm."); *McNeal v. Hi-Lo Powered Scaffolding, Inc.*, 836 F.2d 637, 644 (D.C. Cir. 1988) ("In the District of Columbia, proximate cause encompasses both foreseeability of injury, and the decision that liability will not attach unless the breach of duty has a substantial and direct causal link to the plaintiff's injury.'" (citation modified)).

Insofar as foreseeability is just one aspect of proximate cause, the fact that Section 111(b)(1) incorporates that aspect but not other potential aspects of proximate cause strongly indicates that Congress did *not* intend to actually incorporate the common law principle of proximate cause into the provision. Instead, Congress intended to do exactly what the statute says: to require reasonable foreseeability of harm *and nothing more*. Indeed, in *CSX Transportation*, the Supreme Court concluded that "when the legislative text uses less legalistic language [than 'proximate cause'], *e.g.,* 'caused by,' 'occasioned by,' 'in consequence of,' or, as in FELA, 'resulting in whole or in part from,' and the legislative purpose is to loosen constraints on recovery, there is little reason for courts to hark back to stock, judge-made proximate-cause formulations." 564 U.S. at 702-703 (holding that juries applying statutory language asking whether harm "result[ed] in whole or in part from" carrier negligence were properly instructed that a railroad "caused or contributed to" a railroad worker's injury "if [the railroad's] negligence played a part – *no matter how small* – in bringing about the injury" (emphasis added)).[109]

Plus, EPA's assumption about Congressional intent pointedly ignores what Congress itself said when it adopted this language, which, far from promoting proximate causation, was intended to address the fact that "[m]an's ability to alter his environment has developed far more rapidly than his ability to foresee with certainty the effects of his alterations." H.R. Rep. 95-294 at 46. The phrase "may reasonably be anticipated to endanger" was thus intended to "reflect awareness of the uncertainties and limitations in the data" and "emphasize the preventive or precautionary nature of the act … [and] the predominant value of protection of public health." H.R. Rep. 95-294 at 49-50.[110]

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[109] Notably, that statute – the Federal Employers' Liability Act – establishes a legislative form of personal injury compensation. The Court there was thus up against much stronger presumptions in favor of traditional "proximate cause" than in modern environmental statutes like the Clean Air Act that deal with industrial activities harming the environment and the public at large.

[110] Nor does *Hicks v. United States* rehabilitate EPA's claim. *See* 91 Fed. Reg. at 59023. That case considered whether the hospital's negligence was a "substantial factor" in the cause of the harm, not merely whether the consequences were "foreseeable." *See Hicks*, 511 F.2d 407, 421

Even if Section 111 did incorporate principles of proximate cause, however, the harms from greenhouse gas pollution are now plainly foreseeable and EPA has developed no record to the contrary. *See id.* On the contrary, this pollution is essentially *guaranteed* to endanger health and welfare. The strength of the causal chain between the emission of greenhouse gases and the dangerous effects of climate change is a factual question that is knowable and known. The International Panel of Climate Change has stated with "high confidence" that "[g]lobal surface temperature has increased faster since 1970 than in any other 50-year period over at least the last 2000 years."[111] The United States is warming even faster than the global average.[112] Alongside this warming, extreme weather events, such as heat and heatwaves, droughts, heavy precipitation events, and wildfires, have become increasingly severe or frequent.[113]

Climate attribution science – the branch of climate science that identifies and quantifies the contribution of specific causal factors to observed changes in the climate system – has advanced significantly. The advancement has both strengthened scientific confidence that human greenhouse gas emissions "unequivocally caused global warming,"[114] but also to show how greenhouse gas emissions have contributed to the increasing severity or frequency of extreme weather events and resulting economic, property, and public health harms.[115]

EPA is well aware of these scientific developments. In the Supplemental Proposal, EPA "acknowledges that we are proposing action in the context of a subject matter that has generating

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(D.C. Cir. 1975). And in any case, the court's assessment of proximate cause there affirmed that something "may be the proximate cause of a disaster, though it may operate through successive instruments," provided the harm was "the natural and probable consequence" of the original act and "ought to have been foreseen." *Id.* at 420. There is no plausible argument that warming and its attendant harms are not the "natural and probable consequence" of increasing concentrations of greenhouses gases, as these connections have been established by scientists – as well as the emitting industries – for decades. *See, e.g.*, Hiroko Tabuchi, *Exxon Scientists Predicted Global Warming, Even as Company Cast Doubt, Study Finds*, New York Times (Jan. 12, 2023).

[111] IPCC, *Climate Change 2023: Synthesis Report – Summary for Policymakers* 4 (2023), available at: https://tinyurl.com/546wpt8j.

[112] USGCRP, Fifth National Climate Assessment 2-18 (2023), available at: https://tinyurl.com/5sr45k88 (hereinafter "Fifth National Climate Assessment") ("The science of evaluating the effects of human-caused climate change on extreme weather and climate events has advanced significantly. Human influence has changed the frequency and intensity of some types of extreme events, and it is now possible to quantify the influence of anthropogenic climate change on certain types of specific extreme events.").

[113] Fifth National Climate Assessment at 3-18.

[114] IPCC, *Climate Change 2023: Synthesis Report – Summary for Policymakers* at 4; National Academies, *Effects of Human-Caused Greenhouse Gas Emissions on U.S. Climate, Health, and Welfare* 9 (2025), https://tinyurl.com/4rrv8x4d; Fifth National Climate Assessment at 1-17, 2-11, 3-5.

[115] Fifth National Climate Assessment at 3-18.

scientific and technical literature, including findings and reports of the [NAS]," including developing literature on climate attribution. 91 Fed. Reg. at 59019. Nevertheless, in an apparent attempt to avoid confronting the strong science, EPA has disclaimed any intent to revise its assessment of the pollution's connection to harm here, asserting that its proposal is "legal in nature" and so does not implicate "scientific and technical literature … discussing the attribution of extreme weather events" to "GHG emissions produced from human activities." *Id.* Without a new factual record, and a confrontation with the 2015 Finding's full factual record, EPA cannot claim it has reached a new determination that greenhouse gas pollution *does not* harm the public – or, for that matter, that greenhouse gas pollution is, in actuality, "too uncertain, conjectural, remote, and convoluted by intervening and confounding factors to fit within the terms 'cause,' 'contribute,' and 'reasonably be anticipated to endanger' as used in CAA section 111(b)(1)(A)." *Id.* at 59023. Even where proximate cause analysis is performed, it is performed on the basis of specific facts, not vague and unsubstantiated talking points. As both the 2015 Finding and this comment show, there is no factual basis to conclude greenhouse gas pollution is not harmful, so EPA could not succeed at such a task in any case. *See* 80 Fed. Reg. at 64510; Comment Parts VII & VIII.[116]

Nor can EPA establish that the chain of causation for global pollutants is inherently more complicated than for supposedly local and regional pollutants. To the contrary, the fact that greenhouse gas emissions mix uniformly in the global atmosphere *simplifies* analysis of causation. Because greenhouse gas emissions are long-lived, and so mix evenly across the globe, the location from which they are emitted does not matter with respect to the primary harms they cause.[117] They trap heat and drive climate change and extreme weather events equally regardless of where they were emitted. This stands in contrast to many other pollutants EPA admits it can regulate, such as NO_X, that disperse unevenly over sub-global distances. The complex modeling of upwind and downwind directionality and variable interaction with other pollutants and environmental conditions that is needed to address interstate transport of NO_X is completely unnecessary for greenhouse gases. Thus, the global, well-mixed nature of greenhouse gas emissions shortens, rather than attenuates the causal chain.

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[116] Nor could EPA rely on "uncertainty" as a basis not to exercise authority under Section 111. *See Ethyl Corp.*, 541 F.2d at 27-28 (addressing earlier "will endanger" language in the Clean Air Act and explaining that "[w]here a statute is precautionary in nature, the evidence difficult to come by, uncertain, or conflicting because it is on the frontiers of scientific knowledge, the regulations designed to protect the public health, and the decision that of an expert administrator, we will not demand rigorous step-by-step proof of cause and effect," but will instead allow EPA "to draw conclusions from suspected, but not completely substantiated, relationships between facts, from trends among facts, from theoretical projections from imperfect data, from probative preliminary data not yet certifiable as 'fact,' and the like"); H.R. Rep. 95-294 at 43-49 (describing its adoption of Section 111's "reasonably be anticipated to endanger" language as added "to emphasize the precautionary or preventive purpose of the act (and, therefore, the Administrator's duty to assess risks rather than wait for proof of actual harm)").

[117] Though, as noted above, certain effects from greenhouse gas pollution, such as ocean acidification, also occur locally or regionally.

Indeed, one can write an equally if not more complex causal chain for NO_X as for greenhouse gases. The proposal claims that greenhouse gases should be excluded because:

> Emission of greenhouse gases → impacts on global temperature & ocean pH → environmental phenomena that, along with additional factors → variable harm in different regions

91 Fed. Reg. at 59023. That formulation is wrong because greenhouse gas pollution directly harms public health and welfare – through heat, ocean acidification, and intensifying ozone – even before accounting for the harms from increases in wildfires, hurricanes, flooding, infectious diseases, and so on. *See* Comment Parts VII & VIII. But in any case, nitrogen oxides are regulated despite a chain of causation akin to the one EPA claims is unreasonable:

> Emission of nitrogen oxides → distributed across long distances → interaction with an adequate volume of VOCs, along with the presence of sunlight → variable and non-linear creation of ozone → variable harm in different regions

See Wisconsin v. EPA, 938 F.3d 303, 309 (D.C. Cir. 2019). EPA fails to explain how these two causal chains should be treated differently even under its own principles of proximate causation, so EPA's proposal is arbitrary and capricious.[118]

EPA is similarly incorrect that "intervening and confounding factors" prevent greenhouse gases from causing or contributing to harm. Pollution that increases global temperatures that in turn amplify public harms on a massive scale easily exhibits "some direct relation between the injury asserted and the injurious conduct alleged." *City of Miami*, 581 U.S. at 202-03 (internal quotation omitted). Greenhouse gas emissions are far and away the primary driver of climate change, so any other "intervening and confounding factors" are minor by comparison. To the extent these "intervening and confounding factors" are meant to refer to other countries' or source categories' emissions of greenhouse gases beside those from U.S. power plants, the statute anticipates this with the phrase "causes, *or contributes significantly to*," which, as discussed extensively, assumes the existence of other pollution sources.

In any case, EPA's logic here, if adopted, would also exclude regulation of ozone precursors, which all parties (including EPA) acknowledge is lawful under Section 111. *See* 91 Fed. Reg. at 59023. As shown above, by themselves, neither NO_X emissions nor VOC emissions will form ozone; they require one another (as well as energy from the sun), and are typically emitted from different source categories. As such, the creation of ozone and its attendant harms do not follow directly from a rise in the concentration of NO_X only or VOCs only, but requires both. Yet EPA has never suggested that the "multiple intervening actors" involved in ozone formation prohibit a source category's NO_X or VOC emissions from falling within the terms

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[118] So too for particulate matter pollution:

> Natural and anthropogenic emissions of $NO_X/SO_X/VOCs/NH_3$ → transport (of some pollutants) over long distances → interaction in the atmosphere in the presence of sunlight, humidity, etc. → secondary PM formation → contribution to total atmospheric PM (along with direct anthropogenic PM emissions and natural PM like dust) → harm to human health and welfare.

"cause" or "contribute," or the phrase "reasonably be anticipated to endanger." Indeed, greenhouse gases have a *more* direct link to the harm they cause than do NO_X or VOCs, since their main impact – radiative forcing – occurs without any chemical interactions in the atmosphere. *See Massachusetts*, 549 U.S. at 509-10 (explaining that emissions of greenhouse gases "increas[e] the atmospheric concentrations of … greenhouse gases [which] will enhance the greenhouse effect" that warms the earth's surface); *Sierra Club v. FERC*, 867 F.3d 1357, 1371 (D.C. Cir. 2017) ("[O]nce in the atmosphere, [emissions of] carbon dioxide will add to the greenhouse effect."); 74 Fed. Reg. at 66517 (explaining that greenhouse gases are "directly emitted," rather than formed by precursor gases, and exert a warming effect "by trapping in heat that would otherwise escape to space"). EPA's logic is also internally inconsistent: the Supplemental Proposal describes air pollutants that will contribute to ozone with intervening combinations as covered by Section 111, noting that in 1996 EPA began regulating "non-methane organic compounds emitted from landfills on the basis that they cause or contribute to ozone formation." 91 Fed. Reg. at 59023.

Furthermore, EPA ignores relevant precedent. The Supreme Court in *Massachusetts*, in ruling that plaintiffs had established standing, rejected similar arguments that the chain of causation between vehicle greenhouse gas emissions and the resulting harm was too attenuated. *Massachusetts*, 549 U.S. at 524-26. Relatedly, in *Ethyl Corp.*, the D.C. Circuit sitting *en banc* addressed the threshold for regulation under a more stringent version of the "endangerment" language that originally appeared in Clean Air Act Section 202 and that directed EPA to regulate air pollution "which endangers" the public health or welfare. Explaining that Section 202 had distinct tests for whether vehicle emissions contribute to air pollution and whether that pollution (not the emissions themselves) endangers the public, the court explained that distinction "is important, for not all air pollutants contribute to dangerous air pollution and, more importantly, not all dangerous air pollution is caused by air pollutants that are, themselves, dangerous." 541 F.2d at 16 n.27. Thus, "[Section] 202 allows for the regulation of such apparently innocent pollutants, which *indirectly* cause dangerous pollution." *Id.* (emphasis added); *see also Nat'l Lime Ass'n v. EPA*, 627 F.2d 416, 431 n.48 (D.C. Cir. 1980) (explaining that a "dust 'nuisance'" would still satisfy the phrase "endanger[] public health or welfare" because it impacts public welfare "even if the dust were shown innocuous to public health").

Moreover, the court in *Ethyl Corp.* was specifically considering the endangerment associated with lead in gasoline. Examining Section 211, which the court considered equally or more restrictive of EPA's authority than Section 202, the court held that EPA had rationally found endangerment associated with emissions from lead gasoline where airborne lead emitted from vehicles then fell to the ground in particles where it mixed with dust, which could then be consumed by the group of children with pica (a condition that is relatively common among pre-school children involving the ingestion of non-food substances). The court acknowledged that lead paint, rather than atmospheric deposition, was the primary source of lead poisoning in children, but nevertheless found EPA's "reliance on the dustfall theory" consistent with the Act's "will endanger" standard. *Ethyl Corp.*, 541 F.2d at 44. Per the court, "If the intermediate steps are supported by the evidence, the validity of the Administrator's conclusion as a reasonable hypothesis is unassailable." *Id.* As noted above, EPA makes no effort to disprove the causal links that connect greenhouse gas pollution to enormous public harm. Nor does it recognize, let alone explain, how that causal chain diverges from the case law.

Significantly, in the 1977 Clean Air Act amendments, Congress specifically ratified the holding in *Ethyl Corp*. H.R. Rep. 95-294 at 43-49. Congress described its addition of the language "may reasonably be anticipated to endanger" in both Section 202 and Section 111 as, *inter alia*, "intended to support the views expressed in the majority opinion of the en banc panel … in the *Ethyl* case" by emphasizing the precautionary nature of the act; authorizing EPA to "weight risks and make reasonable projections of future trends"; assuring consideration of cumulative impacts from all sources of a pollutant when setting standards (not just the regulated class of sources); providing "the same standard of proof for regulation of any air pollutant, whether that pollutant comes from stationary or mobile sources"; and "reflect[ing] awareness of the uncertainties and limitations in the data" so that EPA may "assess risks rather than wait for proof of actual harm." *Id.* at 49-51. EPA's proposal acknowledges these amendments – saying they were designed "consistent" with *Ethyl Corp.*, 91 Fed. Reg. at 59011 – and yet EPA's "best reading" does not align with that case's holding and understanding of indirect harms, or with the Senate report explaining Congress's contemporaneous understanding of that "reasonably be anticipated to endanger" test. EPA, yet again, fails to address a significant aspect of the problem and that failure is arbitrary, capricious, and unreasonable.

vii. EPA's supposed "futility" analysis is irrelevant to the best reading.

EPA's convoluted suggestion that its statutory interpretation is bolstered by its "independent" conclusion that regulating greenhouse gases would be "futile," *see* 91 Fed. Reg. at 59021, is equally flawed. As described in Comment Part VIII.D, the "futility" conclusion EPA proposes here would not demonstrate that Congress always intended to exclude greenhouse gases from Section 111. That futility analysis is fundamentally flawed and, even so, correlates with massive harms to public health and welfare. *See* Comment Part VIII. Plus, EPA's *present* view of the source category's future emissions potential or danger cannot logically bear on what types of pollutants and pollution problems Congress authorized EPA to address, *see* Comment Part VIII.D. As such, it has no relevance to the best reading of the text.[119]

* * *

EPA's best reading ultimately amounts to a collection of interpretive band-aids, each trying to solve a problem left over by the other. Some regulated pollutants harm locally, but that cannot be the line because ozone is formed across large regions. Some regulated pollutants harm through exposure, but that cannot be the line because "contamination" and "toxicity" do not explain why the Act's definition of welfare include impacts to "weather, visibility, and climate." Some regulated pollutants harm directly by their presence in the air, but that cannot be the line because SO_2 must interact "with additional airborne chemicals" to form acid rain, and NO_X must interact with VOCs and solar energy to create an ozone problem. The result is a definition so haphazardly gerrymandered that EPA has difficulty even writing it out: it must "impact health or welfare through local or regional exposure," where sometimes "the emissions themselves are the air pollution" but sometimes "the emissions contribute to air pollution … by interacting with

[119] EPA's final assertion – that its best reading is consistent with the case law, 91 Fed. Reg. at 59029 – grossly rewrites those precedents, which, as explained above, uniformly support EPA's authority to regulate power plant greenhouse gas emissions. *See supra* Comment Part II.A.

other airborne chemicals or environmental factors such as sunlight to create the air pollution" and where "we use the phrase 'local or regional exposure' to distinguish air pollution that impacts public health or welfare by its presence in the ambient air from 'air pollution' consisting of six well-mixed GHGs that … impacts public health and welfare only indirectly." 91 Fed. Reg. at 59025. Also, exposure includes harm through "inhalation and physical contact," but not just that, so long as there is a sense of "dangerousness and contamination." *Id.* at 59022. And the pollutants "may travel a certain distance," provided they harm without becoming "globally well-mixed" and without "a further chain of subsequent effects" – though of course *some* chain of effects is fine per earlier instruction. *Id.* at 59029. These contortions reveal themselves for what they are: an effort to effectuate a policy preference against regulating greenhouse gases, not a principled reading of the plain text.

This administration evidently has policy objections to the regulation of greenhouse gases, but those objections do not alter the authority granted by the plain text or countenance this new effort to find "original" anti-regulatory language in a statute intended to assure pollution control. Just as the courts have policed attempts to broaden narrow statutory language, so too must they police attempts to artificially constrain agency authority or to disclaim obligations Congress plainly imposed. Nor should it go unnoticed that EPA's "discovery" of Congress's original intent in this proposal post-dates even this same administration's attempt to regulate this pollution in the Affordable Clean Energy rule. 84 Fed. Reg. 32520 (July 8, 2019). Like an agency claiming to discover authority "in a long-extant statute," *UARG*, 573 U.S. at 324, EPA's claim of having suddenly discovered a limitation on authority it has exercised in multiple presidential administrations is the kind of regulatory whiplash that renders EPA's new "discovery" especially suspect.

In total, EPA looks to defeat the plain text of Section 111 and its defined terms – not to mention D.C. Circuit and Supreme Court precedent – with inapplicable dictionary definitions, inferences from dissimilar provisions, and a willfully blinkered understanding of both the pollutants it regulates and the foundations of the Clean Air Act. The Agency's support for its position ends there, demonstrating just how far afield these circumstances are from the facts in *UARG*. EPA's "best reading" of Section 111 as excluding greenhouse gases is thus arbitrary, capricious, unreasonable, and contrary to law.

III. THE MAJOR-QUESTIONS DOCTRINE PROVIDES NO BASIS FOR REPEALING THE ENDANGERMENT FINDING.

A. The applicability of the major-questions doctrine to Section 111 is asked-and-answered by *Massachusetts* and its progeny.

The proposal's invocation of the major-questions doctrine fails for a threshold reason: the Supreme Court itself has already determined that regulating climate pollution from vehicles and powerplants does *not* trigger the doctrine.

1. *Massachusetts* holds that setting emissions standards on vehicles' climate pollution is not a major question.

The major-questions doctrine is a "tool of statutory interpretation," used to determine how much authority a statute should be read to delegate to federal agencies. *Save Jobs USA v.*

DHS, 111 F.4th 76, 80 (D.C. Cir. 2024). The doctrine stems from the Supreme Court's admonishment in *FDA v. Brown & Williamson Corp.* that in "extraordinary cases . . . there may be reason to hesitate before concluding" that Congress intended to implicitly delegate sweeping, transformative power to an agency. 529 U.S. 120, 159 (2000); *see also id.* ("Congress is more likely to have focused upon, and answered, major questions, while leaving interstitial matters to answer themselves in the course of the statute's daily administration") (quoting Stephen Breyer, Judicial Review of Questions of Law and Policy, 38 Admin. L. Rev. 363, 370 (1986)). Whether the significance of regulating greenhouse gases under Section 202 provides "reason to hesitate" under *Brown & Williamson* was decided in *Massachusetts*.[120] As discussed above, in 2003 EPA denied a petition to regulate motor vehicle emissions of greenhouse gases, citing *Brown & Williamson*'s "caution[] . . . against using broadly worded statutory authority to regulate in areas raising unusually significant economic and political issues when Congress has specifically addressed those areas in other statutes." 68 Fed. Reg. 52922, 52925 (Sept. 8, 2003). The denial detailed what it viewed as the "economic and political significance" of regulating greenhouse gases, including the possibility that regulation would lead to a "widespread effort to switch away from fossil fuels in [the transportation or power] sector," and the prominence of arguments on how to address climate change in Presidential campaigns, international negotiations, and Congress. *Id.* at 52928. From there, EPA asserted that it was "unreasonable to conclude that the [Clean Air Act] provides the Agency with such authority," and that it was "proper[]" to "await[] congressional direction before addressing a fundamental policy issue such as global climate change, instead of searching for authority in an existing statute that was not designed or enacted to deal with the issue." *Id.* In the Supreme Court, EPA likewise argued that, per *Brown & Williamson*, Section 202(a) did not provide a clear enough command that EPA may regulate greenhouse gases. *See* U.S. Br. 20-21, S. Ct. No. 05-1120 (asserting that agencies should not use "broadly worded statutes to regulate in areas raising unusually significant political and economic issues").

The Supreme Court expressly rejected EPA's argument. 549 U.S. at 530-31. The Court concluded the Clean Air Act "unambiguously" authorized EPA to regulate greenhouse gas emissions upon a science-based endangerment finding. EPA's "reliance on *Brown & Williamson"* to avoid that result was "misplaced." *Id.* at 530. The Court explained that acknowledging EPA's jurisdiction over greenhouse gas emissions from vehicles "would lead to no such extreme measures" as the ban on tobacco products that would have necessarily resulted from reading the statute at issue in *Brown & Williamson* to cover tobacco. *Id.* at 531. Instead, "EPA would only *regulate* emissions," and in doing so would have to comply with limitations written into the statute. *Id.* (emphasis in original). In the context of the Clean Air Act, there is "nothing counterintuitive to the notion that EPA can curtail the emission of substances that are putting the global climate out of kilter." *Id.*

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[120] The proposal's suggestion that *Massachusetts* did not consider EPA's authority to regulate climate pollution under Section 202 – or the major-questions implications thereof – because it only construed the Clean Air Act's general definition section is erroneous, for the reasons already discussed. *See* Part II.A, *supra*.

The Court further explained that, in contrast to the tobacco issue in *Brown & Williamson*, there were no other Clean Air Act provisions or other enactments conflicting with the Court's reading of Section 202. In *Brown & Williamson* there existed "an unbroken series of congressional enactments that made sense only if adopted 'against the backdrop of the FDA's consistent and repeated statements that it lacked authority . . . to regulate tobacco.'" *Id.* With regard to Section 202(a), by contrast, EPA "has not identified any congressional action that conflicts in any way with the regulation of greenhouse gases from new motor vehicles," notwithstanding the Agency's assertion that sections of the Clean Air Act specifically addressing funding for climate change research supplied such a conflict. *Id.* And EPA itself "had never disavowed the authority to regulate greenhouse gases" prior to the decision under review, but had in fact "affirmed that it *had* such authority" nearly a decade prior. *Id.* The Court therefore found "no reason," let alone a "compelling" one, to hesitate before adopting the statute's "clear" meaning. *Id.*

Massachusetts' rejection of EPA's *Brown & Williamson* arguments amounted to a conclusion that the major-questions doctrine did not apply in that case, notwithstanding that the name for that doctrine had not yet been coined. As the Supreme Court later explained in *West Virginia,* the major-questions "label[] . . . refers to an identifiable body of law developed over a series of significant cases all addressing a particular and recurring problem: agencies asserting highly consequential power beyond what Congress could reasonably be understood to have granted." 597 U.S. at 723-24. That body of law is expressly grounded in *Brown & Williamson*, a decision that is cited repeatedly throughout *West Virginia*. *Id.* at 721, 723-24; *see also, e.g.*, *UARG*, 573 U.S. at 324;549 U.S. at 159 (quoting Justice Breyer's recognition that Congress generally addresses "major questions" itself).[121]

To the extent that *West Virginia* and *UARG* may have refined or expanded on the precise test for when major questions are implicated, the core inquiry remains the same: whether the novelty and breadth of an asserted regulatory power provides reason to doubt that Congress intended to implicitly delegate that authority, notwithstanding Congress' use of broad or general language that could literally encompass that authority. *See, e.g.*, *West Virginia,* 597 U.S. at 721 ("Our precedent teaches that there are 'extraordinary cases' that call for a different approach – cases in which the 'history and the breadth of the authority that [the agency] has asserted, and the 'economic and political significance' of that assertion, provide a 'reason to hesitate before concluding that Congress' meant to confer such authority." (quoting *Brown & Williamson*)); *UARG*, 573 U.S. at 324 ("When an agency claims to discover in a long-extant statute an unheralded power to regulate 'a significant portion of the American economy,' . . . we typically

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[121] *See also Nebraska v. Biden*, 600 U.S. 477, 500 (2023); *Alabama Ass'n of Realtors v. HHS*, 594 U.S. 758, 764 (2021); *King v. Burwell*, 576 U.S. 473, 485-86 (2015); *NFIB v. Dep't of Labor,* 595 U.S. 105, 122 (2022) (Gorsuch, J., concurring). The proposal's observation that subsequent Supreme Court decisions have not stated that *Massachusetts* is a major-questions case is irrelevant. None of the cases the proposal references purports to provide a comprehensive listing of cases decided based on major-questions principles. And it would make little sense to flag *Massachusetts* as an example of the doctrine in action when *Massachusetts* specifically concluded that the doctrine was *not* applicable to the statutory question under review.

greet its announcement with a measure of skepticism." (quoting *Brown & Williamson*)).[122] That is the precise question that the parties posed and the Supreme Court answered in *Massachusetts* regarding regulating greenhouse gas emissions under Section 202(a). *See* 549 U.S. at 530-31. In answering that question, *Massachusetts* looked to factors that were also applied in those subsequent cases.[123]

2. *Massachusetts, UARG*, and *West Virginia* all confirm that the authority to regulate climate pollution from power plants likewise does not, by itself, pose a major question.

The major-questions analysis in *Massachusetts* applies equally to the regulation of emissions from power plants under Section 111, and the proposal offers no reason why it should not. Section 111, after all, directs EPA to do functionally the same thing with regard to power plants that Section 202 authorizes with regard to vehicles: to set an emissions standard (for a category of sources whose emissions are already regulated under the Act), for the purpose of curbing the source category's contribution to climate change. *Massachusetts* found no reason to doubt Congress in enacting the Clean Air Act provided authority to do just that. As was true of vehicles, regulating greenhouse gases from power plants does not inevitably lead to "extreme measures." To be sure, in *West Virginia*, the Supreme Court found that some specific ways EPA has attempted to exercise that authority go beyond the pale of what the statute authorizes. *See Massachusetts*, 549 U.S. at 531. But *West Virginia* confirmed EPA's authority to set technology-based standards for climate pollution from power plants. And as was true for regulating greenhouse gas emissions from motor vehicles, no Congressional pronouncement "conflicts in any way with" regulating climate pollution from stationary sources. *Id.*

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[122] Likewise, the Supreme Court's recent decision in *Learning Resources* looked to the nature of the delegation at issue – the "core congressional power of the purse" – as well as the dearth of historical examples of President's claiming that authority, and the "extravagant" nature of the power granted. 607 U.S. at 246.

[123] For example, the Court in *Massachusetts* looked to the economic and political consequences of recognizing EPA's authority, including the extent to which doing so would transform the Agency's previously recognized regulatory powers. *See* 549 U.S. at 530-31; *compare West Virginia*, 597 U.S. at 713-15, 729; *UARG*, 573 U.S. at 321-23; *Learning Resources*, 607 U.S. at 246. It likewise considered the vintage of the posited authority. 549 U.S. at 531 (noting EPA memorandum asserting the authority nearly a decade prior); *compare West Virginia*, 597 U.S. at 724-28, 730; *UARG*, 573 U.S. at 324; *Learning Resources*, 607 U.S. at 245-46. The Court also considered whether Congress' past actions suggested that it had reserved the issue of how to regulate greenhouse gases for itself. 549 U.S. at 531 (rejecting EPA's assertion of conflict with other statutory provisions); *compare West Virginia*, 597 U.S. at 731-32; *UARG*, 573 U.S. 325-26; *Learning Resources*, 607 U.S. at 243-44. And as in *West Virginia, UARG,* and *Learning Resources*, the Court assessed those considerations against the clarity with which Congress spoke to EPA's authority to regulate greenhouse gases. 549 U.S. at 531 (concluding that *Brown* considerations provided no reason to depart from statute's "clear" meaning); *compare West Virginia*, 597 U.S. at 732; *UARG*, 573 U.S. at 324; *Learning Resources*, 607 U.S. at 242-45.

The textual distinctions between Sections 111 and 202 do not render *Massachusetts'* analysis inapplicable. Section 111 authorizes EPA to regulate a category of sources that "causes, or contributes *significantly* to" air pollution that endangers public health or welfare, whereas Section 202 does not contain the modifier "significantly." 42 U.S.C. § 7411(b)(1)(A), 7521(a). But that distinction does not go to the types of action Congress permitted EPA to take under the statute, only what factual findings EPA must make before taking such action. Moreover, to the extent "significantly" imposes a meaningfully higher burden for EPA to clear before it may regulate (a point this comment does not concede), then the inclusion of that modifier in Section 111 would, if anything, make it harder for EPA to take action, making a major-questions problem even less likely.

Also immaterial is the fact that Section 111 directs EPA to determine the particular categories of stationary sources to which it applies. As discussed further below, the way in which EPA has determined which categories qualify does not offend the major-questions doctrine, and does not support the proposal's conclusion that EPA lacks *any* authority to regulate climate pollution under Section 111.

Subsequent major-questions decisions confirm that regulating emissions from power plants in particular is not in and of itself suspect and thus that *Massachusetts'* major-questions holding controls. *UARG* and *West Virginia* found major questions as to *which* stationary sources EPA may regulate, and *how* EPA may regulate climate pollution sources, respectively. But neither one questioned *whether* EPA has that authority with regard to power plants. Rather, *UARG* squarely confirmed that the authority to regulate climate pollution from already-regulated stationary sources does not present a major question. And *West Virginia* recognized with regard to power plants in particular that there are ways to regulate greenhouse gas emissions that do not offend the doctrine.

A close look at *UARG's* holding is particularly instructive. That decision held that requiring stationary sources to obtain preconstruction and operating permits under the Clean Air Act's Prevention of Significant Deterioration (PSD) and Title V provisions solely because they emit greenhouse gases above the statutory thresholds contravened Congress' intent by increasing the number of sources subject to those provisions by orders of magnitude:

> Under the PSD program, annual permit applications would jump from about 800 to nearly 82,000; annual administrative costs would swell from $12 million to over $1.5 billion; and decade-long delays in issuing permits would become common, causing construction projects to grind to a halt nationwide . . . . The number of sources required to have permits [under Title V] would jump from fewer than 15,000 to about 6.1 million; annual administrative costs would balloon from $62 million to $21 billion; and collectively the newly covered sources would face permitting costs of $147 billion.

Id. at 322. Further, "the great majority of additional sources brought into the PSD and title V programs would be small sources that Congress did not expect would need to undergo permitting" under those programs, which are administratively complex regimes aimed at "a relative handful of large sources capable of shouldering heavy substantive and procedural burdens." *Id.* at 322. Indeed, EPA agreed that it could not apply the actual text of those

provisions to all sources that emit greenhouse gases and that it would instead need to effectively rewrite the statutory thresholds by way of regulations to make the provisions functional. *Id.* at 324-25. By contrast, *UARG* held that it was lawful – *i.e.*, it posed no major-questions problem – for EPA to require Best Available Control Technology for greenhouse gas emissions from sources that were already subject to PSD permitting because they emit more than threshold amounts of *other* regulated pollutants. 573 U.S. at 329.[124]

Regulating greenhouse gases from power plants under Section 111 clearly falls on the permissible side of the major-questions line drawn by *UARG*. Power plants are already regulated under Section 111 based on their emissions of other pollutants. Regulating greenhouse gases from power plants under Section 111 therefore does not increase the universe of sources that are subject to that section – let alone at the outsize levels contemplated by subjecting all greenhouse gas emitters above 100 or 250 tons per year (which are miniscule amounts of greenhouse gases, but not of other pollutants) to PSD and Title V. Nor does regulating greenhouse gases under Section 111 require any part of the statute to be functionally rewritten. Instead, it subjects the same universe of sources already subject to various emission limitations to an additional limitation – just like setting greenhouse gas standards for "anyway" sources otherwise subject to PSD and Title V. *See* 573 U.S. at 329.

West Virginia likewise demonstrates that regulating climate pollution under Section 111 does not inherently trigger the major-questions doctrine. That decision applied the doctrine to strike down one specific way of regulating greenhouse gas emissions from power plants under Section 111. In particular, *West Virginia* held that EPA erred in determining that the "best system" of emissions reduction for existing power plants consisted of shifting generation from high-emitting power plants to lower- or non-emitting plants – in the Court's characterization, functionally amounting to nationwide caps on how much energy can be produced from fossil fuels. 597 U.S. at 725-29. The Supreme Court reasoned that EPA had departed from its usual practice of basing emissions limits on "measures that improve efficiency at the power plants," in favor of a "broader, forward-thinking approach" that – instead of "focus[ing] on improving the performance of individual sources" – would "improve the *overall power system* . . . by forcing a shift throughout the power grid from one type of energy source to another." *Id.* at 727-28 (emphasis in original) (citation modified); *see also id.* at 728 (quoting EPA's admission that "the rule was not about pollution control"). In doing so, EPA necessarily had to consider "areas such as electricity transmission, distribution, and storage" involving "technical and policy expertise

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[124] *UARG*'s reference to *Chevron* to uphold regulation of so-called "anyway" sources does not undermine UARG's conclusion that such exercise of authority does not violate the major-questions doctrine. First, while the Court noted that EPA's construction of Section 7475(a)(4) as permitting regulation of greenhouse gases at "anyway" sources was "permissible interpretation of the statute under *Chevron*," it asserted that it would reach the same holding "*[e]ven if the text were not clear*," indicating that there was *not*, in fact, ambiguity on this point. 573 U.S. at 331-32 (emphasis added). Moreover, as discussed above, the Supreme Court explicitly preserved prior precedents relying on *Chevron* when it overturned that doctrine. *See Loper Bright*, 603 U.S. at 412. And in any event, even under *Chevron* the Court would not defer to an interpretation that the major-questions doctrine ruled out. *See UARG*, 573 U.S. at 329.

not traditionally needed in EPA regulatory development." *Id.* (internal quotation marks omitted). And, in the Court's view, the regulatory system it devised "conveniently" resembled "a program" – cap and trade – that, "long after the dangers posed by greenhouse gas emissions had become well known, Congress considered and rejected multiple times." *Id.* at 731 (internal quotation marks omitted).

West Virginia, like *UARG*, accordingly establishes that some exercises of regulatory authority under the Clean Air Act trigger the major-questions doctrine, while recognizing that others – including imposing technology-based standards that improve the emission rate of individual power plants themselves – do not.[125] For the reasons discussed further below, the proposal fails to demonstrate that regulating climate pollution from power plants under Section 111 would require EPA to go beyond the use of technology-based standards that require sources to operate more cleanly. The fact that at least *some* types of climate pollution standards of power plants under Section 111 do not offend the major-questions doctrine is fatal to the proposal's assertion that the doctrine supports total disavowal of EPA's authority to enact *any* such standards.

B. The proposal deviates without adequate explanation from EPA's prior recognition that imposing technology-based climate pollution standards on power plants does not offend the major-questions doctrine.

Two years ago, EPA addressed in detail whether imposing technology-based standards on climate pollution from existing power plants offended the major-questions doctrine. It concluded that it did not. 89 Fed. Reg. 39798, 39899-901 (May 9, 2024). That analysis post-dated and accounted for the judicial decisions that the proposal now says call into question EPA's authority. *See id.* (concluding that technology-based standards are "fully consistent with the Supreme Court's interpretation of the EPA's authority in *West Virginia"*). True, aspects of that analysis were specific to the particular suite of technology standards contained in the 2024 Carbon Pollution Standards, and EPA repealed those standards on technical grounds, simultaneous with the present proposal to deny all authority to regulate climate pollution from power plants. But EPA's repeal of the 2024 standards was itself arbitrary and capricious and unlawful. *See generally* Pet. for Review, *Am. Lung Ass'n v. EPA*, D.C. Cir. No. 26-1238 (Sept. 17, 2026). More fundamentally, even if EPA were correct that the specific 2024 standards were infeasible (for example, that they required an unachievably high percentage reduction in carbon dioxide emissions), that conclusion would not establish that there is *no* feasible level of reduction technology. Indeed, standards for *new* plants have been on the books since 2015, confirming that methods of effectively regulating climate pollution from power plants exist. The 2024 major-questions analysis would apply equally to any and all feasible standards, to the extent that they, like the 2024 rule, rely on "traditional 'add-on [pollution] control[ ]' akin to measures that the

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[125] The proposal is flatly incorrect when it says that *West Virginia* held "the EPA's statutory authority to establish emission limits under CAA section 111(a)(1) and (d) 'is not close to the sort of clear authorization required by our precedents.'" 91 Fed. Reg. at 59033. The quoted language from *West Virginia* addresses whether "generation shifting can be described as a 'system,'" not whether EPA may establish *any* kind of climate pollution standards under Section 111. 597 U.S. at 732.

EPA identified as BSER in prior CAA section 111 rules" that "improv[e] the performance of individual sources." 89 Fed. Reg. at 39899 (quoting *West Virginia*, 597 U.S. at 727). Any final rule that likewise fails to acknowledge, let alone rebut, the Agency's prior detailed analyses of the major-questions issue would be arbitrary and capricious. *See Fox,* 556 U.S. at 515-16.

C. Were a court to consider the major-questions doctrine on a fresh slate, that doctrine would not support the proposed repeal.

Even assuming EPA were free to consider afresh whether regulating climate pollution from power plants implicates the major-questions doctrine, the proposal's conclusion is incorrect.

1. The major-questions doctrine is not pertinent where the Supreme Court has already definitively interpreted the statute and Congress has ratified that interpretation.

As noted above, the major-questions doctrine is used where there is an open question about how much authority Congress intended to delegate to an agency. Per the Supreme Court's most recent pronouncement on the subject, the doctrine provides relevant "context" in which ambiguous statutory grants of authority should be interpreted: "[B]oth separation of powers principles and a practical understanding of legislative intent suggest[] Congress would not have delegated highly consequential power through ambiguous language." *Learning Resources, Inc. v. Trump*, 607 U.S. 229, 243 (2026); *see also id.* at 246 (observing that " 'a reasonable interpreter would [not] expect Congress to 'pawn[]' such a 'big-time policy call[] . . . off to another branch" (quoting *Biden v. Nebraska*, 600 U.S. 477, 515 (2023) (Barrett, J., concurring))); *id.* at 301 (Barrett, J., concurring).[119] Regarding regulation of climate pollution under Section 111, however, there is no open question to resolve. As discussed, the Supreme Court has already held that Section 202(a) of the Clean Air Act unambiguously provides authority for EPA to regulate greenhouse gases based on their contribution to climate change. Critically, Congress has confirmed that reading.

Congress is the one actor in the federal system that could freely overrule *Massachusetts* and the other Supreme Court decisions cited above. *See, e.g.*, *Kimble v. Marvel Entm't., LLC*, 576 U.S. 446, 456 (2015). Yet Congress has never taken away EPA's authority to regulate climate pollution under Clean Air Act regulatory provisions, including Section 111.[120] To the contrary, Congress has repeatedly taken action that makes sense only against the background understanding that Section 111 does authorize EPA to regulate greenhouse gases based on their contribution to climate change. Of particular note, the Inflation Reduction Act of 2022 expressly contemplates in multiple locations that EPA will set greenhouse gas emissions standards for certain sources under Section 111. For example, Section 136 imposes a charge on certain facilities' methane emissions, but provides an exemption for facilities that are "subject to and in compliance with methane emissions requirements" established by EPA "pursuant to subsections (b) and (d) of section 7411." *See* 42 U.S.C. § 7436(f)(6)(A). Section 135, titled the Low Emissions Electricity Program and referencing "reductions in greenhouse gas emissions that result from domestic electricity and use" in several provisions, in particular provides substantial funding to the EPA Administrator "to ensure that reductions in greenhouse gas emissions are achieved through use of the existing authorities of this Act." *Id*. § 7435. That phrase would make little sense if EPA lacked any authority to secure reductions of greenhouse gas emissions from electric generating units. Indeed, when Congress added that instruction in 2022, EPA was, and

had been, actively pursuing greenhouse gas reductions through its existing authorities in Section 111, 202, and 231. *See, e.g.*, Repeal of the Affordable Clean Energy Rule, 89 Fed. Reg. 39798, 39,824-25 (May 9, 2024) (summarizing history of Section 111 greenhouse gas standards for power plants); 89 Fed. Reg. at 27882-83 (summarizing history of Section 202(a) greenhouse gas standards on vehicles); Control of Air Pollution From Airplanes and Airplane Engines, 86 Fed. Reg. 2136 (Jan. 11, 2021) (setting Section 231 greenhouse gas standards on aircraft engines); *see generally* Greg Dotson & Dustin J. Maghamfar, The Clean Air Act Amendments of 2022: Clean Air, Climate Change, and the Inflation Reduction Act, 53 Envtl. L. Rptr. 10017, 10026-35 (2023) (summarizing 2022 amendments and implications for regulation of greenhouse gases under the Clean Air Act), https://perma.cc/4JPV-AE2M.

In addition, provisions added by the Inflation Reduction Act repeatedly refer to carbon dioxide and other greenhouse gases as "air pollutants," with no indication that the usage of that term was intended to be distinct from other appearances in the Act. For example, Section 135, the Low Emissions Electricity Program, states that "[t]he term 'greenhouse gas' means *the air pollutants* carbon dioxide, hydrofluorocarbons, methane, nitrous oxide, perfluorocarbons, and sulfur hexafluoride." 42 U.S.C. § 7435(c) (emphasis added); *accord id.* §§ 7432(d)(4), 7436(i), 7438(d), 7545(o)(1)(G). Section 133 concerns grants "to reduce air pollution" and directs consideration of strategies to reduce, among other things, greenhouse gases – defined as "the air pollutants carbon dioxide, hydrofluorocarbons, methane, nitrous oxide, perfluorocarbons, and sulfur hexafluoride." *Id.* § 7433(d)(2). Section 137 refers to "Greenhouse Gas Air Pollution Plans and Implementation Grants," and establishes funding for states to "develop[] a plan for the reduction of greenhouse gas air pollution." *Id.* § 7437(b); *see also id.* § 7437(d)(2) (defining the "air pollutants" comprising greenhouse gas). Coming well after *Massachusetts* and after EPA's promulgation of greenhouse gas standards under Section 111 specifically, these provisions reflect Congressional ratification of *Massachusetts* and its progeny.[121]

Beyond the Inflation Reduction Act, Congress has repeatedly recognized EPA's authority to set greenhouse gas emissions limits for vehicles under the similarly worded Section 202 – including by creating tax credits for vehicles that meet EPA's standards. *See, e.g.*, 26 U.S.C. §§ 30B(b)(3)(B), 30D(f)(7); *see also* 42 U.S.C. §§ 17013(a)(1) (establishing incentive program for advanced technology vehicles, defined with regard to compliance with EPA standards); 42 U.S.C. §§ 13212(f)(3)(C). Congress has also appropriated funds to EPA in response to Agency budget requests specifically referencing the need for appropriations to fund the development and promulgation of greenhouse gas regulations under the Clean Air Act – in some cases, after rejecting the efforts of individual legislators to prohibit the use of funds for developing greenhouse gas emissions regulations. *See, e.g.*, U.S. Environmental Protection Agency, Fiscal Year 2015, Justification of Appropriation Estimates for the Committee on Appropriations, at 12, 213, EPA-190-R-14-002 (2014); Continuing Appropriations Resolution, 2015, Pub. L. No. 113-164, 128 Stat. 1867 (2014); Consolidated and Further Continuing Appropriations Act, 2015, Pub. L. No. 113-235, 128 Stat. 2130 (2014); *see generally* Greg Dotson, Looking for Your Friends at a Cocktail Party: the Dubious Role of Rejected Legislation and the Overlooked Potential of the Presidential Appropriations Process, Harv. L. Sch. J. on Legis. Online (2024), https://perma.cc/3HW7-7G2J.

None of the proposal's purported counter-examples demonstrate that Congress understands Section 111 differently. Congress' disapproval under the Congressional Review Act

of certain EPA actions taken under the Clean Air Act – which do *not* implicate EPA's authority to set greenhouse gas standards – says nothing about whether Congress understands Section 111 to authorize regulation of climate pollutants. *See generally* 5 U.S.C. § 801 et seq. Far more relevant is the fact that Congress used the Congressional Review Act to disapprove a Trump I administration effort to *repeal* greenhouse gas emissions standards for oil and gas operations under Section 111. *See* Pub. L. No. 117-23; 85 Fed. Reg. 57018 (Sept. 14, 2020). As discussed elsewhere in this comment, the underlying standards that the disapproved rule sought to repeal regulated methane emissions from oil and gas operations expressly based on methane's contribution to climate change. *See* 81 Fed. Reg. 35824, 35834-37 (June 3, 2016).

The unenacted 2007 bill referenced by the proposal would have given EPA additional authorities to address climate change, going far beyond the authority to set emissions standards for particular classes of sources already conferred by Section 111 – including the authority to set a total nationwide cap on greenhouse gas emissions from *all* sources. *See* H.R. 1590, sec. 701, 704 (2007). Likewise, the unenacted 2009 bill would have put in place economy-wide greenhouse gas emission reduction targets, in addition to addressing a host of other topics including renewable energy standards, grid improvements, and energy efficiency. *See* H.R. 2454, tit. VII (2009). Congress' apparent decision not to give EPA and other agencies *additional* authority to fight climate change does not disprove that EPA has pre-existing authority under the Clean Air Act to set emissions standards for particular source categories. To the contrary, the 2007 and 2009 bills confirm that EPA has such pre-existing authority, including by setting deadlines and minimum-stringency floors for EPA to use that authority. *See* H.R. 1590, sec. 706 (directing EPA to enact greenhouse gas emissions standards for vehicles under Section 202 at least as stringent as standards adopted by California in 2004, and providing deadlines for subsequent revisions to require further reductions); H.R. 2454, sec. 821(a) (directing EPA to promulgate greenhouse gas emissions standards for vehicles under Section 202 by a date certain); *see also* H.R. 2454, sec. 811(a)(2) (directing EPA to use its authority "under section 111" to set greenhouse gas emissions standards for certain sources).

In a similar vein, the 2020 American Innovation and Manufacturing Act requires the production and use of hydrofluorocarbons to drop below set targets in certain subsectors, including vehicle A/C systems. But it does not speak to – let alone displace – EPA's separately conferred authority to regulate climate pollution from major sources under Section 111. There is no conflict between delegating to EPA the authority to limit greenhouse gas emissions from a subset of sources under Section 111 and enacting a detailed regime placing additional restrictions on the refrigeration and air conditioning sector's use of a particularly deleterious subset of greenhouse gases.

Likewise, the RFS program provides additional, not displacing authority. *Cf. Massachusetts*, 549 U.S. at 530 n.29 ("We are moreover puzzled by EPA's roundabout argument that because later Congresses chose to address stratospheric ozone pollution in a specific legislative provision, it somehow follows that greenhouse gases cannot be air pollutants within the meaning of the Clean Air Act."). Indeed, EPA itself acknowledged two years ago that its rule implementing the AIM Act phasedown and its source-specific greenhouse gas emissions standards (in that case, its vehicle standards under Section 202(a)) complemented each other. *See* 89 Fed. Reg. at 27918. The proposal fails to acknowledge or explain EPA's deviation from its own prior position that the two regulatory authorities coexist harmoniously, as required for

reasoned administrative decisionmaking. *See generally FCC v. Fox Television Stations, Inc.,* 556 U.S. 502, 515-16 (2009) ("*Fox*"). And it is well established that EPA may regulate emissions of air pollutants under its general authority to set standards for certain categories of sources (such as stationary sources that contribute significantly to dangerous pollution under Section 111, and vehicles under Section 202(a)), notwithstanding that specialized provisions of the Clean Air Act impose additional restrictions on the same pollutants. For example, EPA sets standards for emissions of volatile organic compounds (VOCs) from vehicles under Section 202(a), *see, e.g.*, 89 Fed. Reg. at 28095, and from stationary source categories listed under Section 111, *see generally* 40 C.F.R. part 60, notwithstanding that Section 183 of the Act directs EPA to set emissions standards for VOCs from consumer or commercial products, *see* 42 U.S.C. § 7511b(e), and Section 112 directs EPA to regulate named VOCs as part of the hazardous pollutants program, *id.* § 7412(b). EPA also regulates precursor pollutants that cause acid rain under the National Ambient Air Quality Standards program, *see* 40 C.F.R. §§ 50.11, 50.17, and under Section 202(a), *see* 89 Fed. Reg. at 27833, notwithstanding that Title IV provides additional authority to curb acid deposition. *See* 42 U.S.C. § 7651 *et seq.*

Nor is there any conflict between EPA's authority to regulate climate pollution from power plants under Section 111 and Congress' subsequent establishment of programs that incentivize reductions in greenhouse gases from other sources, as in Sections 135 and 136 of the Inflation Reduction Act. As discussed above, those two provisions affirmatively support EPA's authority to regulate greenhouse gases under other provisions of the statute. More to the point, Congress is free to offer both sticks and carrots to tackle the same or related issues. The use of one does not logically preclude the other, particularly where the provisions are complementary – for example, regulatory restrictions on the quantity of greenhouse gases emitted from power plants, and the establishment of funding streams for industry-related outreach, technical assistance, and partnerships designed to reduce greenhouse gas emissions in the electricity sector. *See* 42 U.S.C. § 7435.

For this reason, Congress' express reference to greenhouse gases in these provisions does not carry the same negative implication that the Supreme Court assigned to statutory provisions explicitly delegating authority to impose tariffs in *Learning Resources*. In that case, the Court held that Congress' explicit delegation of the heartland-Legislative Branch authority to raise funds via tariffs in some statutory provisions counseled against assuming Congress intended to implicitly delegate that same authority in a separate provision. 607 U.S. at 243-44. Here, by contrast, the proposal suggests that Congress' express delegation of one authority precludes implicit delegation of a *distinct* authority, simply because both relate to the same underlying problem. Given that Congress itself has confirmed that the Clean Air Act confers on EPA the authority to regulate climate pollution under Section 111, there is simply no occasion for EPA to call on the major-questions doctrine to attempt to divine what Congress intended.

2. The proposal elides the relevant interpretive question.

Even assuming there was an open question of Congressional design left for the major-questions doctrine to answer, the proposal gets the application of the doctrine wrong from the jump. As noted above, the major-questions doctrine is a tool to determine what a statute means. What interpretive question the tool is used to answer therefore matters as much as whether the tool is wielded correctly or incorrectly. Here, the question is whether EPA has at least some

authority under Section 111 to set emissions standards on climate pollution from power plants. If the answer to that question is yes, then EPA's proposal to disclaim *any* authority to regulate climate pollution from power plants is contrary to the statute.

The proposal therefore misses the mark to the extent it relies on "the types of controls that the EPA has historically required regulated entities to implement" under Section 111. 91 Fed. Reg. at 59033. For the reasons already discussed, whether EPA has *authority* to regulate climate pollution from power plants under Section 111 – that is, to set any standards at all – is a distinct interpretive question from whether it has authority to impose particular kinds of standards, as demonstrated by *West Virginia*. *See* 597 U.S. at 727 (contrasting requirements imposed on power plants under the Clean Power Plan with "more traditional air pollution control measures" like "efficiency improvements, fuel-switching, and add-on control" (quotation marks omitted)).

The only time that the mere authority to regulate climate pollution from a source category – as opposed to a particular method of regulation – has been held to pose a major question was in *UARG*, which held that Congress did not intend EPA to regulate under the PSD and Title V programs relatively small stationary sources that would trip those programs' numerical emissions thresholds solely by virtue of the amount of greenhouse gases they emit. As discussed, the Supreme Court held that *any* regulation of greenhouse gas emissions from such sources (but not from "anyway" sources that were already subject to those permitting programs for other emissions) would contravene Congress' intent by increasing the number of sources subject to those provisions by orders of magnitude, and by subjecting to regulation small sources that Congress did not expect would be subject to the administratively complex Title V and PSD regimes. *Id.* at 327. This was evidenced by the fact that, when applied to greenhouse gas emissions, the Clean Air Act's statutory thresholds for triggering permitting requirements are 100 or 250 tons per year of any regulated pollutant – thresholds that have a dramatically different and more expansive impacts when applied to greenhouse gas pollution compared to other pollutants.

No such contrary textual indicators are present here. Separate and apart from their contribution to climate pollution, power plants are subject to regulation under the Clean Air Act because of the other pollutants they emit. Imposing climate-pollution standards on power plants therefore does not expand the range of entities regulated under the statute. Nor does anything in the wording of Section 111 need to give way in order for EPA to sensibly regulate climate pollution from power plants. To the contrary, EPA follows the same process for setting climate pollution standards under Section 111 as it does other types of pollutant standards. For new power plants, it sets a federal "standard of performance" defined as "a standard for emissions of air pollutants which reflects the degree of emission limitation achievable through the application of the best system of emission reduction which (taking into account the cost of achieving such reduction and any non-air quality health and environmental impact and energy requirements) the Administrator determines has been adequately demonstrated." 42 U.S.C. § 7411(a)(1), (b)(1)(B). And for existing power plants, EPA "shall prescribe regulations which shall establish a procedure" similar to that used in Section 110 of the act "under which each State shall submit to the Administrator a plan" setting a standard of performance for the pollutant. *Id.* § 7411(d). Thus, applying Section 111 to regulate climate pollution from power plants is not akin to applying the PSD and Title V programs to a whole new universe of sources, but is instead akin to regulating greenhouse gases from large stationary sources that were already subject to the PSD and Title V

programs by virtue of the large quantity of other pollutants they emitted. *UARG* explicitly held that the latter type of regulation was permissible. *Id.* at 329.

The proposal nevertheless maintains that the major-questions analysis may consider not just EPA's bare authority to regulate climate pollution from power plants under Section 111, but the specific methods of regulation EPA has employed in practice – in particular, methods that "shift[] the power sector away from fossil fuels." 91 Fed. Reg. at 59033. As an initial matter, the proposal is incorrect in suggesting that any standards that have the practical result of inducing more production of one type of energy than another is suspect. But even taking the argument on its own terms, it fails. The proposal insists that EPA's "past statements and regulatory efforts demonstrate that the only way to meaningfully address GHG emissions from fossil fuel-fired power plants is generation shifting." *Id.* But the proposal does not back up that assertion. It points to the 2015 Clean Power Plan and the 2024 Carbon Pollution Standards. But of those two, only the Clean Power Plan was premised on shifting power generation from fossil fuels to renewable sources. According to the proposal, the Carbon Pollution Standards were more of the same because they "included a retirement subcategory that incentivized voluntary retirement of fossil fuel-fired plants in favor of different forms of generation." *Id.* Not only does this description not match the Carbon Pollution Standards' approach of creating subcategories that recognize the different cost-reasonableness of controls based on available periods of amortization considering planned retirements and operating horizons of power plants, but even if it were accurate, provisions that *incentivize* generation-shifting are logically distinct from provisions that *require* generation-shifting.

For reasons discussed further below, the Carbon Pollution Standards did not offend the major-questions doctrine. But even spotting EPA the proposition that the 2024 Carbon Pollution Standards contemplated generation-shifting and were impermissible, the proposal makes no effort to demonstrate that it is *impossible* for EPA to impose emissions controls different than the suite selected in the Carbon Pollution Standards. The fact that EPA previously determined that that suite of standards was the best way to regulate emissions from power plants does not establish that no other ways exist. The proposal does not, for example, contend that primary system of emissions reduction relied on by the Carbon Pollution Standards (carbon capture and sequestration) resembles the method of regulation prohibited by *West Virginia.* Ditto the suite of heat rate improvements that the first Trump administration identified as the best system of reduction available in the 2019 Affordable Clean Energy Rule. *See* 84 Fed. Reg. 32520 (July 8, 2019). Regardless of debates one may have about the relative merits of these different technologies for reducing power plants' greenhouse gas emissions, EPA does not show – nor can it show – that Section 111 categorically excludes them from consideration as a system of emission reduction that might serve as the basis for standards. The proposal's myopic focus on one particular type of regulation dooms its major-questions analysis.

Lastly, EPA ignores the fact that, if all other systems of emission reduction truly were infeasible, it could set a standard based on the most efficient generation technology currently in use. This would which would at least provide an enforceable baseline emission limit that would prevent backsliding, avoid the use of poorer and less efficient plant models that certain operators might prefer, and prevent unexpected pollution increases, even if these standards did not appreciably *reduce* emissions from the status quo. While such "business-as-usual" standards are rarely be justified in light of more effective technologies, EPA has not shown that Congress

would prefer *no* standards at all for such sources – which would be the effect of EPA's proposed application of the major-questions doctrine.

3. The authority to regulate power plant climate emissions under Section 111 does not, by itself, meet the major-questions criteria identified by the Supreme Court.

The power to impose an additional technology-based emissions standard on power plants does not trigger the major-questions doctrine. That doctrine applies only to "extraordinary cases." *Brown & Williamson*, 529 U.S. at 159. In *Brown & Williamson*, the doctrine was triggered because, among other reasons, Congressional pronouncements foreclosed the reading in question. *Id.*; *cf. Learning Resources*, 607 U.S. at 243-44 (noting that Congress typically speaks in express terms when it delegates the power of the purse in particular but did not do so in statute under review). But for the reasons already stated, Congress has endorsed EPA's authority to regulate climate pollution under Section 111.

Absent a *Brown & Williamson*-style conflict with another Congressional enactment, such extraordinary cases occur where an agency's assertion of newfound authority is both "unheralded," *UARG*, 573 U.S. at 324, and a "transformative expansion" of the scope of its authority (especially under an ancillary or little-used provision of a statute). *West Virginia*, 597 U.S. at 721; *see also Nebraska*, 600 U.S. at 501. The authority in question must also have profound economic and political significance. *West Virginia*, 597 U.S. at 721. None of those factors are implicated by regulating climate pollution from power plants under Section 111, let alone all three.

a. The authority to regulate climate pollution from power plants is well-established, not unheralded.

The proposal entirely misses an important aspect of the problem, *see State Farm*, 463 U.S. at 43, by focusing on whether regulating greenhouse gases was novel at the time EPA issued the endangerment finding for power plants in 2015, and failing to consider whether exercise of that authority is unheralded *today*. It ignores Congress, the federal judiciary, and EPA's own consistent recognition of that authority in the ensuing 10-plus years, all of which cut against any finding that regulating greenhouse gases from power plants under Section 111 is a new or obscure invention.

Even looking solely at the state of play in 2015, EPA's authority to regulate greenhouse gases from power plants under Section 111 was presaged by express recognition from all three branches. Looking first to the judiciary, as discussed elsewhere in this comment, the Supreme Court explicitly recognized that Section 202 authorizes EPA to regulate climate pollution from vehicles in *Massachusetts* in 2007, employing reasoning that is equally applicable to Section 111. The Court then confirmed in *AEP* in 2011 that Section 111 "speaks directly to emissions of carbon dioxide from" power plants and authorizes EPA to regulate them. 564 U.S. at 424-25 (quotation marks omitted). Indeed, the Supreme Court explicitly recognized in *AEP* that EPA was, at that time, "currently engaged in a [Section 111] rulemaking to set standards for greenhouse gas emissions from fossil-fuel fired powerplants," presenting that rulemaking as consistent with the regime set up by the statute to address climate pollution from power plants. *Id.* at 425. The Supreme Court's express recognition of EPA's authority to regulate climate pollution from power plants four years before the Agency promulgated its first standards defeats

any suggestion that EPA's 2015 actions were an instance of an agency taking it upon itself to discovery new authority in a long-extant statute. *Contra West Virginia*, 597 U.S. at 724*; UARG*, 573 U.S. at 324.

Congress likewise understood and expected long before 2015 that the Clean Air Act would authorize EPA to regulate climate-altering emissions. As has already been discussed, the plain text and legislative history both demonstrate that Congress intended to empower EPA to mitigate harms caused by changes to the climate. Further, as the Supreme Court recognized, Congress was well aware when it enacted the Clean Air Act that it did not know all substances that were or would come to be recognized as air pollutants and drafted broadly "in an intentional effort to confer the flexibility needed to avoid . . . obsolescence." *Massachusetts*, 549 U.S. at 532.

EPA itself also recognized well before 2015 that the Clean Air Act authorized it to regulate climate pollution from covered sources. As the Supreme Court held in *Massachusetts,* EPA announced its understanding that the Clean Air Act's definition of "air pollutant" extended to greenhouse gases decades before EPA began issuing greenhouse gas emissions standards for power plants. In a 1998 memorandum to the EPA Administrator, EPA's general counsel confirmed that "CO_2 . . . [is] a 'physical [and] chemical . . . substance which is emitted into . . . the ambient air,' and hence, [it] is an air pollutant within the meaning of the Clean Air Act." Memorandum, Jonathan Z. Cannon, General Counsel, U.S. EPA (Apr. 10, 1998) at 2, available at: https://perma.cc/R3Q2-B4EP. EPA reiterated that view again a year later in Congressional testimony, explaining that "[g]iven the clarity of the statutory provisions defining 'air pollutant' and providing authority to regulate air pollutants, there is no statutory ambiguity" about greenhouse gases' status as air pollutants under the Act. Testimony of Gary S. Guzy, General Counsel, U.S. EPA, Before a Joint Hearing of the Subcommittee on National Economic Growth, Natural Resources and Regulatory Affairs of the Committee on Government Reform and the Subcommittee on Energy and Environment of the Committee on Science, U.S. House of Representatives (October 6, 1999), available at: https://perma.cc/3S6R-6QP4. While both pronouncements were clear that EPA had not yet made the "factual and scientific" conclusions on endangerment that were the predicates to *regulating* under that authority, both were equally clear that EPA did not lack for authority over greenhouse gases. In fact, the only time, prior to the current Presidential administration, that EPA retreated from the position that the Clean Air Act's regulatory provisions apply to climate-altering greenhouse gases, it was in the 2003 petition denial that was corrected by *Massachusetts*.[126]

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[126] The proposal is incorrect in asserting that a 2008 advanced notice of proposed rulemaking took a contrary position. In the immediate aftermath of *Massachusetts*, EPA issued a 2008 notice recognizing that *Massachusetts* "concluded that GHGs meet the CAA definition of 'air pollutant,' and that section 202(a)(1) of the CAA therefore authorizes regulation of GHGs" to the extent EPA makes an endangerment finding. 73 Fed. Reg. at 44396. To be sure, the 2008 notice expressed reservations about the policy implications of that decision and of regulating greenhouse gases under the Clean Air Act and also sought public comment on numerous issues related to how it should assess the scientific question whether greenhouse gas pollution endangers public health and welfare. But then, unlike now, it did not argue that *Massachusetts*

b. EPA's authority to set emissions standards for climate pollution from power plants is consistent with other authority it exercises under the statute, not transformative.

As noted above, Section 111 permits EPA to submit an already regulated source category to an additional, technology-based standard. Subjecting already-regulated sources to an additional standard generally does not mark a transformative expansion of a regulatory agency's authority. *See UARG*, 573 U.S. at 329; *cf. Biden v. Missouri,* 595 U.S. 87 (2022) (upholding agency's authority to issue COVID-19 vaccine mandate to healthcare workers, where agency had historically issued other vaccine mandates to healthcare workers under the statutory provisions at issue).

That is no less true here, especially given that Section 111 requires EPA to follow the same process and apply the same considerations when it sets emissions standards for climate pollutants as it does for other pollutants. *See AEP*, 564 U.S. at 424-25. That process is far from a blank check to EPA; the statute requires that standards be set with due regard for the cost of achieving reductions, "any nonair quality health and environmental impact and energy requirements, and other factors. 42 U.S.C. § 7411(a)(1).

To the extent the proposal posits that the nature of the *problem* posed by climate pollution renders any standards targeting greenhouse gases inherently transformative, such argument is foreclosed by *UARG*. *See* 573 U.S. at 329 (holding that the statute permitted EPA to set greenhouse gas emissions standards under certain stationary programs for sources that were already subject to regulation due to their emission of other pollutants); *cf. AEP*, 564 U.S. at 424-25. Moreover, as noted above, Section 111 provides EPA with a single tool for addressing that significant problem: setting technology-based standards for specific stationary source categories. *See West Virginia*, 597 U.S. at 726-27. The statute does not permit EPA to seize broader control over other parts of the economy in the name of responding to the climate crisis. And, in particular, the statute does not permit EPA to limit emissions by setting "national policy" on what kinds of energy power plants must produce in the first place (*i.e.*, renewable versus fossil fuel). *Id.* at 728-31. For that reason, the proposal's contention that it is "highly unlikely that Congress would leave to agency discretion the decision of how power plants generate electricity" is beside the point. 91 Fed. Reg. at 59034; *see also id.* (discussing Congressional action "addressing GHGs and global climate change concerns more generally," and noting public debate surrounding statutory incentive programs separate from EPA's authority to set source standards under Section 111).

As noted above, the proposal sidesteps the statutory constraints on EPA's authority by noting that past EPA standards – notably the 2015 Clean Power Plan – have exceeded the authority bestowed by Section 111. But the fact that the Supreme Court struck down the Clean Power Plan in *West Virginia* in fact bears out that statutory limits bar EPA from using its Section 111 authority in transformative ways. As that decision recognized, EPA's authority to regulate under Section 111 is distinct from "the ways in which Congress intended EPA to exercise its

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left it free to decide whether the Clean Air Act is concerned with greenhouse gas pollution from covered sources in the first place. And in any event, the 2008 notice was not EPA's final legal position; the agency went forward with making an endangerment finding for vehicles in 2009.

power under that provision." 597 U.S. at 730. *West Virginia* proves that there is no ground to artificially constrain the former in order to police the borders of the latter.

The proposal also invokes the now-repealed 2024 Carbon Pollution Standards as evidence of Section 111 standards that would have permitted EPA to control the nation's energy mix. But as the proposal itself concedes, the Carbon Pollution Standards did *not* require generation shifting; according to the proposal, they merely "included a retirement subcategory that *incentivized* voluntary retirement of fossil fuel-fired plants in favor of different forms of generation." 91 Fed. Reg. at 59033 (emphasis added). This, of course, is true of any regulation that has the effect of raising the cost of a higher-emitting process relative to a lower-emitting one (which is true of nearly all regulations; otherwise, such lower-emitting processes would typically be adopted voluntarily by the industry).

Even EPA's description of the incentive structure that arises from the Carbon Pollution Standards is in tension with the Agency's finding in the Carbon Pollution Standards rule itself. That rule explained that the Carbon Pollution Standards "do not require any coal-fired steam EGU to retire, nor are they intended to induce retirements. Rather, these guidelines simply set forth presumptive standards that are cost-reasonable and achievable for each subcategory of existing coal-fired steam EGUs." 89 Fed. Reg. at 39892. In fact, the subcategories "were designed, at industry's request, to ensure that subcategories of units that can feasibly and cost-reasonably employ emissions reduction technologies – and only those subcategories of units that can do so – are required to reduce their emissions commensurate with those technologies." *Id.* The subcategory for plants set to retire reflected the common-sense reality that, while EPA determines the best system of emissions reduction available for a source category based on the assumption that "a source will operate indefinitely," the true best system, taking into account cost, may be different for a plant that is set to retire. *Id.*[127] It is not uncommon for EPA's actions under the Clean Air Act to take into account planned source retirements. *See, e.g.*, 79 Fed. Reg. 60895, 60986, 60990 (Oct. 9, 2014) (approving state regional haze implementation plan that was premised in part on voluntary retirement of two generating station units).

EPA went on to explain in exhaustive detail why the Carbon Pollution Standards did *not* implicate the major-questions doctrine. *See generally* 89 Fed. Reg. at 39899-91. To summarize, EPA specifically found:

- The Carbon Pollution Standards "do[] not affect a fundamental revision of the statute," because the best system of emissions reduction selected – carbon capture and sequestration – "is not directed at improvement of the overall power system," but is

[127] *See also* Edison Electric Institute, Comments on EPA's Proposed Clean Air Act Section 111 Rules for Power Plants at 17 (Aug. 8, 2023) ("EEI Comments"), EPA-HQ-OAR-2023-0072-0772 ("[T]he proposed retirement subcategories … are consistent with many of the trends in the sector regarding already planned unit retirements and will be beneficial for many companies and their customers."); *id.* at 181-82 ("In this rulemaking, EPA has the opportunity and authority under CAA section 111 to incorporate compliance flexibilities and mechanisms to help EGUs reduce GHG emissions. EPA has included several important and well-founded compliance flexibilities in the Proposed Section 111 Rules.").

instead "a traditional 'add-on [pollution] control[ ]' akin to measures that the EPA identified as BSER in prior CAA section 111 rules." *Id*. at 38899.

- In setting the Carbon Pollution Standards, EPA "appl[ied] the criteria specified in CAA section 111(a)(1) – including adequate demonstration, costs of control, and emissions reductions." *Id*.
- While the Carbon Pollution Standards were projected to have the practical effect "that, collectively, coal-fired power plants will likely produce less electricity, and other sources (like gas-fired units and renewable sources) will likely produce more electricity," those trends were consistent with historical trends showing that "over the past two decades . . . coal-fired units have retired in high numbers because gas-fired units and renewable sources have become increasingly able to generate lower-cost electricity. Thus, "coal-fired units will become increasingly marginal and continue to retire," with or without the standards. Moreover, coal-fired units that install carbon capture and sequestration technology were projected to run at higher capacity due to tax incentives, such that "the coal-fired units that install CCS collectively generate nearly the same amount of electricity in the 2040 model year as do the group of coal-fired units in the base case." *Id.* at 39990-91.
- The standards are "affordable", and their projected impacts are "the unremarkable consequence of marginally increasing the cost of doing business in a competitive market. *Id*.
- The standards do not "announce what the market share of coal, natural gas, wind, and solar must be, and then requiring plants to reduce operations or subsidize their competitors to get there." *Id*. (quoting West Virginia, 597 U.S. at 731 n.4).

Despite its invocation of the Carbon Pollution Standards, the proposal fails to grapple with this analysis, which post-dates the primary Supreme Court decisions on which the proposal's major-questions analysis relies. But the most important point of all is that – even if the proposal were correct that, notwithstanding EPA's prior analysis, the Carbon Pollution Standards (or some future set of standards) crossed the line into impermissible generation-shifting – the answer would be the same one applied by the Supreme Court in *West Virginia*: to vacate those standards, not to extinguish EPA's underlying authority.

For these reasons, the proposal's citation to specific methods of regulation employed in past standards simply does not answer the question at hand. The proposal neither establishes that the specific methods mentioned are the only possible ways to regulate climate pollution under Section 111, nor explains what would be novel about setting standards that rely on those other technologies – including heat-rate improvements. After all, the first Trump administration itself recognized that such standards are consistent with "the sort of 'systems of emission reduction' it had always before selected" including "'efficiency improvements, fuel-switching, and add-on controls.'" *West Virginia*, 597 U.S. at 727 (quoting 80 Fed. Reg. at 64874). The existence of plainly non-transformative methods of setting climate pollution standards for power plants – even if they far from the only or most appropriate methods – forecloses the proposed finding that regulating climate pollution from power plants is inherently transformative.

c. The economic and political consequences of regulating climate pollution from power plants under Section 111 do not trigger the major-questions doctrine.

The major-questions doctrine is limited to cases where *both* the "history and the breadth" of the authority asserted *and* the "economic and political significance" of the authority provide reason to hesitate before assuming Congress intended to bestow it. *West Virginia*, 597 U.S. at 721; *see also, e.g.*, *Learning Resources*, 607 U.S. at 242 (noting that in all major-questions cases "the Government claimed broad, expansive power on an uncertain statutory basis" before going on to discuss significant consequences); *Biden*, 600 U.S. at 501. A broader conception of the doctrine could lead to its application becoming the rule, rather than the "extraordinary" exception. *Brown & Williamson*, 529 U.S. at 159. To wit: a huge swath of the regulations promulgated by federal agencies are economically and politically significant. Putting a thumb on the scale against finding a delegation of authority in all such cases risks systematic deviation from the standard rules of textual interpretation wherever the results are consequential – notwithstanding that in many cases, Congress made the delegation with full awareness that significant consequences would follow. *See, e.g.*, *Motor & Equip. Mfrs.*, 627 F.2d at 1118; *cf. Loper Bright,* 603 U.S. at 399 ("Presumptions have their place in statutory interpretation, but only to the extent that they approximate reality."). Because setting climate pollution standards for power plants under Section 111 is not a novel, transformative exercise of authority, the economic and political significance of that authority is immaterial to the analysis.

In any event, the proposal does not demonstrate that the economic and political significance of regulating greenhouse gases from power plants under Section 111 is inherently different in kind than that of regulating other pollutants.[128] It is worth emphasizing once again the burden the Agency would need to carry in order to rely, even in part, on economic and political significance as a basis for concluding that it has no authority to regulate greenhouse gases under Section 111. The potential for significant costs – including incidental and indirect costs – is inherent in setting emissions standards, and Congress recognized and accepted as much when it enacted the Clean Air Act. *Cf. Motor & Equip. Mfrs.,* 627 F.2d at 1118. As EPA itself previously recognized, "Congress intended the EPA to promulgate regulations even where emissions controls had economic costs." 89 Fed. Reg. at 39900-01 (citing Senate Committee Report for the 1970 Clean Air Act Amendments). In this context, significant consequences are not enough to trigger the doctrine; there would have to be vast economic and political consequences that are different in kind from the consequences of other types of emissions regulations.

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[128] *See* Jay Duffy, Degree Versus Kind: A Coherent Method for Implementing the "Major Questions" Doctrine, 56 Env't L. Rep. 10416, 10416 (2026) ("When courts apply the major questions doctrine to strike down agency action, they almost invariably conclude that the agency has adopted a regulatory scheme that is qualitatively different from the one Congress authorized – 'a fundamental revision of the statute, changing it from one sort of scheme of regulation into an entirely *different kind*.' (quoting *West Virginia*, 597 U.S. at 721 (emphasis added)). Courts thus should reject major-questions challenges when the agency is addressing the same type of problem, using the same type of expertise and regulatory tools, even if the problem has grown larger or the solution more consequential.").

Moreover, because EPA is proposing that it has *no* authority whatsoever to regulate climate pollution under Section 111, it would not be enough to show that *some* exercises of Section 111 authority could have extreme political and economic significance. Instead, the Agency would need to show that *every* conceivable exercise of Section 111 authority to regulate greenhouse gases would have extreme consequences that are different in kind than issuing emissions standards for other pollutants under Section 111. The proposal does not begin to do so.

Looking first to political significance, to the extent the proposal suggests that the electoral, legislative, or other prominence of climate issues necessarily makes regulating greenhouse gases too politically consequential runs into the wall of Supreme Court precedent recognizing EPA's authority to regulate greenhouse gases. *See Massachusetts,* 549 U.S. at 530-31; *AEP,* 564 U.S. at 424; *UARG*, 573 U.S. at 329; *cf. West Virginia*, 597 U.S. at 727. It is also at odds with the best reading of Section 111 and a long chain of Congressional and administrative action, as discussed elsewhere in this comment. And it ignores that the authority at issue is circumscribed: not the power to set national climate policy writ large, but to set technology-based standards for certain pollutants from a category of already-regulated sources.

Turning to economic significance, the proposal makes no effort to demonstrate that it is impossible to set emissions standards for greenhouse gases from power plants without imposing costs that are different in kind than those associated with other standards. Any attempt to do so would face the strong headwinds of EPA's prior findings, which the proposal does not address. For example, the agency concluded with regard to the heat-rate-improvement standards in the first Trump Administration's Affordable Clean Energy rule that:

> the costs of the HRI technologies and practices . . . are reasonable because they improve the efficiency of the units to which they are applied. This results in lower operating costs (especially lower fuel costs). In fact, these HRI technologies and practices are the types of efficiency improvement measures that some owners and operators have reasonably implemented at times over the course of the operating life of their EGUs.

84 Fed. Reg. at 32541. Likewise, the 2024 Carbon Pollution Standards rule, which EPA has unlawfully repealed, found that the costs of achieving the Agency's greenhouse gas standards were not only reasonable, but reasonable in comparison to the cost of standards imposed on power plants to control emissions of other air pollutants. 89 Fed. Reg. at 39882. The proposal ignores both sets of findings.

To the extent the proposal invokes "over a decade of high-stakes litigation and tremendous regulatory uncertainty for the power sector," 91 Fed. Reg. at 59033, that it attributes to EPA's regulation of greenhouse gases under Section 111 as a significant consequence that itself justifies invoking the major-questions doctrine, it errs. Litigation is a feature of virtually every major Clean Air Act rule that EPA issues; that does not nullify its authority under the statute. Furthermore, anytime Congress confers on an agency discretionary authority to regulate within specified statutory bounds, there is a possibility that different administrations will choose to exercise that authority differently, with different ramifications for regulated entities and the public. Yet there is no question that Congress may do just that. *See Loper Bright*, 603 U.S. at 395 ("When the best reading of a statute is that it delegates discretionary authority to an agency, the

role of the reviewing court under the APA is, as always, to independently interpret the statute and effectuate the will of Congress subject to constitutional limits. The court fulfills that role by recognizing constitutional delegations, 'fix[ing] the boundaries of [the] delegated authority,' . . . and ensuring the agency has engaged in '"reasoned decisionmaking"' within those boundaries"). When the discretionary authority is significant, the potential swings may be greater – although the obligation to engage in reasoned decisionmaking (including appropriate consideration of reliance interests) and political accountability exert counterpressure. But, for the reasons already stated, twisting the major-questions doctrine into a rule against delegating consequential regulatory authority is inconsistent with the doctrine and at odds with Congress' prerogative to decide how much discretion to confer on agencies, within the bounds provided by the nondelegation doctrine.

Section 111's delegation with regard to climate pollution does not trip over those bounds, for the reasons discussed below. Moreover, the proposal cites no evidence to demonstrate that the range of permissible regulatory options delegated to EPA under Section 111 – and thus the magnitude of uncertainty for regulated parties – is inherently greater or different in kind with regard to climate pollution than other pollutants. Nor does it explain why its logic would not apply equally to every statutory delegation that gives agencies discretion to impose (and reconsider) consequential standards. It also bears noting that the magnitude of the swings that the proposal attributes to the best reading of Section 111 stems in large part from EPA's *misuse* of the statute, rather than the authority actually conferred. Put bluntly, to the extent the proposal treats the 2015 Clean Power Plan and the present proposal to renounce all regulatory authority as the poles between which the potential costs to regulated parties fluctuate, neither extreme is permissible under the statute, for the reasons explained in *West Virginia* and in *Massachusetts* and its progeny, respectively. Neither EPA nor the courts are at liberty to retract power conferred by Congress based on the agency's attempted misuse of that power: such a choice is for Congress alone, which – for the reasons already stated – has made no effort to trim the delegation.

4. There is no Constitutional basis for constricting EPA's Section 111 authority.

To the extent EPA proposes, in the teeth of the foregoing, that it must apply the major-questions doctrine's clear-authorization requirement to avoid constitutional concerns, it is in error. As noted, above, while some jurists have characterized the major-questions doctrine as not merely a tool of statutory interpretation but a substantive presumption necessary to avoid nondelegation or other constitutional questions, that view of the doctrine has not been adopted by a majority of the Supreme Court, *see Learning Resources*, 607 U.S. at 244 (2026), and is not universal. *Contrast id.* at 272 (Gorsuch, J., concurring) *with id.* at 301 (Barrett, J., concurring).[129] But even assuming the doctrine is one of constitutional avoidance, there is no problem here to avoid.

[129] Moreover, to the extent the major-questions doctrine safeguards constitutional values, it does so through application of the factors that the Supreme Court has set forth. None of those factors are implicated by regulating greenhouse gases under Section 111, for the reasons already discussed. EPA has no authority to devise a different test than the Supreme Court itself has adopted.

Regulating climate pollution under Section 111 does not create nondelegation issues. As discussed above, Congress provided EPA with specific direction about when and how to regulate stationary sources under Sections 111(b) and (d). With regard to when, EPA may only regulate categories of sources if "in [the Administrator's] judgment" the category "causes, or contributes significantly to, air pollution which may reasonably be anticipated to endanger public health or welfare." 42 U.S.C. § 7411(b)(1)(A). That express guardrail easily satisfies the intelligible-principle requirement. *See FCC v. Consumers' Research*, 606 U.S. 656, 673 (2025) ("in examining a statute for the requisite intelligible principle, we have generally assessed whether Congress has made clear both 'the general policy' that the agency must pursue and 'the boundaries of [its] delegated authority'"); *Whitman*, 531 U.S. at 473-75.[130] This is true regardless of whether Section 111 requires EPA to make a significant contribution finding with regard to the category's contribution to air pollution in general, or with regard to its contribution to each specific type of pollution for which EPA sets a standard. Even in the former circumstance, the statute sets the outer boundaries of which source categories can be regulated and what they can be regulated for: any substance the category emits that fits the statutory definition of air pollution and for which rational standards of performance meeting the statutory criteria can be devised. To be sure, EPA may have discretion in deciding for which of the covered emissions it will set standards. But those kinds of prioritization decisions are inherent in agency enforcement discretion, and EPA's exercise of that discretion is constrained by the broader objectives of Section 111 and the Clean Air Act as a whole. In any event, any concern is academic: even if the statute had to be read to require a significant contribution finding for each regulated pollutant a source category emits, EPA has determined as a matter of fact that power plants do contribute significantly to greenhouse gas pollution that endangers human health or welfare, and the proposed repeal does not dispute the facts underlying that finding.

With regard to how EPA regulates, Section 111 directs EPA to set a federal "standard of performance" for new power plants, defines what that standard requires, and what factors EPA shall consider when deciding what technologies satisfy the standard. 42 U.S.C. § 7411(a)(1), (b)(1)(B). For existing power plants, EPA "shall prescribe regulations which shall establish a procedure" similar to that used in Section 110 of the act "under which each State shall submit to the Administrator a plan" setting a standard of performance for the pollutant. *Id.* § 7411(d). These express directions likewise satisfy the intelligible-principle requirement.

D. Even assuming the major-questions doctrine applies, Section 111 provides the requisite clear congressional authorization to regulate greenhouse gas emissions.

The major-questions doctrine does not provide that a statute may never be read to delegate extraordinary power to an agency. It simply provides that a court should not infer such a delegation absent "clear congressional authorization." *West Virginia*, 597 U.S. at 732. Here, even if the doctrine were implicated, the Clean Air Act provides that clear congressional authorization

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[130] The Court in *Whitman* even included an aspect of Section 111 not at issue here, Section 111(i) covering "country elevators," as an example in its discussion of intelligible principles, *see* 531 U.S. at 475, and discussed Section 111's factors for setting "standards of performance" as providing clear guidance to Congress to consider cost – hardly lacking an intelligible principle, *see id.* at 467.

regarding EPA's authority to climate pollution under Section 111. For all the reasons discussed above, Supreme Court precedent holds that the statute confers that authority. Under *Loper Bright*, that is the single, correct meaning of the statute and is not subject to revisiting by EPA – or even by the Supreme Court itself, absent the exceptional showing required to depart from statutory stare decisis. *See* 603 U.S. at 400. And traditional tools of statutory interpretation reach the same conclusion, in any event.

The proposal's contrary arguments fail. First, the proposal cites the fact that EPA has in the past stated that it may regulate any air pollutant emitted by a source that contributes significantly to *some* kind of dangerous air pollution, provided it has a rational basis. That argument is a non sequitur. On that reading of the statute, Congress' charge to EPA is no less clear for being capacious: the agency has authority to set performance standards for any and all statutorily-defined air pollutants that the source category emits, for which standards of performance can be rationally devised. The existence of discretion over what regulatory targets to prioritize under a capacious grant of authority does not prove that Congress did not intend to grant that authority. As just one example, the Supreme Court recognized that a statute authorizing the Secretary of Human Health & Services to impose conditions on the receipt of Medicare and Medicaid funds that the "the Secretary finds necessary in the interest of the health and safety of individuals who are furnished services" permitted the Secretary to impose a COVID-19 vaccine mandate on healthcare workers. *Missouri*, 595 U.S. at 93. Under that statute, as under Section 111, the agency had wide latitude to decide which of the myriad conditions that satisfy the capacious statutory trigger ("necessary in the interest of" treated individuals in *Missouri*, air pollutant emitted by a major source, here) to impose. More fundamentally, even if the proposal were correct that reading the statute not to require a significant contribution finding for each regulated pollutant posed a major-question problem, the answer would be to read the statute to require such a pollutant-specific finding. EPA has already made that finding with regard to power plants' contribution to greenhouse gas pollution, and the proposal nowhere concludes otherwise.

Second, the proposal relies on a series of major-questions decisions that it maintains rejected textual bases for regulation that were "merely plausible." But reading Section 111 to apply to climate pollution from power plants is far more than plausible: it is compelled by Supreme Court precedent and is the best interpretation of the statute, for the reasons already discussed. Moreover, the cases cited by the proposal are distinguishable, for the reasons discussed.

IV. EPA'S ASSERTIONS CONCERNING DISPLACEMENT AND PREEMPTION ARE INCORRECT.

If, as EPA proposes, Section 111 does not authorize regulation of greenhouse gases to address global climate change, there is no basis for displacement of federal common law or preemption of state common law.

A. Federal common law.

EPA's proposed interpretation that it lacks authority to regulate greenhouse gases under Section 111 would also mean that the Clean Air Act no longer displaces federal common law, at a minimum for power plant sources but potentially for all regulated source categories. In *American Electric Power Co. v. Connecticut*, the Supreme Court concluded that EPA's authority to regulate

greenhouse gases under the Clean Air Act protected covered industries from certain federal common-law claims, including for tort damages. 564 U.S. at 424. If EPA were correct that Congress never granted the Agency that regulatory authority, there would be no basis for such displacement. The proposal is thus incorrect that if the proposal is finalized, "[t]he CAA would continue to displace any Federal common-law claims that might otherwise be available to those seeking to regulate GHG emissions from power plants." 91 Fed. Reg. at 59043.

In *AEP*, the Court held that Section 111 "speaks directly to the question" of EPA's authority to regulate greenhouse gases to reduce the threat of global climate change. 564 U.S. at 424 (citation modified) (quoting *Mobil Oil Corp. v. Higginbotham*, 98 S. Ct. 2010, 56 L.Ed.2d 581 (1978)). For that reason, the Court held that the Act "excludes the declaration of federal common law." 564 U.S. at 424. Because the Clean Air Act "provides a means to seek limits on emissions of carbon dioxide" from particular sources, the Court reasoned, there is "no room for a parallel track" to compel reductions from those sources under federal common law. *Id*. at 425. The Court's ruling thus tied together the authority granted as to particular sources (in the case of *AEP*, power plants) and the displacement of federal common law suits against those sources: "The critical point is that Congress delegated to EPA the decision whether and how to regulate carbon-dioxide emissions from powerplants; the delegation is what displaces federal common law." *Id*. at 426.

But EPA's proposal here now argues, among other things, that Section 111 does not authorize EPA to set standards for greenhouse gas emissions to address global climate change concerns, first, because Section 111 authority is supposedly limited only to pollution that harms through "local and regional exposure" and, second, because Congress supposedly did not supply greenhouse gas regulatory authority with sufficient clarity to satisfy the major-question doctrine. With these arguments, EPA is necessarily contending that the Court erred in *AEP* in holding that the Clean Air Act *does authorize* EPA to regulate greenhouse gases to address climate change. If EPA were right that there is no such Clean Air Act authority, then there would be no basis to conclude that the Act displaces the pre-existing federal common law.[131]

EPA misreads *AEP's* statement that "Congress delegated to EPA the decision whether and how to regulate" greenhouse gas emissions as somehow granting the agency the authority to decide for itself the *legal standard* for deciding whether climate-changing pollutants are subject to Section 111. 91 Fed. Reg. at 59043. That claim flies in the face of *Loper Bright*, which holds that it is for courts, not agencies, to determine the "best reading" of a statute's authorization. 603 U.S. 369, 395 (2024).

By "whether and how," the *AEP* Court did not suggest that Congress had delegated EPA authority to decide for itself the scope of its own authority, *i.e.*, whether greenhouse gases are subject to regulation at all. 564 U.S. at 426. For one thing, the Supreme Court already answered that question in *Massachusetts* and *AEP*. "Whether," as used in *AEP*, simply recognizes that the Act delegates some authority to apply facts to the legal standard to determine whether the

[131] This is not just our view. *See* Edison Elec. Inst., et al. Amicus Br., *West Virginia v. EPA*, No. 20-1530 (S. Ct. Jan. 25, 2022) (brief of utilities recognizing that arguments against EPA's authority over greenhouse gases undermine federal common-law displacement under *AEP*).

statutory prerequisites for listing and regulating power plants' carbon dioxide emissions are met. On this, we have shown that the record facts overwhelmingly support the 2015 endangerment finding for power plants under 111 (as they do the 2009 endangerment finding for vehicles under Section 202).

As to "how," that criterion goes to the *way* in which EPA may regulate those emissions. In *West Virginia*, the Court found that the generation-shifting structure of the 2015 Clean Power Plan exceeded EPA's "how" authority under Section 111, but the Court affirmed EPA's authority under that section to regulate power plant carbon dioxide emissions through traditional technology-based standards that "improve the pollution performance of individual sources." 597 U.S. 697, 724, 734 (2022). Nothing in *AEP* or *West Virginia* allows EPA to deny its statutory authority to regulate greenhouse gases outright.

For all of the reasons discussed throughout this submission, commenters strenuously object to EPA's premise that the Clean Air Act does not permit EPA to establish greenhouse gas standards for power plants under Section 111. But if the Agency nonetheless decides to finalize its proposal, it cannot have its cake and eat it too: if EPA's regulatory authority falls, so does the shield against federal common-law suits.

EPA appears to suggest that displacement of federal common law could survive because EPA retained the authority to regulate one or more of the six greenhouse gases if they harm health or welfare in some way other than through climate change. EPA notes that it has regulated methane, for example, in part because it is explosive. But there is no reason to think that *AEP* intended to shield a pollutant from climate-related federal common-law suits if it was regulated under the Clean Air Act for an entirely different reason. If Section 111 were properly understood to reach only pollution that harms through "local or regional exposure," it would not displace common-law suits over climate damages because the "congressional legislation" in question plainly would not "speak[] directly to the question at issue." *AEP*, 564 U.S. at 424 (citation modified).

B. State common law.

The proposal asserts also that "the proposed repeals would not impact preemption under the CAA and other applicable constraints on State regulation of State common-law claims, statutes, or regulations that seek to regulate out-of-state GHG emissions." 91 Fed. Reg. at 59043. EPA's sweeping state common law preemption assertions have multiple flaws.

First, the Supreme Court took no position in *AEP* on the availability of state common-law suits. That, the Court stated, was left for a future case interpreting whether the Clean Air Act has preemptive intent. 564 U.S. at 429.

Second, even if EPA were right that the Clean Air Act addresses only local or regional pollution, it would be wrong that the statute preempts state common law addressed to climate change. To be sure, a statute can affirmatively preempt state common law *without* supplying federal regulatory authority, but there is no Clean Air Act provision that expressly does so. Far from it, the Act includes savings clauses for both state regulatory and common law. A federal statute cannot *silently, implicitly* preempt state common law addressed to a problem that the

federal statute (in EPA's telling) simply does not address. Even more so, the Clean Air Act cannot silently, implicitly preempt suits addressing fraud, misrepresentation, or other similar causes of action, subjects the Act does not address in *any* context. As in *Puerto Rico Dept. of Consumer Affairs v. Isla Petroleum Corp.*, EPA cannot, in now disclaiming authority, "leave behind a pre-emptive grin without a statutory cat." 485 U.S. 495, 504 (1988).

Third, the Clean Air Act does not preempt state common law even when it *does* provide federal regulatory authority. EPA implies that *International Paper Co. v. Ouellette*, 479 U.S. 481 (1987), interpreting similar provisions of the Clean Water Act, held that state common-law suits are preempted. In fact, the Court held the opposite: "[N]othing in the Act bars aggrieved individuals from bringing a nuisance claim pursuant to the law of the source State." 479 U.S. at 497. The *AEP* Court specifically noted this holding from *Ouellette.* 564 U.S. at 429. Even if *Ouellette's* source-state-law proviso also applies under the Clean Air Act, state common-law suits to address interstate emissions would still be *allowed*, not barred altogether. As Professor Rachel Rothschild observes: "In an opinion attentive to states' traditional police powers over natural resources, the Court in *International Paper Co. v. Ouellette* upheld the use of state common law for tort suits over transboundary pollution so long as such cases did not obstruct federal permitting programs. Since then, tort suits involving transboundary environmental issues have proceeded under state law against a variety of companies and polluters."[132]

Fourth, EPA does not address the mismatch between its view of the scope of its federal regulatory authority and its view of the scope of preemption. Even if EPA were correct that, despite *Ouellette*, federal regulatory authority preempts the common law of both receiving- and source-states, the scope of that preemption would logically have to be limited to the scope of federal regulatory authority. As noted above with respect to federal common law, EPA appears to suggest that it retains authority to set Section 111 standards for a few source categories that emit methane (*e.g.*, oil and gas and landfills), potentially for non-climate protection reasons (such as

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[132] Rachel Rothschild, *The Collision of State Climate Tort Suits with Federal Deregulation*, Yale Law Journal Forum (Oct. 3, 2026), https://yalelawjournal.org/essay/the-collision-of-state-climate-tort-suits-with-federal-deregulation. The proposal cites *City of New York v. Chevron Corp*., 993 F.3d 81 (2d Cir. 2021). Professor Rothschild notes that this is the only federal circuit court decision that so holds and it stands in conflict with two state supreme court decisions, in Colorado and Hawaii. *Cnty. Comm'rs v. Suncor Energy USA, Inc.*, 586 P.3d 161, 165 (Colo. 2025), *cert. granted,* 146 S. Ct. 1605 (2026); *City & Cnty. of Honolulu v. Sunoco LP*, 537 P.3d 1173, 1181-82 (Haw. 2023).[132] The state supreme court decisions proceed, correctly, from the premise that EPA *has* regulatory authority over greenhouse gases for climate-protection purposes. Nonetheless, they reject the argument that the Clean Air Act preempts state common-law suits over damages caused by such emissions, and even more so over damages caused by fraud or misrepresentation. They found nothing explicit or implicit that has preemptive effect.

The Supreme Court has the preemption issue before it now in the *Suncor* case. Questioning from the Justices appeared to focus on whether a federal statute that *does* grant EPA regulatory authority (as the Court has held now four times) and that contains a provision saving state common law nevertheless implicitly preempts it. *Ouelette* shows that a statute can authorize federal action and save state remedies at the same time.

explosion prevention). EPA seems to assert that this suffices to preempt *all* state common law climate suits. EPA has failed to explain how the authority to control emissions from a few sources for non-climate reasons could implicitly preempt state common-law suits addressed to the climate impacts of those sources. *See, e.g.*, *Mozilla Corp. v. FCC*, 940 F.3d 1, 75 (D.C. Cir. 2019) ("[I]n any area where the Commission lacks the authority to regulate, it equally lacks the power to preempt state law"). Plus, EPA's reasoning also fails to take account of its recent proposal to substantially weaken oil and gas standards, which indicates that EPA intends to review whether the views on Agency authority in this Supplement Proposal, if finalized, will "require revisions to the oil and gas regulations" as well, 91 Fed. Reg. at 68244 – yet more evidence that the supposed scope of preemption if this proposal is finalized would be narrower than EPA claims.

Fifth, "Agencies may act only when and how Congress lets them." *Cent. United Life Ins. Co. v. Burwell*, 827 F.3d 70, 73 (D.C. Cir. 2016). They cannot "pronounce on pre-emption absent delegation by Congress." *Wyeth v. Levine*, 555 U.S. 555, 576-77 (2009). EPA's view on preemption here is not "thorough[], consisten[t], or persuasive[]," *id.* at 577, so it should be given no weight.

In short, EPA's sweeping state common law preemption theory is illogical and wrong.

V. EPA'S APPROACH TO THE COMBINED SOURCE CATEGORY IN 2015 WAS LAWFUL AND THE ALLEGED FLAW EPA IDENTIFIES IS NOT AN INDEPENDENT BASIS FOR REPEAL.

EPA claims as an "independent" basis for repeal that EPA acted improperly in 2015 when it combined the steam generator and combustion turbine source categories into a single source category without a new endangerment finding. 91 Fed. Reg. at 59030. That proposal – which EPA also offered in the Significant Contribution Proposal – is incorrect for the reasons described in our comments on that earlier proposal, *see* Significant Contribution Comment at Section IV.B. As those comments explained, a new endangerment finding is not required to merge two previously listed source categories. *Id.* Those comments further note that EPA made a new endangerment finding for the combined source category in the alternative, so the sources were properly listed and regulated whether or not a new endangerment finding was required. *Id.*

The Supplemental Proposal acknowledges the endangerment finding EPA made in the alternative, but claims it was insufficient because it assessed endangerment in the same manner "as analyzed for CAA section 202(a)(1) purposes" in 2009 and consequently failed to find that "GHG emissions from fossil fuel-fired power plants cause or contribute significantly to dangerous air pollution – *i.e.*, air pollution that endangers through local or regional exposure." 91 Fed. Reg. at 59030. As explained above, *see supra* Part II.B, the "local/regional exposure" interpretation of Section 111(b)(1)(A) is unlawful and unreasonable. Moreover, EPA properly assessed endangerment in 2015, including on the basis of new record material not considered in 2009, *see* 80 Fed. Reg. at 64530-31; *supra* Comment Part VI.A, so EPA's new, impermissible gloss on the statutory text is not a basis for repealing that finding.

EPA is also incorrect that the failure to find in 2015 that greenhouse gas pollution "endangers through local or regional exposure," *see* 91 Fed. Reg. at 59030 (V.A.2.a of the Supplemental Proposal), constitutes an "independent" basis for this proposal. This argument, on its face, presupposes that EPA is correct that Section 111 refers only to pollution "that endangers through local or regional exposure." *Id.* But that interpretation of the listing criteria in Section 111(b)(1)(A) is the subject of this proposal and this comment, not an interpretive *fait accompli*. EPA's proposal concerning improper listing thus depends on other (incorrect) proposals advanced here. EPA is, therefore, both incorrect that EPA's 2015 listing was flawed and incorrect that the purported flaw would form an independent basis for repeal.

VI. EPA'S SEPARATE REPEAL OF THE 2009 VEHICLES ENDANGERMENT FINDING IS NOT A BASIS FOR REPEAL.

A. Rescission of the 2009 Endangerment Finding has no legal effect on the 2015 Findings and does not require that they be likewise rescinded.

EPA points to a second supposed "flaw" that it claims "independently and collectively . . . render[s] the 2015 Findings ineffective." 91 Fed. Reg. at 59030. EPA asserts that its own recent choice to rescind the 2009 Endangerment Finding "[a]brogates the [b]asis and [i]nterpretations [u]nderlying the 2015 [f]indings." *Id*. EPA quotes the 2015 final rule preamble, in which the Agency had observed that "our approach here . . . is substantially similar to that reflected in the 2009 Endangerment Finding and the 2010 denial of petitions to reconsider." *Id.* EPA states, "we believed at the time that this reliance made sense given what we assumed to be similarities between CAA section 202(a)(1) and CAA section 111(b)(1)(A)." *Id.* EPA now characterizes its 2015 Findings as having "relied on the interpretations in and approach of the 2009 Endangerment Finding rather than independently interpreting and applying CAA section 111(b)(1)(A)," and proposes that "the rescission of the 2009 Endangerment Finding in February 2026 abrogates the legal foundation of the 2015 Findings." *Id.* EPA's proposal is misguided and unsupported for many reasons.

1. EPA's change of interpretation of Clean Air Act Section 202(a)(1) has no legal effect on endangerment and substantial contribution findings made under Section 111(b)(1)(A).

To begin, even if EPA were correct in stating that the 2015 Findings "relied" on legal interpretations in the 2009 Endangerment Finding, under *Loper Bright*, EPA's recent change in its long-standing interpretations of Section 202(a) does not carry the determinative weight EPA ascribes to it. *See Loper Bright,* 603 U.S. at 400-01 ("Perhaps most fundamentally . . . agencies have no special competence in resolving statutory ambiguities. Courts do."). "After *Loper Bright*," courts "must review (and correct) [EPA's] mistaken interpretation of [legal] terms without giving it deference." *Kentucky v. EPA*, 123 F.4th 447, 467 (6th Cir. 2024); *accord U.S. Sugar Corp. v. EPA*, 113 F.4th 984, 991 n.7 (D.C. Cir. 2024) (courts must "construe statutes de novo, without deference to the views of agencies entrusted to administer the statutes"). And whatever degree of "respect" remains due to agency statutory interpretations following *Loper Bright* is much diminished when, rather than "remain[ing] consistent over time," an agency suddenly changes its long-held view as EPA seeks to do in this Supplemental Proposal. *Loper Bright,* 603 U.S. at 386; *see supra* Comment Part II.B.1 (demonstrating that the statutory

interpretation EPA now proposes is contrary to its prior long-held understanding of its statutory authority as evident from its past implementation practice).

In this case, EPA's new-found interpretation that it lacks authority to regulate greenhouse gases under Section 202(a), as explained in the Vehicle Endangerment Repeal, 91 Fed. Reg. at 7686, is directly contrary to the Supreme Court's decision in *Massachusetts,* three subsequent Supreme Court decisions, and seventeen subsequent years of EPA practice. *Massachusetts*, 549 U.S. at 532 ("Because greenhouse gases fit well within the Clean Air Act's capacious definition of 'air pollutant,' we hold that EPA has the statutory authority to regulate the emission of such gases from new motor vehicles."); *AEP*, 564 U.S. at 424 ("Massachusetts made plain that emissions of carbon dioxide qualify as air pollution subject to regulation under the Act"). Moreover, the Court also has held it is "equally plain" that Clean Air Act Section 111 "'speaks directly' to emissions of carbon dioxide" from power plants. *Id.* 564 U.S. at 424. The Court later reaffirmed EPA's authority to regulate greenhouse gas emissions in both *UARG* and *West Virginia*. *UARG*, 573 U.S. at 331-34 (upholding EPA's treatment of greenhouse gas emissions from "anyway" sources as "pollutant[s] subject to regulation under this chapter" for purposes of applying BACT requirements); *West Virginia*, 597 U.S. at 730-31 (acknowledging *AEP's* holding regarding EPA's greenhouse gas regulatory authority under Section 111 but concluding that the Clean Power Plan called into question "the ways in which Congress intended EPA to exercise its power under that provision").

Additionally, the D.C. Circuit upheld the 2015 Findings against all legal and record-based challenges. It held that EPA made a sufficient endangerment finding under Section 111(b)(1)(A) with respect to greenhouse gas emissions from power plants, and that the Agency made all required findings. *Am. Lung Ass'n*, 985 F.3d at 974-77, *rev'd on other grounds* by *West Virginia*, 597 U.S. at 734-35; *see also supra* Comment II.A.3 (the Supreme Court also left undisturbed, in *UARG*, the D.C. Circuit's opinion holding the 2009 Endangerment Finding). These holdings remain binding law, as the Supreme Court only reviewed challenges to the emission guidelines for existing source power plants that EPA had promulgated in 2015 under Section 111(d) – *i.e.*, the "Clean Power Plan." The Court made this distinction clear in its opinion: "[T]he only interpretive question before us, and the only one we answer, is more narrow: whether the 'best system of emission reduction' identified by EPA in the Clean Power Plan was within the authority granted to the Agency in Section 111(d) of the Clean Air Act." 597 U.S. at 734-735. And, due to this binding precedent construing the best reading of Section 111 as giving EPA authority that encompasses greenhouse gas emissions from power plants, EPA has no power to adopt a different reading for the reasons explained above. *Infra* Comment II.A.

Thus, a late-breaking reversal of EPA's interpretation of its authority under a different statutory provision, Section 202(a) – a reversal that itself is unlawful as well as arbitrary and capricious and that is currently undergoing as-yet unresolved judicial review – does not constitute an intervening change in the legal status of the 2015 Findings. Where the best reading of the statute forecloses the agency's interpretation, the D.C. Circuit has explained that "[n]o explanation could justify or make lawful the agency's new interpretation of the statute." *Centro de Trabajadores Unidos v. Bessent*, 167 F.4th 1218, 1238 (D.C. Cir. 2026). And when "the question is whether the agency has reasonably exercised its discretion," *id.*, such discretion does not permit EPA to act arbitrarily and capriciously, including by violating the change-in-position doctrine. EPA's reversal under Section 202(a) is neither a lawful interpretation of the statute nor

the product of reasoned decision making. By itself, EPA's new reading of Section 202(a) does not affect the legal status and effect of the 2015 Findings in any way, much less require that EPA rescind them.

In sum, to the extent EPA proposes to bootstrap the Vehicle Endangerment Repeal – itself an unlawful action – as a convenient justification for taking action to similarly rescind the 2015 Findings, EPA's approach is contrary to law.

2. The Supplemental Proposal's reliance on rescinding the 2009 Endangerment Finding is inconsistent with EPA's own interpretation that *UARG* requires text in Section 111 to be evaluated independently of other Clean Air Act provisions.

In addition to the legal flaws noted above, EPA's proposal that the Vehicle Endangerment Repeal "abrogates the legal foundation" for the 2015 Findings contradicts EPA's own analysis of *UARG* and its proposed interpretation of how *UARG* guides consideration of whether EPA has legal authority to regulate greenhouse gas emissions under Section 111. Elsewhere in the Supplemental Proposal, EPA asserts that "*Massachusetts* must be [] harmon[ized] with *UARG*" and that, pursuant to the latter decision, "EPA's authority to regulate an 'air pollutant' must be evaluated in the context of the particular statutory provision that confers authority to regulate," referring to Section 111(b)(1)(A). 91 Fed. Reg. at 59029.[133] EPA's discussion of *UARG* is incorrect to the extent it suggests there is no significance whatsoever to other Clean Air Act provisions' use of similar language to that in Section 111(b)(1)(A). *See Azar v. Allina Health Services*, 587 U.S. 566, 574, (2019) (the usual rule is that a word carries the same meaning throughout a single statute); *see also supra* Comment II.A.2.a. *UARG* merely rejected the "categorical position that greenhouse gases *must* be air pollutants for all purposes regardless of the statutory context." 573 U.S. at 319 (quotations omitted). It did not hold that a term used in multiple provisions of a statute must be construed only in narrow isolation within each separate provision, ignorant of the same term's usage elsewhere in the same statute.

Nonetheless, EPA's own explanation elsewhere in this Supplemental Proposal of how it is applying *UARG* appears contrary to its suggestion here that its repeal of the 2009 Findings automatically legally abrogates the 2015 Findings, given that these Findings were made pursuant to separate statutory provisions. And, it also contradicts the position the United States has taken before the Supreme Court in *Suncor*, where the government asserts that EPA's conclusion that it lacks greenhouse gas regulatory authority under Section 202(a)(1) "does not apply to EPA's authority under section 7411 to regulate emissions from stationary sources." *Suncor*, Br. for the United States as Amicus Curiae Supp. Pet'rs 34 n.4. EPA's failure to even acknowledge, let alone consider and attempt somehow to reconcile these internal contradictions in its own and the United States' views about the relationship between sections 202(a)(1) and 111 renders its

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[133] EPA is obviously wrong in its further contention that "the Court has not yet had cause to analyze the term 'air pollution' in the context of CAA section 111(b)(1)(A)." 91 Fed. Reg. at 59029; *see AEP*, 564 U.S. at 424-25 (holding that the text of section 111(b)(1)(A) and the structure of section 111 as a whole "provide[] a means to seek limits on emissions of carbon dioxide from domestic powerplants"); *see also Am. Lung Ass'n*, 985 F.3d at 974-77, *rev'd on other grounds by West Virginia*, 597 U.S. at 731.

"automatic legal abrogation" proposal arbitrary and capricious for failure to consider an important aspect of the problem. *See State Farm*, 463 U.S. at 43.

3. The Vehicle Endangerment Repeal cannot abrogate the record basis for the 2015 Findings because EPA did not reevaluate the scientific record for either the 2009 Endangerment Finding or the 2015 findings.

As noted above, contrary to EPA's characterization in this Supplemental Proposal, EPA's analysis of its legal authority in the 2015 Findings principally focused on the text and structure of Section 111 and the caselaw interpreting that section. *See* 80 Fed. Reg. at 64529-31. But there undoubtedly was substantive overlap in the scientific record basis for the 2009 and 2015 Findings. That is to say, in 2015, EPA appropriately considered scientific evidence that had been compiled in the records for the 2009 Endangerment Finding and for EPA's 2010 denials of administrative reconsideration petitions, coupled with subsequent assessments describing developments in climate science since those actions, and other scientific information received in comments on the proposed Section 111(b) findings. *See id.* at 64530-31.

It is unclear if EPA proposes to find that the Vehicle Endangerment Repeal abrogates the scientific evidentiary basis for the 2015 Findings, or just their "legal foundation." 91 Fed. Reg. at 59030. But to the extent the former contention is part of what EPA proposes, that claim is belied by EPA's admission that the Endangerment Finding Repeal did not rely on reevaluation of the scientific record for the 2009 Endangerment Finding. EPA clearly stated as much in the preamble to the final Endangerment Finding Repeal. There, EPA explained that it considered all questions relating to the "alternative climate science basis" it had originally proposed as a possible ground for repealing the 2009 Endangerment Finding, 91 Fed. Reg. at 7695, to be beyond its legal authority to resolve. *Id. at* 7696. Likewise, EPA stated that "comments received on these subjects are outside the scope of the final action." *Id.* In other words, the Vehicle Endangerment Repeal made no science-based finding regarding endangerment from greenhouse gases because, "although the Administrator continue[d] to harbor concerns regarding the scientific determinations underlying the 2009 Endangerment Finding," he concluded that "we cannot resolve these questions under our regulatory authority." *Id.* Therefore, EPA's own characterization of the Vehicle Endangerment Repeal confirms that the Repeal has no bearing or effect on the scientific record basis for *any* greenhouse gas endangerment, cause-or-contribute, or substantial contribution finding, whether made in 2009 under Section 202(a)(1) or in 2015 under Section 111(b)(1)(A).

B. EPA's collection of supposed errors in the 2009 Endangerment Finding is not an adequate or independent basis for repeal of the 2015 finding.

In the proposal, EPA purports to identify fatal flaws in its original "legal and analytical approach" to evaluating the question of endangerment – an approach that EPA first used in the 2009 Finding and then "carried through" to the 2015 Finding. The agency contends that the 2015 Finding (like the 2009 Finding) violated the text and structure of the Clean Air Act by severing the "contribution" and "endangerment" components of the analysis, which EPA says resulted in "a conceptual mismatch" between "air pollutants" (*i.e.*, the domestic greenhouse gases emitted annually by U.S. power plants) and "air pollution" (*i.e.*, the temporally and globally cumulative greenhouse gases in the Earth's atmosphere). *See* 91 Fed. Reg. at 59031. EPA further contends that the 2015 Finding's sequential, two-step approach for evaluating endangerment led EPA to

err by unlawfully defining the relevant "air pollutant" as six well-mixed greenhouse gases, despite the fact that domestic power plants only emit one of these six – CO_2 – in meaningful quantities. *See id*. It also argues that the sequential approach "lacks a limiting principle" and would lead to "untenable results," such as EPA's regulation of water vapor and other "trivial" contributions to greenhouse gas concentrations under Section 111. *Id*. These arguments are no more persuasive here than they were in the context of Section 202, and cannot justify the agency's proposed rescission of the power plants EF.

1. Section 111's "cause or contribute" and "endangerment" prongs are distinct and merit separate consideration.

a. The plain text of Section 111(b)(1)(A) directly contradicts EPA's argument.

The 2015 Endangerment Finding included two distinct components. First, based on a review of the 2009 EF and as well as subsequent research – including nine reports issued between 2010 and 2014 by the Intergovernmental Panel on Climate Change (IPCC), the U.S. Global Change Research Program (USGCRP), and the National Research Council – EPA determined that greenhouse gases qualify as pollution that endanger public health and welfare. 80 Fed. Reg. at 64517-22, 64530-32. Second, the agency considered the quantity of greenhouse gas emissions from U.S. power plants and found that these sources cause or contribute significantly to that pollution. *Id.* at 64522-24, 64530-32. Thus, while the agency maintained that Section 111(b)(1)(A) did not require a new endangerment finding in this context (as EPA was not listing a new source category), it nevertheless made an affirmative finding to the extent one is necessary.

In its repeal proposal, EPA now contends that it erred in 2015 by "[s]evering the analysis of endangerment from the analysis of significant contribution," the 2015 rule "produced a result that is incompatible with the statute." 91 Fed. Reg. at 59032. According to EPA, it must evaluate the endangerment and contribution factors as part of "a single causal chain," in which it asks not whether the atmospheric accumulation of greenhouse gases from all sources endangers health and welfare and then whether greenhouse gas emissions from the electric power sector cause or contribute significantly to that atmospheric accumulation of greenhouse gases, but instead whether power sector greenhouse gas emission *themselves* (and by themselves) endanger health and welfare. In other words, EPA now asserts that "that the relevant consideration is a source category's contribution to *endangerment*, rather than only to *air pollution*." *Id.*

The plain text of the statute forecloses EPA's argument. On its face, Section 111(b)(1)(A) asks EPA to determine whether "a category of sources . . . causes, or contributes significantly to, air pollution which may reasonably be anticipated to endanger public health or welfare." 42 U.S.C. § 7411(b)(1)(A). This language is straightforward, and entails two distinct components: It asks whether those sources cause or contribute significantly "to air pollution," then says what kind of air pollution that must be. In grammatical terms, the restrictive clause ("which may be reasonably anticipated to endanger public health or welfare") modifies "air pollution," not "category of sources." Under the rule of the last antecedent, "a limiting clause or phrase . . . should ordinarily be read as modifying only the noun or phrase that it immediately follows." *Barnhart v. Thomas*, 540 U.S. 20, 26 (2003) (citing 2A N. Singer, Sutherland on Statutory Construction § 47.33, p. 369 (6th rev. ed. 2000)); *Lopez v. Gonzales*, 549 U.S. 47, 56 (2006) ("[T]he last thing [our interpretive regime] would do is divorce a noun from the modifier next to

it without some extraordinary reason."). EPA's position that "that the relevant consideration is a source category's contribution to *endangerment,*" rather than the accumulated mass of "air pollution" to which the source category contributes, 91 Fed. Reg. at 59032, thus violates this canon of construction – and normal grammatical presumption – without "extraordinary reason," so it cannot be the best reading of the statute.

In faulting the 2009 Finding for having failed to evaluate whether power plant emissions "have a more than *de minimis* effect on the *danger* identified with respect to elevated concentrations of GHGs in the upper atmosphere," 91 Fed. Reg. at 59031, EPA thus identifies a non-existent flaw. Under EPA's reading of Section 111(b)(1)(A), the statute would direct the agency to determine whether "a category of sources . . . causes, or contributes significantly to, ~~air pollution which may reasonably be anticipated to~~ [the] endanger[ment of] public health or welfare." Had Congress drafted the statute in this manner, then a single-step endangerment finding might be the proper course of action. But that is not what Congress wrote. If EPA's aim can only be accomplished by deleting an entire clause, adding a definite article, nominalizing a verb, and inserting a preposition, then its construction serves to transform, not best read, the statutory text. As courts have consistently held, "EPA's discretion cannot include the power to rewrite a statute and reshape a policy judgment Congress itself has made." *Nat. Res. Def. Council, Inc. v. EPA*, 902 F.2d 962, 977 (D.C. Cir. 1990), *vacated on other grounds*, 921 F.2d 326 (D.C. Cir. 1991); *Louisiana Pub. Serv. Comm'n v. F.C.C.*, 476 U.S. 355, 376 (1986) ("[O]nly Congress can rewrite [a] statute.").

This is not, of course, to say that EPA may regulate power plant emissions that contribute to air pollution that is dangerous, but not to the danger caused by that air pollution. Indeed, it is not even clear how that would be possible: if air pollution is dangerous, and a source category's emissions contribute to the pollution, it necessarily follows that those emissions contribute to the danger as well. Analytically, however, it may often be extremely difficult as a practical matter to characterize or quantify the relationship between an individual source category's emissions (in this case, greenhouse gas emissions from U.S. power plants) and specific manifestations of endangerment (here, impacts to human health and welfare due to climate change), particularly where that source category's emissions intermingle with those from many other sources of that same pollutant. Recognizing this, Congress made the sensible choice to direct EPA to evaluate the danger to health and welfare that results from the air *pollution* – the accumulated atmospheric total – and separately to evaluate the source category's quantitative contribution *to that pollution* – an analytically manageable task, involving tons of emissions, parts-per-million, etc. – rather than the resulting harm to health and welfare.

This is apparent from Congress's use in Section 111(b)(1)(A) of the phrase "cause[], *or contribute*[] *significantly to.*" Unless the verb "contribute" exists as mere surplusage, it must play some textual role distinct from "cause." *See United States v. Philip Morris USA, Inc.,* 396 F.3d 1190, 1198 (D.C. Cir. 2005) (explaining that courts should "strive to give meaning to every word"). In the Supplemental Proposal, EPA argues that EPA erred by considering the health and welfare impacts from the accumulated total of air pollution, rather than from power plant emissions only. Yet its very nature, "contribute" assumes there is more than one source of the atmospheric contaminants (*i.e.*, the "air pollution") in question apart from power plants. Therefore, what is endangering health or welfare – in this case, all greenhouse gases – must be conceptually distinct from the specific power plant emissions that contribute to that pollution.

Indeed, the legislative history leaves no doubt about this. In its Report on the 1977 Clean Air Act Amendments, the House Committee on Interstate and Foreign Commerce explained that "[b]y its use of the words 'cause or contribute to air pollution,' the committee intends to require the Administrator to consider *all sources of the contaminant which contribute to air pollution*,[134] not just those covered under the resulting standards. Thus, both the text of the statute and the logic of its operation support EPA's decision to determine endangerment based on the accumulated total of greenhouse gases and "significant contribution" based and power plants' quantitative contribution to that larger amount of pollution.

b. The relevant case law supports a clear distinction between Section 111(b)(1)(A)'s contribution and endangerment prongs.

In *Coalition for Responsible Regulation*, which interpreted analogous language under Section 202(a)(1), the D.C. Circuit made clear not only that the contribution and endangerment prongs are two separate inquiries rather than one undifferentiated whole, but that both questions turn on scientific evidence, not on policy factors or judgments as to whether the resulting regulations would be wise or not. As the court explained, "[a]t bottom, § 202(a)(1) requires EPA to answer only *two questions:* whether particular 'air pollution' – here, greenhouse gases – 'may reasonably be anticipated to endanger public health or welfare,' *and* whether motor-vehicle emissions 'cause, or contribute to' that endangerment. These questions require a 'scientific judgment' about the potential risks greenhouse gas emissions pose to public health or welfare – not policy discussions." 684 F.3d at 117-18 (emphasis added) (citing *Massachusetts*, 549 U.S. at 534); *see also id.* at 119 ("However 'absurd' Petitioners consider [the] consequence [of regulating vehicle greenhouse gas emissions], though, it is still irrelevant to the endangerment inquiry."). It is only at the stage of determining the emission standards that technological feasibility, economic cost, and specified other factors come into consideration.

In fact, the D.C. Circuit has understood this for decades. In *Ethyl Corp*, a case centered primarily on the regulation of fuel and fuel additives under Section 211(C)(1)(A) of the Clean Air Act, the court had occasion to interpret Section 202(a)(1) in response to arguments raised by petitioners. 541 F.2d at 7. The court held that the "causes or contributes"[135] language under Section 202(a)(1) "refers not to the causal relationship between air pollution and health, but to the relationship between automobile emissions and air pollution," with EPA's task being to "determin[e] whether the emitted air pollutant, which would be regulated, contributes to the air pollution which is found dangerous." *Id.* at 15-16. The court contrasted this provision with Section 211(c)(1)(A), which, at that time, required the Agency to "control or prohibit . . . any fuel or fuel additive . . . if any emission products of such fuel or fuel additive will endanger the public health or welfare." 42 U.S.C. § 1857f-6c(c)(1)(A) (1970). Whereas Section 202(a)(1) "allow[ed] for a somewhat attenuated chain of causation," Section 211 "simply skips this chain of causation and requires instead that the emission products [directly] . . . endanger the public health" in order to be subject to regulation, rather than "contribute to air pollution that in turn endangers the

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[134] H.R. Rep. No. 95-294, at 51 (1977).

[135] *See supra* note **Error! Bookmark not defined.**, regarding the slight difference in language between the original and current versions of Section 202(a)(1).

public health, as required by 202." *Ethyl Corp.*, 541 F.2d at 16, n.25. The logic that supports this reading of Section 202(a)(1) applies equally to Section 111(B)(a)(A).

Further undermining EPA's interpretation of Section 202(a) is *Massachusetts*, which made perfectly clear that the relevant question under that provision with respect to endangerment is not whether vehicles' greenhouse gas emissions in particular endanger health and welfare by causing climate change, but instead whether the accumulated mass of greenhouse gases in the atmosphere does. For example, the opinion states that "[u]nder the clear terms of the Clean Air Act, EPA can avoid taking further action only if it determines that greenhouse gases do not contribute to climate change or if it provides some reasonable explanation as to why it cannot or will not exercise its discretion to determine whether they do." *Massachusetts*, 549 U.S. at 533. It further states that, "[i]n short, EPA has offered no reasoned explanation for its refusal to decide whether greenhouse gases cause or contribute to climate change." *Id*. at 534. Extending this logic to Section 111(b)(1)(A)'s parallel language, *Massachusetts* leaves no doubt: An endangerment determination under this clause does not refer to greenhouse gases emitted by power plants *in particular*, but rather to greenhouse gases *in general*.

c. EPA's assertion that separate contribution and endangerment findings would permit the Agency to regulate power plants' emissions of water vapor is fanciful and factually wrong.

EPA asserts that by separating Section 111(b)(1)(A)'s significant contribution and endangerment prongs, the 2015 Finding's would allow for no limiting principle, and would permit "absurd" outcomes like EPA's regulation of water vapor emissions from domestic power plants. 91 Fed. Reg. at 59031-32. This contention rests on a basic misunderstanding of the science of atmospheric hydrology: in fact, emissions of water vapor from vehicles, or from *any* human activity, do *not* increase the volume or concentration of water vapor in the atmosphere in any meaningful way, because water vapor has a very short lifetime in the atmosphere of mere days, and anthropogenic water vapor emissions are many orders of magnitude smaller than natural evaporation. Thus, even if elevated levels of atmospheric water vapor relative to a natural baseline could be classified as pollution that endangers public health or welfare, power plant emissions do not even "contribute" to that pollution, let alone contribute "significantly," and so EPA's concern on this point is misplaced.

Setting aside the fact that EPA has never even remotely considered regulating water vapor in the years since issuing either the 2009 or 2015 Finding, the proposal betrays a deep ignorance as to how the hydrologic cycle works. Water enters the atmosphere through evaporation from the oceans, seas, lakes, and other water bodies, and from land, and leaves the atmosphere through precipitation after a period of a few days.[136] At any given global average temperature, the amount of water vapor the atmosphere can hold is subject to a fixed limit that is determined by what is

[136] Sodemann, H., "Beyond Turnover Time: Constraining the Lifetime Distribution of Water Vapor from Simple and Complex Approaches," *J. of Atmospheric Sci.*, 77(2), 430-31(Feb. 1, 2020).

known as the Clausius-Clapeyron relation.[137] Once that threshold is reached, condensation occurs, and the water returns to land or water bodies as precipitation. Therefore, while fuel combustion at power plants puts water into the atmosphere, due to its short atmospheric lifetime, anthropogenic water vapor does not continue accumulating in the atmosphere in a way that has any impact at all on public health or welfare, and certainly cannot qualify as a "significant contributor" to the greenhouse gas pollution that is driving climate change.[138]

In this regard, water vapor is categorically different from CO_2 and the other greenhouse gases covered in the 2009 and 2015 Findings, which accumulate in the atmosphere above naturally occurring baseline levels as a result of anthropogenic emissions. Ironically, emissions of these six pollutants *do* affect the total quantity of water vapor in the atmosphere by raising atmospheric temperatures, increasing the atmosphere's capacity to hold water via the Clausius-Clapeyron relation.[139] In other words, as NASA has explained, "[i]ncreased water vapor doesn't *cause* global warming. Instead, it's a consequence of it."[140] More water in the atmosphere traps more heat than would baseline levels of atmospheric water vapor, creating a feedback-amplification effect, and research indicates that the total amount of water in the atmosphere has been growing by approximately one percent per decade as a result of increasing temperatures.[141] But emissions of water vapor from combusting fuel at power plants and other human activities are thus not the driver; emissions of the six greenhouse gases addressed in the 2009 and 2015 Findings are.[142]

The quantity of vehicle water vapor emissions is simply far too small and remains in the atmosphere for far too short a time to meaningfully contribute to atmospheric concentrations, and is therefore truly *de minimis in* light of the total amount of water cycling through the atmosphere

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[137] The Bodner Group, Purdue University, *The Clausius-Clapeyron Equation*; Adam, David, "What a 190-year-old equation says about rainstorms in a changing climate," *PNAS*, 120(14), 2 (March 30, 2023).

[138] *See generally* MIT Climate Portal, *Why do we blame climate change on carbon dioxide, when water vapor is a much more common greenhouse gas?*, (Nov. 3, 2023), https://climate.mit.edu/ask-mit/why-do-we-blame-climate-change-carbon-dioxide-when-water-vapor-much-more-common-greenhouse; Science Feedback, *Water vapor is a greenhouse gas, but it is not a major driver of global warming* (Dec. 8, 2023), https://science.feedback.org/review/water-vapor-greenhouse-gas-not-major-driver-global-warming/.

[139] Adeliyi, T.E. and Akinsanola, A.A., "Recent trends and variability of temperature and atmospheric water vapor over South Asia," *Atmospheric Research*, (309) 107556, 2 (Oct. 15, 2024).

[140] NASA, *Steamy Relationships: How Atmospheric Water Vapor Amplifies Earth's Greenhouse Effect* (Feb. 8, 2022), https://perma.cc/3CGV-V6RF

[141] Adeliyi, T.E., et al., *supra*.

[142] Indeed, EPA considered and rejected regulating water vapor for many of these same reasons in 2009, and the Proposal fails to acknowledge or explain its divergence from its prior reasoning. 74 Fed. Reg. at 66520.

from natural sources, which is many orders of magnitude greater than water emitted by power plants. Based on information from EIA and other sources, we calculate that the total amount of water vapor produced from U.S. coal-, gas-, and oil-fired power plants to be roughly 4.7x10^12 kilograms per year.[143] This is approximately 0.036% of the total water vapor in the atmosphere at any given moment,[144] 0.00095% of the total water cycling through the Earth's atmosphere in any given year,[145] and 0.00000034% of the total water in the Earth's hydrologic system (which constitutes the stock from which the atmosphere can draw water).[146] Under any conceivable metric, this is not a "significant contribution," and is many orders of magnitude less than the contribution of CO_2 – a pollution that remains in the atmosphere for centuries or more, not mere weeks – from U.S. power plants to global stocks of greenhouse gases.

EPA also suggests that "slip-and-fall injuries, drownings, and damage to crops, livestock, and property" resulting from rainfall could require or authorize the regulation of water vapor emissions from power plants if the 2015 Endangerment Finding were to stand. 91 Fed. Reg. at 59031. To be sure, climate change is causing increased death, illness, property loss, and other harms due to greater rainfall and flooding in some places (along with greater drought in others). But power plants' water vapor emissions are not contributing to those harms because, as explained above, they are many orders of magnitude lower than natural rates of evaporation. Instead, domestic power plants' emissions of CO_2 and other listed greenhouse gases *are*

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[143] These calculations reflect coal-, oil, and gas-specific H_20 emission factors for electricity generation, cooling evaporation, and coal drying at fossil fuel-fired power plants that appear in U.S. Dep't of Energy, Nat'l Energy Tech. Lab., *Water Vapor from Thermoelectric Power Plants, Does it Impact Climate?* 2-3 (May 2, 2008), http://www.ctcombustion.com/oxc/sources/06-WaterVaporImpactsFinal2.pdf/. For data on coal, oil, and gas fuel inputs to the electric power sector in 2025, we relied on EIA, *Monthly Energy Review* (Sept. 29, 2026), Table 6.2 Coal Consumption by Sector (https://www.eia.gov/totalenergy/data/monthly/pdf/sec6_4.pdf), Table 3.7c Petroleum Consumption: Transportation and Electric Power Sectors (https://www.eia.gov/totalenergy/data/monthly/pdf/sec3_23.pdf), Table 4.3 Natural Gas Consumption by Sector (https://www.eia.gov/totalenergy/data/monthly/pdf/sec4_6.pdf). To EIA's measurement units for distillate fuel oil and residual fuel oil (thousand barrels per day), and for coal (short tons) into metric tons and ultimately kilograms, we relied on CME Group, *Compliance Calculator*, https://www.cmegroup.com/tools-information/calc_refined.html. For this same conversion (thousand barrels per day into metric tons and ultimately kilograms) as applied to petroleum coke, we relied on EIA, *Petroleum & Other Liquids*, https://www.eia.gov/dnav/pet/tbldefs/pet_move_imp_tbldef2.asp. And to convert EIA's units for natural gas (billions of cubic feet) into metric tons and ultimately kilograms, we relied on the DOE/NETL study listed above.

[144] NASA Earth Observatory, *The Water Cycle: A Multi-Phased Journey*, https://perma.cc/B4J6-MCK6 (12,900 cubic km is the current maximum amount of water in the Earth's atmosphere at a given moment).

[145] *Id.* (495,000 cubic km of water cycle through Earth's atmosphere in a given year).

[146] U.S. Geological Survey, *How Much Water is There on Earth?* (Nov. 13, 2019), https://perma.cc/7UNU-58HB.

contributing significantly to those harms by increasing the Earth's temperature and thus the amount of moisture that can exist in and precipitate out of the atmosphere.

2. The Rescission Proposal fails to show an impermissible "mismatch" in the 2015 Finding between power plants' greenhouse gas emissions and the "air pollution" to which it contributes.

In the rescission proposal, EPA introduces an awkward argument that the 2015 Finding is fatally flawed due to a supposed incompatibility between specific emissions subjection to regulation under Section 111(b) – here, CO_2 emissions from domestic fossil fuel-fired power plants – and the "air pollution" that those emissions cause or contribute significantly to – that is, the six well-mixed greenhouse gases. *See* 91 Fed. Reg. at 59031. This argument includes several bases for the putative mismatch, and none of them come close to impugning the logic, coherence, or legal durability of the 2015 Finding.

To understand exactly why EPA's argument here falters, it is helpful to consider an extended quote from the proposal:

> The CAA sets out distinct thresholds for regulating and distinct modes of regulation for various types of sources, including new motor vehicles and engines, vehicles in use, and aircraft engines, and separately addresses when and how to respond to international emissions that impact the United States. However, the EPA's approach to endangerment effectively attributed all GHG emissions coming from all of these various distinct sources within the United States, as well as from all international sources, to fossil fuel-fired power plants. Although the statute anticipates that "air pollution" may reflect contributions from multiple source categories, interpreting CAA section 111(b)(1)(A) as extending to global climate change concerns results in an approach to endangerment that impermissibly sweeps in emissions from source categories far beyond the reach of CAA section 111.

91 Fed. Reg. at 59031. EPA asserts here that because the "air pollution" identified in the 2015 endangerment finding – the aggregated mass of six well-mixed greenhouse gases in the atmosphere – results from emissions from many different sources, including sources like motor vehicles and aircraft that are subject to different Clean Air Act programs, it was impermissible for the agency to use that pollution as a basis for regulating emission from domestic power plants only. In other words, the regulated "air pollutant" must be not just the same *kind* of emissions, but same *specific emissions themselves* as the "air pollution" that endangers public health or welfare. Yet as emphasized above, Section 111(b)(1)(A) asks whether the source category "causes, *or contributes significantly to*, air pollution that may reasonably be anticipated to endanger public health or welfare." 42 U.S.C. 7411(b)(1)(A) (emphasis added). The word "contribute" necessarily means that there are other sources of the pollution at issue besides the regulated source category: something cannot logically "contribute" to a set of things that consists only and entirely of itself.

Apparently aware of the obvious flaw in its logic, EPA acknowledges that "the statute anticipates that 'air pollution' may reflect contributions from multiple source categories," but concludes that interpreting "air pollution" to include greenhouse gases would "impermissibly

sweep[] in emissions from source categories far beyond the reach of CAA section 111." 91 Fed. Reg. at 59031. This is nonsensical: EPA admits that the word "contributes" implies multiple other source categories, but insists that greenhouse gases cannot qualify as "air pollution" because that would implicate emissions from other source categories, which is "impermissibl[e]" under the statute. Nowhere does EPA state which, or how many, other source categories are "permitted" under Section 111(b)(1)(A)'s concept of "contribution," but ensures us that they cannot possibly include source categories other than power plants that emit greenhouse gases. It is difficult to imagine more of an ad hoc limitation that appears nowhere in the statute, nor agency reasoning that is more arbitrary and capricious.

The Proposal also suggests that the global scope of greenhouse gases as "air pollution" conflicts with the domestic nature of U.S. power plant emissions, and so a two-step endangerment-and-contribution analysis betrays the statute. But this is an observation without an argument: EPA is taking as its *starting point* the position that it is impermissible under Section 111(b)(1)(A) to regulate domestic emissions that intermingle globally with emissions from other countries, and so the two-step EF process that resulted in that regulatory posture must be forbidden. But that is the very thing EPA is attempting to prove. In other words, EPA's argument begs the question. Yet, as discussed in Comment Part II.B, nothing the text, history, and structure of the Clean Air Act, nor in the relevant case law, supports EPA's position. Nor does Section 111(b)(1)(A)'s reference to "contribution" – which, as we have discussed, necessarily implies the existence of other pollution sources beyond the source category subject to regulation – place any limits on what or where those other sources must be.

The agency also objects to what it considers a temporal mismatch between the 2015's Finding's comparison of greenhouse gas emissions from power plants, which it "measured in annual terms," and the "air pollution" to which those emission contribute, which encompasses the "past, current, and projected" greenhouse gas emissions that that remain in the atmosphere as an accumulated mass. 91 Fed. Reg. at 59031. This argument reflects a blinkered understanding of how pollution works. Under Section 111, EPA regulates emissions of an air pollutant from a particular source category. Emissions occur continuously, are very typically measured on an annual basis, and from a practical standpoint, are often enforced through time-bounded maximum emission rates (*i.e.*, rolling thirty-day averages, rolling annual averages, etc.). But these pollutants may linger in the atmosphere once they are emitted and continue to cause harm, sometimes for years or decades – or in the case of CO_2, centuries or more. In these cases, as a matter of accurate science, EPA must analyze the "air pollution" that endangers health and welfare with respect to past, present, and projected emissions, since all of those together constitute the accumulated mass that is driving climate change.

Nothing in the text of the statute prohibits EPA from following this scientifically grounded, commonsense approach, nor from considering a source category's "contribut[ion]" to that long-lived cumulative mass in terms of its annual emissions of the same pollutant, which is the most common way to measures those emission and corresponds to the most typically used averaging periods for compliance purposes. Under EPA's interpretation, the Clean Air Act would effectively forbid the Agency from regulating emissions of *any* long-lived pollutants, since it would necessarily require the supposed "mismatch" EPA objects to here. The idea that Congress wanted EPA to address only pollution problems that were transitory or quantitively static, while leaving those pollutants that accumulate in the atmosphere and thus increase in danger as time

goes by entirely uncontrolled, is precisely the kind of "absurd consequence[]" that courts must seek to avoid. *Kaseman v. District of Columbia*, 370 U.S. App. D.C. 292, 297 (D.C. Cir. 2006).

As a fourth argument, EPA contends that by severing Section 111(b)(1)(A)'s contribution and endangerment prongs, the 2015 Finding produced a "mismatch" between the air pollution at issue – defined as six well-mixed greenhouse gases (CO_2, CH_4, N_2O, HFCS, PFCs, and SF_6) – and the fact that "fossil fuel-fired power plants only emit[], for all intents and purposes, one of them: CO_2." 91 Fed. Reg. at 59031. Again, this argument cannot withstand the actual statutory language of Section 111(b)(1)(A) discussed above, nor does it even reflect basic mathematical logic: one component very obviously "contributes" to a larger set of six components that consists of that component plus five others. This is not "compar[ing] apples and oranges," 91 Fed. Reg. at 7720, as EPA alleged with regard to the same issue in the 2009 EF; rather, it is like asking whether someone has "contributed" to a collection of apples when they add a Honeycrisp to a basket that also includes Fuji, Gala, Granny Smith, Golden Delicious, and Macintosh varieties. The answer is undoubtedly yes, and EPA's arguments on this front fail to impugn the 2015 Finding. From a scientific standpoint, it was wholly appropriate for the 2015 EF to treat these compounds as together constituting the relevant "air pollution" under Section 111(b)(1)(A). It is undisputed that the six substances addressed in the 2015 Finding all share relevant common characteristics: they each persist in the atmosphere for periods of years, long enough to become evenly distributed (well-mixed) in the global atmosphere, and they each produce a warming effect by absorbing outgoing infrared radiation that otherwise would escape to space. The Agency was therefore fully justified in considering them as part of a collective group, something that is clearly authorized under the Clean Air Act's definition of air pollutant as "any air pollution agent *or combination of such agents*." 42 U.S.C. § 7602(g) (emphasis added).

Nor is it relevant that "each of the five GHGs not emitted in material quantities by fossil fuel-fired power plants has a higher global warming potential – in some cases much higher – than CO_2," which EPA claims is a "material" factor. 91 Fed. Reg. at 59031. It is certainly true that an individual molecule of CH_4, N_2O, HFCs, PFCs, or SF_6 traps more thermal energy than an individual molecule of CO_2. It is also true that there are far more molecules of CO_2 in the atmosphere than of the other pollutants, that CO_2 is particularly long-lived in the atmosphere, and that CO_2 this is by far the greenhouse gas most responsible for driving climate change. Data from the EU's Emissions Database for Global Atmospheric Research (EDGAR) show that, even accounting for the differing global warming potentials of the different greenhouse gases, CO_2 still accounted approximately seventy-three percent of global greenhouse gas emissions and nearly seventy-nine percent of U.S. emissions.[147] It is simply specious to argue (as EPA now does) that a pollutant that a major source of CO_2 cannot be said to "contribute" to pollution that is made up mostly of CO_2.

Indeed, EPA has frequently set Clean Air Act standards for groups of compounds that differ in molecular composition but share common characteristics. Three examples are enough to prove the point. Pursuant to Section 202(b), EPA has for over fifty years issued standards for vehicle emissions of hydrocarbons. *See, e.g.*, 36 Fed. Reg. 12664 (July 2, 1971) (first set of

[147] European Comm'n, *EDGAR - Emissions Database for Global Atmospheric Research*, "GHG emissions of all world countries: 2026 Report," https://edgar.jrc.ec.europa.eu/report_2026.

vehicle hydrocarbon standards issued under Section 202(b)); 42 U.S.C. § 7521(b)(1)(A). Hydrocarbons are a diverse group of chemicals emitted by motor vehicles that share the common characteristic of contributing to the formation of ozone. Not every vehicle or engine emits the same set of hydrocarbons in the same proportions, yet EPA nonetheless regulates them as a single group, based on the total grams per mile of hydrocarbons emitted.

More broadly, numerous provisions in Title I of the Act – including regulations issued under Section 111 – direct EPA to regulate volatile organic compounds (VOCs) as a single pollutant. *See, e.g.*, 40 C.F.R. §§ 60.312 (VOC standards for surface coating of metal furniture), 60.432 (VOC standards for publication rotogravure printing), 60.482-1 through 60.482-10 (synthetic organic chemicals manufacturing industry), 60.542 (rubber tire manufacturing industry), 60.562-2 (polymer manufacturing industry), 60.592 (refineries). VOCs include hundreds of specific compounds (including hydrocarbons) that also are necessary ingredients of ozone. Many industries and products emit VOCs. As with vehicles, every VOC-emitting industry or product emits different chemicals in different combinations, yet EPA regulates their total VOC emissions collectively.

A third example is particulate matter, PM, which consists of dozens, if not hundreds, of different chemicals. They share the common property of small size, enabling them to penetrate deeply into the lungs and beyond, and they are regulated for their contribution to human mortality and morbidity. PM is emitted by a wide variety of stationary and mobile sources, and the Agency has regulated it for decades as a single, consolidated pollutant. *See, e.g.*, 36 Fed. Reg. 24876 (Dec. 23, 1971) (setting PM standards for fossil fuel-fired steam generators, incinerators, and Portland cement plants); 45 Fed. Reg. 14496 (Mar. 5, 1980) (setting PM standards for diesel-fueled light-duty vehicles and light-duty trucks). Indeed, the D.C. Circuit has ruled that EPA may regulate emissions of particulate matter under Section 111 even when the specific type of particle emitted "were shown [to be] innocuous to public health." *Nat'l Lime Ass'n*, 627 F.2d at 431 n.48 (noting that welfare effects and previous EPA findings on particulate matter as a health-harming category of air pollution were sufficient). In exactly the same manner, the 2015 Finding evaluated the six greenhouse gases as a single pollutant (and the Agency's standards since that time have regulated them as such) because of their common characteristics and their common contribution to climate change. The proposal offers no persuasive reason why this course of action has been incorrect.

VII. SCIENTIFIC EVIDENCE UNEQUIVOCALLY ESTABLISHES THAT GREENHOUSE GAS POLLUTION ENDANGERS PUBLIC HEALTH AND WELFARE.

A. Current scientific evidence overwhelmingly supports EPA's endangerment finding.

There is overwhelming evidence that greenhouse gases released by human activity cause global average temperature increases and a host of impacts on the climate system that result in destructive and harmful consequences for people and their health, food and infrastructure, including impacts on sea level rise, extreme heat, water supply, and conditions for agriculture and fish harvests, as well as to ecosystems, biodiversity, and the environment. Over time, scientific advances and longer observational records have served to further confirm the impact of greenhouse gases released by human activities on the systems that support public health and

welfare. We are now able to observe and document with an even greater degree of certainty that greenhouse gases released by the burning of fossil fuels have caused record high temperatures in the ocean and on land; have enhanced conditions for wildfires and stronger hurricanes; have caused marine heatwaves that have damaged coral reefs and fisheries; have caused more severe droughts and flooding in many areas, increasing human hazards and harms to trees and crops; and have expanded the range of diseases that adversely affect human, wildlife, and plant health.

We draw from the peer-reviewed, published scientific literature and the over 35-year history of peer-reviewed scientific assessments such as the Intergovernmental Panel on Climate Change assessment reports, the U.S. National Climate Assessment, and the U.S. National Academies of Science, Engineering, and Medicine publications that have summarized the state of climate science and impacts, which reflect the work of thousands of scientists. Most notably, as we discuss more fully in Comment IX.D.2, *infra*, on September 17, 2025, the National Academies of Sciences, Engineering, and Medicine released *Effects of Human-Caused Greenhouse Gas Emissions on U.S. Climate, Health, and Welfare*.[148] Consistent with the evidence we examine here, the National Academies report concludes that "the evidence for current and future harm to human health and welfare created by human-caused GHGs is beyond scientific dispute" and that "EPA's 2009 finding that the human-caused emissions of greenhouse gases threaten human health and welfare was accurate, has stood the test of time, and is now reinforced by even stronger evidence."[149]

B. Overview.

It is now an "established fact" that carbon dioxide and other greenhouse gases released through the use of fossil fuels, industrial processes, and other activities are influencing the climate system.[150] Levels of carbon dioxide are higher now than they have been for at least 800,000 years.[151] The United States, since the pre-industrial era, has contributed more climate pollution to the atmosphere than any other country.[152] The observational record as of 2020 shows

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[148] Nat'l Acad. of Sci., Eng'g, & Med., *Effects of Human-Caused Greenhouse Gas Emissions on U.S. Climate, Health, and Welfare* (2025), https://doi.org/10.17226/29239 (hereinafter "NASEM 2025 Climate Report").

[149] NASEM 2025 Climate Report, *supra,* at 1, 2.

[150] Paola A. Arias et al., *Technical Summary*, *in Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, 35, 41 (V. Masson-Delmotte et al., eds. 2021), https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_TS.pdf (hereinafter "Arias et al."); E.M. Fischer & R. Knutti, *Anthropogenic contribution to global occurrence of heavy-precipitation and high-temperature extremes*, 5 Nature Climate Change 1 (2015), https://doi.org/10.1038/NCLIMATE2617.

[151] Dieter Lüthi et al., *High-Resolution Carbon Dioxide Concentration Record 650,000-800,000 Years Before Present*, 453 Nature 379 (2008), https://doi.org/10.1038/nature06949.

[152] EPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks, 1990-2023*, EPA 430-R-25-003 (2025), https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks.

an increase of approximately 1ºC in global average temperature since the period 1850-1900 (when industrial activity started)[153] – and since 1970, the continental U.S. has warmed 60% faster than the global average.[154]

Increased concentrations of greenhouse gases in the atmosphere caused by human activity have led to increases in average temperatures and heatwaves on land and in the ocean, to the melting of glaciers and Arctic sea ice, to increases in sea level and coastal flooding, to the drying of parts of the land surface and enhanced conditions for wildfire, to more intense, heavy rainfall events that can lead to flooding, to shifts in weather patterns that can lead to lower crop yields and nutritional value, and to worsening air quality and an increase in the spread of pests and diseases.[155] Climate change has already affected the severity of many extreme weather events – like making the 2021 Pacific Northwest heatwave at least eight times more likely[156] and fostering more dangerous conditions for wildfires across the western United States[157] exposing millions of Americans to unhealthy air associated with heart and lung disease deaths. According to a recentstudy in *Nature*, climate-induced wildfire smoke particulate matter "will cause an additional 26,500 to 30,040 annual excess deaths by mid-century" in the United States.[158]

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[153] Hans-Otto Pörtner et al., *Technical Summary, in Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, 37, 58, 60 (Hans-Otto Pörtner et al. eds. 2022), https://www.ipcc.ch/report/ar6/wg2/chapter/technical-summary/ [hereinafter "Pörtner et al."]; *see also* Copernicus, European Union's Earth Observation Programme, https://climate.copernicus.eu/climate-indicators/temperature (noting the latest five-year-average global temperature through 2025 is the highest on record, and estimating a 1.4°C increase since pre-industrial).

[154] EPA, *Climate Change Indicators: U.S. and Global Temperature* (Jan. 2021), https://19january2021snapshot.epa.gov/climate-indicators/climate-change-indicators-us-and-global-temperature_.html.

[155] Pörtner et al., *supra*, at 37-118.

[156] Nicholas J. Leach et al., *Heatwave Attribution Based on Reliable Operational Weather Forecasts*, 15 Nature Commc'n 1 (2024), https://doi.org/10.1038/s41467-024-48280-7.

[157] John T. Abatzoglou & A. Park Williams, *Impact of Anthropogenic Climate Change on Wildfire Across Western US Forests*, 113 Proc. Natl. Acad. Sci. 11770 (2016), https://doi.org/10.1073/pnas.1607171113.

[158] Minghao Qiu et al., *Wildfire smoke exposure and mortality burden in the US under climate change*, 647 Nature 935, 941 (2025), https://doi.org/10.1038/s41586-025-09611-w.

Extreme heat exposure now causes thousands of deaths,[159] over 100,000 emergency room visits,[160] and approximately $100 billion annually in lost labor productivity across the U.S.[161]

Climate change also endangers the natural systems we depend on. Warmer winters reduce snowpack, posing an unprecedented threat to the water supply for millions throughout the western United States.[162] That means less water to drink, grow crops, create electricity, and provide recreation. Higher water temperatures also kill coral reefs and threaten water quality by enhancing the growth of pathogens and harmful algal blooms, posing health and economic risks to people in places like Florida and elsewhere who are subjected to reoccurring blooms.[163] Sea level rise is worsening flooding, causing some U.S. coastal communities to have to relocate and others to spend billions of dollars to remain in place.[164] Increased extreme weather disaster costs

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[159] Jeffrey T. Howard et al., *Trends of Heat-Related Deaths in the US, 1999-2023*, 332 J. Am. Med. Ass'n 1203 (2024), https://doi.org/10.1001/jama.2024.16386.

[160] Ambarish Vaidyanathan et al., *Heat-Related Emergency Department Visits - United States, May-September 2023*, 73 Morbidity & Mortality Weekly Rep 324 (2024), https://doi.org/10.15585/mmwr.mm7315a1.

[161] Adrienne Arsht-Rockefeller Fdn. Resilience Ctr., *Extreme Heat: The Economic and Social Consequences for the United States* (2021), https://www.atlanticcouncil.org/wp-content/uploads/2021/08/Extreme-Heat-Report-2021.pdf.

[162] Diana R. Gergel et al., *Effects of Climate Change on Snowpack and Fire Potential in the Western USA*, 141 Climatic Change 287 (2017), https://doi.org/10.1007/s10584-017-1899-y; Kevin G. Wheeler et al., *What Will it Take to Stabilize the Colorado River?*, 377 Science 373 (2022), https://doi.org/10.1126/science.abo4452; Mu Xiao et al., *On the Causes of Declining Colorado River Streamflows*, 54 Water Res. Rsch. 6739 (2018), https://doi.org/10.1029/2018WR023153.

[163] Michelle T.H. van Vliet et al., *Global River Water Quality Under Climate Change and Hydroclimatic Extremes*, 4 Nature Rev. Earth & Env't 687 (2023), https://doi.org/10.1038/s43017-023-00472-3; Cynthia Ann Heil & Amanda Lorraine Muni-Morgan, *Florida's Harmful Algal Bloom (HAB) Problem: Escalating Risks to Human, Environmental and Economic Health with Climate Change*, 9 Frontiers in Ecology & Evolution 1 (2021), https://doi.org/10.3389/fevo.2021.646080.

[164] Ashish Shrestha et al., *A Review of Climate Change-Induced Flood Impacts and Adaptation of Coastal Infrastructure Systems in the United States*, 3 Env't Rsch.: Infrastructure & Sustainability (2023), https://doi.org/10.1088/2634-4505/ad097b; Michael Oppenheimer et al., *Sea Level Rise and Implications for Low-Lying Islands, Coasts and Communities*, *in IPCC Special Report on the Ocean and Cryosphere in a Changing Climate* 321 (H.-O. Pörtner et al. eds. 2019), https://doi.org/10.1017/9781009157964.006.

are disrupting insurance markets, raising costs for Americans and, in some areas, making it difficult to obtain coverage.[165]

Vulnerable populations are experiencing higher mortality rates due to the impacts of floods, droughts, and storms, with observed mortality rates "15 times higher for countries ranked as highly vulnerable compared to less vulnerable countries in the last decade."[166] Individual studies of risks to vulnerable populations indicate that, globally, 35-132 million people will be pushed to extreme poverty by 2030, and 330-396 million people will be exposed to lower crop yields and associated impacts to their livelihood, with Arctic subsistence populations facing severe livelihood, cultural, and economic risks.[167]

Contrary to what the proposal asserts, the evidence base for conclusions about the influence of human activity on the climate system and subsequent warming of the atmosphere, oceans, and land surface has only become stronger in recent years.[168] The evidence rests on longer observational datasets including satellite records, improved understanding of climate impacts, and refinement and testing of climate models. New analyses and evidence have been able to discern the role of natural variability in longer term patterns of temperature. It is "virtually certain" that reducing greenhouse gas emissions will limit future temperature increases and associated changes.[169]

For instance, since EPA issued the 2009 Endangerment Finding that greenhouse gas pollution endangers human health and welfare: atmospheric CO_2 levels are up 10.5 percent; sea level rise, globally (compared to 1993-2008 average), is up 2.13 inches (more than twice as much as it was in 2009); billion-dollar extreme weather disasters in the U.S. have increased 200

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[165] Carolyn Kousky et al., *Insurance and Climate Risks: Policy Lessons from Three Bounding Scenarios*, 121 Proc. Nat'l Acad. Sci. e2317875121 (2024), https://doi.org/10.1073/pnas.2317875121.

[166] Pörtner et al., *supra*, at 50; *see also* Joern Birkmann et al., *Understanding human vulnerability to climate change: A global perspective on index validation for adaptation planning*, 803 Science of the Total Env't 150065 (2022).

[167] Pörtner et al., *supra*, at 116, fig.TS.AII.2; Edward Byers et al., *Global Exposure and Vulnerability to Multi-Sector Development and Climate Change Hotspots*, 13 Env't Rsch. Letters 055012 (2018), https://doi.org/10.1088/1748-9326/aabf45; James D. Ford et al., *The Rapidly Changing Arctic and Its Societal Implications*, 12 WIREs Climate Change e735 (2021), https://doi.org/10.1002/wcc.735.

[168] Arias et al., *supra*, at 52; Philip B. Duffy et al., *Strengthened Scientific Support for the Endangerment Finding for Atmospheric Greenhouse Gases*, 363 Science 1 (2019), https://doi.org/10.1126/science.aat5982; NASEM 2025 Climate Report, *supra*; Nathan P. Gillett, et al., *Constraining human contributions to observed warming since the pre-industrial period*, 11 Nature Climate Change 207 (2021), https://doi.org/10.1038/s41558-020-00965-9.

[169] Arias et al., *supra*, at 63; Claudia Tebaldi et al., *Climate Model Projections from the Scenario Model Intercomparison Project (ScenarioMIP) of CMIP6*, 12 Earth Sys. Dynamics 253 (2021), https://doi.org/10.5194/esd-12-253-2021.

percent, with exponential increases in deaths and associated costs; eight of the top ten hottest years on record have occurred; and the frequency and duration of heatwaves in the U.S. have increased 34 percent and 17 percent, respectively.[170] In the face of these intensifying harms, the Endangerment Finding and the greenhouse gas pollution standards it supports have delivered (and will continue to deliver) vital pollution reductions that are needed to address these harms and protect communities.

C. Impacts of greenhouse gas pollution on climate system and public health and welfare.

Human-caused greenhouse gas pollution is a driver of many changes in the atmosphere, ocean, cryosphere, and biosphere that are in turn causing harmful impacts to public health and welfare. The following paragraphs briefly summarize current science on impacts in key areas that the proposal largely (and arbitrarily) ignores.

Human Health. Globally, increasing temperatures and heatwaves have increased mortality and morbidity,[171] with those working in non-air-conditioned settings, especially doing manual labor (*e.g.*, construction, farming), are at particularly heightened risk of suffering health impacts from heat. Hours of work lost due to heat have increased in the last two decades.[172] In the United States, higher temperatures not only affect direct mortality[173] but also negatively affect pregnancy and birth outcomes and mental health, and lead to increased hospitalizations related to cardiovascular disease, diabetes, respiratory outcomes and other increases in morbidity.[174] Higher temperatures also worsen air quality, including exposure to ground-level

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[170] *See* Env't Defense Fund, *Dangers of Planet-Heating Pollution: The Science and Evidence Are Clear* 2 (2025), https://library.edf.org/AssetLink/l4obr783jyswtwyj41b1583cx64ksgt8.docx (citing data from NOAA and EPA, and comparing to 2024 data).

[171] Pörtner et al., *supra*, at 51; A.M. Vicedo-Cabrera et al., *The Burden of Heat-Related Mortality Attributable to Recent Human-Induced Climate Change*, 11 Nature Climate Change 492 (2021), https://doi.org/10.1038/s41558-021-01058-x.

[172] Pörtner et al., *supra*, at 51; Nick Watts et al., *The 2019 Report of The Lancet Countdown on Health and Climate Change: Ensuring That the Health of a Child Born Today Is Not Defined by a Changing Climate*. 394 Lancet 1836 (2019), https://doi.org/10.1016/s0140-6736(19)32596-6.

[173] Marcus C. Sarofim et al., *Temperature-Related Death and Illness*, *in The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment* 43, 44 (U.S. Global Change Rsch. Prog. 2016), https://ntrs.nasa.gov/api/citations/20160011261/downloads/20160011261.pdf; Vaidyanathan et al., *supra*; Drew T. Shindell et al., *The Effects of Heat Exposure on Human Mortality Throughout the United States*, 4 *GeoHealth* e2019GH000234 (2020), https://doi.org/10.1029/2019GH000234; Kate. Marvel et al., *Climate Trends*, *in Fifth National Climate Assessment* ch.2, at4 (A.R. Crimmins et al. eds., U.S. Global Change Rsch. Prog. 2023).

[174] Mary H. Hayden et al., *Human Health*, *in Fifth National Climate Assessment* ch.15, at 6 (A.R. Crimmins et al. eds., U.S. Global Change Rsch. Prog. 2023), https://repository.library.noaa.gov/view/noaa/61592.

ozone and airborne particulate matter, and are projected to increase the spread of diseases like Lyme and West Nile.[175] Exposure to wildfire smoke has also increased,[176] with climate change greatly increasing the area susceptible to and conditions for large forest fires in the western U.S.[177] Wildfire smoke exposes millions to unhealthy air, resulting in heart and lung disease deaths.[178]

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[175] L. J. Mickley et al., *Effects of future climate change on regional air pollution episodes inthe United States*, 31 Geophysical Research Letters L24103 (2004); Antonis Analitis et al., *Effects of Heat Waves on Mortality: Effect Modification and Confounding by Air Pollutants*, 25 Epidemiology 15 (2014), doi:10.1097/EDE.0b013e31828ac01b; Jan C. Semenza, Joacim Rocklov & Kristie L. Ebi , *Climate Change and Cascading Risks from Infectious Disease*, 11 Infectious Diseases & Therapy 1371 (2022), https://doi.org/10.1007/s40121-022-00647-3; Igor Dumic & Edson Severnini, *"Ticking Bomb": The Impact of Climate Change on the Incidence of Lyme Disease*, 2018 Canadian J. Infectious Diseases & Med. Microbiology 1 (2018), https://doi.org/10.1155/2018/5719081; Ryan J. Harrigan et al., *A Continental Risk Assessment of West Nile Virus Under Climate Change,* 20 Global Change Biology 2417 (2014), https://doi.org/10.1111/gcb.12534.

[176] Pörtner et al., *supra*, at 52.

[177] John T. Abatzoglou & A. Park Williams, *Impact of Anthropogenic Climate Change on Wildfire Across Western US Forests*, 113 Proc. Nat'l. Acad. Sci. 11770 (2016), https://doi.org/10.1073/pnas.1607171113; S.A. Parks & John T. Abatzoglou, *Warmer and Drier Fire Seasons Contribute to Increases in Area Burned at High Severity in Western US Forests From 1985 to 2017*, 47 Geophysical Rsch. Letters e2020GL089858 (2020), https://doi.org/10.1029/2020GL089858.

[178] Pörtner et al., *supra*, at 52; Yuanyu Xie et al., *Tripling of Western US Particulate Pollution from Wildfires in a Warming Climate*, 119 Proc. Nat'l Acad. Sci. e2111372119 (2022), https://doi.org/10.1073/pnas.2111372119; Yiqun Ma, et al., *Long-Term Exposure to Wildland Fire Smoke PM2.5 and Mortality in the Contiguous United States*, 121 Proc. Nat'l Acad. Sci. e2403960121 (2024), https://doi.org/10.1073/pnas.2403960121; Marshall Burke et al., *The changing risk and burden of wildfire in the United States*, 118 Proc. Nat'l Acad. Sci. e2011048118 (2021), https://doi.org/10.1073/pnas.2011048118.

Ocean. Greenhouse gases in the atmosphere have led to warmer ocean temperatures,[179] increased stratification,[180] and more frequent marine heatwaves.[181] In addition, warmer temperatures in the ocean lead to decreases in oxygen availability.[182] Addition of carbon dioxide to the ocean is reducing the pH (*i.e.*, making it more acidic), and reversing trends of increasing pH (*i.e.*, *less acidic*) that have been in place over the last 50 million years.[183] These trends in temperature, oxygen, and pH cause displacement and disruption to ocean ecosystems and to the food webs that people depend on.[184]

Ice and Permafrost. Greenhouse gases in the atmosphere have led to a reduction in land glaciers and Arctic sea ice.[185] Continued greenhouse gas emissions "greatly increase the likelihood of potentially irreversible changes in the global climate system," including ice sheet

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[179] Roberto A.F. Bilbao et al., *Attribution of Ocean Temperature Change to Anthropogenic and Natural Forcings Using the Temporal, Vertical and Geographical Structure*, 53 Climate Dynamics 5389 (2019), https://doi.org/10.1007/s00382-019-04910-1; Veronika Eyring et al., *Human Influence on the Climate System*, *in Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* 423, 478 (V. Masson-Delmotte et al. eds. 2021), https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter03.pdf.

[180] Nathaniel L. Bindoff et al., *Changing Ocean, Marine Ecosystems, and Dependent Communities*, *in IPCC Special Report on the Ocean and Cryosphere in a Changing Climate* 447 (H.-O. Pörtner et al. eds. 2019), https://doi.org/10.1017/9781009157964.007; Guancheng Li et al., *Increasing Ocean Stratification Over the Past Half-Century*, 10 Nature Climate Change 1116 (2020), https://doi.org/10.1038/s41558-020-00918-2.

[181] Thomas L. Frölicher & Charlotte Laufkötter, *Emerging Risks from Marine Heat Waves*, 9 Nature Commc'ns 650 (2018), https://doi.org/10.1038/s41467-018-03163-6; Mathew Collins et al., *Extremes, Abrupt Changes and Managing Risk*, *in IPCC Special Report on the Ocean and Cryosphere in a Changing Climate* 589 (H.-O. Pörtner et al. eds. 2019), https://doi.org/10.1017/9781009157964.008.

[182] Bindoff et al., *supra*.

[183] Sergey K. Gulev et al., *Changing State of the Climate System*, *in Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, 287 (V. Masson-Delmotte et al., eds. 2021); Li-Qing Jiang et al., *Surface Ocean pH and Buffer Capacity: Past, Present and F uture*, 9 Sci. Rep. *18624*(2019), https://doi.org/10.1038/s41598-019-55039-4; I. Halevy & A. Bachan, *The Geologic History of Seawater pH*, 355 Sci. 1069 (2017), https://doi.org/10.1016/j.isci.2026.117756.

[184] Pörtner et al., *supra*, at 48; Andrew S. Brierley & Micheal J. Kingsford, *Impacts of Climate Change on Marine Organisms and Ecosystems*, 19 Current Biology R602 (2009), https://doi.org/10.1016/j.cub.2009.05.046.

[185] Arias et al., *supra*, at 76; M. Kathleen Brennan et al., *Arctic Sea-Ice Variability During the Instrumental Era*, 47 Geophysical Rsch. Letters e2019GL086843 (2020), https://doi.org/10.1029/2019GL086843.

loss causing global sea level rise.[186] In addition, permafrost is thawing, compromising the structural integrity of pipelines, roads, and buildings in communities whose infrastructure has been built assuming frozen ground.[187] Ice cover in the Arctic is shrinking andthe winter seasonlasts for less time, making it difficult for Indigenous people to conduct their livelihoods in the far north, *e.g.*, fishing and hunting, on ice.[188] Transportation is also adversely impacted, with fewer days available for travel on ice roads.[189] Furthermore, greening in the Arctic can exacerbate warming through changes to both albedo and water vapor, which may accelerate feedback to the climate system through accelerated permafrost thaw, as well as through increased plant respiration, resulting in additional greenhouse gas emissions.[190]

Carbon Cycle. From 2010 to 2019, about 54% of the global emissions of carbon dioxide have been removed from the atmosphere and stored in the ocean and on land.[191] In other words, the amount of carbon dioxide in the atmosphere would be approximately twice as high if those natural processes on land and ocean were not taking it up. These natural sources of carbon removals will become less efficient over time *as* climate change worsens, and therefore causing potentially a greater proportion of anthropogenic emissions to remain the atmosphere and contribute to climate change.[192] CO_2 fertilization effects (*i.e.*, effects on plant growth from

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[186] Arias et al., *supra*, at 63; Robert M. DeConto et al., *The Paris Climate Agreement and Future Sea-Level Rise From Antarctica*, 593 Nature 83 (2021), https://doi.org/10.1038/s41586-021-03427-0.

[187] Jan Hjort et al., *Impacts of Permafrost Degradation on Infrastructure*, 3 Nature Rev. Earth & Env't 24 (2022), https://doi.org/10.1038/s43017-021-00247-8.

[188] HenryP. Huntington et al., *Alaska*, *in Fifth National Climate Assessment* ch. 29 (A.R. Crimmins et al. eds., U.S. Global Change Rsch. Prog. 2023), https://doi.org/10.7930/NCA5.2023.CH29; Pörtner et al., *supra,* at 116, fig. TS.AII.2.

[189] Jeffrey A. Hicke et al., *North America*, *in Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, 1929, 1975 (Hans-Otto Pörtner et al. eds. 2022), https://doi.org/10.1017/9781009325844.016.

[190] Linfei Yu et al., *Disentangling the Contributions of Water Vapor, Albedo and Evapotranspiration Variations to the Temperature Effect of Vegetation Greening Over the Arctic*, 646 J. Hydrology 132331 (2025), https://doi.org/10.1016/j.jhydrol.2024.132331; Edward A.G. Schuur et al., *Permafrost and Climate Change: Carbon Cycle Feedbacks From the Warming Arctic*, 47 Ann. Rev. Env't & Res. 343 (2022), https://doi.org/10.1146/annurev-environ-012220-011847; Sybryn L. Maes et al., *Environmental Drivers of Increased Ecosystem Respiration in a Warming Tundra*, 629 Nature 105 (2024), https://doi.org/10.1038/s41586-024-07274-7.

[191] Arias et al., *supra*, at 80; Pierre Friedlingstein et al., *Global Carbon Budget 2020*, 12 Earth Sys. Sci. Data 3269, 3271 (2020), https://doi.org/10.5194/essd-12-3269-2020.

[192] Joseph G. Canadell et al., *Global Carbon and Other Biogeochemical Cycles and Feedbacks*, *in Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* 673, 677(V. Masson-Delmotte et al., eds. 2021), https://doi.org/10.1017/9781009157896.007; Julia K. Green

increased CO_2 levels) in terrestrial ecosystems, which are not categorically positive or occurring at the same rate in different areas or for all plant types, are increasingly limited by drought and warming.[193]

Land. Land surface temperatures are rising faster than the global average temperature.[194] Heatwaves and hot extremes have been more common and more intense and are attributable to greenhouse gas emissions.[195] The combination of heatwaves and droughts is also becoming more common.[196] The IPCC has "high confidence" that the five years of 2016-2020 were the hottest five years in the instrumental record.[197] Observations show that the number of heavy precipitation events has increased and are also more intense.[198]

Ecosystems. There is "very high confidence" that climate change caused by greenhouse gas emissions is leading to changes to marine, freshwater and ocean ecosystems worldwide, including for all three of these biomes in North America.[199] Changes in the physiology, range,

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et al., *Large Influence of Soil Moisture on Long-Term Terrestrial Carbon Uptake*, 565 Nature 476 (2019), https://doi.org/10.1038/s41586-018-0848-x; *see also* Jens Daniel Müller et al., *Decadal Trends in the Oceanic Storage of Anthropogenic Carbon From 1994 to 2014*, AGU Advances (2023), https://doi.org/10.1029/2023AV000875.

[193] Pörtner et al., *supra*, at 47; Shijie. Li et al., *Vegetation Growth Due to CO_2 Fertilization is Threatened by Increasing Vapor Pressure Deficit, 619 J. Hydrology* 129292 (2023), https://doi.org/10.1016/j.jhydrol.2023.129292.

[194] Arias et al., *supra*, at 82.

[195] Sonia I. Seneviratne et al., *Weather and Climate Extreme Events in a Changing Climate*, *in Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* 1513*,* 1552 (V. Masson-Delmotte et al., eds. 2021), https://doi.org/10.1017/9781009157896.013; Samuel. Bartusek, Kai Kornhuber & Mingfang Ting, *2021 North American Heatwave Amplified by Climate Change-Driven Nonlinear Interactions*, 12 Nature Climate Change 1143 (2022), https://doi.org/10.1038/s41558-022-01520-4.

[196] Sourav Mukherjee & Ashok Kumar Mishra, *Increase in Compound Drought and Heatwaves in a Warming World*, 48 Geophysical Rsch. Letters e2020GL090617 (2021) https://doi.org/10.1029/2020GL090617; Andrew Jarvis & Piers M. Forster, *Estimated Human-Induced Warming from a Linear Temperature and Atmospheric CO_2 Relationship*, 17 Nature Geoscience 1222 (2024), https://doi.org/10.1038/s41561-024-01580-5; Steven C. Sherwood et al., *An Assessment of Earth's Climate Sensitivity Using Multiple Lines of Evidence*, 58 Rev. Geophysics e2019RG000678 (2020), https://doi.org/10.1029/2019RG000678; Qiaohong Sun et al., *A Global, Continental and Regional Analysis of Changes in Extreme Precipitation*, 34 J. Climate 243 (2020), https://doi.org/10.1175/JCLI-D-19-0892.1.

[197] Arias et al., *supra*, at 41.

[198] Arias et al., *supra*, at 84; Pörtner et al., *supra*, at 49.

[199] Pörtner et al., *supra*, at 46 fig. TS.3.

seasonal timing, growth, and abundance of both plants and animals have been observed in response to climate change. Although some of these changes are adaptive, they have often been insufficient in preventing species loss, susceptibility to disease, and mass mortality among plants and animals.[200] Additionally, there has been a shift in terrestrial and marine species distribution, with half to two-thirds of species shifting to higher latitudes and two-thirds shifting toward earlier spring life events, including shifts in the timing of flowering and insect emergence.[201] These species shifts have impacted biodiversity by, *e.g.*, reducing diversity in warm regions, as local populations exceed adaptation limits (*e.g.*, where species temperature range maximums have been exceeded) and homogenizing species types when new species have moved into an area.[202] The contraction of polar ecosystems has resulted in the decline of ice-dependent species – such as the polar bear in the Arctic, and declining ranges of krill and emperor penguins in the Antarctic.[203] In marine environments, coral reefs are experiencing global declines.[204] In terrestrial ecosystems, changes in plant species composition fueled by CO_2 fertilization have led to woody shrub invasion reducing grazing lands, and an increase in invasive grass populations have led to increased fire risk.[205] For instance, because of the differential response of plants to the carbon dioxide fertilization effect can *disrupt* the biodiversity in natural ecosystems where nuisance species gain an advantage.[206] Climate related extreme events like droughts, floods, wildfires, and marine heatwaves have driven changes to ecosystems that have caused economic damage and losses to livelihoods, such as to forest, agricultural productivity and lead to the collapse of fisheries.[207]

Agriculture and Food. Climate change has affected the productivity of the agriculture,[208] forestry, and fishery sectors of the economy, with droughts, wildfires, floods, and land and marine heatwaves contributing to food insecurity and increased food prices.[209] For example,

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[200] Pörtner et al., *supra*, at 45.

[201] Pörtner et al., *supra*, at 45, 48.

[202] Pörtner et al., *supra*, at 45, 47.

[203] Pörtner et al., *supra*, at 45, 47.

[204] Tyler Eddy et al., *Global Decline in Capacity of Coral Reefs to Provide Ecosystem Services*, 4 One Earth 1278 (2021), https://doi.org/10.1016/j.oneear.2021.08.016.

[205] Pörtner et al., *supra*, at 47.

[206] Oliver L. Phillips et al., *Increasing Dominance of Large Lianas in Amazonian Forests*, 418 Nature 770 (2002), https://doi.org/10.1038/nature00926; Jacqueline E. Mohan et al., *Biomass and Toxicity Responses of Poison Ivy (Toxicodendron Radicans) to Elevated Atmospheric CO_2*, 103 Proc. Nat'l Acad. Sci. 9086 (2006), https://doi.org/10.1073/pnas.0602392103.

[207] Pörtner et al., *supra*, at 48.

[208] Ariel Ortiz-Bobea et al., *Anthropogenic Climate Change Has Slowed Global Agricultural Productivity Growth*, 11 Nature Climate Change 306 (2021), https://doi.org/10.1038/s41558-021-01000-1.

[209] Pörtner et al., *supra*, at 48.

along the west coast of North America and east coast of Australia marine heatwaves have led to the collapse of local fisheries,[210] Climate-related food safety risks have increased globally, including fungal mycotoxin infection of crops (associated with cancer and stunting growth in children) and seafood contamination from marine toxins and pathogens.[211] Impacts related to increased atmospheric carbon dioxide and climate change, like heat stress, high vapor pressure deficit, and drought, can exacerbate nutrient dilution and diminish yield. Elevated carbon-dioxide-induced nutrient dilution (and the potential subsequent significant human nutrient deficiencies) represents a real and ongoing risk to public health. For example, Smith and Myers (2014) estimated that reduced zinc, protein, and iron levels in certain crops under anticipated 2050 carbon dioxide levels could cause zinc deficiencies in 175 million people, with 122 million more deficient in protein, with 1.4 billion women of childbearing age and children at-risk of losing dietary iron in countries with high anemia prevalence.[212] Furthermore, carbon dioxide emissions from fossil fuel combustion are often accompanied by ozone precursors (carbon monoxide, volatile organic compounds, and oxides of nitrogen), and ground-level ozone formation can also increase under high temperatures. Many studies show that ozone has adverse effects on crop yields at the global scale and across the Northern Hemisphere. For example, increased tropospheric ozone levels decreased estimates of global yields for soybean (from 8.5 to 14 percent), wheat (from 3.9 to 15 percent), and maize (from 2.2 to 5.5 percent) in 2000 resulting

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[210] Thomas L. Frölicher & Charlotte Laufkötter, *Emerging Risks from Marine Heat Waves*, 9 Nature Commc'n 650 (2018), https://doi.org/10.1038/s41467-018-03163-6.

[211] Avery et al., *supra*, at 555.

[212] Chunwu Zhu et al., *Rising Temperatures Can Negate CO_2 Fertilization Effects on Global Staple Crop Yields: A Meta-Regression Analysis*, 342 Agric. & Forest Meteorology 1, (2023), https://doi.org/10.1016/j.agrformet.2023.109737; Dalong Zhang et al., *VPD Modifies CO_2 Fertilization Effect on Tomato Plants via Abscisic Acid and Jasmonic Acid Signaling Pathways*, 10 Horticultural Plant J. 1165 (2024), https://www.sciencedirect.com/science/article/pii/S2468014123001747?via%3Dihub; Matthew R. Smith & Samuel S. Myers, *Impact of Anthropogenic CO_2 Emissions on Global Human Nutrition*, 8 Nature Climate Change 834 (2018), https://doi.org/10.1016/j.hpj.2023.07.005.

in estimated economic losses of billions of dollars.[213] The adverse impacts of ozone on tree species are also well documented in the scientific literature.[214]

Water. Climate change has intensified the extremes of the water cycle, leading to more droughts, water scarcity, and floods.[215] More specifically, in the United States, extreme precipitation events and extended droughts are increasing.[216] The intensity of precipitation has increased in many areas since the 1950s, with more people living in areas that experience "unfamiliar" precipitation patterns (*e.g.*, dry spells, extreme precipitation).[217] Many communities across the U.S., have had to adapt their stormwater management systems to address impacts from climate-related increases in storm frequency and/or intensity.[218] Droughts have reduced hydropower production, impacting energy supplies and increasing competition for scarce water resources.[219]

Glacier melting and snowpack declines are occurring at unprecedented rates. Populations that depend on those water resources for drinking and irrigation are facing the loss of critical

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[213] John R. Porter et al., *Food Security and Food Production Systems*, *in Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel of Climate Change* 485 (C. B. Field et al., eds. 2014), https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap7_FINAL.pdf; Shiri Avnery et al., *Global Crop Yield Reductions Due to Surface Ozone Exposure: Crop Production Losses and Economic Damage Under Two Scenarios of O3 Pollution*, 45 Atmospheric Env't 2297 (2011), http://dx.doi.org/10.1016/j.atmosenv.2011.01.002;

[214] Nathan R. Pavlovic et al., *Quantification of Ozone Exposure Impacts and their Uncertainties on Growth and Survival of 88 Tree Species Across the United States*, 130 J. Geophysical Rsch. e2024JD042063 (2025), https://doi.org/10.1029/2024JD042063.

[215] Arias et al., *supra*, at 85; Daniel L. Swain et al., *Hydroclimate olatility on a arming Earth*, 6 Nature Rev. Earth & Env't 35 (2025), https://doi.org/10.1038/s43017-024-00624-z.

[216] Elizabeth A. Payton et al., *Water*, *in Fifth National Climate Assessment* ch. 4 (A.R. Crimmins et al. eds., U.S. Global Change Rsch. Prog. 2023), https://doi.org/10.7930/NCA5.2023.CH4.

[217] Pörtner et al., *supra*, at 49.

[218] Horsley-Witten Grp., *Assessment of Climate Change Impacts on Stormwater BMPs and Recommended BMP Design Considerations in Coastal Communities* (2015), https://www.mass.gov/doc/assessment-of-climate-change-impacts-on-stormwater-bmps-and-recommended-bmp-design-considerations-in-coastal-communities/download; Olympia Sea Level Rise Response Collaborative, *Olympia Sea Level Rise Response Plan: Five-Year Implementation Update* (2025), https://www.olympiawa.gov/Document_center/Community/Climate%20Change%20Response/SLR/SLR-5yr-Update-031925.pdf.

[219] Asphota Wasti et al., *Climate Change and the Hydropower Sector: A Global Review*, 13 WIRES Climate Change e757 (2022), https://doi.org/10.1002/wcc.757.

resource.[220] Snowpack is declining across the western U.S., where 40 million people rely on the Colorado River, a snowpack-driven watershed that serves municipal, agricultural, and ecosystem demands of the Colorado River Basin.[221] Increased temperatures lead to less snowpack, which means less runoff from melting snow and less water available. Higher temperatures are also causing spring runoff to occur earlier in the year, resulting in even less water availability through the dry summer season.[222]

Coastal Communities. Coastal communities are already experiencing compounding effects from sea level rise and climate variability. About a tenth of the world's population lives in a low elevation coastal zone (defined as less than 10 m/30 feet above sea level).[223] Approximately 1*29* million people live in coastal counties in the U.S.,[224] and 20 million coastal U.S. residents could be at risk of inundation due to sea level rise and/or storm surge by 2030.[225] Coastal communities are often experiencing climate change impacts that compound other non-climate impacts, like land subsidence. By 2030, 108-116 million people will be exposed to sea level rise in Africa.[226] There is evidence of acceleration of sea level rise, driven by contributions from the Greenland and Antarctic ice sheets; this highlights the importance and urgency of mitigating climate change and formulating coastal adaptation plans to mitigate the impacts of ongoing sea level rise.[227]

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[220] M.A Caretta et al., *Water*, *in Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, 570 (Hans-Otto Pörtner et al. eds. 2022), https://doi.org/10.1017/9781009325844.006.

[221]https://doi.org/10.1038/s41558-021-01014-9 Becky Bolinger et al., *Climate Change in Colorado* (3d. ed. 2024), https://doi.org/10.25675/10217/237323.

[222] Keith N. Musselman et al., W*inter Melt Trends Portend Widespread Declines in Snow Water Resources*, 11 Nature Climate Change 418 (2021), https://doi.org/10.1038/s41558-021-01014-9. https://doi.org/10.25675/10217/237323

[223] Pörtner et al., *supra*, at 54.

[224] *Economics and Demographics*, Off. for Coastal Mgmt., NOAA, https://coast.noaa.gov/states/fast-facts/economics-and-demographics.html (last visited Oct. 22, 2026).

[225] Kelsea Best et al., *Demographics and Risk of Isolation Due to Sea Level Rise in the United States*. 14 Nat. Commc'ns., 7904 (2023). Erratum in: *Nat Commc'ns.*, *14*(1), p. 8305. PMID: 38036553; PMCID: PMC10689761.

[226] Pörtner et al., *supra*, at 62.

[227] Xianyao Chen et al., *The Increasing Rate of Global Mean Sea-Level Rise During 1993–2014*. 7 Nat. Clim. Chang 492 (2017). https://doi.org/10.1038/nclimate3325; *see also* Copernicus, European Union's Earth Observation Programme, *Climate Indicators: Ice Sheets*, https://climate.copernicus.eu/climate-indicators/ice-sheets.

Infrastructure. Key infrastructure and services, such as energy supply and distribution, transportation, communication, water and waste systems are increasingly vulnerable to compounding climate impacts such as sea level rise, droughts, heatwaves, floods, wildfires, and more, with the most vulnerable populations often located where the capacity to respond is limited.[228] In the United States, there are numerous examples of infrastructure system stresses – *e.g.*, when more frequent and/or extreme rainfall and drought stress the existing capacity of municipal water systems[229] and natural gas infrastructure,[230] or when electricity access is lost due to risks, one such as wildfires, the resulting power outage can lead to compounding impacts, including the inability to cool down during a heatwave [231] or other lifesaving infrastructure.[232]

The science is clear that greenhouse gas pollution is driving changes in the atmosphere, ocean, cryosphere, and biosphere that are already causing and will increasingly cause significant harm to public health and welfare.

D. The proposal's scientific claims are inaccurate, misleading, and incomplete.

Notwithstanding this overwhelming body of scientific evidence, the proposal nonetheless claims the science is too uncertain to support regulating greenhouse gas emissions from power plants under Section 111. The proposal characterizes the health risks and welfare effects identified in the 2009 Endangerment Finding as "speculative, multi-faceted, and multi-causal," 91 Fed. Reg. at 59036, and asserts that "[g]lobal climate change concerns involve causal relationships that are too uncertain, conjectural, remote, and convoluted by intervening and confounding factors" to satisfy Section 111(b)(1)(A), *id.* at 59023. The Administrator's discussion comes nowhere close to the more detailed justification required when a new policy rests on factual determinations that contradict those supporting its prior policy. *Fox*, 556 U.S. at 515 (more detailed justification required when a "new policy rests upon factual findings that contradict those which underlay [an agency's] prior policy").

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[228] Pörtner et al., *supra*, at 53.

[229]James E. Neumann et al., *Climate Change Risks to US Infrastructure: Impacts on Roads, Bridges, Coastal Development, and Urban Drainage*, 131 Clim Change. 97 (2014). https://doi.org/10.1007/s10584-013-1037-4; Zia J Lyle et al., *Climate change hazard index reveals combined risks to United States drinking water utilities*, 4 Environmental Research: Climate 015007 (2025), https://iopscience.iop.org/article/10.1088/2752-5295/adab10.

[230] Hamed Moftakhari et al., *Increasing Exposure of Energy Infrastructure to Compound Hazards: Cascading Wildfires and Extreme Rainfall*, 14 Res. Lett. 104018 (2019).

[231] Brian Stone Jr. et al., *Compound Climate and Infrastructure Events: How Electrical Grid Failure Alters Heat Wave Risk*, 55 Envtl. Sci. & Techn. 6957 (2021), https://doi.org/10.1021/acs.est.1c00024.

[232] Gabrielle Wong-Parodi, *When Climate Change Adaptation Becomes a "Looming Threat" to Society: Exploring Views and Responses to California Wildfires and Public Safety Power Shutoffs*, 70 Energy Res. & Soc. Sci. 101757 (2020), https://doi.org/10.1016/j.erss.2020.101757.

1. The proposal's claim that anticipated harms have not materialized is unsupported and wrong.

The proposal asserts that "global GHG concentrations in the upper atmosphere have continued to rise, driven primarily by increased emissions from foreign sources, all without producing the degree of adverse impacts to public health and welfare in the U.S. anticipated in the 2009 Endangerment Finding and 2015 NSPS and 2015 CPP." 91 Fed. Reg. at 59005. This conclusion arbitrarily ignores EPA's long record of finding the opposite to be true, including in multiple recent final rules where the Agency has documented that new observational records are being set for worsening extreme events in the U.S. *See, e.g.*, EPA, Climate Change Indicators in the United States (5th Ed. 2024), at 67 ("Climate Change Indicators"), https://www.epa.gov/system/files/documents/2024-09/climate_indicators_2024.pdf; 80 Fed. Reg. at 64517-22; 81 Fed. Reg. at 35833; 89 Fed. Reg. at 39807-08, 40064 ("Since the 2016 Endangerment Finding, the climate has continued to change, with new observational records being set for several climate indicators such as global average surface temperatures, GHG concentrations, and sea level rise. . . . These updated observations and projections document the rapid rate of current and future climate change both globally and in the U.S.").

We are now able to observe and document with an even greater degree of certainty that greenhouse gases released by the burning of fossil fuels have caused record high temperatures in the ocean and on land; have enhanced conditions for wildfires and stronger hurricanes; have caused marine heatwaves that have damaged coral reefs and fisheries; have caused more severe droughts and flooding in many areas, increasing human hazards and harms to trees and crops; and have expanded the range of diseases that adversely affect human, wildlife, and plant health.

The proposal's own record contradicts its claim. Under the proposal's modeling, "[t]he modeled GMST" (global mean surface temperature) "in the 2026 baseline year is estimated to be 1.33 °C [about 2.4 °F] above pre-industrial temperatures," 91 Fed. Reg. at 59037, yet the proposal acknowledges that "GMST observations in 2024 were 1.55 [about 2.8 °F] (1.42-1.68) °C relative to 1850–1900," *Id.* at 59039 n.214. Thus, observed warming already exceeds the proposal's baseline. The same modeling projects that GMST will "increase to 1.89 °C [about 3.4 °F] (95 percent CI: 1.44–2.37 °C) and 2.66 °C [about 4.8 °F] (95 percent CI: 1.86–3.87 °C [up to about 7.0 °F]) above pre-industrial temperatures by the years 2050 and 2100, respectively," and that global sea level rise will "be 38.9 cm [about 15 inches] (95 percent CI: 26.5–50.1 cm) by 2050 and 97.1 cm [more than 3 feet] (95 percent CI: 59.6–166.3 cm [up to about 5.5 feet]) by 2100 relative to pre-industrial [levels]." *Id.* at 59037.

2. The proposal's emphasis on foreign emissions and "indirect" harm reduction ignores basic physics.

The proposal attributes rising concentrations to emissions "driven primarily by increased emissions from foreign sources," *Id.* at 59005, and asserts that "[f]or global climate change, however, harm reductions do not occur directly as result of emission reductions" because "non *de minimis* harm reductions necessarily depend on coordinated action across many, many sources," *Id.* at 59041. But in terms of cumulative emissions over the past three decades, if the

U.S. power sector were its own country, it would rank fifth in the world after China, India, Russia, and the United States itself (sixth if counting the European Union as a bloc).[233]

It is a very basic fact that greater higher greenhouse gas concentrations in the atmosphere results in greater radiative forcing and thus higher global temperatures. As EPA itself explained on its website, until it was removed in 2025, "an increase in the atmospheric concentrations of greenhouse gases produces a positive climate forcing, or warming effect."[234] Limiting CO_2 emissions from U.S. power plants will reduce greenhouse gas concentrations in the atmosphere relative to what they would be in the absence of those standards, thus reducing radiative forcing, even if other countries continue to increase their emissions. Likewise, the Supreme Court itself found that "[j]udged by any standard," comparable amounts of emissions from motor vehicles "make a meaningful contribution to greenhouse gas concentrations and . . . to global warming." *Massachusetts*, 549 U.S. at 525.

3. The proposal misrepresents the uncertainties identified in the 2009 Endangerment Finding.

The proposal recounts that the Administrator "noted that the 2009 Endangerment Finding recognized significant uncertainties in its conclusions and assumptions that should be evaluated in light of more recent empirical data and scientific evidence," 91 Fed. Reg. at 59007, and that the Finding identified welfare effects "although the evidence was uncertain for several categories that may see near-term benefits," *Id.* at 59036. The proposed reconsideration's description of uncertainties described in the Endangerment Finding is misleading. The Supplemental Proposal repeats the same mischaracterizations:

- On cold-related mortality, the Endangerment Finding identified a "risk that projections of cold-related deaths, and the potential for decreasing their numbers due to warmer winters, can be overestimated unless they take into account the effects of season and influenza, which is not strongly associated with monthly winter temperature." 74 Fed. Reg. at 66525 (emphasis added). Thus, even with this acknowledged uncertainty of overestimation of reduced deaths, EPA previously correctly determined that "the net impact on mortality is more likely to be adverse," and the proposed reconsideration offers no evidence to undermine that conclusion. *See id*. at 66526.
- On increases in allergenic illnesses and pathogen-borne disease vectors, the evidence "provide[d] directional support for an endangerment finding.' *Id*. at 66526, 66498 (emphasis added). Considering that the scientific literature was not as definitive on these areas, EPA also did "not plac[e] primary weight on these factors." *Id*. at 66526. Thus, even acknowledging uncertainty, the Endangerment Finding properly concluded there was directional evidence, and the Endangerment Finding did not depend on this evidence in any event.

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[233] Peter H. Howard & Jason A. Schwartz, *The Scale of Significance: Power Plants* 3-4 (Inst. for Pol'y Integrity, 2025), https://perma.cc/5D4Y-88E3.

[234] EPA, *Climate Change Indicators: Greenhouse Gases*, (last updated Aug. 1, 2025) https://perma.cc/8PJH-5CWK .

- On food production and crop yields, the Endangerment Finding noted uncertainty over whether any potential near-term beneficial effects for certain crops due to increased carbon dioxide concentrations would occur due to the "various potential adverse impacts of climate change on crop yield," and EPA also concluded, based on the "body of evidence," that there was an "increasing risk of net adverse impacts on U.S. food production and agriculture over time, with the potential for significant disruptions and crop failure in the future." *Id.* at 66498; *see also id*. at 66535.

The proposed reconsideration's descriptions of uncertainties in the Endangerment Finding are either misleading mistakes due to a lack of understanding of EPA's previous conclusions or intentional obfuscations. EPA does not display awareness that it is changing position on these uncertainties, nor does it provide a more detailed justification for disregarding the facts regarding these areas of support for the Endangerment Finding. *See Fox*, 556 U.S. at 515-16.

To the extent uncertainty remains, it tends toward greater harm than estimated in 2009, not less. The 2023 Social Cost of Greenhouse Gases (SC-GHG) estimates are the most rigorous assessment EPA has produced of the monetized harms from greenhouse gas emissions. In 2023, EPA published updated SC-GHG estimates that implemented the National Academies' recommendations and incorporated developments in the economic and scientific literature since the metric's last substantive update.[235] After EPA published a draft report in 2022, the estimates underwent public comment and expert peer review. Numerous federal agencies assessed EPA's updated estimates and determined that they reflect the best available science on monetizing greenhouse gas emissions,[236] and EPA applied them in numerous rulemakings including its 2024 power-sector regulations under Section 111. 89 Fed. Reg. 39798, 40006-08 (May 9, 2024).

Although EPA's estimates are the best currently available, they omit some key damage categories and are thus widely considered to understate the true costs of climate change.[237] EPA's

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[235] U.S. EPA, Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances (2023) [hereinafter EPA SC-GHG Report].

[236] U.S. Off. of Mgmt. & Budget, Report to Congress on the Benefits and Costs of Federal Regulations and Agency Compliance with the Unfunded Mandates Reform Act: Fiscal Year 2023 at 21-22 & n.52 (2024) (discussing the Department of Transportation, Department of Energy, Department of the Treasury, and OMB's own determination).

[237] For instance, many of the peer reviewers on EPA's estimates recognized that these values, though robust and based on the best available science, very likely underestimate the true SC-GHG. *See, e.g.*, U.S. EPA, External Letter Peer Review of Technical Support Document: Social Cost of Greenhouse Gas "Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances" at 7 (2023) [hereinafter Peer Review Report] (Dr. Cropper explaining that EPA's modeling "does not cover all aspects of climate change (e.g., precipitation impacts and extreme weather events)"; *id.* (Dr. Kling recognizing the "many important omissions from the current estimates of this metric" that, if included, would very likely

estimates omit major damage categories such as impacts from many extreme weather events and effects on infectious disease transmission, water consumption, forestry, ecosystem services, and national security. For this reason and others, EPA concluded that its "SC-GHG estimates likely underestimate the marginal damages from greenhouse gas pollution."[238] And even after the inclusion of two additional climate tipping points, EPA recognized that its territorial estimates do not model "(1) the slowdown of the Atlantic Meridional Overturning Circulation (AMOC), (2) the release of ocean methane hydrates, (3) shifts in boreal ecosystems, (4) the breakup of the low-latitude stratocumulus cloud deck, and (5) the die-off of tropical coral reefs," and "the disruption of the Indian summer monsoon."[239]

The Supplemental Proposal does not engage with any of this. It neither disputes the 2023 estimates' scientific basis nor offers a replacement. Instead, it dismisses EPA's prior use of SCC values as a misplaced focus on "estimates of GHG emission reductions" rather than "the possible dangers to public health or welfare." 91 Fed. Reg. at 59041. That criticism inverts what the SC-GHG does: it calculates how the emission of an additional unit of greenhouse gases affects atmospheric greenhouse gas concentrations, how that change in atmospheric concentrations affects the climate, and how that change in climate incrementally contributes to health and economic damages. The 2023 estimates are thus EPA's own best quantification of the very harms to public health and welfare the proposal now calls "speculative," and they show those harms to be large and, if anything, understated. EPA cannot invoke uncertainty to discard its best available evidence while offering no evidence of its own.

4. The proposal's characterization of climate science as "speculative" and "disputed" is baseless.

The proposal asserts that the "nature of these specific health risks and welfare effects is speculative, multi-faceted, and multi-causal," and that "there are significant uncertainties related to climate modeling and significant, ongoing disputes regarding climate science and modeling." *Id* at 59036. The proposal identifies no source for these "disputes." To the contrary, there is overwhelming evidence that greenhouse gases released by human activity cause global average temperature increases and a host of impacts on the climate system that result in destructive and harmful consequences for people and their health, food and infrastructure, including impacts on sea level rise, extreme heat, water supply, and conditions for agriculture and fish harvests, as well as to ecosystems, biodiversity, and the environment. Over time, scientific advances and longer observational records have served to further confirm the impact of greenhouse gases released by human activities on the systems that support public health and welfare.

In its 2025 assessment, the National Academies of Sciences, Engineering, and Medicine concluded that "EPA's 2009 finding that the human-caused emissions of greenhouse gases

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increase the SC-GHG); *id.* at 11 (comments of Dr. Oppenheimer); *id.* at 12-13 (comments of Dr. Forest and Dr. Schlenker); *id.* at 17.

[238] EPA SC-GHG Report supra at 87 tbl.3.2.1, 105.

[239] Elizabeth Kopits et al., *Economic Damages from Climate Change to U.S. Populations: Integrating Evidence from Recent Studie*s 64 (NCEE Working Paper 25-01 2025).

threaten human health and welfare was accurate, has stood the test of time, and is now reinforced by even stronger evidence." It further concluded "that the evidence for current and future harm to human health and welfare created by human-caused GHGs is beyond scientific dispute."

Uncertainty in climate impacts, moreover, cuts in the opposite direction from the one the proposal suggests. This uncertainty is primarily due to high-end risk – that is, that climate damages may be much higher than current SC-GHG estimates. The fact that climate damages may be catastrophic is not a valid reason to ascribe them no value. A recent meta-analysis from economists Frances Moore and co-authors finds nearly unanimous consensus among economic studies and experts that the SC-GHG is positive and significantly above zero, with a high-end fat tail representing the possibility that the SC-GHG is much higher than expected. In other words, while there is uncertainty about the value of the SC-GHG, that uncertainty primarily represents the possibility of catastrophic risk.[240] The probability distributions of estimates from the federal government and outside experts consistently find that climate damages could be far higher than anticipated but are unlikely to be much lower than expected (*i.e.*, they are right skewed)."[241]

Most prominently, Nobel prize winning U.S. economist Dr. William Nordhaus has emphasized that "[w]hen taking uncertainties into account," the "social cost of carbon . . . would increase, not decrease" and cautioned governments not to wait until uncertainty is eliminated to take meaningful climate action.[242] For example, Richard Tol, whose damage model was incorporated into the Interagency Working Group's estimates, explained: "[N]egative surprises seem more likely than positive surprises. While it is relatively easy to imagine a disaster scenario for climate change – for example, involving massive sea level rise or monsoon failure that could even lead to mass migration and violent conflict – it is not at all easy to imagine that climate change will be a huge boost to human welfare."[243] Other experts have similarly recognized that "despite a wide variety of analytical approaches addressing different types of climate change uncertainty, none of those studies supports the argument that no action against climate change

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[240] Frances C. Moore et al., *Synthesis of Evidence Yields High Social Cost of Carbon Due to Structural Model Variation and Uncertainties*, 121 Procs. of the Nat'l Acad. of Scis. 1, 3 fig.1 (2024).

[241] *E.g.*, EPA SC-GHG Report *supra* at 80 fig.3.1.1; Moore, *supra* at 3 fig.1

[242] William Nordhaus, *Projections and Uncertainties about Climate Change in an Era of Minimal Climate Policies*, 10 Am. Econ. J.: Econ. Pol'y 333, 335, 359 (2018) ("It might be tempting to conclude that nations should wait until the uncertainties are resolved, or at least until the fog has lifted a little. The present study finds the opposite result. To reiterate, by taking uncertainties into account, the strength of policy (as measured by the social cost of carbon or the optimal carbon tax) would increase, not decrease.").

[243] Richard S.J. Tol, *The Social Cost of Carbon*, 3 Ann. Rev. Res. Econ. 419 (2011).

should be taken until uncertainty is resolved. On the contrary, uncertainty . . . is often found to favor a stricter policy."[244]

The proposal's own analysis undercuts its claim of scientific dispute. The proposal relies on the FaIR climate model, noting that "[t]he National Academies of Sciences, Engineering and Medicine (NASEM) in a 2017 report endorsed the use of the FaIR model," and that "[r]educed complexity models like BRICK and FaIR allow for the flexibility to analyze custom scenarios, quantitatively discern changes between any scenarios, and characterize uncertainties surrounding global change." 91 Fed. Reg. at 59037. Yet it uses those models "without endorsing the underlying assumptions reflected in these commonly used models." *Id.* at 59036.

The proposal cannot have it both ways. The National Academies explained in its 2017 report that FaIR is "consistent with the current, peer-reviewed scientific understanding of the relationships over time between CO_2 emissions, atmospheric CO_2 concentrations, and CO_2-induced global mean surface temperature change, including their uncertainty," specifically praising the model for its "uncertainty characterization" and calling it "proof of concept" that a model can capture the state of science on this issue. In its own assessment, EPA pointed to the National Academies' findings and recognized that reduced-complexity climate models like FaIR robustly "allow[] for the exploration of uncertainty."[245]

5. The proposal's claims that climate harms are too remote and indirect are scientifically and legally wrong.

The proposal asserts that "[g]lobal climate change concerns involve causal relationships that are too uncertain, conjectural, remote, and convoluted by intervening and confounding factors to fit within the terms 'cause,' 'contribute,' and 'reasonably be anticipated to endanger' as used in CAA section 111(b)(1)(A)." 91 Fed. Reg. at 59023. It emphasizes the 2009 statement that "[n]one of th[e] human health effects are associated with direct exposure to [greenhouse gases]." *Id.* at 59013 (quoting 74 Fed. Reg. at 66527).

But greenhouse gases are "directly emitted," rather than formed by precursor gases, and exert a warming effect "by trapping heat that would otherwise escape to space." 74 Fed. Reg. at 66517. Although all greenhouse gases eventually undergo atmospheric transformation that remove them from the atmosphere, their warming effect occurs before such transformation, which is thus not the basis for the harm they cause. By contrast, while NO_X and VOCs do have some direct health impacts, they are primarily regulated under Section 111 as ozone precursors. In this regard, greenhouse gases' chain of causation to harm may be less attenuated than for

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[244] Alexander Golub, Daiju Narita, & Matthias G. W. Schmidt, *Uncertainty in Integrated Assessment Models of Climate Change: Alternative Analytical Approaches*, 19 Env't Modeling & Assessment, 107 (2014).

[245] National Academies of Sciences, Engineering, and Medicine, *Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide* at 13, 88, 86, 108 (2017), https://doi.org/10.17226/24651; EPA SC-GHG Report *supra* at 35; Peer Review Report *supra* at 31 (comments of Dr. Gernot Wagner recognizing that EPA's climate module "reflects the latest consensus assessment by the IPCC" including the assessment of "climate uncertainty").

certain other pollutants that have always been understood to cause "significant" contributions to dangerous pollution from their major source categories.

The court in *Ethyl Corp.* was specifically considering the endangerment associated with lead in gasoline. Examining Section 211, which the court considered equally or more restrictive of EPA's authority than Section 202, the court held that EPA had rationally found endangerment associated with emissions from lead gasoline where airborne lead emitted from vehicles then fell to the ground in particles where it mixed with dust, which could then be consumed by the group of children with pica (a condition that is relatively common among pre-school children involving the ingestion of non-food substances). The court acknowledged that lead paint, rather than atmospheric deposition, was the primary source of lead poisoning in children, but nevertheless found EPA's "reliance on the dustfall theory" consistent with the Act's "will endanger" standard. Per the court, "If the intermediate steps are supported by the evidence, the validity of the Administrator's conclusion as a reasonable hypothesis is unassailable." *Ethyl Corp. v. EPA*, 541 F.2d 1 at 44 (D.C. Cir. 1976). EPA in the Supplemental Proposal makes no effort to disprove the causal links that connect greenhouse gases to enormous public harm. *See also id.* at 18 ("[P]ublic health may properly be found endangered both by a lesser risk of a greater harm and by a greater risk of a lesser harm."). Indirect harms are no less real, as the infrastructure examples in the preceding section illustrate.

Section 111 of the Clean Air Act particularly embodies the importance of considering uncertainty, as it directs EPA to regulate air pollution that "may reasonably be anticipated to endanger public health or welfare," without requiring complete certainty before acting. 42 U.S.C. § 7411(b)(1)(A). When adopting this language, legislators emphasized that "making comparative assessment of risks [and] projections of future possibilities" and "extrapolating from limited data" are "necessary and permissible . . . to protect public health." H.R. Rep. No. 95-294, at 50-1 (1977). Federal courts have repeatedly recognized that agency analysis necessitates making predictive judgments under uncertain conditions, explaining that "[r]egulators by nature work under conditions of serious uncertainty" and "are often called upon to confront difficult administrative problems armed with imperfect data." *Pub. Citizen v. Fed. Motor Carrier Safety Admin.*, 374 F.3d 1209, 1221 (D.C. Cir. 2004); *Mont. Wilderness Ass'n v. McAllister*, 666 F.3d 549, 559 (9th Cir. 2011). "[T]he proper response" to the problem of uncertain information is "for the [agency] to do the best it can with the data it has." *Id*.

E. The proposal's scientific claims conflict with previous EPA findings.

EPA has, myriad times since adopting the Endangerment Finding, considered the evidence that greenhouse gases harm human health and welfare – consistently finding that the scientific evidence only more strongly supported its original conclusions. During that time, EPA also considered and rejected many of the critiques that the proposal now adopts. The proposal's failure to acknowledge, let alone explain its departure from these detailed and consistent findings over the course of nearly two decades is further reason it is arbitrary and capricious. That record is directly relevant here. EPA's 2015 approach to endangerment from power plant emissions was "substantially similar to that reflected in the 2009 Endangerment Finding and the 2010 denial of petitions to reconsider," 91 Fed. Reg. at 59015 (quoting 80 Fed. Reg. at 64531), and the proposal now contends that the 2015 determination "was flawed because it attempted to demonstrate endangerment based on global climate change concerns as analyzed for CAA section 202(a)(1)

purposes in the 2009 Endangerment Finding and subsequent reconsideration denials," *Id*. at 59030.

1. EPA has noted the strengthened evidence for endangerment in its rulemakings since 2009, including in its 2015 and 2024 power plant rules.

We discuss four broad areas of evidence reflected in EPA's Endangerment Finding that EPA has clearly and continuously reaffirmed since 2009 – subsequent history that is unacknowledged or unexplained in the current proposal. These are: 1) human activities are driving accumulation of greenhouse gases in the atmosphere; 2) there has been an unprecedented rise in greenhouse gases; 3) greenhouse gas emissions cause climate change; and 4) human-induced climate change harms human health and welfare.

a. Human activities are driving the accumulation of greenhouse gases in the atmosphere.

In the 2009 Endangerment Finding, EPA determined that "human activities are intensifying the naturally occurring greenhouse effect by adding greenhouse gases to the atmosphere," and concluded the "high atmospheric concentrations of greenhouse gases are the unambiguous result of human activities." 74 Fed. Reg. at 66499, 66517. EPA further specified that increasing concentrations of all the greenhouse gases, including carbon dioxide, methane, nitrous oxide, and fluorinated gases, can primarily be attributed to anthropogenic sources. *See Id*. at 66517. EPA relied on an exhaustive review of peer-reviewed climate change science assessments (IPCC, USGCRP, and NRC) to conclude that there is overwhelming evidence to support the conclusion that greenhouse gas emissions are primarily driven by anthropogenic sources.[246]

Over the past 15 years, EPA has continuously re-affirmed this finding through continuous review of scientific literature in its promulgation of several specific industry standards and rules, and in its denials of petitions to reconsider the initial endangerment finding. For example:

- In 2012, in the final rule for model year 2017 and later light-duty vehicle greenhouse gas emissions and CAFE standards, EPA noted more recent climate science assessments have reached similar conclusions to the initial Endangerment Finding, including that greenhouse gas emissions are "caused largely by human activities." 77 Fed. Reg. 62624, 62895 (Oct. 15, 2012).
- In EPA's 2016 finding that greenhouse gases from aircraft cause air pollution, "EPA finds that . . . recent assessments [from IPCC, USGCRP, and NRC] support and strengthen evidence cited in 2009 Endangerment Finding that current atmospheric GHG concentrations… are a result of both historic and current anthropogenic emissions." 81 Fed. Reg. 54422, 54444 (Aug. 15, 2016).

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[246] Initial climate assessments include USGCRP (2009), IPCC (2007), and NRC (2001), which were synthesized in EPA's Technical Support Document. *See* EPA, *Technical Support Document for Endangerment and Cause or Contribute Findings for Greenhouse Gases under Section 202(a) of the Clean Air Act* (Dec. 7, 2009).

- As of 2024, in updated standards for fossil fuel-fired electric generating units, EPA states "atmospheric concentrations of GHGs . . . continue to climb, primarily because of both historical and current anthropogenic emissions." 89 Fed. Reg. 39798, 39808 (May 9, 2024).

EPA has also reinforced these findings through the Agency's 2010 and 2022 denials of petitions for reconsideration of the Endangerment Finding. In its 2010 denial of ten petitions that claimed flaws in the scientific evidence, EPA reaffirmed its "ability to state with confidence … that there is compelling evidence that anthropogenic emissions of greenhouse gases are the primary driver" of climate change. 75 Fed. Reg. 49556, 49557 (Aug. 13, 2010). Similarly, in its 2022 denial of four petitions, EPA leveraged updated climate assessments from 2016-2021[247] to conclude that recent climactic changes can be "attributed… to the human-induced buildup of greenhouse gases in our atmosphere."[248] Furthermore, the first Trump Administration itself acted to deny four petitions to reconsider the Finding, although the Biden Administration later withdrew the denial on the basis that it lacked adequate justification and issued its own denials.[249]

b. There has been an unprecedented rise in atmospheric greenhouse gases.

In the 2009 Endangerment Finding, EPA determined that "current atmospheric greenhouse gas concentrations are now at elevated and essentially unprecedented levels as a result of both historic and current anthropogenic emissions." 74 Fed. Reg. at 66497. Further, EPA also established that these "well-mixed greenhouse gases have been increasing, and are projected to continue increasing unless the major emitters take action to reduce emissions." 74 Fed. Reg. at 66539. Over the past 15 years, EPA has continuously re-affirmed this finding through review of scientific literature in its promulgation of several specific industry standards and rules, and in its denials of petitions to reconsider the initial endangerment finding. In the process of developing these standards, EPA followed a comprehensive approach to updating and reviewing the scientific consensus on the finding and incorporating input from commenters and continually reinforcing that the scientific evidence supports its claims. For example:

- From 2015 to 2024, EPA consistently cited evidence in introducing and updating standards for electricity generation in particular and has documented the anthropogenic increase through 2022 by showing that "the average concentration of CO_2 as measured on top of Mauna Loa was 387 parts per million [in 2009], far above preindustrial concentrations of about 280 parts per million," 80 Fed. Reg. at 64520, and rose further "at Mauna Loa in Hawaii and at other sites around the world . . . [to]

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[247] Updated climate assessments include USGCRP (2016, 2017–2018), IPCC (2018, 2019, 2021), NAS (2016, 2017, 2019), and NOAA (2021).

[248] EPA, 2022 Denial of Petitions Decision Document at 11-13 (Apr. 29, 2022); *see* 87 Fed. Reg. 25412 (Apr. 29, 2022).

[249] EPA, Denial of Petitions to Reconsider EPA's Greenhouse Gas Endangerment Finding (Jan. 19, 2021), https://perma.cc/B6X8-WJXK; 87 Fed. Reg. at 25412; 2022 Reconsideration Decision Memo at 11-14.

419 parts per million (ppm) in 2022. . . . The 2022 CO_2 concentration of 419 ppm is already higher than at any time in the last 2 million years."[250]

- In the oil and gas industry, EPA, relying on evidence from NOAA, recognizes the increase in methane concentration as it stated "atmospheric methane concentrations in 2014 were about 1,823 parts per billion, 150 percent higher than methane concentrations were in the year 1750." EPA Oil and Natural Gas Standards, 81 Fed. Reg. 35824, 35836 (June 3, 2016). By 2024, methane concentration had "reached 1,912 parts per billion … more than two and a half times the preindustrial concentration of 722 ppb." EPA Oil and Natural Gas Standards, 89 Fed. Reg. 16820, 16840 (Mar. 8, 2024). In these standards, EPA also highlighted warming trends as they state, "the last 30 years were likely the warmest 30-year period of the last 1,400 years [in the Northern Hemisphere]."[251]
- Emissions from the transportation sector are well recognized by EPA, in particular, CO_2, CH_4 and N_2O concentrations: "The combined radiative forcing due to the cumulative (*i.e.*, 1750 to 2005) increase in atmospheric concentrations of CO_2, CH_4, and N_2O is . . . very likely to have been unprecedented in more than 10,000 years."[252]

EPA has reaffirmed the increase in greenhouse gas concentrations and its warming effects by stating that "[it] is a well-documented and straightforward observation" through its 2010 and 2022 denials of petitions for reconsideration of the Endangerment Finding. 75 Fed. Reg. at 49564. In EPA's 2022 denial, the Agency stressed that petitioners ignored the vast and growing body of science.[253] The 2022 denial went on to further establish the scientific attribution to the

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[250] *See* 89 Fed. Reg. at 39808. These findings were also mentioned in other industry standards such as electricity, oil and gas, transportation and landfills. *See* 80 Fed. Reg. at 64520; 89 Fed. Reg. at 39808; 89 Fed. Reg. at 16820, 16838; 81 Fed. Reg. at 73478; 89 Fed. Reg. at 27862; EPA Denial of Petitions, 75 Fed. Reg. at 49564.

[251] United States average temperatures have similarly increased by 1.3° to 1.9 °F since 1895, with most of that increase occurring since 1970." *See* 81 Fed. Reg. at 35836. EPA reiterated this claim in 2024 by stating "Global average temperature has increased by about 1.1 °C (2.0 °F) in the 2011-2020 decade relative to 1850–1900.43 The years 2015–2021 were the warmest 7 years in the 1880–2021 record, contributing to the warmest decade on record with a decadal temperature of 0.82 °C (1.48 °F) above the 20th century. The IPCC determined (with medium confidence) that this past decade was warmer than any multi century period in at least the past 100,000 years." *See* 89 Fed. Reg. at 16838.

[252] EPA also highlighted the increase as unusual in many of its standards: "The global atmospheric CO_2 concentration has increased about 38% from pre-industrial levels to 2009, and almost all of the increase is due to anthropogenic emissions. The global atmospheric concentration of CH4 has increased by 149% since pre-industrial levels (through 2007); and the N2O concentration has increased by 23% (through 2007)." *See* 75 Fed. Reg. at 25324, 25491-92.

[253] EPA 2022 Denial of Petitions Decision Document at 12-13. EPA relied on the following scientific assessments to document climate change and human-induced buildup of greenhouse gases: USGCRP 2016 Climate and Health Assessment and 2017-2018 Fourth National Assessment, 1.5 Degrees Celsius, 2019 Climate Change and Land, 2019 Ocean and Cryosphere in a Changing Climate, three volumes of the 2021 IPCC Sixth Assessment Report, NAS 2016

Endangerment Finding as they "considered the entirety of the evidence regarding both historical and projected climate change . . . [and] there is independent scientific evidence regarding projected climate impacts that also supports the finding of endangerment." EPA 2022 Denial of Petitions Decision Document at 16.

c. The warming effect of greenhouse gases and other impacts.

In the 2009 Endangerment Finding, EPA determined that the "six well-mixed greenhouse gases constitute the largest anthropogenic driver of climate change" and the "warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level." *See* 74 Fed. Reg. at 66517. Among the observed and projected effects of climate change include changes in precipitation, increases in extreme events, ocean acidification, and changes in physical and biological systems.254 Over the past 15 years, EPA has re-affirmed these findings through continuous review of scientific literature in its promulgation of several specific industry standards and rules, and in its denials of petitions to reconsider the initial endangerment finding. Throughout the process of developing these standards, which included its ongoing review of the scientific consensus, incorporation of input from commenters, and updating its findings over time, EPA has continually reinforced that greenhouse gases exert a warming effect on the climate and this warming effect is demonstrated by increasing global air and ocean temperatures, rising sea levels, and shrinking ice. For example:

- In the 2011 greenhouse gas emissions standards for vehicles, EPA reinforced the "warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level." EPA specified that "Nine of the 10 warmest years on record have occurred since 2001." 76 Fed. Reg. 57106 (Sept. 15, 2011).
- In EPA's 2015 greenhouse gas emissions standards for electric generating units, EPA documented the measurable climate impacts of warming effects, stating that "U.S. average temperatures have similarly increased by 1.3 to 1.9 °F since 1895, with most of that increase occurring since 1970. Global sea levels rose 0.19 m (7.5 inches) from 1901 to 2010. Contributing to this rise was the warming of the oceans and melting of land ice." Additionally, EPA noted that "2014 was the warmest year globally in the modern global surface temperature record, going back to 1880; this now means 19 of the 20 warmest years have occurred in the past 20 years, and except for 1998, the ten warmest years on record have occurred since 2002." 80 Fed. Reg. 64510, 64520 (Oct. 23, 2015).
- In EPA's 2016 finding that greenhouse gases from aircrafts cause air pollution, EPA reviewed recent climate assessments to further conclude that the "heating effect caused by the human-induced buildup of these and other GHGs in the atmosphere, plus other

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Attribution of Extreme Weather Events in the Context of Climate Change, 2017 Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide, and 2019 Climate Change and Ecosystems assessments, NOAA's State of the Climate Report 2021.

[254] Technical Support Document for Endangerment and Cause or Contribute Findings for Greenhouse Gases under Section 202(a) of the Clean Air Act at 23-44, U.S. EPA (December 7, 2009).

human activities… is extremely likely (>95 percent likelihood) to be the cause of most of the observed global warming since the mid-20th century." 81 Fed. Reg. at 54424. This certainty increased from the initial "very likely" level found in the 2009 Endangerment Finding. 74 Fed. Reg. at 66518. EPA considered "these observed changes as additional evidence of the unequivocal warming of the climate system driven primarily by elevated atmospheric GHG concentrations." 81 Fed. Reg. at 54443.

- In the more recent 2024 Oil and Gas standards, EPA again reaffirmed these conclusions, saying "[s]ince the 2016 Endangerment Findings, the climate has continued to change, with new records being set for several climate indicators such as global average surface temperatures, GHG concentrations, and sea level rise" and that "[w]arming temperatures in the atmosphere, ocean, and land have led to, for example: increased numbers of heat waves, wildfires, and other severe weather events; reduced air quality; more intense hurricanes and rainfall events; and sea level rise." 89 Fed. Reg. 16820, 16837, 16867 (Mar. 8, 2024).

EPA's 2010 and 2022 denials of petitions for reconsideration likewise reinforced these findings. In the 2010 denial, which noted that petitioners had raised no objections to the Administrator's analysis of climate risks, EPA explained that "the physical effect of greenhouse gases on climate and the environment remains a basic scientific fact – greenhouse gases slow the loss of Earth's heat, which would otherwise escape to space." Further, EPA stated that "the scientific literature is clear that the heating effect caused by the buildup of greenhouse gases is warming the climate system." 75 Fed. Reg. at 49568. Similarly, in its 2022 denial of four petitions, EPA emphasized that petitioners disregarded updated scientific assessments,[255] reaffirmed its finding, and concluded that newer science was "largely consistent with, and in many cases strengthen[ed] and add[ed] to" the basis for the 2009 Endangerment Finding. EPA, 2022 Denial of Petitions Decision Document at 1, 3, 5, 16 (citing 81 Fed. Reg. at 54442).

d. Human-induced climate change harms human health and welfare.

In the 2009 Endangerment Finding, EPA determined that climate change has "the potential to affect essentially every aspect of human health, society and the natural environment." 74 Fed. Reg. at 66523. Specifically, EPA considered health risks from "changes in air quality, increases in temperatures, changes in extreme weather events, increases in food- and water-borne pathogens, and changes in aeroallergens." 74 Fed. Reg. at 66497. EPA evaluated welfare impacts associated with "numerous and far-ranging risks to food production and agriculture, forestry, water resources, sea level rise and coastal areas, energy, infrastructure, and settlements, and ecosystems and wildlife." *Id.* Over the past 15 years, EPA has continuously re-affirmed this

[255] Major recent assessments include USGCRP's 2016 Climate and Health Assessment and 2017–2018 Fourth National Climate Assessment; IPCC's 2018 Global Warming of 1.5°C, 2019 Climate Change and Land, and 2019 Ocean and Cryosphere in a Changing Climate assessments, as well as the three volumes of the 2021 IPCC Sixth Assessment Report (AR6); the NAS 2016 Attribution of Extreme Weather Events in the Context of Climate Change, 2017 Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide, and 2019 Climate Change and Ecosystems assessments; and NOAA's annual State of the Climate reports published by the Bulletin of the American Meteorological Society, most recently in August of 2021.

finding through review of scientific literature in its promulgation of several specific industry standards and rules, and in its denials of petitions to reconsider the initial endangerment finding. Throughout the process of developing these standards, which included its ongoing review of the scientific consensus, incorporation of input from commenters, and updating its findings over time, EPA has continually reinforced that emissions of greenhouse gases harm the public. *See e.g.,* 75 Fed. Reg. at 25399; EPA Denial of Petitions, 75 Fed. Reg. at 49557; 80 Fed. Reg. at 64517, 64518; 81 Fed. Reg. at 59276, 59338; 89 Fed. Reg. at 39808; 89 Fed. Reg. at 16837; EPA 2022 Denial of Petitions Decision Document at 3, 16. For example, among others:

- In introducing 2011 vehicle emissions standards, EPA explained that "[s]etting GHG emissions standards for the heavy-duty sector will help to ameliorate climate change," concluding that six greenhouse gases "in combination result in air pollution which may reasonably be anticipated to endanger both public health and welfare…" 76 Fed. Reg. at 57109; *see also* 75 Fed. Reg. at 25324; 77 Fed. Reg. at 62624; 81 Fed. Reg. at 35824.
- In a 2016 oil and gas emissions standards ruling, EPA stated that, since the 2009 Finding, "the climate has continued to change, with new records being set for a number of climate indicators." EPA emphasized that new assessments, which have been through rigorous peer review by the expert community, "strengthen the case that GHGs endanger public health and welfare both for current and future generations." 81 Fed. Reg. 35824, 35834 (June 3, 2016) ; *see also* 89 Fed. Reg. at 27842; 80 Fed. Reg. at 64510; 89 Fed. Reg. at 39798.
- In 2016, in EPA's finding on aircraft emissions causing air pollution EPA found additional evidence to "strengthen and further support the judgement that GHGs in the atmosphere may reasonably be anticipated to endanger the public health and welfare of current and future generations." Additionally, EPA found that "No information or assessments published since late 2009 suggest that it would be reasonable for the EPA to now reach a different or contrary conclusion." 81 Fed. Reg. at 54424.
- Most recently, in a 2024 oil and gas rule, EPA found that "major scientific assessments continue to demonstrate advances in our understanding of the climate system and the impacts that GHGs have on public health and welfare." 89 Fed. Reg. at 16837.[256]

EPA has repeatedly reaffirmed that climate change from greenhouse gases endangers public health and welfare through its 2010 and 2022 denials of petitions for reconsideration of the Endangerment Finding. In its 2022 denial, EPA concluded: "The science supporting the Administrator's finding that elevated concentrations of greenhouse gases in the atmosphere may

[256] This evidence included references to U.S. Global Change Research Program's (USGCRP) 2016 Climate and Health Assessment 30 and 2017–2018 Fourth National Climate Assessment (NCA4); IPCC's 2018 Global Warming of 1.5 °C, 2019 Climate Change and Land, and the 2019 Ocean and Cryosphere in a Changing Climate assessments, as well as the 2023 IPCC Sixth Assessment Report (AR6); the NAS 2016 Attribution of Extreme Weather Events in the Context of Climate Change, 2017 Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide, and 2019 Climate Change and Ecosystems assessments; National Oceanic and Atmospheric Administration's (NOAA) annual State of the Climate reports published by the Bulletin of the American Meteorological Society, most recently in 2022; EPA Climate Change and Social Vulnerability in the United States: A Focus on Six Impacts (2021).

reasonably be anticipated to endanger the public health and welfare of current and future U.S. generations is robust, voluminous, and compelling, and has been strongly affirmed by recent scientific assessments of the National Academies, the US Global Change Research Program, and the Intergovernmental Panel on Climate Change." EPA, 2022 Denial of Petitions Decision Document at 1, 3. In that 2022 denial, EPA also stressed that petitioners ignored the updated scientific assessments,[257] reaffirmed the same conclusion,[258] and noted that newer science strengthened the 2009 record.[259]

e. EPA made the same findings for power plants, and courts have upheld EPA's scientific record.

For power plants, EPA's 2015 Carbon Pollution Standards determined that power plants contribute significantly to the atmospheric greenhouse gas pollution that endangers public health and welfare, considering both the scientific record underlying the 2009 Endangerment Finding as well as more recent evidence concerning harm from greenhouse gas emissions and the power sector's contribution to those emissions. 80 Fed. Reg. 64510, 64529-30 (Oct. 23, 2015).

The D.C. Circuit considered the very question of the scientific record's support for the 2009 Finding for vehicles and concluded that "[t]he body of scientific evidence marshaled by EPA in support of the Endangerment Finding is substantial" and supported every link in the causal chain between motor vehicle emissions, a warming climate, and the hazards to public health and welfare that result." *Coal. for Responsible Regul., Inc. v. EPA*, 684 F.3d 102, 120 (D.C. Cir. 2012). The Supreme Court denied certiorari on that central question. *See Chamber of Com. v. EPA*, 571 U.S. 951 (2013). More recently, the D.C. Circuit again rejected challenges to EPA's denial of petitions for reconsideration of the 2009 Endangerment Finding, and the Supreme Court again denied review. *See Concerned Household Electricity Consumers Council v.*

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[257] Major recent assessments include USGCRP's 2016 Climate and Health Assessment and 2017-2018 Fourth National Climate Assessment; IPCC's 2018 Global Warming of 1.5°C, 2019 Climate Change and Land, and 2019 Ocean and Cryosphere in a Changing Climate assessments, as well as the three volumes of the 2021 IPCC Sixth Assessment Report (AR6); The NAS 2016 Attribution of Extreme Weather Events in the Context of Climate Change, 2017 Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide, and 2019 Climate Change and Ecosystems assessments; NOAA's annual State of the Climate reports published by the Bulletin of the American Meteorological Society, most recently in August of 2021.

[258] EPA 2022 Denial of Petitions Decision Document at 1, 3 ("The science supporting the Administrator's finding that elevated concentrations of greenhouse gases in the atmosphere may reasonably be anticipated to endanger the public health and welfare of current and future U.S. generations is robust, voluminous, and compelling, and has been strongly affirmed by recent scientific assessments of the National Academies, the US Global Change Research Program, and the Intergovernmental Panel on Climate Change.").

[259] EPA 2022 Denial of Petitions Decision Document at 5, citing 81 Fed. Reg. at 54442 ("These new assessments are largely consistent with, and in many cases strengthen and add to, the already compelling and comprehensive scientific evidence detailing the role of the six well-mixed GHGs in driving climate change, explained in the 2009 Endangerment Finding.").

EPA, No. 22-1139, 2023 WL 3643436 (D.C. Cir. May 25, 2023), *cert. denied*, 144 S. Ct. 497 (2023).

The Supplemental Proposal ignores the long record of EPA findings, stating without support and without acknowledging or explaining its departure from prior findings that greenhouse gas concentrations have risen, "without producing the degree of adverse impacts to public health and welfare in the U.S. anticipated in the 2009 Endangerment Finding and 2015 NSPS and 2015 CPP." 91 Fed. Reg. at 59005. The proposal's unsupported assertions do not discharge EPA's duty to provide a more detailed explanation where the Agency is proposing to depart from consistent and long-standing past factual findings, which are themselves supported by detailed evidence from peer-reviewed scientific assessments.

2. EPA has previously considered and rejected the scientific claims this proposal now advances.

The Supplemental Proposal asserts that "the flaws identified in the 2009 Endangerment Finding similarly render the 2015 Findings insupportable." 91 Fed. Reg. at 59020. But the final rescission of the 2009 Endangerment Finding identified no scientific flaws. EPA there "decided not to finalize this scientific alternative rationale," is "not finalizing new findings by the Administrator with respect to global climate change concerns," and "does not rely on any specific critique of climate science as a necessary justification for this action." 91 Fed. Reg. at 7734, 7737. EPA cannot borrow from the rescission scientific conclusions that the rescission expressly declined to reach. Nor can EPA now advance, in this Supplemental Proposal, scientific doubts it disclaimed reliance on months ago without acknowledging and explaining that shift.

In addition to the extensive regulatory history that the proposal ignores, EPA also has previously considered and rejected the specific claims the Supplemental Proposal now advances. For instance:

- *Mortality risk from temperatures.* The proposal dismisses heat-related health risks as "speculative." 91 Fed. Reg. at 59036. In the 2016 finding that greenhouse gas emissions from aircrafts cause air pollution, however, EPA concluded "climate change increases the likelihood of heat waves, which are associated with increased deaths and illnesses" and while "climate change is also expected to lead to reductions in cold-related mortality… increases in heat-related mortality due to global warming in the United States were unlikely to be compensated for by decreases in cold-related mortality." 81 Fed. Reg. at 54452. EPA does not acknowledge or explain its departure from this prior position.
- *Sea level rise*. The proposal treats sea level rise impacts as speculative, *id.*, even as its own modeling projects global sea level rise of 97.1 cm above pre-industrial levels by 2100, *id.* at 59037. In EPA's recent 2024 greenhouse gas standards for fossil fired-electric generating units, the Agency concluded "the climate has continued to change with new observational records being set for several climate indicators such as… sea level rise." 89 Fed. Reg. at 39807.
- *Food production and agriculture*. The proposal emphasizes that the 2009 evidence "was uncertain for several categories that may see near-term benefits." 91 Fed. Reg. at 59036. However, in EPA's 2022 Denial of Petitions for Reconsideration, the Agency concludes that "the body of evidence points towards increasing risk of net adverse impacts on U.S.

food production and agriculture, with the potential for significant disruptions and crop failure in the future." EPA does not acknowledge or explain this departure from its prior findings. EPA, 2022 Denial of Petitions Decision Document at 32.

F. Greenhouse gas emissions unquestionably endanger public health and welfare.

Emission of greenhouse gases cause numerous direct and indirect health impacts, and there is expert consensus that the continued unfettered emission of harmful pollutants will drive increased climate-attributable morbidity and mortality.[260] The public health impacts of greenhouse gas emissions are unequally distributed – lower-income populations, younger, elderly, disabled, and Indigenous individuals, and women will face a greater health burden.[261] EPA cannot reasonably proceed here without first considering the full scope of public health impacts detailed above and summarized below and addressing countervailing facts that contradict the Agency's reversal in policy.

Air quality. Worsening air quality due to greenhouse gas emissions causes significant negative health impacts.[262] There are multiple direct and indirect pathways through which greenhouse gas emissions deteriorate air quality. Pollution generated by wildfires – including particulate matter, carbon monoxide, and hazardous air pollutants – contributes to death, respiratory disease, cardiac events, and negative birth outcomes.[263] Additionally, wildfire pollution, particulate matter pollution, and aeroallergens are all produced in heightened quantities with warmer ambient temperatures that result from greenhouse gas emissions.[264] Each of these is associated with heightened climate-sensitive cardiovascular and respiratory distress.[265] Ground-level ozone (commonly referred to as "smog") is also associated with increased ambient temperatures and causes respiratory disease, obstructive pulmonary disease, asthma attacks, lung disease, preterm and low birthweight infants, cancer, harms to brain health, and premature death.[266]

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[260] Pörtner et al., *supra*, at 50.

[261] Pörtner et al., *supra*, at 78.

[262] *Air Pollution*, World Health Org., https://www.who.int/health-topics/air-pollution#tab=tab_2 (last visited Oct. 22, 2026) (WHO estimates that ambient and indoor air pollution jointly cause approximately 7 million premature deaths annually).

[263] Jessica A. Wentz, *Climate Change and Human Health: A Synthesis of Scientific Research and State Obligations Under International Law*, 17 (Sabin Ctr. for Climate Change L., Columbia L. Sch., May 2024), https://scholarship.law.columbia.edu/sabin_climate_change/223/.

[264] *Id.*; A.B. Singh & Pawan Kumar, *Climate Change and Allergic Diseases: An Overview*, 3 Front Allergy 964987 (2022), https://doi.org/10.3389/falgy.2022.964987.

[265] Pörtner et al. (2022), *supra*, at 11.

[266] Hans Orru et al., *Impact of Climate Change on Ozone-Related Mortality and Morbidity in Europe*, 41 Eur. Respir. J. 285 (2013), https://doi.org/10.1183/09031936.00210411; *Health Effects of Ozone Pollution*, EPA, https://perma.cc/S43R-JP53 (last updated Feb. 24, 2026) (EPA also lists the following health impacts of ozone: coughing and sore or scratchy throat; difficulty

Extreme weather events. Emissions of greenhouse gas raise ambient temperatures, which in turn heightens the frequency and severity of extreme weather events, including extreme heat, precipitation, and flooding.[267] These extreme events directly cause mortality and morbidity and indirectly contribute additional health stressors, by disrupting health services and emergency management systems.[268] Extreme heat attributable to greenhouse gas emissions has significant implications for public health, contributing to more mortality than any other climatic hazard.[269] Conclusively, health impact studies have found that climate change induced by greenhouse gas emissions has contributed to rising ambient temperatures, increasing the pervasiveness of extreme heat exposure.[270] Exposure to extreme heat causes a variety of health issues including heat stroke, heat exhaustion, heat cramps, rhabdomyolysis, heat rashes, and hyperthermia.[271] Further, extreme heat can exacerbate existing health issues, including cardiovascular and respiratory diseases, diabetes-related health issues, and cerebrovascular disease.[272] The climatic impacts resulting from greenhouse gas emissions increase severe precipitation, storm, and flooding events.[273] Directly, extreme weather events cause mortality, property loss, and displacement.[274] Indirectly, these events threaten already fragile infrastructure, health services, and emergency response systems, resulting in high public and private costs.[275] Emissions-induced climate change also increases the occurrence of fire weather, which heightens the risk

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breathing; inflammation and damage to the airways; aggravation of lung diseases such as asthma, emphysema, and chronic bronchitis, increased frequency of asthma attacks).

[267] Pörtner et al., *supra*, at 8, 11.

[268] Pörtner et al., *supra*, at 11.

[269] Vicedo-Cabrera et al., *supra,* at 492; Jagadeesh Puvvula et al., *Estimating the Burden of Heat-Related Illness Morbidity Attributable to Anthropogenic Climate Change in North Carolina*, 6 GeoHealth e2022GH000636 (2022), https://doi.org/10.1029/2022GH000636.

[270] Wentz, *supra*, at 12; Maria Romanello et al., *The 2023 Report of the Lancet Countdown on Health and Climate Change*, 402 Lancet 2346, (2023), https://doi.org/10.1016/s0140-6736(23)01859-7.

[271] *See Heat Stress and Workers*, Nat'l Inst for Occupational Safety & Health, https://perma.cc/P2W4-4J4H (last updated Mar. 3, 2026); Wentz, *supra*, at 12.

[272] *Weather Extremes*, Nat'l Inst. of Env't Health Sci., https://www.niehs.nih.gov/health/topics/agents/extremeweather (last updated Sep. 4, 2026); *Heat and Health*, World Health Org., https://www.who.int/news-room/fact-sheets/detail/climate-change-heat-and-health (last updated Jul. 31, 2026); Wentz, *supra*, at 12.

[273] Wentz, *supra*, at 14.

[274] Wentz, *supra*, at 14.

[275] Wentz, *supra*, at 14; *New Report: Extreme Weather Events Cost Economy $2 Trillion Over the Last Decade*, Int'l Chamber of Commerce, https://iccwbo.org/news-publications/policies-reports/new-report-extreme-weather-events-cost-economy-2-trillion-over-the-last-decade/ (Nov. 11, 2024).

and potential severity of wildfires.[276] In addition to morbidity, loss of property, and displacement, wildfires produce harmful smoke that is associated with severe respiratory ailments.[277]

Disease, water quality, and water quantity. Ambient warming caused by greenhouse gas emissions increases the instances of infectious diseases, including vector-borne illnesses such as malaria and diarrheal disease.[278] The prevalence of infectious diseases increases with higher ambient temperatures – which expand the geographic range of zoonotic-borne diseases – and through increased human displacement.[279] Climatic changes resulting from greenhouse gas emissions threaten the ability of local governments to provide safe drinking water and adequate sanitation services.[280] Elevated runoff of pollutants and sediment from heavy precipitation degrades water quality.[281] Additionally, the increasing frequency and duration of droughts strain the existing water supply and undermine food production and distribution systems.[282] Finally, saltwater intrusion – which is exacerbated by drought and sea-level rise – reduces the supply of potable water.[283]

Other public health benefits. The public health benefits of greenhouse gas reductions are large.[284] Regulation that decreases emissions is a cost-effective way to avert premature climate-related morbidity and mortality.[285] Additionally, because of the co-emittance of harmful

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[276] Wentz, *supra,* at 15.

[277] Wentz, *supra*, at 17.

[278] Pörtner et al., *supra*, at 11; Anthony J. McMichael et al., *Chapter 20: Global Climate Change in World Health Org., Comparative Quantification of Health Risks: Global and Regional Burden of Disease Attributable to Selected Major Risk Factors* 1606 (Majid zzati et al. eds., 2004).

[279] Pörtner et al., *supra*, at 51-52.

[280] *Climate Adaptation and Source Water Impacts*, EPA, https://19january2021snapshot.epa.gov/arc-x/climate-adaptation-and-source-water-impacts_.html (last updated Sep. 29, 2016) (EPA also notes increased prevalence of harmful algal blooms, which can have secondary impacts on human health).

[281] Jinghong Gao et al., *Public Health Co-benefits of Greenhouse Gas Emissions Reduction: A Systematic Review*, 627 Sci. of the Total Env't. 388, 390 (2018), https://doi.org/10.1016/j.scitotenv.2018.01.193; Drew T. Shindell et al., *Climate and Health Impacts of US Emissions Reductions Consistent with 2°C*, 6 Nat. Climate Change 503 (2016), https://doi.org/10.1038/nclimate2935; J. Jason West et al., *Co-benefits of Mitigating Global Greenhouse Gas Emissions for Future Air Quality and Human Health*, 3 Nat. Climate Change 885 (2013), https://doi.org/10.1038/nclimate2009.

[282] Gao et al., *supra*, at 388; Shindell et al. (2016), *supra*, at 503; West et al., *supra*, at 885.

[283] Gao et al., *supra*, at 388; Shindell et al. (2016), *supra*, at 503; West et al., *supra*, at 885.

[284] Gao et al., *supra*, at 388; Shindell et al. (2016), *supra*, at 503; West et al., *supra*, at 885.

[285] Wentz, *supra*, at 18.

pollutants – such as nitrogen oxides and particulate matter – with greenhouse gas, there are significant health co-benefits from emissions reducing regulation.[286]

VIII. EPA WRONGLY CONCLUDES THAT THERE IS NO ENDANGERMENT AND THAT REGULATION WOULD BE FUTILE.

The Supplemental Proposal includes a so-called "futility rationale" as a "separate and independent basis" for the proposed rescission and repeals, 91 Fed. Reg. at 59021. Specifically, "EPA is proposing that the Agency cannot or should not exercise its regulatory authority under CAA section 111 when that exercise would have no meaningful impact on the identified dangers to public health and welfare." *Id.* at 59035. The Supplemental Proposal then proposes to find, as a factual matter, that even the elimination of all CO_2 emissions from fossil fuel-fired power plants in the United States "would have no more than a trivial effect." *Id.* at 59035. On the basis of that finding, EPA proposes to determine that it lacks the statutory "prerequisite" to control power-plant greenhouse gases under Section 111, and that regulation would otherwise be unreasonable. *Id.* at 59006. EPA further proposes that its futility rationale "supports the conclusion that GHG emissions from fossil fuel-fired EGUs do not 'contribute significantly' to air pollution" under Section 111(b)(1)(A), *id.*, as well as the conclusion that "section 111(b)(1)(A) does not authorize [power-plant] regulation based on global climate change concerns," *id.* at 59028. *See also id.* at 59024.

EPA's futility determination is premised on the Agency's technical analysis of the projected impacts of U.S. power-plant emissions on Global Mean Surface Temperature (GMST) and Global Sea Level Rise (GSLR), which we describe in these comments with shorthand such as global temperature and global sea level rise. *See* 91 Fed. Reg. at 59036. The Agency purports to calculate the changes in global temperature and sea level rise attributable to U.S. power-sector greenhouse gas emissions as proportions of total global anthropogenic impacts over specific time periods. *See* 91 Fed. Reg. at 59036-39; EPA Technical Memo, *Temperature, CO2 Concentration, and Sea Level Rise Impacts of CO2 Emissions from U.S. Electricity Generating Units* (Aug. 2026), Docket ID No. EPA-HQ-OAR-2025-0124 ("Temperature Memo"). EPA also advances a so-called "illustrative" scenario that cuts emissions by 50% as a proxy for regulation. *See id.* at 59039-40. Finally, EPA purports to compare these impacts against three *de minimis* yardsticks: (i) the "range of measurability" of global temperature and sea level rise, (ii) global temperature "variability" over time (though the specific years EPA considered is unclear), and (iii) a 1% contribution threshold that, EPA asserts, courts have consistently viewed as *de minimis. See id.* at 59040. The Agency asserts that the impacts are so small as to be *de minimis* when measured against any of these yardsticks. *See id*.

As we explain in detail in this section, EPA's futility rationale – including the Agency's technical methodology and analysis, its factual findings and determinations based on that analysis, its new legal conclusions and statutory interpretations, and its proposed application of those findings and determinations to support the proposed rescission and repeals and other statutory interpretations – lacks any legal foundation or rational basis and is otherwise fundamentally flawed, arbitrary and capricious, inadequately explained, and unlawful, and it

[286] Gao et al., *supra*, at 388; Shindell et al. (2016), *supra*, at 503; West et al., *supra*, at 885.

cannot support finalization of the proposed rescission and repeals (or any other agency action) in any way.

Subsection VIII.A below explains that EPA's futility modeling, which is the foundation of the Agency's futility rationale, is fundamentally flawed and arbitrary. Among other errors, EPA:

- arbitrarily and without sufficient explanation selected inappropriate metrics that obscure massive health and welfare harms to the United States, and which the Agency erroneously conflated with the materiality of reducing emissions;
- arbitrarily and without adequate explanation neglected to consider more relevant metrics such as the damages to society caused by greenhouse gas emissions and the corresponding benefits of mitigating such emissions, and despite EPA's long history of considering such metrics in other rulemaking actions;
- made modeling choices that irrationally negate decades of outsized power-plant emissions;
- irrationally chose to model only a single scenario that arbitrarily assumes zero change in emissions from electricity generation after 2050; and
- failed to appropriately account for the cumulative and long-term nature of greenhouse gas emissions impacts.

We present the results of new expert modeling demonstrating that even assuming EPA's own modeling inputs, U.S. power-plant greenhouse gases cause massive human health and welfare harms of approximately $20.4 trillion by 2100, an amount that is not *de minimis* by any reasonable measure. And we present our own modeled scenarios, which illustrate the gravity of EPA's technical errors and the sensitivity of the Agency's findings to inputs and assumptions. Under our alternate illustrative scenarios, U.S. power-plant emissions' impacts on global temperature and sea level rise easily exceed EPA's alleged *de minimis* thresholds, showing such impacts are in fact meaningful even under EPA's flawed futility methodology.

Subsection VIII.B describes how, even without addressing the numerous flaws we have identified, EPA's proposed determination that regulation of power-sector greenhouse gas emissions would be futile is contrary to the evidence, arbitrary, and erroneous. Among other critical flaws, EPA's determination relies on a so-called "illustrative" scenario that the Agency concedes is not fit for this purpose, and on *de minimis* comparison metrics that are erroneous and arbitrary. In addition, it is fundamentally arbitrary for the Agency's determination of whether it has regulatory authority to turn on one modeling case with a single set of assumptions and parameters – especially given the demonstrated sensitivity of the analysis to such choices.

Subsection VIII.C explains that, even if EPA's futility analysis were not critically flawed (which it is), and even if its futility determinations were correct (they are not), EPA's futility analysis still would not necessitate or justify the proposed repeals and rescissions. The Agency is wrong that the Clean Air Act requires or permits EPA to determine *a priori* whether the exercise of regulatory authority under Section 111 would reduce health or welfare danger beyond some threshold amount. In fact, nothing in the statutory text nor background principles of law suggests that a futility determination has any relevance to the scope of the agency's statutorily conferred regulatory authority under Section 111(b)(1)(A).

Subsection VIII.D argues that EPA's proposed futility rationale also does not, and cannot, have any bearing on the best reading of the text of Section 111, including the phrase "contribute significantly" in Section 111(b)(1)(A). An agency modeling exercise conducted today is irrelevant to determining the scope of authority Congress intended to confer to EPA in the plain text of Section 111.

Finally, Subsection VIII.E explains that EPA's alternative determination that retaining power-plant greenhouse gas emission standards is unreasonable based on comparison of EPA's flawed futility analysis and findings to unspecified regulatory costs, *see* 91 Fed. Reg. at 59006, is inadequately noticed and inadequately explained, and otherwise is arbitrary, capricious, and unlawful.

A. EPA's futility modeling is error-ridden, inadequately explained, and not fit for purpose.

EPA's modeling of power-plant CO_2 emissions, global temperature, and global sea level rise presented in the Supplemental Proposal is arbitrary and capricious and cannot serve as a rational basis for any determination regarding the materiality of power-plant greenhouse gas regulation. Below, we detail numerous critical flaws and limitations in EPA's choice of parameters. We also present the results of our own technical modeling, which illustrate how different methodological choices significantly affect EPA's outputs, findings, and rationale. Our own modeling results illustrate the gravity of the flaws in EPA's analysis and show how changes to certain inputs result in significantly higher global temperature and sea level rise impacts attributable to U.S. power-plant CO_2 emissions. Our results also project that the monetized value of health and welfare dangers from U.S. power-plant CO_2 emissions by 2100, *even assuming EPA's own flawed modeling results*, is between $11.7-37.1 trillion – a sum that cannot reasonably be considered *de minimis*.

Given the sensitivity of EPA's modeling outputs to the parameters selected, each of EPA's methodological flaws alone renders the analysis arbitrary and irrational. Together, these numerous and compounding flaws and limitations demonstrate that the proposed futility analysis is so fundamentally erroneous that the Agency could not lawfully finalize a corrected analysis without publishing a second supplemental proposal for public comment. *See* 42 U.S.C. § 7607(d)(3) (EPA must provide notice of its proposed action that "shall be accompanied by a statement of its basis and purpose," including "the factual data on which the proposed rule is based" and "the methodology used in obtaining the data and in analyzing the data"); *Chesapeake Climate Action Network v. EPA*, 952 F.3d 310, 320-21 (D.C. Cir. 2020). The Supplemental Proposal therefore should be withdrawn.

1. EPA errs by solely considering the proportion of global average temperature and sea level changes caused by power-plant emissions, obscuring their enormous harms to U.S. health and welfare.

EPA's sole reliance on two metrics – the proportional contribution of U.S. power-sector CO_2 emissions to changes in global average temperature and sea level rise – is an incomplete and arbitrary way of measuring and valuing the wide variety of health and welfare harms from those emissions and of assessing the purported futility of the U.S. power-plant greenhouse gas standards. As EPA concedes, these intermediate metrics do not actually measure U.S. health and

welfare harms at all. *See* 91 Fed. Reg. at 59036. EPA cannot rationally rely on only these metrics to evaluate the efficacy of exercising its legal authority; and EPA cannot use such metrics as proxies for assessing health and welfare harms in lieu of direct assessment of such harms using proven and available methodologies that the Agency has long used to inform other regulatory action.

The Supplemental Proposal recognizes that under Section 111, the core regulatory concern is "specific health risks and welfare effects," 91 Fed. Reg. at 59036, and that "CAA section 111(b)(1)(a) instructs that the appropriate indicator of impact is not emissions or concentrations, but public health and welfare impacts," *id.* at 59039. Nonetheless, the Agency irrationally selects proportional global temperature and sea level rise changes as its exclusive metrics for evaluating futility. *See id.* Both are metrics of physical climate change and do not directly represent health or welfare impacts. As EPA concedes in the Supplemental Proposal, these metrics are not themselves, and do not translate directly to, adverse health and welfare impacts and are merely "a proxy for public health and welfare impacts." *Id.* Thus, while global average surface temperatures and sea level rise are certainly relevant to climate change and may be reasonably considered in evaluating whether greenhouse gas pollution endangers health and welfare, they are only intermediate metrics. EPA acted irrationally by considering *only* these intermediate metrics and by not considering the ultimate health and welfare impacts resulting from projected temperature and sea level increases, as well as other pathways by which emissions harm health and welfare.[287]

EPA's argument for why relying on global temperature and sea level rise is superior to other impacts is conclusory and unsupported. The Agency claims that other physical impacts – such as more frequent heat waves and extreme weather events – are "speculative, multi-faceted, and multi-causal." 91 Fed. Reg. at 59036. But there is a strong scientific consensus that extreme weather events, such as hurricanes, floods, and heat waves, are becoming more frequent and intense due to climate change; and relatedly, increasing atmospheric CO_2 concentrations are also aggravating ocean acidification. *See* Appendix D. These metrics are more direct measures of public health and welfare impacts than the intermediate metrics of average global temperature or sea level increases. That is, the American people and economy palpably and directly experience a hurricane hitting the Gulf Coast, a 100-year flood in Texas, a heat wave in the Pacific northwest, and a degradation of coral reefs and fisheries off the coast of Florida. From such events, it is possible to project health and welfare impacts, such as loss of life, injuries and illnesses, and property losses, along with the estimated dollar value of such harms. As such, it is EPA's chosen metrics – global temperature and sea level rise – that are poorly suited to measuring whether damages are trivial. EPA's cursory explanation for relying exclusively on global temperature and sea level rise in lieu of other physical, human health, and welfare factors in evaluating potential regulatory futility is arbitrary and unjustifiable.

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[287] As our comments separately explain, this choice is doubly irrational given its divergence from the Agency's historical practice concerning metrics for evaluating the costs of greenhouse gas emissions and associated harms. *See infra* Comment X.C.

There are proven, available methodologies for assessing the health and welfare damages associated with power-plant emissions instead of solely relying on global temperature and sea level rise. EPA's failure to use those methodologies is arbitrary and capricious. The U.S. government, including EPA, has long relied on robust analytic tools to translate the U.S power sector's raw emission figures into estimates that reflect monetary damages, lost human lives, and other impacts to U.S. health and welfare. Since at least 2010, federal agencies including EPA have used estimates of the social cost of carbon dioxide (SC-CO2), later expanded to include methane and nitrous oxide as the social cost of greenhouse gases (SC-GHG), for exactly this purpose. *See* 91 Fed. Reg. at 59041 & nn.223, 225 (citing 75 Fed. Reg. 25324 (May 7, 2010); 80 Fed. Reg. 62662, 64920-30 (Oct. 23, 2015)). The SC-GHG puts a dollar value on the damages caused by emitting one additional metric ton of a greenhouse gas, "including changes in net agricultural productivity, human health effects, property damage from increased flood risk, changes in the frequency and severity of natural disasters, disruption of energy systems, risk of conflict, environmental migration, and the value of ecosystem services."[288] EPA's SC-GHG values are the average of results from three independently developed damage modules: (1) the Greenhouse Gas Impact Value Estimator (GIVE), developed by Resources for the Future and academic collaborators ("a country-scale, sectoral damage function"); (2) the Climate Impact Lab's Data-driven Spatial Climate Impact Model (DSCIM) ("a subnational-scale, sectoral damage function"); and (3) a global damage function derived from a meta-analysis of the economic literature.[289] Separately, EPA has also developed the Framework for Evaluating Damages and Impacts (FrEDI), a tool that allows EPA to estimate climate damages within the United States by translating the projected trajectory of global temperature change into impacts in the contiguous United States by sector, State, and region.[290] FrEDI estimates impacts including, among other things, heat- and air quality-related mortality, lost labor productivity, coastal property damage, and damage to roads, rail, and other infrastructure.[291]

Despite having this array of peer-reviewed tools built to analyze the health and welfare impacts of power-plant greenhouse gas emissions – tools EPA itself has developed and/or previously utilized – the Agency arbitrarily and unjustifiably fails to incorporate them into the Supplemental Proposal, instead relying only on two physical indicators – global temperature and sea level rise – disconnected from any actual assessment of impacts. EPA concedes that global temperature and sea level rise figures are proxies and that "the proper focus is not on the emissions themselves, but on the possible dangers to public health or welfare," 91 Fed. Reg. at 59035, 59039, 59041. Yet EPA's futility analysis never reaches health or welfare at all. EPA suggests that the global temperature and sea level rise figures "cannot be assumed to translate with precision directly to specific adverse health or welfare impacts," 91 Fed. Reg. at 59039,

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[288] EPA, *Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances* 1 (Nov. 2023), https://perma.cc/8XBU-CLW4.

[289] *Id.* at 2.

[290] EPA, *Technical Documentation for the Framework for Evaluating Damages and Impacts (FrEDI)*, EPA 430-R-24-001, ES-1, 2 (Aug. 2024), ttps://perma.cc/DS48-8C5L.

[291] *Id.* at 9-11 tbl.1.

entirely ignoring the SC-GHG and FrEDI frameworks that have been designed and historically used to translate emissions or temperature trajectories through to monetized and physical health and welfare outcomes and which account for just such ranges and uncertainties.[292] EPA offers no scientific or methodological critique of GIVE, DSCIM, FrEDI, or its own 2023 report on SC-GHG. And the Agency gives no reasoned justification for ignoring these established, peer-reviewed tools and therefore failing to provide any actual health and welfare damages valuation.

Moreover, EPA's sole reliance on measures of *average* global change in temperature or sea level is arbitrary because such impacts do not occur uniformly throughout the globe. As we detail in Appendix B, annual global mean temperatures and annual global mean sea level rise do not account for national and regional variations that impact the United States, where both metrics are in many cases much higher than global averages. The continental United States has warmed 60% faster than the global average since 1970.[293] And many U.S. regions have warmed even faster, with arctic Alaska warming at nearly three times the global average rate,[294] and Northeastern states such as Maine, New Jersey, and Rhode Island warming at nearly twice the global average.[295] Thus, EPA's projected global temperature impacts would likely be associated with greater impacts in those regions of the United States.

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[292] Here and elsewhere, *see, e.g.*, Off. of Mgmt. & Budget, Memorandum M-25-27, *Guidance Implementing Section 6 of Executive Order 14154, Entitled "Unleashing American Energy"* (May 5, 2025), https://www.whitehouse.gov/wp-content/uploads/2025/02/M-25-27-Guidance-Implementing-Section-6-of-Executive-Order-14154-Entitled-Unleashing-American-Energy.pdf, EPA and the White House have objected that uncertainties or a lack of "precision" in translating emissions to damages excuses the Agency ignoring this key value. But EPA's failure to estimate the damages *at all*, when rigorous, peer-reviewed tools exist and have been previously used, is insufficient. Moreover, research suggests that any uncertainty in SC-GHG estimates indicates higher – not lower – health and welfare costs. *See, e.g.*, Peter Howard et al., Inst. For Pol'y Integrity, *Zero Rationality: What OIRA's New Memorandum Gets Wrong on Monetizing Climate Impacts* 4-5 (May 2025), https://policyintegrity.org/files/publications/ZeroRationality_IssueBrief_2025.05.13.pdf.

[293] *See* Kate Marvel et al., *Climate Trends*, *in* Fifth National Climate Assessment 2-4 (Allison R. Crimmins et al eds., U.S. Glob. Change Rsch. Prog. 2023), https://toolkit.climate.gov/sites/default/files/2025-07/NCA5_Ch2_Climate-Trends.pdf.

[294] Appendix B at 2; T.J. Ballinger et al., NOAA, *Arctic Report Card 2025: Surface Air Temperature* 1 (Nov. 18, 2025), https://arctic.noaa.gov/report-card/report-card-2025/surface-air-temperature-2025/; M.L. Druckenmiller et al., NOAA, *Arctic Report Card 2025: Executive Summary* (Dec. 23, 2025), https://doi.org/10.25923/NRZF-J897.

[295] *See* Appendix B at 8-9 (collecting authorities); *see also* Env't L. & Pol'y Ctr., *An Assessment of the Impacts of Climate Change on the Great Lakes* 10 (2019), https://elpc.org/wp-content/uploads/2020/04/2019-ELPCPublication-Great-Lakes-Climate-Change-Report.pdf ("In the Great Lakes region, the U.S. states bordering the Great Lakes have seen an overall increase in annually averaged temperature of 1.4°F for the period 1985-2016 relative to 1901-1960, with the largest changes at the higher latitudes… For the extent of the Great Lakes Basin…, the

Similarly, regions of the United States are experiencing far greater sea level rise than the global average. Continental U.S. sea level rise has significantly exceeded global average sea level rise over the past century. *See* Appendix B at 4 (explaining that "the U.S. coastline is experiencing rates of change that diverge sharply from the global mean"); Appendix B at 5 (noting study measuring relative sea level rise along the U.S. coast at over 4.3 millimeters per year in 2024, compared to a global average of about 3.1 millimeters per year for recent decades). According to the National Academies of Sciences, along the continental United States, regional relative sea level "rose on average by approximately 11 inches" since 1900, with about half of that amount in the last three decades,[296] compared to global mean sea level rise of about 7 inches since 1900.[297] Certain U.S. cities, particularly along the East and Gulf Coasts, are experiencing even more rapid sea level rise. *See* Appendix B at 5. For example, Grand Isle, Louisiana, is currently experiencing a rise rate of 7.72 mm/year, while Rockport, Texas faces a rate of 6.71 mm/year – more than double the global mean of approximately 3.1 mm/year.[298] As with temperature, EPA's projected sea level rise impacts would likely be associated with greater impacts in these and other parts of the United States.

As Appendix B further details, there are also limitations when averaging temperature and sea level rise over temporal scales to assess U.S. risk. "[G]lobal annually-averaged temperatures mask true risks to people's health and well-being because they fail to take into account climate-driven temperature extremes such as heatwaves, which are increasing in frequency and duration and are a known driver of climate-related morbidity and mortality." *See* Appendix B at 1, 9-12. For example, the annual number of U.S. heatwaves has doubled since the 1980s and the heatwave season has increased threefold in length since the 1960s, with these heatwaves driving a substantial increase in deaths among older U.S. adults each year. Appendix B at 9. Between 2000 and 2018, 8,307 observed heatwaves in the contiguous United States were associated with an estimated 17,603 excess deaths. *Id.*

Additionally, "the relationship between temperature and sea level is not static over space or time," with the rate of sea level rise doubling over the past 30 years, and "[t]he impact of sea-

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temperature change is 1.6°F over this time period. These trends are higher than the overall change of 1.2°F over the contiguous United States (and found globally) for the trends over these time periods.").

[296] Nat'l Acad. of Sci., Engineering, & Med., *Effects of Human-Caused Greenhouse Gas Emissions on U.S. Climate, Health, and Welfare* 22-23 (2025), https://doi.org/10.17226/29239 [hereinafter NASEM 2025 Climate Report].

[297] NASEM 2025 Climate Report, *supra*, at 22.

[298] *See* Appendix B at 5; John D. Boon et al., *Anthropocene Sea Level Change: A History of Recent Trends Observed in the U.S. East, Gulf, and West Coast Regions*, Va. Inst. of Marine Sci., Applied Marine Sci. and Ocean Eng'g, Spec. Rep. No. 467, at IV-2 (2018), https://scholarworks.wm.edu/entities/publication/fc099785-8ecc-47ec-9818-835ea9c8f19e; William V. Sweet et al., NOAA, *Global and regional sea level rise scenarios for the United States: Technical Report NOS.01*, at 7 (Feb. 2022), https://earth.gov/sealevel/us/resources/2022-sea-level-rise-technical-report/; *see also* Appendix B at 5.

level rise on flooding is often exponential, not linear," with "a small increase in the baseline sea level dramatically increas[ing] the frequency of high-tide flooding." *Id.* at 10, 13.

Finally, "overlapping climate impacts, such as heat, drought and wildfire, or storm surge from intensified tropical storms riding on higher sea levels, can lead to compounding and cascading impacts that magnify risks to people's health and welfare – interactions that are often obscured by solely focusing on mean global surface temperature and sea level values." *See* Appendix B at 1, 3, 19. Reliance on average temperature and sea level rise "fails to capture the intensification of local extreme weather events – hurricanes, droughts, and floods – which serve as the primary vectors for health impacts and economic disruption from climate change." Appendix B at 2-3 (collecting sources). Even accepting the basic premise of EPA's futility framework, it would still be arbitrary to withdraw regulatory authority or repeal findings and standards based on allegedly *de minimis* impacts on global averages when, as Appendix B clearly presents, American cities and States would suffer greater and meaningful harms.

2. EPA arbitrarily selected 2026 as the baseline year for its impacts modeling, neglecting decades of massive power-plant pollution.

EPA also erred by arbitrarily selecting 2026 as the baseline year for its impacts modeling and 2025 as the baseline year for its emissions modeling. The selection of 2026 as the baseline year for evaluating impacts is inconsistent with EPA's claim that the Agency lacks *any* statutory authority to regulate greenhouse gases from power plants. EPA is not using this analysis to support a finding that prospective regulation is no longer appropriate. Rather, the Agency is asserting that *any* past, present, or future power-plant greenhouse gas emission standards are futile, that Section 111 therefore provides no statutory authority to regulate greenhouse gases at all, and consequently, that EPA must repeal the entire program. But EPA cannot demonstrate that any and all power-plant greenhouse gas emission standards under Section 111 are necessarily futile based only on modeling of the prospective impacts of regulating CO_2 emissions today, beginning in 2026. Rather, even if futility were somehow a legitimate basis for withdrawing the Agency's statutory authority – and EPA fails to show that it is, as explained below – the Agency would have to show that greenhouse gas regulation was futile *ab initio*, including such circumstances as existed at the time Congress conferred the authority, and at least as of the time that EPA listed fossil fuel-fired turbines and steam generators in power plants as sources subject to regulation under Section 111, and it necessarily will remain futile under all circumstances. In other words, to use futility as a basis for disclaiming all statutory authority to regulate greenhouse gases, EPA would have to show that regulation *always* was and will be futile – not merely starting in year 2026. *Cf. United States v. Salerno*, 481 U.S. 739, 745 (1987) (in a facial challenge to a statute, "the challenger must establish that no set of circumstances exists under which the Act would be valid"). But EPA has not done so, or even purported to do so, instead selecting 2026 as its sole analytical baseline year, without analyzing any other scenarios with different baselines.

In particular, the 2026 baseline year EPA selected arbitrarily ignores the fact that for decades, fossil fuel-fired power plants emitted more dangerous climate-warming pollution than

any other U.S. sector.[299] Those past emissions will remain in the atmosphere for centuries, compounding health and welfare harms in the United States today and in the future.[300] Excluding those years from analysis inappropriately neglects the harm from those emissions and deflates EPA's calculation of power-plant emissions materiality. This is a result of EPA's chosen methodology: EPA proposes to evaluate the materiality of power-plant greenhouse-gas emissions by calculating the change in total global effects over a specific time period, and determining what proportion of that change is attributable to U.S. power plants. Historically, global annual CO_2 emissions were lower overall, and U.S. power plant CO_2 emissions were higher, compared to today. Both of those factors (lower global emissions and higher emissions attributable to U.S. power plants) would increase EPA's calculation of power-plant climate effects. By cutting out of the analysis many years where U.S. power plants emitted a much higher percentage of global emissions, EPA's cumulative impact calculation is lower than it should be to accurately capture whether the source category is a meaningful contributor to climate change.

Moreover, unlike the uncertainties inherent in forecasting future emissions, it would be relatively simple for EPA to consider accurate historical data on global and U.S. power-plant CO_2 emissions prior to 2025. (We illustrate this through alternative scenarios in our own modeling, presented below). Looking back in time to historical data is an equally good, if not superior, exercise to future emissions forecasting, particularly given the Agency's methodology of assessing the source category's relative impact against several absolute-value *de minimis* metrics and making a one-time determination of futility for all time.

3. EPA arbitrarily selected 2050 and 2100 as final years for its modeling, obscuring the full climate change harms caused by U.S. power-sector greenhouse gases, which persist long after 2100.

The futility analysis is also flawed because EPA arbitrarily selected two endpoints, 2050 and 2100, for its modeling of U.S. power-plant CO_2 emissions and their impacts on global temperature and sea level rise as a proportion of global anthropogenic greenhouse gas impacts. *See* 91 Fed. Reg. at 59037. The Agency's choice to analyze only these two points in time is arbitrary because they significantly undervalue the increasing and long-term adverse harms of climate pollution from U.S. power plants in two critical ways.

First, EPA anticipates the proportional contribution of U.S. power plants to global emissions will increase over time. EPA's own modeling shows that if the Agency stops controlling U.S. power-plant greenhouse gas emissions, the proportional contribution of those emissions to annual global totals will more than double over time, from approximately 4% of 2026 global emissions to 9% of 2100 emissions. *See* 91 Fed. Reg. at 59038, tbl.1. Contrary to what EPA has claimed about U.S. power plants being such a small slice of the total emissions pie

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[299] *See* EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2022 tbl. 2-10 (2024), https://perma.cc/Z3UP-EL56. .

[300] *See* Hoesung Lee et al., Intergovernmental Panel on Climate Change, *Summary for Policymakers, in Climate Change 2023: Synthesis Report* 12, 16-17 (H. Lee et al. eds. 2023), https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_SPM.pdf.

that they are not worthwhile to control, eliminating regulation is expected to *increase* the slice of the pie attributable to U.S. power plants, even as other nations and sectors reduce their emissions. Moreover, 9% of global CO_2 emissions is by any account a significant portion of an air pollution problem – even without considering its global nature. Petitioners are not aware of, and EPA does not reference, any Agency precedent for determining that regulation of a category of air pollutant emissions that amounts to 9% of the total air pollution problem would have *de minimis* effects. To appropriately account this effect, EPA should have modeled both power-plant emissions and the temperature and sea level rise impacts of those emissions beyond 2100.

Second, EPA's failure to consider impacts after 2100 also ignores the long-lasting and cumulative impacts of greenhouse gas emissions, which accumulate in the atmosphere and continue to affect the physical climate for centuries and even millennia after their release. The warming effect of a ton of greenhouse gases emitted into the atmosphere today persists over very long timeframes. Significant portions of emitted CO_2 remain in the atmosphere for centuries and even millennia, generating a persistent physical climate response. While other greenhouse gases have different atmospheric lifetimes,[301] all result in climate responses that persist far beyond the year they are emitted. And U.S. power plants produce emissions year after year, with annual emissions largely stacking on top of one another as they accumulate, similar to water that continues to be added into a bathtub slower than it drains. By modeling only impacts through 2100, EPA arbitrarily ignores the persistent and cumulative impacts of U.S. power-plant greenhouse gases on climate change that last beyond 2100.

EPA's truncated modeling time-period contrasts sharply with how the Agency assesses the harm done by ozone-depleting chemicals and the benefits of curbing those chemicals. In 2020, EPA assessed those harms and benefits over a substantially longer time period in the context of stratospheric ozone protection. EPA's Atmospheric and Health Effects Framework Model (in use since the 1980s) "estimates the number of skin cancer and cataract cases and deaths from skin cancer in the United States that will be prevented by protecting the ozone layer" for people born in the U.S. from 1890 through 2100.[302] Persons born in 2100 may have a life expectancy of some 75 years (if not longer), meaning that the time-period for this EPA modeling should extend to at least 2175, encompassing most of the 22nd century. EPA has not provided any basis for adopting a more truncated period for analysis in this rulemaking.

The above errors compound each other. Setting a cut-off date of 2100 for the modeling of both emissions and impacts underweights the impact of latter years of higher proportional emissions (*e.g.*, the percentage of global CO_2 emissions in 2100 and later), and setting a cut-off date of 2100 for the modeling of impacts underweights the long-lasting and cumulative harms of greenhouse gas emissions emitted in 2026–2100 long beyond 2100. Both obscure the full impacts of power-plant greenhouse gases on climate change. Extending the modeling periods for both emissions modeling and impacts modeling would more fully capture the effects of U.S.

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[301] *See* NASA, *Major Greenhouse Gas Sources, Lifespans, and Possible Added Heat* (June 22, 2023), https://perma.cc/724Q-AAKG.

[302] EPA, *Updating the Atmospheric and Health Effects Framework Model: Stratospheric Ozone Protection and Health Benefits* (May 2020), at 1, https://perma.cc/Z97D-APEQ).

power-plant greenhouse gas emissions on global climate change concerns. EPA acted arbitrarily in cherry-picking the 2050 and 2100 endpoints without adequate explanation. And as we quantitatively demonstrate through our own modeling (results presented below), the selection of different endpoints leads to significantly different conclusions.

4. EPA irrationally assumed a single power-sector scenario, including an assumption of flat emissions from U.S. power plants after 2050.

An additional flaw in the futility analysis is that EPA modeled a single power-sector scenario in which it made one forecast of 2025–2050 emissions and then assumed CO_2 emissions from U.S. power plants would remain flat from 2050 to 2100.[303] *See* Temperature Memo at 6. EPA provides no explanation for this arbitrary assumption of flat emissions beyond a single sentence claiming there is "[an] absence of … information about electricity supply and demand between 2050 and 2100." *Id.* EPA's choice to rely on a single power-sector scenario with flat emissions for its futility analysis is irrational, unexplained, and unjustifiable. There is a real possibility that load will grow over time, and that emissions-free energy deployment will not offset 100% of that load growth, especially in the absence of federal greenhouse gas standards. This modeling choice inappropriately hinged the Agency's consequential determination regarding the scope of its regulatory authority on a future power sector projected with arbitrary assumptions; and by only modeling one scenario, EPA did not consider how sensitive its futility determination is to that foundational assumption – *i.e.*, the extent to which the incorrect assumption dictates the outcome of EPA's analysis.[304]

First, EPA's decision to hold U.S. power-plant emissions constant from 2050 to 2100 is inadequately explained. It is not even clear to the public what exactly EPA assumed. EPA's one-sentence explanation in the Temperature Memo accompanying the Supplemental Proposal states only that "CO2 emissions for U.S. EGUs are held constant between [2050 and 2100] at 2050 levels." Temperature Memo at 6. EPA does not explain whether emissions are "held constant" in the model because the Agency assumes that demand will remain exactly the same and all of the same sources will continue to operate over those decades at exactly the same levels as in 2050 (a far-fetched supposition), or something else. Indeed, EPA does not explain what it projected about the power-plant fleet mix over this period at all, nor explicitly notes any emission rate (*i.e.*, tons

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[303] EPA modeled both a 100% power-plant emissions scenario and an "illustrative" 50% power-plant emissions scenario, but EPA did not alter or expand its set of assumptions about the power sector across those scenarios. EPA considered only a single set of assumptions about the power sector across its modeling.

[304] In addition, EPA's novel "composite forecast [for 2025–2050 emissions] developed specifically for this analysis" is inadequately explained. 91 Fed. Reg. at 59036. EPA briefly notes that its bespoke forecast diverges in unspecified ways from the U.S. Energy Information Administration's (EIA) *Annual Energy Outlook 2025*, allegedly in order to account for subsequent legislative changes to the Inflation Reduction Act – though that justification is implausible. *See* Temperature Memo at 6; Appendix A at 1. EPA does not describe what it did with sufficient detail to enable the public to meaningfully understand or critique how EPA manipulated the EIA's 2025 forecast.

of CO_2 per megawatt-hour of electricity produced) it ascribed to generation from that fleet; we do not know what EPA assumed about clean generation growth versus emissions-intensive generation growth, or existing plant retirements, or why; and we do not have any insight into what underlying assumptions EPA might have made about supply and demand over that period. Because this critical modeling choice is unexplained, the public is limited in its capacity to understand EPA's analysis at a basic level or to engage meaningfully with it.

Regardless of what exactly EPA assumed and why, EPA is wrong that "[an] absence of … information about electricity supply and demand between 2050 and 2100" justifies EPA's choice to assume a single scenario of *no* change. Temperature Memo at 6. EPA is implicitly projecting either that there will be no change in supply and demand between 2050 and 2100, or that any additional demand will be offset entirely by deployment of emissions-free energy sources. Either is plainly irrational as the Agency's only considered scenario. EPA's own most recent "Reference Case" forecast and other expert forecasts show there is a reasonable possibility that load will grow after 2050, and that generation growth going forward will not be offset completely by clean, emissions-free energy deployment[305] – especially in the absence of federal emissions standards.[306]

Uncertainty is inherent in supply and demand forecasting; there is no crystal ball. That is why forecasters – including independent power-sector experts, power companies and utilities, regional transmission organizations, state regulators, and federal agencies – routinely consider a range of differing assumptions about load growth, clean energy uptake, and power-sector emission rates in their long-term power-sector forecasts.[307] Indeed, it is standard practice in

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[305] *See, e.g.*, EPA, *Updates in the EPA 2025 Reference Case* 2 & tbl.3-2 (2025), https://perma.cc/4B6X-2PPB (projecting increasing total electric load through 2055, reflecting *inter alia* "higher levels of data center demand); Nico Bauer et al., *Shared Socio-Economic Pathways of the Energy Sector – Quantifying the Narratives*, 42 Global Env't Change 316 (2017), https://www.sciencedirect.com/science/article/pii/S0959378016301224 (forecasting supply growth through 2100 in four out of five modeled scenarios, including multiple scenarios that project energy per capita consumption increases in developed countries); Hannah Kolus et al., Rhodium Group, *Taking Stock 2026: US Energy and Emissions Outlook* 15 (2026), https://rhg.com/research/taking-stock-2026/ (forecasting power sector emissions through 2050, concluding that "[t]echnology costs and natural gas prices influence retirement decisions" after 2030 and drive emissions outcomes in the power sector).

[306] U.S. Energy Info. Admin., *Annual Energy Outlook 2026*, Narrative at 30 (2026), https://www.eia.gov/outlooks/aeo/ (energy-related CO_2 emissions largely depend on changes to technology costs, including the relative cost of natural gas, and policy assumptions, such as the extent to which the U.S. regulates power-plant CO_2 emissions).

[307] *See, e.g.*, U.S. Energy Info. Admin., *Annual Energy Outlook 2026* (2026), https://www.eia.gov/outlooks/aeo/; Pieter Gagnon et al, Nat'l Renewable Energy Lab'y, *2024 Standard Scenarios Report: A U.S. Electricity Sector Outlook* (2024), https://docs.nlr.gov/docs/fy25osti/92256.pdf (forecasting multiple scenarios of electricity

sophisticated models to consider the sensitivity of the forecast to key factors that could influence supply and demand. Contrary to EPA's claim, there is ample "information" available to guide EPA in modeling a reasonable range of projections for its long-term analysis in the face of uncertainty about supply and demand. In fact, EPA already knows well how to do this. In modeling the impacts of the existing carbon pollution standards in 2024, for instance, EPA considered a range of cases to evaluate "lower natural gas prices, higher electricity demand and also higher electricity demand coupled with EPA's additional Power Sector Rules."[308]

In particular, EPA's futility analysis should have accounted for the real possibility that U.S. electricity generation and load will increase in 2050–2100 due to factors such as increasing electrification (*e.g.*, electric vehicle charging, heat pumps, electric water heaters), development and operation of data centers (driven by the expansion of artificial intelligence and cryptocurrency), other industrial facilities, economic growth, and higher temperatures and more extreme weather events. Electrification, extreme weather, and data center development are already driving load increases and – combined with higher natural gas prices and slowed coal retirements – driving recent power-sector emissions increases.[309] For instance, Rhodium Group recently reported that "[t]he pace of demand growth in the 2020s so far is more than double the recent historical rate" and "projected increases in demand mark … a return to the higher growth rates that characterized the late 1900s."[310] Rhodium projects "substantial increases in power demand from data centers … more than tripling in 2040 relative to 2025 levels," and notes that projected "growth rates are particularly sensitive to assumptions around … data centers."[311] FERC's most recent *State of the Market* report also documents load growth over recent years across regions, and reports that regional grid operators are projecting compound annual growth rates up to nearly 4%, "represent[ing] a large upward shift in expectations from" even just a few years ago.[312] Yet, the record reflects no consideration of this evidence by EPA after 2050. EPA also apparently and unreasonably failed to consult with other expert bodies regarding what

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demand growth and changes to fuel prices, technology costs, resource availability, and the policy environment); Kolus et al., *supra.*

[308] *See* EPA, *Regulatory Impact Analysis for the Final New Source Performance Standards for Greenhouse Gas Emissions from New, Modified, and Reconstructed Fossil Fuel-Fired Electric Generating Units; Emission Guidelines for Greenhouse Gas Emissions from Existing Fossil Fuel-Fired Electric Generating Units; and Repeal of the Affordable Clean Energy Rule* 3-41 (2024), Docket ID: EPA-HQ-OAR-2023-0072-8913, https://perma.cc/4JN8-R6QS.

[309] *See, e.g.*, Michael Gaffney & Ben King, Rhodium Grp., *Preliminary US Greenhouse Gas Emissions Estimates for 2025* (2026), https://rhg.com/research/us-greenhouse-gas-emissions-2025/; Federal Energy Regulatory Comm'n, *2025 State of the Markets* 7 (2026), https://www.ferc.gov/sites/default/files/2026-03/26_State-of-the-Market_0324_1430.pdf.

[310] Kolus et al., *supra*, at 13; *see also id.* at 14, fig. 4 (data centers, transportation, and industrial users largely account for demand growth through 2040).

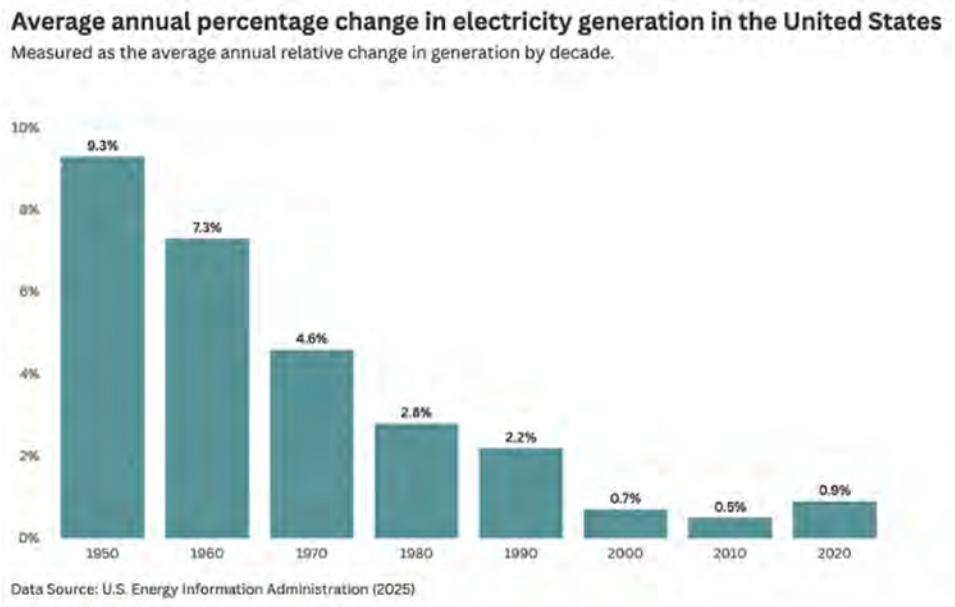
[311] Kolus et al., *supra*, at 13.

[312] FERC, *2025 State of the Markets, supra*, at 4-5.

would constitute a reasonable set of assumptions for U.S. electricity supply and demand from 2050–2100.

EPA's choice to consider a single flat-emissions scenario is also irrational when viewed against the history of the U.S. power sector, which has experienced varying generation growth rates and emission rates over time. Electricity demand growth rates have varied over the past several decades but have always been positive (and sometimes large, in terms of added terawatt-hours per year).[313] Generation growth rates for the U.S. power sector have varied year to year; but since at least the 1950s, generation has grown on average over each subsequent decade, as shown in the Figure below. In the 1950s and 1960s, annual electricity generation grew at rates of more than 5% most years, sometimes exceeding 10% growth.[314] Throughout the 1970s and 1980s, growth rates ranged from 3% to 4% most years.[315]

Figure 1[316]



Power-plant CO_2 emissions have also varied over time, including periods of marked increase. For instance, U.S. power-sector CO_2 emissions increased from 1990 through 2007 and

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[313] Kolus et al., *supra*, at 13, fig. 3.

[314] *See* Hannah Ritchie, *How unprecedented is power demand growth in the United States?*, By the Numbers (Oct. 20, 2025), https://hannahritchie.substack.com/p/usa-electricity-growth (analyzing 2025 EIA data).

[315] *See* Ritchie, *supra* (analyzing 2025 EIA data).

[316] Ritchie, *supra.*

from 2024 to 2025.[317] Power-plant CO_2 emissions were 14% higher in 2000 compared to 1995.[318] As Rhodium Group notes, power-sector emissions projections "are primarily determined by the composition of capacity additions that fill in behind retiring coal or deploy to meet increasing demand," and Rhodium Group forecasts that new fossil fuel-fired generation will continue to be added to the grid over the coming decades.[319] Even EPA's own projections of 2026–2050 U.S. power-plant emissions in its futility analysis in this Supplemental Proposal, which are roughly based on *Annual Energy Outlook 2025* generation projections, show annual emissions that are projected to vary over time, with periods of power-plant emissions growth. *See* Temperature Memo at 6. In comparison, the lack of any citation to support the Agency's choice to hold emissions constant over five decades in 2050–2100 speaks for itself: there is no rational basis for this choice. We certainly are not aware of any other example of a credible long-term power-sector forecast that simply assumes flat emissions and/or growth in the face of uncertainty. EPA instead should have considered and explained how documented growth trends, as well as expert projections, intersect with its analysis, and it should have accounted for factors that reasonably could influence growth by analyzing a range of scenarios.

In sum, EPA could have dampened the impact of its arbitrary zero-growth assumption for 2050–2100 by modeling multiple scenarios with varying assumptions. (We provide the results of our own modeling of such illustrative scenarios below.) EPA did not do so. EPA's failure to consider or even acknowledge that it could have considered a range of scenarios here, particularly given the Agency's acknowledgement of significant uncertainty about long-term trends, renders its Supplemental Proposal both arbitrary and capricious and inadequately explained.

At base, as the Agency proposes that the scope of its statutory authority turns on the results of a modeling exercise, the Agency at the very least needs to proffer a reasonably credible modeling exercise that adheres to the standard practices routinely used in power-plant emissions forecasting, including practices of the Agency itself in its own previous power-sector rulemakings. This futility analysis, which evaluates a single (and questionable) scenario, falls far short of that bare minimum.

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[317] *See* EPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2022*, at 2-17 fig. 2-8 (2024), https://perma.cc/Z3UP-EL56; Gaffney & King, *supra*, at 4 (estimating that "a 2.4% increase in total electricity generation and a 13% increase in coal generation relative to 2024 pushed emissions from electricity generation up by 55 MMT (3.8%)" in 2025); U.S. Energy Info. Admin., *U.S. Energy-Related Carbon Dioxide Emissions* tbl. 1 (2025), https://perma.cc/MA9Q-NRL6 (estimating that power-plant CO_2 emissions increased by 5 MMT in 2024 (0.4%) and 58 MMT in 2025 (4%)).

[318] EPA, *Power Sector Evolution* (June 10, 2026), https://perma.cc/PV9X-3ZYU.

[319] Kolus et al., *supra*, at 15 & fig. 5.

5. Our additional modeling demonstrates the severity of EPA's methodological flaws and the sensitivity of EPA's findings to those errors.

To illustrate the severity of the errors infecting EPA's futility analysis and how different methodological choices significantly affect EPA's outputs, findings, and rationale, we modeled our own additional scenarios. Our modeling shows significantly higher global temperature and sea level rise impacts attributable to U.S. power-plant CO_2 emissions compared to EPA's modeling. Below, we summarize the methodology for the different emissions inputs and analytical timeframes in each of the five emissions scenarios we modeled. We then present the results for U.S. power-plant emissions of CO_2, and the contribution of U.S. power plants to changes in atmospheric CO_2 concentrations, global temperature, and global sea level rise over longer time periods than EPA considered. A more detailed description of our methodology and results is in Appendix A.

In sum, our modeling shows that EPA's futility modeling is flawed, inappropriately constrained, and arbitrary, and that consequently, the Supplemental Proposal's entire futility rationale is arbitrary and capricious and cannot provide a rational basis for any finalization of the proposed repeals and rescissions, or any other agency action.

a. Modeling methodology.

Our modeling methodology is described in detail in Appendix A. In summary, besides the differences summarized below, the initial steps of our modeling generally followed EPA's methodology, including in the selection of the SSP2-4.5 baseline global emissions scenario, and the use of the same models as EPA used: the Finite amplitude Impulse Response climate emulator model (FaIR) (v2.2.3) and the Building Blocks for Relevant Ice and Climate Knowledge model (BRICK) (v1.0.1). We modeled six emissions scenarios:

- **Scenario A**: using data in EPA's record, we reproduced EPA's base case, including EPA's U.S. power-sector CO_2 emissions inputs from 2025 through 2100.

- **Scenario A-50%**: identical to Scenario A, except that we reduced annual emissions in each year by 50%.

- **Scenario B**: this case includes historical actual power-sector CO_2 emissions from 1977–2024 in addition to EPA's inputs for CO_2 emissions from the U.S. power sector from 2025–2050, and we project emissions from 2050–2125 assuming that electricity demand continues to grow at the previous five years' compound average rate, and that the emissions rate per megawatt-hour remained constant.

- **Scenario B-50%**: identical to Scenario B, except that we reduced annual emissions in each year by 50%.

- **Scenario C**: this case starts from historical actual power-sector CO_2 emissions in 1977, grows emissions forward using the emissions rate for electricity generation in the United States in 1977 (1,495 lbs per megawatt-hour) multiplied by historical net generation in 1977–2025, then the same emissions rate multiplied by projected net generation for 2026–2050 from EIA's *Annual Energy Outlook 2026*, and the same emission factor

multiplied by projected generation growth from 2051–2125 assuming growth at the previous five years' compound average rate (as in Scenario B).

- **Scenario D**: mirrors Scenario A (EPA's base case), but adopts a moderate growth rate for emissions after 2050, equivalent to the previous five years' compound average rate of electricity demand.

Scenarios B and D address EPA's arbitrary choice to examine only scenarios with a 2025 emissions baseline year, a 2100 emissions end point, and an assumption that emissions from U.S. electricity generation will remain flat for five decades. As we explained above, even assuming that this kind of futility analysis is relevant to EPA's authority to issue greenhouse gas standards, EPA would have to show that *any* such standards would be futile, not only a standard commencing in 2025, and not only if emissions from U.S. electricity generation never grow. To illustrate the impact of selecting different assumptions, we chose to evaluate a U.S. power-sector emissions scenario (Scenario B) from a baseline of 1977, when EPA listed fossil fuel-fired combustion turbines, including those used in power plants, in a source category under Section 111(b)(1)(A). *See* 42 Fed. Reg. 53657 (Oct. 3, 1977) (listing "stationary gas turbines"); *see also* 36 Fed. Reg. 5931 (Mar. 31, 1971) (prior listing of "fossil fuel-fired steam generators of more than 250 million Btu per hour heat input"). And to illustrate the impact of selecting different scenarios that does not discount a potential future where electricity demand and emissions grow from 2050 to 2100, we chose to evaluate in Scenarios B and D a growth rate that is equivalent to the CAGR that EIA's *Annual Energy Outlook 2026* projects for U.S. net electricity generation between 2045 and 2050.[320] To illustrate the impact of selecting different scenarios that do not obscure the long range of harms caused by U.S. power-sector CO_2 after 2100, we also used 2125 as an end date for the emissions modeling in Scenarios B and D.

Scenario C illustrates a counterfactual scenario where U.S. power-plant CO_2 emissions *did not* decline over time due to factors other than federal regulation under Section 111. To construct this scenario, we assumed a counterfactual history of a U.S. power fleet whose CO_2 emissions rate (that is, the tons of CO_2 emitted by power plants per megawatt-hour of electricity generated) remained the same over time as it actually was in 1977, when EPA listed stationary turbines as a source category subject to regulation under Section 111. Regardless of whether this scenario would have been considered likely at the time, which we did not evaluate, it certainly would have been one possible future from the perspective of the 1970s-era EPA and the Congress that authorized EPA to regulate power-plant pollution under the Clean Air Act. Like Scenario B, Scenario C also uses an earlier baseline year and later end point for emissions modeling than EPA's futility analysis and assumes some emissions growth after 2050. This scenario illustrates the mutability of EPA's exercise, and how attempting to quantify "futility" at a particular point in time is assumption-dependent and inherently uncertain. Scenario C also illustrates our critique

[320] *See* U.S. Energy Info. Admin., *Annual Energy Outlook 2026*, at tbl.8 (2026), https://www.eia.gov/outlooks/aeo/data/browser/#/?id=8-AEO2026&cases=cb2026&sourcekey=0.

that EPA's futility analysis is inappropriately focused on the effects of prospective regulation versus EPA's statutory authority – past, present, and future.

For each of these scenarios, we produced an emissions estimate (through 2100 for Scenarios A and A-50%, and through 2125 for Scenarios B, B-50%, C, and D) that we used to run FAIR and BRICK to replicate the global temperature and sea level rise benchmarks presented in EPA's analysis. We produced these benchmarks for both 2050 and 2100 (to mirror EPA's modeling end points) and 2125 and 2200. Evaluating temperature and sea level rise impacts in 2125 and 2200 permits a fuller evaluation of the impacts of power-plant greenhouse gases and further illustrates the impacts of the errors described above in EPA's futility analysis.

We then also took an additional modeling step that EPA did not take when the Agency decided to truncate its analysis at the intermediate metrics of global average temperature and sea level rise: we analyzed health and welfare impacts using two well-established damages valuation methodologies: the Framework for Evaluating Damages and Impacts (FrEDI) and EPA's 2023 social cost of greenhouse gases metric (SC-GHG) for Scenarios A, A-50%, B, B-50%, and C. As described above, EPA has a long history of using damages evaluation tools in its regulatory actions, including stationary source standards for greenhouse gas emissions and other types of air pollutants. FrEDI models how climate-warming emissions will impact temperature-related mortality, hurricane wind damage, water quality, agriculture, and other categories of damages at a national level. FrEDI's outputs include monetized damages (in dollars) as well as quantified physical impacts such as the number of premature deaths from with power-plant CO_2 emissions. EPA's 2023 SC-GHG metric translates the impact of additional tons of power-plant CO_2 emissions into dollar values. Additional details regarding our damages modeling are in Appendix A.

b. Modeling results.

Our modeling results illustrate that, even assuming EPA's basic approach, the Agency's analysis is severely flawed and cannot support the Supplemental Proposal.

As explained in detail *infra*, we do not believe that EPA's futility analysis is relevant to whether the Clean Air Act authorizes EPA to regulate power-sector greenhouse gas emissions. We also disagree with EPA's findings that power-plant greenhouse gas emission standards are futile, the methodology EPA used to reach those findings, and EPA's conclusion that retaining power-plant greenhouse gas standards is unreasonable. Our presentation of modeling results does not imply we agree with EPA's legal premises or the methodologies in the Supplemental Proposal. Nor do we mean for our modeling to represent the definitively correct ways to evaluate the futility of U.S. power-sector greenhouse gas regulation. Rather, our modeling demonstrates that – even assuming the basic framework of EPA's modeling approach – the results are highly sensitive to parameters such as the baseline year, the final year of analysis, assumptions about electricity supply and demand and emissions rates, and other parameters. The mutability of the results further highlights the arbitrary nature of EPA's reliance on only one modeling scenario, calculated based on a single set of assumptions, to determine that all power-sector greenhouse gas regulations – past, present, and future – are facially futile. Indeed, our results illustrate the innate absurdity of proposing that a one-scenario modeling exercise conducted today provides

any definitive insight regarding the scope of legal authority that Congress conferred to EPA in Section 111.

Table 1: Change in global CO_2 emissions concentrations (ppm) relative to 2025 for Scenario A, A-50%, and D. Median (% contribution)

	From 2025 Baseline	Scenario A contribution	Scenario A-50% contribution	Scenario D contribution
2050	61	2.92 (4.8%)	1.46 (2.4%)	2.92 (4.8%)
2100	121	7.30 (6.0%)	3.66 (3.0%)	8.74 (7.2%)
2125	119	6.57 (5.5%)*	3.29 (2.8%)*	12.57 (10.6%)

*Because EPA's emission scenario ends in 2100, the percent contribution decreases in 2125 relative to 2100 in our analysis for Scenario A and Scenario A-50%.

Table 2: Change in global CO_2 emissions concentrations (ppm) relative to 1977 for Scenario B, B-50%, and C. Median (% contribution)

	From 1977 Baseline	Scenario B contribution	Scenario B-50% contribution	Scenario C contribution
2025	86	5.85 (6.8%)	2.93 (3.4%)	7.53 (8.8%)
2050	147	8.19 (5.6%)	4.11 (2.8%)	13.24 (9.0%)
2100	207	13.94 (6.7%)	6.99 (3.4%)	30.54 (14.8%)
2125	205	17.66 (8.6%)	8.88 (4.3%)	41.48 (20.3%)

Table 3: Change in Global Mean Surface Temperature (degrees Celsius) relative to 2025 for Scenarios A, A-50%, and D. Median (% contribution)

	From 2025 Baseline	Scenario A contribution	Scenario A-50% contribution	Scenario D contribution
2050	0.54	0.013 (2.4%)	0.007 (1.3%)	0.013 (2.4%)
2100	1.26	0.036 (2.9%)	0.018 (1.4%)	0.042 (3.3%)
2125	1.4	0.036 (2.6%)*	0.018 (1.3%)*	0.062 (4.4%)

*Because EPA's emission scenario ends in 2100, the percent contribution decreases in 2125 relative to 2100 in our analysis for Scenario A and Scenario A-50%.

Table 4: Change in Global Mean Surface Temperature (degrees Celsius) relative to 1977 for Scenarios B, B-50%, and C. Median (% contribution)

	From 1977 Baseline	Scenario B contribution	Scenario B-50% contribution	Scenario C contribution
2025	0.97	0.034 (3.5%)	0.017 (1.8%)	0.042 (4.4%)
2050	1.51	0.046 (3.1%)	0.023 (1.5%)	0.070 (4.7%)
2100	2.23	0.073 (3.3%)	0.037 (1.7%)	0.154 (6.9%)
2125	2.37	0.095 (4.0%)	0.047 (2.0%)	0.217 (9.2%)

Table 5: Change in Global Sea Level Rise (cm) relative to 2025 for Scenarios A, A-50%, and D. Median (% contribution)

	From 2025 Baseline	Scenario A contribution	Scenario A-50% contribution	Scenario D contribution
2050	13	0.08 (0.6%)	0.04 (0.3%)	0.08 (0.6%)
2100	74	1.17 (1.6%)	0.44 (0.6%)	1.26 (1.7%)
2125	117	2.00 (1.7%)	0.83 (0.7%)	2.38 (2.0%)

Table 6: Change in Global Sea Level Rise (cm) relative to 1977 for Scenarios B, B-50%, and C. Median (% contribution)

	From 1977 Baseline	Scenario B contribution	Scenario B-50% contribution	Scenario C contribution
2025	10	0.26 (2.6%)	0.13 (1.3%)	0.30 (3.0%)
2050	23	0.69 (3.0%)	0.34 (1.5%)	0.90 (3.9%)
2100	84	3.92 (4.7%)	1.85 (2.2%)	7.06 (8.4%)
2125	127	5.71 (4.5%)	2.67 (2.1%)	10.88 (8.6%)

Our modeling results demonstrate several things. First, the results quantitatively demonstrate commenters' arguments above: that the projected emissions, temperature impacts, and sea level impacts are highly sensitive to starting assumptions and methodologies. This reinforces the substantive arbitrariness of EPA's determinations. For example, considering

Scenario A, projected global temperature impacts increase from 0.013 degrees Celsius (°C) in 2050 to 0.036°C in 2100, while sea level impacts increase from 0.08 cm in 2050 to 1.17 cm in 2100. The impacts are larger in Scenario D, which assumes a moderate growth rate for emissions after 2050: CO_2 emissions from U.S. power plants elevate temperatures by 0.062°C and sea level by 2.38 cm by 2125. The impacts are even larger in Scenario B, which evaluates emissions dating back to the era when EPA listed power plants as source category subject to regulation: assessed from that baseline, CO_2 emissions from U.S. power plants elevate temperatures by 0.095°C and sea level by 5.71 cm by 2125, or more.

The impacts are larger still in Scenario C, which evaluates a counterfactual history and roughly illustrates a scenario that would have been one possible future from the perspective of EPA and Congress in the 1970s. If a futility analysis were conducted at that point in time instead of today, EPA might have considered the possibility that CO_2 emissions from U.S. power plants could increase temperatures by 0.217°C and sea level by 10.88 cm by 2125, or more.

Second, these impacts are grave. It bears remembering that this represents potential impacts from just *one* portion of *one* sector from *one* country – U.S. fossil fuel-fired power plants – yet, the resulting harms to our global climate are staggering. (Indeed, the fact that U.S. power plant emissions impact *planet-wide* phenomena is indicative of their massive impact. That alone would be a high bar that many federal regulations authorized by Congress would fail to meet.)

Third, as explained above, many American communities will bear far greater impacts than suggested by these global average figures. Global average temperature increases are not distributed evenly across space, with, for example, Arctic Alaska warming at nearly three times the global average rate and some Northeastern states warming at nearly twice the global average. *See* Appendix B at 2, 8-9. A region that warms three times the above-described 0.269°C projection would warm by 0.807°C, or nearly 1.5 degrees Fahrenheit (1.453°F), a palpable difference. The same is true for sea level rise, and some U.S. cities have experienced sea level rise at over twice the global average. *See* Appendix B at 5. Further, even apparently "small" global average temperature increases can yield severe increases in the intensity and frequency of extreme weather, such as hurricanes, droughts, rainfall, heatwaves, wildfires, and floods, with devastating impacts for human health and welfare. And vulnerable populations, such as economically and socially disadvantaged communities and Indigenous or minority populations, are especially vulnerable to climate change.[321]

Finally, we used the projected emissions, global temperature, and sea level impacts associated with modeled emissions scenario to quantify and evaluate the massive health and welfare harms caused by U.S. power-sector CO_2 emissions using various well-established damages-valuable methodologies. As detailed in Appendix A, we project that EPA's estimated level of U.S. power-plant CO_2 emissions will cause approximately $20.4 *trillion* in global

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[321] *See* Comment of Environmental Defense Fund (EDF), et al., at 159-61 (Sept. 22, 2025), EPA-HQ-OAR-2025-0194-3060 (hereinafter "Vehicle Standards Comment"), available at regulations.gov.

climate change damages through 2100.[322] In our Scenario B with a different end point and growth assumptions, calculated damages from 2026–2125 emissions increase to as much as $28.2 trillion by 2125.[323] For context, the entire U.S. economy's Gross Domestic Product in 2024 was $29.3 trillion (in current dollars).[324] Thus, from today through 2125, U.S. power-plant CO_2 emissions conceivably could cause damages to society on par with the annual economic output of the entire United States. Obviously, this is massive harm.[325]

Table 7: Climate costs from U.S. power-sector CO_2 emissions (trillion 2024$), 2% discount rate

	Scenario A	Scenario A-50%	Scenario B	Scenario B-50%	Scenario C*
2050	$9.1	$4.5	$9.1	$4.5	$20.5
2100	$20.4	$10.2	$23.1	$11.6	$62.3
2125	-	-	$28.2	$14.1	$77.4

*These values only include emissions starting in 2026.

As detailed in Appendix A, we also project that EPA's estimated level of U.S. power-plant CO_2 emissions will cause an estimated 101,700 premature deaths in the United States by 2100, and 479,500 premature deaths by 2200. In our Scenario B, projected U.S. premature deaths increase to 1,312,600 by 2200. We further project that EPA's estimated level of U.S. power-plant CO_2 emissions will cause over 100,000 childhood asthma cases, over 22,000 hospital or emergency room visits, and 1.8 million lost school days by 2100. In our Scenario B, projected impacts are even larger: over 364,000 childhood asthma cases, over 72,000 hospital or emergency room visits, and 6.7 million lost school days by 2100. This is staggering public health and welfare harm. As explain further below, any conclusion that such enormous harm to the health and welfare of this nation is *de minimis* is patently arbitrary and capricious and lacks any rational basis.

Table 8: U.S. premature deaths due to U.S. power-sector CO_2 emissions, calculated by FrEDI (thousands)

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[322] As we explain in Appendix A, this calculation is based on Scenario A, EPA's 2023 updated approach to calculating SC-GHG, and a 2% discount rate.

[323] *See* Appendix A. This presents results for Scenario B applying the SC-GHG methodology at a 2% discount rate. Only emissions starting in 2026 were included in the monetization.

[324] World Bank Group, *GDP (current US$) - United States*, https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=US (last accessed Oct. 30, 2026).

[325] These figures do not account for other sources of harm associated with power generation from higher-emitting sources, such as criteria pollutant damages, lost electricity consumer savings, energy security harms, and more.

	Scenario A	Scenario A-50%	Scenario B	Scenario B-50%	Scenario C
2050	7.5	3.7	74.9	37.6	97.1
2100	101.7	50.9	314.4	157.1	548.1
2200	479.5	239.7	1,312.6	664.9	2,801.3

Table 9: U.S. childhood asthma cases due to U.S. power-sector CO_2 emissions, calculated by FrEDI (thousands)

	Scenario A	Scenario A-50%	Scenario B	Scenario B-50%	Scenario C
2050	7.2	3.6	72.2	36.2	93.2
2100	105.7	53.2	364.3	183.1	640.2
2200	607.9	305.2	1811.8	933.7	3841.1

Table 10: U.S. emergency department and hospital visits due to U.S. power-sector CO_2 emissions, calculated by FrEDI (thousands)

	Scenario A	Scenario A-50%	Scenario B	Scenario B-50%	Scenario C
2050	1.5	0.7	14.9	7.4	19.1
2100	22.4	11.2	72.6	36.4	127.1
2200	118.7	59.5	341	174	725.6

Table 11: U.S. lost school days due to U.S. power-sector CO_2 emissions, calculated by FrEDI (millions)

	Scenario A	Scenario A-50%	Scenario B	Scenario B-50%	Scenario C
2050	0.3	0.1	2.4	1.2	3.1
2100	1.8	0.9	6.7	3.4	11.1
2200	10	5.1	29.8	14.9	62.9

B. EPA's determination that regulation would be futile is unreasonable and contrary to the best evidence.

Even if the Agency's methodology were not tainted by numerous critical flaws – which it is, as described in detail above – EPA's proposed determination that regulating power-plant greenhouse gas emissions is futile is nonetheless unreasonable and wrong. This is because EPA's new *de minimis* tests are arbitrary and capricious and contrary to law.

EPA "proposes that the results of [its] modeling demonstrate that even the complete elimination of GHG emissions from the U.S. power sector, and at minimum, any plausible reduction in GHG emissions from the U.S. power sector that could result from application of CAA section 111, would have no more than *de minimis* impacts on the key indicators of adverse

impacts attributed to global climate change." 91 Fed. Reg. at 59006. EPA's determination relies on three *de minimis* comparison metrics against which the Agency compares the modeled impacts of U.S. power-sector emissions: (i) the "range of measurability" for global temperature and sea level rise, (ii) global temperature "variability," and (iii) a 1% *de minimis* threshold it claims has been recognized by courts. 91 Fed. Reg. at 59040. Below, we explain that all of EPA's *de minimis* tests are flawed and inappropriate for assessing the materiality of reducing U.S. power-plant greenhouse gas emissions. Consequently, EPA's futility finding is erroneous, arbitrary, and unjustifiable, and should be withdrawn.

In addition, Commenters note that there are multiple differences between EPA's futility methodology and rationale in this Supplemental Proposal and the futility methodology and rationale in the final Vehicle Endangerment Repeal, 91 Fed. Reg. at 7686, though they are otherwise nearly identical. It appears that EPA in this Supplemental Proposal considered and attempted to address a portion of the flaws identified in the Petition for Administrative Reconsideration of the Vehicle Endangerment Repeal filed by Environmental Defense Fund et al., Docket No. EPA-HQ-OAR-2025-0194-31118. The Supplemental Proposal cannot cure EPA's unlawful failure to provide notice and comment on the Vehicle Endangerment Repeal's futility rationale. And the Supplemental Proposal's futility rationale remains deeply and critically flawed, as explained herein. But finalizing this Supplemental Proposal's updated futility rationale would confirm that EPA's futility rationale in the Vehicle Endangerment Repeal is arbitrary and capricious.

1. EPA's "measurability" and "variability" metrics suffer from numerous flaws.

As we explain below, EPA's "measurability" and "variability" metrics are inadequately explained, conflate distinct technical concepts, and reflect numerous basic statistical errors. EPA calculated or cited numbers for these metrics that are simply wrong. We show that adjusting for errors in EPA's measurability and variability metrics results in far smaller variability and measurement uncertainty numbers, such that EPA's projected U.S. power-plant CO_2 impacts on global temperature and sea level rise actually exceed the metrics. And when we both address the variability and measurability errors and run our own scenarios, we identify impacts that far exceed the variability and measurement comparators – thus illustrating that even hypothetically assuming the propriety of EPA's methodology, the agency erred in determining that U.S. power-sector impacts were *de minimis*.

a. EPA's measurability and variability metrics are inadequately explained.

As an initial matter, it is not evident what EPA means by the concepts of "measurability" and "variability," which the Agency describes in various terms, such as: "the range of inherent variability in measurement for trends in GMST and GSLR," 91 Fed. Reg. at 59020; "the range of measurability," *id.* at 59040; "the level of uncertainty," *id.* at 59040 n.217; and "variability," *id.* at 59040 & n.218. As we explain further in Appendix C, EPA fails to fully detail its methodology for deriving or defining these comparative metrics, so it is not clear what they represent.

The Supplemental Proposal does report two sets of values, though both are woefully inadequate and unclear as an explanation of the Agency's approach. EPA claims that "GMST variability from 2016–2025 was 0.14 °C" based on a NOAA website. *Id.* at 59040. But then in an immediately following footnote, the Agency seemingly contradicts itself by saying it actually

considered "data from 2016–2025 (*exclusive of 2016*)." *Id.* at 59040 n.218 (emphasis added). It is thus unclear whether the Agency in fact considered data from 2016–2025 or from 2017–2025, and what the Agency otherwise means by excluding the first year from a timespan the Agency itself selected.[326]

EPA does not state the value it ascribed to global temperature uncertainty, other than to imply such value is higher than 0.035°C, the impacts of power-plant CO_2 emissions through 2100 according to EPA's modeling. *See* 91 Fed. Reg. at 59040. EPA does claim that "the level of uncertainty in GMST estimates for the year 2020" has been "calculated by several global products," but it cites as an example ("*e.g.*") a figure in only one published study, Lenssen et al. (2024). [327] This suggests EPA may have in fact considered other calculations that it did not identify in the Supplemental Proposal. EPA's use of the word "several" is also misleading: the cited figure in Lenssen et al. (2024) plots six products, but half of those have values *lower* than 0.035°C, two more are actually from the same product, and the final product has since been updated to an uncertainty measurement of 0.032°C for 2020. *See* Appendix C at 17. Moreover, EPA barely uses 100 words to describe its understanding and position on global temperature measurability, which is a robust area of scientific research as well as a critical component of EPA's futility analysis.

These two descriptions in EPA's preamble thus serve to further confuse rather than clarify. We carefully reviewed EPA's supporting record, including the Temperature Memo that explains the methodology for estimating global temperature and sea level rise impacts, and EPA's Regulatory Impacts Analysis, the document that would typically detail key technical methodologies. But we could not identify any material that further explains how these metrics were calculated or what precisely they mean.

Furthermore, although EPA claims that the estimated impacts of power-plant CO_2 emissions on global sea level rise fall below the range of measurability, we could not identify in the record either the methodology for calculating the range of global sea level rise measurability or even what EPA believes that number to be, beyond the Agency's implication that it is lower than the projected global sea level rise impact of 1.37 cm. *See* 91 Fed. Reg. at 59020 (EPA's results "indicate that even the elimination of all CO_2 emissions from fossil fuel-fired power plants in the United States … would not yield impacts beyond a level that is well below the range of inherent variability in measurement for trends in … GSLR.").

Given the critical importance of these comparative metrics for EPA's futility findings, the agency's lack of transparency as to what these comparative metrics are or how the Agency

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[326] And if EPA in fact considered the time span of 2017–2025, it fails to explain why it is now using a different methodology to define temperature variability than it used in the Vehicle Endangerment Repeal. *See* 91 Fed. Reg. at 7691, 7733.

[327] 91 Fed. Reg. at 59040 n.217 (citing Nathan Lenssesn et al., *A NASA GISTEMPv4 Observational Uncertainty Ensemble*, 129 J. Geophysical Rsch.: Atmospheres, at fig. 4 (2024), https://doi.org/10.1029/2023JD040179).

derived them not only is arbitrary and capricious but also constitutes a notice failure. *See* 42 U.S.C. § 7607(d)(3).

b. EPA erroneously conflates measurability, variability, and the materiality of emissions reductions.

EPA's explanatory failures aside, the Agency's choice to conflate measurability and variability, and to equate them with the materiality of emissions, is wrong at a conceptual level.

The terms "variability" and "measurability" have distinct meaning in relation to global temperatures. They are two distinct concepts. Climate variability is a property of the physical climate system itself. For example, global temperature variability refers to the actual physical fluctuations in average surface temperature over a specific time range. These fluctuations occur over multiple time scales – such as the daily time scales from the Earth's rotation; the yearly to multidecadal time scales of the El Niño Southern Oscillation (ENSO), the Pacific Decadal Oscillation (PDO), the Atlantic Multidecadal Oscillation (AMO), and solar cycles; up to the century or millennial time scales of anthropogenic forcings from greenhouse gas emissions.[328] Variability thus encompasses both short-term as well as long-term dynamics.[329] However, over longer time scales, the effects of anthropogenic climate change will dominate over the short-term fluctuations. In relation to EPA's analysis, variability captures both the desired signal (*i.e.*, U.S. power-plant policy impacts) and surrounding noise (*e.g.*, El Niño patterns).

By contrast, measurability is an observational and epistemic question – how precisely and accurately can we determine temperature at a given point or over a given period?[330] Measurability is affected by numerous factors, such as spatial coverage gaps (*e.g.*, the relative lack of sensor stations in the Arctic, Southern Ocean, and parts of Africa), inhomogeneities in the records for particular stations (*e.g.*, changes in the instruments used by that station, changes in location of the stations, time-of-observation biases in when temperatures are measured), differences between sea surface temperature datasets, and the statistical methods used to infill or interpolate.[331] Measurability defines the uncertainty envelope around estimates of what the temperature actually was. Measurability has also improved significantly over time and continues to improve with updates to instruments and methodologies.

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[328] *See, e.g.*, Veronika Eyring et al., *Human Influence on the Climate System*, *in Climate Change 2021: The Physical Science Basis, Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, at 436, 502, 515 (Valérie Masson-Delmotte et al. eds., 2021), https://www.ipcc.ch/report/ar6/wg1/chapter/chapter-3/.

[329] *See* Eyring et al., *supra*, at 517.

[330] *See, e.g.*, C.P. Morice et al., *An updated assessment of near-surface temperature change from 1850: the HadCRUT5 data set*, 126 J. of Geophysical Rsch.: Atmospheres 1, 2 (Feb. 2021), https://doi.org/10.1029/2019JD032361.

[331] *See* Morice et al., *supra*, at 2-3, 15.

To be clear, variability and measurability mean two completely different things. Variability refers to changes in the climate system itself. Measurability refers to how precisely and accurately we measure that system.[332] EPA suggests that both variability and measurability can be conflated such that impacts below either or both thresholds are meaningless. But this is conceptually wrong, and a red herring. Both concepts are completely distinct from whether reducing emissions and corresponding global temperature (or global sea level rise) changes have a material impact on human health and welfare. In brief, suppose one were to project that in a given future year global temperature is 60 degrees, ±2 degrees, for a range of 58–62 degrees. This does not mean that a policy that reduces global temperature by 1 degree is futile, as that policy would still shift the projection to 59 degrees ±2 degrees, for a projection band of 57–61 degrees. That 1-degree reduction is plainly material given the entire band of projected outcomes shifts down by 1 degree. Moreover, as explained above, a 1-degree change does not translate into the whole world becoming 1-degree cooler all the time, but rather manifests as significantly reduced incidence and intensity of local extreme weather and other unevenly distributed climate events that pose catastrophic danger to human health and welfare.

EPA's conflation of measurability, variability, and the materiality of emissions reductions is irredeemably arbitrary at a fundamental level and would render the Supplemental Proposal's futility rationale unlawful if finalized.

c. EPA's measurability and variability values are arbitrary.

Even hypothetically accepting EPA's irrational framework of using variability and measurement uncertainty to evaluate futility, the Agency's calculations for measurability and variability are technically flawed, resulting in figures for these thresholds that are wrong. In this subsection, we detail such flaws and show that addressing them would yield significantly lower variability and measurability figures, such that even assuming EPA's general methodology, U.S.

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[332] Global sea level rise variability and measurability occur due to a different set of factors than for global temperature; however, the basic distinction between variability and measurability remains the same. Global sea level rise variability is a property of the ocean-ice-land system and refers to the actual physical fluctuations in average sea level over time – driven by factors like thermosteric expansion (ocean heat uptake), mass loss from ice sheets (Greenland, West and East Antarctica) and glaciers, changes in land water storage, and shorter-term dynamics like ENSO-driven redistribution of ocean mass and heat. By contrast, global sea level rise measurability refers to how precisely and accurately we can determine sea level at a given point or over a given period. This depends on other factors such as the uneven spatial distribution of tide gauges (concentrated along developed coastlines, sparse in the Southern Hemisphere and open ocean), corrections for vertical land motion (*e.g.*, tectonic, sediment compaction, glacial isostatic adjustment), the calibration, reference frame stability, and inter-mission continuity of satellite altimetry records, and the statistical methods used to reconcile tide gauge and altimetry records into a coherent global mean. *See generally* Thomas Frederikse et al., *The causes of sea-level rise since 1900*, 584 Nature 393 (2020), https://doi.org/10.1038/s41586-020-2591-3; Josh Blumenfeld, *The Precision Behind Sea Level Rise,* NASA EarthData (last updated Jan. 16, 2025), https://www.earthdata.nasa.gov/news/feature-articles/precision-behind-sea-level-rise.

power-sector impacts would exceed those figures and not be *de minimis*. We further detail our analysis in Appendix C.

As with our modeling of alternative scenarios, we do not intend to suggest that our figures are the appropriate metrics by which to evaluate the materiality of U.S. power-sector impacts on health and welfare. As explained above, EPA's conceptual framework for determining futility is arbitrary and capricious. Comparing projected impacts of U.S. power-plant CO_2 emissions on global temperature and sea level rise with variability and measurability metrics is, at bottom, a flawed apples-to-oranges comparison. No amount of patching over the calculations can redeem what is fundamentally unsound. If anything, the fact that the ultimate finding of futility is so sensitive to the diversity of datasets, statistical techniques, and assumptions described below only further highlights the arbitrary nature of EPA's methodology.

i. Global sea level rise measurability.

Beginning with global sea level rise measurement uncertainty, EPA does not report any value or methodology, beyond implying, without analysis or citation, that the value it considered exceeds EPA's modeled impacts of 1.37 cm. *See* 91 Fed. Reg. at 59020, 59037. Our review of global sea level rise measurement uncertainty found that NASA reports annual global sea level rise uncertainties of only 4.0 mm, or 0.4 cm, per year.[333] The 1.37 cm global sea level rise change projected by EPA in 2100 is roughly 3.4 times (*i.e.*, 242.5% greater than) NASA's measurement uncertainty value. This demonstrates that even applying EPA's preferred methodology, EPA's conclusion that U.S. power-plant emissions are *de minimis* is arbitrary and capricious.

To the extent that EPA later identifies sources reporting higher measurement uncertainty in response to these comments, any such sources do not exist in the Supplemental Proposal itself and are not available for public review and critique, and thus the agency would be required to convene a new notice-and-comment proceeding. *See* 42 U.S.C. § 7607(d)(3). In any event, for the reasons explained above, any such sources cannot cure EPA's error in comparing projected emissions impacts with uncertainty values, which is fundamentally an apples-to-oranges comparison.

ii. Global temperature measurability.

Turning to global temperature measurability, EPA posits that the impacts of modeled power-plant emissions on temperature through 2100 (0.035°C) are "below the range of measurability for GMST," 91 Fed. Reg. at 59040, because they are "less than the level of uncertainty in GMST estimates for the year 2020" as presented in a figure in a 2024 paper by Lenssen et al., among other unspecified sources. *Id.* at 59040, n.217. But EPA's cited source does not include the information the Agency claims it does, and multiple independent datasets report measurement uncertainties materially lower than the levels EPA deemed *de minimis*.

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[333] NASA, *Global Mean Sea Level*, https://sealevel.nasa.gov/understanding-sea-level/key-indicators/global-mean-sea-level/; *see also* Michael Ablain et al., *Uncertainty in satellite estimates of global mean sea-level changes, trend and acceleration*, 11 Earth Sys. Sci. Data 1189 (2019), https://essd.copernicus.org/articles/11/1189/2019/.

As described in Appendix C, only one of the products plotted in the cited figure in Lenssen et al. (2024) has an uncertainty larger than 0.035°C; three have an uncertainty lower than 0.035°C; and one of the products, NOAAGlobalTemp, does not have a 2020 value plotted in the figure but has an uncertainty below 0.035°C for every year between 1986 and 2015, the last year data is available. *See* Appendix C at 17. We were able to find one additional GMST dataset with uncertainty measurements, DCENT.[334] And DCENT's 2020 measurement uncertainty is 0.01°C – well below 0.035°C. In other words, of the six global average temperature anomaly datasets with uncertainty measurements we could find, at least four (and likely five) have measurement uncertainties in 2020 that are *smaller* than 0.035°C. For EPA to point to one supporting source and completely ignore multiple other contradictory sources is the very definition of arbitrary.

In addition to incorrectly characterizing the uncertainty values for 2020 in the scientific literature, EPA also only considers the measurement uncertainty for a *single* year. EPA does not explain why 2020 was the only year the Agency considered, nor does EPA attempt to justify using data from a year that saw unprecedented global events, the COVID19 pandemic. As explained in Appendix C, large global events can impact global temperature measurement uncertainty. EPA seemingly failed to consider this. EPA's use of a single year is also inherently arbitrary. This is evident when considering all of the datasets represented in the cited figure in Lenssen et al. (2024): every product has at least 30 years between 1950 and 2025 with uncertainties less than 0.035°C, and one of the products has an uncertainty less than 0.035°C for 60 of the years between 1950 and 2025. An additional product not included in Lenssen et al. (2024) is DCENT, which has a measurement uncertainty below 0.035°C for *every* year between 1950 and 2025. *See* Appendix C at 19. EPA's selection of one year to consider measurement uncertainty is clearly arbitrary and indefensible.

EPA, moreover, fails to explain why it is appropriate to look at *annual* uncertainty metrics when the policies in question are long-term pollution-control policies with impacts that occur over multiple decades. Global temperature measurement uncertainty can decrease when averaging time periods of greater length. For example, Berkeley Earth includes a five-year uncertainty that is, on average since 2000, 16% lower than its calculation of annual uncertainty and an average of 21% lower since 1975. Every year since 1966 has a five-year uncertainty lower than 0.035°C.[335]

iii. Global temperature variability.

EPA calculated a global temperature variability value of 0.14°C. 91 Fed. Reg. at 59040. As described above, EPA fails to adequately explain its methodology for arriving at this calculation, and provides confusing, internally contradictory descriptions that obscure which NOAA data EPA actually considered. We assume here that EPA considered data from 2016–

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[334] *Available at* https://dcent-i.github.io/#access ("Global Annual Time Series").

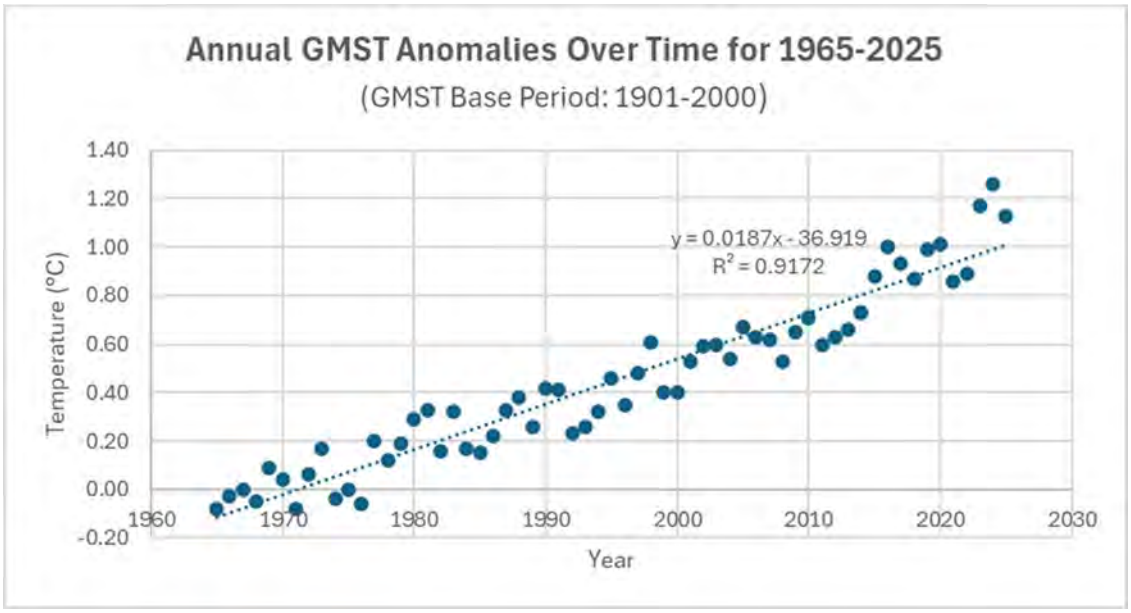
[335] *See* Appendix C at 20 (citing Robert A. Rohde & Zeke Hausfather, *The Berkeley Earth Land/Ocean Temperature Record*, 12 Earth Syst. Sci. Data (2020), https://doi.org/10.5194/essd-12-3469-2020).

2025, as stated in the body of the preamble. *See id.* at 59040 ("GMST variability from 2016 – 2025 was 0.14 °C").

As we explain below, the methodology that EPA apparently used to calculate its 0.14°C variability value is critically flawed in five independent ways: 1) EPA failed to correct for the underlying upward trend in global mean temperature, 2) annual averages are an inappropriately short timeframe to assess whether an increase in temperature would be inconsequential given the "variability" in the system, 3) EPA should have used population standard deviation and not sample standard deviation if the Agency meant to describe "variability" for 2016–2025, 4) EPA used an unjustified and historically anomalous reference window (2016–2025), and 5) EPA's use of a 10-year time interval to calculate variability was arbitrary. Each of these errors inflates EPA's variability estimate. Taken together, these errors cause EPA to overstate temperature variability by as much as 85%.

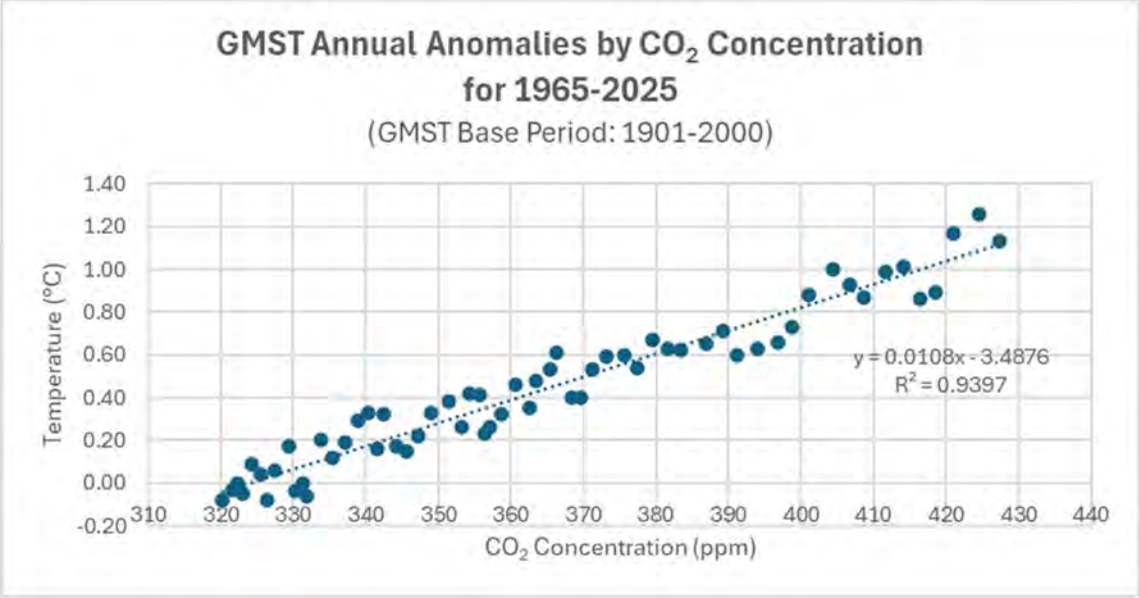
First, EPA failed to correct for the underlying upward trend in global mean temperature. Standard deviation measures the amount of variation of a variable around its arithmetic average. For example, suppose the average life expectancy of adult men in the United States is 78 years. The standard deviation would then measure how dispersed adult male life expectancy is from the average, *e.g.*, are the majority of men within one year on either side of the average or within ten years? However, global temperature data from 2016–2025 are not intended to measure values around a stable arithmetic average. Rather, they measure the trend in temperature over time, a trend that is noticeably increasing due to anthropogenic greenhouse gas emissions. In other words, it makes no sense to pretend that the temperature values from 2016–2025 are scattered around one stable average temperature, when the annual temperatures are obviously going up over time and with increasing atmospheric greenhouse gas levels, as shown in the figures below.

Figure 2: Global Mean Surface Temperature Anomalies (°C) Over Time, 1965-2025, Relative to 1901-2000 Average Global Temperature



GMST data was sourced from the NCEI Climate at a Glance: Global Time Series. Each dot represents the temperature anomaly for a given year. The dotted line is the line of best fit, which shows that GMST anomalies have increased during this period by a rate of roughly 0.019°C/year.

Figure 3: Global Mean Surface Temperature Anomalies (°C) Relative to Atmospheric CO_2 concentration (ppm), 1965-2025, Relative to 1901-2000 Average Global Temperature.



GMST data was sourced from the NCEI Climate at a Glance: Global Time Series. CO_2 data was sourced from NASA[336] for the years 1965-2011 (the most recent year available) and from the NOAA Global Monitoring Lab[337] for the years 2012-2025. Each dot represents the temperature anomaly and CO_2 concentration for a given year. The dotted line is the line of best fit, which shows that GMST anomalies have increased during this period by a rate of roughly 0.011°C/ppm CO_2.

Calculating a sample standard deviation without accounting for these trends would mean that a perfectly linear increase in temperatures could have the same standard deviation as highly noisy data that bounce around each other. For example, the two lines in the figure below have the exact same values, but they are arranged in different orders. That ordering makes a visible difference, such that the purple line displays a clear increasing trend, while the orange line displays noisy datapoints that are bouncing around. But EPA's approach would mean that these two lines have the exact same variability. That makes no sense. In this case, a better metric of

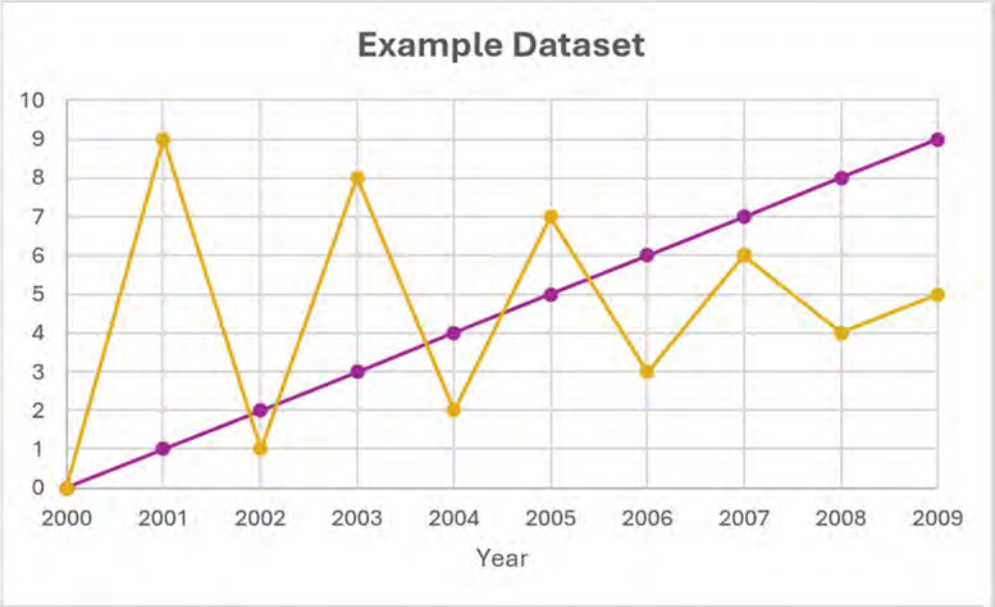
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[336] NASA Goddard Institute for Space Studies, *Global Mean CO_2 Mixing Ratios (ppm): Observations* (2012), https://data.giss.nasa.gov/modelforce/ghgases/Fig1A.ext.txt.

[337] NOAA Global Monitoring Lab'y, *Mauna Loa CO_2 annual mean data (CSV)*, *Carbon Cycle Greenhouse Gases: Trends in CO_2, CH_4, N_2O, SF_6* (2021), https://gml.noaa.gov/ccgg/trends/data.html.

variability would account for the trend in the purple line and indicate that it has lower variability than the orange line.

Figure 4: Two Sample Datasets (Orange and Purple Dots and Lines) Showing the Importance of Accounting for Trends in Determining Variability



The purple line shows a steady and unequivocal upward trend while the orange line shows noisy data that is varying around a constant mean of 4.5. Though both datasets have a standard deviation of 2.87, the interannual variability of the datasets is different.

Second, EPA inappropriately considered an annual average. The timeframe of the data inputs is consequential, including the period across which temperatures are averaged for each datapoint, for example, whether each datapoint represents averages across one month, one year, or ten years. EPA's cited source appears to average the data across one year. This is an inappropriately short timeframe to assess whether an increase in temperature would be inconsequential given the "variability" in the system. To understand the variability in the long-term state of the climate, apart from short-term variations (such as the El Nino and other ocean-atmospheric oscillations described above), scientists often look at temperature data averaged over longer time periods than just one year.[338] To put it simply, while annual temperatures tell us what the atmosphere is doing right now, including in response to temporary natural cycles, longer-term assessments allow scientists to discern whether the climate is changing in more permanent ways, such as in response to climate pollution.

Third, EPA arbitrarily used the sample standard deviation in lieu of population standard deviation. The Agency "assumes for the purposes of this comparison that the 'variability' in

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[338] *See, e.g.*, Nat'l Ctrs. for Env't Info., NOAA, *Accounting for Natural Variability in Our Changing Climate* (Aug. 5, 2019), https://perma.cc/PC3J-85BZ.

GMST is represented by the standard deviation of the global annual land and ocean average temperature anomaly data from 2016–2025 (exclusive of 2016).” 91 Fed. Reg. at 59040 n.218. As noted above, we assumed EPA considered 2016–2025 data. Taking EPA at its word that it meant to calculate global temperature variability from 2016-25, the Agency should have used population standard deviation, as we know the temperature data for each year from 2016–25, *i.e.*, the entire “population” of years. This is not a situation where we only know the temperature from a subset, or “sample” of those years, so it is statistically unsound to apply the sample standard deviation. Alternatively, to the extent EPA actually meant to calculate global temperature variability across a longer time period and relied upon 2016–2025 data as a sample, the Agency erred in not choosing a random sample and in arbitrarily selecting the 2016–2025 time period, which yields atypically high variability, as we further explain in Appendix C.

Fourth, EPA used an unjustified and historically anomalous reference window. Although the Supplemental Proposal is unclear about exactly which data EPA considered, as we explained above, we assume that EPA assesses a ten-year period beginning in 2016 and ending in 2025. Annual temperatures during 2016–2025 exhibited especially high variability relative to most prior ten-year periods. EPA’s selection of this time window biases variability upwards due to historically anomalous climate behavior resulting from climate change. That is, the 2016–2025 period coincides with the highest recorded greenhouse gas concentrations in human history. At these elevated greenhouse gas concentrations, the climate system is operating in a regime that is measurably different from earlier decades, with altered patterns of climate extremes that are themselves a consequence of the underlying warming trend. That is to say, the elevated variability during the 2016–2025 window is not random and does not merely reflect natural internal climate variability. It is at least partly a reflection of the altered climate state produced by the very greenhouse gas emissions whose regulation EPA now claims are meaningless. The Agency’s argument is therefore circular: the elevated variability EPA cites as a reason not to regulate is itself a consequence of the kind of emissions that Clean Air Act Section 111 greenhouse gas regulation is meant to address.

EPA does not explain why data from the ten-year period of 2016–2025 are the right inputs. The Agency’s referenced NOAA website itself highlights that changing the temporal parameters can result in significantly different datasets.[339] The cited NOAA webpage contains multiple temporal parameters that the user can adjust and that significantly affect the results, including parameters for “Time Scale,” “Month,” “Start Year,” and “End Year.” In Appendix C, we further elaborate on the sensitivity of the variability figure to these temporal parameters, showing that selection of the ten-year period from 2016–25 happens to result in unusually high variability relative to other time periods. Given that EPA is asserting that greenhouse gas regulation is facially futile, the agency is obligated to demonstrate that such futility exists not only in a single arbitrarily cherrypicked timeline but across a wide range of reasonable periods. Moreover, as explained in these Comments, climate change induced by increasing greenhouse gas pollution is not a short-term annual phenomenon, but rather occurs over long periods of time,

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[339] *See* 91 Fed. Reg. at 59040 n.218 (citing NOAA, National Centers for Environmental Information, *Climate at a Glance,* https://www.ncei.noaa.gov/access/monitoring/climate-at-a-glance/global/time-series/globe/land_ocean/tavg/ytd/12/1950-2025).

as greenhouse gas pollution accumulates and causes increasing temperatures, climate volatility, and other impacts that endanger human health and welfare.

Finally, EPA's use of a 10-year time interval to calculate variability was arbitrary. EPA's decision to characterize climate variability using a 10-year time interval is a consequential methodological choice that was made without justification. Regardless of which interval length is used, EPA's choice of the most recent available window consistently produces one of the highest variability estimates in the historical record. The combination of an unjustified interval length and an unjustified window selection systematically biases EPA's variability estimate upward relative to what a different methodological choice would produce.

Addressing each of the above flaws would result in lower variability. For example, when we account for the relationship between temperature and atmospheric CO_2 concentrations, use 10-year averages (as opposed to annual averages) of temperature data from 1965 to 2025, and calculate population standard deviation, we determine a variability of only 0.0193°C. This value is 15% of EPA's reported variability 0.14 °C, that is, 85% smaller than EPA's value. Notably, EPA's projection of U.S. power-plant CO_2 emissions impacts in 2100 of 0.035°C also significantly exceeds this value, such that even otherwise assuming EPA's general methodology of assessing temperature variability, the impacts of U.S. power-plant greenhouse gases are not *de minimis.* We detail our calculations for this scenario, as well as other scenarios, in Appendix C.

d. Addressing the compounding flaws in EPA's modeling and variability and measurability metrics further illustrates the meaningful impact of U.S. power-sector greenhouse gas emissions.

As explained above, EPA's modeling of the impacts of power-plant CO_2 emissions proceeds from arbitrary choices that depress the modeled impacts, while EPA's variability and measurability metrics are arbitrarily elevated. These flaws compound each other when EPA compares its modeling results to the thresholds. When we address both sets of flaws at the same time, we observe that the impacts of U.S. power-plant CO_2 on global temperature and sea level from our modeled scenarios actually far exceed variability and measurability comparators. As there are numerous permutations of such comparisons, we present only a sampling of potential comparisons to illustrate the severity of EPA's errors.

Beginning with temperature, as explained in Appendix C, we report a temperature variability statistic of as low as 0.011°C. EPA's reported 2100 temperature impact of 0.035°C exceeds that value, so that even otherwise assuming EPA's methodology, such impacts are not *de minimis*. When we model our own scenarios that respond to the flaws in EPA's modeling, we report significantly higher temperature impacts, for example 0.036°C in 2125 assuming EPA's emissions inputs (Scenario A), 0.062°C in 2125 assuming moderate emissions growth after 2050 (Scenario D), and 0.095°C in 2125 had EPA also considered the impacts of earlier power-plant greenhouse gases (Scenario B). These figures far exceed the measurability and variability comparators.

The same story holds true for sea level rise changes. We report a measurement uncertainty of 0.4 cm based on a NASA dataset.[340] As already explained, EPA's reported 2100 sea level rise impact of 1.37 cm is already 3.4 times this amount. When we alter assumptions and inputs in EPA's modeling, we report significantly higher sea level rise impacts, for example 2.00 cm in 2125 assuming EPA's emissions inputs (Scenario A), 2.38 cm in 2125 had EPA assumed moderate emissions growth after 2050 (Scenario D), and 5.71 cm in 2125 had EPA also considered the impacts of earlier power-plant greenhouse gases (Scenario B). These figures grossly exceed the measurability uncertainty.

And under Scenario C, which illustrates an emissions scenario that would have been one possible future from the perspective of EPA and Congress in the 1970s, where power plants continued to pollute at 1977-era emission rates, impacts are even higher, exceeding the measurability and variability comparators by enormous margins: nearly 20 times the size of the above the corrected temperature variability metric (0.217°C), and nearly 27 times the size of the above the sea level rise measurement uncertainty metric (10.88 cm) by 2125.

2. EPA articulates a *de minimis* percentage test for hypothetical regulation that is both contrary to law and arbitrary and capricious.

The Supplemental Proposal announces a third *de minimis* yardstick: a 1% test for determining whether emission impacts are *de minimis* and therefore allegedly absolve EPA of its statutory duty to regulate power-plant greenhouse gases under Clean Air Act Section 111. 91 Fed. Reg. at 59040. EPA asserts that the impact of its 50%-reduced emissions scenario on trends in global temperature and sea level rise equals approximately 1% or less of the projected changes through 2100. *Id.* Based on this novel 1% test, EPA concludes, these impacts are *de minimis* and the futility of greenhouse gas emission standards under Section 111 further supports the understanding that Congress did not design that provision to authorize or require the Administrator to prescribe standards in response to global climate change concerns. *Id.* Below, we demonstrate that EPA's 1% threshold, and EPA's process for deriving and considering that metric, are arbitrary and inconsistent with precedent.

a. EPA's 1% de minimis threshold is contrary to law and arbitrary.

EPA misleadingly claims that "regulatory agencies and courts have viewed impacts of one percent as *de minimis* and therefore not encompassed within general statutory language." 91 Fed. Reg. at 59040. Contrary to EPA's claims, general principles of *de minimis* case law make clear that determining when something is "truly *de minimis* naturally will turn on the assessment of particular circumstances, and the agency will bear the burden of making the required showing." *Alabama Power Co. v. Costle*, 636 F.2d 323, 360 (D.C. Cir. 1979). Whether an amount is *de minimis* depends on whether the regulation will "yield a gain of trivial or no value," *id*. at 361, and "the Agency must follow a rational approach to determine what level of emission is a *de minimis* amount." *Id*. at 405. Yet EPA made no effort to "bear [its] burden" of showing that the Supplemental Proposal's 1% threshold weeds out "truly *de minimis*" emissions in the

[340] As noted above, EPA does not calculate a variability statistic for sea level, so we also do not present a variability statistic here.

context of regulating stationary source greenhouse gases. *Id.* at 360. The Supplemental Proposal's 1% threshold is also contrary to the principle that the *de minimis* doctrine "is not available to thwart a statutory command," *Pub. Citizen v. Young*, 831 F.2d 1108, 1113 (D.C. Cir. 1987), "but rather [it is] a tool to be used in implementing the legislative design." *Alabama Power Co*., 636 F.2d at 360.[341]

EPA cites to five cases in support of its novel proposition that regulatory agencies and courts have consistently viewed impacts of 1% as *de minimis*, misconstruing and misapplying each one in a futile attempt to justify its arbitrary threshold. 91 Fed. Reg. at 59040 n.221. All five cases use different thresholds, and none identify a particular threshold that broadly applies as *de minimis* in all circumstances. Of the cited cases, *EPA v. EME Homer City Generation, L.P.*, 572 U.S. 489 (2014), is the only case in which an agency utilized a 1% *de minimis* threshold. Yet this case and underlying rule involved a different statutory provision and different record, and it provides no support for EPA's assertion that the courts generally view such a threshold as *de minimis*. Clean Air Act Section 110(a)(2)(D)(i), the provision at issue in *EME Homer*, conditions state implementation plan obligations on whether upwind air pollution "contribute[s] significantly to nonattainment" in downwind states. The interstate air pollution Transport Rule at issue in *EME Homer* used 1% of the relevant National Ambient Air Quality Standards (NAAQS) to screen out upwind contributions below that threshold for purposes of further regulation, but it did not use that threshold alone to determine which amounts of air pollution do or do not constitute "amounts which will . . . contribute significantly." *EME Homer*, 572 U.S. at 495. The Final Rule's suggestion that the 1% threshold used in that context supports the use of a 1% threshold in deciding whether regulation under Clean Air Act Section 111 is futile misrepresents *EME Homer*; the Court never so much as hints that the 1% threshold at issue there is appropriate in any other context.

Additionally, EPA's arbitrary and capricious reliance on the Transport Rule's 1% threshold as justification for a *de minimis* threshold in the Supplemental Proposal ignores both the purpose of that threshold in the context of Section 110(a)(2)(D)(i) and EPA's robust analytical work to justify that threshold within that different context. The Transport Rule used the 1% threshold to regulate a large (albeit not complete) set of contributors to downwind nonattainment and maintenance problems. By contrast, EPA in the Supplemental Proposal uses the 1% threshold to disclaim *any responsibility at all* to implement the statutory command under Clean Air Act Section 111 to regulate power-plant greenhouse gases. Additionally, EPA provides no technical justification for the use of such threshold in the Supplemental Proposal, whereas the Transport Rule, in seeking to identify a rational solution to the downwind pollution problem exacerbated by collective upwind pollution, contained significant technical analyses of several potential thresholds in order to justify the use of 1%. *See* 76 Fed. Reg. 48208, 48237 (Aug. 8, 2011). The Transport Rule's use of 1% was thus a carefully selected screening threshold in order to efficiently resolve most of the problem targeted by the statutory provision; it was not a *de*

[341] *See also* Comment of Natural Resources Defense Counsel (NRDC), et al. at 85-89 (Sept. 22, 2025), EPA-HQ-OAR-2025-0194-2608 (hereinafter "Vehicle Endangerment Comment"), available at regulations.gov.

minimis threshold used to justify defying the Clean Air Act's legislative design, nor was it ever intended to apply across other Clean Air Act programs that tackle entirely different problems.

Here, EPA arbitrarily neglects the context of climate change, where a 1% contribution translates into catastrophic health and welfare damages. Even if global temperature and sea level rise were appropriate touchstones for evaluating the potential futility of power-plant greenhouse gas standards (which they are not), the Agency's choice to focus on the impact of U.S. power plants as a *proportion* of global anthropogenic impacts is independently arbitrary. Practically speaking, where the ultimate harm – like that of climate change – is catastrophic, even a tiny increment of harm can be highly meaningful and legally cognizable.[342] For example, while a 1% increase in the chance that you will pay a $100 parking ticket may be *de minimis*, a 1% increase in the chance that you will get cancer is certainly *not de minimis*.[343] Neither is a 1% decrease in the stock market, or a 1% decrease in the GDP. And a 1% disparity between an architect's plans and a builder's product could very well be the difference between a functioning building and a heap of rubble. Federal courts have repeatedly recognized this, including striking down agency analyses that purported to find insignificant climate impacts by comparing a large number of emissions to larger geographic totals. *See, e.g.*, *350 Montana v. Haaland*, 50 F.4th 1254, 1266 (9th Cir. 2022) (explaining that "virtually *every* domestic source of GHGs may be deemed to have no significant impact as long as it is measured against total global emissions" and calling for a more robust assessment of a project's climate effects); *Dine Citizens Against Ruining Our Env't v. Haaland*, 59 F.4th 1016, 1041 (10th Cir. 2023) (rejecting an agency's "comparative percentage-based standard that can be downplayed and manipulated based on the size of the comparator," and agreeing with "[o]ther courts [that] have also concluded an agency must adopt reasonable methods for considering the impacts of cumulative GHG emissions if such methods are available"); *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Admin.*, 538 F.3d 1172, 1216 (9th Cir. 2008) (explaining that measuring against total global emissions "does not discuss the *actual* environmental effects resulting from [the action's] emissions"); *see also Ethyl Corp. v. EPA*, 541 F.2d. 1, 18 (D.C. Cir. 1976) ("[P]ublic health may properly be found endangered by a lesser risk of greater harm and by a greater risk of lesser harm."); *Southwestern Elec. Power Co. v. EPA*, 920 F.3d 999, 1032 (5th Cir. 2019) (discussing water pollution and recognizing that even a seemingly "very small portion of a gargantuan source of ... pollution" may "constitute[] a gargantuan source of ... pollution on its own terms.").

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[342] *See, e.g*., *Citadel Sec. LLC v. SEC*, 45 F.4th 27, 36 (D.C. Cir. 2022) (observing that significance is context-dependent: "a one-second delay during a cruise across the Atlantic may be *de minimis*, but a one-second delay during a 100-yard dash is enormous"); *Ethyl Corp. v. EPA*, 541 F.2d 1, 18 (D.C. Cir. 1976) (en banc) ("[P]ublic health may properly be found endangered both by a lesser risk of a greater harm and by a greater risk of a lesser harm"); H.R. Rep. No. 95-294, at 50 (1977), *reprinted in* 1977 U.S.C.C.A.N. 1077, 1128).

[343] *See, e.g.,* 42 U.S.C. § 7412(f)(2)(A) (requiring EPA to promulgate risk-based air toxics emissions standards where technology-based standards "do not reduce lifetime excess cancer risks to the individual most exposed to emissions from a source in the category or subcategory to less than one in one million").

As explained earlier in these Comments with extensive evidence, the absolute impacts of U.S. power-plant greenhouse gas emissions on the public health, the environment, and the economy are massive by any measure. *See supra* Comment Part VII.[344] And even small increases in greenhouse gas emissions can cause material harms to public health and welfare. We may not know – as EPA highlights – with perfect precision how fast the planet is warming. But we know with certainty that it is warming. We also know, based on our basic physical understanding of how the world works, that every ton of anthropogenic greenhouse gas emissions contributes to that warming.[345] In turn, every increment of warming is associated with increasing and catastrophic risks of climate change.[346] Conversely, every ton of emissions reduction reduces warming and the risks of climate change. That is the consensus of climate scientists, and it was recently affirmed by an authoritative study from the National Academies of Sciences, Engineering, and Medicine,[347] a body whose expertise Congress recognized in enacting the Clean Air Act. *See* 42 U.S.C. § 7607(d)(3). As a recent United Nations report also explained, "Every fraction of a degree avoided and every year by which overshoot is shortened will save lives, protect ecosystems and reduce economic losses."[348]

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[344] *See also* NASEM 2025 Climate Report, *supra*, at 4-8.

[345] IPCC, *Summary for Policymakers, in: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* 28 (2021), https://www.cambridge.org/core/books/climate-change-2021-the-physical-science-basis/summary-for-policymakers/8E7A4E3AE6C364220F3B76A189CC4D4C ("Every tonne of CO_2 emissions adds to global warming").

[346] IPCC, *Summary for Policymakers*, *supra*, at 15 ("With every additional increment of global warming, changes in extremes continue to become larger."); *see also* U.S. Global Change Research Program, *Overview, in Fifth National Climate Assessment* 1-5 (2023), https://toolkit.climate.gov/sites/default/files/2025-07/NCA5_Ch1_Overview.pdf ("Each additional increment of warming is expected to lead to more damage and greater economic losses compared to previous increments of warming, while the risk of catastrophic or unforeseen consequences also increases. However, this also means that each increment of warming that the world avoids – through actions that cut emissions or remove carbon dioxide (CO_2) from the atmosphere – reduces the risk and harmful impacts of climate change.").

[347] *See* NASEM 2025 Climate Report, *supra*, at 38 ("As long as global emissions of CO_2 stay above zero, concentrations and radiative forcing will continue to increase and global temperature will increase roughly in proportion to cumulative CO_2 (*i.e.*, each additional ton emitted adds an increment more to temperature increase) with small contributions from other long-lived gases including N2O and F-gases. As global emissions of GHGs are spread across all nations, a collective effort at reducing emissions is required to limit future warming.").

[348] United Nations Environment Programme, *Limiting Overshoot: Navigating Exceedance of 1.5°C and Pathways Towards Return* 1 (2026), https://wedocs.unep.org/items/156d074c-ab1d-4833-acf8-6343589ede9b; *see also id.* at 8 ("Every fraction of a degree avoided reduces risks. Every year by which overshoot duration is shortened reduces exposure. Every investment in

This is particularly so given the existence of feedback loops and "tipping points" at which even slight emission increases can generate large and irreversible harms.[349] A long literature pioneered by economist Martin Weitzman demonstrates that even a small chance of extreme warming justifies strong climate action, because the possibility of catastrophic damages outweighs other considerations,[350] and probability distributions of estimates consistently find that climate damages could be far higher than anticipated but are unlikely to be much lower than expected.[351] One peer-reviewed synthesis concludes that several tipping points may be triggered at 1.5°C to 2°C of warming, and that many more are likely at 2°C to 3°C of warming,[352] well within EPA's projection of 2.66°C warming by 2100 (95% confidence interval of 1.86°C to 3.87°C). *See* 91 Fed. Reg. at 59038 tbl.4. Near a threshold, a small increment of warming can matter far more than its size suggests. EPA's futility analysis ignores this point and arbitrarily and unreasonably treats every hundredth of a degree as equally trivial. Moreover, economic research confirms that tipping points materially increase expected damages. For example, a study by Dietz et al. (2021) demonstrated that tipping points imply economic losses across every global region, reinforcing the need to factor these into climate studies.[353] And EPA's own SC-GHG Report notes that the inclusion of some tipping points in one peer-reviewed study increased the

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resilience preserves future options."); *id.* at 89 ("Every fraction of a degree and every year above 1.5°C increases exposure to climate hazards and the likelihood of irreversible loss").

[349] *See* E. Kopits et al., *Moving Forward with Incorporating 'Catastrophic' Climate Change Into Policy Analysis*, EPA National Center for Environmental Economics Working Paper #13-01 (Jan. 2013), https://www.epa.gov/sites/default/files/2014-12/documents/incorporating_catastrophic_climate-change_into_policy_analysis.pdf (review of literature related to tipping points); IPCC, *Climate Change 2023: Synthesis Report*, Summary for Policymakers ¶ B.3.2 (finding with "high confidence" that "[t]he likelihood and impacts of abrupt and/or irreversible changes in the climate system, including changes triggered when tipping points are reached, increase with further global warming").

[350] Martin L. Weitzman, *Fat Tails and the Social Cost of Carbon*, American Economic Rev. 544-46 (2014); G. Wagner & M.L. Weitzman, *Potentially Large Equilibrium Climate Sensitivity Tail Uncertainty* 168 Economic Letters 144-46 (2018).

[351] *See, e.g.*, Frances C. Moore et al., *Synthesis of Evidence Yields High Social Cost of Carbon Due to Structural Model Variation and Uncertainties* 121 Procs. of the Nat'l Acads. of Scis. 1, 3 fig.1 (2024); EPA, *EPA Report on the Social Cost of Greenhouse Gases: Estimate Incorporating Recent Scientific Advances* 80 fig.3.1.1 (Nov. 2023), https://www.epa.gov/system/files/documents/2023-12/epa_scghg_2023_report_final.pdf.

[352] David I. Armstrong McKay et al., *Exceeding 1.5C Global Warming Could Trigger Multiple Climate Tipping Points* 377 Science (Sept. 9, 2022), https://www.science.org/doi/10.1126/science.abn7950.

[353] S. Dietz et al., *Economic Impacts of Tipping Points in the Climate System*, 118 Proceedings of the Nat'l Acad. of Sci. 1 (2021), https://www.pnas.org/doi/epdf/10.1073/pnas.2103081118.

social cost of carbon valuation by 24.5%.[354] EPA's choice of a percentage *de minimis* threshold that obscures and ignores these impacts is arbitrary and unsupported.

b. EPA's comparison of an "illustrative" 50% emissions-reduction scenario to the 1% threshold is arbitrary and capricious.

The Supplemental Proposal posits an "illustrative" 50% reduction scenario where the Agency examines the effects of a hypothetical 50% reduction in power-plant CO_2 emissions over time. 91 Fed. Reg. at 59039. Although EPA calls this scenario "illustrative," the Agency's futility finding under the 1% *de minimis* metric relies critically on it. The Agency's modeling of the impacts of U.S. power-plant CO_2 emissions on global temperature and sea level rise *without* the 50% reduction shows the impacts are approximately 3% for global temperature and 2% for global sea level rise in 2100, both of which exceed EPA's stated 1% *de minimis* threshold. *See* Temperature Memo at 5, tbls. 5 & 7. Only by applying this so-called "illustrative" scenario does EPA then claim that the potential impacts of regulation are 1% or less. *See id.* Thus, far from being merely "illustrative," EPA's 50% scenario is the critical linchpin of its futility finding as to this metric: without this 50% reduction, even EPA's own numbers would defeat its *de minimis* argument at the Agency's own threshold.

As a threshold matter, it is unjustified and fundamentally arbitrary for EPA to consider its 50% reduction scenario only against the 1% *de minimis* threshold. Doing so raises suspicions that the Agency intentionally constructed its 50% scenario to produce outputs that would fall below the 1% threshold, once the Agency determined that the 100% emissions scenario exceeded the 1% threshold. The Agency's lack of consistency, explanation, and scientific rigor undermine its analysis and cast serious doubt on this entire exercise. In any event, as we explain below, there is no justification for the Agency to consider its arbitrary 50% reduction scenario against *any* stated *de minimis* metric, including the 1% threshold. The 50% reduction EPA modeled is arbitrary and baseless, and the lower contribution numbers derived from scenario compound the flaws made in EPA's original modeling of all U.S. power-sector emissions; this is well illustrated by our own modeled Scenario B-50%, which produces significantly greater contributions than Scenario A-50% even after applying the same kind of 50% emissions reduction.

EPA's choice to reduce emissions by 50% in order to determine futility is irrational. The Agency claims that eliminating only some of the total impacts of the U.S. power sector is appropriate because eliminating all impacts "substantially overestimates the impacts of the EPA's GHG regulations," 91 Fed. Reg. at 59039, and "is unrealistic," *id.* at 59037. In support of these conclusions, the Agency claims that "[t]he 2015 NSPS was projected to result in only 'negligible CO_2 emission changes,'" and other greenhouse gas regulations adopted since "all fall well below a 100 percent reduction in emissions from U.S. power plants," *id.* at 59039, and their associated emissions are also below "the composite forecast emissions of the 50 percent reduction scenario," *id.* at 59040. EPA claims that the 50% reduction scenario is presented as "a proxy for a more likely, real-world scenario." *Id.* EPA further opines that the illustrative scenario does not

[354] EPA, *EPA Report on the Social Cost of Greenhouse Gases: Estimate Incorporating Recent Scientific Advances* 82 (Nov. 2023), https://www.epa.gov/system/files/documents/2023-12/epa_scghg_2023_report_final.pdf.

reflect what greenhouse gas standards would realistically achieve "given technical and statutory constraints" and thus is likely an overestimation of actual impacts. *Id.* EPA concedes, however, that making any predictions about the impact of future regulations "is highly uncertain and turns on factors that are difficult to predict." *Id.* at 59039.

EPA's cursory justification of its methodology is baseless. The Agency admits that the illustrative scenario "cannot be assumed to translate with precision directly to specific adverse health or welfare impacts." 91 Fed. Reg. at 59039. In plain English, that means the illustrative results were produced by a method not intended for this purpose and do not actually mean the thing the Agency wants them to mean. That is, the results are wrong.

None of EPA's rationales sufficiently explain a 50% reduction, and they only further demonstrate the fundamental conceptual flaws in EPA's methodology. While the efficacy of prior or prospective rules relative to the prior greenhouse gas rule baseline may be relevant to determining the reasonableness of those rules themselves, there is no reason for using an approximation of this value to evaluate whether greenhouse gas regulation generally would be futile under any circumstances. As we explained above, EPA is not merely determining that a prospective regulation of greenhouse gases that requires a 50% emissions reduction is unreasonable. It instead uses this analysis to justify that any past, present, or future Section 111 greenhouse gas emissions standards for power plants would be futile, and the repeal of all existing greenhouse gas rules.

Moreover, the reductions achievable today are unlikely to be the maximum reductions achievable over the course of a regulatory program. Based on evolving pollution-control measures, a future Administrator could set more protective standards than prior rules or any rules that EPA would consider today to represent a "real-world scenario." 91 Fed. Reg. at 59039. EPA's 50% reduction thus reflects (imprecisely) specific facts that EPA alleges exist today, not any inherent limitation on statutory authority. A future Administrator might reasonably project greater emission reductions as technology advances, consistent with EPA's historical exercise of Clean Air Act authority to promote technological development and achieve significant reductions of certain pollutants. The statute, moreover, contemplates not merely the "control" of emissions but their "prevent[ion]," 42 U.S.C. § 7521(a)(1), "that is, the reduction or elimination, through any measures, of the amount of pollutants produced or created at the source," *id.* § 7401(a)(3). The quantum of emission reductions driven by a future greenhouse gas standard would continue to depend on relevant facts – such as technological feasibility, costs, infrastructure availability, and so forth. EPA's Supplemental Proposal disclaims all authority to establish greenhouse gas standards on the theory that standards are futile under any circumstance, meaning that the Agency must contend with the impacts of doing just that, not merely a crude approximation of the impacts of prior rules or rules it might otherwise adopt today.

Finally, the low contribution numbers in EPA's illustrative scenario are the product of compounding errors with its original modeling. In above results Tables, we show global temperature and sea level impacts for Scenarios A-50% and B-50%, which include the assumption of a 50% emissions reduction, in 2050, 2100, and 2125.

As with our other modeling results, the Scenario A-50% and Scenario B-50% results show that EPA's results are highly sensitive to different methodological assumptions and

parameters. Our modeling further reinforces that the impacts are not *de minimis*. For example, if EPA had analyzed a different baseline and end point year and made different assumptions about emissions growth (Scenario B-50%), the temperature and sea level rise impacts attributable to U.S. power-plant emissions would be calculated as 2% or more by 2125. This is at least double EPA's supposed 1% threshold. Even assuming EPA's methodology, this is obviously not *de minimis*.

3. EPA's *de minimis* tests cannot be reconciled with prior agency determinations that even smaller impacts are meaningful for Clean Air Act regulatory purposes.

EPA also neglects to explain why it is adopting these new comparative metrics for global temperature and sea level rise impacts at all, when earlier greenhouse gas rules explicitly found that small changes in global temperature and sea level rise are in fact meaningful. *See, e.g.*, 75 Fed. Reg. 25324, 25495-96 (May 7, 2010); 77 Fed. Reg. 62624, 62897-98 (Oct. 15, 2012).

For example, in the 2010 light-duty greenhouse gas rule, EPA's modeling of the rule's impacts showed that "global mean temperature is estimated to be reduced by 0.006 to 0.015 °C by 2100 ... and sea-level rise is projected to be reduced by approximately 0.06-0.14cm by 2100." 75 Fed. Reg. at 25495. EPA then addressed adverse comments "that the projected changes in climate impacts resulting from this action are small and therefore not meaningful," stating that the agency "disagrees with this view as the reductions may be small in overall magnitude, but in the global climate change context, they are quantifiable showing a clear directional signal across a range of climate sensitivities. EPA therefore determines that the projected reductions in atmospheric CO_2, global mean temperature and sea level rise are meaningful in the context of this rule." *Id.* EPA further explained that such changes were meaningful regardless of whether they were within the range of measurement sensitivity, and that measurability was not an appropriate criterion for evaluating the materiality of greenhouse gas emissions reductions. *See* EPA Response to Comments Document for Joint Rulemaking of Light-Duty Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards 5-389 to 5-390 (2010). Finally, EPA noted that its "rule takes many factors into consideration," and that apart from global temperature and sea level rise impacts, "[t]he benefits of greenhouse gas emissions reductions can be characterized both qualitatively and quantitatively, some of which can be monetized." *Id.* at 5-391. Later EPA vehicle greenhouse gas rules reprised similar modeling exercises and continued to find that even smaller impacts on global temperature and sea level rise lead to meaningful health and environmental effects.[355]

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[355] *See, e.g.*, 77 Fed. Reg. 62624, 62895-96 (Oct. 14, 2012) ("Although the projected reductions and improvements are small in comparison to the total projected climate change, they are quantifiable, directionally consistent, and will contribute to reducing the risks associated with climate change. Climate change is a global phenomenon and EPA recognizes that this one national action alone will not prevent it: EPA notes this would be true for any given greenhouse gas mitigation action when taken alone or when considered in isolation…. [T]his rule obviously results in 'meaningful mitigation of greenhouse gas emissions[.]'"); 76 Fed. Reg. 57106, 57298-99 (Sep. 15, 2011) (similar); 81 Fed. Reg. 73478, 73835 (Oct. 25, 2016) (similar).

The Supplemental Proposal's modeled changes in global temperature and sea level rise from U.S. power-plant emissions are far greater than those projected in earlier rules. Despite this, EPA has not reconciled its prior finding that its greenhouse gas standards had meaningful impacts with its novel conclusion that the far greater impacts of all U.S. power-plant greenhouse gases – and all standards in any conceivable circumstance – are now *de minimis,* nor has it even acknowledged this sudden about-face. *See FCC v. Fox TV Stations, Inc.*, 556 U.S. 502, 515 (2009) ("The requirement that an agency provide reasoned explanation for its action would ordinarily demand that it display awareness that it *is* changing position. An agency may not, for example, depart from a prior policy *sub silentio* or simply disregard rules that are still on the books."). EPA's failure to address the reasoning provided in the earlier rules renders its deviation from past practice procedurally unexplained and substantively wrong.

C. EPA's futility rationale is not relevant to EPA's authority.

Even if EPA's futility analysis and findings were reasonable and correct (which they are not), the futility rationale still would not be relevant to EPA's regulatory authority. The Agency is wrong in its novel interpretation that the Clean Air Act requires or permits EPA to consider, as a prerequisite to regulation under Section 111, "a source category's contribution to the *endangerment* caused by air pollution, rather than to just the air pollution itself." 91 Fed. Reg. at 59024 (emphasis added). And EPA is wrong that the statute further requires EPA to determine "that emission standards be capable of having a material impact on the identified danger." *Id.* at 59040. In fact, nothing in the statutory text (nor background principles of law) suggests that the type of futility analysis EPA proposes here has any relevance to the scope of regulatory authority that Congress conferred in Section 111 – let alone dictates that EPA lacks Section 111 authority over a source category whenever the Agency purports to determine that exercise of its authority has not or could not have a large enough impact. As detailed below, EPA's unprecedented interpretation contradicts statutory text, context, and purpose, as well as the Agency's long history of regulating other pollutants under Section 111.

1. EPA's new interpretation of Section 111 as requiring a futility analysis contradicts the text, context, and purpose of the Clean Air Act.

EPA proposes that Section 111(b)(1)(A) – especially "Congress's use of [the term] 'significantly,'" 91 Fed. Reg. at 59028 – "requires that emission standards be capable of having a material impact on the identified danger for the Administrator to conclude that regulated air pollutant from a listed source category …'contributes significantly' to air pollution that may 'reasonably be anticipated' to endanger public health and welfare." 91 Fed. Reg. at 59040; *see also id.* at 59020 (reading the text of Section 111(b)(1)(A) in light of "the background principles that Congress does not require futile efforts or include *de minimis* concerns in general statutory terms"); *id.* at 59036 (describing background legal principles). At other points, the Supplemental Proposal claims Congress intended that the effect of regulation of a source category on endangerment "must be something appreciably more than *de minimis*," or rising to the level of "a relatively large impact on the danger." *Id.* at 59028.

This statutory interpretation is wrong. Any implied *de minimis* condition on EPA's authority must be based on the level of contribution to *air pollution* from the sources – not a projection of the level of mitigation that regulation has achieved or could hypothetically achieve. *See* Significant Contribution Comment at III.B.1.i. (explaining that the text is unambiguous

because the word 'significantly' modifies the verb "contributes," not "endangers," and does not reference either the subsequent regulations or amelioration of harm – all choices Congress could have made, but did not). The D.C. Circuit has also already rejected this exact type of approach to "gauging the effectiveness of whatever emission standards EPA would enact to limit greenhouse gases" as not "inform[ing] the 'scientific judgment'" about endangerment of air pollution and contribution of air pollutants that the relevant statutory provision requires. *Coal. for Responsible Regul.*, 684 F.3d at 118. EPA's proposed interpretation also runs against the canon against surplusage, which reflects a "general reluctance to treat statutory terms as surplusage." *Freeman v. Quicken Loans, Inc.*, 566 U.S. 624, 635 (2012) (cleaned up). This useful canon is "subordinate to the cardinal canon that a legislature says in a statute what it means and means in a statute what it says." *Mullin v. Al Otro Lado*, 609 U.S. 258, 273 (2026) (cleaned up). Under either approach, EPA cannot write the term "air pollution" out of the statute. Congress could have written a statutory provision that connected "cause[], or contribute[]" directly to endangerment of public health or welfare, but it did not. The Supplemental Proposal cannot now assert that Section 111 "requires the Agency to evaluate a source category's contribution to endangerment, not merely to air pollution." *See* 91 Fed. Reg. at 59039 n.216. That reading would render the term "air pollution" mere surplusage and would rewrite the statute in a way that Congress did not intend.

EPA's consistent and contemporaneous approach, upheld by courts, has been to determine if a source category causes or contributes significantly to the *air pollution*, which itself endangers public health or welfare. In *National Lime Association*, the D.C. Circuit upheld EPA's ability to issue Section 111 standards covering particulate matter emissions from lime manufacturing plants based on the fact that they contributed significantly to air pollution even though petitioners asserted lime dust emitted by the plants was beneficial. *See* 627 F.2d at 431 n.48. In particular, the Court explained that "EPA does not appear to have relied on this effect of the lime emissions in support of its standard. It focused instead on the sheer quantity of dust generated by lime plants." *Id.* (citing 42 Fed. Reg. 22507). Instead, EPA had determined how much particulate matter the industry emitted and based its finding on the "danger of particulate emissions' effect on health" in prior "sufficiently supported … determinations" that provided a rational basis in the case. *Id.* Indeed, the *National Lime* Court drew a fine line on the inquiry by placing the phrase "(which may reasonably be anticipated to endanger public health or welfare)" in parentheses. *Id.* This EPA interpretation was issued contemporaneously with the enactment of the 1977 amendments, has remained consistent over time, and is "especially warranted" "respect." *See Loper Bright*, 603 U.S. at 386. The Supplemental Proposal's novel construction of Section 111, which would render the term "air pollution" superfluous by reading it out of the text, is not.

Just as with the Primary Proposal, the Supplemental Proposal's approach creates an unreasonable circularity by requiring EPA to list sources on the basis of regulatory choices that it is only supposed to make after a listing. *See* Significant Contribution Comment at 53. The Supplemental Proposal asserts that "the *effect of regulation* of [a] source category on the adverse impacts resulting from the air pollution of interest must be something appreciably more than *de minimis*." 91 Fed. Reg. at 59028. But nothing in the text of Section 111(b)(1)(A) ties the decision of whether to regulate to the effect of regulation. Indeed, the setting of standards through regulations occurs at a subsequent step, in Section 111(b)(1)(B). EPA cannot collapse these two steps together. If Congress intended to tie EPA's ability to regulate emissions under Section 111 to whether regulation was "appropriate and necessary," it could have done so; indeed, it did so in

Section 112 for power-plant emissions of hazardous air pollutants. *See* 42 U.S.C. § 7412(n)(1); *Michigan v. EPA*, 576 U.S. 743, 752-54 (2015) (explaining relevance of health and environmental effects of the emissions from specific categories of sources, rather than air pollution broadly, and requiring consideration of technologies and their costs to control those emissions); *see generally* Significant Contribution Comment at Part IV. Congress did not choose to do so here, and EPA cannot on its own whim rewrite Section 111 to resemble other provisions.

Furthermore, EPA's cited caselaw does not support the idea that Section 111 provides an "implied authority to exempt *de minimis* concerns" when it comes to reducing the public health and welfare harms from climate change. *See* 91 Fed. Reg. at 59036 (citing *Ala. Power Co. v. Costle*, 636 F.2d 323, 360-61 (D.C. Cir. 1979)). In that case, the D.C. Circuit ruled such an "implied authority is not available for a situation where the regulatory function does provide benefits, in the sense of furthering the regulatory objectives, but the agency concludes that the acknowledged benefits are exceeded by the costs. For such a situation any implied authority to make cost-benefit decisions must be based not on a general doctrine but on a fair reading of the specific statute, its aims and legislative history." *Ala. Power Co.*, 636 F.2d at 361. Here, the regulation of greenhouse gases from power plants under Section 111 undoubtedly does further the regulatory pollution-prevention objectives of the Clean Air Act. S*ee* 42 U.S.C. § 7401(b)(1) (setting purpose of Clean Air 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"); *Massachusetts*, 549 U.S. at 532 (explaining "EPA has been charged with protecting the public's 'health' and 'welfare'" (quoting 42 U.S.C. § 7521(a)(1)). And under Section 111, any consideration of whether the effects of regulation are worth it, which would serve the balancing function described by the court in *Alabama Power*, occurs at the standard-setting phase, when EPA is tasked with determining the cost reasonableness of systems of emission reduction with defined factors that do not revisit significance, *see* 42 U.S.C. § 7411(a)(1), not at the threshold phase of determining whether emissions cause or contribute to air pollution. As the D.C. Circuit has explained, "situations covered by a de minimis exemption must be truly de minimis … otherwise the exemption reflects impermissible second-guessing of Congress's calculations, as opposed to avoidance of absurd or futile results." *Shays v. Fed. Election Comm'n*, 414 F.3d 76, 114 (D.C. Cir. 2005) (cleaned up). Here, the Supplemental Proposal is exactly that kind of impermissible second-guessing.

It is also meaningful that Congress did not include a numerical threshold or *de minimis* qualifier for pollution amounts in Section 111, as it did in other parts of the Clean Air Act. *See Loughrin v. United States*, 573 U.S. 351, 358 (2014) ("We have often noted that when 'Congress includes particular language in one section of a statute but omits it in another' – let alone in the very next provision – this Court 'presume[s]' that Congress intended a difference in meaning." (quoting *Russello v. United States*, 464 U.S. 16, 23 (1983)). For instance, Section 112 defines major source by tons per year emitted of hazardous air pollutants, *see* 42 U.S.C. § 7412(a)(1), as does the definition of "major emitting facility" in the prevention of significant deterioration program, *see id.* § 7479(1). The hazardous air pollution program also sets the threshold for "modification" at more than *de minimis* amounts of increases to hazardous air pollutants. *See id.* § 7412(a)(5). And where Congress did reference "major stationary sources" in Section 111, it did so for the purposes of prioritizing setting regulations – not creating a threshold for what to regulate. *See* 42 U.S.C. § 7411(f). If Congress had meant to put a threshold amount or *de minimis*

restriction on air pollution for Section 111, whether at the source level or source category level, it could have done so. It is meaningful that it did not.

As explained above, the statutory text plainly gives EPA authority to address pollution problems by establishing standards that reduce emissions, and does not require that such standards achieve some extra-statutory "measurable" impact on the harms caused by air pollution. The Clean Air Act is designed to address large-scale problems – atmospheric scale problems – caused by numerous and diverse emission sources. It does so by directing EPA to identify air pollutants that endanger public health and welfare. Once those pollutants have been identified, it directs EPA to set (and as control technologies and scientific understanding advance, revise) standards that will mitigate emissions from different source categories. Congress made that decision. EPA has no authority to change it. And the Supreme Court has already rejected this line of argument. "Agencies, like legislatures, do not generally resolve massive problems in one fell swoop, … but instead whittle away over time, refining their approach as circumstances change and they develop a more nuanced understanding of how best to proceed." *Massachusetts v. EPA*, 549 U.S. 497, 499 (2007).

EPA claims that "significantly" allows it to reject listing of source categories based on projections of regulatory "futility" – regardless of their volume of emissions. EPA points to nothing in the statutory text that gives a futility argument such weight. To the contrary, EPA's self-aggrandizing futility argument would contravene the purpose of the Act by essentially giving the agency the power to decide when to follow Congress's directives, making up its own test of what is a sufficient "measurable" impact.

EPA cannot reasonably defend this proposition. The Merriam-Webster definition states that "significant" means: "having or likely to have influence or effect: important; *also*: large enough to be noticed or to have an effect."[356] This definition reveals the error in EPA's reading. EPA cannot ignore the latter meaning – "large enough to be noticed or to have an effect" – which is recognized in other dictionaries,[357] and which is plainly relevant in the context of air pollution. *See American Trucking*, 531 U.S. at 465-66 (choosing between dictionary definitions and concluding that "[w]ords that can have more than one meaning are given content … by their surroundings").

Air pollution, including greenhouse gas pollution, is a numerically measurable phenomenon, *see, e.g.*, 89 Fed. Reg. at 39808, so understanding "significantly" as asking about the "amount" or "extent" of pollution best fits the circumstances. That this is a natural reading of the phrase "contributes significantly" is emphasized by the statute's use of the adverb

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[356] "Significant," *Merriam-Webster.com Dictionary*, https://www.merriam-webster.com/dictionary/significant (Definition "2a") (emphasis in original).

[357] *See also, e.g.*, "Significant," *The American Heritage Dictionary of the English Language* (5th ed. 2022), https://ahdictionary.com/word/search.html?q=significantly (defining the adjective "significant" as "2. Having or likely to have a major effect; important … 3. Fairly large in amount or quantity").

"significantly." In its adverb form, "significantly" asks a question of degree or extent.[358] Likewise, "significantly" modifies "contribute," a word that means "to have a part or share in producing." *See Bluewater Network v. EPA*, 370 F.3d 1, 13 (D.C. Cir. 2004) (interpreting "contribute" in the context of the Clean Air Act's "cause or contribute" provisions).

The definitions of "significant" and "significantly," at a minimum, leave that question open to be "clarified by the remainder of the statutory scheme." *See Util. Air. Regul. Grp. v. EPA*, 573 U.S. at 321 ("A statutory provision that may seem ambiguous in isolation is often clarified by the remainder of the statutory scheme … because only one of the permissible meanings produces a substantive effect that is compatible with the rest of the law." (citing *United Sav. Ass'n of Tex. v. Timbers of Inwood Forest Ass'n*, 484 U.S. 365, 371 (1988))). The statutory scheme favors commenters' understanding, not EPA's, so EPA's proposal is not the best reading of the statute.

To be sure, there may be circumstances where the modifier "significantly" would allow EPA to determine that *additional* source categories should be listed for regulation, even in the absence of a large quantum of emissions contributing to the concentration of air pollution (for example, if warranted by other factors like the geographic concentration of emissions in vulnerable areas or the greater potency of even smaller quantities of emissions). But the term is best read to require a listing of categories that contribute "noticeably and measurably large amounts" of air pollution, even if it may *also* encompass sources whose contribution is significant by some additional measure of severity. As such, EPA cannot refuse to list source categories that meet the more specific definition concerning contribution in large amounts, even if they might also list smaller contributors whose contributions can be otherwise justified as significant. *Cf., e.g.*, *RadLAX Gateway Hotel, LLC v. Amalgamated Bank*, 566 U.S. 639, 645 (2012) ("It is a commonplace of statutory construction that the specific governs the general." (internal quotation marks omitted)).[359]

As discussed above, U.S. power plants have had, and will continue to have, an indisputably outsized influence on the scope of the greenhouse gas pollution problem, including when considering contributions from other sectors, emissions of other nations, and EPA's own past listing decisions. The Agency cannot now reasonably call these sources "insignificant." Either way, EPA's reading is implausible and so arbitrary, capricious, and unreasonable. In sum, the Agency's proposed interpretation is not the best reading of the statute, and "if it is not the

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[358] *See, e.g.*, "Significantly," *Merriam-Webster.com Dictionary*, https://www.merriam-webster.com/dictionary/significantly (defining the adverb "significantly" as "in a significant manner: to a significant degree"); "Significantly," *Oxford English Dictionary Online*, https://www.oed.com/search/dictionary/?scope=Entries&q=significantly (defining "significantly" as "to a significant degree or extent").

[359] Similarly, a phrase like "having reached maturity" might be defined as "reaching the age of adulthood" as well as "being fully grown or developed." In that case, you could not rightfully exclude 18-year-olds – the accepted age of adulthood – even if you could *also* designate additional members of the category according to more qualitative criteria concerning mental or physical development.

best, it is not permissible." *Loper Bright*, 603 U.S. at 400. At a minimum, EPA has failed to address an important aspect of the term's plain meaning and so failed to provide public notice and comment on the Agency's view of this aspect. *Cf. Jazz Pharms., Inc. v. Kennedy*, 141 F.4th 254, 261 (D.C. Cir. 2025) (casting doubt on a statutory reading that "brushe[d] past" part of the dictionary definition "without explanation"). For each of these reasons, it cannot finalize the proposed rule.

2. EPA's unprecedented statutory interpretation is inadequately explained and cannot be reconciled with EPA's control of other pollutants.

EPA claims that its new interpretation of Section 111(b)(1)(A) requires the Agency to consider a source category's contribution to the endangerment caused by *any* air pollution – not just greenhouse gas pollution, but EPA does not, and cannot, explain how the Agency's long history of stationary source regulation could be reconciled with this novel reading. *See* 91 Fed. Reg. at 59024. Indeed, EPA's novel foray into the materiality of greenhouse gas pollution regulation could wreak havoc on the entire stationary-source emissions program if the same approach were more broadly applied to other pollutants. These grave implications of EPA's new interpretation – which are wholly at odds with Congress's desire to control dangerous pollution, as well as EPA's regulatory practice for decades – reinforce that EPA's new interpretation cannot be the best reading of Section 111(b)(1)(A). An interpretation that renders Congress's directives ineffectual simply cannot be the best reading of the Act, and "if it is not the best, it is not permissible." *Loper Bright*, 603 U.S. at 400; *see also id.* at 386 ("[T]he longstanding practice of the government – like any other interpretive aid – can inform a court's determination of what the law is." (citation modified)).

For illustration, as with greenhouse gas pollution, other pollution is caused by numerous factors beyond power-plant emissions. Many pollution problems arise from diverse anthropogenic emission sources, including mobile, stationary, and area sources; as well as natural factors, such as temperature wind, humidity, sunlight, and natural emissions (*e.g.*, volatile organic compounds emitted by organic matter, sea spray aerosols, volcanic eruptions). For example, ground-level ozone formation is significantly affected by not only power-plant emissions of NO_X and VOCs, but also by other anthropogenic emissions, sunlight and higher ultra-violet radiation, higher temperatures that accelerate chemical reactions and increase natural VOC emissions, atmospheric stagnation (*e.g.*, due to thermal inversions or calm winds), and humidity. EPA has never before posited that the fact that other dynamics also affect criteria air pollution formation precludes it from addressing sources otherwise under its regulatory purview. EPA cannot regulate the sun, or predict with complete precision when there will be a sufficient amount sunlight to enable ozone formation, and therefore precisely what effect reductions in VOC and NO_X emissions will have on ozone formation in a given year, or the resulting health outcomes. EPA knows, however, that reducing VOC and NO_X emissions will reduce ozone formation and the resulting health and welfare harms, and has set standards that require VOC and

NO_X emission reductions. In doing so, EPA has ensured significant improvements in ozone pollution.[360]

Applying EPA's focus on the materiality of pollution impacts to ozone pollution would raise significant concerns. Might controlling NO_X pollution be futile because, for instance, the effects of such technology on ozone formation will depend on the number of warm sunny days, as opposed to cool cloudy days? Would the existence of regulatory authority depend on the relative impact of the contribution of power-plant NO_X emissions to ozone formation compared to non-power-plant sources, or compared to the uncertainties found in historical data trends? Or would it depend on the uncertainties in the measurement of ambient ozone, for example the discrepancies between monitored ozone concentrations and actual ozone concentrations prevailing across a region (*e.g.*, due to spatial or temporal variability) or instrument uncertainties (*e.g.*, calibration drift, instrument detection limits, etc.), and the relative size of those uncertainties compared to the impacts of controlling power-plant NO_X emissions? Would regulation be futile because ozone formation cannot be eliminated without eliminating ozone and NO_X transport from other countries? Would it be futile because the subsequent effects on the harms caused by ozone, NO_X, and VOCs – respiratory, cardiovascular, nervous system, cancer, mortality, visibility impairment, materials damage, etc. – could not be predicted with a certain level of precision and certainty? To our knowledge, none of EPA's prior stationary source criteria pollutant rules have engaged in these kinds of analyses, whether for ozone or any other pollutant[361] – and such analyses are irrelevant under the correct reading of the statute.[362]

In addition, EPA fails to explain why it newly conditions greenhouse gas regulation on meeting this atextual standard for materiality when it has never taken the same approach to

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[360] *See* EPA, *Our Nation's Air: Trends Through 2023* (2024), https://gispub.epa.gov/air/trendsreport/2024/.

[361] We provide ozone as an illustrative example, but ozone is not the only pollution problem with these characteristics. For example, ambient PM pollution is also subject to complex causal chains, involving diverse anthropogenic and natural emissions (*e.g.*, sea salt, natural VOC and ammonia emissions) and meteorological factors (*e.g.*, temperature, sunlight, humidity, cloud and fog cover, wind and mixing, precipitation, wildfires and dust storms, etc.). Ambient PM measurement is also subject to uncertainties, including those related to spatial and temporal variability, and limits on instrument precision and accuracy. PM pollution also has complex and attenuated pathways through which it causes endangerment. The same sources of uncertainties (*e.g.*, diverse primary sources, numerous factors affecting secondary formation, measurement uncertainties, complex and attenuated harm pathways) apply to many air toxics as well.

[362] Indeed, the D.C. Circuit has reached a similar conclusion in another context. *Cf. Catawba Cty. v. EPA*, 571 F.3d 20, 39 (D.C. Cir. 2009) ("Given that the statute uses the word 'contribute' and that a contribution may simply exacerbate a problem rather than cause it, we see no reason why the statute precludes EPA from determining that a county's addition of PM2.5 into the atmosphere is significant even though a nearby county's nonattainment problem would still persist in its absence . . . . We may not interpret 'contribute' in a way that does such violence to [the provision]'s very purpose.").

criteria pollutant regulation. To the contrary, EPA has routinely regulated other emissions from other sources based on far smaller contributions to the air pollution problem than power-plant greenhouse gases. For example, during the Bush administration, EPA regulated criteria pollutant emission from motorcycles based on findings that, inter alia, "highway motorcycles are significant contributors to mobile-source air pollution, currently accounting for 0.6 percent of mobile-source hydrocarbon (HC) emissions, 0.1 percent of mobile-source oxides of nitrogen (NO_X) emissions, and less than 0.1 percent of mobile-source particulate matter (PM) emissions." 69 Fed. Reg. 2398, 2399 (Jan. 15, 2004); *see also* Significant Contribution Comment at 35-36 (describing EPA regulation of refineries and of Portland cement plants under Section 111). EPA fails to explain why greenhouse gases should be singled out for special treatment.

And although EPA explicitly indicates its intent to not affect criteria regulation in this Supplemental Proposal, *see* 91 Fed. Reg. at 59006, its unprecedented interpretation raises significant questions for the vitality of the entire stationary source emissions program – and the Clean Air Act writ large. The agency's radical and atextual interpretation undermines the text, operation, and purpose of Section 111, not only for greenhouse gas regulation but also for the other pollutants that Congress explicitly mandated EPA to regulate.

D. EPA's futility rationale has no bearing on the best reading of Section 111.

The Supplemental Proposal additionally claims that EPA's futility finding "reinforces [EPA's] proposed interpretation" of Section 111(b)(1)(A)). 91 Fed. Reg. at 59020. Specifically, EPA proposes that its futility analysis "support[s] the conclusion that the EPA lacks authority" to control power-plant greenhouse gas emissions under Section 111 "in response to global climate change concerns." 91 Fed. Reg. at 59005; *see also id.* at 59028 ("[EPA's] futility analysis … further supports the conclusion that 'air pollution' … does not include global climate change concerns."); *id.* at 59006; *id.* at 59024 ("Our proposed futility analysis below further supports this conclusion.").

EPA cannot rely on the proposed futility analysis to support its other proposed conclusions. As an initial matter, the futility finding is fatally flawed for all of the reasons set forth above and therefore inappropriate to inform any reading of Section 111, even if futility were a relevant consideration in statutory construction.

More importantly, EPA's present-day modeling of forward-looking greenhouse gas emissions cannot have any relevance on what pollutants (or pollution) Congress placed within EPA's fundamental authority decades ago. To the contrary, Congress stated at the time that its design of Section 111 was intended to be "preventive" and "precautionary," and not dependent on "conclusive proof of harm." H.R. Rep. 95-294 at 47-51.[363] As a provision governing emission

[363] Notably, Congress also stated that it had designed the 1977 amendments to Section 111 to "assure consideration of the cumulative impacts of all sources of a pollutant," *id.* at 49-50, which is directly contrary to EPA's blinkered futility analysis. Even if individual source categories might still be found to contribute less than a significant amount to the collective pollution problem, such an assessment would not mean the pollution itself does not and could never fall within EPA's regulatory authority under the Act.

standards for new facilities, that is, those not yet built, Section 111 is intended to address pollution problems before they arise – and even before it is known precisely how substantial those problems might be. It makes no sense, then, for EPA to suggest that its current view of the "effect of regulation" should control what pollutants *might conceivably* be regulated under the Act as a matter of law. That is why the Act is best understood as setting a test that any pollutant might meet, without categorically excluding any.[364] The Supplemental Proposal's suggestion that an agency can do later analysis that would alter the scope of Congressionally-delegated authority is thus patently illogical and an affront to Congress's legislative powers.

EPA's modeling is also designed to cast doubt on the effects of greenhouse gas reductions by framing it in terms of "measurability," even though EPA defines that term as being about "uncertainty." 91 Fed. Reg. 59040 n.217. Through this sleight of hand, EPA attempts to evade clear judicial direction regarding how to deal with uncertainty. In *Massachusetts*, the Supreme Court commanded that EPA cannot "avoid its statutory obligation by noting the uncertainty surrounding various features of climate change and concluding that it would therefore be better not to regulate at this time.… That EPA would prefer not to regulate greenhouse gases because of some residual uncertainty … is irrelevant." 549 U.S. at 534. And the D.C. Circuit has stated that "the existence of some uncertainty does not, without more, warrant invalidation of an endangerment finding" given the Clean Air Act is "precautionary in nature." *Coal. for Responsible Regulation*, 684 U.S. at 121. EPA cannot repackage already rejected arguments about uncertainty in terms of measurability and futility.

Notably, despite asserting that the proposed futility analysis supports EPA's best reading argument, EPA also contends that "[e]ach of the legal bases proposed in this action is independent from the others." 91 Fed. Reg. at 59020. The agency cannot have it both ways. As courts have held, "EPA's actions must also be consistent; an internally inconsistent analysis is arbitrary and capricious." *Nat'l Parks Conservation Ass'n v. EPA*, 788 F.3d 1134, 1141 (9th Cir. 2015) (citing *Gen. Chem. Corp. v. United States*, 817 F.2d 844, 857 (D.C. Cir. 1987) (per curiam)). Furthermore, the supposed support from the proposed futility analysis for EPA's best reading argument undermines the Supplemental Proposal's assertion that "scientific and technical literature" are not relevant because the "issues raised in this supplemental proposal, however, are legal in nature and turn on statutory interpretation and the application of judicial precedent." 91 Fed. Reg. at 59018. EPA cannot disregard scientific and technical information, which as shown elsewhere in this comment clearly establish the ways greenhouse gas pollution from power plants endangers public health and welfare, while also asserting that its flawed modeling attempt supports its statutory interpretation argument. EPA's rationales cannot be independent or intertwined depending on what best suits the Agency's deregulatory goals in a given moment, it must present a coherent rationale.

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[364] Nor, of course, does the text of the Act suggest that the scope of EPA's authority depends on forward-looking projections of source category emissions compared to global emissions, or changes of specific amounts to future effects such as temperature or sea level rise if the pollution were regulated.

Finally, EPA cannot use this convoluted argument as some sort of "backdoor" to convert its futility analysis into a factual assessment of significance itself. EPA's proposal is clear that it "[t]he rationale proposed in this supplemental notice is distinct from the rationale presented in the primary proposal of the June 2025 NPRM, which sought public comment on whether the EPA has authority to regulate GHG emissions from power plants based on the significance of the fossil fuel-fired EGU source category's contribution," and EPA is "not seeking additional comment" on the latter. 91 Fed. Reg. at 59008. In any event, EPA could not make new substantive conclusions about the "significance" of the source category's contributions to air pollution without addressing the factual record on significance presented in the 2015 Finding, which this proposal does not do.

E. EPA cannot rationally determine that retaining power-plant greenhouse gas emission standards is unreasonable.

EPA also proposes to conclude, without any further explanation, "that retaining futile GHG standards for fossil fuel-fired EGUs under CAA section 111 would be unreasonable given the significant costs they impose on regulated parties, consumers, and the economy." 91 Fed. Reg. at 59006; *see also id.* at 59036 (in light of EPA's futility determination, "it would be unreasonable … to retain associated standards"). As an initial matter, two glib, conclusory sentences fail to satisfy either the statutory notice requirement or the threshold for reasoned agency decision-making. *See* 42 U.S.C. § 7607(d)(3) (requiring EPA to publish notice of a proposed rulemaking, which "shall be accompanied by a statement of its basis and purpose"); *State Farm*, 463 U.S. at 43; *FCC v. Prometheus Radio Project*, 592 U.S. 414, 423 (2021) (agency action must be "reasonably explained"). The public cannot understand from these conclusory statements how EPA is weighing the futility determination against the costs of its standards, and in light of its statutory obligations, which costs the agency is considering, and whether and how EPA is considering the benefits of its standards.

Moreover, these unsupported assertions cannot serve as an independent basis for repealing and rescinding prior agency findings and rules that were themselves supported by robust records, including regulatory impact analyses with detailed cost and benefit calculations. If an agency's "new policy rests upon factual findings that contradict those which underlay its prior policy," the agency must provide a "more detailed justification than what would suffice for a new policy created on a blank slate." *Fox Television*, 556 U.S. at 515-16; *see also FDA v. Wages & White Lion Invs., L.L.C.*, 604 U.S. 542 (2005); *Organized Vill. of Kake v. U.S. Dep't of Agric.*, 795 F.3d 956, 969 (9th Cir. 2015) (en banc) ("The absence of a reasoned explanation for disregarding previous factual findings violates the APA."); *R.J. Reynolds Vapor Co. v. FDA*, 65 F.4th 182, 192 (5th Cir. 2023) (agency action was likely arbitrary and capricious where agency "brushed over its prior statements" and failed to reconcile prior factual findings). EPA must confront its prior factual findings about the benefits of its greenhouse gas standards and thoroughly explain why EPA now believes that its change in position is a good and permissible policy choice despite the significant lost health and welfare benefits.

Indeed, EPA evaluated the emissions reductions, benefits, and costs of the final 2024 carbon pollution standards and projected reductions of 1.38 billion metric tons of CO_2 systemwide through 2047 as well as tens of thousands of tons of harmful particulate matter, sulfur dioxide, and nitrogen oxide emissions. 89 Fed. Reg. at 40004. In 2035 alone, EPA

estimated the emissions reductions would have led to 1,200 avoided premature deaths; 870 avoided hospital and emergency room visits; 1,900 avoided cases of asthma onset; 360,000 avoided cases of asthma symptoms; 48,000 avoided school absence days; and 57,000 avoided lost workdays.[365] The climate and health benefits of the 2024 rule substantially outweighed the compliance costs. Between 2024 and 2047, EPA projected net climate and health benefits of up to $370 billion. 89 Fed. Reg. at 40008. The proposed futility analysis does not disrupt or call into question EPA's prior cost-benefits analyses and findings in any way. In fact, as discussed above, our conversion of EPA's own futility analysis findings into monetized values shows benefits of $9.1 trillion by 2050 – dwarfing the projected compliance costs associated with EPA's 2024 carbon pollution standards ($19 billion at a 2% discount rate). 89 Fed. Reg. at 40005. In light of these prior findings, the only rational conclusion is that EPA should maintain existing standards as reasonable and overwhelmingly net-beneficial.

In any event, EPA's methodology of negating the full range of benefits of regulation and comparing solely EPA's futility analysis to costs is arbitrary and capricious and counter to all federal guidance and historical practice regarding cost-benefit analysis. *See Window Covering Mfrs. Ass'n v. Consumer Prod. Safety Comm'n*, 82 F.4th 1273, 1288 (D.C. Cir. 2023) ("'an unreasonable assessment of social costs and benefits' can render a rule arbitrary and capricious" (citing *Thompson v. Clark*, 741 F.2d 401 (D.C. Cir. 1984)). Executive orders governing regulatory review direct agencies to assess the actual effects of regulatory requirements and explicitly require analysis of both direct and indirect costs and benefits. *See, e.g.*, Exec. Order No. 12,866, 58 Fed. Reg. 51735 (Oct. 4, 1993), § 6(a)(3)(C); Exec. Order No. 13,563, 76 Fed. Reg. 3821 (Jan. 21, 2011), § 1(a). The Office of Management and Budget directs agencies to consider "any important" benefits.[366] Adhering to those guidelines, EPA has for decades undertaken a robust cost-benefit analysis when evaluating Clean Air Act regulations. It would be arbitrary and capricious indeed for EPA to stray from its well-established decision-making practice for a rule with as grave consequences as repealing the Agency's entire regulatory program for a dangerous pollutant. *See State Farm*, 463 U.S. at 43 (agency cannot "rel[y] on factors which Congress has not intended it to consider" or "entirely fail[ ] to consider an important aspect of the problem").

Overall, EPA has failed to explain why it now abandons its longstanding metrics for assessing the efficacy of power-plant regulation – such as emissions impacts and monetized benefits – in favor of this novel methodology. EPA's unexplained deviation from past practice is arbitrary and capricious.

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[365] EPA, *Regulatory Impact Analysis for the New Source Performance Standards for Greenhouse Gas Emissions from New, Modified, and Reconstructed Fossil Fuel-Fired Electric Generating Units; Emission Guidelines for Greenhouse Gas Emissions from Existing Fossil Fuel-Fired Electric Generating Units; and Repeal of the Affordable Clean Energy Rule*, at 4-51 tbl. 4-7 & 4-56 tbl. 4-12 (2024), Doc. ID No. EPA-HQ-OAR-2025-0124-0053.

[366] Office of Mgmt. & Budget, Circular A-4: Regulatory Analysis 26 (2003), https://www.whitehouse.gov/wp-content/uploads/2025/08/CircularA-4.pdf.

IX. THE PROPOSAL VIOLATES FUNDAMENTAL PRINCIPLES OF ADMINISTRATIVE LAW AND IS THEREFORE ARBITRARY AND CAPRICIOUS.

The Supplemental Proposal violates multiple fundamental principles of administrative law and is thus arbitrary and capricious and must be rescinded. Among its many flaws, the Supplemental Proposal fails to meet the requirements for agency policy change, relies on factual assumptions it has failed to justify, unlawfully disregards relevant findings and National Academies of Science reports, does not reflect consultation with the Science Advisory Board or comply with scientific integrity requirements, failed to provide meaningful opportunity to comment, reflects the actions of an Administrator with a closed mind, and failed to incorporate adequate stakeholder consultation. Each of these failures is enough on its own to render the entire proposal arbitrary and capricious, and together each failure compounds the others. This section discusses these overarching failures of the proposal to comply with basic tenets of administrative law, and specifics of these failures are discussed throughout the comment.

Revising standards under Section 111 is governed by Section 307(d), which incorporates and basic principles of administrative law. *See* 42 U.S.C. § 7607(d)(1)(C), (d)(9); *Catawba County v. EPA*, 571 F.3d 20, 41 (D.C. Cir. 2009) (discussing Clean Air Act and Administrative Procedure Act review standards). Among other requirements, the Clean Air Act requires a notice of proposed rulemaking to "be accompanied by a statement of its basis and purpose" that includes a summary of "(A) the factual data on which the proposed rule is based; (B) the methodology used in obtaining the data and in analyzing the data; and (C) the major legal interpretations and policy considerations underlying the proposed rule." 42 U.S.C. § 7607(d)(3).

EPA cannot finalize a rule that is "arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law," "in excess of statutory jurisdiction, authority, or limitations, or short of statutory right," or "without observance of procedure required by law." 42 U.S.C. § 7607(d)(9). Under this standard, "an agency rule would be arbitrary and capricious if the agency has relied on factors which Congress has not intended it to consider, entirely failed to consider an important aspect of the problem, offered an explanation for its decision that runs counter to the evidence before the agency, or is so implausible that it could not be ascribed to a difference in view or the product of agency expertise." *State Farm*, 463 U.S. at 43. An agency must establish a "rational connection between the facts found and the choice made." *Id.* at 52.

The proposed reconsideration fails to meet that standard, and if finalized, would be arbitrary and capricious.

A. EPA fails to meet the standard for agency policy change.

EPA is not writing on a blank slate – it is proposing to repeal a policy supported by extensive scientific evidence developed over decades. When reversing a policy, as proposed here, it must provide a "more detailed justification than would suffice for a new policy written on a blank slate" if the "new policy rests upon factual findings that contradict those which underlay its prior policy." *FCC v. Fox Television Stations, Inc.*, 556 U.S. 502, 515 (2009). As the Supreme Court has held, it "would be arbitrary and capricious to ignore such matters." *Id.* That is why a "reasoned explanation is needed for disregarding facts and circumstances that underlay . . . the prior policy." *Id.* at 516.

The Supplemental Proposal falls woefully short of the legal requirement for an agency policy change. Whereas the 2009 Endangerment Finding found a likelihood of adverse health impacts from increased frequency and severity of hurricanes, flooding, and wildfire, and EPA's 2015 findings "confirm[ed] and strengthen[ed]" that view, 80 Fed. Reg. at 64518, EPA proposes here to conclude (without support) that greenhouse gases fall beyond the terms of the Act because they "involved casual relationships that are too uncertain, conjectural, remote, and convoluted by intervening and confounding factors." 91 Fed. Reg. at 59023. Likewise, EPA took the position in its February repeal of the 2009 Endangerment Finding that "extreme weather events have not demonstrably increased relative to historical highs," 90 Fed. Reg. at 36309, and uses a flawed modeling analysis to assert that regulating greenhouse gases from power plants "would have no meaningful impact on the identified dangers to public health and welfare," 91 Fed. Reg. at 59035 – an error discussed in full, *supra* at Comment Part VIII. EPA's purportedly legal theories for concluding it has no authority under Clean Air Act Section 111 to regulate harmful emissions are, in fact, intertwined with policy choices for which EPA provides little or no record. Accordingly, EPA's explanation for its departure from prior practice fails to meet its obligations for reasoned explanation and is thus arbitrary. *See Fox*, 556 U.S. at 515-16.

B. EPA's supposed legal determinations rely on factual assumptions the Agency has failed to justify and for which it lacks an adequate record.

Throughout the Supplemental Proposal, EPA's legal determinations rely on factual assumptions that are unsupported by the scientific and administrative record. As discussed in other sections of this comment, EPA repeatedly declines to engage with the extensive scientific and factual record supporting the power plants rules it now proposes to repeal. Instead, EPA asserts that its legal determinations do not require reliance on such scientific evaluations. However, the legal analysis leaps EPA makes in the Supplemental Proposal rely on factual assumptions never fully explained or supported and contradicted by scientific and factual analyses the agency now chooses to ignore.

For example, EPA argues that greenhouse gas emissions "impact health or welfare only indirectly," 91 Fed. Reg. at 59026. It also asserts that "the threshold for a quantity of GHGs to comprise a 'significant' contribution to either elevated atmospheric GHG concentrations . . . or the adverse impacts thereof, is well above the likely contributions of a single source category." 91 Fed. Reg. at 59024. EPA also states, as noted above, that "GHG emissions from fossil fuel-fired power plants in the United States do not have a sufficiently close connection to the harms identified in the 2015 Findings to fit within the legal meaning of 'cause' or 'contribute'" because "[g]lobal climate change concerns involve causal relationships that are too uncertain, conjectural, remote, and convoluted by intervening and confounding factors." 91 Fed. Reg. at 59023. EPA provides little to no analysis to support these assertions and expressly refuses to utilize the analytical tools previously relied upon by the agency for assessing the impacts of increased emissions from U.S. power plants that would result from its decision.

These "legal" determinations require factual and scientific assumptions that can and should be tested and considered with a more robust scientific record. EPA's legal analysis relies on the validity of these assumptions. EPA's failure to consider an important aspect of the problem or offer a robust explanation for making a decision that runs counter to evidence before the agency is arbitrary and capricious. *State Farm*, 463 U.S. at 43. Likewise, the legal analysis

based on factual leaps over gaping holes of information does not provide the requisite "rational connection between the facts found and the choice made." *Id.* at 52.

C. EPA unlawfully disregards evidence before the Agency, including pertinent findings, recommendations, and comments by the National Academy of Sciences.

EPA has also unlawfully disregarded evidence before the Agency. EPA "cannot ignore evidence that undercuts its judgment." *See Inteliquent, Inc. v. FCC*, 35 F.4th 797, 802 (D.C. Cir. 2022); *see also Comcast Corp. v. FCC*, 579 F.3d 1, 8 (D.C. Cir. 2009) (explaining the court has "not hesitated to vacate a rule when the agency has not responded to empirical data or to an argument inconsistent with its conclusion"); *State Farm*, 463 U.S. at 43 (holding an agency action is arbitrary and capricious if the agency has "offered an explanation for its decision that runs counter to the evidence before the agency"). However, that is exactly what the Supplemental Proposal does.

The Supplemental Proposal blatantly disregards the National Academies research, National Climate Assessments, and IPCC reports reflecting scientific consensus on climate change. These reports, however, are high quality sources of scientific information that reflect overwhelming consensus. In the 2009 Endangerment Finding, EPA included a copy of the National Climate Assessment's guidance to agency leads on preparation of synthesis and assessment products (SAPs), which explained that each agency lead must follow OMB's information quality procedures.[367] EPA concluded that the "process was robust, objective, transparent, and complete and ensured that the USGCRP and CCSP reports . . . were consistent with the [OMB Information Quality Act] Guidelines."[368] It subsequently based its 2015 Endangerment Finding on the same basis as the 2009 Endangerment Finding, in addition to considering the 2010 denial of petitions to reconsider the Finding and "the subsequent assessments from the IPCC and NRC that describe scientific developments since those EPA actions." 80 Fed. Reg. at 64530. The Supplemental Proposal does not even display awareness that EPA previously satisfied OMB's guidelines, nor does it adequately address the numerous reports demonstrating the scientific consensus on climate change. It is therefore arbitrary and capricious. *See Fox*, 556 U.S. at 515-16.

EPA has no valid reason to disregard the evidence and conclusions of the National Climate Assessments, other NRC research findings, or IPCC reports, and it has also failed to consider other government reports on human-caused greenhouse gas emissions, climate change, and their impacts on public health and welfare. In doing so, EPA has acted arbitrarily and capriciously.

Likewise, EPA disregards extensive consensus reports of the National Academy of Sciences ("NAS") in violation of the Clean Air Act. Section 307(d) of the Clean Air Act, which includes the Clean Air Act's requirements for endangerment findings, emissions standards, and

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[367] Endangerment Finding Request for Comments Vol. 1, App. B, at 106, *available at* https://perma.cc/K93T-TRDL.

[368] Endangerment Finding Request for Comments Vol. 1, at 60-61, *available at* https://perma.cc/CYH4-D5Y4.

other specified rulemakings, provides that the statement of basis and purpose supporting a proposed rule:

> shall ... set forth or summarize and provide a reference to any pertinent findings, recommendations, and comments by … the National Academy of Sciences, and, if the proposal differs in any important respect from any of these recommendations, an explanation of the reasons for such differences. All data, information, and documents referred to in this paragraph on which the proposed rule relies shall be included in the docket on the date of publication of the proposed rule.

42 U.S.C. § 7607(d)(3).[369] The proposed rule fails to satisfy these statutory requirements. Rather, it unlawfully disregards decades of pertinent work by the National Academies and fails to grapple with the consensus science represented in these reports. If the Administrator wishes to issue a proposed rule predicated in any part on a reassessment and rejection of mainstream climate science that has been subject to meticulous review by NAS and other leading scientific institutions, it needs to withdraw the proposal and issue a new one that complies with the express requirements of the Clean Air Act, including 42 U.S.C. § 7607(d)(3)(C).

The NAS has published a great volume of work on climate science and climate methodology, as discussed in more detail in our Vehicle Endangerment Comment. EPA's Supplemental Proposal acknowledges NAS's recently published report that examining the science demonstrating how human-caused climate change is impacting extreme weather events.[370] Yet it erroneously claims that this report and prior NAS releases do not conflict with its supposed legal rationale for this proposal and provides no explanation for why its analysis departs from the robust NAS evaluations. 91 Fed. Reg. at 59019 (arguing that the NAS reports do not "differ in any material respect from or conflict with the legal rationales" presented in the proposal).

The Supplemental Proposal entirely fails to reference September 17, 2025, NAS consensus study on the *Effects of Human-Caused Greenhouse Gas Emissions on U.S. Climate,*

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[369] With respect to final rules, Section 307(d)(6) of the Act, 42 U.S.C. § 7607(d)(6), provides:

> (A) The promulgated rule shall be accompanied by (i) a statement of basis and purpose like that ... with respect to a proposed rule and (ii) an explanation of the reasons for any major changes in the promulgated rule from the proposed rule.
>
> (B) The promulgated rule shall also 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.
>
> (C) The promulgated rule may not be based (in part or whole) on any information or data which has not been placed in the docket as of the date of such promulgation.

[370] 91 Fed. Reg. at 59019 (citing National Academies of Sciences, Engineering, and Medicine. 2026. Attribution of Extreme Weather and Climate Events and Their Impacts (National Academies Press 2026) https://doi.org/10.17226/28590, EPA-HQ-OAR-2025-0124-3001).

Health and Welfare.[371] In this report, the NAS concluded that "EPA's 2009 finding that the human-caused emissions of greenhouse gases threaten human health and welfare was accurate, has stood the test of time, and is now reinforced by even stronger evidence."[372] The authors reached that overarching conclusion based on five further conclusions:

1. Emissions of greenhouse gases from human activities are increasing the concentration of these gases in the atmosphere.
2. Improved observations confirm unequivocally that greenhouse gas emissions are warming Earth's surface and changing Earth's climate.
3. Human-caused emissions of greenhouse gases and resulting climate change harm the health of people in the United States.
4. Changes in climate resulting from human-caused emissions of greenhouse gases harm the welfare of people in the United States.
5. Continued emissions of greenhouse gases from human activities will lead to more climate changes in the United States, with the severity of expected change increasing with every ton of greenhouse gases emitted.[373]

The NAS report considered multiple sources of evidence, considered conclusions stronger if supported by independent lines of evidence, and weighed evidence based on type, with observational evidence weighed most heavily.[374] Based on these conclusions, the NAS report concluded "that the evidence for current and future harm to human health and welfare created by human-caused GHGs is beyond scientific dispute."[375] The NAS report clearly sets out the effects of human-caused energy imbalance due to the increase in atmospheric concentrations of greenhouse gases. These include scientific findings on average temperature; extreme temperature; precipitation patterns; extreme precipitation; storms; droughts; ocean heat; marine heat waves; ocean acidification; physical and biological systems; sea ice, glaciers, and permafrost; sea level rise; ground-level ozone; wildfires; and whiplash and compound events. The report discusses how these changes harm public health and welfare including contributions to excess illness and death in the U.S. and globally as well as welfare impacts such as negative impacts on crop production, livestock production, fisheries, forests, water quality and availability, and impacts to the built environment.

EPA's insistence that this proposal turns on legal issues, rather than any scientific analysis, and thus does not require addressing such scientific analysis is inconsistent with its later use of its own climate modeling to evaluate the supposedly "*de minimis*" impacts of U.S. power plant greenhouse gas emissions. *See* 91 Fed. Reg. at 59035. EPA's evaluation of emissions that

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[371] National Academies of Sciences, Engineering, and Medicine. 2025. Effects of Human-Caused Greenhouse Gas Emissions on U.S. Climate, Health, and Welfare. Washington, DC: The National Academies Press. https://doi.org/10.17226/29239. (Summary)

[372] *Id.* at 1.

[373] *Id.* at 1-2.

[374] *Id.* at 6.

[375] *Id.* at 2.

impact global climate change and cause public health and welfare impacts only highlights the necessity of addressing other scientific data like pertinent NAS reports. However, the proposal does not so much as "provide a reference to," 42 U.S.C. § 7607(d)(3), any other NAS report relevant to its proposal.[376] This failure to comply with clear Clean Air Act requirements is particularly serious given the central role that NAS/NRC research has played in supporting the 2009 Endangerment Finding, the rescission of which underpins the Supplemental Proposal.[377]

EPA has plainly not complied with the Clean Air Act's express requirement to that EPA's proposal must "set forth or summarize and provide a reference to any pertinent findings, recommendations, and comments by . . . the National Academy of Sciences, and, if the proposal differs in any important respect from any of these recommendations, an explanation of the reasons for such differences." 42 U.S.C. § 7607(d)(3)(C). Because that information must go in the proposal – allowing the public to assess EPA's reasons for departing from prior NAS research and analysis, *see id.* § 7607(d)(6) – it is not enough for EPA to address these shortcomings in a final rule. Accordingly, the proposal must be withdrawn or reissued in a form that complies with the statute.

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[376] *See, e.g.*, U.S. National Academies of Science and the Royal Society, Climate Change Evidence and Causes: Update 2020, Foreword (2020), https://doi.org/10.17226/25733 ("It is now more certain than ever, based on many lines of evidence, that humans are changing Earth's climate. The atmosphere and oceans have warmed, which has been accompanied by sea level rise, a strong decline in Arctic sea ice, and other climate-related changes. The impacts of climate change on people and nature are increasingly apparent. Unprecedented flooding, heat waves, and wildfires have cost billions in damages. Habitats are undergoing rapid shifts in response to changing temperatures and precipitation patterns."); National Academies of Sciences, Engineering, and Medicine, *Accomplishments of the U.S. Global Change Research Program* (Washington, D.C.: The National Academies Press 2017). https://doi.org/10.17226/24670; National Research Council, *Advancing the Science of Climate Change* (The National Academies Press 2010). https://doi.org/10.17226/12782.

[377] *See* EPA, Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act, 74 Fed. Reg. at 66497 (noting that the National Research Council of the National Academy of Science's climate science assessment served, with assessments from the USGCRP and IPCC, as the "the primary scientific basis supporting the Administrator's endangerment finding."); *id.* at 66,510-11; Technical Support Document for the Endangerment and Cause or Contribute Findings for Greenhouse Gases Under 202(a) of the Clean Air Act, at 8 (2009) (citing five "key reference documents" from the NRC, namely, Climate Change Science: Analysis of Some Key Questions (2001); NRC Radiative Forcing of Climate Change (2005); NRC Surface Temperature Reconstructions for the Last 2,000 Years (2006); NRC Potential Impacts of Climate Change on U.S. Transportation (2008)). *See also Massachusetts v. E.P.A.*, 549 U.S. 497, 508 (2007) (discussing the National Research Council of the National Academy of Science's 1978 finding that relationship between increased carbon dioxide concentrations and climate changes was "unequivocal").

D. EPA failed to consult with the SAB and violated multiple policies ensuring that the agency engages in scientifically-sound decision-making.

1. EPA has not shown that it complied with SAB consultation requirements.

Under the Environmental Research, Development, and Demonstration Authorization Act of 1978 (ERDDAA), "[t]he Administrator, at the time any proposed criteria document, standard, limitation, or regulation under the [CAA] … is provided to any other Federal agency for formal review and comment, shall make available to the [SAB] [that proposed action], together with relevant scientific and technical information in the possession of the [EPA] on which the proposed action is based." 42 U.S.C. § 4365(c)(1). EPA makes no mention of this obligation in its Supplemental Proposal.

The SAB reviewed the scientific and technical basis for the 2024 CPS power plant rule, recommending among other things that EPA increase the stringency of its proposal.[378] EPA has also consistently notified the SAB of vehicle emissions standards rulemakings and provided them to the SAB for review when requested.[379]

Although the Supplemental Proposal does not address whether EPA provided it to the SAB, there are no documents in the docket mentioning SAB. During this administration, the SAB was disbanded and eventually reconstituted in April 2026.[380] However, it has not issued any

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[378] Science Advisory Board Report, EPA-SAB-24-007, "Review of the Science Supporting the Proposed Rule Titled, New Source Performance Standards for Greenhouse Gas Emissions from New, Modified, and Reconstructed Fossil Fuel-Fired Electric Generating Units; Emission Guidelines for Greenhouse Gas Emissions from Existing Fossil Fuel-Fired Electric Generating Units; and Repeal of the Affordable Clean Energy Rule (RIN 2060-AV09)," April 17, 2024, https://perma.cc/F4EH-MEPH.

[379] SAB Draft Regulatory Review Report of Science Supporting EPA Decisions for the Proposed Rule: Control of Air Pollution from New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards (Sept. 27, 2022), https://www.regulations.gov/document/EPA-HQ-OAR-2019-0055-2960; Science Advisory Board Report, "Science Advisory Board (SAB) Consideration of the Scientific and Technical Basis of the EPA's Proposed Rule titled, The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021-2026 Passenger Cars and Light Trucks," (Feb. 27, 2020), https://www.regulations.gov/document/EPA-HQ-OAR-2018-0283-7659; Memorandum from Alison Cullen, Chair, SAB, to Members of the Chartered SAB and SAB Liaisons (June 5, 2023), https://www.regulations.gov/document/EPA-HQ-OAR-2022-0829-5136; EPA's Proposed Rule for Light-duty Vehicle Greenhouse Gas Emissions Standards for Model Years 2023-2026, Briefing for the EPA Science Advisory Board, U.S. EPA, Office of Transportation and Air Quality, December 13, 2021, https://www.regulations.gov/document/EPA-HQ-OAR-2021-0208-0829.

[380] Sean Reilly, *'Do what y'all need to do': How EPA fired its science advisers*, Greenwire (July 24, 2025), https://subscriber.politicopro.com/article/eenews/2025/07/24/do-what-yall-need-to-do-how-epa-fired-its-science-advisers-00469549; EPA Press Release, "Administrator Zeldin

reports since December 2024.[381] Thus, it does not appear that SAB has conducted any review of rulemakings in this administration.

2. EPA violated the Information Quality Act and the Gold Standard Science Executive Order by, among other things, failing to subject the proposal's scientific analysis to peer review.

OMB's Final Information Quality Bulletin for Peer Review, issued pursuant to the Information Quality Act in 2004,[382] requires agencies to subject any "influential scientific information" to peer review before disseminating it. Final Information Quality Bulletin for Peer Review, 70 Fed. Reg. 2664, 2667-68 (Jan. 14, 2005). Such peer review must include opportunities for public participation, including providing the public with the charge questions to the peer review panel and holding a public meeting where members of the public can make presentations to the peer review panel. *Id.* at 2665, 2676.

For a subset of influential scientific information referred to as "highly influential scientific assessments," the Bulletin "requires a more rigorous form of peer review," under which "agencies typically will have to devote greater resources and attention to … issues" such as "individual versus panel review; timing; scope of the review; selection of reviewers; disclosure and attribution; public participation; and disposition of reviewer comments." *Id*. at 2671. The Bulletin defines highly influential scientific assessments based on two characteristics. First, "[a] scientific assessment is an evaluation of a body of scientific or technical knowledge that typically synthesizes multiple inputs, data, models, assumptions, and/or applies best professional judgment to bridge uncertainties in the available information." *Id*. at 2665. Second, a scientific assessment is "highly influential" "if the agency or the OIRA Administrator determines that the dissemination could have a potential impact of more than $500 million in any one year on either the public or private sector or that the dissemination is novel, controversial, or precedent-setting, or has significant interagency interest." *Id.* at 2671.

Likewise, Executive Order 14303, "Restoring Gold Standard Science." EO 14303 establishes nine requirements for federal government science: it must be (1) reproducible; (2) transparent; (3) communicative of error and uncertainty; (4) collaborative and interdisciplinary; (5) skeptical of its findings and assumptions; (6) structured for falsifiability of hypotheses; (7) subject to unbiased peer review; (8) accepting of negative results as positive outcomes; and (9) without conflicts of interest. Exec. Order No. 14303, § 3, 90 Fed. Reg. 22601, 22603 (May 23,

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Announces Selection of Members to the Science Advisory Board," April 17, 2026, https://perma.cc/V59X-BN7N.

[381] EPA, Advisory Reports, *available at* https://perma.cc/J8L2-VFT3.

[382] The Information Quality Act (IQA) directs the White House Office of Management and Budget (OMB), to "issue guidelines . . . that provide policy and procedural guidance to Federal agencies for ensuring and maximizing the quality, objectivity, utility, and integrity of information (including statistical information) disseminated by Federal agencies." Pub. L. No. 106-554, § 515(a), 114 Stat. 2763, A-154 (2000). OMB's IQA guidelines are "binding" on federal agencies. *Prime Time Int'l Co. v. Vilsack*, 599 F.3d 678, 685 (D.C. Cir. 2010).

2025). The Executive Order reinforces the requirement for peer review and consideration of the breadth of relevant research on the subject.

EPA largely discarded the voluminous record of peer reviewed climate science in issuing its Supplemental Proposal. But it did conduct an analysis of the global mean surface temperature (GMST) and global mean sea level (GMSL). As explained in Part VIII, limiting its analysis to GMST and GMSL is contrary to the scientific consensus which shows that seemingly "small" increases in GMST and GMSL translate into profound, non-linear, and compounding[383] risks for the human health and welfare of people in the United States. EPA's failure to subject its approach to peer review, particularly considering its stark departure from consensus science, does not comport with the requirements of the IQA or the Gold Standard Science EO.

E. EPA failed to provide a meaningful opportunity to comment on its proposal.

Under the APA and the Clean Air Act, EPA must provide the public with adequate notice of a proposed rule and a meaningful opportunity to comment on the substance of the rule. *See* 5 U.S.C. § 553(c); 42 U.S.C. § 7607(d); *see also, e.g.*, *Gerber v. Norton*, 294 F.3d 173 (D.C. Cir. 2002) ("Th[e] opportunity for comment must be a meaningful opportunity."). A meaningful opportunity to comment "means enough time with enough information to comment and for the agency to consider and respond to the comments." *Prometheus Radio Project v. FCC*, 652 F.3d 431, 449-50 (3d Cir. 2011). It also means the agency must remain open minded during the comment process. *Rural Cellular Ass'n v. FCC*, 588 F.3d 1095, 1101 (D.C. Cir. 2009). EPA has recognized the legal necessity of undertaking a process that allows for sufficient public engagement.[384] But EPA's provision of only 46 days for public comment on a proposal of this magnitude is woefully inadequate.[385] Additionally, EPA's proposal evinces a closed mind, thus further undermining the public's opportunity to meaningfully comment on the proposal.

1. The current comment period does not provide sufficient time given the magnitude of the proposal.

The current comment period for this rulemaking is woefully inadequate, given the breadth of the proposal and extraordinary harms it will impose on Americans. Indeed, EPA's current "condensed comment period . . . seems to have been designed to elicit as few comments as possible," *Nat'l Ass'n of Manufacturers v. SEC*, 105 F.4th 802, 810 n.4 (5th Cir. 2024), contrary to the Clean Air Act's requirements. EPA should allow the public time to comment on the proposal that is at least comparable to what it allowed for the 2015 power plants NSPS and 2024 CPS rule. *See, e.g.*, *N. Carolina Growers' Ass'n, Inc. v. United Farm Workers*, 702 F.3d 755

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[383] Singh D. et al. 2023. Focus on compound events. In Fifth National Climate Assessment. Crimmins A.R. et al (eds) USGCRP, Washington, DC, USA.

[384] *See, e.g.*, *Zeldin Pledges Public Process to Revisit GHG Finding, Amid Skepticism*, Inside EPA (Apr. 22, 2025), https://insideepa.com/daily-news/zeldin-pledges-public-process-revisit-ghg-finding-amid-skepticism.

[385] EPA also cannot defend its truncated comment period on the basis that the public had an opportunity to review a pre-publication copy of the proposal. The proposed rule was published only three days after EPA posted the signed pre-publication version.

(4th Cir. 2012) (holding that 10-day comment period was not "adequate opportunity for comment" when during the prior rulemaking the agency had allowed 60 days for public comment); *California v. Dep't of the Interior*, 381 F. Supp. 3d 1153, 1177-79 (N.D. Cal. 2019) (finding 30-day comment period inadequate because prior rulemaking included 120 days for comment and vacating final rule based on this and other APA violations). EPA's proposal is dramatically different from the analysis – both factual and legal – contained in the 2009 Endangerment Finding and 2015 and 2024 power plants rules. The public is entitled to sufficient and meaningful time to respond to such a sweeping and damaging proposal.

The proposal, if finalized, will increase greenhouse gas pollution and raise costs across society, severely harming Americans now and for generations to come. The lack of analysis or proper consideration of those harms hinders the public's ability to comment. The Supplemental Proposal also advances novel and baseless legal interpretations that diverge dramatically from EPA's longstanding interpretations of the Clean Air Act and that conflict with judicial precedent. Because the proposal creates potentially highly significant legal and regulatory consequences, the public must have sufficient time to undertake detailed analysis of and comparison to precedent and past practice. Given such far-reaching and damaging consequences, the public needs more than only 46 days to consider the proposal and provide informed comment.

The Supplemental Proposal relies upon the rescission of the Endangerment Finding. The Endangerment Finding was based on a vast and compelling record of scientific evidence demonstrating that "[w]arming of the climate system is unequivocal," "elevated concentrations of heat-trapping greenhouse gases are the root cause of recently observed climate change," "climate change can increase the risk of morbidity and mortality," and "greenhouse gas air pollution and resultant climate change affect climate-sensitive sectors," impacting public welfare. 74 Fed. Reg. at 66517-18, 66524, 66531; *see also id.* at 66497 ("The Administrator has determined that the body of scientific evidence compellingly supports th[e] [Endangerment] [F]inding."). In subsequent rulemakings, including the rulemakings promulgating power plant greenhouse gas emission standards, EPA has *reaffirmed the finding* that greenhouse gas pollution endangers public health and welfare, based on longstanding legal precedent and the original scientific findings, as well as a large amount of updated scientific and technical information.[386] And in 2010 and 2022, EPA denied petitions for reconsideration of the Endangerment Finding. 75 Fed. Reg. 49556 (Aug. 13, 2010) (calling the supporting science "robust, voluminous, and compelling"); 87 Fed. Reg. 25412 (Apr. 29, 2022).[387] The mountain of scientific evidence supporting the Endangerment Finding has only grown over time. Now, however, EPA seeks to reverse these repeated findings as they relate to power plants with little time for the public to comment.

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[386] *See* 2015 New Source Performance Standards, 80 Fed. Reg. 64510 (Oct. 23, 2015) and 2024 Carbon Pollution Standards, 89 FR 39798 (May 9, 2024).

[387] Courts have also upheld the Endangerment Finding, *Coalition for Responsible Regulation, Inc. v. EPA*, 684 F.3d 102 (D.C. Cir. 2012), and EPA's 2023 denial of petitions for reconsideration, *Concerned Household Electricity Consumers Council v. EPA*, No. 22-1139, 2023 WL 3643436 (D.C. Cir. May 25, 2023), *cert denied* 144 S. Ct. 497 (2023).

EPA recognized the need for extensive public comment in its previous rulemakings on the endangerment finding and power plants standards. EPA's original Endangerment Finding proposal in 2009 allowed for a 60-day public comment period and two public hearings, during which the Agency received approximately 370,000 public comments. 74 Fed. Reg. at 66500. Although 60 days too is fairly short for a proposal of this magnitude, "a very large part of the information and analyses for the Proposed [Endangerment] Finding[] had been previously released [on] July 30, 2008," over half a year before the proposed findings were issued in April 2009, as part of EPA's *Advance Notice of Proposed Rulemaking: Regulating Greenhouse Gas Emissions under the Clean Air Act*, 73 Fed. Reg. 44354 (July 30, 2008) ("ANOPR"). 74 Fed. Reg. at 66503. The July 2008 ANOPR was accompanied by a Technical Support Document ("TSD") detailing the extensive scientific support upon which EPA planned to – and did – rely in making the Endangerment Finding, and allowed for its own 120-day comment period, preceding the Endangerment Finding proposal comment period. *See id.* at 66500, 66503. Between the ANOPR and the Endangerment Finding proposal, then, the public had two periods totaling 180 days during which to submit comments relevant to the Endangerment Finding. And the public effectively had *328 days* to consider much of EPA's justification for the Endangerment Finding and to prepare to submit final comments – from July 30, 2008 (the day the ANOPR was published and the TSD explaining the scientific findings was released), through June 23, 2009 (the date comments on the Endangerment Finding proposal were due).

Here, by contrast, EPA did not release the proposal or its justification for dismissing decades of established science and binding legal precedent until September 14, 2026, and has allowed only 46 days for the public to comment after publishing the proposal in the Federal Register on September 17, 2026. And unlike with the Endangerment Finding, where EPA released the underlying scientific and technical basis for the rule along with the ANOPR well in advance of the actual proposal, EPA now references as support flawed modeling designed to demonstrate the futility of regulation and released an Economic Impact Analysis that only assessed the financial benefits to the regulated industry of not having to comply with the regulations.

EPA here seeks to undo two separate power plant greenhouse gas emission standards rulemakings, each of which had their own comment periods of approximately 60 days, and each of which made its own separate, updated legal, scientific, and technical findings of support.[388] Together with the Endangerment Finding, the public had over 600 days to consider and comment on the establishment of these standards. EPA's proposal to tear all of these protections down with a scant 46 days for public comment is plainly inadequate.

Indeed, EPA's past practice in major Clean Air Act rulemakings shows that "adequate" notice and a "meaningful" opportunity to comment have consistently been understood in such contexts to require much more substantial comment periods than that provided here. For example, the proposed *Carbon Pollution Standards for Modified and Reconstructed Stationary Sources: Electric Utility Generating Units* initially provided a 120-day comment period, 79 Fed. Reg. 34960 (June 18, 2014); the proposed *Review of New Source Performance Standards for*

[388] *See* 2015 New Source Performance Standards, 80 FR 64510 (Oct. 23, 2015) and 2024 Carbon Pollution Standards, 89 FR 39798 (May 9, 2024).

Stationary Combustion Turbines and Stationary Gas Turbines, 89 Fed. Reg. 101306 (Dec. 13, 2024), initially had a 90-day comment period; and numerous EPA proposed rules have set comment periods of 60 days, *see, e.g.*, *Mandatory Reporting of Greenhouse Gases, Proposed Rule*, 74 Fed. Reg. 16448 (Apr. 10, 2009); *Repeal of Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, Proposed Rule*, 82 Fed. Reg. 48035 (Oct. 16, 2017); *The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021-2026 Passenger Cars and Light Trucks, Notice of Proposed Rulemaking*, 83 Fed. Reg. 42986 (Aug. 24, 2018). *See also Prometheus Radio Project v. F.C.C.*, 652 F.3d 431, 452 (3d Cir. 2011) (holding a comment period inadequate when it "gave only 28 days for response, not *the usual* 90 days") (emphasis added); *Petry v. Block*, 737 F.2d 1193, 1202 (D.C. Cir. 1984) (stating that a 30-day comment period "cuts the comment period to the bone"). And Executive Order 12866, as amended, provides that "a meaningful opportunity to comment on any proposed regulation … should include a comment period of not less than 60 days." 58 Fed. Reg. 51735, 51740 (Oct. 4, 1993).

2. EPA is acting with a closed mind.

Administrator Zeldin has demonstrated an "unalterably closed mind on matters critical to the disposition of th[is] proceeding." *Ass'n of Nat'l Advertisers v. FTC*, 627 F.2d 1151, 1170 (D.C. Cir. 1979). As a result, either the Administrator must be disqualified from the rulemaking or EPA must withdraw the proposal and begin a new rulemaking process that is untainted by the Administrator's prejudgment. *See Nehemiah Corp. of Am. v. Jackson*, 546 F. Supp. 2d 830, 847 (E.D. Cal. 2008) (describing appropriate remedies when an agency official has prejudged the outcome of a particular matter).

"The whole rationale of notice and comment rests on the expectation that the final rules will be somewhat different and improved from the rules originally proposed by the agency." *Trans-Pacific Freight Conference v. Federal Maritime Com.*, 650 F.2d 1235, 1249 (D.C. Cir. 1980). Thus, regulators "violate the Due Process Clause and must be disqualified … when they act with an unalterably closed mind and are unwilling or unable to rationally consider arguments." *Miss. Comm'n on Envtl. Quality v. EPA*, 790 F.3d 138, 183 (D.C. Cir. 2015) (citation modified). A regulator can "ma[ke] his intention known so that interested parties can contribute to the debate," provided that the regulator in question remains open to an alternative course of action despite their initial intention. *Housing Study Group v. Kemp*, 736 F. Supp. 321, 333 (D.D.C. 1990). But a regulator's statements and actions may show he is "unable to consider meaningfully" the evidence presented in a rulemaking. *Nat'l Advertisers*, 627 F.2d at 1170. In such cases, "[a]llowing the public to submit comments to an agency that has already made its decision is no different from prohibiting comments altogether." *Nehemiah Corp.*, 546 F. Supp. 2d at 847. Indeed, "[t]here is no doubt that the purpose of [rulemaking proceedings] would be frustrated if [agency officials] had reached an irrevocable decision on whether a rule should be issued prior to … final action." *Nat'l Advertisers*, 627 F.2d at 1170; *see also Nehemiah Corp.*, 546 F. Supp. 2d at 847 ("[I]f the public perceives that the agency will disregard its comments, there may be a chilling effect that causes the public to refrain from submitting comments as an initial matter.").

Several patterns of behavior or statements may indicate a regulator is unable to meaningfully consider the public's comments: (1) a senior political official's definitive and

unequivocal announcement of a "dramatic change" in the agency's position, prior to the conclusion of administrative proceeding," *Int'l Snowmobile Mfrs. Ass'n v. Norton*, 340 F. Supp. 2d 1249, 1260-61 (D. Wyo. 2004); (2) an official's statement that his agency "would approve the new rule even in the face of critical comments," *Nehemiah Corp.*, 546 F. Supp. 2d at 847-48; or (3) a preexisting internal directive to reach a particular result, *Nat'l Advertisers*, 627 F.2d at 1172. Administrator Zeldin's conduct exemplifies each of these disqualifying courses of conduct.

3. Administrator Zeldin's statements demonstrate that he is acting with a closed mind.

Public statements can indicate that an official is acting with an unalterably closed mind. *See Int'l Snowmobile*, 340 F. Supp. 2d at 1260-61 (predetermined political decision to ban snowmobiles shown by statements that "there will be no future for these antiquated polluting vehicles in the National Park System"). Several types of statements by Administrator Zeldin demonstrate his predetermined conclusion for this rulemaking.

First, Administrator Zeldin has consistently framed his role as the federal government's top environmental regulator as combatting the "war on coal to destroy reliable and affordable energy" that he claims existed under Presidents Obama and Biden.[389] He has framed prior rulemakings as having the "primary purpose" of "destroy[ing] industries that didn't align with their narrow-minded climate change zealotry" and as "designed to regulate coal, oil and gas out of existence."[390] Administrator Zeldin has claimed his deregulatory agenda is "driving a dagger through the heart of climate-change religion and ushering in America's Golden Age" by "reconsidering rules that throttled oil and gas production and unfairly targeted coal-fired power plants."[391] He explicitly told coal executives that he was working through their wish list of regulatory changes, telling a gathering of the National Coal Council in July 2026 that "[m]any of

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[389] Natalie Weber, *EPA ends greenhouse gas limits for power plants, drawing criticism from Texas environmental groups*, Houston Public Media (Sept. 14, 2026), https://www.houstonpublicmedia.org/articles/news/energy-environment/2026/09/14/561800/epa-ends-greenhouse-gas-limits-for-power-plants-in-hosuton-drawing-criticism-from-texas-environmental-groups/.

[390] Press Release, EPA, EPA Proposes Repeal of Biden-Harris EPA Regulations for Power Plants, Which, If Finalized, Would Save Americans More than a Billion Dollars a Year (June 11, 2025), https://perma.cc/7V44-E2KZ.

[391] Lee Zeldin, *EPA Ends the 'Green New Deal,'* Wall Street Journal, Opinion (March 12, 2025), https://www.wsj.com/opinion/lee-zeldin-epa-ends-the-green-new-deal-aa81de06?gaa_at=eafs&gaa_n=AWEtsqfuX-WmGRyuMz02frSHb-AkpeMGSexU3AdhaVz-ceHQT_nFrByD5ty42lZ8Qg%3D%3D&gaa_ts=698ba9cd&gaa_sig=DrqajCQY2kI-YK74wJyr7IAVpw9myhfZ5qXOcNoI-pW4Oka8AUPpTdXDD_YdfAymLtkKfmdlC_xiUvK5VTVxdQ%3D%3D.

the items that were on your wish list are now done" and that he expected "we'll have a lot to celebrate the next time you all get together again."[392]

Administrator Zeldin has also characterized *announcements* of deregulatory actions, rather than the completion of rulemaking, as marking his decision. For example, in announcing EPA's reconsideration of several climate change-related rules, including the power plant regulations, Administrator Zeldin consistently characterized the *announcement itself* as marking a dramatic change in course, styling March 11, 2025, the date of that announcement, as "the Greatest Day of Deregulation in American History."[393] In Administrator Zeldin's press release accompanying the announced reconsideration proceedings, he once more asserted, "today is the greatest day of deregulation our nation has seen."[394] Multiple press releases reiterate that March 11th is "the greatest and most consequential *day* of deregulation in U.S. history."[395] On March 12, 2025, Administrator Zeldin's *Wall Street Journal* opinion piece declared, "*Yesterday was* the most consequential day of deregulation in American history."[396] Administrator Zeldin repeatedly identified the *announcement* of reconsideration proceedings as the operative action. *See, e.g.*, March 12 EPA "Deregulation Day" Press Release ("*As a result of these announcements*, the cost of living for American families will decrease.").[397] Likewise, in announcing this Supplemental Proposal before a meeting of energy ministers in Houston, TX, Administrator Zeldin said EPA had "determined that the Biden-era carbon pollution standards exceeded the agency's authority under the Clean Air Act."[398] These statements, like the Administrator's comment in *Int'l Snowmobile* that snowmobiles have "no future," indicate that prior to receiving any comments,

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[392] Hannah Northey, *Zeldin vows to fulfill coal industry's 'wish list'*, EENews (July 21, 2026), https://www.eenews.net/articles/zeldin-vows-to-fulfill-coal-industrys-wish-list/.

[393] EPA, *EPA Administrator Lee Zeldin Launches the Greatest Day of Deregulation in American History*, YouTube (Mar. 12, 2025), https://www.youtube.com/watch?v=qae9bhymH50 (emphasis added) [hereinafter March 12 Zeldin 'Deregulation Day' Speech].

[394] *Id*. (emphasis added).

[395] *See id*. (emphasis added); *see also* Press Release, EPA, EPA Releases Proposal to Rescind Obama-Era Endangerment Finding, Regulations that Paved the Way for Electric Vehicle Mandates, (July 29, 2025), https://perma.cc/S7BB-K8GM [hereinafter July 29 EPA Endangerment Finding Press Release].

[396] Lee Zeldin, *EPA Ends the 'Green New Deal,'* Wall St. J.: Opinion (Mar. 12, 2025), https://www.wsj.com/opinion/lee-zeldin-epa-ends-the-green-new-deal-aa81de06 (emphasis added) [hereinafter March 12 Zeldin WSJ Op-Ed].

[397] Press Release, EPA, EPA Launches Biggest Deregulatory Action in U.S. History (Mar. 12, 2025), https://perma.cc/A3AF-KM4C (emphasis added) [hereinafter March 12 EPA 'Deregulation Day' Press Release].

[398] Matt Glasser and Dan Peck, *What to know as EPA announces repeal of power plant emissions limits*, ABC News (Sept. 14, 2026), https://abcnews.com/US/epa-announces-repeal-power-plant-emissions-limits/story?id=136430653.

Administrator Zeldin has already made a definitive decision about whether he would repeal greenhouse gas emission regulations. *See Int'l Snowmobile*, 340 F. Supp. 2d at 1260–61.

Administrator Zeldin has also made other "gratuitous (but prejudicial)" statements, *id.* at 1260, demonstrating contempt for greenhouse gas regulations for power plants. Administrator Zeldin cast wild aspersions against the motive behind and nature of climate change regulations, claiming that the decision to promulgate greenhouse gas regulations was a "quest to destroy the American economy in the name of climate change."[399] In Administrator Zeldin's characterization, "the endangerment finding is considered the holy grail of the climate change religion."[400] Continuing that imagery, Administrator Zeldin referred to "overhauling massive rules on the endangerment finding" as "driving a dagger through the heart of climate-change religion."[401] Administrator Zeldin repeated that line on a podcast, saying the Endangerment Finding Repeal "has been referred to as basically driving a dagger into the heart of the climate change religion."[402] On that same appearance, Administrator Zeldin agreed with the characterization of the endangerment finding as "the left's tent pole to begin the whole climate grift."[403] EPA's news office also promoted a quote of a senator referencing a "climate cult" when covering reaction to EPA's proposal to rescind the 2009 Endangerment Finding.[404] Administrator Zeldin's statements and announcement clearly indicate that he "is unwilling or unable to consider rationally" contrary evidence and public comment. *Nat'l Advertisers*, 627 F.2d at 1173-74.

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[399] Lisa Friedman, *How Lee Zeldin Went from Environmental Moderate to Dismantling the E.P.A.*, N.Y. Times (Mar. 30, 2025), https://www.nytimes.com/2025/03/29/climate/lee-zeldin-epa.html.

[400] Zach Colman and Alex Guillén, *EPA launches attack on 'holy grail' of climate science – and dozens of enviro rules*, E&E News by Politico (Mar. 12, 2025), https://www.politico.com/news/2025/03/12/epa-launches-attack-on-holy-grail-of-climate-science-and-dozens-of-enviro-rules-00226731 (quoting twitter video). To the extent Administrator Zeldin truly believes that this rulemaking to repeal the Endangerment Finding is his attack on a religion practiced by Americans, the Administrator may be violating the Establishment and Free Exercise Clauses of the U.S. Constitution.

[401] March 12 Zeldin WSJ Op-Ed; *see also* Press Release, EPA, ICYMI: Administrator Zeldin in WSJ: "EPA Ends the 'Green New Deal'" (Mar. 17, 2025), https://perma.cc/EKU8-N8CK.

[402] Alex Guillén, *Zeldin confirms EPA will repeal the endangerment finding*, E&E News by Politico (Jul. 29, 2025), https://subscriber.politicopro.com/article/2025/07/zeldin-confirms-epa-will-repeal-the-endangerment-finding-00481043 (quoting Ruthless appearance)

[403] Maxine Joselow and Lisa Friedman, *In Game-Changing Climate Rollback, E.P.A. Aims to Kill a Bedrock Scientific Finding*, N.Y. Times (Jul. 29, 2025), https://www.nytimes.com/2025/07/29/climate/epa-endangerment-finding-repeal-proposal.html (quoting Ruthless appearance).

[404] Press Release, EPA, WHAT THEY ARE SAYING: Leaders Praise the EPA for Launching Largest Deregulatory Action in U.S. History with Proposal to Rescind Obama-Era Endangerment Finding (Aug. 1, 2025), https://perma.cc/34Z9-CZ9X (quoting Senator Cynthia Lummis).

4. The government's full-scale assault on climate science demonstrates a preexisting internal directive to reach a particular result.

EPA claims to engage in an open inquiry while the government shuts down the means of assessing endangerment. This attack on the collection, maintenance, and dissemination of core scientific information about greenhouse gas emissions and climate change is evidence of a preexisting internal directive for EPA to reach a particular result, demonstrating EPA is acting with a closed mind. *See Nat'l Advertisers*, 627 F.2d at 1172. And claiming to rely on scientific evidence while simultaneously erasing it is quintessentially arbitrary and capricious.

First, the administration has launched an unprecedented campaign to scrub critical information about climate change from its websites. For example, the Trump administration scrubbed all past National Climate Assessments from the U.S. Global Change Research Program's website and dismissed the 400 scientists and experts working on the next edition of the assessment.[405] The purpose of National Climate Assessments is to "integrate and summarize current and anticipated climate change impacts on the United States to help inform decision making that will impact America's' [sic] future."[406] These reports are also required by Congress: the 1990 Global Change Research Act requires publication of an updated National Climate Assessment every four years. Additionally, the entire website climate.gov—a valuable resource for the public that housed important information about the impacts of climate changes—has been deleted.[407]

In addition to scrubbing information on climate change from its websites, the government's recent proposals to dismantle climate science research facilities and data collection further demonstrates an internal directive to repeal the endangerment finding and power plants greenhouse gas standards. For example, the administration's proposed 2026 budget would close the Mauna Loa Observatory, which has collected measurements of greenhouse gases in the atmosphere since 1958[408] and is "indispensable to scientists around the world."[409] The same proposal would close down three other observatories in Barrow, Alaska, American Samoa, and the South Pole that collect data that allow scientists to document and study climate change and

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[405] Kate Yoder, *Why the federal government is making climate data disappear*, Grist (Jul. 14, 2025), https://grist.org/language/trump-administration-climate-data-disappear-national-climate-assessment/.

[406] NOAA, The Assessments Program, https://perma.cc/5UVK-3J9J.

[407] Cat Zakrzewski, David Ovalle, Scott Dance and Laura Meckler, *Trump's answer to numbers he doesn't like: Change them or throw them away*, The Washington Post (Aug. 14, 2025), https://www.washingtonpost.com/politics/2025/08/14/trump-data-misinformation/.

[408] National Oceanic and Atmospheric Administration, American Chemical Society Honors Measurement Set at NOAA Observatory (Dec. 23, 2015), available at https://perma.cc/28BA-E7L8.

[409] Rebecca Dzombak, *After 7 Decades of Measurements From a Peak in Hawaii, Trump's Budget Would End Them*, N.Y. Times (July 17, 2025), https://www.nytimes.com/2025/07/17/climate/budget-cuts-climate-observatories.html.

make predictions about extreme weather events like droughts and heat waves.[410] The closure of these stations would end "almost all the climate research being done by the National Oceanic and Atmospheric Administration."[411] Moreover, NOAA's Global Monitoring lab—which processes air samples taken from around the world—would also close.[412] Closing data collection stations and scrubbing data from the government's websites both deprives the public of the information needed to comment on this rulemaking and evinces a predetermined, whole-of-government attack on the 2009 Endangerment Finding.

This administration has also announced that it plans to dismantle the National Center for Atmospheric Research (NCAR), the nation's premier atmospheric research institution. In December 2025, OMB Director Russell Vought announced that the National Science Foundation (NSF) would be "breaking up" NCAR, calling it "one of the largest sources of climate alarmism in the country" and stating that efforts to dissolve it "will begin immediately."[413] Vought told USA Today that the Administration's plan was to eliminate NCAR's "green new scam research activities," and to fully close NCAR's Mesa Laboratory in Boulder.[414] The next day, NSF announced that it would "restructure critical weather science infrastructure."[415] In January 2026, NSF released a "Dear Colleague Letter" seeking public comment on how to go about breaking apart NCAR.[416] In documents released in litigation regarding these plans, emails from staff at OMB clearly state that one of the goals of these destructive actions is to undermine emissions regulations "that the Administration does not support."[417]

Finally, EPA has failed to provide mandatory reports on U.S. contribution to greenhouse gas emissions. The U.S. is required to submit a national greenhouse gas emissions inventory report every year to fulfill its obligations as a member of the United Nations Framework

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[410] *Id*.

[411] *Id*.

[412] *Mauna Loa Observatory faces closure under Trump budget proposal*, The Daily Climate (July 21, 2025), https://www.dailyclimate.org/mauna-loa-climate-lab-faces-closure-under-trump-budget-proposal-2673534443.html.

[413] Russ Vought @russvought, X.com (Dec. 16, 2025, 8:17PM), https://perma.cc/LB77-779H.

[414] Joey Garrison, *Trump Moves to Dismantle Major US Climate Research Center in Colorado*, USAToday (Dec. 16, 2025, updated Dec. 17, 2025 12pm ET), https://www.usatoday.com/story/news/politics/2025/12/16/trump-dismantle-national-center-atmospheric-research-climate/87798771007/.

[415] NSF, *Intent to Restructure Critical Weather Science Infrastructure* (Dec. 17, 2025), https://perma.cc/7YCN-UYL3.

[416] NSF, Dear Colleague Letter on NCAR (Jan 23, 2026), https://perma.cc/PN2P-BWQK.

[417] *Univ. Corp. for Atmospheric Rsch. v. NSF* (*UCAR*), No. 1:26-cv-1061 (D. Colo. Mar. 16, 2026), ECF No. 32-14. (Dec. 17, 2025, email from Sam Black (OMB) to other OMB employees explaining why they are taking action against the Atmospheric Chemistry Observations & Modeling Lab at NCAR).

Convention on Climate Change.[418] The inventory is critical information, as it allows government officials and the public to understand where emissions originate and make informed policy decisions. Yet EPA failed to publish the inventory this year, marking the first time the U.S. has ever failed to meet this annual obligation.[419] Failure to meet this obligation, which EPA has met for the last 30 years, demonstrates not only that EPA has already predetermined the result of this rulemaking but is actively engaged in eviscerating the scientific work Congress directs it to undertake. And on top of this, EPA has proposed to broadly repeal the Greenhouse Gas Reporting Program, which requires sources and suppliers across a range of industrial sectors to report their greenhouse gas emissions data.[420] This recent proposal further illustrates an internal directive to gut publicly available information about climate change and climate science.

All of these efforts flow from President Trump's view that climate change is a "hoax" and a "con job"[421] and that climate predictions "were wrong" and "made by stupid people."[422] These determinations, clearly refuted by the broader scientific community, have resulted in biased and pre-determined regulatory processes aimed at dismantling any climate-related regulation.

F. The 2024 Presidential election is not a cognizable legal basis to justify repealing the greenhouse gas standards.

EPA's Supplemental Proposal makes the extraordinary claim that "the election of a new Administration is an independent and sufficient basis for reassessing and revising legal interpretations to faithfully adhere to the best reading of the statute." 91 Fed. Reg. at 59019. For support, EPA cites Justice Rehnquist's separate opinion in *State Farm* and cases citing that

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[418] United Nations Climate Change, Reporting Requirements, https://unfccc.int/process-and-meetings/transparency-and-reporting/reporting-and-review-under-the-convention/greenhouse-gas-inventories-annex-i-parties/reporting-requirements.

[419] Grace Manthey and Tracey J. Wholf, *CBS Evening News The EPA didn't release its annual U.S. greenhouse gas emissions report, but we got the data. Here's what we found*, CBS News (May 12, 2025), https://www.cbsnews.com/news/greenhouse-gas-emissions-inventory-report-2025/; Jean Chemnick, *Trump admin silent as UN deadline passes for reporting GHG emissions*, E&E News by Politico (Apr. 16, 2025), https://www.eenews.net/articles/trump-admin-silent-as-un-deadline-passes-for-reporting-ghg-emissions/.

[420] EPA, *Reconsideration of the Greenhouse Gas Reporting Program*, 90 FR 44591 (Sep. 16, 2025).

[421] Melina Walling & Seth Borenstein, Trump Called Climate Change a 'Con Job' at the United Nations. Here Are the Facts and Context, PBS (Sept. 25, 2025), https://www.pbs.org/newshour/politics/trump-called-climate-change-a-con-job-at-the-united-nations-here-are-the-facts-and-context.

[422] Melina Walling & Seth Borenstein, Trump Called Climate Change a 'Con Job' at the United Nations. Here Are the Facts and Context, PBS (Sept. 25, 2025), https://www.pbs.org/newshour/politics/trump-called-climate-change-a-con-job-at-the-united-nations-here-are-the-facts-and-context.

opinion. *Id.* (citing *State Farm,* 463 U.S. at 59 (Rehnquist, J., concurring in part and dissenting in part)).

Undoubtedly, a new Presidential administration is entitled to adopt new policies within the constraints of existing law. But an administration change does not dispense with the agency's obligation to comply with the Administrative Procedure Act or the requirements of reasoned decisionmaking, under which the agency must acknowledge policy changes, explain why the agency is adopting the new policy, and present a more detailed justification where the new policy undermines serious reliance interests or contradicts prior factual findings.[423] Nor does it give the agency carte blanche to ignore statutory factors, as Justice Rehnquist's separate opinion in *State Farm* notes, albeit in a section EPA fails to cite.[424] No election is an excuse to dispense with the rule of law.

G. EPA failed to consult Tribes and other relevant stakeholders

As further evidence of the lack of normal process in this rulemaking, the proposal shows a surprising lack of consultation with important stakeholders. This is in stark contrast with previous power plant greenhouse gas emissions standards rulemakings, where EPA consulted with a wide variety of stakeholders both before and during the rulemaking process.

For example, in the rulemaking process for the 2015 power plant rules, EPA offered consultation with Tribal officials throughout the development of the proposed regulations for both new and existing sources. EPA sent consultation letters to 584 Tribal leaders, held consultation and outreach meetings, and solicited additional comments on the proposed rule specifically from Tribal officials. *See* 79 Fed. Reg. at 1501 (proposed Jan. 8, 2014) (Standards of Performance for Greenhouse Gas Emissions From New Stationary Sources: Electric Utility Generating Units), 79 Fed. Reg. at 34948 (proposed June 18, 2014) (Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units). Similarly, during the rulemaking process for the 2024 CPS rule, EPA offered government-to-government consultation with Tribes and conducted stakeholder outreach because it was aware of Tribal interest in the rule. 88 Fed. Reg. at 33419 (proposed May 23, 2023) (New Source Performance Standards for Greenhouse Gas Emissions From New, Modified, and Reconstructed Fossil Fuel-Fired Electric Generating Units; Emission Guidelines for Greenhouse Gas Emissions From Existing Fossil Fuel-Fired Electric Generating Units; and Repeal of the Affordable Clean Energy Rule).

In this Supplemental Proposal, EPA simply states that its action "does not have Tribal implications as specified in E.O. 13175." 91 Fed. Reg. at 59045. The previous 2015 and 2024

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[423] *See generally FDA v. Wages & White Lion Invs., LLC*, 145 S. Ct. 898, 917-18 (2025)("White Lion") (citing *Encino Motorcars, LLC v. Navarro*, 579 U. S. 211, 221-22 (2016); *FCC v. Fox Television Stations*, Inc., 556 U. S. 502, 515 (2009); *Motor Vehicle Mfrs. Ass'n of United States, Inc. v. State Farm Mut. Auto. Ins. Co.*, 463 U. S. 29, 43 (1983)).

[424] *State Farm*, 463 U.S. 29, 59 n.* (1983) (Rehnquist, J., concurring in part and dissenting in part) ("Of course, a new administration may not choose not to enforce laws of which it does not approve, or to ignore statutory standards in carrying out its regulatory functions.").

rulemakings made the same findings regarding Executive Order 13175, but conducted Tribal outreach nonetheless because Tribes and Tribal regulators had a clear interest in the rulemakings – which is demonstrated by the consultations and comments from Tribes throughout those processes. EPA is ignoring a clear history of Tribal interest and input into rulemakings for greenhouse gas emissions from fossil fuel-fire power plants without any explanation or attempted justification in its proposed rule.

EPA even acknowledged there was interest from Tribes on this issue as recently as its 2025 proposal to repeal either all or a subset of greenhouse gas emissions standards for power plants. The proposed rulemaking stated that although E.O. 13175 did not apply, EPA would still offer Tribal consultation "because of Tribal interest on this proposed rule and consistent with the EPA Policy on Consultation with Indian Tribes." 90 Fed. Reg. at 25780. EPA sent a letter and fact sheet on the initial proposed rule to Tribal leaders, informing them about the rule and the opportunity for consultation, yet there is nothing in the record to demonstrate it took any similar action in relation to this Supplemental Proposal.[425] Because this is an entirely separate proposed rule and aims to rescind the 2015 Finding on separate legal bases, EPA cannot rely on its outreach to Tribes for its 2025 proposal as sufficient for this additional rulemaking and the independent actions advanced therein. EPA must conduct similar outreach here or else it acts inconsistently, ignores clear Tribal interest in greenhouse gas regulations at power plants, and violates its own policy.[426]

In addition to Tribal engagement, in previous rulemakings EPA took the time prior to proposing its rules to engage with many other stakeholders, including labor unions, public health organizations, environmental justice and community organizations, NGOs, State energy and environmental regulators, Tribal air regulators, industry entities, utilities, rural electric cooperatives, municipal power agencies, and relevant experts. *See* 88 Fed. Reg. at 33277; 79 Fed. Reg. at 34845; 79 Fed. Reg. at 1445. Despite its past practice of engaging with these stakeholders, there is no evidence from the proposal that EPA has engaged with even a fraction of these stakeholders in this rulemaking. And the proposal offers no explanation for this change in course. This is further evidence of a flawed, prejudged rulemaking process.

H. To the extent EPA has relied on, or intends to rely on, artificial intelligence tools, the failure to disclose that use or intention to use in this proposal violates applicable procedural requirements.

EPA must disclose whether and how it has used artificial intelligence ("AI") in this rulemaking. While EPA provides a general disclosure on its website explaining that it may use AI

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[425] *Tribal Consultation Letter*, EPA-HQ-OAR-2025-0124-0070 (June 11, 2025) https://www.regulations.gov/document/EPA-HQ-OAR-2025-0124-0070.

[426] EPA, *EPA Policy on Consultation with Indian Tribes* (Dec. 7, 2023), https://perma.cc/36N5-9YUG ("The [EPA's] policy is to consult on a government-to-government basis with federally recognized Tribal governments when EPA actions or decisions *may* affect Tribes." (emphasis added)).

to sort and process comments during rulemakings,[427] EPA should provide a more detailed disclosure about how it used AI in this particular rulemaking. Specifically, if AI has been used, EPA must describe the AI tools employed and explain how the agency has used them, including EPA's inputs and the AI tool's outputs.[428] AI can be used appropriately to improve agency efficiency, but its use must be properly moderated and disclosed in order to comply with EPA's obligations under 42 U.S.C. § 7607 and the general requirement that it demonstrate a "rational connection between the facts found and the choice made." *State Farm*, 463 U.S. at 52.

Under the Administrative Procedure Act and the Clean Air Act, EPA is required to accompany its proposed rule with a statement of the rule's basis and purpose. 5 U.S.C. § 553(c); 42 U.S.C. § 7607(d)(3). The Clean Air Act's procedural requirements for rulemaking, 42 U.S.C. § 7607(d), clarify that the statement of the rule's basis and purpose must include a summary of "the factual data on which the proposed rule is based" and "the methodology used in obtaining the data and in analyzing the data." *Id.*§ 7607(d)(3)(A)-(B). If artificial intelligence is used to generate data, analyze data, or otherwise execute data-processing tasks in the course of Agency rulemaking, it constitutes a "methodology" used to generate the proposed rule. Therefore, any use of AI to construct the proposed rule must be disclosed. *Id.* § 7607(d)(3). If the rule is promulgated, EPA will similarly be required to disclose any use of AI in the methodology behind the final rule. *Id.* § 7607(d)(6)(A). These requirements safeguard against potential errors that can occur during rulemaking by providing the public an opportunity to identify and correct such errors. To the extent that EPA has used AI in this proposed rulemaking—or intends to use it in the final rulemaking—and failed to disclose that use or intent to use in the rule's statement of basis and purpose, it removes those safeguards in violation of its statutory obligations.

Additionally, reliance on AI for information or data in any part of the rulemaking must be disclosed under the docket requirements of 42 U.S.C. § 7607(d)(6)(C), and a failure to disclose AI use would result in an incomplete record for judicial review. *Id.* § 7607(d)(7)(A). Courts have declared that these mandatory disclosures are "the safety valves in the use of … sophisticated methodology." *Sierra Club v. Costle*, 657 F.2d 298, 334 (D.C. Cir. 1981). These disclosure requirements are necessary to ensure that agency AI adoption remains open to both public inspection and judicial review. If EPA has used AI in this rulemaking and fails to disclose it in the docket, it hides potential errors and biases from public view, again in violation of the Clean Air Act's procedural requirements.

Moreover, any undisclosed use of AI could render EPA's rule unlawful. When an agency uses computer models to formulate a proposed rule, the agency "must explain the assumptions and methodology used in preparing the model." *Owner-Operator Ind. Drivers Ass'n, Inc. v. Fed. Motor Carrier Safety Admin.*, 494 F.3d 188, 204 (D.C. Cir. 2007). These explanations ensure that

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[427] EPA, Commenting on EPA Dockets (last updated October 1, 2026), https://perma.cc/UP4E-XCTU.

[428] For a more fulsome list of questions EPA should answer in disclosing its AI use, *see AI in Agency Rulemaking: Legal Guardrails Issue Brief*, Governing for Impact (July 2025) at 16, https://governingforimpact.org/wp-content/uploads/2025/07/AI-in-Agency-Rulemaking_Legal-Guardrails.pdf.

the "ultimate responsibility for the policy decision remains with the agency rather than the computer." *Sierra Club*, 657 F.2d at 334-35. Therefore, agencies using AI should disclose, at a minimum, "algorithmic specifications, including the objective function being optimized, the method used for that optimization, and the algorithm's input variables."[429]

In addition to statutory requirements, recent executive branch directives require AI use disclosure. The executive actions reflect the Administration's understanding that agency AI disclosure is necessary for correcting agency errors and shortcomings, in addition to building public trust. For example, the Office of Management and Budget requires in OMB Memo M-25-21 that when an agency uses AI, the agency must "publicly release a summary describing" whether its use is "high-impact."[430] If EPA's rule uses potentially high-impact AI, EPA must follow several additional requirements outlined in OMB Memo M-25-21, Appendix 4. These requirements include, but are not limited to, ensuring that "individuals affected by AI-enabled decisions have access to a timely human review and a chance to appeal any negative impacts, when appropriate."[431] Even if EPA does not use high-impact AI, the Memo recommends that EPA maintain a "transparent process that seeks public input, comments, or feedback from the affected groups in a meaningful, accessible, and effective manner" regarding AI use.[432]

These OMB guidelines are consistent with key executive action from the first Trump administration. In his December 2020 Executive Order, "Promoting the Use of Trustworthy Artificial Intelligence in the Federal Government," President Trump acknowledged that "the ongoing adoption and acceptance of AI will depend significantly on public trust," and required agencies to "design, develop, acquire, and use AI in a manner that fosters public trust." Exec. Order No. 13960, 85 Fed. Reg. 78939 (Dec. 8, 2020). The Order specified that "the design, development, acquisition, and use of AI, as well as relevant inputs and outputs of particular AI applications, should be well documented and traceable." Exec. Order No. 13960. Like the Administrative Procedure Act and Clean Air Act's procedural requirements, this Order compels

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[429] Cary Coglianese and David Lehr, *Regulating by Robot: Administrative Decision Making in the Machine-Learning Era*, 105 GEO. L. J. 1147, 1208 (2017).

[430] Office of Mgmt. & Budget, Exec. Office of the President, Memorandum M-25-21, Accelerating Federal Use of AI through Innovation, Governance, and Public Trust (2025). This document defines "high-impact" as follows: "AI is considered high-impact when its output serves as a principal basis for decisions or actions that have a legal, material, binding, or significant effect on rights or safety."

[431] *Id.* at 17.

[432] *Id.* at 24. These OMB guidelines for federal agencies also reflect country-wide efforts to increase AI oversight and disclosure in government. In 2024 alone, 12 laws regulating public sector uses of AI were passed by state legislatures and over 40 bills were introduced. Quinn Anex-Ries, *Regulating Public Sector AI: Emerging Trends in State Legislation*, CTR. FOR DEMOCRACY & TECH. (Jan. 10, 2025), https://cdt.org/insights/regulating-public-sector-ai-emerging-trends-in-state-legislation/. *See also* OMB Circular A-4 (asking for transparency in regulatory analysis, "[agencies] should clearly set out the basic assumptions, methods, and data underlying the analysis")

disclosure in the interest of avoiding hidden errors and biases in agency decision-making and providing the public a meaningful opportunity to comment on agency practice.

For these reasons, to the extent EPA used or plans to use AI tools in this rulemaking, it must document its use and any relevant inputs and outputs for the public.

X. EPA'S ASSESSMENT OF ECONOMIC IMPACTS IS ARBITRARY AND CAPRICIOUS.

EPA also cannot finalize the Supplemental Proposal because of fundamental flaws in the Agency's assessment of the proposal's costs and benefits. Characterizing the "net benefits" of the Supplemental Proposal as solely the avoided compliance costs of the standards that the proposal would eliminate is fundamentally incorrect, misleading, and unlawful. 91 Fed. Reg. at 59044-45. In its Economic Impacts Analysis, EPA uses a baseline a scenario in which the 2024 Carbon Pollution Standards are repealed in their entirety (which EPA acknowledges is not quite accurate), and which also assumes that a further repeal of the Phase I Standards promulgated in 2015 "would not result in a meaningful change to the modeled cost and emissions outcomes." *Economic Impact Analysis for the Supplemental Proposed Rule*, No. EPA-HQ-OAR-2025-0124-2922 at 7-8 (Sept. 2026). The EIA thus assesses only additional estimated compliance cost savings from repealing the Phase I standards, pointing to the Regulatory Impacts Assessment for the final partial repeal of the 2024 Carbon Pollution Standards for a more complete assessment. *See Regulatory Impact Analysis for the Final Partial Repeal of the Carbon Pollution Standards for Fossil Fuel-Fired Electric Generating Units* ("2026 Partial Repeal RIA"), No. EPA-HQ-OAR-2025-0124-2994 (Sept. 2026).

EPA's approach in the EIA – incorporating the 2024 CPS RIA – is inconsistent with past agency practice, arbitrary, capricious, and unlawful. Ignoring well-established epidemiologic methodologies for valuing health impacts like premature mortality, asthma exacerbations, and cardiovascular hospitalizations resulting from fossil fuel-fired power plant criteria pollution, and established methodologies for valuing the climate change impacts of such plants' greenhouse gas emissions, render EPA's benefit-cost calculations fundamentally asymmetric and legally flawed. *See Window Covering Mfrs. Ass'n v. Consumer Prod. Safety Comm'n*, 82 F.4th 1273, 1288 (D.C. Cir. 2023) ("'an unreasonable assessment of social costs and benefits' can render a rule arbitrary and capricious" (citing *Thompson v. Clark*, 741 F.2d 401, 405 (D.C. Cir. 1984)).

A. EPA fails to give adequate consideration of the disbenefits of the Supplemental Proposal.

EPA's assessment of the costs and benefits of the Supplemental Proposal is a one-sided accounting focused on the Agency's estimates of compliance cost savings. EPA quantifies and analyzes the compliance costs that will be avoided as a result of the Supplemental Proposal. 91 Fed. Reg. at 59044; *Economic Impact Analysis for the Supplemental Proposed Rule* at 12-18. But EPA fails to quantify or monetize the health and climate disbenefits that will result from its proposed action.

EPA's failure to quantify or monetize the negative health impacts of the Supplemental Proposal renders its assertion that net benefits are simply compliance cost savings wholly conclusory and contravenes the requirement of reasoned agency decision-making. Regulatory

cost-benefit analysis under Executive Order 12866 requires that the Agency assess "all identifiable costs and benefits," including "direct effects as well as indirect benefits and costs." Exec. Order No. 12866, 58 Fed. Reg. 51735 (Oct. 4, 1993). Without a full quantification of both the costs and benefits of the Supplemental Proposal and a reasoned comparison and weighing of the two estimates, EPA has not calculated net benefits; instead, it has only estimated compliance cost reductions while ignoring the foregone health benefits. EPA's selective and biased accounting is unreasoned and arbitrary.[433]

In cost-benefit analysis for rescinding a regulation, the relevant comparison is the difference between the preexisting regulatory baseline, including the promulgated regulation, and the proposed change, or the repeal of the regulation. Therefore, EPA should consider the health benefits of the 2015 and 2024 standards that will no longer be in effect.[434]

The Regulatory Impact Analysis for the 2024 Carbon Pollution Standards rule estimated that from 2024 to 2047 there would be $270 billion in climate benefits, and between $59 and $120 billion in health benefits from reductions in PM2.5 and ozone emissions. *Regulatory Impact Analysis for the New Source Performance Standards for Greenhouse Gas Emissions from New, Modified, and Reconstructed Fossil Fuel-Fired Electric Generating Units; Emission Guidelines for Greenhouse Gas Emissions from Existing Fossil Fuel-Fired Electric Generating Units; and Repeal of the Affordable Clean Energy Rule* ("CPS RIA"), No. EPA-HQ-OAR-2023-0072-8913 (May 9, 2024) at 4-87, tbl. 4-30 (figures in 2019 dollars). EPA ignores prior estimates of these benefits, many of which will be foregone as a result of the Supplemental Proposal.

EPA may not exclusively account for certain "benefits" of the Supplemental Proposal while arbitrarily failing to estimate and monetize the corresponding *disbenefits* that result from the pollution increases that the proposal will cause. *See, e.g.*, *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Admin.*, 538 F.3d 1172, 1198 (9th Cir. 2008) (agency "cannot put a thumb on the scale by undervaluing the benefits and overvaluing the costs of more stringent standards"); *see also California v. Bernhardt*, 472 F. Supp. 3d 573, 623 (N.D. Cal. 2020) ("It is arbitrary for an agency to quantify an action's benefits while ignoring its costs where tools exist to calculate those costs."); *State of N.Y. v. Reilly*, 969 F.2d 1147, 1153 (D.C. Cir. 1992) (where EPA admitted that a previous proposal would provide air quality benefits, the Agency needed to justify the foregone air quality benefits in declining to adopt the proposal); *cf. Michigan v. EPA*, 576 U.S. 743, 752-3 (2015) ("Consideration of cost reflects the understanding that reasonable regulation ordinarily requires paying attention to the advantages *and* the disadvantages of agency decisions."). An agency's refusal to monetize the value of known environmental harms due to purported uncertainty is arbitrary and capricious. *Ctr. for Biological Diversity*, 538 F.3d at 1200.

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[433] *See* Off. Of Mgmt. & Budget, Circular A-4: Regulatory Analysis at 19 (2003) ("2003 OMB Circular A-4") OMB Circular A-4 at 19 (agencies "should not assume that the 'avoided' costs of not doing another regulatory alternative represent the benefits of a regulatory action where there is no direct, necessary relationship between the two").

[434] 2023 OMB Circular A-4 at 19 ("To the extent possible, [an agency] should monetize any . . . forgone benefits and add them to the other costs of that alternative.").

The Agency's failure to engage in any comparable accounting of the costs and benefits of the Supplemental Proposal is impermissible. By proposing regulatory action that concedes a definite increase in pollutant emissions without quantifying or analyzing the associated negative health impacts, EPA failed to articulate a "satisfactory explanation" and set forth a "rational connection between the facts found and the choice made." *State Farm*, 463 U.S. at 43 (quoting *Burlington Truck Lines, Inc. v. U.S.*, 371 U.S. 156, 168 (1962)).

B. EPA fails to analyze or monetize criteria pollutant disbenefits.

EPA's failure to monetize the health harms that will occur as a result of the Supplemental Proposal is arbitrary, capricious, and unlawful. In the 2026 Partial Repeal RIA, EPA details at length its past practice and methodologies for monetizing the health harm of criteria pollutant emissions like particulate matter, NO_X and SO_X. *2026 Partial Repeal RIA*, No. EPA-HQ-OAR-2025-0124-2994 at 4-1 to 4-9. Despite providing this background, EPA does not actually monetize those disbenefits here but rather promises that it will "investigate" methods to estimate health impacts from emissions before using them "in a regulatory analysis even for informational purposes." *Id*. at 4-9. EPA's decision to jettison its rigorous, peer-reviewed methodology for quantifying health impacts is not adequately explained or justified and is likewise unlawful.

EPA points to uncertainties at various steps in its traditional health effects monetization analysis. *2026 Partial Repeal RIA* at 4-5, 4-7. But waving a hand at uncertainty is not sufficient to support EPA's failure to quantify health impacts here. EPA's own Science Advisory Board has affirmed that EPA's existing methods for health effects monetization analysis are "essential tools in estimating the scale of health benefits," described them as "scientifically robust," and found EPA's three-tiered uncertainty approach to be "fundamentally a sensible one."[435] The SAB's recommendations were forward-looking refinements, not a repudiation of the methodology as EPA implies. *2026 Partial Repeal RIA* at 4-6. Furthermore, where the SAB identified methodological gaps, those gaps likely contribute to an undervaluation of health harms and their associated costs.[436] Even if the estimation of impacts were truly uncertain, governing guidance instructs that those impacts should "not be excluded from a regulatory analysis."[437] An agency may not omit consideration of an entire category of regulatory impacts simply because quantification is difficult or somewhat uncertain. *See, e.g.*, *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Admin.*, 538 F.3d 1172, 1200 (9th Cir. 2008).

Moreover, EPA never explains why its generalized concerns justify wholly rejecting these estimates. In particular, EPA never articulates why it declines to adopt recommendations from expert reviewers or why it declines to refine its estimates and their presentation; instead it rejects them wholesale. EPA provides no explanation as to why its longstanding methods for evaluating

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[435] EPA Sci. Advisory Bd., "*Transmittal of the Science Advisory Board Report* Review of BenMAP and Benefits Methods" at cover page and 37 (Jan. 17, 2024) ("*SAB Report*").

[436] *See SAB Report* at 20-28 (identifying underestimated impacts of cardiac arrest, stroke, lung cancer, and neurodegenerative disease).

[437] Off. Of Mgmt. & Budget, *Circular A-4: Regulatory Analysis* at 40 (2023) ("*2023 OMB Circular A-4*").

and presenting uncertainties around its health impacts estimates are no longer appropriate. Finally, EPA identifies no new scientific evidence or flaw in the existing scientific literature that could justify entirely failing to quantify or monetize health benefits wholesale.

By refusing to quantify, monetize, and weigh the health disbenefits of the Supplemental Proposal, EPA arbitrarily disregards decades of guidance from experts, its own formal economic analysis guidelines, and a large and longstanding body of empirical evidence documenting the strong relationship between pollution exposure, morbidity, and mortality.[438] EPA's abandonment of its established practice – and the failure to consider health impacts in regulatory decision-making – runs afoul of substantive and procedural statutory requirements, and the Agency's failure to explain this stark change in policy renders the Supplemental Proposal arbitrary and capricious. *See Fox Television*, 556 U.S. at 515 (when an agency chooses to depart from a prior position, it must "provide reasoned explanation for its action . . . display[ing] awareness that it *is* changing position" and "show that there are good reasons for the new policy"); *see also Encino Motorcars, LLC v. Navarro*, 579 U. S. 211, 222 ("An [u]nexplained inconsistency in agency policy is a reason for holding an interpretation to be an arbitrary and capricious change from agency practice." (citation omitted)).

An agency that proposes to eliminate health-protective standards must grapple honestly and thoroughly with the public health consequences of that choice. EPA has not done so here. As a result, the Supplemental Proposal is fundamentally arbitrary, capricious, and unlawful.

C. EPA fails to monetize climate disbenefits.

EPA's failure in the Supplemental Proposal to monetize or otherwise value the lost CO_2-reduction benefits of the 2024 Rule is irrational and contrary to the best available science on monetizing climate impacts. There are reliable, rigorous, peer-reviewed economic tools for monetizing the greenhouse gas impacts – in fact, EPA did so in the 2024 Carbon Pollution Standards, which projected that those standards would yield millions to billions of dollars in monetized climate benefits. Refusing to monetize or otherwise evaluate the loss of CO_2-related climate benefits under the proposed action demonstrates that the agency has arbitrarily failed to consider an important aspect of the decision.

EPA's explanation for refusing to monetize CO_2 benefits in the Regulatory Impact Assessment that accompanies the proposal does not justify the agency's approach. *See 2026 Partial Repeal RIA* at 1-5. EPA primarily asserts that there are "significant uncertainties related to the monetization of greenhouse gases," which the agency concludes could lead to "flawed decision-making due to overreliance on highly uncertain values." *2026 Partial Repeal RIA* at 6-3 to 6-4. That bury-our-heads-in-the-sand approach is the opposite of rational decision-making and conflicts with agency and inter-agency guidance, which emphasize the need to rigorously consider uncertainty using the best available methods, not disregard the best available evidence simply because uncertainty exists.

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[438] *See 2003 OMB Circular A-4* at 26-27, 40-41; EPA, *Guidelines for Preparing Economic Analyses* at 5-2 & n.2, 11-2, 11-4 (3d ed. 2024), https://www.epa.gov/environmental-economics/guidelines-preparing-economic-analyses-3rd-edition.

EPA's Guidelines for Preparing Economic Analyses recognize that "[u]ncertainty is inherent in" regulatory analysis, and thus "treatment of uncertainty is an essential component of analysis" to "present useful conclusions to inform policy decisions."[439] The Guidelines specifically instruct agency analysts to "[p]resent outcomes or conclusions based on expected or most plausible values," along with "descriptions of all known key assumptions, biases, and omissions," and describe models and probabilistic methods for quantifying and assessing uncertainties.[440]

The 2003 Circular A-4, the Office of Management and Budget's guidance on best practices for regulatory analysis, likewise directs that "[w]henever it is possible to characterize quantitatively the probability distributions, some estimates of expected value (*e.g.*, mean and median) must be provided in addition to ranges, variances, specified low-end and high-end percentile estimates, and other characteristics of the distribution."[441] The updated 2023 guidance further states that "[a]n effect of a regulation should not be excluded from a regulatory analysis simply because its estimation is highly uncertain," because "even for highly uncertain effects, it is often possible to use available evidence to produce estimates of those effects for inclusion in a regulatory analysis that are more accurate than assuming uncertain effects do not occur or have no benefits or costs."[442]

EPA's refusal to monetize CO_2 benefits here ignores this guidance and constitutes irrational, arbitrary and capricious decision-making. Federal courts have repeatedly recognized that rational agency analysis requires making predictive judgments under uncertain conditions, because regulators "are often called upon to confront difficult administrative problems armed with imperfect data." *Mont. Wilderness Ass'n v. McAllister*, 666 F.3d 549, 559 (9th Cir. 2011). The "proper response" to uncertainty is "for the [agency] to do the best it can with the data it has," not to willfully ignore available information. *Id*. The U.S. Court of Appeals for the D.C. Circuit has further explained that, even when armed with imperfect and imprecise information that enables the agency to "determine only the range" of impacts, agencies must still assess regulatory costs when feasible. *Chamber of Com. of U.S. v. Sec. & Exch. Comm'n*, 412 F.3d 133, 143 (D.C. Cir. 2005) (citing *Pub. Citizen v. Fed. Motor Carrier Safety Admin*., 374 F.3d 1209, 1221 (D.C. Cir. 2004)).

Based on these bedrock regulatory principles, in 2008, the U.S. Court of Appeals for the Ninth Circuit held that uncertainty is not a sufficient reason to not monetize climate effects in

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[439] EPA, *Guidelines for Preparing Economic Analyses* 5-29 (3d ed. 2024), https://www.epa.gov/environmental-economics/guidelines-preparing-economic-analyses-3rd-edition.

[440] EPA, *Guidelines for Preparing Economic Analyses* 5-29 (3d ed. 2024), https://www.epa.gov/environmental-economics/guidelines-preparing-economic-analyses-3rd-edition.

[441] *2003 OMB Circular A-4* at 40-41 (2003).

[442] *2023 OMB Circular A-4* at 67.

regulatory decision-making. *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Admin.*, 538 F.3d 1172, 1198-1203 (9th Cir. 2008). Even where there was some uncertainty in the proper valuation of climate damages, the court explained that "the value of carbon emissions reduction is certainly not zero." *Id*. at 1200. The Court held both that "it is possible to monetize" greenhouse gas emissions reductions and that the agency's failure to do so was arbitrary and capricious. *Id*.

And it *is* possible to monetize the benefits of avoiding CO_2 emissions. The benefits arising from CO_2 reduction are both capable of quantification and are essential to consider in EPA's Supplemental Proposal. Experts first developed estimates of the social cost of carbon in the 1990s, and federal agencies began developing estimates of the social cost of greenhouse gases based on the growing scientific literature. EPA published its first technical support document recommended social cost of greenhouse gasses (SC-GHG) estimates capturing the total marginal damages from a ton of greenhouse gas emission in 2008.[443] The White House subsequently convened an Interagency Working Group on the Social Cost of Carbon, which has released and frequently updated climate-damage estimates based on three independent and widely used climate-economic models, known as integrated assessment models.

These models and methods have now been used by federal agencies for more than a decade to monetize CO_2 benefits of regulatory action. Indeed, EPA has monetized CO_2 benefits in countless rulemakings over the fifteen years, including in the 2024 Carbon Pollution Standards rule itself, where EPA estimated that the standards would yield $270 billion in climate benefits. 89 Fed. Reg. at 40021. The agency explained in a 2023 Report on the Social Cost of Greenhouse Gases, that its methodology "reflects the societal value of reducing emissions of CO_2 by one metric ton and is the theoretically appropriate value to use in conducting benefit-cost analyses of policies that affect CO_2 emissions."[444] The agency recognized the existence of uncertainty but explained that the estimated CO_2 benefits "likely underestimate the marginal benefits of abatement." *Id*.

EPA acknowledges that it had used the social cost of carbon methodology in the past, 91 Fed. Reg. at 59041, but points to a memorandum "Guidance Implementing Section 6 of Executive Order 15154, entitled 'Unleashing American Energy,'" to justify its refusal to monetize the greenhouse gas impacts of its proposal. *2026 Partial Repeal RIA* at 6-4. Executive Order 14154's direction to abandon use of the guidance and methodologies for estimating the social cost of carbon issued by the Interagency Working Group on the Social Cost of Greenhouse Gases does not absolve EPA of its statutory responsibility to engage in reasoned decision-making. *See, e.g.*, *Ctr. for Biological Diversity*, 538 F.3d at 1198-1203. EPA cannot hide behind an Executive Order to avoid its obligation to consider all relevant aspects of a problem. If following that Order requires EPA to analyze a problem arbitrarily and capriciously, then the agency action is arbitrary or capricious and must be set side.

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[443] EPA, *Technical Support Document on Benefits of Reducing GHG Emissions* 13 (June 12, 2008), https://downloads.regulations.gov/EPA-HQ-OAR-2008-0318-0078/content.pdf.

[444] EPA, *Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances*, No. EPA-HQ-OAR-2021-0317 (Nov. 2023)

In short, rigorous methods for estimating and monetizing the benefits of CO_2 reduction exist, and EPA and OMB guidance as well as federal caselaw require EPA to use available tools to estimate those benefits to fully and rationally assess the proposed action. Rejecting those methods and ignoring that guidance leads EPA to arbitrarily underestimate the costs of proposal and is an irrational and unreasonable approach.

D. EPA's flawed assessment has a material, substantive effect on the rule.

EPA failure to perform a reasoned assessment of the costs of its action does more than expose its generally sloppy and irrational approach to the Supplemental Proposal; it also infects its substantive analysis. For example, EPA "proposes that retaining futile GHG standards for fossil fuel-fired EGUs under CAA section 111 would be unreasonable given the significant costs they impose on regulated parties, consumers, and the economy," 91 Fed. Reg. at 59006, a judgment reached without the benefit of a complete, fair assessment of the costs that those consumer and the economy will bear as a result of increased health and welfare risks and climate change impacts. Likewise, as discussed in more detail in Comment Part VIII (concerning EPA's futility analysis), EPA's analysis of the asserted "futility" of regulating greenhouse gas emissions from power plants states generally that "the changes in CO_2 emissions and global CO_2 concentrations by 2050 and 2100 resulting from the complete elimination of all CO_2 emissions from U.S. power plants would be relatively minor," 91 Fed. Reg. at 59039, but quantifying and monetizing the impacts of the avoided greenhouse gas emissions would give a more concrete view of the social costs of those emissions. *See also id.* (EPA basing its argument on "EPA's prior regulatory impact analyses for power sector regulations"). That failure is particularly egregious given that, in explaining the modeling that EPA contends supports its "futility" analysis, EPA cites to a National Academies of Science book that actually estimates the social cost of carbon. *See id.* at 59037 n.211 (citing National Academies of Sciences, Engineering and Medicine, *Valuing Climate Damages: Updated Estimation of the Social Cost of Carbon Dioxide* (2017)). The information was right in front of EPA's nose, but it chose to ignore it.

EPA's failure to consider the health and climate costs of its proposal renders it arbitrary, capricious, and unlawful. EPA should withdraw the proposal.

XI. EPA'S SUPPLEMENTAL PROPOSAL VIOLATES THE ENDANGERED SPECIES ACT.

EPA has ignored its duty of consultation under the Endangered Species Act ("ESA"), 16 U.S.C. § 1531 *et seq.*, in promulgating the Proposal. Before finalizing the Proposal, EPA must comply with the ESA's consultation provisions.

A. The Supplemental Proposal is a non-ministerial action that triggers the ESA's duty to consult.

The Supplemental Proposal is a discretionary and thus non-ministerial action for a number of reasons. EPA used its discretion to decide whether to review the Section 111 endangerment finding at all; whether to revoke the prior powerplant greenhouse gas regulations in addition to the endangerment finding; and whether to propose revoking the Section 111 endangerment finding. The agency also used its discretion in deciding which factors to analyze in

its review of the endangerment finding, how to analyze and weigh the significance of those factors, and how to analyze and weigh the factual and legal bases for its conclusions as described in its Proposal.

Similar to the instant Proposal, EPA recently purported to eliminate its rules regulating greenhouse gas emissions from certain motor vehicles under Clean Air Act Section 202, and also sought to revoke its own endangerment finding allowing such rules. In that rulemaking process, 90 Fed. Reg. 36288 (Aug. 1, 2025), EPA wrote:

> In proposing this alternative, we note that the Supreme Court has continued to emphasize that agencies have significant discretion when making complex judgments within the bounds of an authorizing statute. We propose that the Administrator may now exercise the discretion expressly delegated to him by Congress in the text of CAA section 202(a) by rescinding the Endangerment Finding.

Id. at 36291 (footnote omitted). And:

> The EPA proposes that nothing in the language of the statute prohibits or conditions our general authority to rescind prior actions. CAA section 202(a)(1) grants the Administrator discretion to ''revise'' standards prescribed ''in accordance with the provisions of this section'' and does not require retaining the same level of stringency when revising or rescinding existing standards.

Id. at 36296.

Accordingly, the Supplemental Proposal is a discretionary, non-ministerial action by EPA and subject to the requirements of the ESA.

B. EPA must complete ESA consultation because the Proposal may affect listed species or critical habitats.

Section 7 of the ESA requires a federal agency (here, EPA) to complete formal consultation with the United States Fish and Wildlife Service or the National Oceanic and Atmospheric Administration (depending on the location of the species) if the agency determines that any action on its part "may affect" any listed species or critical habitat. 50 C.F.R. Section 402.14(a) provides in part:

> Each Federal agency shall review its actions at the earliest possible time to determine whether any action may affect listed species or critical habitat. If such a determination is made, formal consultation is required, except as noted in paragraph (b) of this section.

In *Center for Biological Diversity v. U.S. Bureau of Land Management*, 141 F.4th 976, 1011 (9th Cir. 2025), the Court explained:

> If listed species "may be present" in an agency's project area, the agency must conduct a "biological assessment" to identify listed species "likely

> to be affected" by the project. [16 U.S.C.] § 1536(c)(1). If the agency determines that its proposed action "may affect" any listed species or its critical habitat, then consultation – either formal or informal – is required. *Karuk Tribe [of Cal. v. U.S. Forest Service]*, 681 F.3d [1006,] 1027 [(9th Cir. 2012)]. An agency can only avoid consultation if its action will have "no effect" on a listed species or critical habitat. *Id*.

See also W. Watersheds Project v. Kraayenbrink, 632 F.3d 472, 495 (9th Cir. 2011) (Section 7 requires formal consultation if the agency determines that any action on its part "may affect" any listed species or critical habitat.)

"'May affect' purposefully sets a low bar: 'Any possible effect, whether beneficial, benign, adverse or of an undetermined character, triggers the formal consultation requirement.'" *Growth Energy v. EPA*, 5 F.4th 1, 30 (D.C. Cir. 2021) (quoting 51 Fed. Reg. 19926, 19949 (June 3, 1986)); *see also Karuk Tribe*, 681 F.3d at 1027; *N. Plains Res. Council v. U.S.- Army Corps of Eng'rs*, 454 F. Supp. 3d 985, 991 (D. Mont. 2020).[445] In carrying out the consultation process, agencies must use the "best scientific and commercial data available" to fulfill the requirements of the ESA. 16 U.S.C. § 1536(a)(2). Only if the federal agency finds that its proposed action "will not affect any listed species or critical habitat in any way" – *i.e.*, makes a no effect determination – can it skip the consultation process. *In re Ctr. for Biological Diversity*, 53 F.4th 665, 668 (D.C. Cir. 2022) (internal quotation marks omitted).

Here, the Proposal will maintain or increase greenhouse gas and criteria pollutant increases that are expected from EPA's accompanying final rule repealing most provisions of the 2024 Carbon Pollution Standards for greenhouse gas emissions from fossil fuel-fired electric generating units. The Regulatory Impact Analysis for the for the Final Partial Repeal of the Carbon Pollution Standards for Fossil Fuel-Fired Electric Generating Units, found at https://www.epa.gov/system/files/documents/2026-09/utilities_ria_final_partial_repeal_of_cps_2026-09.pdf, shows increases in CO_2 emissions (Tables 1-2 and 3-3) as well as increases in NO_X, SO_2, mercury, and ozone (Table 3-4). For regulatory purposes, those increases are baked into the analysis for the Proposal. They can only get worse as electricity demand increases, for example to power new data centers or for additional air conditioning use as heat waves associated with climate change expand. This is the factual background for the ESA "may affect" analysis of the Proposal.

Once a finding is made that a proposed federal agency action may affect any listed species or critical habitat, consultation is required. During that consultation, pursuant to 50 C.F.R. § 402.02 the Fish and Wildlife Service will determine the effects of the action, defined in 50 C.F.R. § 402.02 as:

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[445] *See also* U.S. Fish & Wildlife Serv. & Nat'l Marine Fisheries Serv., *Endangered Species Consultation Handbook* E-13(Mar. 1998) (defining "may affect" as "the appropriate conclusion when a proposed action may pose **any** effects on listed species or designated critical habitat" (emphasis in original)).

> [A]ll consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action but that are not part of the action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action.

If the agency determines that the proposed action may affect and is likely to adversely affect a listed species, then formal consultation with EPA is required. 50 C.F.R. 402.14(a)-(b)?

Here, because EPA has not initiated any consultation with the Fish and Wildlife Service or the National Marine Fisheries Service (collectively the "Services"), formal or informal, the evidence in this letter that the Proposal[446] "may affect" an endangered species or its habitat is enough to require the initiation of consultation by EPA. During consultation, there is more than sufficient evidence in the record to show that adverse effects described in that evidence are "consequences" of the Proposal in that they meet both the "but for" and "reasonably certain to occur" provisions of 50 CFR § 402.02, thus requiring a full Biological Opinion from the Services.

C. The scientific evidence clearly shows that the Supplemental Proposal will adversely affect federally listed species, including causing adverse modification of critical habitat and jeopardy for some species.

As detailed below, the Supplemental Proposal clearly crosses the "may affect" threshold because the resulting increases in greenhouse gas and criteria air pollutant emissions would unquestionably affect hundreds of federally listed species that are threatened by greenhouse gas-driven climate change and NO_X and SO_2 emissions.

For example, the increase in greenhouse gas emissions resulting from the Proposal will not only adversely affect sea ice-dependent polar bears, ringed seals, and bearded seals, but it will also adversely modify their critical habitat and cause jeopardy for polar bears by appreciably diminishing the species' likelihood of survival and recovery. The Proposal's increases in greenhouse gas emissions will also adversely affect many other climate-sensitive listed species and their critical habitat such as corals and coastal and island species. The Proposal's resulting increases in NO_X criteria air pollutants will likewise adversely affect listed species such as the endangered Lange's metalmark butterfly which is threatened by nitrogen deposition. The scientific evidence detailed below clearly shows that the Proposal "may affect," and is likely to adversely affect, numerous listed species, including, but not limited to, the species described in these comments. The scientific evidence further shows that the Proposal would cause jeopardy and adverse modification to critical habitat for some sensitive species such as the polar bear.

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[446] The promulgation of Federal Regulations are actions subject to the ESA (50 CFR § 402.02).

1. The proposal will result in significant emissions of greenhouse gases and criteria pollutants.

The Regulatory Impact Analysis for the Final Partial Repeal of the Carbon Pollution Standards for Fossil Fuel-Fired Electric Generating Units estimates decades of increases in CO_2 and certain criteria pollutants.

The National Climate Assessments and Intergovernmental Panel on Climate Change reports make clear that every ton of additional CO_2 emissions matters: "[e]very ton of CO_2 adds to global warming"[447] and its harms. The reports underscore that the damages of climate change are long-lived and the choices governments make now on reducing greenhouse gas pollution will affect the severity of the harms that will be suffered in the coming decades and centuries: "[t]he more the planet warms, the greater the impacts. Without rapid and deep reductions in global greenhouse gas emissions from human activities, the risks of accelerating sea level rise, intensifying extreme weather, and other harmful climate impacts will continue to grow. Each additional increment of warming is expected to lead to more damage and greater economic losses compared to previous increments of warming, while the risk of catastrophic or unforeseen consequences also increases."[448] These reports find that the U.S. must make immediate, deep reductions in CO_2 and other greenhouse gas emissions such that global greenhouse gas emissions peak by 2025, fall 48% below 2019 levels by 2030, and reach net zero by early 2050s to meet Paris Agreement climate targets and avoid devastating damages, including to species and ecosystems.[449] The Fifth National Climate Assessment states that "US net greenhouse gas emissions remain substantial and would have to decline by more than 6% per year on average, reaching net zero around midcentury, to meet current national climate targets and international temperature goals (*very high confidence*)),"[450] and that national greenhouse gas reductions would include "widespread improvements in energy efficiency, substantial electricity generation from

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[447] Intergovernmental Panel on Climate Change (IPCC), *Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* 83 (2023); *see also* NASEM 2025 Climate Report 39, ("As long as global emissions of CO_2 stay above zero, concentrations and radiative forcing will continue to increase and global temperature will increase roughly in proportion to cumulative CO_2 (*i.e.*, each additional ton emitted adds an increment more to temperature increase) with small contributions from other long-lived gases including N_2O and F- gases. As global emissions of GHGs are spread across all nations, a collective effort at reducing emissions is required to limit future warming.").

[448] U.S. Global Change Research Program, *Fifth National Climate Assessment* 1-5.

[449] Intergovernmental Panel on Climate Change, *Summary for Policymakers*, in *Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (2022), 21, 22, 30.

[450] U.S. Global Change Research Program, *Fifth National Climate Assessment* 32-6.

solar and wind energy, and widespread electrification of transportation and heating (*high confidence*)."[451]

2. Anthropogenic greenhouse gas emissions and resulting climate change have well-documented adverse impacts on species and ecosystems.

An enormous body of scientific research has documented the growing harms of greenhouse gas emissions and resulting anthropogenic climate change on species and ecosystems, "as rising temperatures, more extreme weather events, coastal flooding, sea ice and glacier melt, and other climate hazards make conditions more inhospitable."[452] Emissions-driven climate change is disrupting species' distributions, timing of breeding and migration, physiology, vital rates, and genetics.[453] It is promoting the spread of diseases and invasive species; increasing mortality; and deteriorating ecosystem processes.[454] Worldwide an estimated one million animal and plant species are threatened with extinction, with climate change as a major driver, alongside

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[451] *Id.* at 32-13.

[452] Shaye Wolf et al., *Scientists' Warning on Fossil Fuels*, 5 Oxford Open Climate Change kgaf011 (2025); *see also* William J. Ripple et al., *Climate Change Threats to Earth's Wild Animals,* 75 BioScience 519 (2025).

[453] Camille Parmesan & Gary Yohe, *A Globally Coheren Fingerprint of Climate Change Impacts Across Natural Systems*, 421 Nature 37 (2003); Tery L. Root et al., *Fingerprints of Global Warming on Wild Animals and Plants*, 421 Nature 57 (2003); Camille Parmesan, *Ecological and Evolutionary Responses to Recent Climate Change*, 37 Annu. Rev. Ecol. Evol. Syst. 637 (2006); I-Ching Chen et al., *Rapid Range Shifts of Species Associated with High Levels of Climate Warming*, 333 Science 1024 (2011); Ilya M. D Maclean,. & Robert J. Wilson, *Recent Ecological Responses to Climate Change Support Predictions of High Extinction Risk*, 108 PNAS 12337 (2011); Rachel Warren et al., *Increasing Impacts of Climate Change upon Ecosystems with Increasing Global Mean Temperature Rise*, 106 Climatic Change 141 (2011); Abigail E Cahill et al., *How Does Climate Change Cause Extinction?*, 280 Proceedings of the Royal Society B 20121890 (2012); Michela Pacifici et al., *Species' Traits Influenced Their Response to Recent Climate Change*, 7 Nature Climate Change 205 (2017); Fiona E.B. Spooner et al. *Rapid Warming Is Associated with Population Decline Among Terrestrial Birds and Mammals Globally*, 24 Glob. Change Biol. 4521 (2018); P.D. McElwee et al., *Chapter 8: Ecosystems, Ecosystem Services, and Biodiversity*, in *Fifth National Climate Assessment* (U.S. Global Change Research Program 2023).

[454] Brett R. Scheffers et al., *The Broad Footprint of Climate Change from Genes to Biomes to People*, 354 Science 719 (2016).

habitat destruction and exploitation.[455] Climate change-related local extinctions are already widespread.[456]

Every increase in greenhouse gas pollution and resulting climate change stress increases extinction risk. At 2°C compared with 1.5°C of temperature rise, species' extinction risk will increase substantially,[457] leading to a doubling of the number of vertebrate and plant species losing more than half their range, and a tripling for invertebrate species.[458] Studies have projected catastrophic species extinction during this century if greenhouse gas emissions continue unabated: 15 to 37% of the world's plants and animals committed to extinction by 2050 under a mid-level emissions scenario[459]; the potential extinction of 10 to 14% of species by 2100[460]; global extinction of 5% of species with 2°C of warming and 16% of species with business-as-usual warming[461]; the loss of more than half of the present climatic range for 57% of plants and 34% of animals by the 2080s under a no-mitigation scenario[462]; and the extinction of 30% or more of species included in one study in the next 50 years.[463]

The Fifth National Climate Assessment confirmed that "[s]pecies [c]hanges and [b]iodiversity [l]oss [a]re [a]ccelerating," concluding that "[t]he interaction of climate change with other stressors is causing biodiversity loss, changes in species distributions and life cycles, and increasing impacts from invasive species and diseases, all of which have economic and social consequences (*very likely, high confidence*). Future responses of species and populations will depend on the magnitude and timing of changes, coupled with the differential sensitivity of

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[455] Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), *The Global Assessment Report on Biodiversity and Ecosystem Services* XXVIII, 126-27 (2019); IPBES, *Summary for Policymakers of the Thematic Assessment of the Underlying Causes of Biodiversity Loss, Determinants of Transformative Change and Options for Achieving the 2050 Vision for Biodiversity* (2024).

[456] John J. Wiens, *Climate-Related Local Extinctions Are Already Widespread Among Plant and Animal Species*, 14 PLOS Biol. e2001104 (2016).

[457] Mark C. Urban, *Climate Change Extinctions*, 386 Science 1123 (2024).

[458] Intergovernmental Panel on Climate Change, *Global Warming of 1.5°C: An IPCC Special Report on the Impacts of Global Warming of 1.5°C Above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty* 37 (2018).

[459] Chris D. Thomas et al., *Extinction Risk from Climate Change*, 427 Nature 145 (2004).

[460] Maclean & Wilson (2011).

[461] Mark C. Urban, *Accelerating Extinction Risk from Climate Change*, 348 Science 571 (2015).

[462] Rachel Warren et al., *Quantifying the Benefit of Early Climate Change Mitigation in Avoiding Biodiversity Loss*, 3 Nature Climate Change 678 (2013).

[463] Cristian Román-Palacios & John J. Wiens, *Recent Responses to Climate Change Reveal the Drivers of Species Extinction and Survival*, 117 PNAS 4211 (2020).

organisms; species that cannot easily relocate or are highly temperature sensitive may face heightened extinction risks (*very likely, high confidence*)."[464]

3. Anthropogenic greenhouse gas emissions and resulting climate change have well-documented adverse impacts on federally protected species.

The harms from greenhouse gas emissions, and resulting climate change, to federally listed species have been extensively documented in the published scientific literature[465] and in federal listing determinations, 5-year reviews, critical habitat designations, and recovery plans under the Endangered Species Act. A 2025 study identified climate change as the leading threat to species protected under the ESA.[466] The study found that 91% of the 1,602 ESA-listed species analyzed, all within the U.S. or U.S. territories and listed as of 2023, are threatened by climate change.

Greenhouse gas emissions harm federally listed species in ways that are not only measurable but also causally understood. Greenhouse gas-driven climate change impacts such as sea ice loss, ocean heat stress and ocean acidification, sea level rise, the increasing frequency of extreme weather events, decreasing snowpack, and elevational and latitudinal shifts in habitat are several of the ways that greenhouse gas emissions harm federally protected species, all of which must be assessed prior to finalizing the Proposal.

Loss of sea ice and harms to listed sea-ice dependent species. In 2008, the U.S. Fish and Wildlife Service (hereafter "FWS") listed the polar bear (*Ursus maritimus*) as a threatened species due to greenhouse gas emissions-driven climate change and the resulting loss of Arctic sea ice on which the species depends for survival. 73 Fed. Reg. 28212, 2855-62, 28292-93 (May 15, 2008); *see also In re Polar Bear Endangered Species Act Listing*, 709 F.3d 1 (D.C. Cir. 2013) (affirming FWS's decision to federally list the polar bear as threatened due to the effects of global climate change on polar bear habitat). The loss of sea ice also jeopardizes the polar bear's

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[464] McElwee et al., *Chapter 8: Ecosystems, Ecosystem Services, and Biodiversity*, in *Fifth National Climate Assessment*, at 16.

[465] Anthony Povilitis & Kierán Suckling, *Addressing Climate Change Threats to Endangered Species in U.S. Recovery Plans*, 24 Conservation Biology 372 (2010); Aimee Delach et al., *Agency Plans Are Inadequate to Conserve US Endangered Species Under Climate Change*, 9 Nature Climate Change 999 (2019); Stephanie Jenouvrier et al., *The Call of the Emperor Penguin: Legal Responses to Species Threatened by Climate Change*, 27 Global Change Biology 5008 (2021); Amy Wrobleski et al., *The Impact of Climate Change on Endangered Plants and Lichen*, 2 PLOS Climate e0000225 (2023); Theodore Weber et al., *Agency Management Plans Also Fail to Address Threatened Species Vulnerability to Climate Change in the US*, 284 Biological Conservation 110184 (2023).

[466] Talia E. Niederman et al., *US Imperiled Species and the Five Drivers of Biodiversity Loss*, 75 BioScience 524 (2025).

sea-ice dependent prey species – ringed and bearded seals – which were listed as federally threatened in 2012 due to sea ice loss from climate change.[467]

Alaska and the Arctic have experienced some of the most severe and rapid heating due to greenhouse gas emissions, with temperatures increasing two to nearly four times faster than the global average.[468] Arctic summer sea ice extent and thickness have decreased by 30-40% during the past several decades,[469] with each metric ton of CO_2 emissions estimated to lead to an average sustained loss of three square meters of summer sea ice area.[470] The Arctic lost 95% of its oldest and thickest sea ice over three decades, and the remaining thinner, younger ice is more vulnerable to melting.[471] Sea ice loss has accelerated since 2000, with Alaska's coasts suffering some of the fastest declines.[472] The length of the sea ice season is shortening as ice melts earlier in spring and forms later in autumn.[473] Along Alaska's northern and western coasts, the sea ice season has already shortened by more than 90 days.[474] As summarized by the Fourth National Climate Assessment:

> Since the early 1980s, annual average arctic sea ice has decreased in extent between 3.5% and 4.1% per decade, has become thinner by between 4.3 and 7.5 feet, and is melting at least 15 more days each year. September sea ice extent has decreased between 10.7% and 15.9% per decade (very high confidence). Arctic

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[467] 77 Fed. Reg. 76706 (Dec. 28, 2012); 77 Fed. Reg. 76740 (Dec. 28, 2012).

[468] U.S. Global Change Research Program, *Fifth National Climate Assessment* (2023), at 29-5; Mika Rantanen et al., *The Arctic Has Warmed Nearly Four Times Faster than the Globe Since 1979*, 3 Commc'ns Earth & Env't 168 (2022).

[469] Walter N. Meier et al., *Arctic Sea Ice in Transformation: A Review of Recent Observed Changes and Impacts on Biology and Human Activity*, 51 Revs. Geophysics 185 (2014); U.S. Global Change Research Program, *Fourth National Climate Assessment*, Vol. I, at 29, 57, 303 (2017); U.S. Global Change Research Program, *Fourth National Climate Assessment*, Vol. II, at 1192-93 (2018); Intergovernmental Panel on Climate Change, *Summary for Policymakers in Climate Change 2021: The Physical Science Basis* 6 (2021).

[470] Dirk Notz & Julienne Stroeve, *Observed Arctic Sea-Ice Loss Directly Follows Anthropogenic CO_2 Emission*, 354 Science 747 (2016).

[471] *Arctic Report Card 2018*, at 2 (E. Osborne et al. eds. 2018).

[472] U.S. Global Change Research Program, *Fourth National Climate Assessment*, Vol. I, at 305(2017); U.S. Global Change Research Program, *Fifth National Climate Assessment* 29–6 (2023).

[473] Claire L. Parkinson, *Spatially Mapped Reductions in the Length of the Arctic Sea Ice Season*, 41 Geophysical Research Letters 4316 (2014).

[474] U.S. Global Change Research Program, *Fourth National Climate Assessment*, Vol. I, at 307 (2017).

> sea ice loss is expected to continue through the 21st century, *very likely* resulting in nearly sea ice-free late summers by the 2040s (*very high confidence*).[475]

It is precisely this sea ice loss, and the lack of adequate regulatory mechanisms addressing greenhouse gas pollution, that led the FWS to list the polar bear as a threatened species in 2008 and to designate sea ice habitat off Alaska as critical habitat in 2010. 73 Fed. Reg. at 28293; 75 Fed. Reg. 76086 (Dec. 7, 2010). As a top Arctic predator, the polar bear relies on sea ice for all its essential activities, including hunting for prey, moving long distances, finding mates, and building dens to rear cubs. Federal documents acknowledge that shrinkage and premature breakup of sea ice due to climate change is the primary threat to the species, leaving polar bears with vastly diminished hunting grounds, less time to hunt, and a shortage of sea ice for other essential activities such as finding mates and resting.[476] As summarized in the FWS's 5-year reviews, sea ice loss and a shorter sea ice season makes hunting calorie-rich seals more difficult for polar bears, leading to nutritional stress, reduced body mass, and declines of some populations.[477] As the sea ice retreats, polar bears have been forced to swim longer distances,[478] which is more energetically costly,[479] and they are spending more time on land where they have reduced access to food.[480] Females are denning more often on land than on ice, increasing the potential for conflicts with humans.[481] Because polar bears have high metabolic rates, increases in movement resulting from loss and fragmentation of sea ice result in higher

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[475] *Id.* at 29, 303.

[476] 73 Fed. Reg. at 28255-65; U.S. Fish & Wildlife Serv., *Polar Bear (Ursus maritimus) Conservation Management Plan* (2016); U.S. Fish & Wildlife Serv., *Polar Bear (Ursus maritimus) 5-Year Review: Summary and Evaluation* (2017); U.S. Fish & Wildlife Serv., *Polar Bear (Ursus maritimus) 5-Year Review: Summary and Evaluation* (2023).

[477] U.S. Fish & Wildlife Serv., *Polar Bear (Ursus maritimus) 5-Year Review* 16 (2017); U.S. Fish & Wildlife Serv., *Polar Bear (Ursus maritimus) 5-Year Review* 5 (2023).

[478] George M. Durner et al., *Consequences of Long-Distance Swimming and Travel over Deep-Water Pack Ice for a Female Polar Bear During a Year of Extreme Sea Ice Retreat*, 34 Polar Biology 975 (2011); Anthony M. Pagano et al., *Long-Distance Swimming by Polar Bears (Ursus maritimus) of the Southern Beaufort Sea During Years of Extensive Open Water*, 90 Can. J. Zoology 663 (2012); Nicholas W. Pilfold et al., *Migratory Response of Polar Bears to Sea Ice Loss: To Swim or Not to Swim*, 40 Ecography 189 (2017).

[479] Blaine D. Griffen, *Modeling the Metabolic Costs of Swimming in Polar Bears (Ursus maritimus)*, 41 Polar Biology 491 (2018).

[480] Seth G. Cherry et al., *Fasting Physiology of Polar Bears in Relation to Environmental Change and Breeding Behavior in the Beaufort Sea*, 32 Polar Biology 383 (2009); John P. Whiteman et al., *Summer Declines in Activity and Body Temperature Offer Polar Bears Limited Energy Savings*, 349 Science 295 (2015).

[481] J.W. Olson et al., *Collar Temperature Sensor Data Reveal Long-Term Patterns in Southern Beaufort Sea Polar Bear Den Distribution on Pack Ice and Land*, 564 Marine Ecology Progress Series 211 (2017); U.S. Fish & Wildlife Serv., *Polar Bear (Ursus maritimus) 5-Year Review* 20-21 (2017).

energy costs that lead to reduced body condition, recruitment and survival.[482] In short, emissions-driven sea ice loss is leading to longer periods of forced fasting for polar bears when they are largely food deprived and must survive on accumulated fat reserves, which reduces their body condition, reproductive success, and survival.[483]

In Alaska, the Southern Beaufort Sea population declined by 25-50 percent during the 2000s, attributed to sea ice loss that limited access to prey over multiple years,[484] and averaged just 565 bears between 2006 to 2015.[485] For the bears in this population, research has linked sea ice loss to decreases in survival, lower success in rearing cubs,[486] shrinking body size,[487] and increases in fasting and nutritional stress.[488]

Highlighting the importance of reducing greenhouse gas emissions to protect sea-ice dependent species, one study estimated that each metric ton of CO_2 emission results in a sustained loss of 3 ± 0.3 m^2 of September Arctic sea ice area.[489] Similar to other research,[490] the study concluded that limiting warming to 2°C is not sufficient to allow Arctic summer sea ice to survive, but that rapid greenhouse gas emission reductions to achieve a 1.5°C target gives Arctic summer sea ice "a chance of long-term survival, at least in some parts of the Arctic Ocean."[491] Based on this analysis, a 7.5 billion metric ton CO_2 increase between 2030-2047 resulting from the repeal of power plant pollution standards would result in a sustained loss of 8,715 square miles of summer sea ice habitat for polar bears – an enormous area the size of New Jersey. *See supra* Part XI.C.2. Designated critical habitat for the polar bear in Alaska includes 179,508 square miles of sea ice in the Bering, Chukchi, and Southern Beaufort seas. 75 Fed. Reg. at

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[482] U.S. Fish & Wildlife Serv., *Polar Bear (Ursus maritimus) 5-Year Review* 17 (2017); Anthony M. Pagano et al., *High-Energy, High-Fat Lifestyle Challenges an Arctic Apex Predator, the Polar Bear*, 359 Science 568 (2018).

[483] Péter K. Molnár et al., *Fasting Season Length Sets Temporal Limits for Global Polar Bear Persistence*, 10 Nature Climate Change 732 (2020).

[484] Jeffrey F. Bromaghin et al., *Polar Bear Population Dynamics in the Southern Beaufort Sea During a Period of Sea Ice Decline*, 25 Ecological Applications 634 (2015).

[485] Jeffery F. Bromaghin et al., *Survival and Abundance of Polar Bears in Alaska's Beaufort Sea, 2001-2016*, 11 Ecology & Evolution 14250 (2021).

[486] Eric V. Regehr et al., *Survival and Breeding of Polar Bears in the Southern Beaufort Sea in Relation to Sea Ice*, 79 J. Animal Ecology 117 (2010); Bromaghin et al. (2015).

[487] Karyn D. Rode et al., *Reduced Body Size and Cub Recruitment in Polar Bears Associated with Sea Ice Decline*, 20 Ecological Applications 768 (2010).

[488] Cherry et al. (2009); Whiteman et al. (2015).

[489] Notz & Stroeve (2016).

[490] Carl-Friedrich Schleussneret al., *Science and Policy Characteristics of the Paris Agreement Temperature Goal*, 6 Nature Climate Change 827, 830 (2016).

[491] Notz & Stroeve 750 (2016).

76121. Although sea ice habitat destruction due to the Proposal would occur across the Arctic, some of the fastest losses of Arctic sea ice are happening in the Bering, Chukchi, and Southern Beaufort seas off Alaska. Therefore, much of the sea ice loss projected to occur due to the Proposal is likely to happen in polar bear critical habitat off Alaska. This significant loss of sea-ice habitat due to the Proposal would undoubtedly constitute adverse modification to critical habitat for polar bears.

Furthermore, a 2020 study found that prolonged fasting periods caused by emissions-driven sea ice loss are likely to have already pushed, or will soon push, polar bear populations beyond critical thresholds for survival, meaning that many polar bear populations could be extirpated in just a few decades absent aggressive reductions in greenhouse gas emissions.[492] The survival of polar bear cubs (*i.e.*, recruitment into the next generation), as determined by the mother's declining ability to provide enough milk, is the first demographic threshold crossed as fasting periods increase. Populations that are not successfully recruiting young can only decline towards extinction. The study determined that some polar bear populations – Western Hudson Bay, Southern Hudson Bay, and Davis Strait – have likely already crossed the "impact threshold" for cub survival in some years. The two Alaskan polar bear populations are likely to experience impacts on cub survival starting in 10 to15 years on a mid-level RCP 4.5 emissions trajectory: in ~2035 for the Southern Beaufort Sea population and ~2042 for the Chukchi Sea population. On an RCP 4.5 emissions trajectory, the study projects that most polar bear populations will experience decreased recruitment and increased adult mortality by or before the end of the century. The study concludes that aggressive emissions reductions are required to prevent polar bear extinction and are critical for allowing substantially more sea ice to persist, increasing the chances that polar bears will survive in Alaska and across their range.[493]

A 2023 study by Amstrup and Bitz confirmed the direct link between anthropogenic CO_2e emissions and declines in polar bear demographic rates.[494] The study quantified the relationship between anthropogenic greenhouse gas emissions and polar bear recruitment (*i.e.*, the survival of bear cubs) across populations, calculating the rate at which cub recruitment has declined with cumulative greenhouse gas emissions and will continue to decline with further greenhouse gas emissions. This analysis allows the estimation of demographic impacts to polar bear populations from specific emissions sources. Based on this analysis, a 7.5 billion metric ton CO_2 increase resulting from the repeal of the power plant pollution standards would directly lead to significant and measurable decreases in cub recruitment that would push all polar bear populations closer to extinction: for example, a 0.83% decrease in cub recruitment for the Chukchi Sea population and 0.49% decrease for the Southern Beaufort Sea population. As

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[492] Molnár et al. (2020).

[493] *See also* Steven C. Amstrup et al., *Greenhouse Gas Mitigation Can Reduce Sea-Ice Loss and Increase Polar Bear Persistence,* 468 Nature 955 (2010); Todd C. Atwood et al., *Forecasting the Relative Influence of Environmental and Anthropogenic Stressors on Polar Bears*, 7 Ecosphere e01370 (2016); Eric V. Regehr et al., *Conservation Status of Polar Bears (Ursus maritimus) in Relation to Projected Sea-Ice Declines*, 12 Biology Letters 20160556 (2016).

[494] Steven C. Amstrup & Cecilia M. Bitz, *Unlock the Endangered Species Act to Address GHG Emissions*, 381 Science 949 (2023).

described above, the two Alaskan polar bear populations are nearing impact thresholds for cub survival, and this Proposal would appreciably push these populations closer to these thresholds. As underscored by this study: "[t]he fundamental dependence of polar bears on sea ice and the documented relationship between declining sea ice and cumulative anthropogenic carbon dioxide (CO_2) emissions assures that polar bear distribution and abundance ultimately can only decline as cumulative emissions increase." In short, a robust body of scientific evidence shows the Proposal would appreciably reduce the likelihood of survival and recovery of the polar bear, leading to jeopardy.

Synthesizing the scientific research on sea ice loss and polar bear persistence, the FWS's 2016 Final Polar Bear Conservation Management Plan clearly states that the polar bear cannot be recovered without significant reductions in the greenhouse gas emissions driving Arctic warming and sea ice loss: "It cannot be overstated that the single most important action for the recovery of polar bears is to significantly reduce the present levels of global greenhouse gas (GHG) emissions, which are the primary cause of warming in the Arctic."[495] The 2023 5-year review similarly concludes that polar bear recovery depends on decisive action to reduce greenhouse gas emissions:

> Based on the best scientific information currently available and our assessment of representation, redundancy, and resiliency, the single most important act for polar bear conservation is decisive action to address Arctic warming, which is driven primarily by increasing atmospheric concentrations of GHG. Short of action that effectively addresses the primary cause of sea ice decline, it is unlikely that polar bears will be recovered.[496]

Sea ice-dependent ringed and bearded seals will also be harmed by the Proposal. Ringed seals are completely dependent on sea ice and snow cover for pupping, nursing, molting and resting. Ringed seals remain in contact with the ice most of the year and give birth and nurse pups on the sea ice in snow-covered lairs in late winter through early spring. Snow caves provide protection for pups from predators and extreme cold. Loss of sea ice and snow cover on the ice due to climate change are the main threat to this species.[497] Bearded seals depend on the availability of sea ice over shallow waters for use as a haul-out platform for giving birth, nursing and rearing pups, molting, and resting. Ongoing declines in the extent and timing of ice cover due to climate change are the main threat to this species. Current and expected future increases in

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[495] U.S. Fish & Wildlife Serv., *Polar Bear (Ursus maritimus) Conservation Management Plan* 11 (2016).

[496] U.S. Fish and Wildlife Serv., *Polar Bear* (*Ursus maritimus*) *5-Year Review* 5 (2023).

[497] B.P. Kelly et al., *Status Review of the Ringed Seal (Phoca hispida)*, NOAA Tech. Memo. NMFS- AFSC-212 (2010); 87 Fed. Reg. 19232 (Apr. 1, 2022); NMFS, *Ringed Seal Five-Year Status Review: Summary and Evaluation* (2024).

ocean temperature and acidification, and changes in community structure, due to climate change also threaten the bearded seal through reductions in prey.[498]

The enormous increase in greenhouse gas emissions resulting from the Proposal will not only "affect" polar bears, ringed seals, and bearded seals, but it will adversely modify their critical habitat and cause jeopardy for polar bears by appreciably diminishing the likelihood of survival and recovery of the species. EPA must consult on how the Proposal would affect federally protected sea-ice-dependent species like the polar bear.

Ocean heating and ocean acidification and harms to listed marine species. Two other incontrovertible environmental impacts caused by greenhouse gas emissions are ocean heating and ocean acidification which are harming many marine species and causing a global collapse of the ocean's coral reef ecosystems. The National Marine Fisheries Service ("NMFS") has listed 24 species of corals under the Endangered Species Act based primarily on threats from ocean heating and ocean acidification, direct consequences of greenhouse gas emissions. In 2006, NMFS listed elkhorn and staghorn corals (*Acropora palmata* and *Acropora cervicornis*) as threatened, citing ocean warming as a key threat to these species. 71 Fed. Reg. 26852, 26859 (May 9, 2006). In 2014 NMFS reaffirmed that ocean warming due to climate change and ocean acidification are primary threats to these species. 79 Fed. Reg. 53852, 53965, 53973-74 (Sept. 10, 2014). In 2014 NMFS listed 20 additional corals as threatened, including five Caribbean coral species and fifteen Indo-Pacific coral species,[499] determining that the most important threats contributing to extinction risk for these species are ocean warming, disease as related to climate change, and ocean acidification. 79 Fed. Reg. at 53885-86.

The world's oceans have absorbed more than 90 percent of the excess heat caused by greenhouse gas warming, resulting in average sea surface heating of 1.3°F (0.7°C) per century since 1900.[500] Marine heat waves – periods of extreme hot surface temperature – have become longer-lasting and more frequent due to climate change, with the number of heat wave days doubling between 1982 and 2016 and projected to increase 23 times under 2°C temperature rise.[501] A 2018 study attributed 87 percent of marine heat waves to human-induced warming.[502] Rapid ocean heating has widespread impacts on species and ecosystems, contributing to rising

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[498] M.F. Cameron et al., *Status Review of the Bearded Seal (Erignathus barbatus)*, NOAA Tech. Memo. NMFS-AFSC-211 (2010); 87 Fed. Reg. 19180 (Apr. 1, 2022).

[499] The five Caribbean coral species are *Dendrogyra cylindrus, Orbicella annularis, Orbicella faveolata, Orbicella franksi,* and *Mycetophyllia ferox*; and the fifteen Indo-Pacific coral species are *Acropora globiceps, Acropora jacquelineae, Acropora lokani, Acropora pharaonis, Acropora retusa, Acropora rudis, Acropora speciosa, Acropora tenella, Acropora spinosa, Euphyllia paradivisa, Isopora crateriformis, Monitopora australiensis, Pavona diffluens, Porites napopora,*and *Seriatopora aculeata*. 79 Fed. Reg. at 54122-23.

[500] U.S. Global Change Research Program, *Fourth National Climate Assessment*, Vol. I, at 364, 367 (2017).

[501] Thomas L. Frölicher et al., *Marine Heatwaves Under Global Warming*, 560 Nature 360 (2018).

[502] Frölicher et al. (2018).

sea levels, declining ocean oxygen levels, increasing rainfall intensity, ice loss from glaciers, ice sheets and polar sea ice, and mass coral bleaching events that are devastating coral reef ecosystems.[503]

The global oceans have absorbed a third of the CO_2 emitted to the atmosphere by human activities, which has significantly increased the acidity of the surface ocean by more than 30%, at a rate likely faster than anything experienced in the past 300 million years.[504] U.S. waters off the West Coast and Alaska are experiencing particularly fast rates of ocean acidification that exceed the global average.[505] Ocean acidity could increase by 150 percent by the end of the century if CO_2 emissions continue unabated.[506] Ocean acidification negatively affects a wide range of marine species by hindering the ability of calcifying marine creatures like corals, oysters, and crabs to build protective shells and skeletons and by disrupting metabolism and critical biological functions.[507] The adverse effects of ocean acidification are already being observed in wild populations, including reduced coral calcification rates in reefs worldwide,[508] severe shell damage to pteropods (marine snails at the base of the food web) along the U.S. west coast,[509] and

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[503] Lijing Cheng et al., *How Fast Are the Oceans Warming?*, 363 Science 128 (2019).

[504] Bärbel Hönisch et al., *The Geological Record of Ocean Acidification*, 335 Science 1058 (2012); U.S. Global Change Research Program, *Fourth National Climate Assessment*, Vol. I, at 372, 374 (2017).

[505] Richard A. Feely et al., *Evidence for Upwelling of Corrosive "Acidified" Water onto the Continental Shelf*, 320 Science 1490 (2008); Julia A. Ekstrom et al., *Vulnerability and Adaptation of U.S. Shellfisheries to Ocean Acidification*, 5 Nature Climate Change 207 (2015); Jeremy T. Mathis et al., *Ocean Acidification in the Surface Waters of the Pacific-Arctic Boundary Regions*, 28 Oceanography 122 (2015); Jeremy T. Mathis et al., *Ocean Acidification Risk Assessment for Alaska's Fishery Sector*, 136 Progress Oceanography 71 (2015); Francis Chan et al., *The West Coast Ocean Acidification and Hypoxia Science Panel: Major Findings, Recommendations, and Actions* (2016); Emily B. Osborne et al., *Decadal Variability in Twentieth-Century Ocean Acidification in the California Current Ecosystem*, 13 Nature Geoscience 43 (2020).

[506] James C. Orr et al., *Anthropogenic Ocean Acidification over the Twenty-First Century and its Impact on Calcifying Organisms*, 437 Nature 681 (2005); Richard A. Feely et al., *Ocean Acidification: Present Conditions and Future Changes in a High CO_2 World*, 22 Oceanography 36 (2009).

[507] Victoria J. Fabry et al., *Impacts of Ocean Acidification on Marine Fauna and Ecosystem Processes*, 65 ICES J. Mar. Sci. 414 (2008); Kristy J. Kroeker et al., *Impacts of Ocean Acidification on Marine Organisms: Quantifying Sensitivities and Interactions with Warming*, 19 Global Change Biology 1884 (2013).

[508] Rebecca Albright et al., *Reversal of Ocean Acidification Enhances Net Coral Reef Calcification*, 531 Nature 362 (2016).

[509] Nina Bednaršek et al., *Limacina helicina Shell Dissolution as an Indicator of Declining Habitat Suitability Owing to Ocean Acidification in the California Current Ecosystem*, 281 Proc. Royal Soc'y B 20140123 (2014).

mass die-offs of larval Pacific oysters in the Pacific Northwest.[510] The 2018 IPCC *Special Report on Global Warming of 1.5°C* concluded that "[t]he level of ocean acidification due to increasing CO_2 concentrations associated with global warming of 1.5°C is projected to amplify the adverse effects of warming, and even further at 2°C, impacting the growth, development, calcification, survival, and thus abundance of a broad range of species, for example, from algae to fish (*high confidence*)."[511]

Rising ocean temperatures and ocean acidification driven by greenhouse gas pollution threaten the continued survival of federally listed coral species due to the increasing frequency of mass bleaching events and coral dissolution. Scientific research has linked anthropogenic ocean heating to the catastrophic, mass coral bleaching events that have been documented since 1980 and are increasing in frequency and intensity as atmospheric CO_2 increases.[512] The period between severe bleaching events has decreased five-fold in the past several decades; such events now occur every six years on average, which is too frequent to allow full recovery of coral reefs.[513] Numerous studies show that the synergistic impacts of climate change and ocean acidification – including coral disease outbreaks driven by heat stress[514] and intensifying

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[510] Alan Barton et al., *The Pacific Oyster, Crassostrea gigas, Shows Negative Correlation to Naturally Elevated Carbon Dioxide Levels: Implications for Near-Term Ocean Acidification Effects*, 57 Limnolology & Oceanography 698 (2012).

[511] Intergovernmental Panel on Climate Change, *Global Warming of 1.5°C*, at SPM 9 (2018).

[512] Ove Hoegh-Guldberg et al., *Coral Reefs Under Rapid Climate Change and Ocean Acidification*, 318 Science 1737 (2007); Simon D. Donner, *Coping With Commitment: Projected Thermal Stress on Coral Reefs Under Different Future Scenarios*, 4 PLoS ONE e5712 (2009); C. Mark Eakin et al., *Caribbean Corals in Crisis: Record Thermal Stress, Bleaching, and Mortality in 2005*, 5 PLoS ONE e13969 (2010); Nat'l Marine Fisheries Serv., *Recovery Plan for Elkhorn Coral (Acropora palmata) and Staghorn Coral (A. cervicornis)* at III-5(2015).

[513] Terry P. Hughes et al., *Spatial and Temporal Patterns of Mass Bleaching of Corals in the Anthropocene*, 359 Science 80 (2018); *Status of Coral Reefs of the World: 2020 Report* (D. Souter et al. eds. 2021).

[514] John F. Bruno et al., *Thermal Stress and Coral Cover as Drivers of Coral Disease Outbreaks*, 5 PLoS Biology e124 (2007); John F. Bruno, *The Coral Disease Triangle*, 5 Nature Climate Change 302 (2015); C.J. Randall & R. van Woesik, *Contemporary White-Band Disease in Caribbean Corals Driven by Climate Change*, 5 Nature Climate Change 375 (2015); William F. Precht et al., *Unprecedented Disease-Related Coral Mortality in Southeastern Florida*, 6 Scientific Reports 31374 (2016); C.J. Randall & R. van Woesik, *Some Coral Diseases Track Climate Oscillations in the Caribbean*, 7 Scientific Reports 5719 (2017); Charles J. Walton et al., *Impacts of a Regional, Multi-Year, Multi-Species Coral Disease Outbreak in Southeast Florida*, 5 Frontiers in Marine Science 323 (2018).

hurricanes[515] – are accelerating coral reef declines.[516] Studies warn that the adaptive capacity of corals is "not likely to keep pace with the impacts of climate change on the majority of reefs without limiting warming well below 2°C."[517]

In the Caribbean, federally listed elkhorn and staghorn corals – once abundant – precipitously declined by more than 90 percent, largely due to outbreaks of white-band disease that were driven by heat stress from rising ocean temperatures.[518] For elkhorn and staghorn corals, ocean temperature rise increases their susceptibility to disease, fragmentation, and mortality, while ocean acidification decreases their fertilization, settlement success, growth and calcification.[519] For endangered pillar corals (*Dendrogyra cylindrus*) which have suffered

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[515] Toby A. Gardner et al., *Hurricanes and Caribbean Coral Reefs: Impacts, Recovery Patterns, and Role in Long-Term Decline*, 86 Ecology 174 (2005); Edwin A. Hernández-Delgado et al., *Stronger Hurricanes and Climate Change in the Caribbean Sea: Threats to the Sustainability of Endangered Coral Species*, 16 Sustainability 1506 (2024).

[516] Scott F. Heron et al., *Impacts of Climate Change on World Heritage Coral Reefs: A First Global Scientific Assessment* (2017); Terry P. Hughes et al., *Global Warming and Recurrent Mass Bleaching of Corals*, 543 Nature 373 (2017); Bradley D. Eyre et al., *Coral Reefs Will Transition to Net Dissolving Before End of Century*, 359 Science 908 (2018); Hughes et al. (2018); William P. Leggat et al., *Rapid Coral Decay is Associated with Marine Heatwave Mortality Events on Reefs*, 29 Current Biology 2723 (2019); Sophie Gwendoline Dove et al., *Ocean Warming and Acidification Uncouple Calcification from Calcifier Biomass Which Accelerates Coral Reef Decline*, 1 Commc'ns Earth & Env't 55 (2020); Christopher E. Cornwall et al., *Global Declines in Coral Reef Calcium Carbonate Production Under Ocean Acidification and Warming*, 118 PNAS e2015265118 (2021).

[517] Christopher Edward Cornwall. et al., *Coral Adaptive Capacity Insufficient to Halt Global Transition of Coral Reefs into Net Erosion Under Climate Change*, 29 Global Change Biology 3010 (2023).

[518] 71 Fed. Reg. at 26872; Randall & van Woesik (2015); R. van Woesik & C.J. Randall, *Coral Disease Hotspots in the Caribbean*, 8 Ecosphere e01814 (2017).

[519] Rebecca Albright et al., *Ocean Acidification Compromises Recruitment Success of the Threatened Caribbean Coral Acropora palmata*, 107 PNAS 20400 (2010); L. Roth et al., *Tracking Acropora Fragmentation and Population Structure Through Thermal-Stress Events*, 263 Ecological Modelling 223 (2013); I.C. Enochs et al., *Effects of Light and Elevated pCO_2 on the Growth and Photochemical Efficiency of Acropora cervicornis*, 33 Coral Reefs 477 (2014); Emma F. Camp et al., *Acclimatization to High-Variance Habitats Does Not Enhance Physiological Tolerance of Two Key Caribbean Corals to Future Temperature and pH*, 283 Proc. Royal Soc'y B 20160442 (2016); D.E. Williams et al., *Thermal Stress Exposure, Bleaching Response, and Mortality in the Threatened Coral Acropora palmata*, 124 Marine Pollution Bull. 189 (2017); Chris Langdon et al., *Two Threatened Caribbean Coral Species Have Contrasting Responses to Combined Temperature and Acidification Stress*, 63 Limnology &. Oceanography 2450 (2018); Erinn M. Muller et al., *Bleaching Causes Loss of Disease Resistance Within the Threatened Coral Species Acropora cervicornis*, 7 eLife e35066 (2018); Elizabeth A. Goergen et

catastrophic declines in Florida, black band disease first emerged following bleaching events in 2014 and 2015 spurred by abnormally high water temperatures.[520] Scientists forecast that an increasing frequency of warm water events, coupled with associated disease outbreaks, will lead to the local extinction of *D. cylindrus* in the Northern Greater Caribbean in modern times.[521] Three listed star corals in the Caribbean – boulder star coral (*Orbicella franksi*), mountainous star coral (*Orbicella faveolata*), and lobed star coral (*Orbicella annularis*) – have experienced long-term declines in reproduction following bleaching events associated with high water temperatures, which scientists warned "may be catastrophic for the long-term maintenance of the population."[522]

Scientific research and federal documents conclude that conservation and recovery actions for listed corals must rapidly reduce greenhouse gas emissions and atmospheric CO_2 levels for corals to survive and recover.[523] NMFS' 2015 *Final Recovery Plan for Elkhorn and Staghorn Corals* includes a recovery criterion with specific targets for ocean surface temperatures and ocean acidification levels[524] that are much lower than today's levels and are

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al., *Identifying Causes of Temporal Changes in Acropora cervicornis Populations and Potential for Recovery*, 6 Frontiers Marine Science 36 (2019).

[520] Cynthia L. Lewis et al., *Temporal Dynamics of Black Band Disease Affecting Pillar Coral (Dendrogyra cylindrus) Following Two Consecutive Hyperthermal Events on the Florida Reef Tract*, 36 Coral Reefs 427 (2017); Andrea N. Chan et al., *Fallen Pillars: the Past, Present, and Future Population Dynamics of a Rare, Specialist Coral-Algal Symbiosis*, 6 Frontiers Marine Science 218 (2019); Karen L. Neely et al., *Rapid Population Decline of the Pillar Coral Dendrogyra cylindrus Along the Florida Reef Tract*, 8 Frontiers Marine Science 656515 (2021) (noting reproductive extinction of D. cylindrus due to absence of juveniles and large geographic distances between genotypes); Karen L. Neely et al., *Saving the Last Unicorns: Genetic Rescue of Florida's Pillar Corals*, 8 Frontiers Marine Science 657429 (2021) (noting that D. cylindrus is <6 percent of its known population, with the dramatic decline accelerated by stony coral tissue loss disease).

[521] Chan et al. (2019).

[522] Don R. Levitan et al., *Long-Term Reduced Spawning in Orbicella Coral Species Due to Temperature Stress*, 515 Marine Ecolology Progress Series 1 (2014).

[523] John E.N. Veron et al., *The Coral Reef Crisis: The Critical Importance of <350 ppm CO_2*, 58 Marine Pollution Bull. 1428 (2009); K. Frieler et al., *Limiting Global Warming to 2ºC is Unlikely to Save Most Coral Reefs*, 3 Nature Climate Change 165 (2012); Ruben van Hooidonk et al., *Opposite Latitudinal Gradients in Projected Ocean Acidification and Bleaching Impacts on Coral Reefs*, 20 Global Change Biology 103 (2014); Nat'l Marine Fisheries Serv., *Recovery Plan for Elkhorn Coral (Acropora palmata) and Staghorn Coral (A. cervicornis)* I-30-31, IV-18 (2015).

[524] Nat'l Marine Fisheries Serv., *Recovery Plan for Elkhorn Coral (Acropora palmata) and Staghorn Coral (A. cervicornis)* xii (2015) ("Sea surface temperatures across the geographic range have been reduced to Degree Heating Weeks less than 4; and Mean monthly sea surface

consistent with a return to an atmospheric CO_2 concentration of less than 350 ppm.[525] The Recovery Plan also recognizes that a primary threat to listed corals is the inadequacy of existing regulations to control greenhouse gas emissions. It specifies a recovery criterion calling for the adoption of "[a]dequate domestic and international regulations and agreements" to abate threats from increasing atmospheric CO_2 concentrations,[526] including a recovery action to "[d]evelop and [i]mplement U.S. and [i]nternational [m]easures to [r]educe [a]tmospheric CO_2 [c]oncentrations to a [l]evel [a]ppropriate for [c]oral [r]ecovery."[527]

The enormous increase in greenhouse gas emissions resulting from the Proposal will adversely modify critical habitat for listed coral species by increasing sea surface temperature, the frequency and severity of bleaching events, heat-driven disease outbreaks, and ocean acidification, and will appreciably decrease the likelihood of the species' survival and recovery. EPA must consult on how the Proposal would affect greenhouse gas-sensitive ocean species like listed corals.

Sea level rise and harms to coastal and low-lying island species. Sea level has risen along U.S. coastlines by 11 inches (28 cm) on average over the past 100 years (1920-2020), with half this rise occurring during the past 30 years.[528] Sea level rise is accelerating in pace, tripling over the past 30 years (1993-2023) compared with 1901-1990.[529] According to the Fifth National Climate Assessment, sea level in the U.S. is projected to rise on average by 0.89 feet (0.27

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temperatures remain below 30°C during spawning periods; and Open ocean aragonite saturation has been restored to a state of greater than 4.0, a level considered optimal for reef growth.").

[525] As stated by the Recovery Plan: "Current projections of increases in ocean temperature, coupled with the numerous other stressors acting on these depleted species, will inhibit recovery. Thus, reducing atmospheric CO_2 levels is likely needed to support recovery of elkhorn and staghorn corals. Model simulations by Donner et al. (2009) suggest that atmospheric CO_2 concentrations may need to be stabilized below 370 ppm to avoid degradation of coral reef ecosystems. Veron et al. (2009), based on the recent history of frequent mass bleaching events and correlated climate conditions, advocated the importance of atmospheric CO_2 concentrations of less than 350 ppm for coral reef health, as mass bleaching events, often associated with El Niño, began when atmospheric CO_2 concentrations were approximately 340 ppm. Veron et al. (2009) also discussed the 1997/98 mass bleaching event, when atmospheric CO_2 concentrations were 350 ppm, as the beginning of a decline in coral reef health from which there has been no significant long-term recovery." Nat'l Marine Fisheries Serv., *Recovery Plan for Elkhorn Coral (Acropora palmata) and Staghorn Coral (A. cervicornis)* I-31 (2015).

[526] Nat'l Marine Fisheries Serv., *Recovery Plan for Elkhorn Coral (Acropora palmata) and Staghorn Coral (A. cervicornis)* III-7 (2015).

[527] Nat'l Marine Fisheries Serv., *Recovery Plan for Elkhorn Coral (Acropora palmata) and Staghorn Coral (A. cervicornis)* IV-18 (2015).

[528] U.S. Global Change Research Program, *Fifth National Climate Assessment* 9-5 (2023).

[529] U.S. Global Change Research Program, *Fifth National Climate Assessment* 9-5 (2023).

meters) by 2050 and 3.28 feet (1.0 meters) by 2100 under an intermediate emissions scenario.[530] Sea level rise will be much more extreme without rapid reductions in greenhouse gas emissions, with sea level rise of 6.56 feet (2.0 meters) possible by 2100 under a high emissions scenario.[531]

Scientific research and federal ESA analyses have concluded that many federally listed species living on islands and coastal areas are endangered by sea level rise. For example, ESA listing rules for Florida coastal species have determined that sea level rise resulting from climate change, and the inadequacy of existing regulatory mechanisms to address climate change, are primary threats endangering the Florida bonneted bat (Eumops floridanus), 78 Fed. Reg. 61004 (Oct. 2, 2013), Cape Sable thoroughwort (Chromolaena frustrata), 78 Fed. Reg. 63796, 63816 (Oct. 24, 2013), Florida semaphore cactus (Consolea corallicola), *id*. at 63817, aboriginal prickly-apple (Harrisia aboriginum), *id*. at 63817, and Florida bristle fern (Trichomanes punctatum ssp. floridanum), 80 Fed. Reg. 60440 (Oct. 6, 2015). A 2025 analysis of Florida coastal vertebrate species highlights that 8 federally listed mammal species and 2 federally listed reptile species have their entire distributions on islands and that "sea level rise represents a significant and immediate threat to the[ir] persistence": Lower Keys marsh rabbit (Sylvilagus palustris hefneri), Key deer (Odocoileus virginianus clavium), Key Largo woodrat (Neotoma floridana smalli), silver rice rat (Oryzomys palustris natator), Key Largo cotton mouse (Peromyscus gossypinus allapaticola), Anastasia Island beach mouse (Peromyscus polionotus phasma), Perdido Key beach mouse (Peromyscus polionotus trissyllepsis), Southeastern beach mouse (Peromyscus polionotus niveiventris), Key ring-necked snake (Diadophis punctatus acricus), and Florida Keys mole skink (Plestiodon egregius egregious). [532]

Research has documented the serious extinction threats that sea level rise poses to listed species on the low-lying islands of the Florida Keys. Florida Keys species are at high risk from even small increases in sea level rise, given that that much of the land is less than 1.5 meters (5 feet) above sea level and significant sea level rise is already occurring, for example, 0.21 meters (0.68 feet) of sea level rise at Vaca Key over 51 years (1971-2022).[533] The Key Largo tree cacti (Pilosocereus millsapaughii) may be the first vascular plant in the U.S. to go extinct in the wild because of sea level rise, which caused salt water intrusion and flooding from increased storm surge.[534] The endangered Key tree-cactus (Pilosocereus robinii) is declining as the soil becomes too salty due to rising sea levels and intensifying storm surge.[535] The endangered semaphore

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[530] U.S. Global Change Research Program, *Fifth National Climate Assessment* xxvii, tbl. 4 (2023).

[531] U.S. Global Change Research Program, *Fifth National Climate Assessment* xxvii, tbl. 4 (2023).

[532] Erin L. Koen et al., *Sea Level Rise Threatens Florida's Insular Vertebrate Biodiversity*, 34 Biodiversity & Conservation 513 (2025).

[533] Jennifer Possley et al., *First U.S. Vascular Plant Extirpation Linked to Sea Level Rise? Pilosocereus millspaughii (Cactaceae) in the Florida Keys, U.S.A.*, 18 J. Botanical Research Inst. Tex. 211 (2024).

[534] Possley et al. (2024).

[535] Joie Goodman et al., *Differential Response to Soil Salinity in Endangered Key Tree Cactus: Implications for Survival in a Changing Climate*, 7 PLoS ONE e32528 (2012).

cactus (Consolea corallicolais), endemic to just two sites, is threatened by sea level rise which is causing salt water intrusion and elevated soil moisture that appears to increase death by a fungal pathogen leading to crown rot.[536] The endangered Lower Keys marsh rabbit (Sylvilagus palustris hefneri) lost 48% of its habitat due to sea level rise between 1959-2006,[537] and the endangered silver rice rat lost 33% of its potential habitat due to sea level rise between 2004 and 2021.[538] The endangered Florida Key deer (Odocoileus virginianus claviumis) would lose almost all its habitat with one meter of sea level rise, which could occur by 2100 if greenhouse gas emissions continue unchecked.[539]

Research and federal documents identify sea level rise as a primary threat to sea turtles by eroding nesting beaches and reducing nesting success.[540] For example, most (87 percent)Northwest Atlantic Ocean distinct population segment loggerhead sea turtle (*Caretta caretta*) nesting occurs on the east coast of Florida, 75 Fed. Reg. 12598 (2010), where 43 percent of the turtle's nesting beaches are projected to disappear with just .5 meters of sea level rise.[541] The listing rules for the green sea turtle, 81 Fed. Reg. 20058, 20078 (Apr. 6, 2016), and loggerhead sea turtle, 76 Fed. Reg. 58868, 58909-10 (Sept. 22, 2011), conclude that sea level rise is likely to have negative effects on these species through beach loss and reduced nesting success.

The enormous increase in greenhouse gas emissions resulting from the Proposal will adversely modify critical habitat for listed island and coastal species by increasing sea level rise,

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[536] Peter Stiling et al., *Prospects for the Long-Term Persistence of a Severely Endangered Plant, Consolea corallicola (Cactaceae)*, 7 Conservation Science & Prac. e70031 (2025).

[537] Jason A. Schmidt et al., *Impacts of a Half Century of Sea-Level Rise and Development on an Endangered Mammal*, 18 Global Change Biology 3536 (2012).

[538] Paul J. Taillie et al., *Sea Level Rise Adaptation Pushes an Insular Endemic Rodent Closer to Extinction*, 32 Biodiversity & Conservation 3939 (2023).

[539] U.S. Fish & Wildlife Serv., *Key Deer (Odocoileus viginianus clavium) 5-Year Review: Summary and Evaluation* (2010); U.S. Fish & Wildlife Serv., *Species Status Assessment for the Key Deer (Odocoileus virginianus clavium)* (2019); Koen et al. (2025).

[540] M. J. Witt et al., *Predicting the Impacts of Climate Change on a Globally Distributed Species: The Case of the Loggerhead Turtle*, 213 J. Experimental. Biology 901 (2010); M.M.P.B. Fuentes et al., *Vulnerability of Sea Turtle Nesting Grounds to Climate Change*, 17 Global Change Biology 140 (2010); David A. Pike et al., *Nest Inundation from Sea-Level Rise Threatens Sea Turtle Population Viability*, 2 Royal Soc'y Open Science 150127 (2015); Marta P. Lyons et al., *Quantifying the Impacts of Future Sea Level Rise on Nesting Sea Turtles in the Southeastern United States*, 30 Ecological Applications e02100 (2020); Marga L. Rivas et al., *Uncertain Future for Global Sea Turtle Populations in Face of Sea Level Rise*, 13 Scientific Reports 5277 (2023).

[541] Joshua S. Reece et al., *Sea Level Rise, Land Use, and Climate Change Influence the Distribution of Loggerhead Turtle Nests at the Largest USA Rookery (Melbourne Beach, Florida)*, 493 Marine Ecology Progress Series 259 (2013).

flooding from increased storm surge, and saltwater intrusion, and appreciably decrease the likelihood of survival and recovery for many listed species, as detailed above. The proposed repeal triggers EPA's legal duty under the ESA to consult on how greenhouse gas emissions-driven sea level rise will adversely affect these listed species.

Disease spread. Emissions-driven temperature rise is increasing the spread of diseases by "promot[ing] range expansions and population growth of disease-spreading (vector) species, increase[ing] host susceptibility via stress, and enhanc[ing] pathogen transmission."[542] On the Hawaiian islands, rising temperatures caused by greenhouse gas pollution are causing population declines and increasing extinction risk for federally listed bird species like the 'i'iwi (*Drepanis coccinea*), 'akikiki (*Oreomystis bairdi*), and 'akeke'e (*Loxops caeruleirostris*) by facilitating the spread of non-native mosquitoes carrying deadly avian malaria.[543] Endangered birds in Hawaii are now largely restricted to high-elevation habitat where it was formerly too cold for disease-carrying mosquitoes to survive, but rising temperatures are allowing mosquitoes to move further upslope, infecting and killing more birds, leaving fewer and fewer high-elevation refuges, and escalating extinction risk for Hawaii's listed birds. EPA must consult on how rising temperatures driven by greenhouse gases affect these listed species.

4. Nitrogen oxide (NO_X) pollution has well-documented adverse impacts on federally protected species.

Fossil fuel power plants emit nitrogen oxide (NO_X) air pollutants which have contributed to the significant increase in nitrogen deposition in many parts of the United States,[544] resulting in widespread impacts to species and ecosystems.[545] The proposed repeal would increase NO_X emissions from fossil fuel power plants, thereby increasing nitrogen deposition in the areas where power plants are operating, with resulting harms to listed species and their critical habitat.

Scientific research has clearly established the linkages between NO_X emissions and harms to federally listed species. A review of the effects of nitrogen pollution on ESA-listed species, based on analysis of FWS and NMFS documents, found that this threat is "substantial"

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[542] McElwee et al., *Chapter 8: Ecosystems, Ecosystem Services, and Biodiversity*, in *Fifth National Climate Assessment*, at 8-21 to 8-23.

[543] Wei Liao et al., *Will a Warmer and Wetter Future Cause Extinction of Native Hawaiian Forest Birds?*, 21 Global Change Biology 4342 (2015); Eben H. Paxton et al., *Collapsing Avian Community on a Hawaiian Island*, 2 Science Advances e1600029 (2016); Wei Liao et al., *Mitigating Future Avian Malaria Threats to Hawaiian Forest birds from Climate Change*, 12 PLoS ONE e0168880 (2017); John H. Neddermeyer et al., *Nowhere to Fly: Avian Malaria is Ubiquitous from Ocean to Summit on a Hawaiian Island*, 279 Biological Conservation 109943 (2023).

[544] Fowler, David et al., The global nitrogen cycle in the twenty-first century, 368 Phil Trans R Soc B 20130164 (2013).

[545] Fenn, Mark E., Ecological effects of nitrogen deposition in the Western United States, 53 BioScience 404 (2003); Hernandez, Daniel L. et al., Nitrogen pollution is linked to US listed species declines, 66 BioScience 213 (2016).

and "geographically widespread."[546] This review, Hernandez et al. (2016), identified evidence for harm from nitrogen pollution for at least 78 federally listed taxa.[547] This includes 50 invertebrates such as mollusks and arthropods, 18 vertebrates such as fish, amphibians, and reptiles, and 8 plants.[548] Harms from nitrogen pollution fell into four main categories: "(1) direct toxicity or lethal effects of [nitrogen][, (2) eutrophication lowering dissolved oxygen levels in water or causing algal blooms that alter habitat by covering up substrate, (3) [nitrogen] pollution increasing non-native plant species that directly harm a plant species through competition, and (4) [nitrogen] pollution increasing non-native plant species that indirectly harm animal species by excluding their food sources."[549]

In its 2020 Final Integrated Science Assessment on the ecological effects of NO_X, EPA identified 17 ways in which NO_X pollution has been shown to have a "causal relationship" to ecological effects, based on a review of the science.[550] Similar to the findings in Hernandez et al. (2016), causal effects of NO_X pollution include direct phytotoxic effects; acidification; eutrophication; and changes to physiology, growth, species richness, community composition, and biodiversity.[551]

Nitrogen deposition from power plants is a well-documented harm to listed species. The endangered Lange's metalmark butterfly (*Apodemia mormo langei*), restricted to the small Antioch Dunes National Wildlife Refuge (ADNWR) in California, is threatened by nitrogen deposition resulting from NO_X emissions from nearby gas-fired power plants.[552] Nitrogen deposition from NO_X emissions gives a competitive advantage to invasive plant species that "reduc[e] the ability of native dune species to colonize, persist, and support Lange's

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[546] Hernandez, Daniel L. et al., Nitrogen pollution is linked to US listed species declines, 66 BioScience 213 (2016) at 220.

[547] Hernandez, Daniel L. et al., Nitrogen pollution is linked to US listed species declines, 66 BioScience 213 (2016) at 215, 220.

[548] Hernandez, Daniel L. et al., Nitrogen pollution is linked to US listed species declines, 66 BioScience 213 (2016) at 216-217 Tables 1, 2, 3.

[549] Hernandez, Daniel L. et al., Nitrogen pollution is linked to US listed species declines, 66 BioScience 213 (2016) at 215.

[550] U.S. Environmental Protection Agency, Integrated Science Assessment for Oxides of Nitrogen, Oxides of Sulfur, and Particulate Matter – Ecological Criteria (Final), Center for Public Health and Environmental Assessment, Office of Research and Development, EPA/600/R-20/278 (2020), at Table ES-1.

[551] U.S. Environmental Protection Agency, Integrated Science Assessment for Oxides of Nitrogen, Oxides of Sulfur, and Particulate Matter – Ecological Criteria (Final), Center for Public Health and Environmental Assessment, Office of Research and Development, EPA/600/R-20/278 (2020), at Table ES-1.

[552] U.S. Fish and Wildlife Service, Lange's metalmark butterfly (*Apodemia mormo langei*) *5*-Year Review, Sacramento Fish and Wildlife Office (2020) at 8.

metalmark."[553] The FWS's 2020 5-year review for the Lange's metalmark identified habitat degradation due to nitrogen deposition from gas-fired power plants as a main threat to the species:

> Habitat degradation due to air particulate deposition from industrial operations:
>
> [* * * *]
>
> Soil analysis of ADNWR showed significant levels of nitrate, and the levels of ammonia were high even for agricultural soil (McNally, 2014). The likely sources of these particles are the natural gas fired power plants west of the Antioch Dunes emitting nitrogen oxides and that use ammonia to control these emissions. These analyses suggest that air particulate deposition is enriching ADNWR soils with nutrients, which can provide additional competitive advantages to invasive weeds, thereby reducing the ability of native dune species to colonize, persist, and support Lange's metalmark in the degraded ecosystem.[554]

The FWS further discussed the harms of invasive plant species that outcompete the butterfly's native host plant (Antioch Dunes buckwheat) and increase fire threats.[555] The Service noted that "[w]hile these effects are all indirect, invasive vegetation currently constitutes the most pervasive and persistent threat currently affecting the very small, isolated and fragmented remnant population of this subspecies."[556]

Similarly, the FWS has determined that nitrogen deposition threatens the federally protected Quino checkerspot butterfly (*Euphydryas editha quino*) and the desert tortoise (*Gopherus agassizii*) by facilitating the spread of non-native species that displace the butterfly's host plants[557] and the tortoise's native forage plants.[558]

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[553] U.S. Fish and Wildlife Service, Lange's metalmark butterfly (*Apodemia mormo langei*) *5*-Year Review, Sacramento Fish and Wildlife Office (2020) at 7-8.

[554] U.S. Fish and Wildlife Service, Lange's metalmark butterfly (*Apodemia mormo langei*) *5*-Year Review, Sacramento Fish and Wildlife Office (2020) at 7-8.

[555] U.S. Fish and Wildlife Service, Lange's metalmark butterfly (*Apodemia mormo langei*) *5*-Year Review, Sacramento Fish and Wildlife Office (2020) at 7.

[556] U.S. Fish and Wildlife Service, Lange's metalmark butterfly (*Apodemia mormo langei*) *5*-Year Review, Sacramento Fish and Wildlife Office (2020) at 7.

[557] U.S. Fish and Wildlife Service, Quino Checkerspot Butterfly (*Euphydryas editha quino*) 5-Year Review: Summary and Evaluation, Carlsbad Fish and Wildlife Office (2009) at 13, 15.

[558] U.S. Fish and Wildlife Service, Mojave Population of the Desert Tortoise (*Gopherus agassizii)* 5-Year Review: Summary and Evaluation, Reno Desert Tortoise Recovery Office (2010) at 24.

Nitrogen pollution has also been shown to worsen the severity of coral bleaching for Acropora corals.[559] For the threatened elkhorn coral (*Acropora palmata*), nitrogen deposition causing elevated levels of nitrate and nitrite likely also contribute to an increase in pathogens, harming the species.[560]

NO_X and SO_X pollution also harm federally listed species by contributing to the acidification of terrestrial and aquatic ecosystems such as soils, rivers, and lakes.[561] The acidification of surface water in streams and lakes by nitrogen deposition can create inhospitable conditions for listed species and cause the decline or loss of acid-sensitive species – with more species lost at higher levels of acidification.[562] Acidified aquatic habitats have been found to have lower numbers of species of fishes, macroinvertebrates, and plankton.[563] Stream acidification has been found to harm the Atlantic salmon (*Salmo salar*).[564] For the endangered dwarf wedgemussel (*Alasmidonta heterodon*), the FWS's recovery plan states that stream acidification can mobilize toxic metals, is harmful to mussels, and may have contributed to the

[559] Donovan, Mary K. et al., Nitrogen pollution interacts with heat stress to increase coral bleaching across the seascape, 117 PNAS 5351 (2020), https://doi.org/10.1073/pnas.1915395117.

[560] Rosales, Stephanie M. et al., Reef site and habitat influence effectiveness of *Acropora palmata* restoration and its microbiome in the Florida Keys, 5 Communications Earth & Environment 689 (2024), https://doi.org/10.1038/s43247-024-01816-7

[561] U.S. Environmental Protection Agency, Integrated Science Assessment for Oxides of Nitrogen, Oxides of Sulfur, and Particulate Matter – Ecological Criteria (Final), Center for Public Health and Environmental Assessment, Office of Research and Development, EPA/600/R-20/278 (2020) at ES-2 through 4.

[562] Driscoll, Charles T. et al., Acidic deposition in the Northeastern United States: Sources and inputs, ecosystem effects, and management strategies, 51 BioScience 180 (2001); U.S. Environmental Protection Agency, Integrated Science Assessment for Oxides of Nitrogen, Oxides of Sulfur, and Particulate Matter – Ecological Criteria (Final), Center for Public Health and Environmental Assessment, Office of Research and Development, EPA/600/R-20/278 (2020) at IS-73.

[563] U.S. Environmental Protection Agency, Integrated Science Assessment for Oxides of Nitrogen, Oxides of Sulfur, and Particulate Matter – Ecological Criteria (Final), Center for Public Health and Environmental Assessment, Office of Research and Development, EPA/600/R-20/278 (2020) at IS-73.

[564] U.S. Environmental Protection Agency, Integrated Science Assessment for Oxides of Nitrogen, Oxides of Sulfur, and Particulate Matter – Ecological Criteria (Final), Center for Public Health and Environmental Assessment, Office of Research and Development, EPA/600/R-20/278 (2020), at 8-16 to 8-18.

species' decline in the Fort River in Massachusetts.[565] The threatened longsolid mussel (*Fusconaia subrotunda*) is sensitive to nitrogen deposition, particularly ammonia deposition.[566]

A review on the effects of nitrogen deposition in the western U.S. highlights the need for policy changes at the national level for reducing air pollution to protect threatened and rare species from nitrogen deposition: "[L]ocal land management strategies to protect these endangered species may not succeed unless they are accompanied by policy changes at the regional or national level that reduce air pollution."[567]

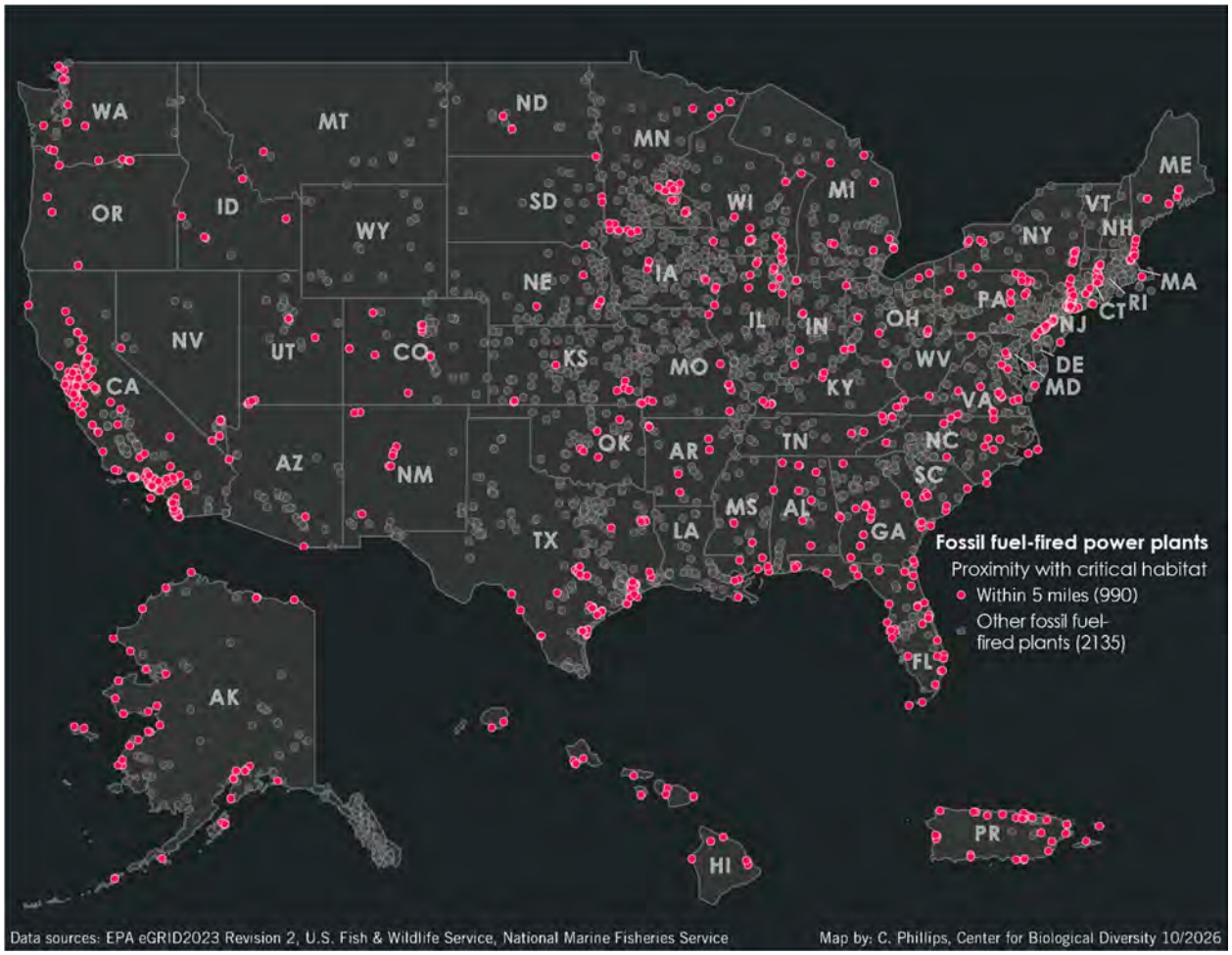
EPA's proposal to eliminate greenhouse gas emission rules for fossil fuel power plants will result in vast amounts of additional NO_X emissions not just for the short term but also for the decades during which these power plants will continue to operate, harming listed species with NO_X pollution. We estimate that 434 federally listed species and subspecies have critical habitat within five miles of at least one fossil fuel power plant as listed in Appendix E.[568] These power plants are shown in red on the figure below.

[565] U.S. Fish and Wildlife Service, Dwarf Wedgemussel Recovery Plan (1993), at 14.

[566] U.S. Fish and Wildlife Service, Species Status Assessment Report for the Longsolid (*Fusconaia subrotunda*), Atlanta, Georgia (2022) at 29; 88 Fed. Reg. 14794.

[567] Fenn, Mark E., Ecological effects of nitrogen deposition in the Western United States, 53 BioScience 404 (2003) at 416.

[568] Appendix E at Table 1. We used the U.S. EPA eGRID 2023 Revision 2 dataset (Emissions & Generation Resource Integrated Database) to map fossil fuel power plants, available at https://www.epa.gov/egrid. We used NMFS critical habitat data available at https://noaa.maps.arcgis.com/home/item.html?id=f66c1e33f91d480db7d1b1c1336223c3 and USFWS critical habitat data available at https://ecos.fws.gov/ecp/report/critical-habitat.



Of the 434 listed species and subspecies, we estimate that 258 have multiple fossil fuel power plants within 5 miles of their critical habitat, ranging from 2 to 72 power plants.[569] We also estimate that 23 of these species and subspecies have at least one fossil fuel power plant directly overlapping their critical habitat.[570] These species and subspecies may be affected by the increased NO_X emissions coming from fossil fuel power plants due to the Proposal. The proposed repeal thus triggers EPA's legal duty under the ESA to consult on how these additional pollutants will affect these listed species.

[569] For example, we estimate that 6 fossil fuel power plants are within 5 miles of critical habitat for the Quino checkerspot butterfly, and 12 fossil fuel power plants are within 5 miles of critical habitat for the desert tortoise, with at least one powe\r plant directly overlapping its critical habitat. Appendix E at Table 2.

[570] Appendix E at Table 3.

5. Sulfur dioxide pollution (SO_2) has well-documented adverse impacts on federally protected species.

Fossil fuel combustion from fossil fuel power plants produces sulfur dioxide (SO_2), as well as precursors such as sulfur oxides ("SO_X"), which have well-documented impacts on species and ecosystems. The proposed repeal would increase SO_2 emissions from fossil fuel power plants, with resulting harms to listed species and their critical habitat.

In its 2020 Final Integrated Science Assessment on the ecological effects of SO_2 and SO_X, EPA identified eight ways in which sulfur pollution has been shown to have a "causal relationship" to ecological effects, based on a review of the science.[571] As reviewed by EPA, the negative ecological effects of SO_2 and SO_X pollution include (a) aquatic acidification and the loss of acid-sensitive species;[572] (b) changes in terrestrial biota due to acidifying deposition, such as "decreased growth and increased susceptibility to disease and injury in sensitive tree species";[573] (c) increased mercury methylation in aquatic environments;[574] and (d) injury to vegetation, including decreased photosynthesis, decreased growth, and visible foliar injury.[575]

In terms of harms to federally protected species, EPA acknowledged that acidifying deposition in aquatic ecosystems can cause the loss of acid-sensitive species such as salmonids many of which are endangered, and that disruption of food web dynamics can cause changes to the diet, breeding distribution and reproduction of bird species.[576] EPA further stated that current rates of acidifying deposition of sulfur and nitrogen oxides are still well above pre-acidification conditions in areas such as the Adirondacks and Shenandoah, and that sulfur and nitrogen deposition loadings of many Adirondack lakes and streams are at levels that can harm aquatic

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[571] U.S. Environmental Protection Agency, Integrated Science Assessment for Oxides of Nitrogen, Oxides of Sulfur, and Particulate Matter – Ecological Criteria (Final), Center for Public Health and Environmental Assessment, Office of Research and Development, EPA/600/R-20/278 (2020), at Table ES-1.

[572] U.S. Environmental Protection Agency, Integrated Review Plan for the Secondary National Ambient Air Quality Standards for Ecological Effects of Oxides of Nitrogen, Oxides of Sulfur and Particulate Matter, EPA-452/R-17-002 (2017), at 3-13.

[573] U.S. Environmental Protection Agency, Integrated Review Plan for the Secondary National Ambient Air Quality Standards for Ecological Effects of Oxides of Nitrogen, Oxides of Sulfur and Particulate Matter, EPA-452/R-17-002 (2017), at 2-5 and 2-6.

[574] U.S. Environmental Protection Agency, Integrated Review Plan for the Secondary National Ambient Air Quality Standards for Ecological Effects of Oxides of Nitrogen, Oxides of Sulfur and Particulate Matter, EPA-452/R-17-002 (2017), at 3-14 and 3-15.

[575] U.S. Environmental Protection Agency, Integrated Review Plan for the Secondary National Ambient Air Quality Standards for Ecological Effects of Oxides of Nitrogen, Oxides of Sulfur and Particulate Matter, EPA-452/R-17-002 (2017), at 2-3 and 3-9.

[576] U.S. Environmental Protection Agency, Integrated Review Plan for the Secondary National Ambient Air Quality Standards for Ecological Effects of Oxides of Nitrogen, Oxides of Sulfur and Particulate Matter, EPA-452/R-17-002 (2017), at 2-5.

biota.[577] EPA also acknowledged that there is a "causal relationship between sulfur deposition *at current levels* and increased [mercury] methylation in aquatic environments,"[578] which is problematic because mercury is highly neurotoxic and, once methylated, can be taken up by zooplankton and macroinvertebrates, and bioaccumulate up the food web.[579]

The FWS has identified numerous federally endangered and threatened species that are negatively affected by atmospheric pollution from SO_2 and SO_X. Federally protected plant species identified by the FWS as threatened by or susceptible to SO_2 and SO_X pollution and acidification include the harperella (*Ptilimnium nodosum*),[580] Zuni fleabane (*Erigeron rhizomaxs*),[581] Mancos milkvetch (*Astragalus humillimus*),[582] Blue Ridge goldenrod (*Solidago spithamaea*),[583] Heller's blazing star (*Liatris helleri*),[584] rock gnome lichen (*Gymnodema lineare*),[585] and Roan Mountain bluet (*Hedyotis purpurea var. montana*),[586] For example, Heller's blazing star is a rare plant endemic to a limited area in the Blue Ridge Mountains of North Carolina, with only a few populations currently known to exist. The recovery plan for this species names acid precipitation as a "pervasive" potential threat.[587] The FWS recovery plan for the rock gnome lichen, which is endemic to the Southern Appalachians, flags that "there is a high

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[577] U.S. Environmental Protection Agency, Integrated Review Plan for the Secondary National Ambient Air Quality Standards for Ecological Effects of Oxides of Nitrogen, Oxides of Sulfur and Particulate Matter, EPA-452/R-17-002 (2017) at 2-5.

[578] U.S. Environmental Protection Agency, Integrated Review Plan for the Secondary National Ambient Air Quality Standards for Ecological Effects of Oxides of Nitrogen, Oxides of Sulfur and Particulate Matter, EPA-452/R-17-002 (2017) at 3-14 and 3-15.

[579] U.S. Environmental Protection Agency, Integrated Review Plan for the Secondary National Ambient Air Quality Standards for Ecological Effects of Oxides of Nitrogen, Oxides of Sulfur and Particulate Matter, EPA-452/R-17-002 (2017) at 3-14 and 3-15.

[580] U.S. Fish and Wildlife Service, Harperella (*Ptilimnium nodosum*) Recovery Plan (1990) at 27.

[581] U.S. Fish and Wildlife Service, Recovery Plan for Zuni Fleabane (*Erigeron rhizomaxs* Cronquist) (1988) at 12.

[582] U.S. Fish and Wildlife Service, Mancos Milkvetch (*Astragalus humillimus)* Recovery Plan (1989) at 13.

[583] U.S. Fish and Wildlife Service, Blue Ridge Goldenrod (*Solidago spithamaea* Curtis) Recovery Plan (1987) at 7, 20.

[584] U.S. Fish and Wildlife Service, Heller's Blazing Star (*Liatris helleri*) Recovery Plan (2000) at iii, 7.

[585] U.S. Fish and Wildlife Service, Recovery Plan for Rock Gnome Lichen (*Gymnodema lineare*) (1997) at 4, 9.

[586] U.S. Fish and Wildlife Service, Recovery Plan for Roan Mountain Bluet (*Hedyotis purpurea var. montana*) (1996) at 20.

[587] U.S. Fish and Wildlife Service, Heller's Blazing Star (*Liatris helleri*) Recovery Plan (2000) at 7.

likelihood that current and previous air pollution levels, especially from sulfates, may be contributing to the decline of this species."[588]

The FWS has also identified numerous listed animal species as threatened by or susceptible to SO_2 and SO_X pollution and acidification, including the Shenandoah salamander (*Plethodon shenandoah*),[589] Cheat Mountain salamander (*Plethodon neftiigi*),[590] Chiricahua leopard frog (*Rana chiricahuensis*),[591] whooping crane (*Grus americana*),[592] Roanoke logperch (*Percina rex*),[593] dwarf wedgemussel (*Alasmidonta heterodon*),[594]and Mobile River Basin aquatic species.[595] For example, the recovery plan for the Chiricahua leopard frog notes that acid rain may adversely affect Chiricahua Leopard Frog populations,[596] likely through reduced hatching of eggs and reduced growth rates.[597]

The Proposal would directly contribute to higher emissions of SO_2 and SO_X from fossil fuel power plants and thus triggers EPA's duty to consult on how these emissions may affect listed species.

D. The Supplemental Proposal will result in an irreversible commitment of resources.

Enactment of the Supplemental Proposal would be an irreversible or irretrievable commitment of resources within the meaning of ESA Section 7(d) because for decades, powerplants will emit more greenhouse gases and criteria pollutants into the atmosphere than

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[588] U.S. Fish and Wildlife Service, Recovery Plan for Rock Gnome Lichen (*Gymnodema lineare*) (1997) at 4.

[589] U.S. Fish and Wildlife Service, Shenandoah Salamander (*Plethodon shenandoah*) Recovery Plan (1994) at 1, 8-10.

[590] U.S. Fish and Wildlife Service, Cheat Mountain Salamander (*Plenthodon nettingi*) Recovery Plan (1991) at 12.

[591] U.S. Fish and Wildlife Service, Chiricahua Leopard Frog (*Rana chiricahuensis*) Final Recovery Plan (2007) at 23-25, 40.

[592] U.S. Fish and Wildlife Service, International Recovery Plan: Whooping Crane (*Grus americana*): Third Revision (2007) at C-1.

[593] U.S. Fish and Wildlife Service, Roanoke Logperch (*Percina rex*) Recovery Plan (1992) at 17.

[594] U.S. Fish and Wildlife Service, Dwarf Wedge Mussel (*Alasmidonta heterodon*) Recovery Plan (1993) at 14.

[595] U.S. Fish and Wildlife Service, Recovery Plan for Six Mobile River Basin Snails (Cylindrical Lioplax, Flat Pebblesnail, Plicate Rocksnail, Painted Rocksnail, Round Rocksnail and Lacy Elimia) (2005) at 16.

[596] U.S. Fish and Wildlife Service, Chiricahua Leopard Frog (*Rana chiricahuensis*) Final Recovery Plan (2007) at 40.

[597] U.S. Fish and Wildlife Service, Chiricahua Leopard Frog (*Rana chiricahuensis*) Final Recovery Plan (2007) at 44

they would under the status quo, and those pollutants will remain in the atmosphere causing the harms described in this comment letter for as long as thousands of years. EPA explains:

> As greenhouse gas emissions from human activities increase, they build up in the atmosphere and warm the climate, leading to many other changes around the world – in the atmosphere, on land, and in the oceans. The indicators in other chapters of this report illustrate many of these changes. These changes have both positive and negative effects on people, society, and the environment – including plants and animals. Because many of the major greenhouse gases stay in the atmosphere for tens to hundreds of years after being released, their warming effects on the climate persist over a long time and can therefore affect both present and future generations.[598]

Maintaining the status quo is an important rationale for Section 7(d). As EPA Region VI has explained:

> Section 7(d) of the ESA requires that, after initiation of consultation under Section 7(a)(2), a federal agency "shall not make any irreversible or irretrievable commitment of resources with respect to the agency action which has the effect of foreclosing the formulation or implementation of any reasonable and prudent alternative measures which would not violate subsection (a)(2) of this section." In other words, any action taken prior to completion of consultation must not interfere with the ability of the agency to implement reasonable and prudent measures determined to be necessary to avoid jeopardy to a protected species or adverse effects to its critical habitat. Section 7(d) of the ESA is a preventative measure designed to ensure that the status quo is preserved during the consultations process and clarifies the requirements of Section 7(a). *Conner v Burford*, 848 F.2d. 1441 (9th Cir 1988).[599]

Here, the status quo is the protection from harm that the Section 111 endangerment finding provides. Eliminating that protection will lead to irreversible adverse changes to air pollution that will harm endangered species, as described in this comment letter.

XII. EPA'S SUPPLEMENTAL PROPOSAL DOES NOT DISTURB THE TECHNICAL RECORD SUPPORTING THE 2015 NSPS.

In 2015, EPA finalized new source performance standards (NSPS) for coal-fired power plants based on what can be achieved through partial carbon capture and storage (CCS) and for gas-fired power plants based on efficiency measures. *See* 80 Fed. Reg. 64510, 64513, 64515 (Oct. 23, 2015) ("Standards Repeal Rule"). Although the Supplemental Proposal characterizes

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[598] EPA Climate Change Indicators: Greenhouse Gases (2021), *available at* https://19january2021snapshot.epa.gov/climate-indicators/greenhouse-gases_.html.

[599] EPA, *Memo to File: ESA Section 7(d) Determination*, 2 (Aug. 29, 2017), https://www.epa.gov/sites/default/files/2017-09/documents/memo_to_file_-_esa_section_7d_determination.pdf.

the finalized Standards Repeal Rule as involving "technical grounds," 91 Fed. Reg. at 59002, EPA does not in this proposal consider or propose any technical grounds for repealing emission limits in the 2015 NSPS. *See also id.* at 59008 (describing the rationale for the Supplemental Proposal in "contrast to the record-based issues" in the Standards Repeal Rule). Indeed, the Supplemental Proposal nowhere evaluates what would qualify as the best system of emission reduction under Section 111 to address carbon pollution emissions from power plants. *See* 42 U.S.C. § 7411.

The Clean Air Act requires EPA to disclose any factual data and any methodology for analyzing data in a proposed rule. *See* 42 U.S.C. § 7607(d)(3)(A), (B). Because EPA presents no factual data or technical grounds to repeal the 2015 NSPS in the proposed rule, it cannot finalize a repeal based on technical or record-based grounds. Relatedly, nothing in the Supplemental Proposal does anything to disturb the technical record underlying the 2015 NSPS or EPA's past conclusions regarding the adequate demonstration, cost reasonableness, or achievability of the 2015 NSPS or the best system of emission that those standards are based on.

The Supplemental Proposal also mischaracterizes the benefits of emission limits in the 2015 NSPS. Specifically, EPA truncates a quote and takes it out of context to assert that the 2015 NSPS were projected to have "only 'negligible CO_2 emissions changes' because the agency anticipated" that new plants would be primarily natural gas combined cycle plants, which would meet the rule's standards. 91 Fed. Reg. at 59041 (quoting 80 Fed. Reg. at 64640). But the Supplemental Proposal leaves out the undisputed fact that, as EPA then concluded, the "CO_2 emissions from even a single new coal-fired power plant may amount to millions of tons each year." 80 Fed. Reg. at 64531. It is those potential emissions that EPA set out to regulate, and the benefits of the 2015 rule involve not having those emissions. The Supplemental Proposal also leaves out several other key pieces of context about EPA's past analysis.

First, although the Supplemental Proposal notes that newly constructed power plants were likely to be compliant with that rule's standards even in the absence of a rule, it leaves out *why*. Specifically, EPA concluded in 2015 that "few, if any" coal-fired powered plants were likely to be built in the foreseeable future. 80 Fed. Reg. at 64526; *see also id.* at 64640-41, 64515, 64563. EPA reached this conclusion based on modeling showing that new coal plants simply were not competitive given factors such as competitive natural gas prices, then-lower electricity demand growth, and increases in renewable energy. *Id.* at 64526. Indeed, those projections have been proven true as no major new coal plants have been built.[600]

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[600] *See* U.S. Energy Information Administration, *Nearly a quarter of the operating U.S. coal-fired fleet scheduled to retire by 2029* (Nov. 7, 2022), https://www.eia.gov/todayinenergy/detail.php?id=54559 ("The last large (greater than 100 MW) coal-fired power plant built in the United States was the 932 MW Sandy Creek Energy Station in Texas, which came online in 2013."). At the same time, EPA's supporting documentation for this proposal confirms that EPA is now "aware that there are companies that are pursuing new coal-fired generation, including two new coal-fired steam generating facilities (one in Alaska and one in West Virginia)," *Economic Impact Analysis for the Supplemental Proposed Rule* at 14 – concrete evidence that this proposal risks more than "negligible" emissions changes if finalized.

Second, the Supplemental Proposal leaves off that EPA considered the 2015 NSPS essential to follow congressional direction, ignoring its earlier statement that even as new coal-fired power plants were unlikely to be built that the agency could "ensure that there are standards in place to make sure that whatever fuel is utilized is done so in a way that minimizes CO_2 emissions, as Congress intended with CAA section 111." 80 Fed. Reg. at 64526. It is that congressional direction that EPA now unlawfully disregards.

Third, the Supplemental Proposal ignores that EPA in 2015 ran an "analysis of the project-level costs of a newly constructed coal-fired steam generating unit with partial CCS that meets the requirements of this final rule," which "indicate[d] that the quantified benefits of the standards of performance would exceed their costs under a range of assumptions." *Id.* at 64564. EPA did this because "some companies may choose to construct coal[-fired] units and has set standards for these units accordingly." *Id.* at 64642. That analysis is particularly important as the administration has announced funding for new coal-fired power plants, defying industry and market trends to the contrary.[601] The Supplemental Proposal's truncated and misleading quotation purports to lend credibility to the supposed futility rationale, but instead it merely shows that the agency is not aware of how it is changing its position. *See FCC v. Fox TV Stations, Inc.*, 556 U.S. at 515.

Given that EPA nowhere evaluates the factors in Section 111 for setting emission limits for carbon pollution, the agency cannot finalize a repeal of the 2015 NSPS based on those considerations. That rule had a strong technical record in support that EPA is not reopening, and nothing in the Supplemental Proposal disturbs that record.

XIII. EPA'S PROPOSAL FAILS TO CONSIDER RELIANCE INTERESTS.

If an agency action represents a reversal in prior policy, the agency must additionally "provide a more detailed justification than what would suffice for a new policy created on a blank slate" when "its new policy rests upon factual findings that contradict those which underlay its prior policy; or when its prior policy has engendered serious reliance interests that must be taken into account." *Fox*, 556 U.S. at 515; *see also Encino Motorcars, LLC v. Navarro*, 136 S. Ct. 2117, 2126 (2016). In reversing pre-existing policy, the agency may not "simply disregard" prior contrary factual determinations or rely on unexplained inconsistencies and generalized conclusions. *Fox,* 556 U.S. at 537; *Air All. Houston v. EPA*, 906 F.3d 1049, 1067 (D.C. Cir. 2018); *Nat'l Cable & Telecommunications Ass'n v. Brand X Internet Servs.*, 545 U.S. 967, 981 (2005); *see also AEP Texas N. Co. v. Surface Transp. Bd.*, 609 F.3d 432, 440-41 (D.C. Cir. 2010). Rather the agency must provide a "reasoned explanation . . . for disregarding facts and circumstances that underlay or were engendered by the prior policy." *Fox*, 556 U.S. at 515-16; *see also id.*at 537 (Kennedy, J. concurring).

Specifically, in changing course, the agency "must be cognizant that longstanding policies may have engendered serious reliance interests." *Dep't of Homeland Sec. v. Regents of*

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[601] *See* DOE, Project Selections for Broad Agency Announcement DE-FOA-0003605, Restoring Reliability: Coal Recommissioning and Modernization (Topic 1), https://www.energy.gov/hgeo/project-selections-broad-agency-announcement-de-foa-0003605-restoring-reliability-coal-0.

the Univ. of California, 591 U.S. 1, 30 (2020) (citing *Encino Motorcars,* 136 S. Ct. at 2126) (internal quotation marks omitted). In evaluating reliance interests, the agency must "assess whether there were reliance interests, determine whether they [are] significant, and weigh any such interests against competing policy concerns." *Id*. at 33 (citing *Vermont Yankee Nuclear Power Corp. v. Nat. Res. Def. Council, Inc.*, 435 U.S. 519, 551 (1978)). Importantly, any interested party can possess reliance interests, including those without a "legally cognizable reliance interest;" though the relative strength of the corresponding interests may vary. *Id.* at 31 (citation omitted). A policy must be in place for a sufficient amount of time in order for a legitimate reliance interest to develop. *See e.g.*, *Food & Drug Admin. v. Wages & White Lion Invs., L.L.C.*, 145 S. Ct. 898, 927 (2025) (citing *Fox*, 556 U.S. at 515). The basis underpinning the significant contribution finding the 111 greenhouse standards represents one of the most thoroughly vetted scientific determinations in EPA's history, and in the intervening 16 years, the scientific evidence has only grown stronger.

Here, EPA's proposal would eliminate all federal greenhouse gas standards for the power sector. While EPA briefly discusses the impacts of the proposed repeal on the power sector, it discusses those impacts purely in terms of avoided compliance costs. *See, e.g.*, 91 Fed. Reg. at 59044-45 ("The analysis considers the power industry's compliance costs as the change in electric power generation costs due to this proposed repeal."). The proposal notes "the 2015 Findings, and in particular regulatory requirements under the 2015 NSPS and 2024 CPS, have imposed significant burdens on Federal, State, and private-sector entities, including costs already incurred . . . that certain States, municipalities, and third-party organizations may have relied on the 2015 Findings or associated regulations in developing additional regulatory or voluntary programs." *Id.* at 59019.

But EPA fails to specify how it intends to address these reliance interests and concludes "we do not believe that any such reliance interests could justify retaining the findings and regulations in the absence of statutory authorization." *Id.* This conclusory statement does not demonstrate that EPA has meaningfully engaged in determining whether these reliance interests are "significant" and "weigh[ing] any such interests against competing policy concerns." *Regents of the Univ. of California*, 591 U.S. at 33. EPA has failed to consider relevant reliance interests involving regulated entities, states' regulatory programs, the U.S. economy, national security, global political impacts, and global trade impacts. EPA must account for these reliance interests, and its failure to do so renders the proposal arbitrary and capricious.

A. States' implementation of clean air policies.

EPA's proposal fails to acknowledge any potential reliance interests on the part of states and municipalities. *See* 91 Fed. Reg. at 59019. Yet numerous states, municipalities, companies, and individuals have made plans and investments in reliance on federal regulations that decrease greenhouse gas emissions and associated co-pollutants.

First, EPA fails to consider the serious reliance interests of States and Cities on EPA's authority to regulate greenhouse gas emissions under the Clean Air Act. EPA's authority has displaced States' authority to pursue claims under federal common law, *see AEP*, 564 U.S. at 428, and EPA further suggests here that that Clean Air Act preempts state law claims as well. 91 Fed. Reg. at 59043; *see supra* Comment Part IV. Having induced reliance on EPA's authority to

regulate greenhouse gases, EPA must account for reliance interests by states and cities before reversing course.

In addition, states have relied on federal greenhouse gas standards to meet and model their attainment and maintenance of the national ambient air quality standards (NAAQS). For example, the 2015 NSPS is included in the Summer 2021 Reference Case which underpins modeling for multiple state attainment plans.[602] EPA fails to account for how the greenhouse gas standards have impacted underlying modeling assumptions in state plans. In its Standards Repeal Rule, EPA claims that "it is a normal course of action for State and local air agencies to re-evaluate their planning in response to changes in Federal air regulations," 91 Fed. Reg. at 58961, but that does not absolve EPA from considering serious reliance interests, especially given that the 2015 NSPS been in place for over a decade. Every state must assure air quality within its geographic area for federally-set limits on carbon monoxide, PM, and ozone, all of which are co-pollutants of power sector sources, and seek EPA approval of a State Implementation Plan (SIP) that sets forth how it will attain and maintain in compliance with the life-saving NAAQS standards. 42 U.S.C. §§ 7407(a), 7410(a)(1), 7408(a). As EPA has recognized, greenhouse gas requirements for the power sector result in reductions of criteria pollutants, resulting in significant co-benefits. EPA itself has noted that federal greenhouse gas standards can help States meet the NAAQS.[603] An increase in criteria pollutant emissions caused by repealing all greenhouse gas rules could undermine a state's assumptions about its future air quality, making it difficult to attain or maintain the standards. To compensate for this increase in emissions, states (and especially downwind states) may need to increase NAAQS compliance obligations for their own in-state sources.

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[602] *See* EPA, *Documentation for EPA's Power Sector Modeling Platform v6 Using the Integrated Planning Model* 3-29 (Sep. 2021) ("For new fossil fuel-fired sources, EPA Platform v6 continues to include the Standards of Performance for Greenhouse Gas Emissions from New, Modified, and Reconstructed Stationary Sources: Electric Generating Units."), https://www.epa.gov/system/files/documents/2021-09/epa-platform-v6-summer-2021-reference-case-09-11-21-v6.pdf; Conn. Dep't of Energy & Env't Prot., *2015 Ozone National Ambient Air Quality Standards Moderate Nonattainment State Implementation Plan Revision* 33 (April 2025) ("The 2023 EGU point source emissions inventory was developed using the updated Summer 2021 Reference Case run of the Integrated Planning Model (IPM)."), https://portal.ct.gov/-/media/deep/air/ozone/ozone_sip_revision/2015moderateozonesipfinal.pdf?rev=232eada89d084ea7946a2ce5afa026ce&hash=3330B8A625690854A84620A33883BB62; Clark County Dep't of Env't & Sustainability, Div. of Air Quality, *Appendix A: Emission Inventories for 2017, 2023, and 2026 for the Clark County Ozone Nonattainment Area* 1 (July 2026), https://www.clarkcountynv.gov/assets/documents/government/departments/environment_and_sustainability/division_of_air_quality/planning/app-a-emissions-inventory.pdf (citing use of 2016v3 which is based on Summer 2021 Reference case)

[603] EPA, Rules that Help States Reduce Emissions and Meet Ozone Standards, https://www.epa.gov/ground-level-ozone-pollution/rules-help-states-reduce-emissions-and-meet-ozone-standards (last updated July 6, 2026) (listing 2015 clean power plan).

Additionally, contrary to EPA's suggestions, States have *not* re-evaluated their planning in response to change in Federal regulations. Instead, both States and EPA continue to rely on modeling based on its Platform v5 and v6, respectively, which includes the 2015 NSPS as an assumption. EPA is using 2016 base year modeling, which incorporates Platform v6, to propose an already legally flawed reconsideration of its disapproval of a number of upwind States' interstate transport SIPs for the 2015 ozone NAAQS. 91 Fed. Reg. 4026 (Jan. 30, 2026). Similarly, States in these SIPs are relying on 2011 base case modeling, which incorporates Platform v5, to purport meeting their Clean Air Act obligations. *Id*.

EPA "ha[s] [an] similar obligation to acknowledge and account for a changed regulatory posture the agency creates – especially when the change impacts a contemporaneous and closely related rulemaking." *Portland Cement Ass'n v. EPA*, 665 F.3d 177, 187 (D.C. Cir. 2011) ("finding it 'seriously disturbing' and 'almost beyond belief' that an agency would take rulemaking action undercutting another 'concurrent' rulemaking process" (citing *Office of Commc'n of the United Church of Christ v. FCC*, 707 F.2d 1413, 1441-42 (D.C. Cir. 1983)). EPA completely fails to acknowledge, let alone explain or account for, the impact of its own proposed repeal on the modeling the agency now seeks to rely upon for its proposed conclusions regarding downwind impacts.

EPA must explain in detail the facts and policy considerations that lead it now to propose to abandon its own key role in cleaning the country's air and shifting much of the burden to the states. EPA must also conduct a comprehensive review of the impacts of its proposal and whether it "support[s] in any way . . . any activity which does not conform" to any approved SIP. 42 U.S.C. § 7506(c)(1). In fact, however, EPA has not even identified this grave problem.[604]

B. Private companies and utilities.

EPA must consider impact on the reliance associated with entities' that have invested in clean energy technologies given the 2015 NSPS and 2024 CPS. For example, EPA's longstanding determination that CCS was the BSER in 2015 and 2024 rules contributed to market expectations that CCS would continue to expand. In recent years, significant investments have scaled up to support CCS.[605] Absent emissions limits for the power sector, it creates a threat that CCS will not

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[604] To the extent that the proposal will result in an increase in criteria pollutants for a state or region for which a nonattainment or maintenance plan exists, the Proposal would violate the Clean Air Act conformity provision, 42 U.S.C. § 7506(c), because, at minimum, it would delay timely compliance with such plans. Several states are in exactly this position with respect to the ozone NAAQS, including New Jersey, New York, Connecticut, Georgia, Ohio, Texas and California (*see* EPA, *Green Book*," *available at* https://perma.cc/HL5C-3279 (last updated Feb. 28, 2026), and increased NO_X emissions will likely increase ozone concentrations and thus make timely compliance with the states' ozone State Implementation Plans (SIPs) more difficult.

[605] DNV, *Energy Transition Outlook: CCS to 2050, Carbon Capture and Storage: From Turning Point in 2025 to Scale by Mid-Century* 53 (2025), https://www.dnv.com/energy-transition-outlook/carbon-capture-storage/ ("Major investments and acquisitions related to CCS are becoming more frequent and substantial. In 2023, ExxonMobil acquired Denbury for USD 4.9bn, gaining access to its CO_2 pipeline infrastructure (ExxonMobil, 2023). SLB acquired a

expand as anticipated and relied upon by investors.[606] No regulations at all will lead to lack of innovation, sunk costs and stranded assets that never produce the returns on investments the private companies reasonably expected. EPA does not appear to be cognizant of these reliance interests or has overlooked them intentionally, and certainly has not explained why they do not count.

In addition, utilities have devoted substantial resources to long-term planning under the premise that greenhouse gas standards would remain. Utilities have evaluated CCS deployment, conducted engineering and feasibility studies, and incorporated compliance with carbon standards into their integrated resources plans.[607]

C. U.S. economy.

EPA must consider the impact on reliance interests associated with the domestic economy. EPA does not address the specific sectoral impacts of the proposed action, for example,

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majority stake in Aker Carbon Capture (SLB, 2024), while Occidental purchased Carbon Engineering for USD 1.1bn, followed more recently by its acquisition of a second DAC company, Holocene (ESG Today, 2025)[] [t]hese moves demonstrate rising investor confidence and mark a shift toward the commercial maturation of CCS and related technologies.").

[606] DNV, *Energy Transition Outlook: CCS to 2050*, at 32.

[607] *See*, *e.g.*, Rocky Mountain Power*, In the Matter of the Application of Rocky Mountain Power for Authority to Amend the Final Plan to Establish Low-Carbon Energy Portfolio Standards, First Amendment to the Final Plan* at 4, Docket No. 20000-720-EA-26 (Wyo. Pub. Serv. Comm'n filed Oct. 2, 2026) ("While the estimated carbon capture facility operating costs and T&S costs were generally consistent with the Company's assumptions prior to initiating the FEED study, Phase 1 results indicated that the carbon capture capital costs and auxiliary loads associated with a carbon capture facility are significantly higher than the proxy costs developed from the Department of Energy ('DOE') published studies, demonstrating the value of Phase 1 and validating the need for developing site-specific data. Proxy inputs were used in the Company's 2025 Integrated Resource Plan ('IRP'), and site-specific CCS performance and cost assumptions from Phase 1 were used in the Company's 2025 IRP Update."); Ameren Missouri, *Integrated Resource Plan: Environmental Compliance* 1 (2026) ("Ameren Missouri has made significant investments to comply with existing environmental regulations and maintain a sufficient compliance margin . . . . In this IRP, we have not included new coal-fired generation as a candidate resource option, but we will continue monitoring advancements, especially in carbon capture and sequestration (CCS) technology.")

with respect to industries such as tourism and recreation,[608] real estate,[609] agriculture and fisheries,[610] forests,[611] insurance and reinsurance,[612] and hazardous chemicals.[613] The impact of increased greenhouse gas emissions on these industries is significant.

EPA also neglects consideration of the consumer impacts associated with its proposal. Reducing greenhouse gas emissions benefits consumers by avoiding negative impacts associated with emissions, including increased product, transportation, and health care costs; higher

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[608] *See, e.g.*, U.S. Climate Resilience Toolkit, *Recreation and Tourism*, https://perma.cc/X65M-993C (last visited Oct. 23, 2026) ("Climate change puts the ecosystems that support . . . recreational opportunities and other valuable goods and services at risk."); Christopher A. Monz et al., *Understanding and Managing the Interactions of Impacts from Nature-Based Recreation and Climate Change*, 50 Ambio 631 (2021) [https://doi.org/10.1007/s13280-020-01403-y] ("Disturbance to ecosystems in parks and protected areas from nature-based tourism and recreation is increasing in scale and severity, as are the impacts of climate change.").

[609] *See, e.g.*, Andrew Freedman, *Climate Change Could Erase $1.4 Trillion in Real Estate Value: Report*, Axios (Feb. 3, 2025), https://www.axios.com/2025/02/03/climate-change-insurance-costs-real-estate ("Human-driven climate change could result in $1.47 trillion in net property value losses from rising insurance costs and shifting consumer demand."); Jeff Masters, *Bubble Trouble: Climate Change is Creating a Huge and Growing U.S. Real Estate Bubble*, Yale Climate Connections, (Apr. 10, 2023), https://perma.cc/ZP4B-RXC4 ("Homes constructed in flood plains, storm surge zones, regions with declining water availability, and the wildfire-prone West are overvalued by hundreds of billions of dollars . . . put[ting] the U.S. financial system at risk.").

[610] *See* EPA, *Climate Change Impacts on Agriculture and Food Supply*, https://perma.cc/9TK8-FB7L (last updated Mar. 25, 2025) ("Agriculture is very sensitive to weather and climate."); Andrew Hultgren et al., *Impacts of Climate Change on Global Agriculture Accounting for Adaptation*, 642 Nature 644 (2025) (finding that US crop systems are optimized for high average yields but not robustness to climate change).

[611] *See Climate Change Impacts on Forests*, U.S. Environmental Protection Agency, https://perma.cc/E2YN-QAPS (last updated Aug. 13, 2025) (explaining that climate change will impact forests through natural disturbances that threaten forest health, reduced carbon storage and associated ecosystem services, reduced moderation of extreme weather impacts on forest watersheds).

[612] *See e.g.*, Cong. Budget Off., *Climate Change, Disaster Risk and Homeowner's Insurance* (Aug. 2024); Nils Röper & Sebastian Kohl, *Bookkeepers of Catastrophes: The Overlooked Role of Reinsurers in Climate Change Debates*, 89 Glob. Env't Change 102931 (2024) (describing the role of reinsurance companies in producing and translating climate change knowledge).

[613] *See e.g.*, Jacob Carter & Casey Kalman, *A Toxic Relationship: Extreme Coastal Flooding and Superfund Sites* 1, Ctr. for Sci. & Democracy (2020) ("About 2,000 official and potential Superfund sites . . . are located within 25 miles of the East or Gulf Coast. As sea levels rise, many of these toxic sites are at risk of flooding. Millions of people live near these sites, and flooding could bring them into contact with these chemicals.").

expenditures on utilities; and reduced employment benefits and earnings.[614] Additionally, consumers often prefer low-emission products, suggesting the fulfillment of personal preferences is served by regulation of greenhouse gas emissions.[615] Thus, reversal of the existing policy would be disruptive and would increase costs borne by consumers. Further, evidence in the factual record suggests that greenhouse gas regulations provide significant labor market benefits by stimulating economic growth, job creation, and emerging technologies.[616] Abatement of greenhouse gas emissions also improves worker health, safety, and compensation.[617] In considering reliance interests, EPA must account for the policy reversal's impact on significant aspects of the labor market and worker wellbeing.

D. Global political impacts & global climate change.

Contrary to the Agency's conclusion that regulating greenhouse gas emissions from the power sector under Section 111 is unimportant and futile, there is significant evidence that U.S. regulation influences global climate policy.[618] Foremost, domestic policy has a technology-diffusing effect by influencing the composition of technology exports, generating cost savings for certain technologies, and signaling to investors and producers the technologies that are most effective and preferable. For example, the global diffusion and universal adoption of catalytic converters as a result of the Clean Air Act is well documented.[619]

The U.S.'s method and stringency of regulating emissions also influence regulation in other countries. Some countries base their regulatory policies on the those adopted by the United States, while others are indirectly influenced through signals communicated by United States

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[614] *See* U.S. Dep't of the Treasury, *The Impact of Climate Change on American Household Finances* (2023) (outlining the impact of climate change on consumers).

[615] *See e.g.*, Jordan Bar Am et al., McKinsey, *Consumers Care About Sustainability – And Back it up with Their Wallets* (Feb. 2023) (finding a shift towards consumer spending on products with ESG-related claims).

[616] *See* U.S. Dep't of the Treasury, *The Impact of Climate Change on American Household Finances* (2023) (detailing the positive impact on workers and the labor market from avoided greenhouse gas emissions).

[617] U.S. Dep't of the Treasury, *The Impact of Climate Change on American Household Finances* (2023).

[618] *See* Jody Freeman, *The Environmental Protection Agency's Role in U.S. Climate Policy – A Fifty-Year Appraisal*, 31 Duke Env't L. & Pol'y F. 1, 64, 75 (2020) ("[EPA's] experience shows that domestic action can drive international climate progress rather than the other way around . . . [U.S.] credibility internationally hinges on our ability to deliver meaningful emission reductions through domestic policies.").

[619] *See, e.g.*, David Gerard & Lester B. Lave, *Implementing technology-forcing policies: The 1970 Clean Air Act Amendments and the introduction of advanced automotive emissions controls in the United States*, 72 Tech. Forecasting & Soc. Change 761 (2005).

policies.[620] Further, reversal of greenhouse gas regulations undermines the U.S.'s position as a global climate and economic leader. The country's retreat from emissions reduction commitments may weaken relationships with allies who are dedicated to climate action and allow competitors like China to strengthen their geopolitical influence by reaffirming investments in renewable energy and interest in global climate coordination efforts.[621] U.S. emissions regulation impacts the trajectory of global greenhouse gas emissions through technology diffusion and signaling of regulatory priorities.

EPA has failed to adequately consider these important global political consequences and associated reliance interests of deregulating power sector greenhouse gas emissions.[622]

E. National security.

Greenhouse gas emissions are directly related to national security, yet EPA does not analyze or consider the implications or reliance interests associated with greenhouse gas emissions in the proposal.

There are numerous national security impacts of greenhouse gas deregulation that warrant meaningful consideration. Increasingly, climate change exacerbates geopolitical tensions over climate responses, increases social and political unrest caused by climate-related displacement and resource scarcity, and erodes state legitimacy.[623] These impacts are more acute under greenhouse gas deregulation, which will necessitate increased investment in national defense systems, diplomatic initiatives, and global development institutions.[624]

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[620] *See, e.g.*, U.S. State Dep't, *FDA Recognizes Canada as Having a Comparable Food Safety System to the U.S.* (May 4, 2016), https://perma.cc/D34B-K32D.

[621] *See* Carlos Garcia-Soto, *Reversing climate progress: consequences and solutions in the wake of U.S. policy rollbacks*, 4 NPJ Climate Action 63 (2025).

[622] *See, e.g.*, Charles F. Parker & Christer Karlsson*, The UN climate change negotiations and the role of the United States: assessing American leadership from Copenhagen to Paris*, 27 Env't Pol. 519, 528 (2018) (finding the US is one of the actors most frequently mentioned as leading in the field of climate change).

[623] *See* Nat'l Intel. Council, *Climate Change and International Responses Increasing Challenges to US National Security Through 2040*, NIC-NIE-2021-10030-A (2021); Sherri Goodman, *Threat Multiplier: Climate, Military Leadership, and the Fight for Global Security* 3-4 (2024); NASEM, *Climate Security in Central America: Proceedings of a Workshop* (2024), https://nap.nationalacademies.org/27203; NASEM, *Climate Security in South Asia: Proceedings of a Workshop* (2023), https://nap.nationalacademies.org/26926.

[624] *See* Nat'l Intel. Council, *Climate Change and International Responses Increasing Challenges to US National Security Through 2040*, NIC-NIE-2021-10030-A at 15 (2021).

Deregulation of greenhouse gas emissions undermines global climate change amelioration efforts and threatens U.S. global strategic interests.[625] Specifically, a 2021 report by the National Security Council on the risks to U.S. interests due to climate change found that:

> Geopolitical tensions are likely to grow as countries increasingly argue about how to accelerate the reductions in net greenhouse gas emissions . . . Debate will center on who bears more responsibility to act and to pay – and how quickly – and countries will compete to control resources and dominate new technologies required for the clean energy transition.[626]

These concerns will be exacerbated by EPA's reversal of greenhouse gas emissions regulation, and the Agency must give adequate weight to this important aspect of its proposed action.[627]

F. Global trade.

EPA disregards how reversal of domestic greenhouse gas regulation affects global trade and associated reliance interests. While expanded reliance on fossil fuels may provide modest short-term benefits through increased energy exports, these gains are insufficient to offset foregone clean-energy investments and diversification.[628] Moreover, the volatility of global energy prices and the lower cost of renewable power as compared to fossil fuels renders fossil-fuel expansion unlikely to result in economic gains.[629]

Importantly, EPA has ignored numerous economic dimensions of global trade that are implicated by greenhouse gas deregulation. First, the Agency has failed to consider how reversal of domestic greenhouse gas regulations will disadvantage U.S. producers. Research demonstrates that domestic climate policy via the Inflation Reduction Act provided the U.S. with a competitive business advantage on energy products as international companies prioritized U.S. production to

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[625] *See* Tom Kertscher, *US versus China: Which nation is doing more to address climate change?*, Politifact (Mar. 27, 2023), https://www.politifact.com/article/2023/mar/27/us-versus-china-which-nation-doing-more-address-cl/ (accessed Oct. 23, 2026) (detailing expert consensus that "regardless of what China does, it's important for the U.S. to continue to reduce its emissions because of its impact on the climate and influence on other countries").

[626] *See* Nat'l Intel. Council, *Climate Change and International Responses Increasing Challenges to US National Security Through 2040*, NIC-NIE-2021-10030-A at 1-7 (2021).

[627] Fiona Harvey, *'Backsliding': most countries to miss vital climate deadline as Cop30 nears*, The Guardian (Feb. 8, 2025), https://perma.cc/FEG6-2LQQ (explaining how geopolitical tension and the devolving trade relationship between China and the United States is partially driven by a divergent view on the importance of climate policy: while the U.S. is backsliding, China has invested heavily in renewable technology and developed significant clean power generation capacity).

[628] *See* Garcia-Soto, Reversing Climate Progress.

[629] Garcia-Soto, Reversing Climate Progress.

capitalize on the resulting tax credits.[630] Additionally, because domestic climate policy reduced the overall price of electricity in the U.S., the country retained an edge over competitors in energy-intensive industries like chemical production.[631] Reversal of greenhouse gas regulation destroys this economic competitiveness by eliminating the global business benefits of U.S. emissions regulation.

EPA has not accounted for the cost of other countries' climate regulations, which will increase the more the U.S. backslides on emissions regulations. Some countries leverage economic policy mechanisms to force international producers to internalize the economic cost of carbon-intensive production and to prevent carbon leakage from areas with more stringent to more lax emissions policies.[632] For example, the European Union's carbon border adjustment mechanism (CBAM) functions by assessing the carbon emissions generated by production of a good and imposing a tariff proportional to those emissions upon importation.[633] Countries that independently internalize the carbon intensity of production via carbon pricing – for example, through an emissions trading scheme or a carbon tax – are exempt from the tariff so long as the exporting country's policy is equivalent to or more stringent than that of the importing county.[634] Then, economic mechanisms like CBAMs can be leveraged against U.S. imports because of the lack of a domestic carbon pricing mechanism.[635]

XIV. EPA HAS FAILED TO MEANINGFULLY CONSIDER ALTERNATIVES TO A FULL REPEAL.

Even if EPA finalizes its proposed rescission of the 2015 Finding, that does not compel a full and simultaneous repeal of the 2015 NSPS and remaining 2024 CPS standards, as explained

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[630] Milan Elkerbout, Dallas Burtraw, Åsa Löfgren & Lars Zetterberg, *Transatlantic Cues: How the United States and European Union Influence Each Other's Climate Policies,* Res. for the Future 6-7 (2024).

[631] Milan Elkerbout, Dallas Burtraw, Åsa Löfgren & Lars Zetterberg, *Transatlantic Cues: How the United States and European Union Influence Each Other's Climate Policies,* Res. for the Future 6 (2024).

[632] *See* Garcia-Soto, Reversing Climate Progress; Goran Dominioni & Daniel C. Esty, *Designing Effective Border Carbon Adjustment Mechanisms: Aligning the Global Trade and Climate Change Regimes*, 65 Ariz. L. Rev. 1, 9-11 (2023); Ali Hasanbeigi and Aldy Darwili, *Embodied Carbon in Trade: Carbon Loophole,* Global Efficiency Intel. 6, 25 (2022), https://www.globalefficiencyintel.com/2022-embodied-carbon-in-trade-carbon-loophole.

[633] Emily Benson et al., *Analyzing the European Union's Carbon Border Adjustment Mechanism*, Ctr. Strategic Int'l Stud. (Feb. 17, 2023), https://www.csis.org/analysis/analyzing-european-unions-carbon-border-adjustment-mechanism.

[634] Emily Benson et al., Analyzing the European Union's Carbon Border Adjustment Mechanism (2023).

[635] *See* Garcia-Soto, Reversing Climate Progress (explaining how countries may elect to exert economic pressure on the U.S. as retribution for reversal of the country's climate policy).

above. Here, EPA has made no attempt to consider alternatives to a full repeal of all power sector standards at the same time it rescinds its 2015 Finding. As our comments have shown, the proposal to repeal the 2015 Finding rests on flawed evidence and incoherent statutory analysis. *See supra* Section X. EPA should, therefore, consider maintaining the existing greenhouse gas standards until the completion of the administrative and likely judicial proceedings regarding the 2015 Finding.

Agencies are required to consider "'significant and viable and obvious alternatives'" to their proposed action. *Dist. Hosp. Partners, L.P. v. Burwell*, 786 F.3d 46, 59 (D.C. Cir. 2015); *see Spirit Airlines, Inc. v. DOT*, 997 F.3d 1247, 1255 (D.C. Cir. 2021) ("[T]he failure of an agency to consider obvious alternatives has led uniformly to reversal." (internal quotations omitted)); *Ky. Mun. Energy Agency v. FERC*, 45 F.4th 162, 188 (D.C. Cir. 2022) (finding FERC's lack of consideration of an alternative "amounts to failure of reasoned decisionmaking"). Courts have repeatedly affirmed the need to consider alternatives, particularly where an agency is reversing a prior action.[636] Moreover, an agency cannot broadly invoke the alleged illegality of one aspect of a regulation to justify its repeal of the entire regulation, especially where the agency has viable alternatives. *See Dept. of Homeland Sec. v. Regents of the Univ. of Cal.*, 591 U.S. 1, 28-31 (2020); *Shieldalloy Metallurgical Corp. v. NRC*, 624 F.3d 489 (D.C. Cir. 2010) ("[A]gencies must evaluate parties' proposals of 'significant and viable' alternatives.") (citing *Farmers Union Cent. Exch., Inc. v. FERC*, 734 F.2d 1486, 1511 n.54 (D.C. Cir. 1984)).

EPA has not justified its repeal or explained why this immediate rescission of the standards is appropriate or necessary. And in light of the reliance interests that EPA's standards have engendered, the agency would be wise to resolve the legality of its repeal – including through a final judgment at litigation – before upending an 11-year-old program and creating regulatory chaos. It is noteworthy that even the American Petroleum Institute has stated it "continues to support a federal role in regulating greenhouse gas emissions."[637]

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[636] *State Farm*, 463 U.S. at 51 (finding that NHTSA had arbitrarily failed to explain its rejection of option requiring airbags despite its prior finding "that airbags are an effective and cost-beneficial life-saving technology"); *Pub. Citizen v. Steed*, 733 F.2d 93, 100 (D.C. Cir. 1984) (setting aside suspension of rule because NHTSA "failed to explain why alternatives, which the rulemaking record indicates were available to the agency, could not correct" problems agency relied on as basis for suspending rule); *Int'l Ladies' Garment Workers' Union v. Donovan*, 722 F.2d 795, 816 (D.C. Cir. 1983) (agency impermissibly failed to consider alternatives to repeal "raised in [the] original notice and the comments"); *Office of Commc'n of United Church of Christ v. FCC*, 707 F.2d 1413, 1439 (D.C. Cir. 1983) (agency improperly eliminated programming logs requirements without giving due consideration to the benefits of retaining a modified form of logs); *Delaware Dept. of Nat. Res. and Envtl. Control v. EPA*, 785 F.3d 1, 58-59 (D.C. Cir. 2015) [missing parenthetical]

[637] Michael Copley*, Businesses face 'chaos' as EPA aims to repeal its authority over climate pollution*, NPR, (Aug. 19, 2025, 5:39 am), available at: https://www.npr.org/2025/08/19/nx-s1-5501576/climate-pollution-epa-regulation-endangerment-finding.

EPA has not evaluated these reliance interests and the disruption that its repeal of its entire greenhouse gas program would cause. Before EPA takes such a harmful action, it must issue a Supplemental Proposal that fully considers all of these reliance interests and examines options that would not disrupt those interests.

XV. EPA HAS NOT ESTABLISHED THAT IT HAS AUTHORITY TO REVERSE AN ENDANGERMENT FINDING OR DELIST A SOURCE CATEGORY.

EPA now, in addition to reversing its significant contribution finding, proposes to reverse its 2015 endangerment finding for greenhouse gas emissions from fossil fuel-fired power plants and delist and deregulate the combined fossil fuel-fired power plant source category as to greenhouse gases. 91 Fed. Reg. at 59002; *see also id.* at 59030 (contending that the 2015 significant contribution and endangerment findings for the combined source category did not constitute a valid listing under Section 111(b)(1)(A)). But, once again, it offers only a cursory analysis of its statutory authority to undertake those actions, and it is far from clear that such authority exists. As explained in our comments on the original proposal, because that analysis does not meet the Agency's procedural obligations, both aspects of the proposal must be withdrawn or reissued with a more fulsome explanation of the Agency's claimed authority, with notice and an opportunity for comment. EPA's Supplemental Proposal does not satisfy those obligations. We therefore reiterate here many of the reasons to question EPA's authority to reverse a finding under Section 111(b)(1)(A), to delist a source category, or to deregulate a source category – even as to one pollutant or class of pollutants.

Regarding its reversal of the endangerment finding, EPA points to Section 111(b)(1)(A) (which does not by its terms authorize revisiting any findings), as well as supposed background authority to rescind an action. *Id.* at 59018. But the D.C. Circuit has been clear that EPA has no "inherent" reconsideration authority, only what it is given by statute, because "it is axiomatic that administrative agencies may act only pursuant to authority delegated to them by Congress." *NRDC v. Regan*, 67 F.4th 397, 401 (D.C. Cir. 2023) (internal quotations omitted). Thus "EPA must point to something in either the Clean Air Act or the APA that gives it authority to" take the proposed action. *Clean Air Council v. Pruitt*, 862 F.3d 1, 9 (D.C. Cir. 2017). That authority to reconsider past actions must at least be "implicit" in the statutory structure. *NRDC v. Regan*, 67 F.4th at 401 (quoting *HTH Corp. v. NLRB*, 823 F.3d 668, 679 (D.C. Cir. 2016)).

EPA fails to establish that such reversal authority is implicit in Section 111(b), so its general assertions of reconsideration authority do not suffice. The handful of cases that the Agency cites as the basis for its authority do not address Section 111 or otherwise do not support EPA's contention. In *FDA v. Wages & White Lion Invs., L.L.C.*, the FDA applied its guidance as to how it would adjudicate applications for premarket authorization of certain drugs; the Court held that the agency had not improperly changed positions with respect to key consideration in its guidance – and, at any rate, the agency's basic authority to alter its guidance as to future adjudications was not at issue. 145 S. Ct. 898, 916 (2025). Similarly, in *Fox Television*, the FCC issued an order resolving complaints as to the use of certain expletives in television broadcasts – but the agency's power to resolve those complaints, and in so doing change its policy as to enforcement, was not contested. 556 U.S. at 517. And in *State Farm*, NHTSA acted under a provision expressly authorizing the agency to "revok[e]" safety standards. 463 U.S. at 34.

Although *Clean Air Council* did consider reconsideration of a rule promulgated under Section 111, that case concerned reconsideration of standards of performance under Section 111(b)(1)(B), not listing decisions under Section 111(b)(1)(A). As such, the court's observation that EPA could reconsider its "regulations" was not addressing the Agency's powers under Section 111(b)(1)(A). 862 F.3d at 9. The cases that EPA relies on thus do not establish whether Section 111(b)(1)(A) itself "implies" authority to reverse findings or listings made under that provision - and EPA must do more to establish that this is the case in order to exercise any such authority here.[638]

That is especially true where the Act provides reason to believe such reversal authority may not have been intended. First, the Act provides that once EPA lists a source category, the Agency has an obligation to regulate its emissions of air pollutants on the statutory timetable. 42 U.S.C. § 7411(b)(1)(B). This statutory chain of events points in only one direction, with an initial determination triggering a non-discretionary duty to issue proposed regulations. That has been enough, in other contexts, to conclude that EPA lacks reconsideration authority over the initial determination. In a case under the Safe Drinking Water Act, the D.C. Circuit explained that EPA could not reverse a conclusion that a pollutant "satisfied" the "criteria for regulating" because under the statute, once EPA made that determination it was "require[d]" to issue a proposed regulation within a specified period of time. *See NRDC v. Regan*, 67 F.4th at 402 ("To read into the statute another course of action – one that allows EPA to withdraw its regulatory determination entirely and decide that it 'shall not' regulate – would be to contravene the statute's clear language and structure and 'nullif[y] textually applicable provisions meant to limit [EPA's] discretion.' (internal quotation marks omitted)). Section 111(b)(1)(A) likewise directs EPA to determine which sources are eligible for regulation, with Section 111(b)(1)(B) requiring the Agency, upon that listing decision, to "publish proposed regulations" within one year. 42 U.S.C. § 7411(b)(1)(A)-(B).[639] EPA has not grappled with the implications of this statutory structure, and its interpretation by the *NRDC v. Regan* court, and so has not adequately explained a major legal interpretation, 42 U.S.C. § 7607(d)(3)(C), or considered an important aspect of the problem. *State Farm*, 63 U.S. at 43.

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[638] EPA grasps for precedent in denials of reconsideration of its endangerment finding for greenhouse gases under Section 202(a)(1). 91 Fed. Reg. at 59018. But denial of reconsideration of a final rule as expressly provided for in Section 307(d)(7)(B) does not imply broader statutory authority to revisit a rule. On the contrary, this specific statutory avenue for seeking changes in a final rule, as well as Section 307(d)'s exclusion of covered actions from the APA's requirements, suggests that blanket authority to revisit rules is not present in the Clean Air Act. *See* 42 U.S.C. § 7607(d) ("The provisions of section 553 through 557 and section 706 of title 5 [of the United States Code shall not, except as expressly provided in this subsection, apply to actions to which this subsection applies."); 5 U.S.C. § 553(e) ("Each agency shall give an interested person the right to petition for the issuance, amendment, or repeal of a rule.").

[639] *NRDC v. Regan* also suggests that the fact that Section 111(b)(1)(A) leaves that determination to the Administrator's "judgment" is not determinative. *See* 91 Fed. Reg. at 59008. The provisions at issue in that case also called for the Administrator to determine "whether or not" to regulate. *See* 67 F.4th at 402.

Section 111(b)'s use of the term "revise" does not alone resolve these important questions. *See* 91 Fed. Reg. at 59018. As an initial matter, EPA points to the statute's reference to revision of *standards*, not a revision of *findings*. *See id.* Beyond that, statutory context provides insight into that that term's meaning as used in Section 111(b). For instance, Section 111(g)(2) directs EPA to "revise" the list to specify a source category that a governor demonstrates contributes significantly to dangerous air pollution – authority that, by its terms, allows EPA to "revise" only by adding, not subtracting, source categories. 42 U.S.C. § 7411(g)(2). No comparable provision exists to demonstrate that "revise" was intended by Congress to address removals as well as additions.

Further, despite Congress's inclusion of a source-category delisting provision and pollutant-delisting provision in Section 112, no such provisions were added to Section 111. In Section 112, Congress specified the conditions under which a source category could be delisted, namely, where the emissions of hazardous air pollutants from no source within the category meet defined levels of risk. *See id.* § 7412(c)(9). Similarly, a pollutant can only be delisted under Section 112 where "there is adequate data on the health and environmental effects of the substance to determine that emissions, ambient concentrations, bioaccumulation or deposition of the substance may not reasonably be anticipated to cause any adverse effects to the human health or adverse environmental effects." *Id.* § 7412(c)(9). In Section 111, however, there are no express standards governing a delisting determination. It would run contrary to statutory purposes to infer some undefined authority to delist or deregulate a source category, or to deem a previously regulated pollutant unfit for regulation, under Section 111. *Id.* § 7401(b)(1) (stated purposes of the Clean Air Act is "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"); *id.* § 7411(b)(1)(A).

Section 111 expressly requires new sources, then within a listed category, to continue to comply with standards finalized or in development at the time of their construction, *id.* § 7411(a)(2), (e), and Section 169 incorporates those standards as a floor in new source permitting to prevent deterioration of air quality that has already been attained, *id.* § 7479(3). These statutory indicia further suggest that EPA cannot presume that authority to revoke a finding, reverse a listing decision, or deregulate a source category under Section 111 is statutorily implicit; rather, it must affirmatively explain how such authority would be consistent with the statutory text, context, structure, and purposes – and provide notice of, and an opportunity for comment on, that interpretation.

Indeed, the proposed action of removing all greenhouse gas requirements under Section 111 from fossil fuel-fired power plants arguably amounts to retroactive regulation, which would ordinarily require express authorization from Congress. *See Bowen v. Georgetown Univ. Hosp.*, 488 U.S. 204, 208 (1988). As noted, permits for major new sources are backstopped by Section 111 standards, *see* 42 U.S.C. § 7479(3); removing those standards could leave the validity of permitting authorities' determinations, and the resulting permit limits and permit shields, in limbo. As for existing sources, no mechanism is present in the statute or in EPA's implementing regulations to unwind or delete an approved state plan that includes federally enforceable standards – standards designed to apply to each source for its "remaining useful life." *Id.* § 7411(d)(1). Thus, the structure of Section 111 strongly implies that Congress did not contemplate or authorize removal of requirements already adopted under Section 111.

EPA has not explained how its proposal to rescind its 2015 findings and deregulate emissions of greenhouse gases from fossil fuel-fired power plants is consistent with the Clean Air Act. Because EPA's authority to reverse its actions under Section 111(b)(1)(A) is a "major legal interpretation . . . underlying the proposed rule," it had to be disclosed at proposal. 42 U.S.C. § 7607(d)(3). Any attempt to cure this defect in the final rule would represent a departure from the proposal, requiring notice and an opportunity to comment on the Agency's previously undisclosed rationale.

XVI. THE PROPOSAL VIOLATES THE CLEAN AIR ACT GENERAL CONFORMITY RULE.

Clean Air Act Section 176(c), 42 U.S.C. § 7506, known as the general conformity rule, provides that:

> (1) No department, agency, or instrumentality of the Federal Government shall engage in, support in any way or provide financial assistance for, license or permit, or approve, any activity which does not conform to an implementation plan after it has been approved or promulgated under section 7410 of this title … Conformity to an implementation plan means –
>
> (A) conformity to an implementation plan's purpose of eliminating or reducing the severity and number of violations of the national ambient air quality standards and achieving expeditious attainment of such standards; and
>
> (B) that such activities will not –
>
> (i) cause or contribute to any new violation of any standard in any area;
>
> (ii) increase the frequency or severity of any existing violation of any standard in any area; or
>
> (iii) delay timely attainment of any standard or any required interim emission reductions or other milestones in any area.

The Proposal will lead to an increase in NO_X emissions from powerplants. NO_X is a precursor to ozone formation. So to the extent that the Proposal will result in an increase in NO_X emissions for a state or region for which an ozone nonattainment or maintenance state implementation plan exists, the Proposal would violate Clean Air Act general conformity because, at minimum, it would delay timely compliance with such plans. Several states are in exactly this position with respect to the ozone NAAQS, including New Jersey, New York, Connecticut, Georgia, Ohio, Texas and California.[640]

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[640] *See* U.S. EPA, *Green Book 8-Hour Ozone (2015) Area Information*, *available at* https://perma.cc/HL5C-3279.

Finally, 40 C.F.R. § 93.154 provides in part that:

> Any department, agency, or instrumentality of the Federal government taking an action subject to this subpart must make its own conformity determination consistent with the requirements of this subpart. In making its conformity determination, a Federal agency must follow the requirements in §§ 93.155 through 93.160 and §§ 93.162 through 93.165 and must consider comments from any interested parties.

The procedures required in Section 93.154 were not followed here. As a consequence of these general conformity violations, the Proposal is invalid.

XVII. THE SUPPLEMENTAL PROPOSAL DOES NOT CURE THE DEFECTS IN THE STANDARDS REPEAL RULE, AND THAT RULE CANNOT PROVIDE A JUSTIFICATION FOR THE SUPPLEMENTAL PROPOSAL.

In the Standards Repeal Rule, EPA failed to consider alternatives within the ambit of the existing policy of the 2024 Carbon Pollution Standards and conceded that the agency was no longer in compliance with its obligations under Section 111(d) to set standards for existing sources in categories covered by the 2015 NSPS. *See* 91 Fed. Reg. at 58968-69, 58987-88, 58993-94. The Standards Repeal Rule attempts to excuse these legal violations by asserting that EPA need not comply with its obligations because it is "simultaneously" or "concurrently" issuing the Supplemental Proposal. Not so. EPA's someday wishes based on a proposed rule do nothing to cure the blatant legal defects in the Standards Repeal Rule.

This unlawful sleight of hand also leaves a very important aspect of the problem unacknowledged in the Supplemental Proposal: 1.38 billion metric tons of carbon emissions. *See* 91 Fed. Reg. at 58969. That number is the amount of emissions reductions that the 2024 Carbon Pollution Standards would have resulted in over roughly two decades. In the Supplemental Proposal, EPA blithely dismisses these reductions as "non-zero impacts." 91 Fed. Reg. at 59039. Just as EPA unlawfully ignored the public health and welfare effects of those emissions reductions in the Standards Repeal Rule, the Supplemental Proposal ignores those effects. Reducing emissions of harmful air pollutants is central to EPA's obligations under Section 111. *See* 42 U.S.C. § 7411(a)(1); *Sierra Club*, 657 F.2d at 326; *West Virginia*, 597 U.S. at 710. By ignoring these emission reductions, EPA is ignoring an important aspect of the problem. Indeed, the "environmental and public health effects" of rules under Section 111 are "arguably the most important aspect" of the problem. *Am. Lung Ass'n*, 985 F.3d at 995.

EPA also cannot here rely on the unlawful Standards Repeal Rule as a justification for this new proposal. In the Supplemental Proposal, EPA states it is "not reopening or soliciting further comment on the distinct issues addressed in the contemporaneous final rule." 91 Fed. Reg. at 59004 & n.2. But the Supplemental Proposal hints at aspects of the 2024 Carbon Pollution Standards included in the Standards Repeal Rule at various points. For instance, the Supplemental Proposal references the subcategorization of existing coal-fired power plants in the 2024 Carbon Pollution Standards as part of its supposed major-question doctrine justification. *See id.* at 59033. Not only does EPA not provide any reason why the subcategorization in the 2024 Carbon Pollution Standards is in any way relevant to the Supplemental Proposal, but EPA

did not provide subcategorization or the major-questions doctrine as reasons for the Standards Repeal Rule. Instead, it took the validity of those subcategories as a given. *See* 91 Fed. Reg. at 58968 ("This final action is based on a record-focused reevaluation of the BSER determinations for the relevant subcategories."). EPA cannot provide a new bogus rationale in this proposal for its already unlawful repeal of the 2024 Carbon Pollution Standards, especially not one as obliquely described as this reference to subcategorization.

XVIII. EPA SHOULD NOT FINALIZE EITHER THE SIGNIFICANT CONTRIBUTION PROPOSAL OR THIS PROPOSAL

EPA states that it is not seeking further comment on the Significant Contribution Proposal, but that "[c]ommenters are welcome to articulate whether and why they believe the distinct rationales presented in this supplemental proposal are or are not preferable" to that proposal. 91 Fed. Reg. at 59005 n.3. Both proposals are arbitrary, capricious, unreasonable, or otherwise not in accordance with law for the reasons expressed in this comment and in our Significant Contribution Comment.[641] The latter comments, as they similarly address EPA's authority over greenhouse gas pollution and the best reading of Section 111, are hereby incorporated by reference in full. As both these comments show, EPA has indisputable authority to regulate greenhouse gas emissions under Section 111 and has made the requisite findings, to the extent required by Section 111(b)(1)(A), that by way of their greenhouse gas emissions, the regulated power plants "contribute[] significantly to . . . air pollution which may reasonably be anticipated to endanger public health or welfare." 42 U.S.C. § 7411(b)(1)(A); *see* 80 Fed. Reg. at 64510. While EPA's authority under Section 111 includes exercising the Agency's "judgment" concerning whether a source category "contributes significantly" to air pollution, and determining whether it is "reasonabl[e]" to "anticipate" that that pollution will harm the public, neither this proposal nor EPA's Significant Contribution Proposal purport to disturb the 2015 findings on the basis of new factual or scientific judgments concerning those determinations – and neither proposal engages with the record underlying those judgments, as would be necessary were it to do so. Accordingly, EPA cannot assert that either proposal concerns, or falls within, the scope of the judgments actually delegated to the Agency by Section 111. Instead, both EPA proposals manufacture legal bases for the repeal of EPA's greenhouse gas program under Section 111 that are precluded by the statutory text, by conclusive precedent, and by other evidence. EPA should not finalize either proposal.

[641] *See generally* Significant Contribution Comment, EPA-HQ-OAR-2025-0124-0648.

APPENDIX A

Technical Memorandum on Modeling

I. Introduction

This technical memorandum supports the comments filed by Public Health and Environmental Organizations ("Commenters") on EPA's proposed rule, "Rescission of the Greenhouse Gas Findings for Fossil Fuel-Fired Power Plants and Repeal of Regulations for Power Plant Greenhouse Gas Emissions Under Clean Air Act Section 111," 91 Fed. Reg. 59,002 (Sep. 16, 2026) ("Supplemental Proposal"). The Supplemental Proposal's futility rationale relies on incomplete and poorly conducted technical analyses. To address the errors in EPA's approach, Commenters have conducted our own analysis. A description of the methodology and results of that analysis are presented below.

II. Emissions Scenario Modeling

A. Recreating and Examining EPA's Emission Projections (Scenario A and A-50%)

In order to critique EPA's futility analysis, we first needed to obtain EPA's emissions inputs, which in turn are used in the temperature and sea level rise modeling. Basic emissions inputs were posted to the regulations.gov docket on September 17, 2026.[1] This serves as Scenario A in our modeling below. EPA also conducts its analysis to assess the impact of only 50% of these emissions. This is referred to as Scenario A-50% in our analysis. As described in more detail, we then utilize these recreated emissions, temperature, and sea level rise values as inputs to multiple damages modeling frameworks.

It should be noted, however, that these emissions data, accompanied by a very short Technical Memo, are not supported by documentation that can validate or recreate the methodology used to arrive at the emissions projections. This is particularly relevant in light of EPA's decision to utilize "a composite forecast" derived from multiple sources "to account for future EGU emissions in the absence of the Inflation Reduction Act," stating that such a methodology is necessary because "[n]o publicly available dataset of GHG emissions projections for the U.S. power sector currently exists that excludes the impacts of the IRA."[2] This statement, however, is false. Annual Energy Outlook (AEO) 2026 was released on April 8, 2026, and includes detailed

[1] *See* EPA Technical Memo, *Temperature, CO2 Concentration, and Sea Level Rise Impacts of CO2 Emissions from U.S. Electricity Generating Units* (Aug. 2026), Docket ID No. EPA-HQ-OAR-2025-0124, and Attachments, *available at* https://www.regulations.gov/document/EPA-HQ-OAR-2025-0124-2921.

[2] EPA Technical Memo, *Temperature, CO2 Concentration, and Sea Level Rise Impacts of CO2 Emissions from U.S. Electricity Generating Units*, *supra*, at 1, 6.

assumptions regarding the recission of the IRA under the One Big Beautiful Bill Act (OBBBA).[3] In addition, EPA conducted its own IPM modeling accounting for the OBBBA, Baseline v7.24, which was first publicly released in February 2026,[4] and is referenced directly in the Regulatory Impact Assessment released accompanying the companion rulemaking to this Supplemental Proposal to partially repeal the Carbon Pollution Standards ("The IPM baseline also includes power-sector related provisions from the One Big Beautiful Bill Act (OBBBA) of 2025.")[5]

B. Additional Emission Scenarios (Scenarios B, B-50%, C, and D)

In the Supplemental Proposal, EPA argues that it "cannot or should not exercise its regulatory authority under CAA section 111 when that exercise would have no meaningful impact on the identified dangers to public health and welfare," and that "[m]odeling analysis performed to evaluate the potential impacts of GHG regulations issued pursuant to CAA section 111 indicates that regulating fossil fuel-fired power plant CO_2 emissions under this provision would have no more than a trivial effect on the key global climate change indicators that relate to adverse public health and welfare impacts." 91 Fed. Reg. at 59,035. However, this modeling makes numerous erroneous and irrational choices and inappropriately limits and manipulates the assessment of emissions impacts in order to support the Agency's proposed findings. To highlight the impact of alternative analytical decisions, including the large impacts of changing key assumptions, Commenters modeled three additional scenarios, identified as Scenario B, Scenario C, and Scenario D.

Scenario B ("Extended Timeline") allows us to calculate the impacts of power sector emissions on global climate indicators beginning in 1977, when EPA listed fossil fuel-fired combustion turbines, including those used in power plants, in a source category under Section 111. In its Supplemental Proposal, EPA has arbitrarily chosen to begin measuring the potential "impact" of GHG emissions in 2026; this Scenario highlights how selecting a different starting point for this calculation results in a significant change to the results. To develop these annual emissions estimates, we first utilized historical reported power sector CO_2 emissions from the Energy Information Administration through 2024.[6] For the years 2025 through 2050, to maintain

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[3] U.S. Energy Info. Admin., *AEO2026: One Big Beautiful Bill Act Assumptions in the Counterfactual Baseline and Core Side Cases* (Apr. 2026), https://www.eia.gov/outlooks/aeo/pdf/2026/OBBBA_Assumptions.pdf.

[4] *See* EPA, *2025 Reference Case: EPA's Power Sector Modeling Platform Using IPM* (Feb. 20, 2026), https://www.epa.gov/power-sector-modeling/2025-reference-case.

[5] EPA, *Regulatory Impact Analysis for the Final Partial Repeal of the Carbon Pollution Standards for Fossil Fuel-Fired Electric Generating Units* 2-2 (Sept. 2026), Docket ID No. EPA-HQ-OAR-2025-0124-2994, https://www.regulations.gov/document/EPA-HQ-OAR-2025-0124-2994.

[6] *See* U.S. Energy Info. Admin., *2026 September Monthly Energy Review* tbl. 11.6 (Sept. 29, 2026), https://www.eia.gov/totalenergy/data/monthly/archive/00352609.pdf. The data, including total energy electric power sector CO_2 emissions, is available for download from the U.S. Energy

consistency with EPA's approach and to isolate the impacts of changing the start and end date assumption, we utilized EPA's projections (as in Scenario A). Finally, for 2051 and beyond, we assumed that electricity demand continued to grow at the previous 5 years' compound average rate, and that the emissions rate per MWh remained constant.[7] We calculated annual emissions through 2125. We also conducted an analysis to assess the impact of only 50% of these emissions, referred to as Scenario B-50%.

Scenario C ("Historical Snapshot") similarly begins the calculation of emissions in 1977. However, instead of using actual emissions rates, this case uses emissions rates per MWh as observed in 1977, when EPA could have conceivably first considered conducting an analysis of domestic power sector emissions and their impact on global climate. This Scenario highlights the importance of emissions rate assumptions, which are necessarily a product of information available at the time that analysis is conducted and assumptions are selected. Regardless of whether this scenario would have been considered likely at the time, which we did not evaluate, it certainly would have been one possible future from the perspective of the 1970s-era EPA and the Congress that authorized EPA to regulate power-plant pollution under the Clean Air Act. This scenario illustrates the mutability of EPA's exercise, and how attempting to quantify "futility" at a particular point in time is assumption-dependent and inherently uncertain. Scenario C also illustrates our critique that EPA's futility analysis is inappropriately focused on the effects of prospective regulation versus EPA's statutory authority – past, present, and future. For this case, this emissions rate (1,495 lb per MWh)[8] was applied to historic electricity demand through 2025, Annual Energy Outlook 2026 projections for 2026 through 2050, and, identical to Scenario B, projected demand assumed to grow at the previous 5 years' compound average rate.

Scenario D mirrors EPA's (Scenario A), but adopts a moderate growth rate for emissions after 2050 rather than assuming that emissions remain flat. Scenario D utilizes EPA's CO_2 emissions projections from 2025 through 2050, and then, identical to Scenarios B and C, applies a growth rate equivalent to the previous 5 years' compound average rate of electricity demand.

Information Administration, at https://www.eia.gov/totalenergy/data/browser/xls.php?tbl=T11.06&freq=m, and attached here as Attachment 1.

[7] *See* U.S. Energy Information Administration, *Annual Energy Outlook 2026* tbl. 8 (2026), *available at* https://www.eia.gov/outlooks/aeo/data/browser/#/?id=8-AEO2026&cases=cb2026&sourcekey=0 (Electricity: Electric Power Sector: Power Only: Total: Counterfactual Baseline case). The data is available for download from the U.S. Energy Information Administration, at https://www.eia.gov/outlooks/aeo/excel/aeotab8.xlsx, and attached here as Attachment 2.

[8] Calculated based on data available for download from the U.S. Energy Information Administration and attached to this Appendix: https://www.eia.gov/totalenergy/data/browser/xls.php?tbl=T11.06&freq=m (Attachment 1); https://www.eia.gov/totalenergy/data/browser/xls.php?tbl=T07.01&freq=m (Attachment 3).

Figure 1 shows annual emissions under each of these scenarios. Figure 2 shows cumulative emissions per scenario. Tables 1 and 2 show these data for key years in table form.

Figure 1. Annual U.S. Power Sector CO_2 Emissions, million metric tons

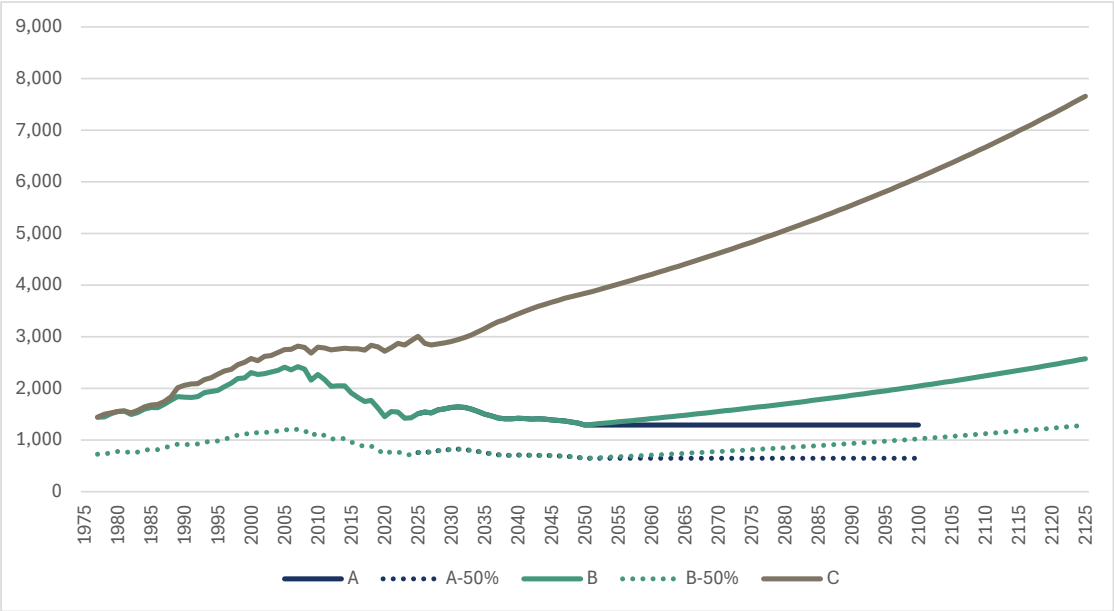


Figure 2. Cumulative U.S. Power Sector CO_2 Emissions, million metric tons

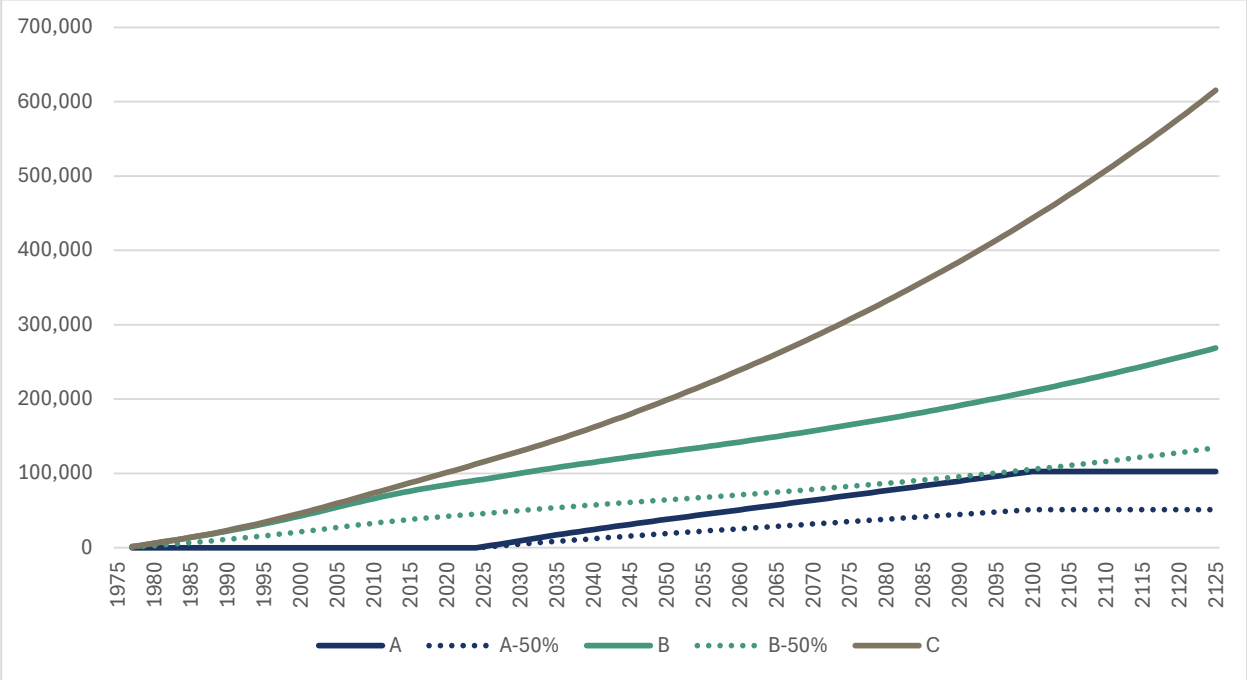


Table 1. Annual U.S. Power Sector CO_2 Emissions, million metric tons (% of global CO2 emissions)

Annual emissions (MMT CO_2)						
	Scenario A	**Scenario A-50%**	**Scenario B**	**Scenario B-50%**	**Scenario C**	**Scenario D**
1977	-	-	1,443 (7.3%)	722 (3.7%)	1,443 (7.3%)	-
2000	-	-	2,306 (9.1%)	1,153 (4.6%)	2,578 (10.2%)	-
2025	1,510 (3.9%)	755 (1.9%)	1,510 (3.9%)	755 (1.9%)	3,004 (7.7%)	1,510 (3.9%)
2050	1,288 (3.0%)	644 (1.5%)	1,288 (3.0%)	644 (1.5%)	3,836 (8.9%)	1,288 (3.0%)
2075	1,288 (3.8%)	644 (1.9%)	1,622 (4.8%)	811 (2.4%)	4,830 (14.3%)	1,622 (4.8%)
2100	1,288 (8.9%)	644 (4.4%)	2,042 (14.1%)	1,021 (7.1%)	6,081 (42.0%)	2,042 (14.1%)
2125	-	-	2,571 (22.2%)	1,286 (11.1%)	7,657 (66.1%)	2,571 (22.2%)

Table 2. Cumulative U.S. Power Sector CO_2 Emissions, billion metric tons (% of cumulative global CO2 emissions)

	Cumulative emissions (MMT CO_2)					
	Scenario A	**Scenario A-50%**	**Scenario B**	**Scenario B-50%**	**Scenario C**	**Scenario D**
2000	-	-	42.8 (8.1%)	21.4 (4.0%)	46.4 (8.7%)	-
2025	1.5 (3.9%)	0.8 (1.9%)	92.1 (6.7%)	46.0 (3.3%)	115.6 (8.4%)	1.5 (3.9%)
2050	38.1 (3.5%)	19.1 (1.8%)	128.7 (5.3%)	64.4 (2.7%)	198.6 (8.2%)	38.1 (3.5%)
2075	70.4 (3.4%)	35.2 (1.7%)	165.1 (4.8%)	82.5 (2.4%)	306.9 (9.0%)	74.5 (3.6%)
2100	102.6 (3.9%)	51.3 (1.9%)	210.9 (5.3%)	105.5 (2.6%)	443.3 (11.1%)	120.3 (4.5%)
2125	-	-	268.6 (6.1%)	134.3 (3.1%)	615.1 (14.0%)	178.0 (5.9%)

*The summed global CO2 emissions begin in 2025 for Scen A, A-50%, and D and in 1977 for Scen B, B-50%, and C.

III. Global Mean Surface Temperature (GMST) and Global Sea Level Rise (GSLR) Modeling

The framework EPA used to model the impact of U.S. power sector emissions was to run a scenario with global emissions based on SSP2-4.5 and then run a scenario where EPA removed U.S. power sector emissions from global emissions. Historic global emissions were pulled from ClimateWatch. To calculate the "contribution" from the U.S. power sector, EPA subtracted the run without the power sector emissions from the baseline run.

We have replicated EPA's general framework. Each of our scenarios was run against this historic and projected global baseline. For CO_2 concentration, GMST, and GSLR, we present the results as EPA did: the total global increase under SSP2-4.5 "Baseline", starting at the relevant year for each Scenario; and the total global increase under SSP2-4.5 less the power sector emissions by

subtracting out the relevant Scenario emissions and conducting each analysis on the revised emissions trajectory.

A. FaIR

The Finite Amplitude Impulse Response (FaIR) model is a reduced-complexity, open-source climate model that translates greenhouse gas emissions into atmospheric concentrations, radiative forcing, and global temperature changes. Commenters used FaIR v2.2.4, initialized over 1750-2200 with default species properties, emissions, and radiative forcing imported from RCMIP for the SSP2-4.5 scenario. Each run subtracts Commenters' CO_2 emission scenarios from fossil CO_2 emissions. Every configuration is run with and without the reduction, and each avoided quantity is the per-configuration difference.

Table 3 shows the emissions concentrations results of each of the Scenarios that begins emissions trajectories in 2025 (EPA's Scenarios A and A-50% and Commenter Scenario D). Under Scenario A, by 2100 power sector emissions have contributed 6% of global CO_2 concentration. Under Scenario D, in which emissions are projected to continue a modest rise after 2050 (rather than an arbitrary emissions freeze after this date as assumed by EPA), this impact rises to 7.2% in 2100 and 10.6% in 2125.

Table 3: Change in global CO2 concentrations (ppm) relative to 2025 for Scenario A, A-50%, and D. Median [95% confidence interval] (% contribution)

	From 2025 Baseline	Scen. A contribution	Scen. A-50% contribution	Scen. D contribution
2050	61 [52-71]	2.92 [2.62–3.22] (4.8%)	1.46 [1.31–1.61] (2.4%)	2.92 [2.62–3.22] (4.8%)
2100	121 [87-157]	7.30 [5.72–8.87] (6.0%)	3.66 [2.86–4.44] (3.0%)	8.74 [6.89–10.54] (7.2%)
2125	119 [79-163]	6.57 [4.82–8.39] (5.5%)*	3.29 [2.41–4.21] (2.8%)*	12.57 [9.53–15.66] (10.6%)

*Because EPA's emission scenario ends in 2100, the percent contribution decreases in 2125 relative to 2100 in our analysis for Scenario A and Scenario A-50%.

Table 4 shows the emissions concentration results of each of the Scenarios that begins emissions trajectories in 1977 (Scenarios B, B-50%, and C). Under Scenario B, by 2100 power sector emissions have contributed 6.7% of global CO_2 concentration and 8.6% by 2125. Under Scenario C, this impact rises to 14.8% in 2100 and 20.3% in 2125.

Table 4: Change in global CO2 concentrations (ppm) relative to 1977 for Scenario B, B-50%, and C. Median [95% confidence interval] (% contribution)

	From 1977 Baseline	Scen. B contribution	Scen. B-50% contribution	Scen. C contribution
2025	86 [89-82]	5.85 [5.47–6.26] (6.8%)	2.93 [2.74–3.14] (3.4%)	7.53 [7.07–8.03] (8.8%)
2050	147 [141-153]	8.19 [7.10–9.31] (5.6%)	4.11 [3.56–4.67] (2.8%)	13.24 [11.61–14.89] (9.0%)
2100	207 [176-239]	13.94 [10.62–17.17] (6.7%)	6.99 [5.32–8.63] (3.4%)	30.54 [23.78–37.12] (14.8%)
2125	205 [168-245]	17.66 [12.97–22.28] (8.6%)	8.88 [6.50–11.20] (4.3%)	41.48 [31.31–52.00] (20.3%)

Table 5 shows the temperature results of each of the Scenarios that begins emissions trajectories in 2025 (EPA's Scenarios A and A-50% and Commenter Scenario D). Under Scenario A, by 2100 power sector emissions have contributed 2.9% of GMST and 2.6% by 2125. Under Scenario D, in which emissions are projected to continue a modest rise after 2050, this impact rises to 3.3% in 2100 and 4.4% in 2125.

Table 5: Change in Global Mean Surface Temperature (deg C) relative to 2025 for Scenarios A, A-50%, and D. Median [95% Confidence Interval] (% contribution)

	From 2025 Baseline	Scen. A contribution	Scen. A-50% contribution	Scen. D contribution
2050	0.54 [0.43-0.80]	0.013 [0.009–0.019] (2.4%)	0.007 [0.005–0.009] (1.3%)	0.013 [0.009–0.019] (2.4%)
2100	1.26 [0.77-2.48]	0.036 [0.024–0.056] (2.9%)	0.018 [0.012–0.028] (1.4%)	0.042 [0.028–0.064] (3.3%)
2125	1.40 [0.84-2.85]	0.036 [0.023–0.063] (2.6%)	0.018 [0.012–0.031] (1.3%)	0.062 [0.041–0.098] (4.4%)

Table 6 shows the GMST results of each of the Scenarios that begins emissions trajectories in 1977 (Scenarios B, B-50%, and C). Under Scenario B, by 2100 power sector emissions have contributed 3.3% of GMST and 4.0% by 2125. Under Scenario C, this impact rises to 6.9% in 2100 and 9.2% in 2125.

Table 6: Change in Global Mean Surface Temperature (deg C) relative to 1977 for Scenarios B, B-50%, and C. Median [95% Confidence Interval] (% contribution)

	From 1977 Baseline	Scen. B contribution	Scen. B-50% contribution	Scen. C contribution
2025	0.97 [0.91-1.05]	0.034 [0.024–0.049] (3.5%)	0.017 [0.012–0.025] (1.8%)	0.042 [0.030–0.061] (4.4%)
2050	1.51 [1.34-1.85]	0.046 [0.031–0.070] (3.1%)	0.023 [0.016–0.035] (1.5%)	0.070 [0.049–0.104] (4.7%)
2100	2.23 [1.68-3.53]	0.073 [0.048–0.118] (3.3%)	0.037 [0.024–0.059] (1.7%)	0.154 [0.102–0.241] (6.9%)
2125	2.37 [1.75-3.90]	0.095 [0.061–0.154] (4.0%)	0.047 [0.030–0.077] (2.0%)	0.217 [0.141–0.347] (9.2%)

B. BRICK

Commenters ran BRICK v1.2.1 (published zenodo-v3 parameters). For each scenario, one BRICK run was paired with each FaIR configuration. To calculate the baseline, sea level is measured from 1967.

Table 7 shows the sea level rise results of each of the Scenarios that begins emissions trajectories in 2025 (EPA's Scenarios A and A-50% and Commenter Scenario D). Under Scenario A, by 2100 power sector emissions have contributed 1.6% of global sea level rise. Under Scenario D, in which emissions are projected to continue a modest rise after 2050, this impact rises to 1.7% in 2100 and 2.0% in 2125.

Table 7: Change in Global Sea Level Rise (cm) relative to 2025 for Scenarios A, A-50%, and D. Median [95% Confidence Interval] (% contribution)

	From 2025 Baseline	Scen. A contribution	Scen. A-50% contribution	Scen. D contribution
2050	13 [10-24]	0.08 [0.05–0.97] (0.6%)	0.04 [0.02–0.08] (0.3%)	0.08 [0.05–0.97] (0.6%)
2100	74 [36-152]	1.17 [0.37–5.49] (1.6%)	0.44 [0.18–2.93] (0.6%)	1.26 [0.40–5.65] (1.7%)
2125	117 [48-228]	2.00 [0.58–8.01] (1.7%)	0.83 [0.29–4.16] (0.7%)	2.38 [0.72–9.93] (2.0%)

Table 8 shows the sea level results of each of the Scenarios that begins emissions trajectories in 1977 (Scenarios B, B-50%, and C). Under Scenario B, by 2100 power sector emissions have contributed 4.7% of global sea level rise and 4.5% by 2125. Under Scenario C, this impact rises to 8.4% in 2100 and 8.6% in 2125.

Table 8: Change in Global Sea Level Rise (cm) relative to 1977 for Scenarios B, B-50%, and C. Median [95% Confidence Interval] (% contribution)

	From 1977 Baseline	Scen. B contribution	Scen. B-50% contribution	Scen. C contribution
2025	10 [8-12]	0.26 [0.17–0.41] (2.6%)	0.13 [0.09–0.21] (1.3%)	0.30 [0.19–0.46] (3.0%)
2050	23 [18-36]	0.69 [0.40–3.54] (3.0%)	0.34 [0.20–2.15] (1.5%)	0.90 [0.51–4.50] (3.9%)
2100	84 [44-164]	3.92 [1.10–10.36] (4.7%)	1.85 [0.55–6.08] (2.2%)	7.06 [1.89–18.93] (8.4%)
2125	127 [56-240]	5.71 [1.59–16.31] (4.5%)	2.67 [0.78–9.18] (2.1%)	10.88 [3.03–33.04] (8.6%)

IV. Damages Modeling

In the futility analysis EPA conducted in the Supplemental Proposal, EPA only considered how U.S. power sector GHG emissions would impact global mean surface temperature and global sea level rise. In doing so, EPA failed to consider how those temperature and sea level increases would harm Americans' public health and welfare. In this section, we illustrate how EPA could have quantified damages through two distinct methodologies, the social cost of greenhouse gases

(SC-GHGs) and EPA's Framework for Evaluating Damages and Impacts (FrEDI) model. We present this analysis for Scenario A based on EPA's emissions inputs, as well as for the higher emissions values in the two additional Scenarios B and C described above. These analyses further demonstrate that EPA cannot reasonably base its proposed futility finding on the analysis in the Supplemental Proposal and that its proposed futility rationale is arbitrary and capricious.

The purpose of this analysis is to highlight that EPA's "futility" methodology—of comparing proportional global mean surface temperature and global sea level rise projections to alleged and unsupported *de minimis* thresholds—is fundamentally absurd as it obscures the very thing for which EPA claims to rely on it: determining whether power sector greenhouse gas emission standards have or could have meaningful impacts on U.S. health and welfare dangers from climate change. To the contrary, EPA's sole focus on the intermediate metrics of temperature and sea level masks massive and catastrophic impacts to human health and welfare endpoints. We do not intend this analysis to provide definitive quantifications of harm or to define specific modeling tools that EPA should have used.

A. Social Cost of Greenhouse Gases

i. Methodology

Commenters used the social cost of greenhouse gas estimates included in the November 2023 EPA's "Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances."[9] We calculated the social cost associated with emissions starting in 2026 for each of the scenarios described above. We converted the values into 2024$ and discounted all three scenarios to 2026.

ii. Results

Under a 2% discount rate, Tables 9 through 13 show that even EPA's limited accounting of the emissions associated with U.S. power sector emissions would impose an estimated $20.4 trillion in global climate costs by 2100, while Scenarios B and C would be even costlier at $23.1 to $62.3 trillion by 2100 and $28.2 to $77.4 trillion through 2125.

Social cost of greenhouse gases calculations monetize the future harms of the pollution emitted in each year with those harms being discounted back to the year the pollution was emitted. The cumulative values below are the accumulated future harms that will result due to the emissions that have been emitted up to that year.

Table 9. Climate Costs from Scenario A CO_2 Emissions (trillion 2024$), various discount rates

	2.5%	**2.0%**	**1.5%**
2050	$5.5	$9.1	$15.7
2100	$11.7	$20.4	$37.1

[9] EPA, *Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances* 1 (Nov. 2023), https://perma.cc/8XBU-CLW4.

Table 10: Climate Costs from Scenario B CO_2 Emissions (trillion 2024$), various discount rates

	2.5%	2.0%	1.5%
2050	$5.5	$9.1	$15.7
2100	$13.2	$23.1	$42.5
2125	$15.5	$28.2	$54.0

Table 11. Climate Costs from Scenario A-50% CO_2 Emissions (trillion 2024$), various discount rates

	2.5%	2.0%	1.5%
2050	$2.8	$4.5	$7.8
2100	$5.9	$10.2	$18.6

Table 12: Climate Costs from Scenario B-50% CO_2 Emissions (trillion 2024$), various discount rates

	2.5%	2.0%	1.5%
2050	$2.8	$4.5	$7.8
2100	$6.6	$11.6	$21.2
2125	$7.7	$14.1	$27.0

Table 13: Climate Costs from Scenario C CO_2 Emissions (trillion 2024$), various discount rates

	2.5%	2.0%	1.5%
2050	$12.4	$20.5	$35.3
2100	$35.2	$62.3	$115.2
2125	$42.1	$77.4	$149.4

B. EPA's Framework for Evaluating Damages and Impacts (FrEDI) Model

In addition to the Social Cost of Greenhouse Gases methodology described above, Commenters used EPA's Framework for Evaluating Damages and Impacts (FrEDI) model to help understand the U.S. specific impacts of the GHG emissions from the U.S. power sector. Commenters used an updated version of FrEDI which is identical to FrEDI 5.0.0 except for an updated Wildfire Sector.

FrEDI models how climate change will impact 25 sectoral categories including temperature-related mortality, hurricane wind damage, water quality, and agriculture, synthesizing information from over 30 peer-reviewed climate impact studies into a common analytical

framework.[10] While the outputs discussed here are aggregated at a national level, FrEDI calculates impacts at a state or regional level for all sectoral categories. Those outputs include monetized damages as well as physical impacts such as number of premature deaths. Based on the outputs from FaIR and BRICK discussed above, Commenters input scenario specific temperature and sea level rise projections. GDP and population follow SSP2 from 2010, with BEA GDP and Census population for 1977–2009.

The newly updated Wildfire Smoke sector uses a Wu–Pope–Turner pooled concentration-response function.[11] All three pooled studies are among those EPA recommends for a "Main" fine-particulate benefits assessment,[12] and they are combined by inverse-variance weighting following the pooling procedure in Appendix K of the BenMAP User Manual, after DerSimonian and Laird (1986).[13] The pooled function covers ages 65–99; the three studies enter with weights 0.29 (Pope et al.), 0.34 (Turner et al.) and 0.37 (Wu et al.).

We ran all 841 FaIR and BRICK ensembles out to 2300 through FrEDI. To understand the impact of the U.S. power sector emissions modeled in each scenario, we subtracted the results of each of our emission scenarios from the modeled baseline to isolate those damages. The median values are presented as the results for each Scenario in the tables below. The monetized harms only include harms starting in 2026. For the scenarios that start in 1977, the health incidences start in 1977.

FrEDI models the harms experienced each year as a result of the rising temperature and sea level from increased GHG emissions. Those values below represent the harms that have occurred by that year in each scenario. As a result, the above social cost of greenhouse gases values should not be compared year against year. The more accurate way to compare the values would be comparing the 2300 value from FrEDI against the 2100 or 2125 value from the above global social cost of greenhouse gases calculations.

As shown in Table 14, under a 2% discount rate, damages through 2100 of EPA's scenario (Scenario A) are $955 billion, rising to over $2.2 trillion by 2300. Emissions from Scenario B, which mimics EPA's scenario in the near term but accounts for emissions beginning in 1977 and

[10] FrEDI only models damages directly related to greenhouse gas emissions, not co-emitted air pollutants.

[11] The three concentration-response functions pooled in the Wildfire Smoke mortality relationship are: C. Arden Pope, III et al., *Mortality Risk and Fine Particulate Air Pollution in a Large, Representative Cohort of U.S. Adults*, 127 Env't Health Persps. 077007 (2019); Michelle C. Turner, et al., *Long-Term Ozone Exposure and Mortality in a Large Prospective Study*, 193 Am. J. Respiratory & Critical Care Med. 1134–1142 (2016); Xiao Wu et al., *Evaluating the Impact of Long-Term Exposure to Fine Particulate Matter on Mortality Among the Elderly*, 6 Sci. Advances eaba5692 (2020).

[12] *See* EPA, Off. of Air & Radiation, *Technical Support Document: Estimating $PM_{2.5}$- and Ozone-Attributable Health Benefits — 2024 Update* §2.4.2.1, p. 60 tbl. 10 (June 2024).

[13] Rebecca DerSimonian & Nan Laird, *Meta-Analysis in Clinical Trials*, 7 Controlled Clinical Trials 177–88 (1986).

assumes that emissions continue to grow after 2050, create damages valued at more than $3 trillion in 2100 and over $6.5 trillion in 2300.

FrEDI also reports non-monetized health incidences; selected values and metrics are shown in Table 15 below. Under Scenario A, emissions from U.S. power plants cause over 101,000 premature deaths, 105,000 additional cases of childhood asthma, 22,400 emergency room and hospital visits and 1.8 million missed school days. Under Scenario B, these emissions harms by 2100 are far greater: over 314,000 premature deaths, 364,000 cases of childhood asthma, 72,000 emergency room and hospital visits and 6.7 million missed school days. Furthermore, the harms of these emissions continue far beyond 2100. Under Scenario B, by 2300, emissions from U.S. power plants cause over 2.5 million premature deaths, 3.7 million cases of childhood asthma, 675,000 emergency room and hospital visits, and 53.3 million missed school days.

Table 14. FrEDI cumulative monetized harms (NPV to 2026 in 2024$ billion), various discount rates

Scenario A				
	1.5%	**2.0%**	**2.5%**	**3.0%**
2050	$123	$114	$105	$97
2100	$1,215	$955	$757	$605
2150	$2,439	$1,715	$1,233	$905
2200	$3,127	$2,050	$1,397	$987
2250	$3,482	$2,186	$1,449	$1,007
2300	$3,659	$2,239	$1,465	$1,012

Scenario A-50%			
1.5%	**2.0%**	**2.5%**	**3.0%**
$61	$57	$53	$49
$607	$477	$378	$302
$1,217	$856	$615	$452
$1,561	$1,023	$697	$492
$1,738	$1,091	$723	$503
$1,827	$1,117	$731	$505

	Scenario B			
	1.5%	**2.0%**	**2.5%**	**3.0%**
2050	$838	$785	$737	$693
2100	$3,760	$3,067	$2,530	$2,111
2150	$6,850	$4,976	$3,718	$2,855
2200	$8,832	$5,940	$4,190	$3,088
2250	$9,911	$6,351	$4,349	$3,150
2300	$10,419	$6,503	$4,395	$3,164

Scenario B-50%			
1.5%	**2.0%**	**2.5%**	**3.0%**
$421	$394	$370	$348
$1,876	$1,531	$1,263	$1,054
$3,419	$2,484	$1,856	$1,426
$4,439	$2,979	$2,099	$1,545
$5,003	$3,195	$2,182	$1,577
$5,265	$3,273	$2,205	$1,585

	Scenario C			
	1.5%	**2.0%**	**2.5%**	**3.0%**
2050	$1,155	$1,080	$1,012	$950
2100	$6,528	$5,252	$4,271	$3,511
2150	$13,419	$9,501	$6,909	$5,161
2200	$17,813	$11,639	$7,959	$5,680
2250	$20,135	$12,525	$8,300	$5,813
2300	$21,250	$12,858	$8,401	$5,843

Table 15: Select Itemized Harms from FrEDI

Scenario A

	Premature Mortality (thousands)	Childhood Asthma Cases (thousands)	ED and Hospital Visits (thousands)	Lost School Days (million)
2050	7.5	7.2	1.5	0.3
2100	101.7	105.7	22.4	1.8
2150	281.5	333.8	67.1	5.4
2200	479.5	607.9	118.7	10.0
2250	686.1	894.1	172.4	14.7
2300	898.2	1,182.9	226.6	19.1

Scen A-50%

	Premature Mortality (thousands)	Childhood Asthma Cases (thousands)	ED and Hospital Visits (thousands)	Lost School Days (million)
2050	3.7	3.6	0.7	0.1
2100	50.9	53.2	11.2	0.9
2150	140.7	168.1	33.6	2.7
2200	239.7	305.2	59.5	5.1
2250	342.9	448.3	86.4	7.4
2300	448.9	592.6	113.5	9.6

Scenario B

	Premature Mortality (thousands)	Childhood Asthma Cases (thousands)	ED and Hospital Visits (thousands)	Lost School Days (million)
2000	4.2	4.5	0.9	0.2
2025	26.7	26.6	5.5	1.1
2050	74.9	72.2	14.9	2.4
2100	314.4	364.3	72.6	6.7
2150	760.1	996.1	191.6	17.6
2200	1,312.6	1,811.8	341.0	29.8
2250	1,940.2	2,830.2	515.1	41.7
2300	2,537.0	3,716.9	675.7	53.3

Scenario B-50%

	Premature Mortality (thousands)	Childhood Asthma Cases (thousands)	ED and Hospital Visits (thousands)	Lost School Days (million)
2000	2.1	2.3	0.5	0.1
2025	13.3	13.3	2.8	0.6
2050	37.6	36.2	7.4	1.2
2100	157.1	183.1	36.4	3.4
2150	379.6	498.6	95.8	8.8
2200	664.9	933.7	174.0	14.9
2250	994.4	1,488.9	267.4	20.9
2300	1,302.9	1,965.4	351.8	26.7

Scenario C

	Premature Mortality (thousands)	Childhood Asthma Cases (thousands)	ED and Hospital Visits (thousands)	Lost School Days (million)
2000	4.4	4.8	1.0	0.2
2025	30.3	30.1	6.2	1.2
2050	97.1	93.2	19.1	3.1
2100	548.1	640.2	127.1	11.1
2150	1,564.2	2,066.7	395.9	35.1
2200	2,801.3	3,841.1	725.6	62.9
2250	4,123.8	5,798.1	1,077.2	90.0
2300	5,441.6	7,685.1	1,425.3	116.7

ATTACHMENT 1

U.S. Energy Information Administration
October 2026 Monthly Energy Review

Note: Information about data precision.

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Table 11.6 Carbon Dioxide Emissions From Energy Consumption: Electric Power Sector

Month	Coal Electric Power Sector CO2 Emissions (Million Metric Tons of Carbon Dioxide)	Natural Gas Electric Power Sector CO2 Emissions (Million Metric Tons of Carbon Dioxide)	Distillate Fuel, Including Kerosene-Type Jet Fuel, Oil Electric Power Sector CO2 Emissions (Million Metric Tons of Carbon Dioxide)	Petroleum Coke Electric Power Sector CO2 Emissions (Million Metric Tons of Carbon Dioxide)	Residual Fuel Oil Electric Power Sector CO2 Emissions (Million Metric Tons of Carbon Dioxide)	Petroleum Electric Power Sector CO2 Emissions (Million Metric Tons of Carbon Dioxide)	Geothermal Energy Electric Power Sector CO2 Emissions (Million Metric Tons of Carbon Dioxide)	Non-Biomass Waste Electric Power Sector CO2 Emissions (Million Metric Tons of Carbon Dioxide)	Total Energy Electric Power Sector CO2 Emissions (Million Metric Tons of Carbon Dioxide)
1973 January	73.118	12.167	2.397	0.128	23.698	26.223	Not Available	Not Available	111.508
1973 February	65.374	11.7	2.08	0.106	19.886	22.071	Not Available	Not Available	99.146
1973 March	65.011	13.984	1.181	0.083	18.851	20.115	Not Available	Not Available	99.11
1973 April	61.722	14.617	1.031	0.13	15.783	16.944	Not Available	Not Available	93.283
1973 May	62.691	17.332	0.957	0.167	16.92	18.044	Not Available	Not Available	98.067
1973 June	67.5	20.251	1.803	0.171	19.916	21.89	Not Available	Not Available	109.642
1973 July	73.677	23.051	1.982	0.15	22.041	24.173	Not Available	Not Available	120.9
1973 August	76.268	22.835	2.559	0.166	23.307	26.032	Not Available	Not Available	125.134
1973 September	69.386	19.284	1.446	0.116	21.166	22.728	Not Available	Not Available	111.398
1973 October	68.646	17.885	1.487	0.102	21.11	22.699	Not Available	Not Available	109.23
1973 November	67.99	13.756	1.552	0.087	20.216	21.855	Not Available	Not Available	103.601
1973 December	72.147	11.858	1.623	0.152	19.389	21.165	Not Available	Not Available	105.169
1974 January	71.57	11.951	1.852	0.183	20.016	22.051	Not Available	Not Available	105.572
1974 February	63.839	11.014	1.854	0.148	17.146	19.148	Not Available	Not Available	94.001
1974 March	65.452	13.85	1.886	0.156	16.634	18.676	Not Available	Not Available	97.978
1974 April	61.419	14.095	1.686	0.11	15.12	16.915	Not Available	Not Available	92.429
1974 May	65.623	16.665	1.946	0.093	17.128	19.168	Not Available	Not Available	101.455
1974 June	65.672	18.846	1.696	0.08	17.596	19.372	Not Available	Not Available	103.89
1974 July	74.763	21.969	2.569	0.096	20.852	23.516	Not Available	Not Available	120.248
1974 August	73.609	20.733	2.047	0.098	20.865	23.01	Not Available	Not Available	117.352
1974 September	64.135	17.015	1.639	0.093	19.245	20.977	Not Available	Not Available	102.127
1974 October	66.364	16.224	1.666	0.296	19.536	21.499	Not Available	Not Available	104.087
1974 November	66.541	12.99	1.946	0.303	20.786	23.035	Not Available	Not Available	102.565
1974 December	72.714	11.236	1.959	0.266	23.175	25.4	Not Available	Not Available	109.349
1975 January	73.759	11.157	2.266	0.034	23.023	25.323	Not Available	Not Available	110.239
1975 February	66.058	10.277	1.594	0.025	18.799	20.418	Not Available	Not Available	96.753
1975 March	67.494	11.488	1.279	0.013	17.671	18.963	Not Available	Not Available	97.945
1975 April	62.871	11.655	0.995	0.013	16.389	17.397	Not Available	Not Available	91.924
1975 May	62.928	14.965	1.399	0.009	15.921	17.329	Not Available	Not Available	95.222
1975 June	68.857	16.749	1.764	0.019	17.387	19.17	Not Available	Not Available	104.776
1975 July	75.256	19.697	1.664	0.022	19.133	20.819	Not Available	Not Available	115.772
1975 August	78.142	19.594	2.022	0.014	21.055	23.091	Not Available	Not Available	120.828
1975 September	67.112	17.183	0.811	0.017	16.594	17.422	Not Available	Not Available	101.718
1975 October	67.615	14.978	0.805	0.016	17.067	17.888	Not Available	Not Available	100.481
1975 November	68.602	12.389	0.761	0.017	16.882	17.66	Not Available	Not Available	98.652
1975 December	76.954	11.639	1.312	0.018	20.659	21.99	Not Available	Not Available	110.583
1976 January	82.439	11.202	2.112	0.017	24.152	26.281	Not Available	Not Available	119.921
1976 February	72.085	10.818	1.143	0.017	19.1	20.259	Not Available	Not Available	103.162
1976 March	74.422	12.083	1.194	0.018	19.431	20.643	Not Available	Not Available	107.148
1976 April	69.696	12.357	1.057	0.013	17.791	18.861	Not Available	Not Available	100.915
1976 May	69.983	14.462	0.951	0.014	16.832	17.797	Not Available	Not Available	102.242
1976 June	75.005	16.997	1.51	0.015	18.93	20.455	Not Available	Not Available	112.458
1976 July	82.138	18.313	1.698	0.018	20.424	22.14	Not Available	Not Available	122.592
1976 August	83.147	17.884	1.444	0.016	21.578	23.037	Not Available	Not Available	124.069
1976 September	74.004	16.004	1.055	0.015	18.084	19.154	Not Available	Not Available	109.163
1976 October	75.827	13.557	1.323	0.023	18.469	19.815	Not Available	Not Available	109.199
1976 November	80.065	11.785	2.09	0.023	22.393	24.506	Not Available	Not Available	116.356
1976 December	85.712	11.642	2.334	0.02	25.517	27.871	Not Available	Not Available	125.226
1977 January	88.476	11.188	4.078	0.014	31.338	35.43	Not Available	Not Available	135.095
1977 February	77.041	10.934	1.348	0.016	22.5	23.864	Not Available	Not Available	111.839
1977 March	76.178	12.648	1.057	0.028	21.798	22.883	Not Available	Not Available	111.709
1977 April	69.633	12.171	0.949	0.036	19.931	20.916	Not Available	Not Available	102.72
1977 May	76	14.174	1.638	0.024	21.141	22.803	Not Available	Not Available	112.976
1977 June	82.112	16.949	1.843	0.029	21.835	23.707	Not Available	Not Available	122.768
1977 July	91.978	18.912	3.303	0.036	25.808	29.147	Not Available	Not Available	140.037
1977 August	90.333	19.134	1.981	0.034	24.526	26.541	Not Available	Not Available	136.009
1977 September	82.146	17.707	1.07	0.025	20.441	21.536	Not Available	Not Available	121.388
1977 October	78.488	15.537	0.806	0.018	17.974	18.798	Not Available	Not Available	112.823
1977 November	79.186	12.767	1.056	0.02	19.193	20.269	Not Available	Not Available	112.222
1977 December	84.483	11.983	1.735	0.02	24.918	26.674	Not Available	Not Available	123.14
1978 January	86.422	12.565	3.536	0.03	28.927	32.494	Not Available	Not Available	131.481
1978 February	72.509	11.577	3.299	0.169	28.155	31.623	Not Available	Not Available	115.709
1978 March	68.809	12.73	2.344	0.198	27.724	30.266	Not Available	Not Available	111.805
1978 April	70.05	12.236	0.92	0.12	19.299	20.339	Not Available	Not Available	102.625
1978 May	75.274	14.298	0.982	0.085	19	20.067	Not Available	Not Available	109.639
1978 June	82.548	17.621	1.528	0.095	20.173	21.796	Not Available	Not Available	121.965
1978 July	89.275	19.857	1.531	0.098	22.447	24.076	Not Available	Not Available	133.208
1978 August	93.164	18.656	1.529	0.094	24.85	26.474	Not Available	Not Available	138.293
1978 September	86.296	16.281	1.41	0.087	20.355	21.852	Not Available	Not Available	124.429
1978 October	80.644	14.412	0.784	0.075	19.948	20.807	Not Available	Not Available	115.863
1978 November	80.438	12.501	0.927	0.082	21.017	22.025	Not Available	Not Available	114.964
1978 December	88.367	12.061	1.557	0.091	25.858	27.507	Not Available	Not Available	127.934
1979 January	95.304	12.538	2.675	0.103	29.378	32.155	Not Available	Not Available	139.997
1979 February	85.124	12.451	2.125	0.099	24.387	26.61	Not Available	Not Available	124.185
1979 March	84.9	14.287	0.798	0.067	17.171	18.036	Not Available	Not Available	117.222
1979 April	79.206	14.321	0.723	0.046	15.957	16.726	Not Available	Not Available	110.253
1979 May	84.393	15.218	0.882	0.072	16.658	17.613	Not Available	Not Available	117.223
1979 June	89.424	17.571	0.992	0.077	18.534	19.603	Not Available	Not Available	126.598
1979 July	97.976	20.267	1.027	0.072	19.779	20.879	Not Available	Not Available	139.121
1979 August	98.652	20.599	1.03	0.072	20.055	21.156	Not Available	Not Available	140.406
1979 September	85.684	18.565	0.743	0.053	17.359	18.155	Not Available	Not Available	122.404
1979 October	87.315	17.729	0.483	0.049	15.79	16.322	Not Available	Not Available	121.367
1979 November	87.335	14.322	0.839	0.056	17.856	18.751	Not Available	Not Available	120.408
1979 December	95.656	13.678	0.819	0.06	19.64	20.519	Not Available	Not Available	129.853
1980 January	102.022	15.062	1.375	0.168	18.738	20.28	Not Available	Not Available	137.365
1980 February	96.233	14.358	1.188	0.066	18.593	19.846	Not Available	Not Available	130.438
1980 March	94.557	15.45	0.945	0.04	15.386	16.371	Not Available	Not Available	126.379
1980 April	82.42	13.961	0.586	0.022	12.359	12.967	Not Available	Not Available	109.347
1980 May	83.982	15.33	0.654	0.034	12.42	13.108	Not Available	Not Available	112.42
1980 June	92.807	18.324	0.839	0.034	13.568	14.441	Not Available	Not Available	125.572
1980 July	108.675	22.87	1.639	0.033	17.119	18.791	Not Available	Not Available	150.336
1980 August	107.781	22.052	1.721	0.047	18.335	20.103	Not Available	Not Available	149.936
1980 September	97.045	19.44	0.924	0.035	13.457	14.417	Not Available	Not Available	130.902
1980 October	91.331	16.389	0.612	0.025	12.053	12.69	Not Available	Not Available	120.41
1980 November	92.558	13.903	0.983	0.021	15.009	16.014	Not Available	Not Available	122.475
1980 December	103.615	13.17	0.994	0.027	17.637	18.658	Not Available	Not Available	135.443
1981 January	109.675	12.59	1.306	0.032	19.302	20.64	Not Available	Not Available	142.905

1981 February	96.089	12.174	0.964	0.026	13.103	14.093	Not Available	Not Available	122.356
1981 March	97.061	14.859	0.604	0.028	13.154	13.786	Not Available	Not Available	125.706
1981 April	87.593	15.699	0.584	0.022	11.439	12.044	Not Available	Not Available	115.336
1981 May	90.245	17.184	0.771	0.044	10.92	11.735	Not Available	Not Available	119.164
1981 June	100.433	20.685	1.163	0.041	14.021	15.226	Not Available	Not Available	136.344
1981 July	112.595	22.309	1.125	0.034	14.932	16.091	Not Available	Not Available	150.995
1981 August	109.263	21.162	0.612	0.041	12.162	12.815	Not Available	Not Available	143.24
1981 September	97.23	17.639	0.492	0.04	11.868	12.4	Not Available	Not Available	127.269
1981 October	95.862	16.388	0.484	0.046	12.312	12.842	Not Available	Not Available	125.092
1981 November	94.285	14.06	0.49	0.036	10.406	10.933	Not Available	Not Available	119.277
1981 December	106.523	13.01	0.567	0.037	12.083	12.686	Not Available	Not Available	132.219
1982 January	114.551	12.943	1.345	0.031	15.234	16.61	Not Available	Not Available	144.104
1982 February	98.529	11.98	0.611	0.029	11.497	12.136	Not Available	Not Available	122.645
1982 March	96.526	13.422	0.561	0.013	10.206	10.78	Not Available	Not Available	120.728
1982 April	87.669	13.41	0.487	0.033	8.457	8.977	Not Available	Not Available	110.056
1982 May	91.966	14.036	0.427	0.037	7.525	7.989	Not Available	Not Available	113.991
1982 June	95.599	16.087	0.453	0.041	7.808	8.302	Not Available	Not Available	119.987
1982 July	111.37	19.208	0.585	0.034	10.174	10.793	Not Available	Not Available	141.371
1982 August	110.544	19.674	0.452	0.039	8.91	9.401	Not Available	Not Available	139.62
1982 September	97.595	15.964	0.396	0.029	7.81	8.236	Not Available	Not Available	121.795
1982 October	93.393	14.856	0.372	0.051	7.549	7.973	Not Available	Not Available	116.222
1982 November	96.355	12.326	0.434	0.056	7.038	7.528	Not Available	Not Available	116.209
1982 December	102.634	11.686	0.471	0.067	8.47	9.008	Not Available	Not Available	123.327
1983 January	107.238	11.292	0.478	0.051	9.786	10.315	Not Available	Not Available	128.845
1983 February	92.004	9.597	0.424	0.057	9.586	10.067	Not Available	Not Available	111.668
1983 March	94.692	11.276	0.407	0.051	9.525	9.982	Not Available	Not Available	115.95
1983 April	87.614	11.004	0.454	0.074	7.73	8.259	Not Available	Not Available	106.878
1983 May	91.84	11.825	0.404	0.091	6.78	7.275	Not Available	Not Available	110.94
1983 June	101.181	13.414	0.439	0.07	8.447	8.956	Not Available	Not Available	123.551
1983 July	121.386	17.014	0.617	0.077	11.039	11.733	Not Available	Not Available	150.133
1983 August	128.173	19.036	0.665	0.073	11.152	11.89	Not Available	Not Available	159.1
1983 September	108.968	16.133	0.649	0.076	8.508	9.234	Not Available	Not Available	134.335
1983 October	101.887	13.582	0.375	0.067	7.551	7.992	Not Available	Not Available	123.46
1983 November	102.884	11.57	0.463	0.052	6.936	7.451	Not Available	Not Available	121.905
1983 December	118.828	11.793	1.738	0.064	11.067	12.868	Not Available	Not Available	143.489
1984 January	120.87	11.729	0.937	0.073	11.682	12.692	Not Available	Not Available	145.292
1984 February	104.88	10.22	0.438	0.064	7.597	8.099	Not Available	Not Available	123.199
1984 March	109.448	11.247	0.438	0.056	8.155	8.649	Not Available	Not Available	129.345
1984 April	95.462	12.007	0.358	0.068	5.652	6.078	Not Available	Not Available	113.547
1984 May	99.36	14.432	0.435	0.071	6.292	6.798	Not Available	Not Available	120.59
1984 June	114.34	16.22	0.83	0.071	8.197	9.098	Not Available	Not Available	139.657
1984 July	121.139	19.012	0.542	0.068	7.768	8.378	Not Available	Not Available	148.529
1984 August	127.234	19.05	0.656	0.061	9.601	10.318	Not Available	Not Available	156.602
1984 September	108.467	15.814	0.429	0.066	5.776	6.271	Not Available	Not Available	130.552
1984 October	109.888	14.683	0.416	0.06	5.878	6.353	Not Available	Not Available	130.924
1984 November	108.838	13.308	0.571	0.054	6.866	7.491	Not Available	Not Available	129.636
1984 December	113.514	11.822	0.494	0.062	5.901	6.456	Not Available	Not Available	131.793
1985 January	126.874	12.372	1.069	0.055	8.769	9.894	Not Available	Not Available	149.14
1985 February	110.62	11.098	0.574	0.051	6.954	7.579	Not Available	Not Available	129.297
1985 March	109.21	11.352	0.422	0.051	5.346	5.818	Not Available	Not Available	126.38
1985 April	101.473	12.764	0.392	0.049	4.514	4.955	Not Available	Not Available	119.192
1985 May	108.835	12.864	0.414	0.041	5.215	5.67	Not Available	Not Available	127.369
1985 June	114.893	15.359	0.479	0.066	5.668	6.212	Not Available	Not Available	136.464
1985 July	128.085	18.304	0.478	0.06	6.25	6.788	Not Available	Not Available	153.177
1985 August	125.741	19.289	0.576	0.058	7.426	8.061	Not Available	Not Available	153.091
1985 September	113.19	14.984	0.422	0.074	5.662	6.158	Not Available	Not Available	134.331
1985 October	109.58	13.579	0.418	0.072	5.693	6.183	Not Available	Not Available	129.341
1985 November	108.268	12.561	0.44	0.072	5.158	5.67	Not Available	Not Available	126.499
1985 December	126.39	11.497	0.62	0.062	8.307	8.989	Not Available	Not Available	146.876
1986 January	128.411	10.03	0.727	0.047	8.146	8.92	Not Available	Not Available	147.362
1986 February	110.396	8.559	0.474	0.046	7.071	7.59	Not Available	Not Available	126.545
1986 March	108.086	9.241	0.4	0.071	7.596	8.067	Not Available	Not Available	125.394
1986 April	96.486	10.794	0.385	0.071	6.864	7.32	Not Available	Not Available	114.6
1986 May	103.116	12.572	0.521	0.077	7.736	8.334	Not Available	Not Available	124.022
1986 June	118.1	14.143	0.599	0.075	8.58	9.254	Not Available	Not Available	141.496
1986 July	136.408	16.354	0.744	0.081	12.199	13.024	Not Available	Not Available	165.786
1986 August	123.749	15.006	0.495	0.097	11.629	12.221	Not Available	Not Available	150.977
1986 September	113.375	13.397	0.477	0.096	8.074	8.647	Not Available	Not Available	135.419
1986 October	108.523	11.767	0.374	0.08	7.419	7.873	Not Available	Not Available	128.163
1986 November	108.606	10.142	0.463	0.105	7.863	8.432	Not Available	Not Available	127.179
1986 December	118.534	9.513	0.512	0.116	8.873	9.501	Not Available	Not Available	137.548
1987 January	125.472	10.054	0.567	0.086	9.002	9.656	Not Available	Not Available	145.182
1987 February	107.985	8.622	0.495	0.088	7.794	8.377	Not Available	Not Available	124.984
1987 March	109.858	10.389	0.528	0.085	7.431	8.045	Not Available	Not Available	128.293
1987 April	103.4	11.23	0.445	0.071	5.805	6.321	Not Available	Not Available	120.951
1987 May	113.551	13.191	0.51	0.095	5.864	6.468	Not Available	Not Available	133.21
1987 June	127.654	15.409	0.606	0.08	7.735	8.421	Not Available	Not Available	151.484
1987 July	142.202	17.33	0.894	0.087	9.061	10.042	Not Available	Not Available	169.574
1987 August	140.872	18.388	0.71	0.096	8.248	9.053	Not Available	Not Available	168.313
1987 September	119.13	14.562	0.398	0.095	5.672	6.166	Not Available	Not Available	139.858
1987 October	114.824	12.942	0.384	0.109	4.975	5.468	Not Available	Not Available	133.233
1987 November	112.499	11.782	0.563	0.084	7.079	7.727	Not Available	Not Available	132.008
1987 December	125.746	10.657	0.52	0.094	8.205	8.819	Not Available	Not Available	145.222
1988 January	134.876	9.082	0.99	0.074	11.709	12.774	Not Available	Not Available	156.732
1988 February	122.057	9.196	0.49	0.083	8.678	9.25	Not Available	Not Available	140.504
1988 March	116.803	11.058	0.45	0.11	7.088	7.648	Not Available	Not Available	135.509
1988 April	107.614	10.804	0.347	0.101	5.492	5.94	Not Available	Not Available	124.357
1988 May	112.373	12.997	0.43	0.101	5.204	5.735	Not Available	Not Available	131.105
1988 June	129.892	15.187	0.8	0.129	6.979	7.908	Not Available	Not Available	152.987
1988 July	142.628	17.764	0.837	0.143	10.216	11.196	Not Available	Not Available	171.588
1988 August	149.592	18.642	1.382	0.125	11.377	12.883	Not Available	Not Available	181.118
1988 September	122.334	12.604	0.433	0.095	7.362	7.89	Not Available	Not Available	142.828
1988 October	118.4	9.831	0.474	0.092	9.81	10.377	Not Available	Not Available	138.608
1988 November	117.89	8.144	0.518	0.095	10.952	11.564	Not Available	Not Available	137.598
1988 December	133.084	7.443	0.936	0.111	13.4	14.446	Not Available	Not Available	154.973
1989 January	133.628	8.884	0.908	0.145	11.16	12.214	0.031	0.371	155.127
1989 February	125.657	10.413	1.073	0.1	12.891	14.064	0.028	0.335	150.496
1989 March	124.098	12.749	1.189	0.107	11.975	13.271	0.031	0.371	150.52
1989 April	112.367	14.177	0.462	0.116	8.645	9.223	0.03	0.359	136.155
1989 May	117.138	15.117	0.673	0.109	7.36	8.142	0.031	0.371	140.799
1989 June	127.361	15.685	0.915	0.117	9.173	10.205	0.03	0.359	153.639
1989 July	139.54	19.277	0.964	0.179	8.882	10.024	0.031	0.371	169.242
1989 August	141.087	18.666	0.677	0.177	8.163	9.016	0.031	0.371	169.171
1989 September	125.909	16.142	0.675	0.165	7.452	8.292	0.03	0.359	150.732
1989 October	121.209	15.317	0.522	0.121	6.102	6.745	0.031	0.371	143.672
1989 November	122.099	11.402	0.656	0.101	8.463	9.22	0.03	0.359	143.109
1989 December	144.775	10.342	2.556	0.152	15.014	17.722	0.031	0.371	173.241
1990 January	132.843	9.176	0.596	0.153	8.811	9.56	0.033	0.492	152.103
1990 February	116.19	8.289	0.469	0.236	7.114	7.819	0.029	0.445	132.772
1990 March	121.733	11.582	0.441	0.236	7.74	8.417	0.033	0.492	142.256
1990 April	115.84	12.522	0.498	0.231	7.651	8.38	0.032	0.476	137.249
1990 May	118.485	15.341	0.552	0.29	7.026	7.868	0.033	0.492	142.218
1990 June	130.641	18.685	0.749	0.251	9.932	10.932	0.032	0.476	160.766

1990 July	143.06	20.493	0.777	0.281	9.654	10.712	0.033	0.492	174.789
1990 August	146.169	21.575	0.779	0.273	8.052	9.104	0.033	0.492	177.373
1990 September	133.961	18.923	0.634	0.297	5.798	6.73	0.032	0.476	160.122
1990 October	128.723	16.154	0.571	0.326	5.189	6.086	0.033	0.492	151.487
1990 November	122.046	11.623	0.438	0.231	4.563	5.232	0.032	0.476	139.409
1990 December	136.945	11.009	0.632	0.296	5.77	6.698	0.033	0.492	155.178
1991 January	143.072	11.119	0.535	0.306	6.792	7.633	0.034	0.612	162.47
1991 February	117.442	9.393	0.362	0.236	6.473	7.072	0.031	0.553	134.489
1991 March	118.759	12.377	0.373	0.302	6.434	7.109	0.034	0.612	138.891
1991 April	111.087	13.834	0.459	0.3	5.782	6.54	0.033	0.592	132.086
1991 May	122.679	15.992	0.818	0.273	7.767	8.858	0.034	0.612	148.175
1991 June	131.874	16.685	0.506	0.208	8.249	8.963	0.033	0.592	158.147
1991 July	143.965	21.144	0.549	0.255	8.233	9.036	0.034	0.612	174.792
1991 August	144.03	20.999	0.622	0.233	8.591	9.445	0.034	0.612	175.12
1991 September	129.029	16.855	0.525	0.214	6.289	7.029	0.033	0.592	153.539
1991 October	123.992	16.884	0.407	0.207	4.662	5.276	0.034	0.612	146.797
1991 November	127.86	12.701	0.516	0.217	5.723	6.457	0.033	0.592	147.643
1991 December	133.561	10.909	0.515	0.243	6.503	7.261	0.034	0.612	152.378
1992 January	137.298	11.385	0.519	0.327	7.627	8.473	0.034	0.718	157.907
1992 February	121.044	11.465	0.379	0.351	6.141	6.871	0.032	0.672	140.083
1992 March	126.116	13.974	0.397	0.383	6.508	7.288	0.034	0.718	148.13
1992 April	118.251	15.413	0.382	0.302	4.789	5.473	0.033	0.695	139.864
1992 May	121.864	15.894	0.397	0.23	3.815	4.442	0.034	0.718	142.952
1992 June	128.967	17.883	0.507	0.302	5.485	6.294	0.033	0.695	153.872
1992 July	148.463	22.439	0.672	0.333	6.241	7.246	0.034	0.718	178.9
1992 August	142.071	20.34	0.476	0.531	5.116	6.124	0.034	0.718	169.286
1992 September	132.677	18.396	0.399	0.449	5.044	5.892	0.033	0.695	157.694
1992 October	126.32	14.29	0.373	0.476	5.043	5.891	0.034	0.718	147.253
1992 November	125.93	12.728	0.472	0.426	4.983	5.881	0.033	0.695	145.266
1992 December	139.512	11.817	0.465	0.485	4.702	5.653	0.034	0.718	157.733
1993 January	139.206	11.498	0.492	0.608	5.21	6.31	0.035	0.73	157.779
1993 February	127.998	11.331	0.454	0.532	5.097	6.083	0.032	0.659	146.103
1993 March	134.538	13.558	0.62	0.569	6.165	7.354	0.035	0.73	156.216
1993 April	119.542	12.157	0.398	0.517	3.679	4.594	0.034	0.706	137.032
1993 May	120.415	11.666	0.422	0.565	3.724	4.71	0.035	0.73	137.556
1993 June	136.635	17.801	0.502	0.643	5.669	6.814	0.034	0.706	161.99
1993 July	157.895	23.355	0.883	0.823	8.147	9.853	0.035	0.73	191.868
1993 August	156.321	24.963	0.761	0.736	8.701	10.198	0.035	0.73	192.246
1993 September	133.375	18.055	0.501	0.846	7.103	8.45	0.034	0.706	160.62
1993 October	130.262	16.387	0.436	0.734	5.458	6.628	0.035	0.73	154.042
1993 November	131.739	14.561	0.43	0.666	5.468	6.564	0.034	0.706	153.605
1993 December	143.854	12.201	0.499	0.791	7.568	8.857	0.035	0.73	165.678
1994 January	153.041	12.005	2.014	0.91	10.052	12.975	0.033	0.792	178.846
1994 February	131.183	10.539	0.758	0.716	7.122	8.596	0.029	0.715	151.062
1994 March	132.472	13.134	0.551	0.76	5.828	7.138	0.033	0.792	153.569
1994 April	120.33	14.397	0.565	0.575	5.614	6.754	0.032	0.766	142.28
1994 May	126.431	15.239	0.632	0.476	5.013	6.122	0.033	0.792	148.617
1994 June	146.564	22.482	1.016	0.579	7.16	8.755	0.032	0.766	178.599
1994 July	153.296	25.573	0.831	0.622	6.814	8.267	0.033	0.792	187.96
1994 August	151.679	26.976	0.554	0.533	4.357	5.444	0.033	0.792	184.924
1994 September	133.167	20.882	0.472	0.505	3.56	4.537	0.032	0.766	159.384
1994 October	129.163	18.623	0.44	0.503	3.215	4.157	0.033	0.792	152.768
1994 November	124.011	16.319	0.468	0.479	3.117	4.064	0.032	0.766	145.191
1994 December	136.605	14.672	0.569	0.462	3.406	4.437	0.033	0.792	156.539
1995 January	143.032	14.188	0.542	0.686	2.923	4.152	0.028	0.85	162.251
1995 February	127.717	12.021	0.675	0.665	5.133	6.473	0.025	0.768	147.003
1995 March	127.29	17.507	0.465	0.56	2.099	3.124	0.028	0.85	148.799
1995 April	118.361	16.36	0.471	0.387	2.294	3.152	0.027	0.823	138.722
1995 May	125.46	18.398	0.582	0.64	3.005	4.227	0.028	0.85	148.962
1995 June	138.85	21.198	0.613	0.737	3.074	4.423	0.027	0.823	165.321
1995 July	159.566	29.035	0.964	0.615	5.157	6.736	0.028	0.85	196.216
1995 August	167.641	33.423	1.464	0.863	5.618	7.945	0.028	0.85	209.887
1995 September	137.412	22.566	0.463	0.709	3.419	4.59	0.027	0.823	165.419
1995 October	132.811	17.101	0.478	0.798	2.33	3.606	0.028	0.85	154.396
1995 November	134.531	14.126	0.539	0.898	2.362	3.799	0.027	0.823	153.305
1995 December	147.324	12.313	0.729	0.669	5.087	6.485	0.028	0.85	167.001
1996 January	153.835	12.634	0.941	0.734	5.586	7.261	0.03	0.841	174.601
1996 February	138.374	10.245	1.203	0.566	5.805	7.574	0.028	0.787	157.008
1996 March	138.29	11.708	0.763	0.462	4.299	5.524	0.03	0.841	156.393
1996 April	124.819	12.714	0.479	0.522	2.127	3.128	0.029	0.814	141.504
1996 May	134.944	19.835	0.648	0.583	2.573	3.804	0.03	0.841	159.455
1996 June	147.153	22.45	0.518	0.578	4.09	5.186	0.029	0.814	175.632
1996 July	160.855	26.808	0.633	0.852	5.603	7.088	0.03	0.841	195.622
1996 August	162.912	27.526	0.537	1.022	4.422	5.981	0.03	0.841	197.29
1996 September	144.02	21.35	0.571	0.848	3.339	4.759	0.029	0.814	170.972
1996 October	143.324	16.968	0.515	0.698	2.208	3.421	0.03	0.841	164.583
1996 November	147.241	12.734	0.533	0.609	2.964	4.106	0.029	0.814	164.925
1996 December	155.728	9.932	0.743	0.652	4.171	5.566	0.03	0.841	172.097
1997 January	162.15	10.256	0.921	0.414	5.827	7.162	0.032	0.877	180.478
1997 February	135.794	10.564	0.464	0.41	3.065	3.94	0.029	0.792	151.118
1997 March	138.414	13.984	0.459	0.256	2.952	3.668	0.032	0.877	156.975
1997 April	130.249	14.261	0.572	0.761	2.498	3.832	0.031	0.849	149.222
1997 May	136.446	17.055	0.521	0.998	2.988	4.507	0.032	0.877	158.916
1997 June	147.538	21.941	0.754	1.069	4.736	6.559	0.031	0.849	176.918
1997 July	169.01	31.656	1.405	1.065	6.1	8.57	0.032	0.877	210.144
1997 August	164.829	28.824	0.74	1.185	5.273	7.198	0.032	0.877	201.759
1997 September	152.264	24.544	0.568	1.195	5.369	7.132	0.031	0.849	184.819
1997 October	152.064	18.012	0.603	1.038	4.994	6.635	0.032	0.877	177.62
1997 November	146.339	13.245	0.568	1.002	4.707	6.277	0.031	0.849	166.741
1997 December	160.899	14.528	0.599	0.978	5.154	6.731	0.032	0.877	183.067
1998 January	159.496	13.021	0.483	1.112	4.526	6.121	0.032	0.863	179.532
1998 February	138.59	10.178	0.378	0.873	4.11	5.361	0.029	0.78	154.937
1998 March	144.047	14.775	0.553	0.893	6.38	7.826	0.032	0.863	167.543
1998 April	133.329	14.459	0.452	1.007	4.865	6.324	0.031	0.835	154.978
1998 May	146.151	22.072	0.931	1.043	6.71	8.684	0.032	0.863	177.802
1998 June	158.485	28.804	1.448	1.19	8.437	11.074	0.031	0.835	199.229
1998 July	174.878	34.157	1.568	1.254	9.668	12.49	0.032	0.863	222.42
1998 August	174.629	34.74	1.451	1.175	9.417	12.043	0.032	0.863	222.306
1998 September	156.604	28.961	1.215	1.109	7.342	9.666	0.031	0.835	196.097
1998 October	147.236	18.691	0.457	1.027	5.336	6.82	0.032	0.863	173.643
1998 November	139.304	13.485	0.464	1.008	5.336	6.808	0.031	0.835	160.462
1998 December	154.215	14.332	0.628	0.927	6.492	8.047	0.032	0.863	177.489
1999 January	161.275	14.834	1.129	0.931	8.023	10.084	0.032	0.872	187.098
1999 February	137.986	12.618	0.425	0.769	6.837	8.032	0.029	0.788	159.452
1999 March	145.069	17.162	0.521	0.981	7.147	8.648	0.032	0.872	171.783
1999 April	137.409	21.258	0.797	0.881	5.805	7.482	0.031	0.844	167.024
1999 May	144.791	22.664	0.607	0.989	6.113	7.708	0.032	0.872	176.068
1999 June	157.269	26.945	0.996	0.993	6.791	8.779	0.031	0.844	193.869
1999 July	179.297	36.322	2.306	1.205	9.126	12.637	0.032	0.872	229.16
1999 August	173.587	36.114	1.424	1.331	7.827	10.582	0.032	0.872	221.187
1999 September	154.768	23.346	0.6	0.824	5.167	6.591	0.031	0.844	185.579
1999 October	147.421	19.903	0.489	0.829	4.224	5.542	0.032	0.872	173.771
1999 November	141.997	14.208	0.555	0.772	2.646	3.973	0.031	0.844	161.054

1999 December	154.28	14.504	0.504	0.983	2.288	3.776	0.032	0.872	173.465
2000 January	172.795	17.571	1.014	1.439	4.161	6.614	0.031	0.859	197.87
2000 February	155.653	15.405	0.612	1.174	2.742	4.528	0.029	0.804	176.418
2000 March	152.252	19.158	0.523	0.777	2.593	3.893	0.031	0.859	176.193
2000 April	137.209	19.809	0.472	0.795	2.836	4.104	0.03	0.831	161.982
2000 May	151.137	28.502	1.101	0.724	5.227	7.052	0.031	0.859	187.582
2000 June	165.668	28.36	0.951	0.88	7.075	8.907	0.03	0.831	203.796
2000 July	172.708	34.422	1.122	0.519	6.577	8.219	0.031	0.859	216.24
2000 August	179.364	37.859	1.26	1.011	8.161	10.432	0.031	0.859	228.544
2000 September	158.528	26.159	0.851	0.775	7.279	8.906	0.03	0.831	194.454
2000 October	156.533	19.687	0.586	0.61	5.523	6.72	0.031	0.859	183.83
2000 November	154.918	16.636	0.741	0.659	4.586	5.986	0.03	0.831	178.401
2000 December	169.408	17.25	3.823	0.709	8.633	13.165	0.031	0.859	200.713
2001 January	171.314	18.447	3.457	0.912	10.161	14.529	0.03	0.925	205.245
2001 February	146.131	16.96	1.151	0.827	6.179	8.157	0.027	0.836	172.111
2001 March	151.011	19.662	1.267	0.813	7.111	9.191	0.03	0.925	180.819
2001 April	136.408	20.835	1.122	0.655	6.854	8.631	0.029	0.896	166.798
2001 May	148.728	23.499	0.933	0.748	6.457	8.138	0.03	0.925	181.32
2001 June	159.396	26.693	0.792	0.843	7.809	9.444	0.029	0.896	196.458
2001 July	176.831	34.334	0.756	0.993	6.889	8.639	0.03	0.925	220.76
2001 August	180.604	37.2	1.129	1.035	9.176	11.34	0.03	0.925	230.099
2001 September	153.144	27.62	0.527	0.95	4.308	5.785	0.029	0.896	187.474
2001 October	146.584	25.234	0.58	0.915	3.536	5.031	0.03	0.925	177.805
2001 November	142.313	18.975	0.456	0.806	3.359	4.621	0.029	0.896	166.833
2001 December	156.654	19.88	0.548	1.044	3.466	5.058	0.03	0.925	182.547
2002 January	159.27	20.588	0.799	1.356	3.244	5.399	0.032	1.083	186.372
2002 February	139.407	18.58	0.494	1.412	2.733	4.639	0.029	0.978	163.632
2002 March	146.515	21.932	0.794	1.496	4.377	6.667	0.032	1.083	176.227
2002 April	138.278	21.825	0.756	1.426	4.101	6.283	0.031	1.048	167.464
2002 May	147.876	22.122	0.876	1.61	4.094	6.58	0.032	1.083	177.692
2002 June	161.474	29.722	0.738	1.734	4.129	6.601	0.031	1.048	198.876
2002 July	179.255	39.565	1.135	1.536	5.4	8.071	0.032	1.083	228.005
2002 August	177.296	38.694	1.056	1.727	5.338	8.121	0.032	1.083	225.224
2002 September	162.594	30.667	0.712	1.572	4.264	6.548	0.031	1.048	200.888
2002 October	155.966	23.843	0.835	1.323	4.292	6.449	0.032	1.083	187.373
2002 November	153.236	18.961	0.583	1.268	3.157	5.009	0.031	1.048	178.284
2002 December	167.695	19.432	0.726	1.427	4.337	6.489	0.032	1.083	194.73
2003 January	175.448	20.734	1.952	1.179	6.639	9.77	0.031	0.972	206.955
2003 February	152.569	18.144	1.666	1.087	5.692	8.445	0.028	0.878	180.064
2003 March	150.858	19.579	1.244	0.909	5.811	7.964	0.031	0.972	179.405
2003 April	138.267	19.084	0.669	1.352	4.992	7.013	0.03	0.941	165.335
2003 May	147.432	21.324	1.075	1.28	4.024	6.379	0.031	0.972	176.137
2003 June	159.992	23.581	1.23	1.535	5.943	8.708	0.03	0.941	193.252
2003 July	178.584	34.117	1.026	1.768	6.942	9.736	0.031	0.972	223.44
2003 August	181.6	36.995	0.886	1.755	7.4	10.04	0.031	0.972	229.638
2003 September	161.877	25.365	0.522	1.704	4.808	7.034	0.03	0.941	195.247
2003 October	155.275	22.135	0.531	1.741	4.559	6.831	0.031	0.972	185.244
2003 November	155.939	18.845	0.483	1.754	3.126	5.363	0.03	0.941	181.118
2003 December	172.359	18.192	0.727	1.773	5.347	7.847	0.031	0.972	199.401
2004 January	175.227	19.642	1.809	1.999	7.912	11.72	0.032	0.946	207.567
2004 February	157.437	20.297	0.614	1.718	5.037	7.369	0.03	0.885	186.018
2004 March	149.315	20.383	0.55	1.733	5.346	7.629	0.032	0.946	178.305
2004 April	138.058	21.145	0.474	1.723	4.982	7.179	0.031	0.915	167.328
2004 May	153.716	26.324	0.714	1.82	5.721	8.255	0.032	0.946	189.273
2004 June	163.907	27.659	0.67	1.714	6.248	8.632	0.031	0.915	201.144
2004 July	178.415	34.073	0.609	1.806	7.198	9.613	0.032	0.946	223.079
2004 August	175.789	33.264	0.574	1.987	6.431	8.992	0.032	0.946	219.024
2004 September	163.068	28.737	0.672	1.691	4.615	6.978	0.031	0.915	199.73
2004 October	155.487	23.87	0.452	1.846	3.901	6.198	0.032	0.946	186.533
2004 November	156.487	20.425	0.398	1.649	3.431	5.477	0.031	0.915	183.336
2004 December	174.797	21.02	0.775	1.844	5.186	7.805	0.032	0.946	204.6
2005 January	175.444	20.933	1.268	2.006	6.167	9.441	0.032	0.955	206.806
2005 February	153.494	17.972	0.376	1.855	3.616	5.847	0.029	0.863	178.204
2005 March	159.793	20.993	0.44	1.947	4.241	6.627	0.032	0.955	188.401
2005 April	140.492	21.209	0.447	1.779	3.374	5.6	0.031	0.924	168.256
2005 May	151.584	22.985	0.48	2.009	3.05	5.538	0.032	0.955	181.095
2005 June	171.065	32.26	0.615	2.13	6.059	8.804	0.031	0.924	213.084
2005 July	184.013	42.204	0.939	2.092	7.425	10.456	0.032	0.955	237.66
2005 August	185.947	42.975	1.062	2.21	8.415	11.686	0.032	0.955	241.596
2005 September	169.154	31.346	0.812	1.92	7.146	9.878	0.031	0.924	211.334
2005 October	160.618	23.584	0.612	1.921	5.645	8.178	0.032	0.955	193.367
2005 November	155.837	20.274	0.445	1.735	3.392	5.573	0.031	0.924	182.639
2005 December	175.594	22.081	1.054	2	7.287	10.34	0.032	0.955	209.002
2006 January	166.102	17.304	0.452	2	2.564	5.016	0.032	0.979	189.433
2006 February	154.167	18.812	0.404	1.774	1.975	4.152	0.029	0.884	178.045
2006 March	156.937	22.114	0.321	1.681	1.332	3.333	0.032	0.979	183.395
2006 April	138.029	23.147	0.426	1.709	1.663	3.798	0.031	0.948	165.951
2006 May	153.162	27.414	0.428	1.591	1.618	3.637	0.032	0.979	185.224
2006 June	166.106	34.18	0.489	1.78	2.522	4.792	0.031	0.948	206.056
2006 July	184.736	46.908	0.619	1.966	3.287	5.872	0.032	0.979	238.528
2006 August	186.773	45.637	0.704	1.852	4.326	6.883	0.032	0.979	240.303
2006 September	160.413	29.763	0.347	1.67	1.882	3.899	0.031	0.948	195.054
2006 October	159.267	28.641	0.411	1.693	2.11	4.215	0.032	0.979	193.135
2006 November	156.544	21.541	0.411	1.485	2.027	3.923	0.031	0.948	182.987
2006 December	170.714	22.512	0.458	1.534	1.766	3.758	0.032	0.979	197.995
2007 January	174.221	24.337	0.604	1.633	2.659	4.897	0.032	0.959	204.445
2007 February	159.665	23.115	1.073	1.291	4.482	6.847	0.029	0.866	190.523
2007 March	155.441	22.584	0.53	1.307	2.438	4.275	0.032	0.959	183.291
2007 April	143.942	24.6	0.413	1.276	2.331	4.02	0.031	0.928	173.52
2007 May	154.181	27.535	0.429	1.385	2.089	3.904	0.032	0.959	186.611
2007 June	170.445	34.095	0.52	1.598	2.611	4.729	0.031	0.928	210.228
2007 July	183.459	41.272	0.505	1.42	2.613	4.538	0.032	0.959	230.26
2007 August	188.281	52.623	0.723	1.475	3.574	5.772	0.032	0.959	247.667
2007 September	167.068	37.069	0.41	1.374	2.277	4.061	0.031	0.928	209.157
2007 October	159.253	32.777	0.475	1.229	2.15	3.853	0.032	0.959	196.875
2007 November	156.561	24.319	0.398	1.162	1.021	2.581	0.031	0.928	184.421
2007 December	173.441	27.038	0.5	1.45	1.539	3.489	0.032	0.959	204.958
2008 January	177.791	28.881	0.685	1.418	1.54	3.644	0.032	0.984	211.332
2008 February	163.047	23.848	0.507	1.311	1.241	3.06	0.03	0.92	190.905
2008 March	156.628	25.027	0.397	1.093	1.097	2.586	0.032	0.984	185.257
2008 April	144.465	25.494	0.397	1.193	1.244	2.834	0.031	0.952	173.776
2008 May	152.563	25.796	0.398	1.125	1.33	2.853	0.032	0.984	182.228
2008 June	168.169	36.108	0.575	1.378	2.231	4.184	0.031	0.952	209.444
2008 July	184.516	42.437	0.423	1.238	1.836	3.498	0.032	0.984	231.466
2008 August	179.919	41.401	0.375	1.299	1.545	3.218	0.032	0.984	225.554
2008 September	160.694	32.699	0.372	1.228	1.856	3.456	0.031	0.952	197.832
2008 October	150.543	29.588	0.328	1.296	1.118	2.742	0.032	0.984	183.889
2008 November	152.239	24.843	0.359	1.182	1.249	2.789	0.031	0.952	180.854
2008 December	168.004	25.879	0.569	1.188	1.767	3.524	0.032	0.984	198.423
2009 January	168.941	26.449	0.8	1.196	2.821	4.816	0.033	0.955	201.193
2009 February	138.4	24.603	0.474	1.091	1.126	2.691	0.03	0.863	166.585
2009 March	134.101	27.097	0.526	1.356	0.955	2.837	0.033	0.955	165.023
2009 April	125.109	24.465	0.333	1.208	0.807	2.348	0.032	0.924	152.877

2009 May	131.263	27.918	0.423	1.219	1.053	2.696	0.033	0.955	162.864
2009 June	147.159	34.82	0.401	1.22	1.107	2.728	0.032	0.924	185.663
2009 July	157.018	42.156	0.372	1.266	1.208	2.846	0.033	0.955	203.007
2009 August	161.476	45.538	0.399	1.225	1.426	3.05	0.033	0.955	211.051
2009 September	137.118	37.387	0.304	1.216	0.89	2.41	0.032	0.924	177.871
2009 October	138.895	29.099	0.349	0.748	1.002	2.099	0.033	0.955	171.08
2009 November	136.18	24.776	0.342	0.737	0.595	1.673	0.032	0.924	163.586
2009 December	164.496	28.204	0.439	0.982	0.6	2.02	0.033	0.955	195.708
2010 January	169.536	29.557	1.054	1.207	1.363	3.625	0.033	0.935	203.686
2010 February	149.728	25.97	0.365	1.136	0.501	2.001	0.03	0.845	178.574
2010 March	142.654	24.722	0.326	1.246	0.593	2.165	0.033	0.935	170.51
2010 April	125.284	25.496	0.3	1.078	0.573	1.951	0.032	0.905	153.669
2010 May	141.692	30.255	0.439	1.167	0.97	2.576	0.033	0.935	175.492
2010 June	163.123	38.157	0.524	1.375	1.486	3.384	0.032	0.905	205.602
2010 July	177.16	48.522	0.561	1.47	1.761	3.793	0.033	0.935	230.443
2010 August	176.65	51.004	0.458	1.15	1.44	3.048	0.033	0.935	231.669
2010 September	148.402	37.668	0.379	1.087	0.871	2.337	0.032	0.905	189.344
2010 October	132.125	30.833	0.331	1.009	0.548	1.888	0.033	0.935	165.814
2010 November	135.915	26.861	0.381	0.88	0.489	1.75	0.032	0.905	165.464
2010 December	165.295	30.549	0.795	1.143	0.973	2.911	0.033	0.935	199.723
2011 January	166.304	29.208	0.566	1.546	0.824	2.936	0.034	0.962	199.444
2011 February	135.734	26.17	0.39	1.219	0.483	2.092	0.03	0.869	164.896
2011 March	133.859	26.061	0.379	1.477	0.545	2.401	0.034	0.962	163.316
2011 April	123.646	28.184	0.424	0.939	0.653	2.016	0.032	0.931	154.81
2011 May	135.484	30.903	0.41	1.004	0.607	2.021	0.034	0.962	169.403
2011 June	155.011	37.791	0.408	1.223	0.615	2.246	0.032	0.931	196.012
2011 July	173.723	50.729	0.479	1.464	0.759	2.703	0.034	0.962	228.151
2011 August	169.982	49.801	0.35	1.316	0.649	2.315	0.034	0.962	223.094
2011 September	141.452	36.966	0.307	1.281	0.473	2.061	0.032	0.931	181.443
2011 October	128.316	31.061	0.313	0.933	0.467	1.713	0.034	0.962	162.086
2011 November	123.625	29.328	0.32	0.703	0.457	1.48	0.032	0.931	155.396
2011 December	135.523	33.203	0.373	1.021	0.455	1.849	0.034	0.962	171.571
2012 January	129.588	35.11	0.357	1.169	0.499	2.025	0.034	0.969	167.725
2012 February	115.288	34.877	0.286	0.927	0.376	1.589	0.032	0.906	152.691
2012 March	105.121	36.456	0.261	0.521	0.424	1.206	0.034	0.969	143.786
2012 April	94.708	38.626	0.294	0.484	0.397	1.175	0.033	0.937	135.48
2012 May	115.001	43.922	0.374	0.617	0.417	1.408	0.034	0.969	161.333
2012 June	131.214	47.572	0.367	0.666	0.644	1.676	0.033	0.937	181.432
2012 July	158.387	58.49	0.399	0.74	0.767	1.905	0.034	0.969	219.786
2012 August	151.414	54.282	0.312	0.779	0.556	1.648	0.034	0.969	208.346
2012 September	127.229	43.384	0.273	0.731	0.417	1.421	0.033	0.937	173.004
2012 October	121.784	36.176	0.293	0.667	0.449	1.409	0.034	0.969	160.371
2012 November	128.019	31.355	0.313	0.695	0.401	1.41	0.033	0.937	161.754
2012 December	134.021	32.434	0.359	0.689	0.414	1.462	0.034	0.969	168.919
2013 January	137.051	34.27	0.465	0.961	0.727	2.153	0.034	0.941	174.449
2013 February	122.559	30.835	0.309	0.844	0.483	1.636	0.031	0.85	155.911
2013 March	128.602	32.755	0.295	0.912	0.417	1.624	0.034	0.941	163.956
2013 April	110.956	30.619	0.304	0.841	0.422	1.568	0.033	0.91	144.086
2013 May	118.025	33.314	0.358	1.194	0.417	1.968	0.034	0.941	154.283
2013 June	137.022	39.947	0.299	1.214	0.445	1.957	0.033	0.91	179.869
2013 July	151.947	49.382	0.452	1.219	0.645	2.317	0.034	0.941	204.621
2013 August	149.697	48.808	0.284	1.266	0.48	2.031	0.034	0.941	201.51
2013 September	132.781	40.723	0.276	1.146	0.414	1.835	0.033	0.91	176.283
2013 October	121.072	34.523	0.279	1.058	0.412	1.749	0.034	0.941	158.319
2013 November	120.441	32.592	0.33	0.833	0.378	1.541	0.033	0.91	155.517
2013 December	141.15	36.283	0.458	1.023	0.56	2.042	0.034	0.941	180.45
2014 January	153.787	36.083	2.114	1.204	2.023	5.341	0.035	0.945	196.191
2014 February	140.044	29.994	0.573	0.989	0.733	2.295	0.032	0.854	173.22
2014 March	132.609	30.511	0.619	1.16	0.836	2.615	0.035	0.945	166.717
2014 April	106.706	29.844	0.28	0.805	0.399	1.484	0.034	0.915	138.984
2014 May	117.623	35.162	0.352	1.083	0.351	1.786	0.035	0.945	155.552
2014 June	136.521	39.173	0.291	1.125	0.378	1.794	0.034	0.915	178.438
2014 July	149.714	45.838	0.281	1.042	0.458	1.781	0.035	0.945	198.313
2014 August	148.933	48.803	0.301	1.045	0.476	1.822	0.035	0.945	200.54
2014 September	126.931	41.903	0.3	1.027	0.391	1.718	0.034	0.915	171.502
2014 October	112.254	38.233	0.279	0.615	0.379	1.273	0.035	0.945	152.741
2014 November	118.788	32.657	0.351	0.79	0.365	1.506	0.034	0.915	153.901
2014 December	124.577	34.752	0.353	1.181	0.355	1.889	0.035	0.945	162.199
2015 January	130.533	38.887	0.544	1.107	0.828	2.48	0.036	0.94	172.876
2015 February	122.733	35.446	1.577	1.16	1.974	4.711	0.032	0.849	163.771
2015 March	106.647	38.731	0.356	0.772	0.404	1.532	0.036	0.94	147.886
2015 April	88.67	36.28	0.265	0.822	0.387	1.473	0.034	0.91	127.366
2015 May	104.429	40.102	0.352	0.964	0.367	1.682	0.036	0.94	147.188
2015 June	126.038	48.409	0.328	0.871	0.417	1.616	0.034	0.91	177.008
2015 July	139.919	57.104	0.311	1.173	0.551	2.035	0.036	0.94	200.034
2015 August	134.843	56.068	0.293	1.105	0.488	1.886	0.036	0.94	193.772
2015 September	118.378	48.876	0.268	1.061	0.43	1.759	0.034	0.91	169.957
2015 October	98.018	43.226	0.265	0.854	0.399	1.517	0.036	0.94	143.738
2015 November	89.457	40.015	0.338	0.737	0.43	1.505	0.034	0.91	131.921
2015 December	91.81	42.003	0.322	0.784	0.374	1.48	0.036	0.94	136.268
2016 January	113.715	42.27	0.531	0.961	0.5	1.991	0.035	0.951	158.962
2016 February	92.717	37.667	0.389	0.937	0.54	1.865	0.033	0.89	133.172
2016 March	73.11	40.653	0.296	1.041	0.321	1.658	0.035	0.951	116.408
2016 April	71.666	39.231	0.27	1.096	0.325	1.691	0.034	0.921	113.544
2016 May	82.506	43.89	0.341	1.035	0.358	1.733	0.035	0.951	129.116
2016 June	115.757	52.949	0.298	1.075	0.409	1.783	0.034	0.921	171.443
2016 July	135.863	62.215	0.341	1.137	0.635	2.113	0.035	0.951	201.178
2016 August	135.228	62.833	0.322	1.192	0.603	2.118	0.035	0.951	201.166
2016 September	114.173	49.944	0.268	1.081	0.406	1.755	0.034	0.921	166.826
2016 October	99.965	40.581	0.267	0.711	0.44	1.418	0.035	0.951	142.95
2016 November	88.174	36.135	0.348	0.862	0.347	1.557	0.034	0.921	126.821
2016 December	118.97	36.633	0.398	0.953	0.425	1.776	0.035	0.951	158.366
2017 January	115.431	36.054	0.381	1.056	0.404	1.842	0.036	0.907	154.269
2017 February	87.212	31.075	0.298	0.793	0.345	1.436	0.032	0.819	120.574
2017 March	88.804	36.718	0.342	0.748	0.346	1.436	0.036	0.907	127.9
2017 April	80.514	34.215	0.282	0.472	0.338	1.092	0.034	0.878	116.733
2017 May	92.482	38.166	0.334	0.945	0.383	1.663	0.036	0.907	133.253
2017 June	106.945	46.386	0.286	0.994	0.43	1.71	0.034	0.878	155.953
2017 July	126.842	59.004	0.287	0.971	0.385	1.643	0.036	0.907	188.431
2017 August	119.583	55.747	0.267	0.845	0.44	1.552	0.036	0.907	177.824
2017 September	99.431	46.821	0.291	0.789	0.388	1.468	0.034	0.878	148.632
2017 October	90.934	42.115	0.316	0.645	0.4	1.361	0.036	0.907	135.352
2017 November	92.592	36.355	0.322	0.832	0.334	1.488	0.034	0.878	131.347
2017 December	106.252	42.855	0.649	0.836	0.748	2.233	0.036	0.907	152.283
2018 January	117.544	42.911	2.248	1.09	1.734	5.071	0.036	0.936	166.498
2018 February	83.05	37.666	0.282	0.883	0.308	1.474	0.032	0.845	123.067
2018 March	80.634	41.318	0.307	0.732	0.306	1.345	0.036	0.936	124.269
2018 April	73.47	38.431	0.332	0.78	0.334	1.446	0.034	0.906	114.288
2018 May	85.689	46.269	0.401	0.596	0.373	1.37	0.036	0.936	134.298
2018 June	101.608	51.968	0.383	0.94	0.413	1.737	0.034	0.906	156.253
2018 July	115.614	66.77	0.308	1.052	0.414	1.774	0.036	0.936	185.129
2018 August	115.462	64.693	0.33	1.016	0.44	1.786	0.036	0.936	182.913
2018 September	97.689	56.177	0.309	0.928	0.464	1.701	0.034	0.906	156.506

2018 October	87.712	48.388	0.332	0.648	0.413	1.393	0.036	0.936	138.464
2018 November	93.742	41.613	0.382	0.779	0.355	1.516	0.034	0.906	137.811
2018 December	100.813	41.588	0.361	0.919	0.322	1.603	0.036	0.936	144.974
2019 January	101.168	46.389	0.505	0.939	0.477	1.921	0.034	0.897	150.409
2019 February	81.568	42.618	0.312	0.79	0.276	1.378	0.03	0.81	126.404
2019 March	79.713	44.463	0.305	0.675	0.292	1.272	0.034	0.897	126.378
2019 April	60.427	40.429	0.268	0.44	0.297	1.006	0.033	0.868	102.762
2019 May	72.386	45.683	0.347	0.844	0.351	1.542	0.034	0.897	120.541
2019 June	80.072	54.103	0.338	0.614	0.377	1.329	0.033	0.868	136.404
2019 July	101.104	68.548	0.319	0.862	0.426	1.607	0.034	0.897	172.189
2019 August	94.777	69.814	0.312	0.788	0.456	1.556	0.034	0.897	167.077
2019 September	85.408	59.023	0.296	0.659	0.377	1.333	0.033	0.868	146.665
2019 October	67.828	51.163	0.305	0.206	0.38	0.891	0.034	0.897	120.812
2019 November	75.879	44.733	0.323	0.368	0.342	1.033	0.033	0.868	122.546
2019 December	73.27	49.823	0.363	0.567	0.363	1.293	0.034	0.897	125.316
2020 January	66.64	51.82	0.334	0.741	0.358	1.432	0.04	0.89	120.822
2020 February	58.05	48.767	0.28	0.636	0.289	1.205	0.037	0.832	108.891
2020 March	52.487	48.624	0.231	0.831	0.28	1.342	0.04	0.89	103.382
2020 April	42.783	42.443	0.201	0.727	0.263	1.191	0.039	0.861	87.316
2020 May	48.501	45.671	0.246	0.746	0.28	1.272	0.04	0.89	96.374
2020 June	66.23	56.808	0.294	0.931	0.334	1.559	0.039	0.861	125.497
2020 July	90.095	73.453	0.316	0.961	0.38	1.657	0.04	0.89	166.135
2020 August	91.279	69.642	0.298	0.894	0.379	1.571	0.04	0.89	163.421
2020 September	70.008	55.433	0.226	0.509	0.339	1.074	0.039	0.861	127.415
2020 October	61.279	51.751	0.269	0.441	0.374	1.084	0.04	0.89	115.043
2020 November	62.059	42.139	0.266	0.651	0.318	1.235	0.039	0.861	106.332
2020 December	78.735	48.32	0.323	0.86	0.362	1.546	0.04	0.89	129.53
2021 January	82.018	47.185	0.303	0.836	0.397	1.536	0.038	0.983	131.76
2021 February	86.995	42.852	0.819	0.805	0.403	2.027	0.035	0.888	132.798
2021 March	62.635	40.498	0.291	0.756	0.309	1.356	0.038	0.983	105.511
2021 April	54.544	41.538	0.321	0.504	0.283	1.108	0.037	0.952	98.178
2021 May	64.696	44.391	0.324	0.632	0.305	1.262	0.038	0.983	111.37
2021 June	87.111	59.314	0.351	0.569	0.336	1.257	0.037	0.952	148.67
2021 July	102.306	67.578	0.302	0.814	0.349	1.465	0.038	0.983	172.37
2021 August	102.09	68.883	0.369	0.894	0.508	1.771	0.038	0.983	173.765
2021 September	80.557	53.936	0.296	0.746	0.409	1.451	0.037	0.952	136.932
2021 October	64.633	51.228	0.318	0.752	0.346	1.416	0.038	0.983	118.298
2021 November	59.611	47.395	0.343	0.943	0.322	1.607	0.037	0.952	109.603
2021 December	62.777	47.983	0.394	0.729	0.337	1.46	0.038	0.983	113.241
2022 January	87.871	51.786	1.096	0.698	1.145	2.939	0.039	0.595	143.23
2022 February	72.132	43.858	0.446	0.741	0.406	1.593	0.035	0.537	118.156
2022 March	62.113	42.356	0.359	0.629	0.348	1.337	0.039	0.595	106.44
2022 April	55.835	40.499	0.288	0.651	0.282	1.221	0.037	0.576	98.168
2022 May	63.491	50.274	0.347	0.712	0.324	1.382	0.039	0.595	115.781
2022 June	75.29	62.374	0.385	0.812	0.298	1.495	0.037	0.576	139.772
2022 July	89.224	76.584	0.394	0.615	0.418	1.427	0.039	0.595	167.869
2022 August	87.267	75.227	0.37	0.697	0.387	1.454	0.039	0.595	164.582
2022 September	67.354	61.31	0.297	0.814	0.411	1.522	0.037	0.576	130.798
2022 October	56.812	51.572	0.313	0.761	0.431	1.504	0.039	0.595	110.521
2022 November	58.521	49.184	0.326	0.666	0.373	1.366	0.037	0.576	109.685
2022 December	75.409	54.13	1.565	0.862	0.857	3.283	0.039	0.595	133.456
2023 January	63.785	52.549	0.349	0.519	0.374	1.242	0.037	0.596	118.209
2023 February	48.244	47.252	0.455	0.484	0.535	1.474	0.034	0.538	97.542
2023 March	51.571	51.065	0.301	0.395	0.375	1.071	0.037	0.596	104.34
2023 April	41.066	47.008	0.304	0.373	0.353	1.03	0.036	0.577	89.716
2023 May	45.744	53.886	0.35	0.426	0.356	1.133	0.037	0.596	101.396
2023 June	60.216	64.151	0.321	0.48	0.365	1.166	0.036	0.577	126.146
2023 July	79.764	80.359	0.301	0.777	0.43	1.508	0.037	0.596	162.264
2023 August	78.822	80.184	0.343	0.779	0.393	1.515	0.037	0.596	161.154
2023 September	61.468	65.299	0.263	0.705	0.423	1.391	0.036	0.577	128.771
2023 October	53.113	55.341	0.293	0.366	0.462	1.121	0.037	0.596	110.208
2023 November	53.052	52.494	0.311	0.235	0.376	0.922	0.036	0.577	107.08
2023 December	57.521	55.584	0.328	0.435	0.372	1.135	0.037	0.596	114.873
2024 January	76.452	62.057	0.662	0.477	0.49	1.629	0.034	0.544	140.716
2024 February	46.843	49.79	0.228	0.348	0.331	0.907	0.032	0.509	98.08
2024 March	40.37	50.128	0.246	0.261	0.334	0.84	0.034	0.544	91.916
2024 April	38.316	47.963	0.356	0.362	0.326	1.044	0.033	0.526	87.883
2024 May	47.169	57.096	0.312	0.407	0.368	1.086	0.034	0.544	105.93
2024 June	62.021	67.509	0.3	0.502	0.378	1.181	0.033	0.526	131.27
2024 July	72.866	83.298	0.381	0.582	0.415	1.377	0.034	0.544	158.119
2024 August	70.933	81.599	0.379	0.572	0.395	1.346	0.034	0.544	154.456
2024 September	56.717	66.645	0.261	0.321	0.377	0.96	0.033	0.526	124.881
2024 October	49.167	58.345	0.3	0.309	0.409	1.018	0.034	0.544	109.108
2024 November	47.417	53.848	0.283	0.299	0.373	0.955	0.033	0.526	102.78
2024 December	63.765	56.568	0.44	0.407	0.486	1.334	0.034	0.544	122.245
2025 January	82.615	61.36	1.331	0.606	0.704	2.641	0.034	0.545	147.195
2025 February	63.358	50.826	0.459	0.403	0.411	1.273	0.031	0.492	115.98
2025 March	50.405	45.279	0.282	0.473	0.36	1.115	0.034	0.545	97.379
2025 April	46.518	45.254	0.294	0.387	0.343	1.024	0.033	0.528	93.356
2025 May	50.241	53.019	0.249	0.409	0.34	0.998	0.034	0.545	104.838
2025 June	65.767	66.088	0.414	0.58	0.424	1.418	0.033	0.528	133.835
2025 July	81.195	81.47	0.378	0.609	0.468	1.454	0.034	0.545	164.699
2025 August	71.449	76.867	0.36	0.584	0.41	1.354	0.034	0.545	150.25
2025 September	60.094	66.587	0.289	0.491	0.388	1.168	0.033	0.528	128.41
2025 October	55.774	56.476	0.289	0.5	0.401	1.19	0.034	0.545	114.02
2025 November	55.72	51.593	0.387	0.409	0.358	1.153	0.033	0.528	109.026
2025 December	66.929	57.114	0.618	0.353	0.797	1.768	0.034	0.545	126.39
2026 January	71.71	59.632	2.337	0.487	1.188	4.012	0.034	0.545	135.933
2026 February	56.164	51.63	1.397	0.441	0.646	2.484	0.031	0.492	110.802
2026 March	45.378	50.052	0.405	0.362	0.368	1.135	0.034	0.545	97.145
2026 April	40.597	48.925	0.341	0.386	0.346	1.073	0.033	0.528	91.156
2026 May	46.33	54.784	0.431	0.47	0.357	1.258	0.034	0.545	102.952
2026 June	57.612	65.359	0.344	0.566	0.389	1.299	0.033	0.528	124.83
2026 July	76.338	83.517	0.557	0.551	0.496	1.604	0.034	0.545	162.039

U.S. Energy Information Administration

October 2026 Monthly Energy Review

Note: Information about data precision.

Release Date: October 29, 2026
Next Update: November 30, 2026

Table 11.6 Carbon Dioxide Emissions From Energy Consumption: Electric Power Sector

Annual Total	Coal Electric Power Sector CO2 Emissions (Million Metric Tons of Carbon Dioxide)	Natural Gas Electric Power Sector CO2 Emissions (Million Metric Tons of Carbon Dioxide)	Distillate Fuel, Including Kerosene-Type Jet Fuel, Oil Electric Power Sector CO2 Emissions (Million Metric Tons of Carbon Dioxide)	Petroleum Coke Electric Power Sector CO2 Emissions (Million Metric Tons of Carbon Dioxide)	Residual Fuel Oil Electric Power Sector CO2 Emissions (Million Metric Tons of Carbon Dioxide)	Petroleum Electric Power Sector CO2 Emissions (Million Metric Tons of Carbon Dioxide)	Geothermal Energy Electric Power Sector CO2 Emissions (Million Metric Tons of Carbon Dioxide)	Non-Biomass Waste Electric Power Sector CO2 Emissions (Million Metric Tons of Carbon Dioxide)	Total Energy Electric Power Sector CO2 Emissions (Million Metric Tons of Carbon Dioxide)
1973	823.529	198.72	20.098	1.559	242.283	263.94	Not Available	Not Available	1286.189
1974	811.7	186.587	22.745	1.922	228.099	252.766	Not Available	Not Available	1251.054
1975	835.65	171.773	16.674	0.216	220.581	237.47	Not Available	Not Available	1244.893
1976	924.524	167.105	17.91	0.209	242.702	260.821	Not Available	Not Available	1352.449
1977	976.055	174.104	20.864	0.3	271.402	292.566	Not Available	Not Available	1442.726
1978	973.796	174.795	20.348	1.225	277.752	299.325	Not Available	Not Available	1447.916
1979	1070.969	191.545	13.134	0.824	232.565	246.524	Not Available	Not Available	1509.037
1980	1153.029	200.316	12.462	0.551	184.673	197.686	Not Available	Not Available	1551.03
1981	1196.855	197.788	9.162	0.427	155.702	165.291	Not Available	Not Available	1559.934
1982	1196.73	175.599	6.595	0.459	110.679	117.733	Not Available	Not Available	1490.063
1983	1256.694	157.594	7.113	0.804	108.106	116.024	Not Available	Not Available	1530.312
1984	1333.44	169.588	6.544	0.774	89.365	96.683	Not Available	Not Available	1599.711
1985	1383.158	166.191	6.305	0.712	74.961	81.978	Not Available	Not Available	1631.327
1986	1373.79	141.579	6.172	0.962	102.05	109.183	Not Available	Not Available	1624.552
1987	1443.194	154.602	6.62	1.069	86.874	94.563	Not Available	Not Available	1692.358
1988	1507.543	142.763	8.086	1.258	108.268	117.611	Not Available	Not Available	1767.917
1989	1534.865	168.21	11.268	1.591	115.28	128.139	0.363	4.366	1835.942
1990	1546.633	175.419	7.137	3.101	87.301	97.539	0.384	5.795	1825.77
1991	1547.351	178.944	6.186	2.995	81.498	90.679	0.398	7.207	1824.579
1992	1568.513	186.051	5.438	4.596	65.494	75.528	0.4	8.476	1838.968
1993	1631.779	187.558	6.397	8.031	71.988	86.416	0.415	8.592	1914.761
1994	1637.942	210.876	8.872	7.119	65.256	81.247	0.384	9.323	1939.772
1995	1659.996	228.248	7.986	8.226	42.501	58.712	0.329	10.008	1957.293
1996	1751.495	204.929	8.083	8.126	47.188	63.397	0.36	9.926	2030.106
1997	1795.994	218.886	8.173	10.371	53.664	72.208	0.374	10.33	2097.793
1998	1826.963	247.692	10.027	12.617	78.62	101.264	0.375	10.164	2186.458
1999	1835.15	259.912	10.353	11.487	71.994	93.834	0.381	10.267	2199.544
2000	1926.174	280.849	13.059	10.073	65.394	88.525	0.362	10.144	2306.054
2001	1869.118	289.389	12.717	10.541	75.304	98.562	0.353	10.896	2268.317
2002	1888.86	305.968	9.503	17.888	49.465	76.856	0.372	12.749	2284.806
2003	1930.2	278.156	12.009	17.836	65.283	95.129	0.371	11.443	2315.298
2004	1941.703	296.849	8.311	21.527	66.009	95.847	0.381	11.165	2345.944
2005	1983.033	318.891	8.55	23.602	65.816	97.969	0.377	11.248	2411.519
2006	1952.95	338.01	5.471	20.734	27.073	53.278	0.374	11.529	2356.141
2007	1985.958	371.418	6.582	16.6	29.784	52.966	0.376	11.293	2422.01
2008	1958.577	362.07	5.385	14.949	18.054	38.388	0.381	11.614	2371.029
2009	1740.155	372.585	5.161	13.463	13.589	32.213	0.386	11.245	2156.582
2010	1827.564	399.668	5.913	13.949	11.568	31.43	0.391	11.011	2270.063
2011	1722.66	409.467	4.719	14.125	6.989	25.833	0.395	11.328	2169.682
2012	1511.773	492.726	3.887	8.685	5.761	18.334	0.4	11.437	2034.67
2013	1571.303	444.109	4.111	12.511	5.799	22.421	0.405	11.074	2049.312
2014	1568.488	443.03	6.096	12.066	7.144	25.305	0.418	11.132	2048.372
2015	1351.475	525.209	5.219	11.408	7.048	23.675	0.419	11.07	1911.848
2016	1241.845	545.042	4.068	12.082	5.308	21.458	0.416	11.234	1819.995
2017	1207.022	505.566	4.055	9.927	4.94	18.922	0.419	10.677	1742.606
2018	1153.026	577.857	5.977	10.363	5.876	22.216	0.419	11.017	1764.535
2019	973.6	616.846	3.995	7.752	4.415	16.162	0.395	10.557	1617.56
2020	788.146	634.908	3.283	8.928	3.957	16.167	0.47	10.505	1450.196
2021	909.972	612.835	4.431	8.98	4.303	17.715	0.451	11.577	1552.55
2022	851.319	659.214	6.187	8.657	5.68	20.524	0.456	7.006	1538.519
2023	694.366	705.219	3.921	5.973	4.816	14.71	0.438	7.015	1421.747
2024	672.037	734.902	4.148	4.846	4.682	13.676	0.406	6.418	1427.438
2025	750.064	711.933	5.35	5.802	5.404	16.556	0.406	6.418	1485.376

ATTACHMENT 2

cb2026.d021826b

Report Annual Energy Outlook 2026
Scenario cb2026 Counterfactual Baseline
Datekey d021826b
Release Date April 2026

8. Electricity Supply, Disposition, Prices, and Emissions

(billion kilowatthours, unless otherwise noted)

Supply, Disposition, Prices, and Emissions	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	Avg Annual Change 2025-2050
Net Generation by Fuel Type																											
Electric Power Sector 1/																											
Power Only 2/																											
Coal	728	694	645	562	532	460	414	140	129	122	118	119	118	119	63	63	63	52	49	24	13	4	1	1	1	1	-22.7%
Petroleum	12	11	11	10	9	9	8	7	7	7	6	6	6	6	5	5	4	4	3	2	1	1	1	1	1	1	-8.2%
Natural Gas 3/	1,573	1,616	1,456	1,438	1,435	1,473	1,479	1,658	1,571	1,555	1,575	1,632	1,698	1,720	1,777	1,797	1,845	1,914	1,978	2,047	2,096	2,153	2,198	2,242	2,281	2,314	1.6%
Nuclear Power	784	802	797	800	801	802	802	802	802	802	802	802	802	802	802	802	802	802	802	802	802	802	802	802	802	802	0.1%
Pumped Storage/Other 4/	-6	-9	-12	-15	-15	-16	-16	-18	-19	-19	-19	-19	-19	-19	-20	-21	-21	-22	-22	-22	-22	-22	-22	-22	-23	-23	5.6%
Hydrogen	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	--
Renewable Sources 5/	1,016	1,116	1,289	1,421	1,489	1,561	1,650	1,810	1,984	2,100	2,177	2,215	2,241	2,287	2,372	2,428	2,456	2,468	2,477	2,491	2,513	2,525	2,537	2,543	2,550	2,561	3.8%
Total	**4,107**	**4,231**	**4,186**	**4,215**	**4,251**	**4,290**	**4,337**	**4,399**	**4,474**	**4,566**	**4,659**	**4,755**	**4,846**	**4,914**	**4,999**	**5,073**	**5,148**	**5,217**	**5,287**	**5,345**	**5,402**	**5,463**	**5,517**	**5,567**	**5,613**	**5,657**	**1.3%**
Combined Heat and Power 6/																											
Coal	5	5	5	5	5	6	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	--
Petroleum	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-0.1%
Natural Gas	132	130	128	128	128	126	123	124	122	120	120	120	120	121	119	120	120	120	119	120	120	120	120	121	120	121	-0.4%
Renewable Sources	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	0.2%
Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.7%
Total	**141**	**140**	**138**	**138**	**138**	**137**	**133**	**128**	**126**	**125**	**125**	**125**	**125**	**125**	**124**	**124**	**124**	**124**	**124**	**124**	**124**	**124**	**125**	**125**	**125**	**125**	**-0.5%**
Total Net Electric Power Sector Generation	**4,249**	**4,371**	**4,324**	**4,353**	**4,389**	**4,426**	**4,470**	**4,527**	**4,601**	**4,691**	**4,784**	**4,880**	**4,971**	**5,040**	**5,122**	**5,198**	**5,272**	**5,341**	**5,411**	**5,469**	**5,527**	**5,587**	**5,642**	**5,692**	**5,738**	**5,782**	**1.2%**
Less Direct Use	21	21	21	20	20	20	20	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	-0.6%
Net Available to the Grid	**4,228**	**4,350**	**4,303**	**4,333**	**4,369**	**4,406**	**4,450**	**4,509**	**4,583**	**4,673**	**4,766**	**4,862**	**4,953**	**5,022**	**5,104**	**5,180**	**5,255**	**5,323**	**5,393**	**5,451**	**5,509**	**5,569**	**5,624**	**5,674**	**5,720**	**5,764**	**1.2%**
End-Use Sector 7/																											
Coal	5	5	5	5	5	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	-0.5%
Petroleum	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2.7%
Natural Gas	111	112	111	111	112	112	113	113	114	113	114	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	0.6%
Other Gaseous Fuels 8/	10	10	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	0.6%
Renewable Sources 9/	140	150	159	166	171	177	185	191	197	203	209	216	223	234	242	250	259	268	276	285	295	304	314	323	334	344	3.7%
Other 10/	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1.3%
Total End-Use Sector Net Generation	**269**	**280**	**289**	**296**	**302**	**308**	**318**	**324**	**330**	**336**	**342**	**349**	**357**	**369**	**378**	**388**	**397**	**407**	**416**	**426**	**436**	**446**	**457**	**469**	**480**	**492**	**2.4%**
Less Direct Use	208	218	236	241	246	251	260	265	270	274	279	285	292	301	309	317	324	333	340	349	357	365	374	384	393	402	2.7%
Total Sales to the Grid	**61**	**62**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**62**	**63**	**64**	**66**	**67**	**69**	**71**	**72**	**74**	**76**	**78**	**79**	**81**	**83**	**85**	**87**	**89**	**1.5%**
Total Net Electricity Generation by Fuel																											
Coal	738	704	655	572	542	471	424	145	133	126	123	123	123	124	67	67	67	56	53	28	17	8	5	5	5	5	-17.9%
Petroleum	14	14	12	12	11	11	10	9	9	9	8	8	8	7	7	7	6	6	5	4	3	3	3	3	3	3	-5.8%
Natural Gas	1,816	1,858	1,696	1,677	1,675	1,712	1,715	1,895	1,807	1,788	1,809	1,866	1,933	1,957	2,013	2,034	2,084	2,154	2,218	2,289	2,339	2,397	2,443	2,488	2,529	2,563	1.4%
Nuclear Power	784	802	797	800	801	802	802	802	802	802	802	802	802	802	802	802	802	802	802	802	802	802	802	802	802	802	0.1%
Renewable Sources 5,9/	1,158	1,268	1,451	1,589	1,662	1,741	1,838	2,003	2,184	2,306	2,389	2,434	2,467	2,523	2,616	2,681	2,717	2,738	2,756	2,779	2,810	2,832	2,853	2,869	2,886	2,908	3.8%
Hydrogen	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	--
Other 11/	7	4	3	0	0	-1	-1	-3	-4	-4	-4	-5	-4	-5	-5	-6	-7	-7	-7	-7	-7	-7	-7	-7	-8	-8	--
Total Net Electricity Generation	**4,518**	**4,651**	**4,613**	**4,649**	**4,691**	**4,734**	**4,788**	**4,851**	**4,931**	**5,027**	**5,126**	**5,229**	**5,328**	**5,408**	**5,500**	**5,585**	**5,669**	**5,748**	**5,827**	**5,895**	**5,963**	**6,034**	**6,100**	**6,160**	**6,218**	**6,273**	**1.3%**
Net Generation to the Grid	**4,289**	**4,412**	**4,357**	**4,388**	**4,424**	**4,463**	**4,508**	**4,568**	**4,643**	**4,735**	**4,829**	**4,926**	**5,018**	**5,089**	**5,174**	**5,250**	**5,327**	**5,397**	**5,468**	**5,528**	**5,588**	**5,651**	**5,707**	**5,759**	**5,807**	**5,853**	**1.3%**
Net Imports	**24**	**31**	**57**	**69**	**75**	**83**	**84**	**88**	**88**	**90**	**92**	**90**	**90**	**89**	**88**	**89**	**88**	**87**	**81**	**80**	**79**	**75**	**72**	**69**	**67**	**64**	**4.0%**
Electricity Sales by Sector																											
Residential 12/	1,529	1,541	1,520	1,545	1,567	1,587	1,606	1,630	1,658	1,688	1,720	1,750	1,778	1,801	1,825	1,845	1,866	1,888	1,908	1,926	1,942	1,959	1,975	1,989	2,003	2,017	1.1%
Commercial 13/	1,473	1,540	1,556	1,578	1,601	1,624	1,648	1,682	1,722	1,766	1,811	1,857	1,900	1,937	1,977	2,015	2,054	2,090	2,124	2,155	2,185	2,213	2,238	2,260	2,279	2,298	1.8%
Industrial	1,060	1,095	1,084	1,077	1,071	1,071	1,071	1,072	1,075	1,089	1,101	1,115	1,131	1,136	1,151	1,164	1,175	1,185	1,190	1,196	1,204	1,215	1,225	1,234	1,243	1,251	0.7%
Transportation	7	7	8	8	8	8	8	8	8	8	8	8	8	8	9	9	9	9	9	9	9	9	9	9	9	9	0.9%
Total	**4,069**	**4,184**	**4,168**	**4,208**	**4,247**	**4,290**	**4,332**	**4,392**	**4,462**	**4,550**	**4,640**	**4,730**	**4,818**	**4,883**	**4,961**	**5,033**	**5,105**	**5,171**	**5,230**	**5,286**	**5,341**	**5,396**	**5,447**	**5,493**	**5,535**	**5,575**	**1.3%**
Direct Use	229	239	256	262	267	272	280	283	288	292	297	303	310	319	326	335	342	350	358	367	375	383	392	402	411	420	2.5%
Total Electricity Use	**4,298**	**4,423**	**4,424**	**4,469**	**4,514**	**4,562**	**4,612**	**4,675**	**4,751**	**4,842**	**4,937**	**5,033**	**5,127**	**5,202**	**5,287**	**5,367**	**5,447**	**5,521**	**5,589**	**5,653**	**5,716**	**5,780**	**5,839**	**5,894**	**5,946**	**5,995**	**1.3%**
End-Use Prices																											
(2025 cents per kilowatthour)																											
Residential	16.7	16.7	16.4	16.0	16.1	16.3	16.8	16.8	16.9	16.9	16.7	16.7	16.8	17.1	17.1	17.1	17.1	17.2	17.2	17.2	17.3	17.3	17.3	17.4	17.4	17.4	0.2%
Commercial	13.5	13.4	13.0	12.7	12.8	13.0	13.5	13.5	13.6	13.5	13.4	13.4	13.5	13.8	13.7	13.7	13.6	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	0.1%
Industrial	9.1	9.0	8.7	8.4	8.5	8.7	9.1	9.2	9.3	9.2	9.1	9.1	9.2	9.3	9.4	9.4	9.3	9.3	9.3	9.3	9.3	9.2	9.2	9.2	9.2	9.2	0.1%
Transportation	15.4	15.4	15.0	14.4	14.4	14.7	15.3	15.2	15.4	15.3	15.2	15.3	15.4	15.8	15.6	15.6	15.6	15.6	15.7	15.7	15.8	15.7	15.8	15.8	15.8	15.8	0.1%
All Sectors Average	**13.5**	**13.5**	**13.1**	**12.8**	**12.9**	**13.1**	**13.6**	**13.7**	**13.8**	**13.7**	**13.6**	**13.6**	**13.7**	**14.0**	**13.9**	**14.0**	**13.9**	**14.0**	**14.0**	**14.0**	**14.0**	**14.0**	**14.0**	**14.0**	**14.0**	**14.0**	**0.1%**
(nominal cents per kilowatthour)																											
Residential	16.7	17.2	17.1	17.1	17.5	18.1	19.1	19.6	20.1	20.4	20.7	21.2	21.7	22.5	22.9	23.5	23.9	24.4	25.0	25.5	26.0	26.5	27.1	27.6	28.2	28.8	2.2%
Commercial	13.5	13.8	13.6	13.5	13.9	14.5	15.4	15.7	16.1	16.4	16.6	17.0	17.4	18.1	18.4	18.7	19.0	19.5	19.9	20.2	20.6	21.0	21.4	21.8	22.2	22.6	2.1%
Industrial	9.1	9.3	9.1	9.0	9.3	9.7	10.3	10.7	11.0	11.2	11.3	11.5	11.8	12.3	12.5	12.8	12.9	13.2	13.5	13.7	13.9	14.2	14.4	14.7	15.0	15.2	2.1%
Transportation	15.4	15.8	15.7	15.3	15.7	16.4	17.4	17.7	18.3	18.5	18.8	19.3	19.9	20.8	20.9	21.3	21.7	22.3	22.8	23.3	23.8	24.1	24.6	25.1	25.7	26.1	2.1%
All Sectors Average	**13.5**	**13.8**	**13.7**	**13.7**	**14.1**	**14.6**	**15.5**	**15.9**	**16.4**	**16.6**	**16.9**	**17.2**	**17.7**	**18.4**	**18.7**	**19.1**	**19.4**	**19.9**	**20.3**	**20.7**	**21.1**	**21.5**	**21.9**	**22.3**	**22.8**	**23.2**	**2.2%**
Prices by Service Category																											
(2025 cents per kilowatthour)																											
Generation	7.6	7.5	7.1	6.6	6.7	6.8	7.2	7.2	7.2	7.1	6.9	6.9	6.9	7.1	7.0	7.0	6.8	6.8	6.8	6.7	6.7	6.6	6.6	6.5	6.5	6.4	-0.7%
Transmission	1.9	1.9	2.0	2.0	2.1	2.1	2.2	2.2	2.2	2.3	2.3	2.3	2.3	2.4	2.4	2.4	2.4	2.5	2.5	2.5	2.5	2.6	2.6	2.6	2.6	2.7	1.4%
Distribution	4.1	4.0	4.1	4.1	4.2	4.2	4.3	4.3	4.3	4.4	4.4	4.4	4.4	4.5	4.5	4.5	4.6	4.6	4.6	4.7	4.7	4.8	4.8	4.8	4.9	4.9	0.8%
(nominal cents per kilowatthour)																											
Generation	7.6	7.7	7.4	7.1	7.3	7.6	8.2	8.4	8.5	8.6	8.6	8.7	8.9	9.3	9.4	9.5	9.6	9.7	9.9	10.0	10.1	10.2	10.3	10.4	10.5	10.6	1.3%
Transmission	1.9	2.0	2.1	2.2	2.3	2.3	2.4	2.5	2.7	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.2	4.3	4.4	3.4%
Distribution	4.1	4.2	4.2	4.4	4.5	4.7	4.8	5.0	5.1	5.3	5.4	5.6	5.7	5.9	6.0	6.2	6.4	6.6	6.7	6.9	7.1	7.3	7.5	7.7	7.9	8.1	2.8%
Electric Power Sector Emissions 1/																											
Sulfur Dioxide (million short tons)	0.56	0.54	0.42	0.38	0.37	0.35	0.33	0.16	0.15	0.15	0.14	0.15	0.14	0.15	0.10	0.10	0.10	0.09	0.08	0.06	0.04	0.03	0.02	0.02	0.02	0.02	-11.7%
Nitrogen Oxide (million short tons)	0.73	0.73	0.62	0.56	0.52	0.54	0.47	0.29	0.26	0.26	0.26	0.26	0.26	0.26	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.25	0.25	0.25	0.25	-4.2%
Mercury (short tons)	3.03	2.87	2.63	2.31	2.20	1.98	1.80	0.67	0.63	0.61	0.60	0.59	0.58	0.58	0.36	0.36	0.36	0.30	0.28	0.13	0.08	0.02	0.01	0.01	0.01	0.01	-22.3%

Data source: U.S. Energy Information Administration (EIA), Short-Term Energy Outlook, November 2025, and EIA, Annual Energy Outlook 2026 (AEO2026)
Projections: EIA, AEO2026 National Energy Modeling System (NEMS) run cb2026.d021826b.
Note: Totals may not equal sum of components due to independent rounding.
1/ Includes electricity-only and combined-heat-and-power plants that have a regulatory status.
2/ Includes plants that only produce electricity and that have a regulatory status.
3/ Includes electricity generation from fuel cells.
4/ Includes non-biogenic municipal waste and battery storage.
5/ Includes conventional hydroelectric, geothermal, wood, wood waste, biogenic municipal waste, landfill gas,
other biomass, solar, and wind power in the electric power sector.
6/ Includes combined-heat-and-power plants whose primary business is to sell electricity and heat to the public
(that is, those that report North American Industry Classification System Code 22 or that have a regulatory status).
7/ Includes combined-heat-and-power plants and electricity-only plants in the commercial and industrial sectors that have a non-regulatory
status. Also includes small on-site generating systems in the residential, commercial, and industrial sectors used primarily for own-use generation
but which may also sell some power to the grid.
8/ Includes refinery gas and still gas.
9/ Includes conventional hydroelectric, geothermal, wood, wood waste, all municipal waste, landfill gas,
other biomass, solar, and wind power in the end-use sectors.
10/ Includes batteries, chemicals, hydrogen, pitch, purchased steam, sulfur, and miscellaneous technologies.
11/ Includes pumped storage, non-biogenic municipal waste in the electric power sector, refinery gas, still gas, batteries,
chemicals, hydrogen, pitch, purchased steam, sulfur, and miscellaneous technologies.
12/ Includes purchased electricity for electric vehicle charging at residential locations.
13/ Includes purchased electricity for electric vehicle charging at commercial locations.
-- = Not applicable

ATTACHMENT 3

U.S. Energy Information Administration

October 2026 Monthly Energy Review

Note: Information about data precision.

Release Date: October 29, 2026
Next Update: November 30, 2026

Table 7.1 Electricity Overview

Month	Electricity Net Generation, Electric Power Sector (Billion Kilowatthours)	Electricity Net Generation, Commercial Sector (Billion Kilowatthours)	Electricity Net Generation, Industrial Sector (Billion Kilowatthours)	Electricity Net Generation, Total (Billion Kilowatthours)	Electricity Imports (Billion Kilowatthours)	Electricity Exports (Billion Kilowatthours)	Electricity Net Imports (Billion Kilowatthours)	Transmission and Distribution Losses and Unaccounted for (Billion Kilowatthours)	Electricity Sales to Ultimate Customers (Billion Kilowatthours)	Electricity Direct Use (Billion Kilowatthours)	Electricity End Use, Total (Billion Kilowatthours)
1973 January	159.913	Not Available	0.305	160.218	1.431	0.218	1.213	16.925	144.505	Not Available	144.505
1973 February	143.257	Not Available	0.282	143.539	1.292	0.197	1.095	5.088	139.546	Not Available	139.546
1973 March	147.847	Not Available	0.312	148.158	1.431	0.218	1.213	12.269	137.102	Not Available	137.102
1973 April	139.292	Not Available	0.298	139.589	1.385	0.211	1.174	9.397	131.366	Not Available	131.366
1973 May	147.088	Not Available	0.307	147.395	1.431	0.218	1.213	17.247	131.361	Not Available	131.361
1973 June	160.945	Not Available	0.298	161.244	1.385	0.211	1.174	22.124	140.293	Not Available	140.293
1973 July	173.467	Not Available	0.266	173.733	1.431	0.218	1.213	22.383	152.562	Not Available	152.562
1973 August	177.109	Not Available	0.257	177.365	1.431	0.218	1.213	21.097	157.481	Not Available	157.481
1973 September	156.651	Not Available	0.224	156.875	1.385	0.211	1.174	0.739	157.31	Not Available	157.31
1973 October	153.954	Not Available	0.244	154.197	1.431	0.218	1.213	9.368	146.042	Not Available	146.042
1973 November	147.881	Not Available	0.257	148.138	1.385	0.211	1.174	11.169	138.142	Not Available	138.142
1973 December	153.307	Not Available	0.298	153.605	1.431	0.218	1.213	17.618	137.199	Not Available	137.199
1974 January	157.254	Not Available	0.301	157.555	1.31	0.232	1.078	14.647	143.986	Not Available	143.986
1974 February	142.474	Not Available	0.274	142.748	1.183	0.209	0.974	6.985	136.737	Not Available	136.737
1974 March	150.048	Not Available	0.294	150.342	1.31	0.232	1.078	15.468	135.952	Not Available	135.952
1974 April	142.021	Not Available	0.291	142.312	1.267	0.224	1.043	10.348	133.007	Not Available	133.007
1974 May	153.513	Not Available	0.3	153.813	1.31	0.232	1.078	21.814	133.077	Not Available	133.077
1974 June	156.161	Not Available	0.279	156.44	1.267	0.224	1.043	15.552	141.931	Not Available	141.931
1974 July	177.992	Not Available	0.255	178.247	1.31	0.232	1.078	27.814	151.511	Not Available	151.511
1974 August	173.879	Not Available	0.24	174.119	1.31	0.232	1.078	17.085	158.112	Not Available	158.112
1974 September	152.239	Not Available	0.229	152.467	1.267	0.224	1.043	-0.108	153.619	Not Available	153.619
1974 October	151.978	Not Available	0.217	152.196	1.31	0.232	1.078	11.919	141.355	Not Available	141.355
1974 November	149.844	Not Available	0.227	150.071	1.267	0.224	1.043	15.33	135.784	Not Available	135.784
1974 December	159.737	Not Available	0.272	160.009	1.31	0.232	1.078	20.235	140.852	Not Available	140.852
1975 January	164.325	Not Available	0.298	164.623	0.957	0.432	0.525	15.754	149.394	Not Available	149.394
1975 February	147.084	Not Available	0.265	147.349	0.864	0.39	0.474	4.85	142.973	Not Available	142.973
1975 March	155.481	Not Available	0.279	155.76	0.957	0.432	0.525	15.536	140.749	Not Available	140.749
1975 April	146.217	Not Available	0.278	146.495	0.926	0.418	0.508	11.17	135.833	Not Available	135.833
1975 May	153.231	Not Available	0.3	153.531	0.957	0.432	0.525	20.488	133.568	Not Available	133.568
1975 June	162.442	Not Available	0.275	162.717	0.926	0.418	0.508	20.23	142.996	Not Available	142.996
1975 July	176.816	Not Available	0.241	177.057	0.957	0.432	0.525	23.378	154.204	Not Available	154.204
1975 August	179.714	Not Available	0.217	179.931	0.957	0.432	0.525	19.554	160.902	Not Available	160.902
1975 September	155.223	Not Available	0.218	155.441	0.926	0.418	0.508	-1.792	157.741	Not Available	157.741
1975 October	154.949	Not Available	0.239	155.188	0.957	0.432	0.525	13.895	141.818	Not Available	141.818
1975 November	152.795	Not Available	0.24	153.035	0.926	0.418	0.508	14.284	139.26	Not Available	139.26
1975 December	169.372	Not Available	0.256	169.628	0.957	0.432	0.525	22.501	147.653	Not Available	147.653
1976 January	178.329	Not Available	0.28	178.609	0.931	0.201	0.729	18.799	160.539	Not Available	160.539
1976 February	156.684	Not Available	0.282	156.966	0.871	0.188	0.682	4.099	153.549	Not Available	153.549
1976 March	164.174	Not Available	0.292	164.467	0.931	0.201	0.729	17.731	147.465	Not Available	147.465
1976 April	153.167	Not Available	0.3	153.467	0.901	0.195	0.706	11.863	142.31	Not Available	142.31
1976 May	157.37	Not Available	0.294	157.664	0.931	0.201	0.729	16.59	141.804	Not Available	141.804
1976 June	173.392	Not Available	0.282	173.674	0.901	0.195	0.706	25.341	149.039	Not Available	149.039
1976 July	186.434	Not Available	0.257	186.691	0.931	0.201	0.729	24.414	163.006	Not Available	163.006
1976 August	186.403	Not Available	0.235	186.639	0.931	0.201	0.729	18.737	168.631	Not Available	168.631
1976 September	165.035	Not Available	0.202	165.237	0.901	0.195	0.706	1.531	164.412	Not Available	164.412
1976 October	163.746	Not Available	0.263	164.009	0.931	0.201	0.729	13.754	150.985	Not Available	150.985
1976 November	169.085	Not Available	0.262	169.346	0.901	0.195	0.706	19.311	150.741	Not Available	150.741
1976 December	183.877	Not Available	0.267	184.144	0.931	0.201	0.729	22.107	162.766	Not Available	162.766
1977 January	196.372	Not Available	0.293	196.665	1.712	0.233	1.479	25.793	172.351	Not Available	172.351
1977 February	162.734	Not Available	0.215	162.949	1.546	0.21	1.336	-1.013	165.298	Not Available	165.298
1977 March	169.157	Not Available	0.281	169.437	1.712	0.233	1.479	14.712	156.204	Not Available	156.204
1977 April	156.853	Not Available	0.264	157.117	1.657	0.226	1.431	10.622	147.926	Not Available	147.926
1977 May	169.332	Not Available	0.265	169.596	1.712	0.233	1.479	22.474	148.602	Not Available	148.602
1977 June	180.787	Not Available	0.244	181.031	1.657	0.226	1.431	23.169	159.294	Not Available	159.294
1977 July	198.93	Not Available	0.238	199.168	1.712	0.233	1.479	25.649	174.998	Not Available	174.998
1977 August	196.126	Not Available	0.237	196.363	1.712	0.233	1.479	19.252	178.59	Not Available	178.59

1977 September	176.265	Not Available	0.233	176.498	1.657	0.226	1.431	5.667	172.262	Not Available	172.262
1977 October	166.402	Not Available	0.244	166.645	1.712	0.233	1.479	8.776	159.348	Not Available	159.348
1977 November	167.099	Not Available	0.289	167.388	1.657	0.226	1.431	17.507	151.312	Not Available	151.312
1977 December	184.267	Not Available	0.322	184.589	1.712	0.233	1.479	23.893	162.175	Not Available	162.175
1978 January	197.835	Not Available	0.272	198.108	1.801	0.126	1.676	23.134	176.649	Not Available	176.649
1978 February	173.504	Not Available	0.241	173.746	1.627	0.113	1.514	5.332	169.927	Not Available	169.927
1978 March	173.193	Not Available	0.268	173.461	1.801	0.126	1.676	11.731	163.406	Not Available	163.406
1978 April	159.738	Not Available	0.275	160.013	1.743	0.121	1.622	11.25	150.385	Not Available	150.385
1978 May	175.236	Not Available	0.312	175.549	1.801	0.126	1.676	25.72	151.504	Not Available	151.504
1978 June	188.312	Not Available	0.273	188.585	1.743	0.121	1.622	24.688	165.519	Not Available	165.519
1978 July	202.682	Not Available	0.266	202.947	1.801	0.126	1.676	25.509	179.114	Not Available	179.114
1978 August	206.418	Not Available	0.241	206.659	1.801	0.126	1.676	24.111	184.223	Not Available	184.223
1978 September	185.572	Not Available	0.23	185.802	1.743	0.121	1.622	4.786	182.638	Not Available	182.638
1978 October	175.802	Not Available	0.212	176.013	1.801	0.126	1.676	10.967	166.722	Not Available	166.722
1978 November	176.172	Not Available	0.217	176.389	1.743	0.121	1.622	18.885	159.126	Not Available	159.126
1978 December	191.865	Not Available	0.24	192.105	1.801	0.126	1.676	25.072	168.709	Not Available	168.709
1979 January	209.692	Not Available	0.295	209.987	1.912	0.185	1.727	26.327	185.387	Not Available	185.387
1979 February	186.337	Not Available	0.25	186.587	1.727	0.167	1.56	6.632	181.515	Not Available	181.515
1979 March	182.849	Not Available	0.305	183.154	1.912	0.185	1.727	11.632	173.249	Not Available	173.249
1979 April	169.962	Not Available	0.299	170.26	1.851	0.179	1.671	10.375	161.557	Not Available	161.557
1979 May	178.069	Not Available	0.341	178.409	1.912	0.185	1.727	20.585	159.551	Not Available	159.551
1979 June	186.682	Not Available	0.294	186.976	1.851	0.179	1.671	21.788	166.86	Not Available	166.86
1979 July	202.255	Not Available	0.268	202.522	1.912	0.185	1.727	25.911	178.339	Not Available	178.339
1979 August	204.85	Not Available	0.25	205.101	1.912	0.185	1.727	19.519	187.309	Not Available	187.309
1979 September	180.751	Not Available	0.223	180.975	1.851	0.179	1.671	3.006	179.64	Not Available	179.64
1979 October	179.716	Not Available	0.237	179.953	1.912	0.185	1.727	15.732	165.948	Not Available	165.948
1979 November	177.506	Not Available	0.263	177.77	1.851	0.179	1.671	17.17	162.271	Not Available	162.271
1979 December	188.703	Not Available	0.268	188.97	1.912	0.185	1.727	21.224	169.473	Not Available	169.473
1980 January	200.005	Not Available	0.292	200.296	2.119	0.347	1.772	22.484	179.585	Not Available	179.585
1980 February	188.715	Not Available	0.246	188.961	1.983	0.325	1.658	11.898	178.721	Not Available	178.721
1980 March	187.464	Not Available	0.281	187.745	2.119	0.347	1.772	15.144	174.373	Not Available	174.373
1980 April	168.72	Not Available	0.297	169.017	2.051	0.336	1.715	9.031	161.701	Not Available	161.701
1980 May	175.734	Not Available	0.333	176.066	2.119	0.347	1.772	22.988	154.851	Not Available	154.851
1980 June	189.43	Not Available	0.319	189.748	2.051	0.336	1.715	26.592	164.872	Not Available	164.872
1980 July	216.776	Not Available	0.281	217.058	2.119	0.347	1.772	32.948	185.882	Not Available	185.882
1980 August	215.393	Not Available	0.236	215.629	2.119	0.347	1.772	20.938	196.464	Not Available	196.464
1980 September	191.485	Not Available	0.213	191.698	2.051	0.336	1.715	3.274	190.139	Not Available	190.139
1980 October	178.555	Not Available	0.206	178.761	2.119	0.347	1.772	10.453	170.08	Not Available	170.08
1980 November	178.55	Not Available	0.222	178.771	2.051	0.336	1.715	18.313	162.174	Not Available	162.174
1980 December	195.613	Not Available	0.236	195.849	2.119	0.347	1.772	22.014	175.607	Not Available	175.607
1981 January	206.467	Not Available	0.292	206.758	3.083	0.26	2.823	17.632	191.949	Not Available	191.949
1981 February	179.613	Not Available	0.246	179.86	2.784	0.235	2.55	0.202	182.207	Not Available	182.207
1981 March	185.553	Not Available	0.281	185.834	3.083	0.26	2.823	15.83	172.826	Not Available	172.826
1981 April	172.545	Not Available	0.297	172.841	2.983	0.252	2.732	12.048	163.525	Not Available	163.525
1981 May	177.806	Not Available	0.333	178.139	3.083	0.26	2.823	17.789	163.173	Not Available	163.173
1981 June	202.702	Not Available	0.319	203.021	2.983	0.252	2.732	26.925	178.827	Not Available	178.827
1981 July	220.373	Not Available	0.281	220.655	3.083	0.26	2.823	25.663	197.814	Not Available	197.814
1981 August	210.403	Not Available	0.236	210.639	3.083	0.26	2.823	15.003	198.459	Not Available	198.459
1981 September	186.838	Not Available	0.213	187.051	2.983	0.252	2.732	3.533	186.25	Not Available	186.25
1981 October	181.352	Not Available	0.206	181.558	3.083	0.26	2.823	13.031	171.35	Not Available	171.35
1981 November	175.57	Not Available	0.222	175.792	2.983	0.252	2.732	13.507	165.016	Not Available	165.016
1981 December	195.59	Not Available	0.236	195.826	3.083	0.26	2.823	22.943	175.705	Not Available	175.705
1982 January	209.403	Not Available	0.292	209.694	2.742	0.193	2.549	20.165	192.079	Not Available	192.079
1982 February	180.299	Not Available	0.246	180.546	2.444	0.23	2.214	-0.045	182.805	Not Available	182.805
1982 March	187.687	Not Available	0.281	187.968	2.19	0.256	1.934	15.943	173.959	Not Available	173.959
1982 April	172.58	Not Available	0.297	172.877	2.248	0.4	1.848	10.213	164.512	Not Available	164.512
1982 May	177.147	Not Available	0.333	177.48	2.583	0.443	2.14	21.051	158.569	Not Available	158.569
1982 June	186.128	Not Available	0.319	186.447	1.722	0.624	1.099	18.807	168.739	Not Available	168.739
1982 July	210.584	Not Available	0.281	210.865	2.341	0.503	1.838	29.136	183.567	Not Available	183.567
1982 August	205.656	Not Available	0.236	205.892	3.376	0.178	3.198	19.349	189.74	Not Available	189.74
1982 September	180.662	Not Available	0.213	180.875	3.354	0.185	3.169	5.748	178.296	Not Available	178.296
1982 October	172.966	Not Available	0.206	173.172	3.482	0.124	3.357	13.113	163.416	Not Available	163.416
1982 November	173.377	Not Available	0.222	173.599	3.384	0.242	3.142	16.261	160.48	Not Available	160.48
1982 December	184.722	Not Available	0.236	184.958	2.986	0.159	2.827	17.507	170.279	Not Available	170.279
1983 January	195.579	Not Available	0.292	195.871	2.903	0.179	2.725	19.42	179.176	Not Available	179.176
1983 February	172.479	Not Available	0.246	172.725	2.976	0.217	2.759	2.019	173.465	Not Available	173.465
1983 March	182.488	Not Available	0.281	182.769	3.088	0.367	2.721	17.907	167.584	Not Available	167.584
1983 April	170.372	Not Available	0.297	170.669	3.163	0.494	2.669	9.531	163.807	Not Available	163.807
1983 May	174.392	Not Available	0.333	174.725	2.798	0.587	2.211	18.017	158.919	Not Available	158.919
1983 June	191.048	Not Available	0.319	191.367	3.024	0.385	2.639	22.402	171.604	Not Available	171.604
1983 July	220.165	Not Available	0.281	220.447	3.29	0.246	3.044	29.337	194.153	Not Available	194.153

1983 August	229.957	Not Available	0.236	230.193	3.419	0.134	3.285	25.363	208.115	Not Available		208.115
1983 September	195.604	Not Available	0.213	195.817	3.715	0.141	3.573	-2.532	201.922	Not Available		201.922
1983 October	182.931	Not Available	0.206	183.137	3.714	0.204	3.509	10.339	176.307	Not Available		176.307
1983 November	182.949	Not Available	0.222	183.171	3.266	0.181	3.086	15.783	170.474	Not Available		170.474
1983 December	212.319	Not Available	0.236	212.555	3.312	0.203	3.109	30.236	185.428	Not Available		185.428
1984 January	216.632	Not Available	0.292	216.924	3.442	0.33	3.112	12.784	207.252	Not Available		207.252
1984 February	189.564	Not Available	0.246	189.81	3.155	0.422	2.733	1.673	190.869	Not Available		190.869
1984 March	200.107	Not Available	0.281	200.387	3.051	0.232	2.819	17.134	186.072	Not Available		186.072
1984 April	181.084	Not Available	0.297	181.381	3.137	0.22	2.917	8.948	175.35	Not Available		175.35
1984 May	192.217	Not Available	0.333	192.55	3.357	0.224	3.133	20.141	175.542	Not Available		175.542
1984 June	209.648	Not Available	0.319	209.967	3.266	0.258	3.007	23.216	189.758	Not Available		189.758
1984 July	221.245	Not Available	0.281	221.526	3.804	0.189	3.614	20.667	204.474	Not Available		204.474
1984 August	229.296	Not Available	0.236	229.532	4.524	0.099	4.425	24.911	209.046	Not Available		209.046
1984 September	195.198	Not Available	0.213	195.411	3.744	0.132	3.612	0.002	199.021	Not Available		199.021
1984 October	190.936	Not Available	0.206	191.142	4.121	0.17	3.951	12.808	182.285	Not Available		182.285
1984 November	190.38	Not Available	0.222	190.602	3.367	0.178	3.189	15.202	178.589	Not Available		178.589
1984 December	199.996	Not Available	0.236	200.232	3.251	0.104	3.148	15.842	187.537	Not Available		187.537
1985 January	227.856	Not Available	0.292	228.148	3.024	0.155	2.869	28.42	202.597	Not Available		202.597
1985 February	198.242	Not Available	0.246	198.488	2.549	0.173	2.376	-1.402	202.266	Not Available		202.266
1985 March	194.97	Not Available	0.281	195.25	4.593	0.948	3.645	12.783	186.113	Not Available		186.113
1985 April	184.877	Not Available	0.297	185.173	3.564	0.707	2.857	9.5	178.53	Not Available		178.53
1985 May	196.79	Not Available	0.333	197.123	3.67	0.401	3.268	21.61	178.781	Not Available		178.781
1985 June	205.363	Not Available	0.319	205.682	4.075	0.514	3.561	18.938	190.305	Not Available		190.305
1985 July	226.722	Not Available	0.281	227.004	4.739	0.488	4.251	26.054	205.201	Not Available		205.201
1985 August	226.05	Not Available	0.236	226.286	4.928	0.405	4.523	20.149	210.66	Not Available		210.66
1985 September	202.499	Not Available	0.213	202.712	3.844	0.161	3.683	0.134	206.262	Not Available		206.262
1985 October	194.789	Not Available	0.206	194.995	3.689	0.293	3.395	13.66	184.73	Not Available		184.73
1985 November	192.427	Not Available	0.222	192.649	3.518	0.295	3.223	15.642	180.229	Not Available		180.229
1985 December	219.255	Not Available	0.236	219.49	3.703	0.424	3.278	24.469	198.299	Not Available		198.299
1986 January	217.47	Not Available	0.292	217.761	3.811	0.209	3.602	11.1	210.264	Not Available		210.264
1986 February	192.336	Not Available	0.246	192.582	3.553	0.846	2.707	0.135	195.154	Not Available		195.154
1986 March	196.834	Not Available	0.281	197.115	3.589	1.201	2.388	10.513	188.99	Not Available		188.99
1986 April	186.074	Not Available	0.297	186.37	2.926	0.551	2.375	10.275	178.47	Not Available		178.47
1986 May	197.315	Not Available	0.333	197.647	3.189	0.361	2.828	20.905	179.57	Not Available		179.57
1986 June	215.015	Not Available	0.319	215.334	2.958	0.251	2.707	20.653	197.389	Not Available		197.389
1986 July	242.672	Not Available	0.281	242.954	3.121	0.143	2.978	26.659	219.272	Not Available		219.272
1986 August	225.166	Not Available	0.236	225.402	4.028	0.231	3.798	10.806	218.394	Not Available		218.394
1986 September	206.692	Not Available	0.213	206.905	3.523	0.15	3.372	5.98	204.297	Not Available		204.297
1986 October	197.754	Not Available	0.206	197.96	3.559	0.542	3.017	6.784	194.193	Not Available		194.193
1986 November	196.432	Not Available	0.222	196.654	3.1	0.25	2.85	17.712	181.791	Not Available		181.791
1986 December	213.551	Not Available	0.236	213.787	3.356	0.081	3.275	16.092	200.969	Not Available		200.969
1987 January	222.749	Not Available	0.292	223.041	4.222	0.328	3.893	17.214	209.721	Not Available		209.721
1987 February	194.034	Not Available	0.246	194.281	5.084	0.77	4.314	0.377	198.218	Not Available		198.218
1987 March	201.849	Not Available	0.281	202.13	5.115	0.74	4.375	12.85	193.655	Not Available		193.655
1987 April	189.496	Not Available	0.297	189.792	4.876	0.345	4.531	9.562	184.761	Not Available		184.761
1987 May	206.074	Not Available	0.333	206.407	3.893	0.327	3.566	20.866	189.107	Not Available		189.107
1987 June	225.589	Not Available	0.319	225.908	4.525	0.435	4.09	22.081	207.917	Not Available		207.917
1987 July	247.915	Not Available	0.281	248.196	4.911	0.267	4.644	23.537	229.303	Not Available		229.303
1987 August	247.645	Not Available	0.236	247.881	4.998	0.545	4.453	16.821	235.513	Not Available		235.513
1987 September	213.008	Not Available	0.213	213.221	3.625	0.36	3.265	-0.037	216.523	Not Available		216.523
1987 October	203.009	Not Available	0.206	203.215	3.985	0.714	3.272	9.253	197.234	Not Available		197.234
1987 November	200.258	Not Available	0.222	200.479	3.353	0.444	2.909	13.063	190.326	Not Available		190.326
1987 December	220.5	Not Available	0.236	220.736	3.632	0.607	3.025	18.766	204.995	Not Available		204.995
1988 January	237.897	Not Available	0.292	238.188	3.791	0.625	3.165	15.58	225.774	Not Available		225.774
1988 February	216.937	Not Available	0.246	217.183	3.754	0.496	3.258	5.361	215.081	Not Available		215.081
1988 March	214.013	Not Available	0.281	214.294	3.514	0.367	3.146	12.279	205.16	Not Available		205.16
1988 April	196	Not Available	0.297	196.297	2.836	0.305	2.531	6.212	192.616	Not Available		192.616
1988 May	208.371	Not Available	0.333	208.704	3.004	0.822	2.183	19.406	191.48	Not Available		191.48
1988 June	232.747	Not Available	0.319	233.066	3.316	0.714	2.602	22.67	212.998	Not Available		212.998
1988 July	257.461	Not Available	0.281	257.742	4.149	0.749	3.4	23.613	237.529	Not Available		237.529
1988 August	267.693	Not Available	0.236	267.929	4.427	0.733	3.694	21.133	250.489	Not Available		250.489
1988 September	220.179	Not Available	0.213	220.392	2.806	0.382	2.424	-3.489	226.305	Not Available		226.305
1988 October	210.608	Not Available	0.206	210.814	2.835	0.616	2.22	7.528	205.505	Not Available		205.505
1988 November	209.593	Not Available	0.222	209.815	2.295	0.601	1.694	12.383	199.126	Not Available		199.126
1988 December	232.752	Not Available	0.236	232.988	2.11	0.656	1.453	18.442	215.999	Not Available		215.999
1989 January	236.975	0.284	9.506	246.766	2.117	0.729	1.388	13.59	225.617		8.948	234.564
1989 February	224.276	0.308	9.199	233.783	2.69	0.854	1.837	11.952	214.979		8.688	223.667
1989 March	231.698	0.325	9.924	241.946	2.132	1.518	0.614	16.577	216.618		9.366	225.984
1989 April	213.179	0.328	9.362	222.869	2.133	1.158	0.975	13.063	201.925		8.856	210.781
1989 May	225.575	0.35	8.9	234.825	2.273	1.083	1.19	25.638	201.923		8.454	210.377
1989 June	241.293	0.372	9.254	250.919	2.141	0.553	1.588	21.923	221.786		8.797	230.583

1989 July	263.45	0.43	9.578	273.458	3.252	1.098	2.154	26.173	240.293	9.146	249.439
1989 August	264.963	0.42	10.036	275.42	2.62	0.905	1.715	23.934	243.644	9.556	253.2
1989 September	233.024	0.381	9.389	242.794	1.927	1.02	0.906	2.828	231.944	8.928	240.873
1989 October	225.641	0.369	9.659	235.669	1.651	1.627	0.025	15.036	211.494	9.164	220.658
1989 November	224.267	0.328	9.655	234.25	1.375	2.271	-0.897	18.492	205.738	9.124	214.861
1989 December	263.885	0.356	10.207	274.448	1.799	2.318	-0.519	33.427	230.849	9.654	240.503
1990 January	243.779	0.393	11.015	255.187	1.259	1.594	-0.336	3.575	240.881	10.395	251.276
1990 February	218.83	0.353	10.316	229.499	0.706	1.724	-1.018	5.356	213.404	9.722	223.126
1990 March	233.252	0.438	11.072	244.761	0.778	1.87	-1.092	19.063	214.12	10.487	224.607
1990 April	218.373	0.445	10.952	229.77	1.062	1.498	-0.436	13.784	205.165	10.384	215.549
1990 May	230.832	0.489	10.452	241.774	1.321	1.63	-0.309	23.273	208.222	9.97	218.192
1990 June	258.176	0.583	10.233	268.992	1.582	1.823	-0.241	31.91	226.986	9.856	236.842
1990 July	275.71	0.618	11.119	287.448	2.373	1.384	0.989	26.209	251.533	10.695	262.228
1990 August	278.19	0.634	11.831	290.655	2.032	1.226	0.806	28.038	252.065	11.358	263.423
1990 September	246.662	0.558	11.137	258.357	2.101	1.479	0.622	3.243	245.08	10.656	255.736
1990 October	232.783	0.506	11.083	244.372	2.481	0.999	1.481	12.993	222.301	10.56	232.86
1990 November	220.509	0.408	10.325	231.242	1.38	0.374	1.006	12.553	209.916	9.78	219.695
1990 December	244.224	0.411	11.134	255.77	1.37	0.533	0.838	23.206	222.882	10.52	233.402
1991 January	256.755	0.414	12.046	269.214	1.255	0.32	0.935	17.715	241.253	11.181	252.434
1991 February	217.949	0.352	9.989	228.29	0.781	0.087	0.693	0.509	219.194	9.28	228.474
1991 March	229.692	0.423	10.446	240.561	1.264	0.089	1.176	17.756	214.226	9.754	223.98
1991 April	217.484	0.44	9.875	227.799	1.379	0.052	1.328	13.498	206.371	9.257	215.628
1991 May	243.999	0.5	10.374	254.873	1.669	0.055	1.614	29.411	217.318	9.758	227.076
1991 June	258.098	0.511	10.49	269.099	1.243	0.185	1.058	22.322	237.963	9.872	247.835
1991 July	283.052	0.592	11.004	294.648	2.54	0.441	2.099	29.408	256.933	10.407	267.34
1991 August	279.481	0.602	12.075	292.159	2.834	0.339	2.495	25.077	258.199	11.377	269.576
1991 September	243.747	0.506	11.774	256.027	2.373	0.208	2.165	2.753	244.419	11.02	255.44
1991 October	233.308	0.492	11.578	245.378	2.582	0.183	2.4	15.389	221.557	10.832	232.389
1991 November	230.132	0.429	11.1	241.661	1.956	0.115	1.841	16.444	216.712	10.346	227.059
1991 December	241.863	0.397	11.829	254.089	2.055	0.232	1.823	17.083	227.857	10.971	238.828
1992 January	254.276	0.456	13.041	267.773	2.236	0.344	1.893	18.819	238.764	12.083	250.847
1992 February	227.67	0.433	11.412	239.514	2.33	0.411	1.92	4.598	226.233	10.603	236.836
1992 March	235.536	0.489	11.707	247.733	1.62	0.337	1.283	18.088	220.009	10.919	230.928
1992 April	221.761	0.496	11.148	233.406	1.838	0.279	1.559	12.579	211.962	10.424	222.386
1992 May	231.471	0.52	10.421	242.412	2.006	0.165	1.841	20.773	213.685	9.795	223.48
1992 June	248.93	0.565	11.582	261.077	1.93	0.221	1.709	24.633	227.279	10.874	238.153
1992 July	280.489	0.683	12.444	293.617	3.061	0.245	2.816	31.593	253.088	11.752	264.84
1992 August	268.665	0.628	12.635	281.927	2.61	0.265	2.345	19.409	252.99	11.873	264.863
1992 September	247.35	0.58	11.996	259.925	2.543	0.183	2.36	11.037	239.99	11.258	251.248
1992 October	232.239	0.489	12.266	244.994	2.831	0.129	2.702	11.486	224.792	11.418	236.21
1992 November	231.404	0.437	12.321	244.162	2.596	0.126	2.47	16.704	218.506	11.421	229.928
1992 December	254.585	0.451	12.307	267.343	2.646	0.123	2.523	22.378	236.066	11.421	247.488
1993 January	257.843	0.503	12.675	271.021	2.35	0.143	2.206	18.01	243.247	11.97	255.217
1993 February	235.701	0.47	11.844	248.015	2.215	0.145	2.07	10.421	228.478	11.185	239.663
1993 March	248.032	0.555	12.661	261.248	2.246	0.21	2.036	18.606	232.675	12.003	244.678
1993 April	222.84	0.469	11.386	234.695	1.743	0.218	1.525	9.623	215.829	10.768	226.597
1993 May	233.572	0.466	10.288	244.326	1.821	0.787	1.034	21.027	214.565	9.768	224.333
1993 June	263.642	0.631	11.087	275.36	1.949	0.893	1.057	28.424	237.349	10.643	247.992
1993 July	299.286	0.777	12.162	312.225	2.922	0.42	2.502	32.763	270.211	11.753	281.964
1993 August	296.936	0.811	13.703	311.45	3.366	0.155	3.211	27.648	273.83	13.183	287.013
1993 September	251.004	0.645	12.384	264.032	3.04	0.149	2.891	2.402	252.687	11.834	264.521
1993 October	237.317	0.6	12.636	250.553	3.351	0.13	3.221	13.424	228.327	12.022	240.349
1993 November	238.942	0.554	12.606	252.102	3.159	0.152	3.007	20.215	222.941	11.954	234.895
1993 December	258.782	0.52	12.863	272.165	3.196	0.139	3.057	21.744	241.322	12.155	253.477
1994 January	274.862	0.533	14.373	289.768	3.509	0.147	3.362	19.538	259.858	13.735	273.593
1994 February	236.341	0.461	12.37	249.172	3.938	0.117	3.821	2.318	238.852	11.823	250.675
1994 March	244.742	0.533	12.723	257.998	4.635	0.12	4.515	18.516	231.782	12.215	243.997
1994 April	228.071	0.549	12.017	240.637	3.376	0.132	3.244	12.233	220.068	11.579	231.647
1994 May	241.149	0.575	11.02	252.745	3.624	0.14	3.484	23.495	222.049	10.685	232.734
1994 June	281.196	0.768	12.198	294.162	3.867	0.208	3.659	33.153	252.721	11.947	264.668
1994 July	296.942	0.833	13.481	311.257	4.28	0.156	4.123	24.182	278.007	13.19	291.197
1994 August	293.669	0.854	13.082	307.605	4.471	0.185	4.286	26.21	272.839	12.841	285.68
1994 September	253.377	0.687	12.197	266.262	3.734	0.198	3.536	3.041	254.884	11.873	266.757
1994 October	243.158	0.654	12.716	256.528	3.743	0.168	3.575	14.028	233.755	12.32	246.075
1994 November	238.846	0.595	12.427	251.868	3.814	0.186	3.627	16.969	226.528	12	238.527
1994 December	256.37	0.576	12.574	269.52	3.843	0.253	3.59	17.773	243.219	12.117	255.337
1995 January	266.982	0.572	12.219	279.773	3.514	0.169	3.346	15.737	255.281	12.102	267.382
1995 February	240.551	0.515	11.241	252.307	3.638	0.273	3.365	5.41	239.139	11.123	250.262
1995 March	248.586	0.618	12.138	261.343	4.155	0.565	3.59	16.398	236.465	12.069	248.535
1995 April	231.845	0.619	12.272	244.736	3.822	0.379	3.443	14.124	221.859	12.196	234.055
1995 May	251.804	0.622	11.862	264.288	3.724	0.227	3.497	26.385	229.589	11.812	241.4

1995 June	273.764	0.735	11.759	286.258	3.978	0.399	3.579	23.006	255.01	11.821	266.831
1995 July	315.391	0.936	14.089	330.416	4.223	0.647	3.575	38.23	281.546	14.215	295.762
1995 August	329.966	1.049	14.765	345.78	4.628	0.277	4.35	36.168	299	14.962	313.962
1995 September	264.128	0.769	12.678	277.575	3.262	0.175	3.088	1.955	265.986	12.722	278.708
1995 October	250.466	0.647	12.865	263.978	2.92	0.114	2.806	12.948	241.053	12.784	253.837
1995 November	248.569	0.588	12.322	261.478	2.468	0.157	2.312	16.097	235.479	12.214	247.693
1995 December	272.179	0.562	12.814	285.554	2.521	0.24	2.281	22.298	252.882	12.655	265.537
1996 January	283.164	0.614	13.145	296.923	2.6	0.259	2.341	13.96	272.182	13.122	285.304
1996 February	258.386	0.571	11.728	270.685	2.986	0.164	2.822	5.673	256.104	11.73	267.834
1996 March	261.97	0.619	12.43	275.019	3.344	0.172	3.172	16.712	249.033	12.445	261.478
1996 April	240.062	0.6	10.951	251.613	3.214	0.115	3.099	13.358	230.337	11.016	241.353
1996 May	269.65	0.792	11.824	282.266	3.4	0.387	3.014	33.581	239.667	12.032	251.7
1996 June	289.121	0.904	12.692	302.717	4	0.259	3.741	27.591	265.901	12.966	278.867
1996 July	313.189	1.043	13.476	327.708	4.792	0.268	4.524	32.415	285.971	13.847	299.818
1996 August	314.253	1.01	14.024	329.286	5.377	0.308	5.068	30.144	289.873	14.338	304.211
1996 September	269.833	0.855	12.463	283.151	4.038	0.339	3.699	6.132	268.016	12.702	280.718
1996 October	257.615	0.77	13.061	271.446	3.371	0.203	3.169	16.192	245.232	13.192	258.423
1996 November	255.681	0.656	12.785	269.122	3.269	0.252	3.017	18.529	240.792	12.819	253.611
1996 December	271.216	0.596	12.437	284.25	3.106	0.576	2.53	16.33	258.019	12.43	270.449
1997 January	286.626	0.546	13.402	300.574	3.074	0.559	2.515	14.437	275.266	13.386	288.652
1997 February	245.914	0.524	11.693	258.131	2.768	0.73	2.038	-2.334	250.778	11.725	262.503
1997 March	259.078	0.605	12.574	272.258	3.102	0.598	2.504	18.561	243.552	12.649	256.201
1997 April	245.431	0.635	12.218	258.284	3.467	0.512	2.955	14.148	234.755	12.335	247.091
1997 May	259.716	0.704	12.493	272.914	2.872	0.57	2.302	25.777	236.773	12.666	249.439
1997 June	285.909	0.805	12.378	299.092	3.608	0.608	3	28.017	261.423	12.652	274.074
1997 July	329.793	1.037	13.687	344.516	4.641	0.599	4.042	38.17	296.258	14.131	310.389
1997 August	318.125	0.975	13.799	332.899	4.525	0.538	3.987	28.342	294.365	14.179	308.544
1997 September	287.287	0.854	12.915	301.057	3.776	0.84	2.936	12.062	278.717	13.215	291.931
1997 October	270.7	0.736	13.534	284.971	3.746	1.519	2.228	10.64	262.863	13.696	276.559
1997 November	257.924	0.614	12.584	271.121	3.795	1.155	2.64	14.535	246.56	12.666	259.225
1997 December	282.872	0.665	12.819	296.356	3.658	0.747	2.912	22.026	264.3	12.941	277.242
1998 January	281.337	0.548	13.375	295.26	2.697	1.132	1.565	11.974	271.099	13.751	284.851
1998 February	248.634	0.481	11.475	260.59	2.495	1.068	1.427	0.949	249.26	11.808	261.068
1998 March	273.664	0.62	12.594	286.878	2.954	1.069	1.884	22.036	253.675	13.051	266.726
1998 April	248.57	0.597	12.063	261.23	3.369	0.804	2.566	11.747	239.545	12.503	252.048
1998 May	286.065	0.773	12.801	299.64	3.166	1.065	2.101	34.654	253.68	13.407	267.087
1998 June	315.857	0.869	12.178	328.903	3.452	1.321	2.13	34.155	283.993	12.885	296.878
1998 July	346.861	1.02	14.055	361.936	4.615	1.147	3.468	36.994	313.522	14.889	328.411
1998 August	341.973	1.028	14.365	357.366	5.108	0.793	4.315	27.824	318.655	15.202	333.857
1998 September	304.726	0.894	13.304	318.924	3.85	1.234	2.616	10.421	297.097	14.022	311.12
1998 October	270.862	0.704	12.88	284.446	3.005	1.531	1.474	6.201	266.303	13.416	279.719
1998 November	254.7	0.557	11.88	267.136	2.262	1.331	0.931	5.77	250.014	12.283	262.297
1998 December	284.166	0.658	13.162	297.986	2.54	1.16	1.38	18.331	267.386	13.649	281.035
1999 January	301.516	0.598	13.7	315.814	2.329	1.546	0.783	18.175	283.533	14.888	298.421
1999 February	262.375	0.544	11.901	274.82	2.1	1.376	0.723	11.435	251.15	12.959	264.108
1999 March	285.337	0.638	12.17	298.145	2.557	1.886	0.671	24.706	260.773	13.336	274.11
1999 April	267.295	0.713	12.711	280.719	3.836	1.348	2.489	22.442	246.788	13.978	260.766
1999 May	285.908	0.756	13.435	300.098	3.768	1.226	2.541	33.507	254.356	14.776	269.133
1999 June	315.311	0.835	12.778	328.924	3.558	1.063	2.495	32.511	284.733	14.174	298.908
1999 July	361.077	1.006	14.455	376.538	3.557	0.908	2.649	38.773	324.315	16.099	340.414
1999 August	348.523	0.968	14.541	364.031	3.531	0.618	2.913	27.815	322.98	16.149	339.129
1999 September	291.766	0.733	13.017	305.516	4.594	0.593	4.001	0.401	294.798	14.317	309.115
1999 October	270.8	0.668	12.467	283.935	4.628	1.326	3.302	8.161	265.399	13.677	279.076
1999 November	258.026	0.551	12.519	271.096	4.58	1.049	3.531	8.489	252.529	13.609	266.138
1999 December	282.049	0.554	12.571	295.174	4.178	1.283	2.895	13.671	270.732	13.667	284.399
2000 January	315.035	0.567	12.392	327.994	3.641	0.73	2.911	29.681	287.764	13.46	301.224
2000 February	281.3	0.523	12.346	294.169	3.958	0.598	3.36	12.067	272.095	13.367	285.462
2000 March	288.212	0.605	12.763	301.58	3.682	1.022	2.66	27.937	262.418	13.885	276.303
2000 April	272.47	0.608	12.5	285.578	3.737	1.232	2.505	25.292	249.175	13.615	262.79
2000 May	309.092	0.765	13.096	322.954	4.296	1.343	2.953	42.246	269.263	14.398	283.661
2000 June	325.431	0.743	12.88	339.054	4.579	1.642	2.937	28.077	299.765	14.15	313.914
2000 July	342.104	0.837	13.587	356.528	5.234	0.844	4.39	28.37	317.566	14.982	332.548
2000 August	353.254	0.891	14.525	368.669	5.459	0.93	4.529	26.454	330.733	16.012	346.745
2000 September	298.835	0.703	12.909	312.447	4.381	1.088	3.293	-2.092	303.693	14.138	317.831
2000 October	275.711	0.605	13.135	289.452	2.761	1.138	1.622	3.967	272.835	14.272	287.107
2000 November	271.325	0.536	12.809	284.67	3.442	1.185	2.257	8.946	264.121	13.861	277.982
2000 December	304.761	0.519	13.731	319.011	3.422	3.077	0.344	12.566	291.988	14.801	306.789
2001 January	318.736	0.629	13.128	332.493	3.415	1.549	1.865	9.223	310.846	14.289	325.135
2001 February	270.971	0.548	11.421	282.94	3.316	2.852	0.464	-1.351	272.324	12.432	284.756
2001 March	287.7	0.553	12.454	300.707	3.527	1.793	1.734	19.616	269.315	13.51	282.825
2001 April	265.855	0.55	11.674	278.079	3.793	1.415	2.378	13.434	254.326	12.697	267.023

2001 May	288.166	0.575	11.751	300.492	4.416	1.549	2.867	26.113	264.442	12.803	277.245
2001 June	315.148	0.598	11.949	327.694	3.695	1.276	2.42	27.103	289.979	13.032	303.011
2001 July	343.834	0.732	13.048	357.614	3.521	1.173	2.348	29.799	315.85	14.313	330.163
2001 August	356.152	0.814	13.566	370.533	3.751	1.158	2.593	25.933	332.256	14.937	347.193
2001 September	293.882	0.636	12.412	306.929	1.936	1.321	0.615	-2.05	296.042	13.552	309.594
2001 October	281.391	0.622	12.721	294.734	1.775	0.797	0.978	14.257	267.596	13.859	281.455
2001 November	266.155	0.548	12.23	278.934	2.136	0.986	1.15	13.868	252.943	13.273	266.216
2001 December	292.063	0.611	12.822	305.496	3.22	0.604	2.616	25.621	268.538	13.953	282.491
2002 January	306.171	0.597	13.173	319.941	3.306	0.841	2.465	17.136	290.967	14.303	305.271
2002 February	269.476	0.5	11.85	281.826	2.793	0.863	1.93	7.2	263.728	12.827	276.556
2002 March	289.322	0.573	12.654	302.549	3.312	1.785	1.527	22.878	267.46	13.738	281.198
2002 April	277.126	0.546	12.176	289.848	3.411	1.73	1.681	20.369	257.946	13.214	271.16
2002 May	294.517	0.566	12.592	307.675	2.392	1.766	0.627	25.312	269.323	13.666	282.99
2002 June	327.553	0.642	12.829	341.023	3.152	1.338	1.814	32.376	296.47	13.992	310.461
2002 July	366.98	0.743	13.82	381.542	4.293	0.707	3.587	32.718	337.285	15.126	352.411
2002 August	360.351	0.797	13.438	374.586	4.067	1.106	2.961	24.647	338.115	14.786	352.9
2002 September	317.976	0.676	12.628	331.279	2.763	1.154	1.609	8.572	310.498	13.818	324.316
2002 October	294.096	0.6	12.363	307.059	2.482	1.16	1.322	10.739	284.178	13.465	297.643
2002 November	283.374	0.554	12.361	296.29	2.537	1.604	0.933	20.774	263.034	13.415	276.449
2002 December	311.516	0.622	12.697	324.834	2.27	1.743	0.527	25.065	286.462	13.833	300.296
2003 January	327.446	0.617	13.926	341.989	3.063	1.737	1.326	23.946	304.263	15.106	319.369
2003 February	286.699	0.55	11.999	299.249	2.725	1.793	0.931	4.905	282.24	13.035	295.275
2003 March	291.086	0.594	12.637	304.317	2.758	2.384	0.374	16.475	274.473	13.743	288.217
2003 April	273.016	0.581	12.159	285.756	2.561	1.724	0.837	16.65	256.71	13.232	269.942
2003 May	294.241	0.598	12.706	307.545	2.783	2.383	0.399	25.338	268.788	13.819	282.607
2003 June	315.306	0.624	12.763	328.694	2.872	2.481	0.391	24.729	290.45	13.905	304.355
2003 July	360.116	0.709	13.571	374.396	3.727	1.423	2.303	27.658	334.209	14.833	349.042
2003 August	367.42	0.718	13.678	381.816	3.614	1.408	2.206	27.25	341.819	14.953	356.772
2003 September	309.751	0.64	12.744	323.136	1.723	2.118	-0.395	2.249	306.59	13.902	320.492
2003 October	293.289	0.636	12.816	306.741	0.855	2.255	-1.399	13.989	277.38	13.973	291.353
2003 November	284.902	0.588	12.377	297.867	1.382	2.153	-0.771	20.653	262.977	13.466	276.443
2003 December	317.887	0.64	13.154	331.68	2.332	2.114	0.218	23.734	293.836	14.328	308.164
2004 January	332.296	0.694	13.555	346.546	2.276	2.149	0.127	24.016	307.856	14.8	322.657
2004 February	301.278	0.654	12.348	314.28	1.89	2.007	-0.117	14.225	286.433	13.505	299.938
2004 March	295.508	0.634	12.67	308.812	1.762	2.685	-0.923	15.889	278.182	13.819	292.001
2004 April	277.603	0.623	12.334	290.56	2.082	2.077	0.004	14.255	262.851	13.458	276.309
2004 May	313.916	0.699	12.765	327.38	2.448	2.272	0.176	34.535	279.036	13.985	293.021
2004 June	331.531	0.702	12.853	345.085	2.944	2.302	0.642	23.876	307.772	14.079	321.851
2004 July	362.932	0.763	13.637	377.332	4.168	1.271	2.897	31.364	333.907	14.957	348.864
2004 August	354.509	0.749	13.181	368.439	4.777	1.349	3.428	26.471	330.927	14.469	345.396
2004 September	322.329	0.707	12.586	335.622	2.938	1.988	0.95	14.199	308.566	13.807	322.373
2004 October	299.476	0.673	12.301	312.45	2.625	1.563	1.062	18.3	281.737	13.476	295.213
2004 November	289.208	0.656	12.237	302.101	3.035	1.539	1.496	20.042	270.163	13.392	283.555
2004 December	327.775	0.714	13.459	341.948	3.266	1.696	1.57	28.746	300.05	14.721	314.771
2005 January	329.896	0.737	12.489	343.121	3.173	1.695	1.478	22.572	309.079	12.948	322.027
2005 February	286.566	0.656	11.279	298.5	2.997	1.197	1.799	9.102	279.514	11.684	291.198
2005 March	304.624	0.702	12.132	317.458	3.445	1.056	2.389	20.491	286.791	12.565	299.356
2005 April	277.402	0.649	11.512	289.562	3.027	1.188	1.838	15.328	264.168	11.905	276.073
2005 May	302.523	0.686	11.853	315.062	3.281	1.762	1.519	30.805	273.5	12.276	285.776
2005 June	350.246	0.763	12.662	363.672	3.587	1.996	1.591	32.738	319.381	13.143	332.524
2005 July	387.63	0.823	13.821	402.274	4.381	1.582	2.799	35.222	355.514	14.337	369.851
2005 August	390.258	0.821	13.862	404.941	4.985	1.467	3.518	31.54	362.544	14.375	376.918
2005 September	337.681	0.718	11.819	350.218	3.709	1.863	1.846	8.867	330.923	12.273	343.197
2005 October	305.201	0.644	10.553	316.398	3.65	1.779	1.871	9.681	297.626	10.962	308.589
2005 November	294.691	0.627	10.797	306.115	3.77	1.715	2.055	22.4	274.585	11.184	285.77
2005 December	335.474	0.665	11.962	348.101	3.925	1.85	2.075	30.471	307.343	12.362	319.705
2006 January	315.254	0.684	12.72	328.658	3.879	2.436	1.443	12.661	304.866	12.574	317.44
2006 February	295.333	0.643	11.357	307.333	3.415	1.84	1.575	16.605	281.046	11.257	292.304
2006 March	306.041	0.643	12.046	318.73	3.702	2.045	1.658	18.514	289.97	11.903	301.873
2006 April	285.788	0.625	11.445	297.858	3.405	2.001	1.403	19.731	268.208	11.322	279.531
2006 May	317.522	0.713	12.38	330.616	3.719	2.265	1.453	32.588	287.198	12.283	299.481
2006 June	351.36	0.724	12.176	364.26	3.776	2.357	1.419	31.739	321.84	12.101	333.941
2006 July	396.263	0.783	13.375	410.421	4.714	1.646	3.068	37.821	362.387	13.281	375.668
2006 August	393.589	0.78	13.394	407.763	4.672	1.596	3.076	28.909	368.634	13.296	381.93
2006 September	319.181	0.682	12.193	332.055	2.18	2.179	0.001	2.696	317.282	12.077	329.36
2006 October	308.218	0.704	12.645	321.567	2.664	2.311	0.354	18.212	291.186	12.522	303.708
2006 November	296.571	0.682	11.906	309.159	2.913	2.154	0.759	20.928	277.182	11.808	288.99
2006 December	322.957	0.709	12.617	336.283	3.652	1.441	2.211	25.873	300.119	12.501	312.62
2007 January	339.968	0.669	12.894	353.531	3.477	1.575	1.902	29.072	315.104	11.258	326.361
2007 February	311.81	0.641	10.779	323.23	4.193	1.356	2.837	15.257	301.331	9.479	310.81
2007 March	308.331	0.659	11.481	320.471	3.894	2.092	1.803	20.536	291.66	10.077	301.738

2007 April	291.254	0.639	11.236	303.129	3.996	1.168	2.828	20.76	275.341	9.857	285.197
2007 May	317.826	0.68	11.697	330.203	4.639	1.155	3.484	30.613	292.8	10.274	303.074
2007 June	350.339	0.707	11.709	362.755	4.492	1.307	3.185	32.627	323.007	10.306	333.313
2007 July	379.914	0.763	12.55	393.226	5.507	1.737	3.77	33.304	352.642	11.05	363.692
2007 August	407.865	0.774	13.157	421.797	5.399	1.908	3.491	40.359	373.365	11.564	384.929
2007 September	342.713	0.684	11.997	355.394	3.838	2.456	1.382	8.725	337.525	10.526	348.051
2007 October	319.83	0.706	12.08	332.615	3.568	1.556	2.012	16.232	307.783	10.613	318.395
2007 November	301.907	0.667	11.528	314.103	4.322	1.789	2.534	20.214	286.299	10.123	296.422
2007 December	333.586	0.686	12.018	346.29	4.07	2.045	2.025	30.066	307.704	10.545	318.249
2008 January	349.836	0.709	12.453	362.998	5.009	1.757	3.252	28.039	326.215	11.997	338.211
2008 February	313.292	0.636	11.178	325.106	4.587	1.533	3.054	12.296	305.095	10.768	315.863
2008 March	312.41	0.619	11.601	324.63	4.796	2.65	2.146	21.013	294.625	11.138	305.763
2008 April	294.203	0.614	11.049	305.865	4.062	1.329	2.733	20.005	277.963	10.63	288.593
2008 May	313.216	0.609	11.42	325.245	5.339	3.028	2.312	28.316	288.276	10.964	299.24
2008 June	360.612	0.675	11.822	373.109	6.12	3.373	2.747	35.873	328.592	11.391	339.983
2008 July	389.318	0.728	12.855	402.9	6.021	1.708	4.313	34.407	360.427	12.38	372.807
2008 August	375.612	0.715	12.66	388.987	5.822	1.481	4.342	29.281	351.856	12.191	364.047
2008 September	327.021	0.675	10.36	338.056	4.856	1.797	3.059	9.152	321.906	10.058	331.964
2008 October	306.769	0.642	11.137	318.547	3.644	2.037	1.606	17.656	291.762	10.735	302.497
2008 November	299.222	0.623	10.201	310.046	3.282	2.06	1.222	23.072	278.33	9.866	288.196
2008 December	332.839	0.681	10.378	343.898	3.481	1.446	2.035	26.938	308.916	10.08	318.996
2009 January	343.516	0.717	10.76	354.993	4.266	2.25	2.017	25.016	321.624	10.369	331.993
2009 February	290.221	0.627	10.04	300.887	3.885	1.531	2.354	7.353	286.251	9.637	295.889
2009 March	299.257	0.668	10.678	310.603	2.949	1.707	1.242	17.786	283.808	10.251	294.059
2009 April	278.994	0.633	9.91	289.537	3.291	1.486	1.806	16.353	265.464	9.526	274.99
2009 May	300.496	0.64	10.17	311.306	4.127	1.39	2.737	28.999	275.276	9.767	285.043
2009 June	336.011	0.675	10.973	347.658	4.73	1.626	3.104	34.718	305.52	10.524	316.044
2009 July	359.842	0.733	11.968	372.542	5.5	1.421	4.079	27.268	337.878	11.475	349.353
2009 August	368.139	0.769	12.314	381.221	5.83	1.355	4.475	29.031	344.845	11.82	356.666
2009 September	315.163	0.693	11.545	327.401	4.471	1.381	3.09	8.87	310.563	11.057	321.62
2009 October	295.093	0.659	11.289	307.04	4.71	1.357	3.353	12.482	287.116	10.795	297.911
2009 November	285.012	0.648	10.975	296.635	3.831	1.283	2.548	20.523	268.158	10.501	278.659
2009 December	338.095	0.703	11.709	350.507	4.6	1.352	3.248	32.25	310.291	11.214	321.505
2010 January	348.128	0.709	12.12	360.957	5.31	1.17	4.14	22.134	331.879	11.084	342.963
2010 February	307.994	0.623	11.118	319.735	4.413	1.025	3.389	14.519	298.46	10.144	308.604
2010 March	299.571	0.661	11.936	312.168	4.355	1.305	3.049	11.822	292.511	10.884	303.395
2010 April	276.121	0.645	11.034	287.8	3.885	1.278	2.608	13.265	267.052	10.091	277.143
2010 May	315.656	0.666	11.614	327.936	3.06	1.737	1.323	34.92	283.729	10.611	294.34
2010 June	362.985	0.699	12.075	375.759	4.055	1.56	2.496	36.325	330.893	11.037	341.93
2010 July	396.195	0.812	12.718	409.725	4.307	1.494	2.813	31.83	369.018	11.69	380.708
2010 August	394.651	0.838	13.395	408.884	3.638	1.819	1.819	26.636	371.769	12.298	384.067
2010 September	333.057	0.75	12.238	346.045	2.907	2.386	0.521	7.602	327.742	11.221	338.964
2010 October	295.646	0.712	11.562	307.921	2.535	2.103	0.432	9.908	287.84	10.605	298.445
2010 November	293.833	0.683	11.493	306.01	2.667	1.874	0.793	21.383	274.9	10.52	285.42
2010 December	348.549	0.793	12.777	362.119	3.951	1.356	2.595	33.942	319.048	11.725	330.773
2011 January	350.001	0.817	12.054	362.872	4.282	1.594	2.688	20.199	334.116	11.245	345.36
2011 February	301.632	0.725	10.77	313.127	3.741	1.521	2.22	8.401	296.903	10.042	306.946
2011 March	306.808	0.753	11.149	318.71	4.023	1.541	2.482	18.742	292.052	10.398	302.45
2011 April	290.519	0.706	11.175	302.401	3.799	1.603	2.196	19.013	275.204	10.38	285.584
2011 May	311.403	0.867	11.359	323.628	4.898	1.276	3.622	28.576	287.993	10.681	298.674
2011 June	354.929	0.86	11.938	367.727	4.483	1.316	3.167	31.005	328.707	11.181	339.888
2011 July	404.802	1.023	12.868	418.693	6.023	1.255	4.768	40.633	370.692	12.136	382.828
2011 August	392.441	0.985	13.085	406.511	5.584	1.009	4.575	26.074	372.72	12.292	385.012
2011 September	325.113	0.87	11.948	337.931	4.036	1.016	3.02	3.505	326.247	11.199	337.446
2011 October	296.676	0.799	11.224	308.699	3.7	0.914	2.787	12.849	288.133	10.504	298.637
2011 November	291.639	0.8	11.663	304.102	3.471	1.13	2.341	20.32	275.235	10.888	286.123
2011 December	322.225	0.874	12.642	335.74	4.26	0.874	3.386	25.474	301.844	11.808	313.652
2012 January	326.185	0.916	12.425	339.526	4.149	0.934	3.215	20.099	310.975	11.667	322.643
2012 February	296.79	0.9	11.699	309.389	3.639	0.869	2.77	14.158	286.983	11.018	298.001
2012 March	296.497	0.911	11.682	309.09	4.205	1.198	3.007	17.353	283.731	11.013	294.744
2012 April	283.183	0.888	11.158	295.229	4.996	1.256	3.739	17.674	270.76	10.535	281.294
2012 May	323.598	0.93	11.988	336.516	5.472	1.15	4.322	32.572	296.968	11.297	308.266
2012 June	347.759	0.975	12.091	360.825	5.37	1.211	4.159	28.398	325.16	11.427	336.587
2012 July	400.316	1.135	13.19	414.641	6.675	1.008	5.667	36.817	370.963	12.528	383.49
2012 August	381.494	1.046	13.16	395.7	6.347	0.85	5.497	23.989	364.785	12.423	377.208
2012 September	321.586	0.93	12.069	334.586	4.908	0.906	4.002	9.13	318.09	11.368	329.458
2012 October	298.906	0.904	11.841	311.652	4.405	0.744	3.661	13.431	290.735	11.146	301.882
2012 November	293.047	0.876	12.052	305.976	4.695	0.8	3.895	20.352	278.212	11.306	289.518
2012 December	320.996	0.888	12.751	334.635	4.397	1.07	3.327	28.746	297.288	11.927	309.216
2013 January	335.062	0.981	12.924	348.967	5.378	1.056	4.322	20.311	320.683	12.296	332.978
2013 February	297.198	0.888	11.642	309.728	5.091	0.845	4.246	11.415	291.48	11.079	302.559

2013 March	311.828	0.995	12.576	325.399	5.578	0.952	4.626	20.799	297.226	12	309.226
2013 April	286.807	0.946	11.58	299.333	5.224	1.248	3.976	14.451	277.782	11.076	288.858
2013 May	309.028	0.981	12.147	322.156	5.972	0.958	5.014	26.164	289.398	11.608	301.006
2013 June	343.286	1.026	12.511	356.823	6.292	0.779	5.514	30.167	320.201	11.969	332.17
2013 July	380.108	1.236	13.502	394.846	6.855	0.983	5.872	28.986	358.701	13.031	371.732
2013 August	370.943	1.147	13.195	385.286	6.991	0.848	6.142	25.167	353.58	12.682	366.262
2013 September	327.638	1.073	12.23	340.941	5.658	0.726	4.932	10.633	323.478	11.762	335.24
2013 October	301.782	0.961	12.182	314.925	5.319	0.971	4.348	13.282	294.37	11.621	305.992
2013 November	301.287	0.936	12.317	314.54	5.559	0.896	4.664	25.991	281.494	11.718	293.212
2013 December	338.748	1.064	13.21	353.021	5.33	1.112	4.218	28.144	316.475	12.621	329.095
2014 January	363.642	1.218	12.391	377.251	5.467	1.282	4.184	28.155	341.238	12.043	353.281
2014 February	312.274	0.961	11.112	324.347	4.437	1.293	3.145	7.868	308.941	10.683	319.624
2014 March	318.912	0.972	11.937	331.821	5.584	1.937	3.647	21.657	302.388	11.423	313.811
2014 April	285.451	0.927	11.251	297.628	4.791	1.337	3.453	14.412	275.894	10.776	286.669
2014 May	312.067	0.986	11.667	324.719	5.39	0.826	4.564	26.666	291.421	11.196	302.617
2014 June	344.984	1.041	11.814	357.84	5.493	1.045	4.448	28.121	322.792	11.376	334.168
2014 July	371.813	1.173	12.79	385.775	6.299	1.03	5.269	27.165	351.524	12.355	363.879
2014 August	370.3	1.181	12.856	384.337	6.678	0.863	5.815	25.848	351.883	12.421	364.304
2014 September	326.752	1.086	12.044	339.883	6.034	0.766	5.268	6.625	326.907	11.619	338.526
2014 October	301.843	1.008	11.667	314.518	5.372	0.951	4.421	11.043	296.68	11.216	307.896
2014 November	304.734	0.96	11.797	317.491	5.583	0.875	4.708	25.498	285.413	11.288	296.701
2014 December	324.189	1.007	12.757	337.953	5.383	1.092	4.291	20.445	309.62	12.179	321.799
2015 January	346.755	0.981	12.717	360.453	6.039	0.817	5.221	23.794	329.666	12.214	341.881
2015 February	322.593	0.932	11.071	334.596	5.574	1.355	4.219	21.343	306.768	10.703	317.472
2015 March	311.862	0.977	11.475	324.314	6.632	0.944	5.688	13.547	305.352	11.103	316.455
2015 April	282.241	0.931	11.005	294.177	6.528	0.585	5.943	14.001	275.475	10.644	286.119
2015 May	309.654	1.013	11.522	322.189	6.616	0.609	6.007	28.928	288.091	11.178	299.268
2015 June	349.151	1.098	12.244	362.493	6.694	0.617	6.077	30.276	326.397	11.897	338.294
2015 July	386.005	1.238	13.292	400.535	6.896	0.647	6.249	30.889	362.938	12.956	375.894
2015 August	377.982	1.206	13.054	392.242	7.168	0.657	6.511	24.005	362.032	12.716	374.748
2015 September	336.686	1.145	12.359	350.19	6.611	0.709	5.902	11.093	332.958	12.042	345
2015 October	299.267	1.049	11.894	312.21	5.26	0.696	4.564	9.177	296.055	11.542	307.598
2015 November	287.677	0.992	12.11	300.779	5.849	0.661	5.188	18.367	275.917	11.684	287.6
2015 December	310.532	1.033	12.97	324.536	5.906	0.805	5.101	19.806	297.344	12.488	309.831
2016 January	339.195	1.022	12.497	352.714	6.523	0.389	6.134	26.038	320.89	11.92	332.81
2016 February	301.253	0.967	11.597	313.816	5.433	0.552	4.881	10.814	296.806	11.078	307.883
2016 March	291.3	1.011	12.117	304.427	5.809	0.671	5.138	12.178	285.812	11.575	297.387
2016 April	280.641	0.961	11.386	292.987	4.702	0.45	4.252	16.822	269.531	10.886	280.417
2016 May	303.962	1.019	11.886	316.867	5.561	0.37	5.191	25.972	284.708	11.379	296.086
2016 June	354.567	1.089	12.248	367.904	6.748	0.61	6.138	32.405	329.878	11.759	341.637
2016 July	397.791	1.263	12.989	412.043	7.674	0.575	7.099	34.404	372.172	12.566	384.739
2016 August	395.489	1.298	13.075	409.861	7.349	0.587	6.762	22.759	381.192	12.672	393.865
2016 September	338.335	1.114	12.111	351.56	5.297	0.587	4.711	7.858	336.752	11.66	348.412
2016 October	300.068	1.021	11.851	312.94	5.751	0.432	5.319	10.228	296.681	11.349	308.03
2016 November	284.286	0.927	11.852	297.065	6.421	0.417	6.004	14.485	277.317	11.268	288.585
2016 December	332.091	1.015	12.283	345.389	5.448	0.574	4.873	27.815	310.722	11.725	322.447
2017 January	330.941	1.103	12.37	344.414	7.019	0.484	6.535	20.661	318.177	12.111	330.288
2017 February	278.967	0.98	11.165	291.113	5.672	0.69	4.982	9.401	275.777	10.917	286.694
2017 March	306.515	1.087	11.867	319.469	6.023	0.998	5.025	21.407	291.444	11.644	303.088
2017 April	283	0.986	11.476	295.462	5.562	1.106	4.456	15.914	272.801	11.202	284.003
2017 May	310.751	1.074	11.67	323.494	5.084	0.832	4.252	24.421	291.871	11.455	303.325
2017 June	345.349	1.138	12.143	358.63	5.993	0.811	5.182	23.291	328.583	11.938	340.521
2017 July	390.399	1.227	12.912	404.537	5.913	0.708	5.205	29.42	367.613	12.709	380.322
2017 August	370.893	1.201	12.743	384.837	6.509	0.773	5.736	17.777	360.263	12.534	372.797
2017 September	323.561	1.098	11.345	336.004	5.228	0.692	4.536	7.63	321.726	11.184	332.91
2017 October	306.146	1.054	11.531	318.731	3.952	0.71	3.242	11.122	299.539	11.312	310.852
2017 November	295.451	1.006	11.731	308.189	3.93	0.823	3.107	16.499	283.347	11.45	294.797
2017 December	336.653	1.105	12.806	350.563	4.799	0.744	4.055	29.899	312.216	12.504	324.72
2018 January	359.598	1.114	12.668	373.379	5.225	1.14	4.085	20.6	344.478	12.386	356.864
2018 February	294.797	0.995	11.265	307.058	4.788	1.268	3.52	6.826	292.732	11.02	303.752
2018 March	308.965	1.058	11.742	321.765	5.599	1.195	4.403	17.664	296.999	11.505	308.504
2018 April	288.81	0.989	11.258	301.057	4.529	1.622	2.907	14.489	278.468	11.007	289.475
2018 May	326.185	1.076	11.967	339.228	5.239	1.141	4.098	28.355	303.248	11.723	314.971
2018 June	358.783	1.163	12.199	372.145	5.494	1.215	4.279	26.331	338.083	12.01	350.093
2018 July	397.18	1.298	13.138	411.617	5.371	0.935	4.435	28.054	375.023	12.975	387.998
2018 August	393.822	1.318	13.212	408.352	6.136	1.134	5.002	19.164	381.131	13.06	394.19
2018 September	343.217	1.156	12.185	356.558	4.251	1.061	3.19	10.494	337.263	11.991	349.253
2018 October	311.888	1.055	12.127	325.07	3.719	0.884	2.835	6.943	309.114	11.848	320.961
2018 November	309.16	0.993	12.313	322.466	3.813	1.285	2.528	22.528	290.507	11.959	302.466
2018 December	328.473	1.095	12.724	342.292	4.099	0.925	3.174	20.907	312.14	12.42	324.56
2019 January	345.543	1.16	13.025	359.729	4.805	1.464	3.341	21.933	328.609	12.528	341.137

2019 February	302.89	1.057	11.335	315.282	4.552	1.418	3.134	11.674	295.798	10.944	306.741
2019 March	313.631	1.173	12.099	326.903	4.95	2.549	2.401	15.73	301.853	11.721	313.574
2019 April	284.599	1.053	11.301	296.953	4.355	1.968	2.386	14.529	273.9	10.91	284.81
2019 May	317.735	1.072	11.854	330.661	4.723	1.682	3.041	25.485	296.802	11.415	308.217
2019 June	339.96	1.133	12.147	353.239	5.156	1.526	3.63	23.68	321.462	11.728	333.189
2019 July	395.874	1.313	13.178	410.365	5.643	1.957	3.685	25.158	376.095	12.798	388.892
2019 August	387.206	1.29	13.236	401.732	5.865	1.785	4.08	20.409	372.574	12.828	385.402
2019 September	347.136	1.15	12.474	360.76	5.293	1.776	3.517	11.782	340.463	12.032	352.495
2019 October	307.164	1.072	12.281	320.518	3.661	1.465	2.196	2.68	308.241	11.793	320.034
2019 November	302.301	1.066	12.531	315.897	4.839	1.244	3.595	21.953	285.532	12.008	297.54
2019 December	324.308	1.151	13.077	338.536	5.212	1.175	4.037	20.185	309.823	12.566	322.388
2020 January	327.71	1.145	13.164	342.019	4.608	1.425	3.182	16.913	315.533	12.755	328.288
2020 February	306.456	1.074	12.169	319.698	4.487	1.655	2.832	16.066	294.659	11.805	306.464
2020 March	296.522	1.05	12.297	309.87	5.095	1.317	3.778	11.855	289.894	11.898	301.792
2020 April	267.767	0.943	11.136	279.846	4.703	1.459	3.244	9.922	262.401	10.767	273.168
2020 May	292.546	1.012	11.278	304.837	5.198	1.493	3.705	22.879	274.707	10.956	285.663
2020 June	339.302	1.103	11.563	351.967	5.203	1.3	3.903	24.525	320.056	11.29	331.346
2020 July	396.375	1.293	12.203	409.871	6.648	1.221	5.427	23.737	379.53	12.031	391.561
2020 August	384.973	1.241	12.321	398.536	6.813	0.931	5.883	23.444	368.885	12.09	380.975
2020 September	321.032	1.097	11.363	333.493	4.694	0.954	3.74	3.571	322.555	11.108	333.662
2020 October	301.415	1.032	11.257	313.703	4.654	0.77	3.885	9.757	296.877	10.954	307.831
2020 November	289.138	0.987	11.278	301.403	4.216	0.803	3.413	16.634	277.249	10.933	288.183
2020 December	330.933	1.069	12.522	344.523	5.129	0.807	4.322	21.401	315.33	12.115	327.445
2021 January	335.508	1.096	12.606	349.21	5.086	0.941	4.145	19.378	321.496	12.48	333.977
2021 February	312.79	0.973	10.136	323.9	4.024	1.097	2.927	17.01	299.698	10.118	309.816
2021 March	299.4	0.988	11.01	311.397	4.569	0.743	3.826	8.951	295.345	10.928	306.273
2021 April	281.725	0.938	10.645	293.308	4.389	1.065	3.324	13.303	272.779	10.55	283.329
2021 May	308.036	0.966	11.179	320.181	4.667	0.972	3.695	22.754	290.061	11.062	301.122
2021 June	360.919	1.101	11.837	373.856	5.246	0.804	4.442	28.099	338.415	11.784	350.199
2021 July	391.705	1.204	12.715	405.624	5.512	1.098	4.414	23.412	373.948	12.678	386.626
2021 August	399.043	1.242	12.579	412.865	4.637	1.266	3.372	22.608	381.039	12.589	393.628
2021 September	335.24	1.115	11.389	347.744	3.915	1.175	2.741	2.652	336.444	11.388	347.832
2021 October	307.591	1.04	11.571	320.202	4.159	1.308	2.851	9.44	302.127	11.486	313.613
2021 November	301.458	1.031	11.82	314.31	2.965	1.803	1.162	16.633	287.134	11.705	298.839
2021 December	323.766	1.074	12.264	337.104	3.997	1.584	2.413	19.982	307.387	12.148	319.535
2022 January	359.855	1.403	12.508	373.766	4.468	1.47	2.998	25.71	338.656	12.397	351.053
2022 February	312.158	1.232	10.921	324.311	3.36	1.539	1.821	9.437	305.863	10.831	316.694
2022 March	311.53	1.328	11.673	324.53	3.681	1.685	1.996	10.64	304.3	11.587	315.887
2022 April	291.814	1.308	10.871	303.994	3.87	1.374	2.496	10.702	284.933	10.855	295.788
2022 May	329.317	1.381	11.485	342.184	4.375	1.608	2.767	23.786	309.697	11.467	321.164
2022 June	366.018	1.455	11.661	379.134	5.515	1.13	4.384	24.722	347.106	11.69	358.796
2022 July	408.874	1.592	12.51	422.975	6.738	1.274	5.464	26.658	389.214	12.567	401.782
2022 August	398.041	1.595	12.498	412.133	7.229	1.316	5.913	15.86	389.626	12.56	402.186
2022 September	338.966	1.417	11.272	351.655	5.188	1.351	3.837	3.64	340.544	11.309	351.853
2022 October	301.419	1.3	11.23	313.949	4.14	1.252	2.888	8.474	297.196	11.167	308.363
2022 November	308.815	1.33	11.635	321.78	3.534	0.907	2.627	20.595	292.258	11.555	303.812
2022 December	347.081	1.397	11.779	360.257	4.873	0.852	4.021	24.76	327.776	11.742	339.518
2023 January	335.037	1.316	11.597	347.95	4.488	1.203	3.285	14.394	325.415	11.427	336.841
2023 February	298.904	1.215	10.803	310.922	3.524	1.58	1.944	9.286	292.946	10.635	303.58
2023 March	318.825	1.264	11.616	331.704	3.891	1.329	2.562	16.415	306.454	11.397	317.851
2023 April	290.513	1.214	10.176	301.903	3.586	1.674	1.913	12.926	280.811	10.079	290.89
2023 May	314.977	1.317	11.18	327.474	3.904	1.279	2.624	20.335	298.706	11.058	309.764
2023 June	346.192	1.381	11.66	359.234	3.066	1.376	1.69	20.585	328.798	11.54	340.338
2023 July	411.67	1.529	12.255	425.455	3.217	1.986	1.231	27.232	387.256	12.198	399.454
2023 August	409.024	1.471	12.41	422.905	3.003	1.619	1.384	19.57	392.436	12.283	404.719
2023 September	347.36	1.37	11.76	360.49	2.356	2.27	0.086	2.481	346.476	11.618	358.095
2023 October	314.037	1.323	11.358	326.718	2.211	2.006	0.205	7.637	308.065	11.221	319.287
2023 November	307.854	1.308	11.622	320.785	2.469	1.829	0.64	15.735	294.248	11.442	305.69
2023 December	334.148	1.358	12.226	347.732	3.202	1.863	1.339	24.408	312.642	12.02	324.662
2024 January	367.315	1.33	12.477	381.122	3.613	1.876	1.737	26.876	343.717	12.266	355.982
2024 February	309.83	1.204	11.181	322.214	2.539	2.379	0.16	8.115	303.258	11.002	314.26
2024 March	312.454	1.221	11.263	324.938	2.207	2.556	-0.349	16.221	297.278	11.09	308.369
2024 April	298.668	1.187	10.925	310.78	1.8	2.263	-0.463	13.3	286.257	10.76	297.017
2024 May	336.017	1.245	11.224	348.485	1.792	1.746	0.045	23.492	313.961	11.077	325.038
2024 June	379.202	1.308	11.122	391.632	2.874	1.453	1.422	26.129	355.882	11.042	366.924
2024 July	415.921	1.435	11.96	429.317	4.001	1.514	2.487	22.031	397.873	11.9	409.773
2024 August	409.363	1.409	12.354	423.127	3.375	1.219	2.156	18.856	394.199	12.227	406.427
2024 September	346.986	1.257	11.154	359.397	3.094	0.991	2.102	7.403	343.071	11.025	354.096
2024 October	322.427	1.215	10.338	333.98	2.796	0.906	1.891	9.705	315.902	10.264	326.166
2024 November	310.289	1.21	10.852	322.351	1.79	1.247	0.543	16.383	295.796	10.715	306.511
2024 December	348.153	1.238	11.9	361.292	3.373	1.287	2.086	23.519	328.188	11.672	339.86

2025 January	388.52	1.351	12.474	402.345	4.073	1.232	2.841	30.923	361.981	12.282	374.263
2025 February	326.482	1.228	10.882	338.592	3.134	1.247	1.887	9.16	320.561	10.758	331.319
2025 March	320.799	1.295	11.535	333.629	2.374	1.563	0.811	15.801	307.241	11.398	318.639
2025 April	308.595	1.196	10.687	320.478	2.913	1.244	1.669	16.743	294.846	10.557	305.403
2025 May	331.852	1.194	10.989	344.034	3.324	0.99	2.334	23.057	312.489	10.822	323.311
2025 June	380.605	1.345	11.335	393.285	2.712	0.905	1.807	26.727	357.1	11.264	368.365
2025 July	432.852	1.474	11.993	446.32	2.152	1.274	0.879	27.604	407.63	11.964	419.594
2025 August	406.689	1.445	12.107	420.242	2.407	1.306	1.101	16.672	392.631	12.04	404.671
2025 September	355.223	1.324	11.598	368.145	2.332	1.034	1.297	11.761	346.202	11.479	357.681
2025 October	332.47	1.357	11.426	345.253	1.582	2.165	-0.584	12.725	320.588	11.357	331.945
2025 November	322.201	1.34	11.445	334.986	1.193	2.231	-1.038	23.568	299.022	11.358	310.379
2025 December	368.913	1.369	11.912	382.194	1.892	2.536	-0.645	32.035	337.716	11.799	349.514
2026 January	386.211	1.362	11.956	399.529	2.18	2.87	-0.69	31.068	355.94	11.831	367.771
2026 February	331.112	1.188	10.501	342.801	2.43	2.031	0.399	9.781	323.035	10.384	333.419
2026 March	336.288	1.318	11.15	348.756	2.287	2.285	0.002	23.373	314.308	11.077	325.385
2026 April	318.838	1.163	10.706	330.707	2.603	1.538	1.064	19.1	302.127	10.544	312.67
2026 May	342.517	1.239	10.934	354.691	3.64	0.946	2.693	26.473	320.096	10.815	330.911
2026 June	387.616	1.33	10.725	399.671	4.08	0.934	3.146	29.707	362.401	10.71	373.111
2026 July	440.356	1.469	11.919	453.744	4.535	1.022	3.514	30.087	415.276	11.894	427.171

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Note: Information about data precision.

Release Date: October 29, 2026
Next Update: November 30, 2026

Table 7.1 Electricity Overview

Annual Total	Electricity Net Generation, Electric Power Sector	Electricity Net Generation, Commercial Sector	Electricity Net Generation, Industrial Sector	Electricity Net Generation, Total	Electricity Imports	Electricity Exports	Electricity Net Imports	Transmission and Distribution Losses and Unaccounted for	Electricity Sales to Ultimate Customers	Electricity Direct Use	Electricity End Use, Total
	(Billion Kilowatthours)	(Billion Kilowatthours)	(Billion Kilowatthours)	(Billion Kilowatthours)	(Billion Kilowatthours)	(Billion Kilowatthours)	(Billion Kilowatthours)	(Billion Kilowatthours)	(Billion Kilowatthours)	(Billion Kilowatthours)	(Billion Kilowatthours)
1949	291.1	Not Available	5.025	296.124	1.764	0.175	1.588	43.201	254.511	Not Available	254.511
1950	329.141	Not Available	4.946	334.088	1.933	0.147	1.786	44.43	291.443	Not Available	291.443
1951	370.673	Not Available	4.626	375.298	2.387	0.2	2.187	47.201	330.285	Not Available	330.285
1952	399.224	Not Available	4.606	403.829	2.506	0.237	2.269	49.934	356.164	Not Available	356.164
1953	442.665	Not Available	4.384	447.049	2.437	0.429	2.008	52.84	396.217	Not Available	396.217
1954	471.686	Not Available	4.571	476.258	2.688	0.348	2.34	54.434	424.164	Not Available	424.164
1955	547.038	Not Available	3.261	550.299	4.567	0.5	4.068	57.618	496.748	Not Available	496.748
1956	600.668	Not Available	3.208	603.876	5.179	0.631	4.548	62.144	546.28	Not Available	546.28
1957	631.517	Not Available	3.125	634.642	4.856	1.254	3.601	62.424	575.82	Not Available	575.82
1958	645.098	Not Available	3.352	648.451	4.078	0.76	3.318	63.906	587.863	Not Available	587.863
1959	710.006	Not Available	3.373	713.379	4.393	0.838	3.554	70.045	646.888	Not Available	646.888
1960	755.549	Not Available	3.607	759.156	5.323	0.788	4.535	75.616	688.075	Not Available	688.075
1961	793.76	Not Available	3.365	797.124	3.17	0.917	2.254	77.428	721.95	Not Available	721.95
1962	854.535	Not Available	3.409	857.944	2.197	1.661	0.536	80.88	777.6	Not Available	777.6
1963	916.793	Not Available	3.235	920.028	2.083	1.985	0.098	87.513	832.613	Not Available	832.613
1964	983.99	Not Available	3.228	987.218	6.209	4.253	1.955	93.115	896.059	Not Available	896.059
1965	1055.252	Not Available	3.134	1058.386	3.558	3.699	-0.141	104.455	953.789	Not Available	953.789
1966	1144.35	Not Available	3.182	1147.532	4.268	3.176	1.092	113.479	1035.145	Not Available	1035.145
1967	1214.365	Not Available	3.431	1217.796	4.051	4.35	-0.299	118.279	1099.217	Not Available	1099.217
1968	1329.443	Not Available	3.383	1332.826	3.654	4.285	-0.631	129.324	1202.871	Not Available	1202.871
1969	1442.182	Not Available	3.276	1445.458	4.902	3.83	1.072	132.696	1313.833	Not Available	1313.833
1970	1531.868	Not Available	3.244	1535.111	6.17	4.209	1.96	144.772	1392.3	Not Available	1392.3
1971	1612.633	Not Available	3.221	1615.854	7.044	3.514	3.53	149.844	1469.54	Not Available	1469.54
1972	1749.662	Not Available	3.316	1752.978	10.495	2.809	7.687	165.504	1595.161	Not Available	1595.161
1973	1860.71	Not Available	3.347	1864.057	16.848	2.57	14.278	165.426	1712.909	Not Available	1712.909
1974	1867.14	Not Available	3.18	1870.319	15.42	2.726	12.694	177.089	1705.924	Not Available	1705.924
1975	1917.649	Not Available	3.106	1920.755	11.268	5.083	6.185	179.849	1747.091	Not Available	1747.091
1976	2037.696	Not Available	3.217	2040.914	10.988	2.378	8.61	194.278	1855.246	Not Available	1855.246
1977	2124.323	Not Available	3.124	2127.447	20.159	2.744	17.416	196.502	1948.361	Not Available	1948.361
1978	2206.331	Not Available	3.046	2209.377	21.208	1.478	19.73	211.185	2017.922	Not Available	2017.922
1979	2247.372	Not Available	3.293	2250.665	22.516	2.182	20.334	199.9	2071.099	Not Available	2071.099
1980	2286.439	Not Available	3.161	2289.6	25.021	4.096	20.926	216.077	2094.449	Not Available	2094.449
1981	2294.812	Not Available	3.161	2297.973	36.298	3.06	33.237	184.108	2147.103	Not Available	2147.103
1982	2241.211	Not Available	3.161	2244.372	32.852	3.536	29.316	187.247	2086.441	Not Available	2086.441
1983	2310.285	Not Available	3.161	2313.446	38.668	3.337	35.33	197.821	2150.955	Not Available	2150.955
1984	2416.304	Not Available	3.161	2419.465	42.219	2.558	39.661	173.33	2285.796	Not Available	2285.796
1985	2469.841	Not Available	3.161	2473.002	45.895	4.965	40.931	189.959	2323.974	Not Available	2323.974
1986	2487.31	Not Available	3.161	2490.471	40.713	4.816	35.897	157.615	2368.753	Not Available	2368.753
1987	2572.127	Not Available	3.161	2575.288	52.219	5.882	46.337	164.352	2457.272	Not Available	2457.272
1988	2704.25	Not Available	3.161	2707.411	38.837	7.067	31.77	161.119	2578.062	Not Available	2578.062
1989	2848.227	4.251	114.828	2967.146	26.11	15.135	10.976	222.487	2646.809	108.826	2755.635
1990	2901.322	5.837	130.83	3037.827	18.445	16.134	2.312	203.056	2712.555	124.529	2837.084
1991	2935.561	5.659	132.579	3073.799	21.931	2.305	19.626	207.365	2762.003	124.057	2886.06
1992	2934.374	6.228	143.28	3083.882	28.247	2.827	25.42	212.096	2763.365	133.841	2897.207
1993	3043.897	7	146.294	3197.191	31.358	3.541	27.817	224.308	2861.462	139.238	3000.7
1994	3088.725	7.619	151.178	3247.522	46.833	2.01	44.823	211.457	2934.563	146.325	3080.888
1995	3194.23	8.232	151.025	3353.487	42.854	3.623	39.231	228.755	3013.287	150.677	3163.963
1996	3284.141	9.03	151.017	3444.188	43.497	3.302	40.195	230.617	3101.127	152.638	3253.765
1997	3329.375	8.701	154.097	3492.172	43.031	8.974	34.057	224.38	3145.61	156.239	3301.849
1998	3457.416	8.748	154.132	3620.295	39.513	13.656	25.857	221.056	3264.231	160.866	3425.097
1999	3529.982	8.563	156.264	3694.81	43.215	14.222	28.993	240.086	3312.087	171.629	3483.716
2000	3637.529	7.903	156.673	3802.105	48.592	14.829	33.763	243.511	3421.414	170.943	3592.357
2001	3580.053	7.416	149.175	3736.644	38.5	16.473	22.027	201.564	3394.458	162.649	3557.107
2002	3698.458	7.415	152.58	3858.452	36.779	15.796	20.983	247.785	3465.466	166.184	3631.65
2003	3721.159	7.496	154.53	3883.185	30.395	23.975	6.42	227.576	3493.734	168.295	3662.029

2004	3808.36	8.27	153.925	3970.555	34.21	22.898	11.312	265.918	3547.479	168.47	3715.949
2005	3902.192	8.492	144.739	4055.423	43.929	19.151	24.778	269.217	3660.969	150.016	3810.984
2006	3908.077	8.371	148.254	4064.702	42.691	24.271	18.42	266.277	3669.919	146.927	3816.845
2007	4005.343	8.273	143.128	4156.745	51.396	20.144	31.252	297.766	3764.561	125.67	3890.231
2008	3974.349	7.926	137.113	4119.388	57.019	24.198	32.821	286.048	3733.965	132.197	3866.161
2009	3809.837	8.165	132.329	3950.331	52.191	18.138	34.053	260.65	3596.795	126.938	3723.733
2010	3972.386	8.592	144.082	4125.06	45.083	19.106	25.977	264.285	3754.841	131.91	3886.752
2011	3948.186	10.08	141.875	4100.141	52.3	15.049	37.251	254.792	3749.846	132.754	3882.6
2012	3890.358	11.301	146.107	4047.765	59.257	11.996	47.261	262.72	3694.65	137.657	3832.306
2013	3903.715	12.234	150.015	4065.964	69.249	11.373	57.876	255.51	3724.868	143.462	3868.33
2014	3936.961	12.52	144.083	4093.564	66.51	13.298	53.212	243.502	3764.7	138.574	3903.274
2015	3920.407	12.595	145.712	4078.714	75.77	9.1	66.671	245.224	3758.992	141.168	3900.16
2016	3918.977	12.706	145.89	4077.574	72.716	6.214	66.502	241.778	3762.462	139.837	3902.298
2017	3878.625	13.06	143.758	4035.443	65.685	9.371	56.314	227.442	3723.356	140.959	3864.315
2018	4020.877	13.312	146.798	4180.988	58.261	13.804	44.456	222.355	3859.185	143.904	4003.089
2019	3968.348	13.689	148.537	4130.574	59.052	20.008	39.044	215.198	3811.15	143.27	3954.421
2020	3854.17	13.046	142.551	4009.767	61.449	14.135	47.314	200.704	3717.674	138.703	3856.377
2021	3957.181	12.768	139.75	4109.699	53.167	13.855	39.312	204.222	3805.874	138.915	3944.789
2022	4073.888	16.737	140.043	4230.668	56.97	15.758	41.212	204.985	3927.169	139.726	4066.895
2023	4028.541	16.066	138.664	4183.27	38.917	20.013	18.904	191.003	3874.253	136.918	4011.172
2024	4156.627	15.258	136.749	4308.634	33.254	19.437	13.817	212.029	3975.382	135.041	4110.422
2025	4275.202	15.917	138.383	4429.502	30.086	17.728	12.358	246.775	4058.007	137.077	4195.085

APPENDIX B

Technical Memorandum on the EPA Supplemental Proposal's Reliance on Global Average Temperature and Sea Level Rise Metrics

L. Delta Merner, Carly A. Phillips, Carlos Martinez & Rachel Cleetus,
Union of Concerned Scientists

I. Introduction

This technical memorandum supports the joint comments filed by Public Health and Environmental Organizations on EPA's proposed supplemental rulemaking entitled "Rescission of the Greenhouse Gas Findings for Fossil Fuel-Fired Power Plants and Repeal of Regulations for Power Plant Greenhouse Gas Emissions Under Clean Air Act Section 111," 91 Fed. Reg. 59,002 (Sept. 17, 2026). This memo examines how EPA's recent use of global mean surface temperature (GMST) and global mean sea level (GMSL) as the only metrics to assess the impacts of climate change is contrary to the scientific consensus which shows that seemingly "small" increases in GMST and GMSL translate into profound, non-linear, and compounding[1] risks for the human health and welfare of people in the United States. We highlight that: (1) global mean temperatures and global mean sea level rise do not account for regional variations in the U.S., which in many cases are much higher than global averages; (2) global annually-averaged temperatures mask true risks to people's health and well-being because they fail to take into account climate-driven temperature extremes such as heatwaves, which are increasing in frequency and duration and are a known driver of climate-related morbidity and mortality; (3) overlapping climate impacts, such as heat, drought and wildfire, or storm surge from intensified tropical storms riding on higher sea levels, can lead to compounding and cascading impacts that magnify risks to people's health and welfare—interactions that are often obscured by solely focusing on mean global surface temperature and sea level values; (4) recent science indicates an acceleration in global warming, demonstrating that relying on past averages may not be a good predictor of future risks from additional greenhouse gas emissions, and (5) recent science also indicates exceptional ocean warming which also has profound implications for conditions on land in the United States and around the world.

Drawing on recent data, scientific reports, and peer-reviewed literature, we demonstrate that global averages obscure critical regional disparities that impact communities and economies across the country. For example, the U.S. East and Gulf Coasts are experiencing accelerating sea-level rise rates that significantly exceed the global mean due to ocean dynamic changes and land

[1] Deepti Singh et al., *Focus on compound events*, *in Fifth National Climate Assessment* (A.R. Crimmins et al. eds., U.S. Global Change Rsch. Prog. 2023).

subsidence.[2,3] A recent study shows that attributable sea level in Charleston, South Carolina—which has experienced higher sea level rise (SLR) than the global average—has been "dominated over time by contributions from mountain glaciers and thermal expansion," both factors that are related to human-caused climate change.[4]

Simultaneously, many regions of the United States are warming faster than the global average, such as arctic Alaska, which has warmed at nearly three times the global rate since 1980,[5] driving cascading ecological and infrastructural failures.[6] New England in the Northeast U.S. is also warming much more and faster than most parts of the world.[7,8] Because of climate change, every U.S. congressional district has warmed since 1970, by an average of 2.8°F, with the fastest warming districts in Alaska (4.8°F) and the Southwest (an average of 3.2°F), followed by districts in the Upper Midwest (an average of 2.9°F).[9,10]

Furthermore, reliance on GMST and GMSL metrics fails to capture the intensification of local extreme weather events—hurricanes, droughts, and floods—which serve as the primary vectors

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[2] Christopher G. Piecuch, *The Rate of U.S. Coastal Sea-Level Rise Doubled in the Past Century*, 6 AGU Advances e2025AV002018 (2025), https://doi.org/10.1029/2025AV002018.

[3] William V. Sweet et al., Nat'l Oceanic & Atmospheric Admin., *Global and Regional Sea Level Rise Scenarios for the United States: Updated Mean Projections and Extreme Water Level Probabilities Along U.S. Coastlines*, NOAA Technical Report NOS 01 (2022).

[4] Daniel M. Gilford et al., *Human-caused sea level rise drives 21st-century worldwide water level extremes*, 12 Sci. Advances 4 (2026), 10.1126/sciadv.adz3595.

[5] Thomas J. Ballinger et al., *Surface Air Temperature, in Nat'l Oceanic & Atmospheric Admin., Arctic Report Card: Update for 2025* (Matthew L. Druckenmiller et al. eds., 2025), https://arctic.noaa.gov/report-card/report-card-2025/

[6] M. L. Druckenmiller, R. L. Thoman, & T. A. Moon, *NOAA Arctic Report Card 2025: Executive Summary* (2025), https://doi.org/10.25923/nrzf-j897.

[7] Stephen S. Young & Joshua S. Young, *Decreasing Snow Cover and Increasing Temperatures Are Accelerating in New England, USA, with Long-Term Implications*, 13 Climate 246 (2025), https://doi.org/10.3390/cli13120246.

[8] Ambarish V. Karmalkar & Radley M. Horton, *Drivers of Exceptional Coastal Warming in the Northeastern United States*, 11 Nature Climate Change 854 (2021), https://doi.org/10.1038/s41558-021-01159-7.

[9] Climate Central, *Fastest-Warming U.S. Congressional Districts* (2026), https://www.climatecentral.org/climate-matters/fastest-warming-congressional-districts.

[10] Daniel M. Gilford et al., *A Multi-Method Framework for Global Real-Time Climate Attribution*, 8 Advances in Stat. Climatology, Meteorology & Oceanography 135 (2022), https://doi.org/10.5194/ascmo-8-135-2022.

for health impacts and economic disruption from climate change.[11,12,13,14] Studies also show that compounding and cascading climate risks, including those from extreme heat and sea level rise, worsen impacts on human health infrastructure and the economy.[15,16] **We argue that relying solely on global averages is a fundamentally flawed way to estimate the threat to the health and welfare of people in the U.S. and the benefits of limiting those threats.**

II. Limitations of Averaging Over Spatial Scales

The most significant flaw in using global averages to assess U.S. risk is the assumption of uniformity with regards to both GMST and GMSL. Sea level is not a flat bathtub that rises evenly everywhere.[17,18] It is a dynamic surface influenced by gravity, ocean currents, wind patterns, and vertical land motion. Further complicating this, the relationship between sea level and temperature is non-linear, and the rate of SLR has been accelerating faster than previously

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[11] Kai Kornhuber et al., *Global Emergence of Regional Heatwave Hotspots Outpaces Climate Model Simulations*, 121 Proc. Nat'l Acad. Scis. e2411258121 (2024), https://doi.org/10.1073/pnas.2411258121.

[12] Richard W. Katz & Barbara G. Brown, *Extreme Events in a Changing Climate: Variability Is More Important than Averages*, 21 Climatic Change 289 (1992), https://doi.org/10.1007/BF00139728.

[13] Adam B. Smith, *U.S. Billion-Dollar Weather and Climate Disasters, 1980 - Present (NCEI Accession 0209268)*, NOAA Nat'l Ctrs. for Env't Info. (2020), https://doi.org/10.25921/STKW-7W73.

[14] Melanie Marino, Matthew J. Eckelman, & Jodi D. Sherman, *Commonwealth Fund State Scorecard on Climate, Health, and Health Care* (2025), https://doi.org/10.26099/8K6M-5D55.

[15] Taejin Park et al., *What Does Global Land Climate Look Like at 2°C Warming?*, 11 Earth's Future e2022EF003330 (2023), https://doi.org/10.1029/2022EF003330.

[16] Kristie L. Ebi, *Understanding the Risks of Compound Climate Events and Cascading Risks*, 2 Dialogues on Climate Change 33 (2025), https://doi.org/10.1177/29768659241304857.

[17] NASA Sea Level Change, *Are Sea Levels Rising the Same All over the World, as If We're Filling a Giant Bathtub?*, https://sealevel.nasa.gov/faq/9/are-sea-levels-rising-the-same-all-over-the-world-as-if-were-filling-a-giant-bathtub/ (last visited Oct. 26, 2026).

[18] John T. Fasullo & R. Steven Nerem, *Altimeter-Era Emergence of the Patterns of Forced Sea-Level Rise in Climate Models and Implications for the Future*, 115 Proc. Nat'l Acad. Scis. 12944 (2018), https://doi.org/10.1073/pnas.1813233115.

projected due to thermal expansion and accelerating land ice loss.[19] Consequently, the U.S. coastline is experiencing rates of change that diverge sharply from the global mean (Fig. 1).[20,21]

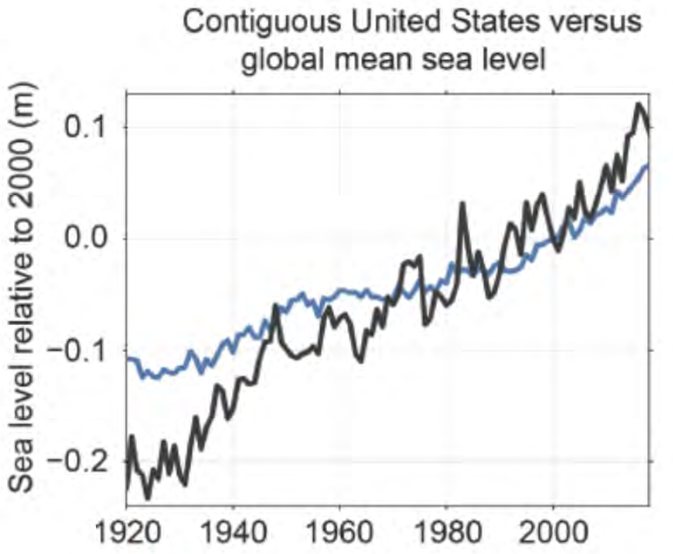


Figure 1 - GMSL change (blue line) as shown in a) with the annual average relative sea level change measured by tide gauges around the contiguous United States (black line; with a linear regression estimate of 28 cm of sea level rise from 1920 to 2020). Data and figure adapted from NOAA's 2022 report, Global and Regional Sea Level Rise Scenarios for the United States (Fig. 1.2) and Frederikse et al. 2020.[22,23]

[19] Sweet et al., *supra*.

[20] Fasullo & Nerem, *supra.*

[21] Christine L. May et al., *Coastal Effects, in Fifth National Climate Assessment* ch. 9 (Allison R. Crimmins et al. eds., U.S. Global Change Rsch. Prog. 2023), https://doi.org/10.7930/NCA5.2023.CH9.

[22] Sweet et al., *supra.*

[23] Thomas Frederikse et al., *The Causes of Sea-Level Rise since 1900*, 584 Nature 393 (2020), https://doi.org/10.1038/s41586-020-2591-3.

Accelerated Sea Level Rise on the East and Gulf Coasts

Recent analysis on sea level rise for U.S. coastal communities shows that the East and Gulf Coasts are consistently hotspots for sea-level rise.[24,25,26] A 2025 study by the Woods Hole Oceanographic Institution found that the rate of relative sea-level rise—measured relative to the local land surface—along the U.S. coast has more than doubled in the past 125 years, increasing from approximately 1.7 millimeters per year in 1900 to over 4.3 millimeters per year in 2024.[27] This rate is well above the global average for sea-level rise **of ~3.1 mm/year** observed in recent decades.[28]

The William & Mary Virginia Institute of Marine Science 2024 Sea Level Report Cards, which analyze data from 36 U.S. coastal communities, confirm this acceleration which can be compared to the global average. The report cards show that sea level rise acceleration rates began increasing notably around 2013-2014 along the East and Gulf Coasts.[29] Most sea level projections are based on an understanding of average global sea level rise, but these local report cards demonstrate that the reality for U.S. coastal communities diverges significantly from global averages due to regional factors. Along the East and Gulf Coasts, land subsidence, changes in ocean currents, and glacial isostatic adjustment create hotspots where relative sea level rise can exceed global averages. For instance, Grand Isle, Louisiana, is currently experiencing a rise rate of 7.72 mm/year, while Rockport, Texas, and Norfolk, Virginia, face rates of 6.71 mm/year and 5.14 mm/year, respectively—far outpacing the global mean of approximately 3.1 mm/year.[30,31] Other regions may experience slower rates. Such spatial variability means communities face divergent risks that global averages and projections do not capture.

Disproportionate Warming Rates

Many regions of the U.S. are experiencing disproportionate warming rates compared to the

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[24] John D. Boon et al., *Anthropocene Sea Level Change: A History of Recent Trends Observed in the U.S. East, Gulf, and West Coast Regions* (Special Rep. in Applied Marine Sci. & Ocean Eng'g No. 467, 2018), https://doi.org/10.21220/V5T17T; *see also* Va. Inst. of Marine Sci., *U.S. Sea Level Report Cards: Trends, Projections, and Process to Aid Coastal Planning*, https://www.vims.edu/research/products/slrc/.

[25] Asbury H. Sallenger Jr. et al., *Hotspot of Accelerated Sea-Level Rise on the Atlantic Coast of North America*, 2 Nature Climate Change 884 (2012), https://doi.org/10.1038/nclimate1597.

[26] Sweet et al., *supra.*

[27] Piecuch, *supra*.

[28] Sweet et al., *supra.*

[29] Boon et al., *supra*.

[30] Sweet et al., *supra.*

[31] Boon et al., *supra*.

global average. For most years since the 1970s, the average surface temperature in the U.S. has risen faster than the global average temperature.[32,33] The 5th U.S. National Climate Assessment states that the continental U.S. has warmed 60% faster than the global average since 1970,[34] exceeding the 1991-2020 average by 0.8°C in 2025.[35] This is in part due to land areas warming faster than oceans, but it also results from regional climate dynamics. This means that the historical and projected warming that Americans experience where they live is inherently higher than the 'global average' temperatures commonly reported (Fig. 2).

For example, Alaska is warming significantly faster than the global average (Fig.2).[36] This phenomenon is called arctic amplification and is driven by the loss of reflective sea ice and snow that drives the Arctic region to warm significantly faster than the global average. When bright, reflective ice melts, it exposes darker ocean waters that absorb more heat from the sun, creating a feedback loop that accelerates warming. The smallest peak sea ice extent in the 47-year satellite record occurred in March 2025.[37]

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[32] EPA, *Climate Change Indicators in the United States*, EPA 430-R-24-003 (5th ed. 2024), www.epa.gov/climate-indicators.

[33] Alexa K. Jay et al., *Overview: Understanding risks, impacts, and responses*, *in Fifth National Climate Assessment* ch. 1 (Allison R. Crimmins et al. eds., U.S. Global Change Rsch. Prog., 2023).

[34] Kate Marvel et al., *Climate Trends*, *in Fifth National Climate Assessment*, ch. 2 (Allison R. Crimmins et al. eds., U.S. Global Change Rsch. Prog., 2023), https://doi.org/10.7930/NCA5.2023.CH2.

[35] *Regional Climates*, *in State of the Climate in 2025*, 107 Bull. Am. Meteorological Soc'y S401 (A. Arguez et al. eds. 2026), https://doi.org/10.1175/2026BAMSStateoftheClimate_Chapter7.1.

[36] Climate Central, *supra*.

[37] NOAA in the Arctic, *Arctic Report Card: Update for 2025* (2025), https://arctic.noaa.gov/report-card/report-card-2025/.

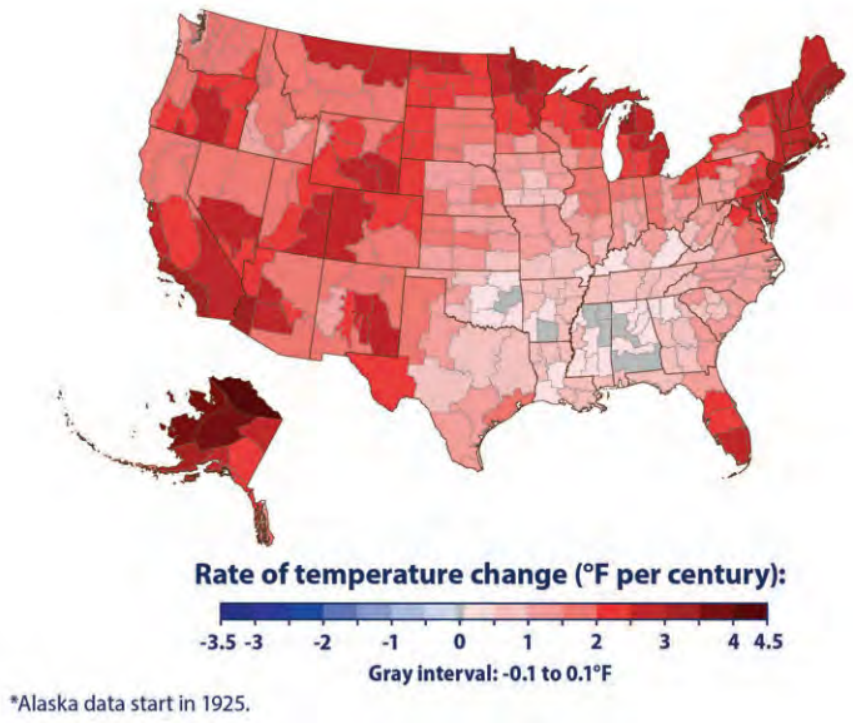


Figure 2 – Rate of Temperature change in the U.S. between 1901 and 2023 for the contiguous 48 states and between 1925 and 2023 for Alaska. The data are shown for climate divisions, as defined by NOAA.[38]

Findings from the 2025 *Arctic Report Card*, released by NOAA, confirm that the Arctic, globally, has warmed nearly three times faster than the rest of the planet since 1980.[39] For the period of October 2024 through September 2025, the Arctic experienced its warmest temperatures on record since measurements began in 1900. The last ten years in the Arctic are the ten warmest on record, with annual temperatures increasing at more than double the global rate since 2006 (Fig. 3).[40]

The Alaska Climate Research Center reported 2025 as one of Alaska's warmest years in the past 100, with northern Alaska exhibiting warming consistent with this broader Arctic pattern.[41] Elevated temperatures throughout the year contributed to diminished spring snowpack, earlier

[38] EPA, *Climate Change Indicators in the United States*, *supra*.

[39] Ballinger et al., *supra*.

[40] NOAA in the Arctic, *Arctic Report Card: Update for 2025* (2025), https://arctic.noaa.gov/report-card/report-card-2025/.

[41] Alaska Climate Rsch. Ctr., *2025 Annual Report* (2025), https://akclimate.org/data/annual-reports/.

snowmelt, and increased wildfire risk, with Interior Alaska experiencing the most pronounced effects.[42]

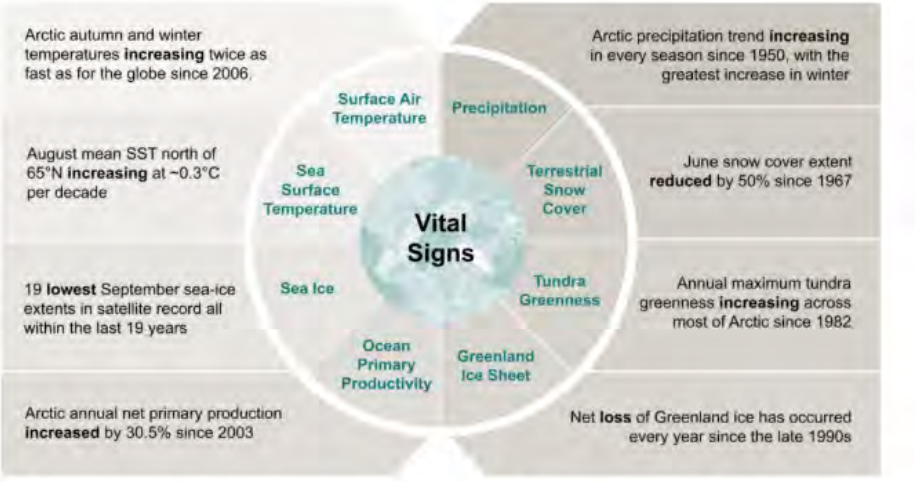


Fig. 1. Arctic Report Card Vital Signs with selected noteworthy trends and observations. The ARC annually reports on eight Vital Sign topics. Vital Sign data records vary in length based on dataset availability and considerations to methodological continuity. The historical record periods are used when computing ranked observations. When reporting anomalies, Vital Signs currently use 1991-2020 as the 30-year reference period, except for Tundra Greenness (2000-24) and Ocean Primary Productivity (2003-24).

Figure 3 - Summary of key Arctic "Vital Signs" showing major environmental changes. Indicators include temperature, precipitation, snow cover, sea ice, ocean productivity, tundra greenness, and the Greenland Ice Sheet. Overall, the Arctic is warming rapidly, with declining ice and snow and increasing precipitation and vegetation.[43]

Another example is in the U.S. Northeast, the fastest warming region in the contiguous U.S.[44] Many Northeast states including Maine,[45] New Jersey,[46] and Rhode Island,[47] have had a 3°F

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[42] Alaska Climate Rsch. Ctr., *2025 Alaska Annual Climate Report* (2026), https://akclimate.org/data/annual-reports/.

[43] NOAA in the Arctic, *Arctic Report Card: Update for 2025* (2025), https://arctic.noaa.gov/report-card/report-card-2025/.

[44] Ambarish V. Karmalkar & Raymond S. Bradley, *Consequences of Global Warming of 1.5 °C and 2 °C for Regional Temperature and Precipitation Changes in the Contiguous United States*, 12 PLOS ONE e0168697 (2017), https://doi.org/10.1371/journal.pone.0168697.

[45] Maine Climate Council Sci. & Tech. Subcomm., *Scientific Assessment of Climate Change and Its Effects in Maine* 8 (Ivan Fernandez & Robert Marvinney eds. 2020).

[46] Kathryn Davies et al., *State of the Climate: New Jersey 2024* (2025), https://doi.org/10.7282/00000539.

[47] Jennifer Runkle et al., *Rhode Island State Climate Summary 2022*, NOAA Technical Report NESDIS 150-RI (2022).

(~1.7°C) to 4°F (~2.2°C) increase in their average temperature since the early 20th Century, nearly twice the rate of global average warming. Studies attribute this amplified regional warming to a combination of anthropogenic-influenced factors: rapid ocean warming across the Northeast continental shelf and consequent regional atmospheric circulation changes,[48] decreasing snow cover that amplify land-warming,[49] and the disproportionate warming of nighttime and winter temperatures relative to daytime and summer temperatures at higher latitudes.[50]

III. Limitations of Averaging Over Temporal Scales

There are also limitations when averaging GMST and GMSL over temporal scales to assess U.S. risk. Mean temperatures alone cannot capture changes in extremes; extremes are impacted by changes to their mean and distribution. Therefore, averaging GMST over a specific time-period may not account for the distributional shifts of extreme events over that period. In fact, data show that GMST masks the increase in heat-related extremes, including multi-day heatwaves, which are consequential for heat-related adverse health outcomes.[51]

For example, in the United States, the annual number of heatwaves has doubled since the 1980s and the heatwave season has increased threefold in length since the 1960s.[52] A recent study of heat-related mortality among older adults in the United States drives home the disproportionate consequences of climate impacts, finding: "Heat waves are associated with a substantial increase in annual all-cause and cause-specific mortality among older adults in the USA, with disproportionate impacts on Black and low income communities."[53] According to the study, "[a]cross the contiguous USA from 2000–18, the 8307 observed heat waves were associated with an estimated 17603 . . . excess deaths."[54]

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[48] Karmalkar & Horton, *supra*.

[49] Young & Young, *supra*.

[50] Marvel et al., *supra.*

[51] Ali Davariashtiyani et al., *Exponential Increases in High-Temperature Extremes in North America*, 13 Sci. Rpts. 19177 (2023), https://doi.org/10.1038/s41598-023-41347-3.

[52] Michelle L. Bell, Antonio Gasparrini & Georges C. Benjamin, *Climate Change, Extreme Heat, and Health*, 390 New Engl. J. Med. 1793 (2024), https://doi.org/10.1056/NEJMra2210769.

[53] James P. Healy et al., *Heat Waves and Annual Mortality among Older Adults (Aged ≥65 Years) in the USA*, 10 The Lancet Planetary Health 101432 (2026), https://doi.org/10.1016/j.lanplh.2026.101432.

[54] Healy et al., *supra.*

Similarly, since 1993, global sea level has risen by 4 inches[55] (10 centimeters), and the rate of rise has doubled over the past 30 years (Fig. 4).[56,57] In 2024, global sea level rose at a rate of 0.23 inches (0.59 cm) per year, more than 30% more than the projected rate of 0.17 inches (0.43 cm).[58] According to a NASA-led analysis, this spike was driven largely by thermal expansion—the physical expansion of seawater as it warms. In a typical year, melting ice contributes the majority of sea-level rise, with thermal expansion accounting for about one-third. However, in 2024, as the warmest year on record, this ratio flipped: two-thirds of the rise came from thermal expansion.[59] **This phenomenon illustrates that the relationship between temperature and sea level is not static over space or time**. As the ocean absorbs excess heat, the water expands. Even a "small" average temperature increase in the upper ocean layers results in a measurable, accelerating rise in sea level.

Furthermore, temperature and sea-level exhibit time-dependent responses; temporal averaging of GMST and GMSL dampens their evolving relationships, feedbacks, and underlying dynamics.

[55] Jane J. Lee, *NASA Analysis Shows Unexpected Amount of Sea Level Rise in 2024*, NASA Sea Level Change (Mar. 13, 2025), https://sealevel.nasa.gov/news/282/nasa-analysis-shows-unexpected-amount-of-sea-level-rise-in-2024/.

[56] Benjamin D. Hamlington et al., *Sea Level Rise in 2024*, 6 Nature Revs. Earth & Env't 246 (2025), https://doi.org/10.1038/s43017-025-00667-w.

[57] Benjamin D. Hamlington et al., *The Rate of Global Sea Level Rise Doubled during the Past Three Decades*, 5 Commc'ns Earth & Env't 601 (2024), https://doi.org/10.1038/s43247-024-01761-5.

[58] Lee, *supra*.

[59] Lee, *supra*.

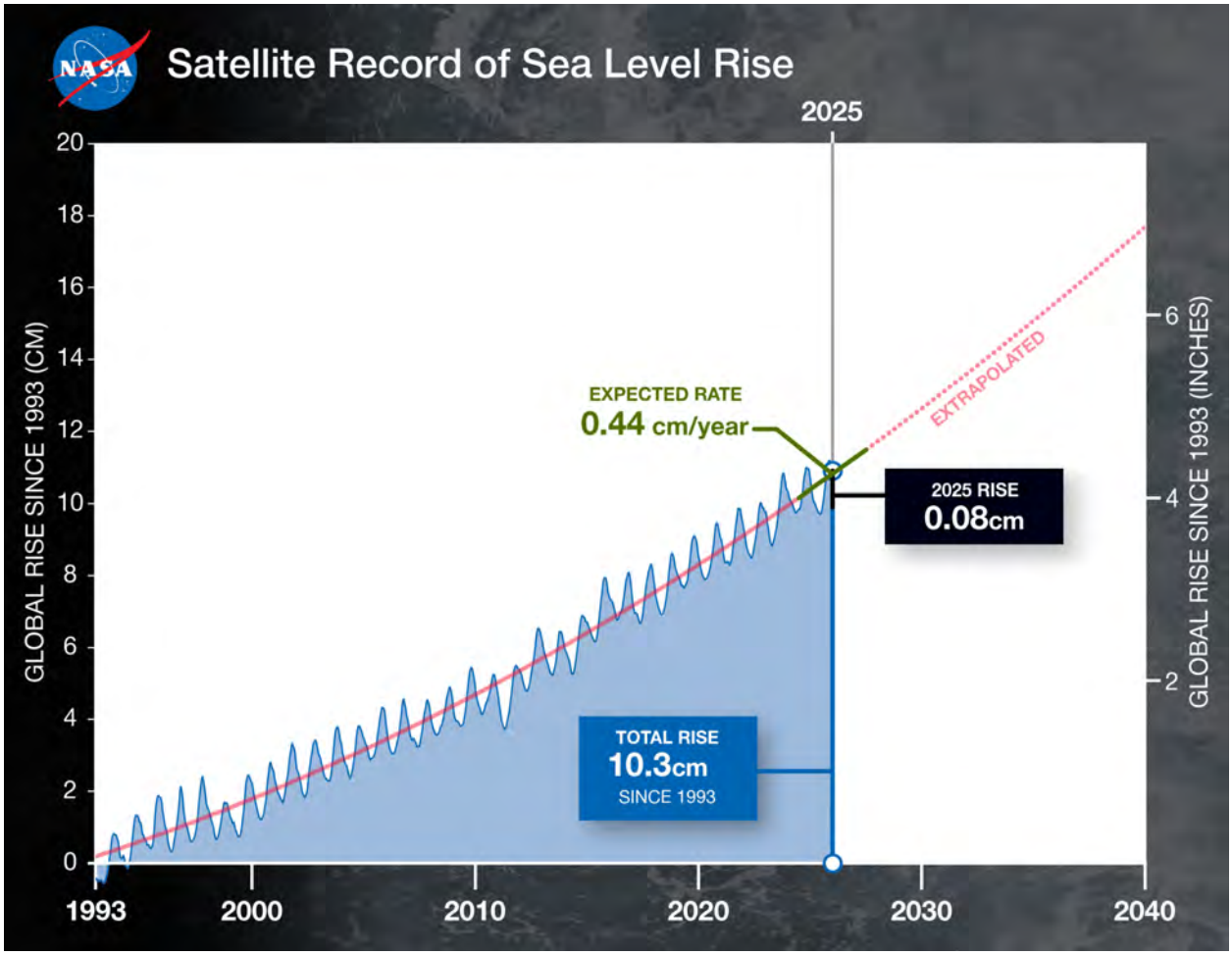


Figure 4 – Satellite-derived record of global mean sea level rise from 1993 to 2025 as measured by five satellites. The blue curve shows observed sea level change with seasonal variability, while the solid red line indicates the long-term trend, which has accelerated over time and more than doubled over three-plus decades. By 2025, global sea level has risen approximately 10.3 cm (about 4 inches) since 1993. The dotted red line represents extrapolated future rise, compared with an expected rate of 0.44 cm (about 0.17 inches) per year. (Source: NASA/JPL-Caltech).[60]

Furthermore, recent studies indicate that the GMST increase is accelerating, a non-linearity that, if ignored, risks understating future risks from additional greenhouse gas emissions.[61] Since the 1970s, GMST has been increasing at an average rate of 0.2°C/decade. Since the 2010s, the average rate is about 0.25-0.40°C/decade. The acceleration also suggests we will breach the 1.5°C global warming threshold sooner than expected, with estimations of breaching it within

[60] NASA, *NASA Analysis Shows La Niña Limited Sea Level Rise in 2025* (Jan. 29, 2026), https://www.nasa.gov/earth/nasa-analysis-shows-la-nina-limited-sea-level-rise-in-2025/.

[61] Grant Foster & Stefan Rahmstorf, *Global Warming Has Accelerated Significantly*, 53 Geophysical Rsch. Letters e2025GL118804 (2026), 10.1029/2025GL118804.

this decade.[62] A breach of this threshold this soon has major implications for existing risk assessments for extreme weather, irreversible land glacial ice loss, and Earth-System tipping points that could become irreversible. Ignoring this acceleration and non-linear behavior of GMST risks failing to accurately understand when these impacts could occur and limits the ability to predict these changes.

IV. Limitations of Ignoring Non-Linearities

Limitations of Global Mean Metrics in Assessing Regional Climate Risk

In regulatory and policy discourse, descriptions of climate change that focus solely on increases in GMST and GMSL can misrepresent these changes as manageable despite strong evidence that small increments of change in global averages trigger disproportionate and potentially disruptive changes in regional climate dynamics, extreme weather frequency and/or intensity, and ecosystem stability. Many climate systems are non-linear, and the impacts of climate change are not distributed evenly across the globe.[63,64,65,66] Domestic regulatory policies must account for the discrepancy between global average impacts and the local reality for Americans. While the globe, on average, may warm by one margin, parts of the U.S. are experiencing temperature changes that are two to three times more severe.[67,68] Similarly, while global average sea levels rise at a seemingly moderate pace, specific American coastlines are facing accelerated flooding

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[62] U.N. Env't Prog., *Limiting Overshoot: Navigating exceedance of 1.5°C and pathways towards return* 13 (2026), https://doi.org/10.59117/20.500.11822/49857.

[63] Shaina Sadai et al., *Antarctic Meltwater Alters Future Projections of Climate and Sea Level*, 16 Nature Commc'ns 9271 (2025), https://doi.org/10.1038/s41467-025-64438-3.

[64] María Dolores Gadea Rivas & Jesús Gonzalo, *Regional Heterogeneity and Warming Dominance in the United States*, 5 PLOS Climate e0000808 (2026), https://doi.org/10.1371/journal.pclm.0000808.

[65] Young & Young, *supra*.

[66] Climate Central, *Earth Day: Fastest-Warming U.S. Cities and States* (Apr. 16, 2025), https://www.climatecentral.org/climate-matters/earth-day-fastest-warming-us-cities-and-states#cm-license.

[67] Druckenmiller et al., *supra*.

[68] Young & Young, *supra*.

and inundation that threaten critical infrastructure, public health, and economic stability much sooner than global models suggest.[69,70,71,72]

The relationship between GMST and extreme weather frequency and/or intensity is governed by non-linear dynamics in the climate system. Incremental increases in atmospheric and oceanic heat content produce disproportionate changes in the distribution of weather events, such as elevated probabilities of extreme events relative to baseline conditions.[73] This phenomenon is well-documented in peer-reviewed literature, where small shifts in mean temperature correspond to non-linear increases in the frequency of threshold-exceeding events, including heat waves, heavy precipitation, drought conditions, and hydroclimate volatility.[74,75,76,77]

The impact of sea-level rise on flooding is often exponential, not linear. As noted in peer-reviewed research, a small increase in the baseline sea level dramatically increases the frequency of high-tide flooding.[78,79] What was once a 1-in-100-year flood event can become a 1-in-10-year

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[69] Piecuch, *supra.*

[70] Sönke Dangendorf et al., *Acceleration of U.S. Southeast and Gulf Coast Sea-Level Rise Amplified by Internal Climate Variability*, 14 Nature Commc'ns 1935 (2023), https://doi.org/10.1038/s41467-023-37649-9.

[71] Elisabeth A. Gilmore, Carolyn Kousky & Travis St.Clair, *Climate Change Will Increase Local Government Fiscal Stress in the United States*, 12 Nature Climate Change 216 (2022), https://doi.org/10.1038/s41558-022-01311-x.

[72] Miyuki Hino et al., *High-Tide Flooding Disrupts Local Economic Activity*, 5 Sci. Advances eaau2736 (2019), https://doi.org/10.1126/sciadv.aau2736.

[73] Sonia I. Seneviratne et al., *Weather and Climate Extreme Events in a Changing Climate, in Intergovernmental Panel on Climate Change, Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report* ch. 11 (Valérie Masson-Delmotte et al. eds., 2021), https://doi.org/10.1017/9781009157896.013.

[74] Noah S. Diffenbaugh & Filippo Giorgi, *Climate Change Hotspots in the CMIP5 Global Climate Model Ensemble*, 114 Climatic Change 813 (2012), https://doi.org/10.1007/s10584-012-0570-x.

[75] Seneviratne et al., *supra*.

[76] Daniel L. Swain et al., *Hydroclimate Volatility on a Warming Earth*, 6 Nature Revs. Earth & Env't 35 (2025), https://doi.org/10.1038/s43017-024-00624-z.

[77] Linda O. Mearns, Richard W. Katz & Stephen H. Schneider, *Extreme High-Temperature Events: Changes in Their Probabilities with Changes in Mean Temperature*, 23 J. Climate & Applied Meteorology 1601 (1984), https://doi.org/10.1175/1520-0450(1984)023<1601:EHTECI>2.0.CO;2.

[78] Sean Vitousek et al., *Doubling of Coastal Flooding Frequency within Decades Due to Sea-Level Rise*, 7 Sci. Rpts. 1399 (2017), https://doi.org/10.1038/s41598-017-01362-7.

[79] Sweet et al., *supra.*

event with only a few inches of rise. Sea level acts as a rising floor, such that storm surges and high tides start from a higher baseline, allowing them to breach defenses that were previously sufficient.

Research published in *Scientific Reports* demonstrated that along most of the U.S. coast, the odds of extreme flooding double roughly every five years due to sea-level rise, even without increases in storm intensity.[80,81] This research highlights how even 10 cm of SLR doubles flooding potential along the west coast of the US, including Seattle, San Francisco, and Los Angeles,[82] highlighting that the "magnitude" of the rise is less relevant than the "frequency" of the resulting impact. A rise of a few inches can double or triple the number of days a coastal community is inundated, leading to chronic infrastructure degradation, mold growth in homes, and disruption of local economies. Related research highlights how even smaller amounts of sea level rise, between 1 and 10 cm, can lead to outsized impacts by increasing the frequency of coastal floods.[83] This underscores why looking at GLSR alone is not sufficient to understand how that change will impact Americans.

Regional Variation in Extreme Weather Event Trends

A focus on only GMST and GSLR fails to account for how changes in those metrics will lead to more frequent and intense extreme weather, the primary way that climate change harms human health and welfare. Americans do not experience "global averages"; they experience hurricanes, droughts, rainfall, heatwaves, wildfires, and floods. Climate change is contributing to the increase in frequency, duration, and/or intensity of these types of events, regardless of the magnitude of the shift in global averages. For example, data show that heatwaves are increasing in frequency and duration, especially in the western U.S. and Southeast.[84] These extreme events are not random; they are symptomatic of a changing climate, which is not fully captured by expressions of global mean temperatures.

In 2024, the U.S. experienced 27 separate extreme weather and climate disasters with costs exceeding $1 billion each (Fig. 5).[85] Over the last decade (2015–2024), the U.S. has been impacted by 190 such disasters, costing approximately $1.4 trillion and killing more than 6,300

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[80] Sweet et al., *supra.*

[81] Mohsen Taherkhani et al., *Sea-level rise exponentially increases coastal flood frequency*, 10 Sci. Rep. 6466 (2020), https://doi.org/10.1038/s41598-020-62188-4.

[82] Vitousek et al., *supra.*

[83] Taherkhani et al., *supra*.

[84] Nat'l Acads. of Scis., Eng'g, & Med. (hereinafter "NASEM"), *Effects of Human-Caused Greenhouse Gas Emissions on U.S. Climate, Health, and Welfare* (2025), https://doi.org/10.17226/29239.

[85] Smith, *supra*.

people (Fig. 5).[86] As of the end of September 2026, 21 billion-dollar disasters have led to 201 deaths and 50.3 billion USD in damages in 2026.[87] The rising costs of disasters are a consequence of growing climate risks as well as an increase in population and development in exposed areas such as coastal and inland floodplains and wildfire-prone geographies.

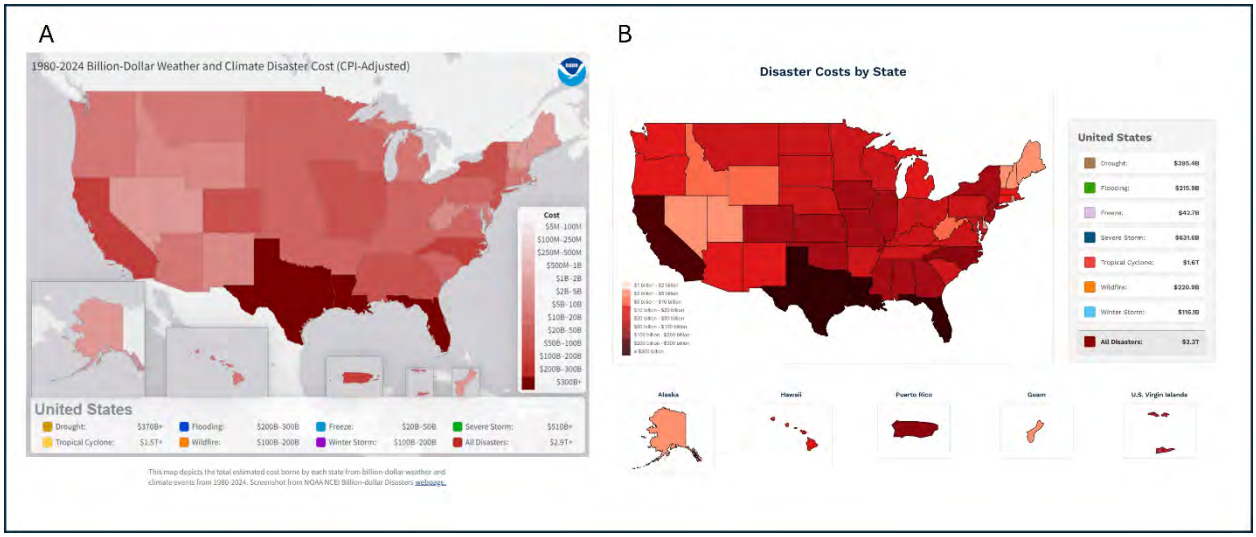


Figure 5 - Map of total costs from billion-dollar weather and climate disasters across the United States from A) 1980 to 2024 and B) 1980-2026 (both CPI-adjusted). Darker shading indicates higher total damages, with the greatest costs concentrated in Gulf Coast and southeastern states.[88, 89]

Non-Linear Impacts from Warming Oceans

The ocean has absorbed about 91% of the excess heat trapped in the earth's atmosphere, primarily from burning fossil fuels, helping to limit the climate-change driven-temperature increase on land thus far.[90] However, the average temperature of the oceans is now rising

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[86] Smith, *supra*.

[87] Climate Central, *Disaster Mapping* (2026), https://www.climatecentral.org/climate-services/billion-dollar-disasters/mapping?years=2026-2026.

[88] Smith, *supra*.

[89] Climate Central, *Disaster Mapping* (2026), https://www.climatecentral.org/climate-services/billion-dollar-disasters/mapping?years=2026-2026.

[90] Nat'l Oceanic & Atmospheric Admin., *Ocean Heat*, https://globalocean.noaa.gov/the-ocean/ocean-heat/ (last visited Oct. 26, 2026).

steadily, and acute marine heatwaves are also increasing.[91,92,93] GMST and GSLR fail to consider the non-linear and profound impacts that these warmer ocean temperatures are having on regional extreme weather events, sea-level rise, and marine ecosystems in the United States. Warmer ocean temperatures provide more energy for hurricanes, leading to stronger, wetter, and in some cases slower-moving hurricanes, which can increase local damage from a single storm.[94,95] Extreme marine heatwaves are having consequential impacts to coastal ecosystems, including the stress and collapse of coral reefs in Florida,[96] Hawaii,[97] and the U.S. Virgin Islands,[98] and degradation of marine wildlife in Alaska,[99] the Gulf of Maine,[100] and the Pacific

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[91] Yuying Pan et al., *Ocean Heat Content Sets Another Record in 2025*, 43 Adv. Atmospheric Sci. 2019 (2026), https://doi.org/10.1007/s00376-026-5876-0.

[92] Joseph Giguere, Daniel M. Gilford & Andrew J. Pershing, *Attributing daily ocean temperatures to anthropogenic climate change*, 3 Env't Res.: Climate 035003 (2024), https://doi.org/10.1088/2752-5295/ad4815.

[93] Climate Central, *Climate Shift Index: Ocean*, https://csi.climatecentral.org/ocean.

[94] James P. Kossin, *A Global Slowdown of Tropical-Cyclone Translation Speed*, 558 Nature 104 (2018), https://doi.org/10.1038/s41586-018-0158-3.

[95] Daniel M. Gilford, Joseph Giguere & Andrew J. Pershing, *Human-Caused Ocean Warming Has Intensified Recent Hurricanes*, 3 Env't Rsch.: Climate 045019 (2024), https://doi.org/10.1088/2752-5295/ad8d02.

[96] Derek P. Manzello et al., *Heat-driven functional extinction of Caribbean Acropora corals from Florida's Coral Reef*, 390 Science 361 (2025), https://doi.org/10.1126/science.adx7825.

[97] Jason M. Gove et al., *Coral reefs benefit from reduced land–sea impacts under ocean warming*, 621 Nature 536 (2023), https://doi.org/10.1038/s41586-023-06394-w.

[98] Emilia C. Dell'Antonio, Lauren Mahoney & Peter J. Edmunds, *Marine heatwave decimates fire coral populations in the Caribbean*, 122 Proc. Nat'l Acad. of Scis. e2518506122 (2025), https://doi.org/10.1073/pnas.2518506122.

[99] Maya C. Rallu De Malibran, Chloe M. Kaplan & Emanuele Di Lorenzo, *Marine heatwaves suppress ocean circulation and large vortices in the Gulf of Alaska*, 5 Commu'ns Earth Env't 622 (2024), https://doi.org/10.1038/s43247-024-01785-x.

[100] Easton R. White et al., *Temperature extremes in the Gulf of Maine: A synthesis of marine heatwaves, cold-spells, and ecological impacts* (preprint 2026), https://doi.org/10.32942/X2TM3D.

Northwest.[101] Ocean warming also leads to thermal expansion, contributing to sea-level rise that can disproportionately cause frequent flooding across the Atlantic and Gulf Coast of the U.S.[102]

V. Global Average Temperatures are the Wrong Metric for Health Impacts

Similarly, a focus on GMST and GSLR fails to account for the inequitably distributed health harms that stem from climate change, including extreme heat, increases in exposure to wildfire smoke, and changes to vector-borne and water-borne diseases.[103,104] GMST and GSLR are spatially and temporally aggregated metrics that smooth over the regional and seasonal extremes and local variabilities where health impacts materialize. They reveal nothing about extreme events, differential exposure, vulnerability, or adaptive capacity—the factors that determine whether a temperature increase becomes a health crisis. An annual global average does not distinguish between an early season extreme heatwave or a community with air conditioning and green space versus one without; similarly, global sea level rise tells us little about which populations live near flood-prone hazardous sites. These metrics were designed to track planetary physics at an aggregated level, not human welfare, much less the welfare of Americans specifically.

GMST is the wrong indicator for health impacts because averages mask the reality of extreme heat and heatwaves or socioeconomic determinants of health, which are known to be major drivers of heat related deaths and illnesses globally and in the U.S. Climate change is already increasing the frequency, duration, and intensity of heatwaves, including increases in night-time heat.[105]

Failing to consider how increases in GMST manifest on the ground in the U.S. obscures the extent of the human health and welfare implications. Extreme heat days are also associated with

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[101] William W.L. Cheung & Thomas L. Frölicher, *Marine heatwaves exacerbate climate change impacts for fisheries in the northeast Pacific*, 10 Sci. Rep. 6678 (2020), https://doi.org/10.1038/s41598-020-63650-z.

[102] Sadaf Mahmoudi et al., *Escalating high tide flooding along the Atlantic and Gulf Coast of the United States due to sea level rise*, 13 Earth's Future e2024EF005328 (2025), https://doi.org/10.1029/2024EF005328.

[103] Ctrs. for Disease Control, *About CDC's Climate and Health Program* (Feb. 9, 2024), https://www.cdc.gov/climate-health/php/about/index.html.

[104] NASEM, *supra*.

[105] Marvel et al., *supra.*

a significant increase in emergency room visits.[106,107,108] Research also shows that climate-driven extreme heat could lead to a loss of about 1.2% in U.S. GDP per degree Celsius increase in temperature, including labor costs, mortality costs, and costs to major economic sectors.[109] Outdoor workers could experience an estimated $49.2 billion in annual earnings at risk by the end of the century.[110] Without action to curtail heat-trapping emissions, the incidence of extreme heat—and its impacts on people—will increase significantly in the U.S.[111] A focus solely on GMST fails to capture human health harms for Americans.

Extreme heat is the leading weather-related killer in the United States.[112] Driven by climate change, extreme heat and drought are becoming hotter, longer lasting, and more frequent.[113] The summer of 2024 was the hottest year on record for the world, however the global mean temperature reflected in that record does not capture the cascade of impacts that directly result from warmer temperatures globally and in the U.S. The long-term trend in the increase in frequency and intensity of heatwaves is a major challenge to human health, through heat exhaustion and heat stroke, and by exacerbating cardiovascular, respiratory, and kidney

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[106] Shengzhi Sun et al., *Ambient Heat and Risks of Emergency Department Visits among Adults in the United States: Time Stratified Case Crossover Study*, 375 BMJ e065653 (2021), https://doi.org/10.1136/bmj-2021-065653.

[107] Michelle Young, Kristina A. Dahl & Shubhayu Saha, *Climate change increases emergency department visits for heat-related illness in the United States*, 179 Climatic Change 1 (2026), https://doi.org/10.1007/s10584-026-04247-9.

[108] Hyojung Jang et al., *Identifying heat-related diagnoses in emergency department visits among adults in Chicago: A heat-wide association study*, 12 Sci. Advances eaed3977 (2026),https://doi.org/10.1126/sciadv.aed3977 https://www.science.org/doi/10.1126/sciadv.aed3977.

[109] Solomon Hsiang et al., *Estimating Economic Damage from Climate Change in the United States*, 356 Science 1362 (2017), https://doi.org/10.1126/science.aal4369.

[110] Rachel Licker, Kristina Dahl & John T. Abatzoglou, *Quantifying the Impact of Future Extreme Heat on the Outdoor Work Sector in the United States*, 10 Elementa: Sci. Anthropocene 48 (2022), https://doi.org/10.1525/elementa.2021.00048.

[111] Kristina Dahl et al., *Increased Frequency of and Population Exposure to Extreme Heat Index Days in the United States during the 21st Century*, 1 Env't Rsch. Commc'ns 07002 (2019), https://doi.org/10.1088/2515-7620/ab27cf.

[112] NOAA Nat'l Weather Serv., *Severe Weather Awareness - Heat Waves*, https://www.weather.gov/mkx/heatwaves (last visited Oct. 26, 2026).

[113] Drew Shindell et al., *The Effects of Heat Exposure on Human Mortality Throughout the United States*, 4 GeoHealth e2019GH000234 (2020), https://doi.org/10.1029/2019GH000234.

conditions.[114,115,116] Outdoor workers, elderly people, young children, pregnant people, people who are unhoused, and people with pre-existing health conditions are most at risk.[117,118] The impacts of climate change compound and build on each other. Heatwaves, for example, exacerbate cardiovascular and respiratory conditions,[119,120] while compromised food and water security[121] due to extreme heat and drought increases risks of malnutrition and infectious diseases.[122] Drought also contributes to respiratory and cardiovascular-related health impacts—dry conditions increase airborne dust and particulate matter while simultaneously elevating wildfire risk, exposing populations to fine particles that penetrate deep into lungs and trigger systemic inflammation.[123,124] Wildfire smoke has contributed to increasing trends of average annual concentrations of $PM_{2.5}$ in the contiguous United States since 2016, with the most

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[114] Marino et al., *supra.*

[115] NASEM, *supra.*

[116] Mary H. Hayden et al., *Human Health, in Fifth National Climate Assessment* ch. 15 (Allison R. Crimmins et al., eds., U.S. Global Change Rsch. Prog., 2023), https://doi.org/10.7930/NCA5.2023.CH15.

[117] Marina Romanello et al., *The 2024 Report of the Lancet Countdown on Health and Climate Change: Facing Record-Breaking Threats from Delayed Action*, 404 The Lancet 1847 (2024), https://doi.org/10.1016/S0140-6736(24)01822-1.

[118] Matthew Francis Chersich et al., *Associations between High Temperatures in Pregnancy and Risk of Preterm Birth, Low Birth Weight, and Stillbirths: Systematic Review and Meta-Analysis*, 371 BMJ m3811 (2020), https://doi.org/10.1136/bmj.m3811.

[119] Ismael H. Silveira et al., *Effects of Heat Waves on Cardiovascular and Respiratory Mortality in Rio de Janeiro, Brazil*, 18 PLOS ONE e0283899 (2023), https://doi.org/10.1371/journal.pone.0283899.

[120] Kyriaki Psistaki et al., *Heatwave Characteristics and Health Impacts: A Review of Epidemiological Evidence and Implications for Heatwave Response Plans*, 3 Env't Rsch.: Health 042003 (2025), https://doi.org/10.1088/2752-5309/ae1861.

[121] Sarah Lawrence, *Infectious Disease and Climate Change: Food & Water Scarcity*, Am. Security Project (Nov. 22, 2021), https://www.americansecurityproject.org/infectious-disease-and-climate-change-food-water-scarcity/.

[122] Romanello et al., *supra.*

[123] Yeongjin Gwon et al., *The Association between Drought Exposure and Respiratory-Related Mortality in the United States from 2000 to 2018*, 20 Int'l J. Env't Rsch. & Public Health 6076 (2023), https://doi.org/10.3390/ijerph20126076.

[124] Yeongjin Gwon et al., *The Effect of Heterogeneous Severe Drought on All-Cause and Cardiovascular Mortality in the Northern Rockies and Plains of the United States*, 912 Sci. Total Env't 169033 (2024), https://doi.org/10.1016/j.scitotenv.2023.169033.

pronounced impacts in western states.[125] Of roughly 164,000 wildfire-smoke deaths from 2006 to 2020, approximately 15,000 were attributable to climate change.[126]

A 2025 Commonwealth Fund report on climate and health highlighted that environmental hazards, many of which are exacerbated by climate change, are responsible for approximately 19% of deaths globally.[127] According to the 2025 Lancet Countdown report on Health and Climate Change, "*on average, 16 (84%) of the 19 life-threatening heatwave days that people were exposed to annually in 2020–24 would not have occurred without climate change."*[128] In the U.S., the health care sector itself is vulnerable: nearly 15% of hospital beds in Florida are in high-hazard flood zones, and facilities across the country are ill-prepared for the increasing frequency of extreme weather.[129] The report found that states with higher environmental risks and weaker clean energy policies face greater health burdens.

The impacts of climate change are not borne equally. Scientific evidence overwhelmingly shows that marginalized communities—low-income populations, communities of color, and Indigenous groups—face disproportionate risks[130] from both sea-level rise[131] and extreme weather, a reality not captured by a focus on global average temperature and global mean sea level rise.

A *Nature Communications* study on sea-level rise and hazardous sites revealed a stark environmental justice crisis. Controlling for population density, neighborhoods with higher proportions of renters, non-voters, linguistically isolated households, and residents living in poverty are significantly more likely to be located near hazardous sites at risk of flooding. They

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[125] Marshall Burke et al., *The Contribution of Wildfire to PM2.5 Trends in the USA*, 622 Nature 761 (2023), https://doi.org/10.1038/s41586-023-06522-6.

[126] Beverly E. Law et al., *Anthropogenic Climate Change Contributes to Wildfire Particulate Matter and Related Mortality in the United States*, 6 Commc'ns Earth & Env't 336 (2025), https://doi.org/10.1038/s43247-025-02314-0.

[127] Marino et al., *supra.*

[128] Marina Romanello et al., *The 2025 Report of the Lancet Countdown on Health and Climate Change: Climate Change Action Offers a Lifeline*, 406 The Lancet 2804 (2025), https://doi.org/10.1016/S0140-6736(25)01919-1.

[129] Marino et al., *supra.*

[130] EPA, Press Release, *EPA Report Shows Disproportionate Impacts of Climate Change on Socially Vulnerable Populations in the United States* (Sept. 2, 2021), https://www.epa.gov/newsreleases/epa-report-shows-disproportionate-impacts-climate-change-socially-vulnerable.

[131] Lara J. Cushing et al., *Sea Level Rise and Flooding of Hazardous Sites in Marginalized Communities across the United States*, 16 Nature Commc'ns 9711 (2025), https://doi.org/10.1038/s41467-025-65168-2.

found that a one standard deviation increase in the proportion of renters is associated with an up to 41% higher likelihood of having a hazardous site within 1 kilometer.[132]

This inequity is the result of historical land-use decisions and systemic discrimination. When sea levels rise or floods occur, these communities are the first to suffer contaminant releases, displacement, and health impacts. The cumulative impact of all of these factors exacerbates the disproportionate adverse health and welfare impacts for these communities, which EPA has completely failed to account for.

The Commonwealth Fund scorecard further illustrates this inequity. States with higher environmental risks often have weaker health care infrastructure and fewer resources for adaptation.[133] For example, low-lying coastal states like Florida and Louisiana have a high percentage of health care facilities in flood zones.

A focus on GMST and GSLR fails to capture both the human health impacts of climate change and the unequal effects of these impacts across populations and communities. As such, this focus is insufficient for preparing for the risks associated with current and further climate change in the U.S.

VI. Summary

The characterization of climate change impacts based solely on global mean surface temperature and global mean sea level oversimplifies the complex challenges that arise from physical, societal, economic, and ecological impacts associated with these increases. While the global averages may appear "small" in isolation, they mask a reality of profound regional disparity and escalating risk. The U.S. East and Gulf Coasts are facing accelerated sea-level rise that inundates communities and threatens to flood hazardous sites within decades, not centuries. Alaska is warming at a rate that is destabilizing the very ground its communities stand on. Such regional differences highlight how GMST and GSLR alone are inadequate measures of the full impact of climate change on communities, ecosystems, and economies across the United States. And across the nation, extreme weather events, supercharged by climate warming, are inflicting billions of dollars in damage and causing significant threats to public health, including loss of life.

Here we show how frameworks that rely on global averages to assess risk at regional and local levels can systematically underestimate the threat to American health and welfare. For many Americans, the climate crisis is not a distant future scenario defined by global averages, but a present-day emergency defined by rising waters, intensifying storms, and disproportionate harm to the most vulnerable.

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[132] Cushing et al., *supra.*

[133] Marino et al., *supra.*

APPENDIX C

Technical Memorandum on EPA's Supplemental Proposal Analysis of Variability and Measurability

Ellen Robo & Grace Hauser, Environmental Defense Fund

This technical memorandum supports the comments filed by Public Health and Environmental Organizations on EPA's proposed rule "Rescission of the Greenhouse Gas Findings for Fossil Fuel-Fired Power Plants and Repeal of Regulations for Power Plant Greenhouse Gas Emission Under Clean Air Act Section 111," 91 Fed. Reg. 59,002 (Oct. 17, 2026) ("Supplemental Proposal"). This memorandum provides technical analysis demonstrating that EPA's methods for assessing temperature variability and measurability thresholds in the Supplemental Proposal were flawed and systematically biased toward overstating temperature variability and temperature and sea level measurement uncertainty.[1] Section 1 addresses temperature variability, identifying five independent errors in EPA's approach – including failure to correct for the underlying upward trend in global mean surface temperature (GMST), reliance on annual rather than multi-year averages, a potentially inaccurate use of sample rather than population standard deviation, use of an unjustified and historically anomalous reference window (2016–2025), and inadequate consideration of interval length effects – each of which inflates EPA's variability estimate. Taken together, these errors cause EPA to overstate temperature variability by as much as 85%. Section 2 addresses measurability, showing that EPA's cited source does not support its stated uncertainty value, and that multiple independent datasets report measurement uncertainties materially lower than the levels EPA deemed de minimis.

I. Temperature Variability

As discussed in the body of the comments, EPA's use of "temperature variability" as a metric to determine futility is inherently arbitrary. Here we demonstrate that – even accepting EPA's fatally flawed methodology of comparing projected global mean surface temperature impacts from Section 111 regulation of power-plant CO2 emissions to a global mean surface temperature variability metric – EPA's stated GMST variability metric is itself arbitrary and appears to be the result of an arbitrary and unjustifiable methodology. EPA's process for determining the temperature variability in the climate system was flawed for at least five reasons which materially change the final result: (1) EPA failed to correct for the underlying increasing trend in

[1] This memorandum accepts as the starting point EPA's basic methodology of comparing certain variability and measurability metrics to projected impacts of U.S. power-plant greenhouse gases in order to determine the futility of Section 111 greenhouse gas regulation. However, as explained in the comments, the underlying methodology is fundamentally arbitrary, capricious, and contrary to law. The more discrete critiques articulated in this memorandum, including the technical methodologies and numerical figures we present, do not imply that we in any way agree with EPA's proposed methodology or legal rationale for assessing futility.

global mean surface temperature; (2) annual averages are an inappropriately short timeframe to assess whether an increase in temperature would be inconsequential given the "variability" in the system; (3) EPA should have used population standard deviation and not sample standard deviation if the Agency meant to describe "variability" for 2016–2025; (4) the use of the selected time period, 2016–2025, was arbitrary and particularly unsupportable if intended to represent "variability" in 1950–2025; and (5) the use of a 10-year time interval to calculate variability was arbitrary. Each of these arbitrary and/or irrational choices operates in the direction of overstating variability and therefore overstating the degree to which the signal is obscured by background noise. Section 1 identifies and addresses these flaws and undermines EPA's central claim that U.S. power plant greenhouse gas regulation is futile because its temperature impact is immaterial.

A. EPA Failed to Correct for the Underlying Upward Trend in Global Mean Surface Temperature (GMST).

Global mean surface temperature has risen dramatically over the past century due to increasing concentrations of greenhouse gases, such as carbon dioxide (CO_2), in the atmosphere (Figure 2). The global mean surface temperature anomalies time series[2] referred to by EPA has a clear and well-documented upward trend (Figure 1). EPA states that it computed the variability in GMST from 2016–2025 to be 0.14°C. 91 Fed. Reg. at 59,040 ("GMST variability from 2016–2025 was 0.14 °C.") The Agency claims it arrived at this result by calculating the standard deviation of the global annual land and ocean average temperature anomaly data from 2016–2025. But in footnote 218, EPA clarifies that this period does not include 2016. 91 Fed. Reg. at 59,040, n.218 ("EPA assumes for the purposes of this comparison that the 'variability' in GMST is represented by the standard deviation of the global annual land and ocean average temperature anomaly data from 2016–2025 (exclusive of 2016)."). Thus it is unclear if EPA computed the variability statistic for 2016–2025 or 2017–2025. In the remainder of this memorandum, we assume EPA used the 2016–2025 period and replicate this methodology and critique it accordingly. The analysis and conclusions do not meaningfully change if we had used 2017–2025.

[2] *See* Nat'l Ctrs. for Env't Info., Nat'l Oceanic & Atmospheric Admin., *Climate at a Glance: Global Time Series* (Oct. 2026), https://www.ncei.noaa.gov/access/monitoring/climate-at-a-glance/global/time-series [hereinafter NCEI Climate at a Glance: Global Time Series].

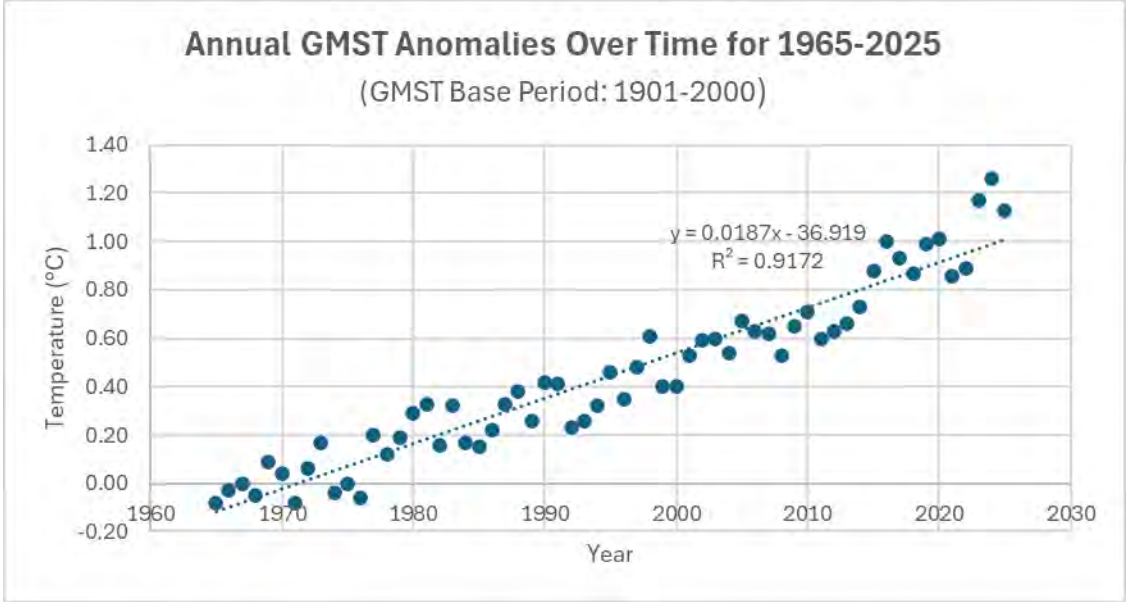


Figure 1. *Global mean surface temperature (GMST) anomalies (°C) with respect to the 1901–2000 average vs. time for 1965–2025. GMST data was sourced from the NCEI Climate at a Glance: Global Time Series. Each dot represents the temperature anomaly for a given year. The dotted line is the line of best fit, which shows that GMST anomalies have increased during this period by a rate of roughly 0.019°C/year.*

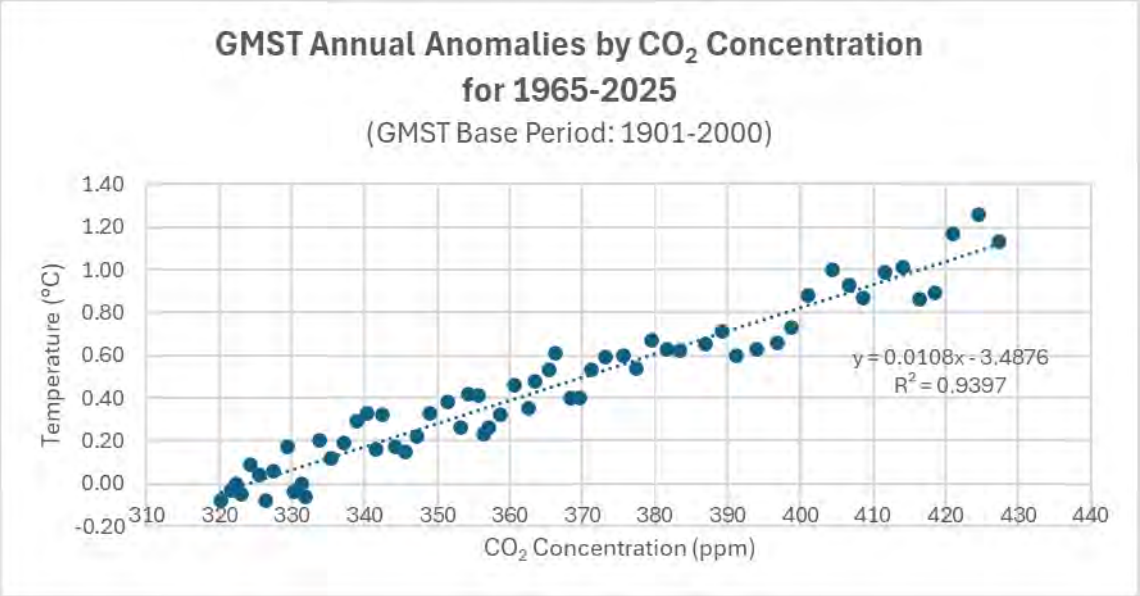


Figure 2. *Global mean surface temperature (GMST) anomalies (°C) with respect to the 1901–2000 average vs. Carbon dioxide (CO_2) concentration (ppm) for 1965–2025. GMST data was sourced from the NCEI Climate at a Glance: Global Time Series. CO_2 data was sourced from*

NASA[3] for the years 1965–2011 (the most recent year available) and from the NOAA Global Monitoring Lab[4] for the years 2012–2025. Each dot represents the temperature anomaly and CO_2 concentration for a given year. The dotted line is the line of best fit, which shows that GMST anomalies have increased during this period by a rate of roughly 0.011°C/ppm CO_2.

Global mean surface temperature changes across multiple time scales – from day-to-day and seasonal fluctuations to longer-term changes driven by anthropogenic greenhouse gas emissions.[5] Standard deviation measures dispersion around a constant mean and is best suited for a symmetric, bell-curved distribution.[6] When a long-term trend is present in the data, as with the well-documented upward trajectory of temperature, the data are not symmetrically distributed, and standard deviation is not appropriate to apply directly.[7] Statistical best practice requires first fitting and subtracting the trend, for instance using a least squares regression – retaining only the residuals[8]—EPA's cited 0.14°C standard deviation over 2016–2025 does not appear to account

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[3] NASA Goddard Inst. for Space Studies, *Global Mean CO_2 Mixing Ratios (ppm): Observations* (Feb. 6, 2012), https://data.giss.nasa.gov/modelforce/ghgases/Fig1A.ext.txt.

[4] Nat'l Oceanic & Atmospheric Admin., *Mauna Loa CO_2 annual mean data (CSV), Carbon Cycle Greenhouse Gases: Trends in CO_2, CH_4, N_2O, SF_6*, Global Monitoring Laboratory (Feb. 10, 2021), https://gml.noaa.gov/ccgg/trends/data.html.

[5] E. Hawkins & R. Sutton, *The potential to narrow uncertainty in regional climate predictions*, 90 Bulletin of the Am. Meteorological Soc'y 1096 (2009), https://doi.org/10.1175/2009BAMS2607.1 ("The first is the internal variability of the climate system, that is, the natural fluctuations that arise in the absence of any radiative forcing of the planet. Appreciation of these fluctuations is an important matter for decision makers because they have the potential to reverse—for a decade or so—the longer-term trends that are associated with anthropogenic climate change."). *See also* V. Masson-Delmotte et al. eds., *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, Fig. SPM.1, at 6 (2021) (showing global temperature changes from paleoclimate and instrumental records, including natural variability and recent human-caused warming).

[6] S. El Omda & S.R. Sergent, *Standard Deviation*, StatPearls Publishing (2024), https://www.ncbi.nlm.nih.gov/books/NBK574574/ ("The main issue is in data sets where there are extreme values or severe skewness, as these results can influence the mean and SD by a significant amount. Consequently, in scenarios where the data set does not follow a normal (Gaussian) distribution, other measures of dispersion are often used. Most commonly, the interquartile range (IQR) is used alongside the median of the dataset.").

[7] Frank Harrell, *What Does a Statistical Method Assume?*, Statistical Thinking (Mar. 23, 2024), https://www.fharrell.com/post/assume/ ("The standard deviation assumes that Y has a symmetric distribution whose dispersion is well described by a root mean squared measure."; "When the Y distribution is not symmetric, the SD may not be representative of the overall dispersion of Y…").

[8] P.J. Brockwell & R.A. Davis, Introduction to Time Series and Forecasting at 20 (3d. ed. 2016) https://weblibrary.mila.edu.my/upload/ebook/management%20_and_business/2016_Book_IntroductionToTimeSeriesAndFor.pdf ("If the seasonal and noise fluctuations appear to increase with

for this step, meaning the estimate likely conflates the underlying warming trend with genuine temperature variability, overstating the relative magnitude of variability. *See* 91 Fed. Reg. at 59,040 ("GMST variability from 2016-2025 was 0.14 °C, which is almost four times greater than the GMST change estimated in 2100 from eliminating all U.S. power plant GHG emissions."). This failure to follow well-established statistical practices is clearly erroneous.

To illustrate why using standard deviation as a statistical method to evaluate variability without first correcting for the underlying trend is incorrect, we created a sample data set of annual means plotted in Figure 3. The purple line represents data with a steady and unequivocal upward trend over time, such as global mean surface temperature, while the orange line displays noisy data that is varying around a constant mean of 4.5, such as the trend exhibited by internal climate variability. The purple and orange lines have the same exact population standard deviation, 2.87, but the "interannual" variability is clearly greater for the orange line than the purple line.

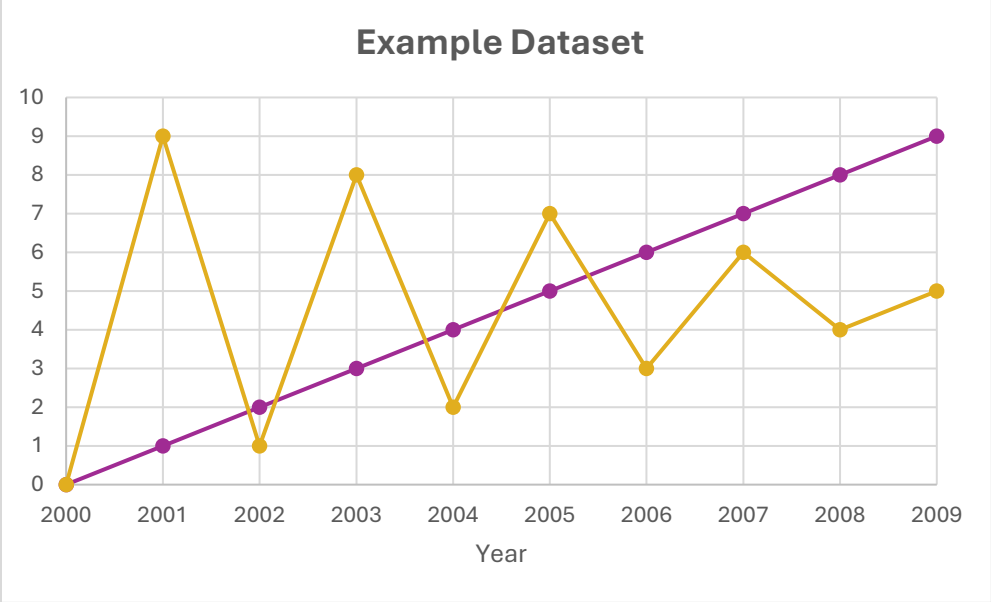


Figure 1. *Example dataset illustrating how standard deviation is not an appropriate way to measure variability. The purple line shows a steady and unequivocal upward trend while the orange line shows noisy data that is varying around a constant mean of 4.5. Though both datasets have a standard deviation of 2.87, the interannual variability of the datasets is different.*

Here we account for the underlying upward trend in global mean surface temperature over time. We use the same NCEI Climate at a Glance: Global Time Series dataset from which EPA sourced 1950–2025 global land and ocean average temperature anomalies data. We then plotted the 2016–2025 GMST anomalies data and calculated the line of best fit using linear least squares (Figure 4). We then calculated the residuals, or the difference between the observed data points and the line of best fit. Next, we calculated the sample standard deviation of the residuals. The result was a value of 0.1073°C, which is roughly 23% lower than EPA's calculated value of

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the level of the process, then a preliminary transformation of the data is often used to make the transformed data more compatible with the model.").

0.14°C. Thus, EPA's choice to not correct for the trend before calculating the standard deviation was arbitrary and materially changed the outcome of the analysis.

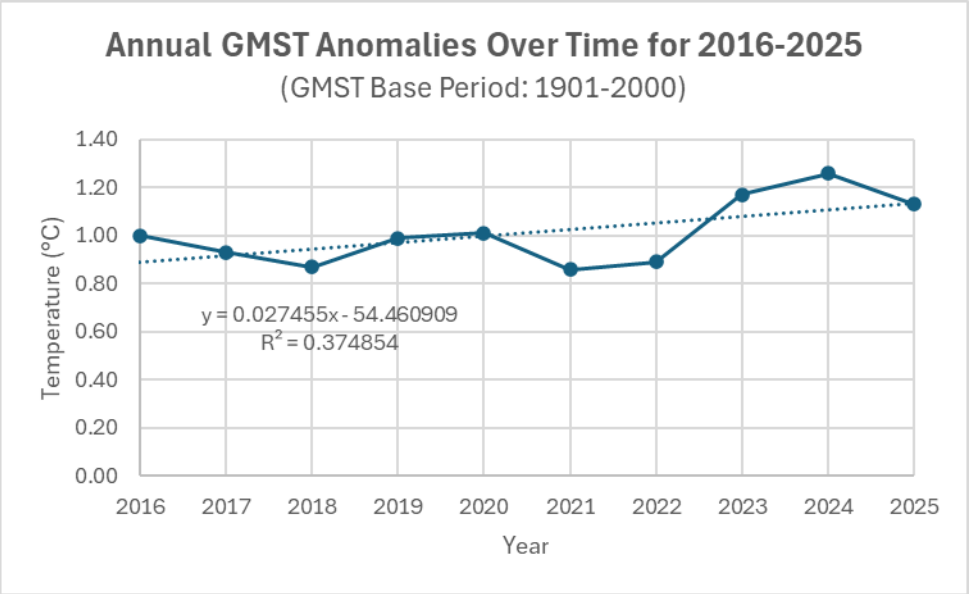


Figure 2. *Global mean surface temperature (GMST) anomalies (°C) with respect to the 1901–2000 average vs. time for 2016–2025. GMST data was sourced from the NCEI Climate at a Glance: Global Time Series. Each dot represents the temperature anomaly for a given year. The dotted line is the line of best fit, which shows that GMST anomalies have increased during this period by a rate of roughly 0.028°C/year.*

The underlying cause of the temperature trend is not time itself – time is just a proxy. The actual physical driver of the trend is increasing concentrations of atmospheric CO_2 and other greenhouse gases. To be more precise, here we repeat the process above but treat CO_2 as the independent variable and global mean surface temperature anomalies as the dependent variable (Figure 5). We calculated the sample standard deviation of the residuals to be 0.1049°C, and 25% lower than EPA's calculated value of 0.14°C.

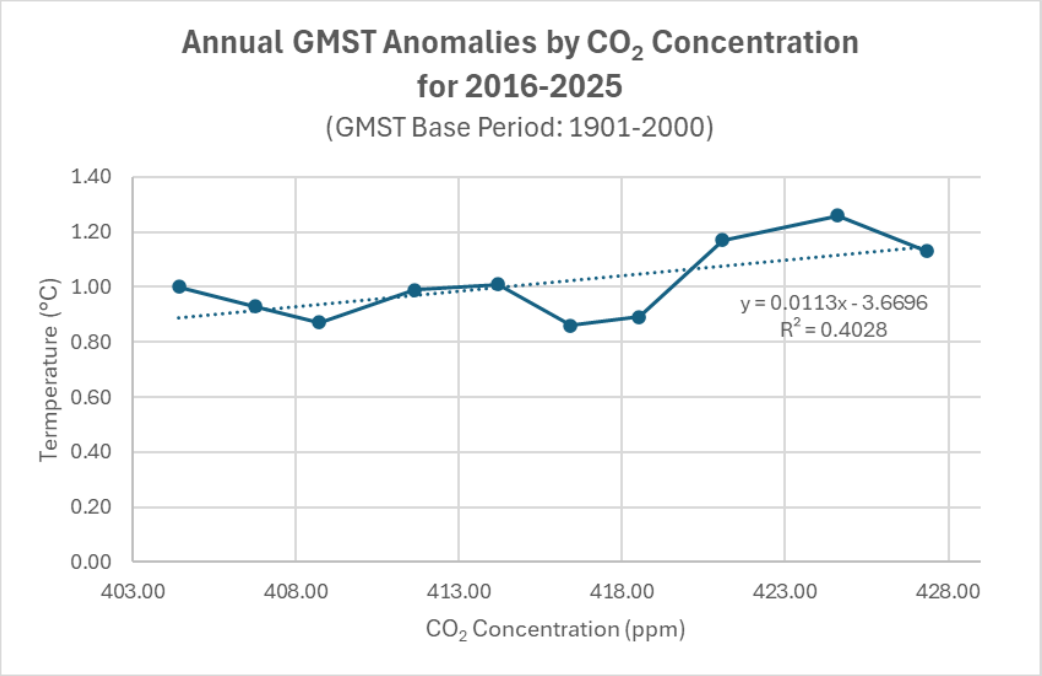


***Figure** 3. Global mean surface temperature (GMST) anomalies (°C) with respect to the 1901–2000 average vs. carbon dioxide (CO_2) concentration (ppm) for 2016–2025. GMST data was sourced from the NCEI Climate at a Glance: Global Time Series. CO_2 data was sourced from NASA for the years 1965–2011 (the most recent year available) and from the NOAA Global Monitoring Lab for the years 2012–2025. Each dot represents the temperature anomaly and CO_2 concentration for a given year. The dotted line is the line of best fit, which shows that GMST anomalies have increased during this period by a rate of roughly 0.011°C/ppm CO_2.*

Finally, even this approach is likely to overestimate true variability because it considers only CO_2 as the only explanatory variable. Global mean surface temperature is driven by a combination of radiative forcings, including other well-mixed greenhouse gases (such as methane and nitrous oxide), aerosols, and natural forcings such as volcanic and solar variability. Climate science literature consistently shows that incorporating the full set of radiative forcings further reduces unexplained variability in temperature time series, as a larger share of the observed temperature change is attributed to known physical drivers rather than treated as residual noise.[9] Thus, a more complete physically based model would be expected to yield an even lower standard deviation of residuals than the CO_2 analysis presented here, reinforcing that EPA's estimate substantially overstates true temperature variability.

[9] V. Eyring et al., *Ch.3 Human Influence on the Climate System, in Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* 423–552 (V. Masson-Delmotte et al. eds. 2021), 10.1017/9781009157896.005.

B. Annual Averages Are an Inappropriately Short Timeframe to Assess Whether an Increase in Temperature Would Be Inconsequential Given the "Variability" in the System.

EPA's use of annual averages to consider sustained changes in temperature is inappropriate for a fundamental reason: annual temperature values contain a large amount of short-term noise driven by internal climate dynamics such as El Niño-Southern Oscillation (ENSO), which can shift global mean surface temperatures by several tenths of a degree from one year to the next. This short-term noise is not representative of the background climate change against which multi-decadal signals should be assessed. NOAA's NCEI explicitly recognizes this, noting that conventional climate normals are calculated as 30-year averages and serve as the standard benchmark for climate conditions. As NCEI states, these 30-year averages are used by meteorological organizations around the world precisely because they smooth out short-term fluctuations and provide a stable reference for assessing climate conditions.[10] Using annual values rather than multi-year averages conflates this short-term noise with any remaining background variability that EPA claims is relevant for its assessment, artificially inflating the variability estimate EPA then used to declare the policy signal de minimis.

This error is particularly glaring because time data is almost always averaged in some way already, whether it be daily, monthly, seasonally, annually, or multi-annually. As such, EPA is already using averaged data; the Agency cites 12-month average global mean surface temperature anomalies data. EPA could more accurately represent long-term temperature changes by averaging over a longer period, in accordance with best practices of climate science.

Furthermore, as discussed in Section 1.a., EPA did not correct for the well-documented upward trend in global mean surface temperature before calculating standard deviation. Because the trend was not removed, the standard deviation of the annual values not only represents both genuine year-to-year variability, but also the directional movement of the underlying trend, inflating the resulting figure. A standard approach in climate time series analysis, referred to as filtering out high frequency noise, is to separate long-term trends from higher-frequency noise prior to estimating variance.[11,12,13]

To illustrate the consequences of EPA's methodological choices, here we recalculate temperature variability using longer averages. To be clear, we are not suggesting that a correct approach

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[10] Nat'l Ctrs. for Env't Info., Nat'l Oceanic & Atmospheric Admin., *New type of U.S. Normals addresses influence of El Niño and La Niña,* Accounting for Variability in Our Changing Climate (Aug. 5, 2019), https://www.ncei.noaa.gov/news/accounting-natural-variability-our-changing-climate.

[11] Hans von Storch & Francis W. Zwiers, *Statistical Analysis in Climate Research* 10–11, 197–215 (1999).

[12] Brockwell & Davis, at 20.

[13] B. García-Carreras & D. C. Reuman, *Are Changes in the Mean or Variability of Climate Signals More Important for Long-Term Stochastic Growth Rate?* 8 PLoS ONE e63974 (2013), https://doi.org/10.1371/journal.pone.0063974.

would be to use a 10-year window as opposed to annual data, but to illustrate how the standard deviation is sensitive to the period the data is averaged over. We calculated 10-year average global mean surface temperature anomaly data from the same annually averaged NCEI Climate at a Glance: Global Time Series data used by EPA; fit a linear least squares regression to the data and subtracted the resulting trend line, retaining only the residuals; and then calculated the standard deviation of the residuals. This approach, described above, is well established in climate science and separates out the long-term trend from the short-term noise.

Using 10-year averages for temperature anomaly and time with the long-term trend removed via linear least square regression, the sample standard deviation is 0.0515°C, roughly 63% lower than EPA's reported "variability" statistic of 0.14°C (Figure 6). Using 10-year averages for temperature and CO_2 concentration with the long-term trend removed via linear least square regression, the sample standard deviation is 0.0208°C, roughly 85% lower than EPA's reported "variability" statistic of 0.14°C (Figure 7). These results demonstrate that EPA's choice of annual averages, combined with its failure to detrend, produced a statistically inappropriate estimate that overstates variability by as much as 85%.

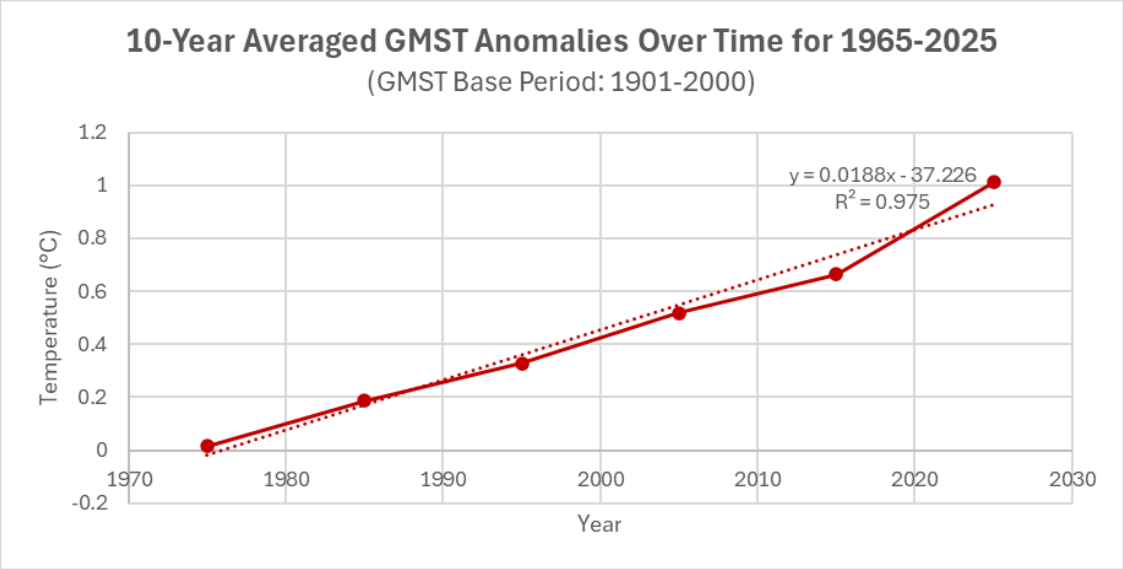


Figure 6. *10-year average global mean surface temperature (GMST) anomalies (°C) with respect to the 1901–2000 average vs. time for 1965–2025. GMST data was sourced from the NCEI Climate at a Glance: Global Time Series. Each dot represents the average temperature anomaly for the previous 10-year period. For example, the dot at 1975 represents the mean temperature anomaly compared to the 1901–2000 average for the years 1966–1975. The dotted line is the line of best fit, which shows that GMST anomalies have increased during this period by a rate of roughly 0.019°C/year.*

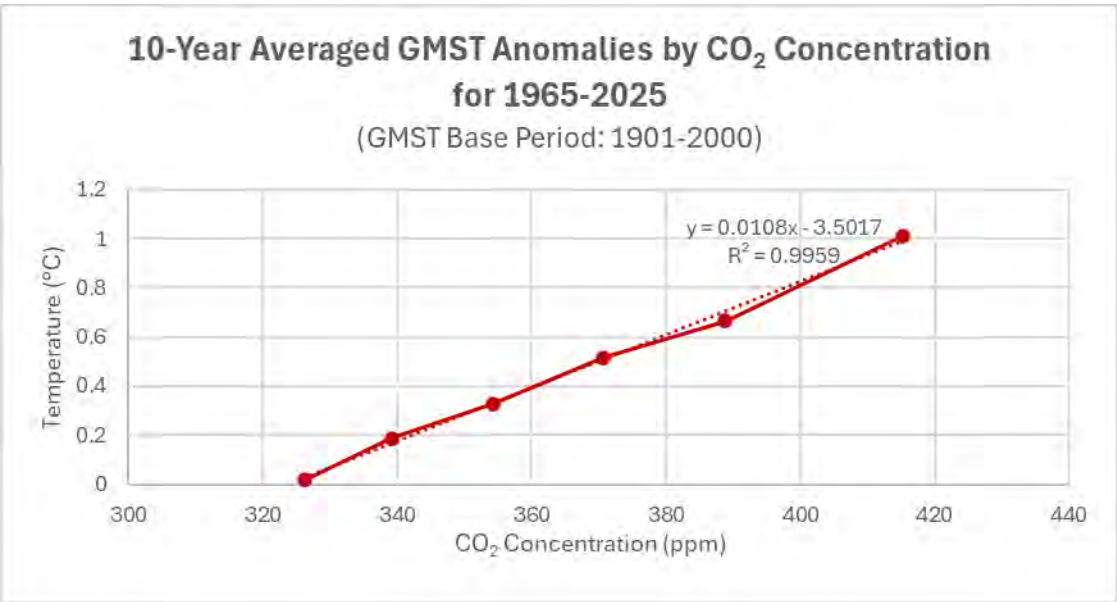


Figure 7. *10-year average global mean surface temperature (GMST) anomalies (°C) with respect to the 1901–2000 average vs. carbon dioxide (CO_2) concentration (ppm) for 1965–2025. GMST data was sourced from the NCEI Climate at a Glance: Global Time Series. CO_2 data was sourced from NASA for the years 1965–2011 (the most recent year available) and from the NOAA Global Monitoring Lab for the years 2012–2025. Each dot represents the average temperature anomaly and average CO_2 concentration for the previous 10-year period. The dotted line is the line of best fit, which shows that GMST anomalies have increased during this period by a rate of roughly 0.011°C/ ppm CO_2.*

C. EPA Should Have Used Population Standard Deviation and Not Sample Standard Deviation If the Agency Meant to Describe "Variability" For 2016–2025.

The premise of EPA's argument that natural climate variability is large relative to the projected temperature impact of U.S. power-plant greenhouse gas standards depends critically on how variability is measured. EPA calculated a 0.14°C "variability" figure for the 2016–2025 period. It is unclear if the Agency did so with the intent to measure standard deviation in this period alone (i.e., the population of data is restricted to the 2016–2025 data), or if the Agency were using the 2016–2025 period to represent the entirety of data from 1950–2025 (i.e., the 2016–2025 data is only a sample). For the purposes of this section, our interpretation of EPA's inadequately short description is that the Agency intended to represent just the variability of 2016–2025.

The distinction between population and sample standard deviation relies on a fundamental question: are the data points in question a sample drawn from a larger population, or do they constitute the entire population of interest? The formula for calculating sample standard deviation divides by the number of observations minus one (n-1) to account for the bias introduced when a sample mean is used to estimate an unknown population mean.[14] This adjustment is appropriate when the observed values are a subset of a larger group that was not

[14] El Omda & Sergent.

fully observed, as is often the case with climate data.[15] Conversely, population standard deviation divides by the number of observations (n) and is appropriate when the observed values constitute the complete population, such as a fully enumerated set of observations within a defined temporal window where all elements of interest are observed without sampling uncertainty (i.e., a closed set of annual GMST values over a specified period).

In the case of EPA's variability calculation, first we will assume that the Agency's intention was to calculate variability of the ten annual global mean surface temperature values from 2016–2025. As such, these data can be understood as fully observed measurements of a specific, completely enumerated set of years. There is one Earth, and its average global mean surface temperature for each of those years has been measured and recorded. There is no larger population of unobserved years from which these 10 values were drawn; they are the population. EPA therefore should have divided by n=10 rather than n-1=9 when calculating the standard deviation of these values. Here, we proceed as EPA should have to quantify the impacts of its error. Population standard deviation equals sample standard deviation multiplied by $\sqrt{(n-1/n)}$. With n=10, this adjustment factor is $\sqrt{(9/10)} \approx 0.9487$, meaning EPA's reported variability figure of 0.14°C should be reduced to approximately 0.133°C to adjust for this error alone, or a reduction of approximately 5.4%.

For the sake of consistency with EPA's methods, throughout this technical memorandum, we reported standard deviations as calculated using the sample standard deviation formula. Here we recalculate these using the population standard deviation formula (Table 1).

Table 1. *Comparison of standard deviation estimates when calculating using the formula for sample standard deviation vs. population standard deviation.*

Data	Figure	Sample Standard Deviation of the Residuals (°C)	Population Standard Deviation of the Residuals (°C)
EPA's variability estimate	-	0.1358[16]	0.1328
Recent GMST annual anomalies over time (2016-2025)	Figure 4	0.1073	0.1018
Recent GMST annual anomalies with CO_2 concentrations (2016-2025)	Figure 5	0.1049	0.0995
10-year averaged GMST anomalies with time (1965-2025)	Figure 6	0.0515	0.0477
10-year averaged GMST anomalies with CO_2 concentrations (1965-2025)	Figure 7	0.0208	0.0193

[15] Storch & Zwiers, at 69.

[16] EPA provided two significant figures for their estimate and thus reported this value as 0.14.

D. EPA's Use of Its Selected Time Period, 2016–2025, Was Inadequately Considered, And Is Particularly Unsupportable If Intended to Represent "Variability" in 1950–2025.

If, in fact, EPA was using the 2016–2025 period to represent the entirety of data from 1950–2025 (i.e., the 2016–2025 data is only a sample), EPA's decision was still arbitrary. The Agency provided no explanation for why the period from 2016–2025 was selected as the reference period, nor any sensitivity analysis showing how the results would change under alternative window choices. As we show here, a more representative reference window would produce a lower variability estimate.

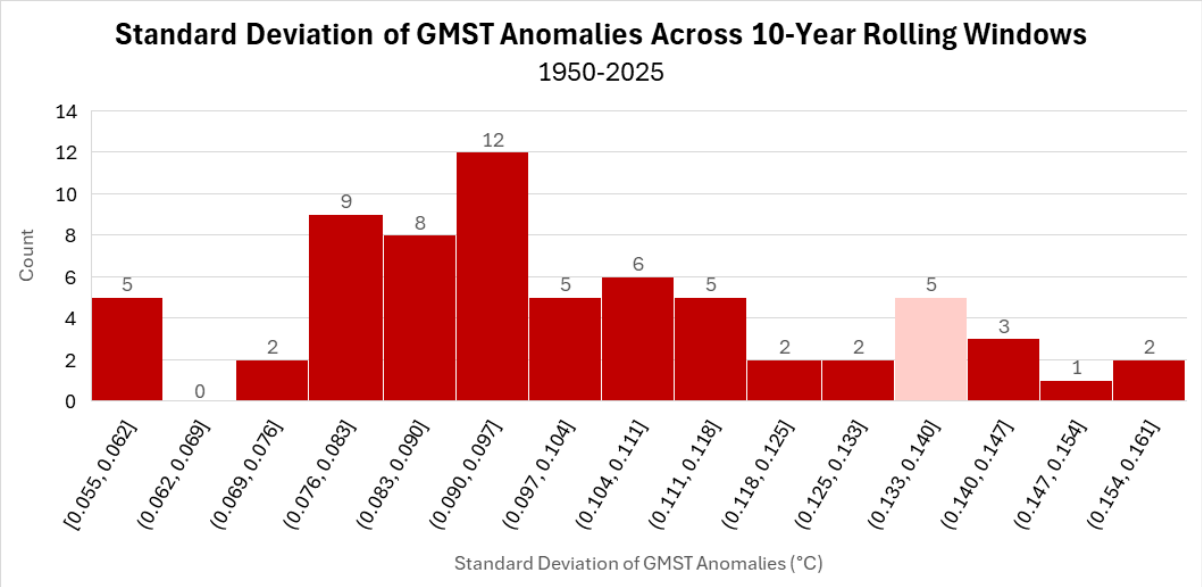


Figure 8. *Standard deviation of GMST anomalies (°C) across 10-year rolling windows from 1950–2025. GMST data was sourced from the NCEI Climate at a Glance: Global Time Series. The lightest-hued bin contains the standard deviation for 2016–2025: 0.136°C. Only seven of the 67 windows have standard deviations above that of the 1950–2025 period.*

To evaluate how consequential this choice of a reference window is, we calculated the standard deviation of GMST anomalies for each 10-year rolling period (i.e. 1950–1959, 1951–1960, etc.) from 1950–2025. This produced 67 distinct 10-year windows, each with its own standard deviation. We calculated the sample standard deviation for the anomalies in global mean surface temperature for the period 2016–2025 to be 0.136°C. As shown in Figure 8, the sample standard deviation for the 2016–2025 window is among the highest of all windows examined.[17] Of the 67 rolling 10-year windows calculated, only seven produced a higher sample standard deviation than the 2016–2025 period. In other words, EPA's chosen reference window falls in roughly the top 10% of the 67 different 10-year windows in terms of internal variability. By selecting, without justification, one of the most internally variable 10-year periods in the modern temperature record (Figure 8), EPA has systematically overstated the background variability

[17] We plotted the data with a range of bin sizes, which did not meaningfully impact the shape of figure or the conclusions drawn from Figure 8.

against which the policy signal of 0.035°C is being compared. Had EPA chosen a more typical window, the resulting standard deviation would have been meaningfully lower. For example, had EPA chosen the median 10-year window (1983-1992), the resulting sample standard deviation would have been 0.0974°C, roughly 30% lower than EPA's calculated value of 0.14°C. If EPA had chosen the window with the median sample standard deviation in the 1950-2025 period, the Agency would have selected the 1981-1990 window, which has a sample standard deviation of 0.0962°C, roughly 31% lower than EPA's calculated value of 0.14°C.

EPA's choice of 2016–2025 as the reference window is not merely arbitrary; it is systematically biased toward a period of historically anomalous climate behavior. The IPCC Special Report on Global Warming of 1.5°C found that, "trends in the intensity and frequency of some climate and weather extremes have been detected over time spans during which about 0.5°C of global warming occurred."[18] This finding has direct implications for EPA's choice of reference window. The 2016–2025 period coincides with some of the highest recorded greenhouse gas concentrations in human history.[19] At these elevated greenhouse gas concentrations, the climate system is operating in a regime that is measurably different from earlier decades, with altered patterns of climate extremes that are themselves a consequence of the underlying warming trend. By selecting a reference window that falls within this altered climate regime, and without correcting for the underlying trend that produced it, EPA has compounded the error identified in Section 1.a.: the Agency not only failed to detrend the temperature series but also selected a window in which the residual variability is itself partially a product of the trend it failed to remove. In other words, the elevated variability of the 2016–2025 window relative to earlier periods is not purely a reflection of natural internal climate variability. It is at least partly a reflection of the altered climate state produced by the very greenhouse gas emissions whose regulation is under consideration. Using this window to argue that climate variability renders U.S. power-plant greenhouse gas regulation futile is therefore circular: the elevated variability EPA cites as a reason not to regulate is itself a consequence of the kind of emissions that Section 111 greenhouse gas regulation is meant to address.

E. EPA Did Not Adequately Consider the Impacts of a 10-Year Time Interval on Variability.

EPA's decision to characterize climate variability using a 10-year time interval is a consequential methodological choice that was made without justification. As shown in Figure 9, the choice of window length materially affects the resulting standard deviation estimate. We are not suggesting that a 10-year window is an appropriate window length to use to characterize variability, but rather, as shown in Figure 9, to illustrate how the window length selected

[18] O. Hoegh-Guldberg et al., *Ch.3 Impacts of 1.5ºC Global Warming on Natural and Human Systems, in Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty* 175–312, 177 (V. Masson-Delmotte et al. eds. 2018), https://doi.org/10.1017/9781009157940.005.

[19] Robert Rohde, *Global Temperature Report for 2025*, Berkeley Earth (Jan. 14, 2026), https://berkeleyearth.org/global-temperature-report-for-2025/.

considerably affects the final variability estimate. This suggests that the basic methodological approach undertaken by EPA is arbitrary. This arbitrariness is compounded by the fact that EPA's specific 10-year window of 2016–2025 is itself an outlier within the distribution of all possible 10-year windows, as shown in Figure 8 and discussed in Section 1.d.

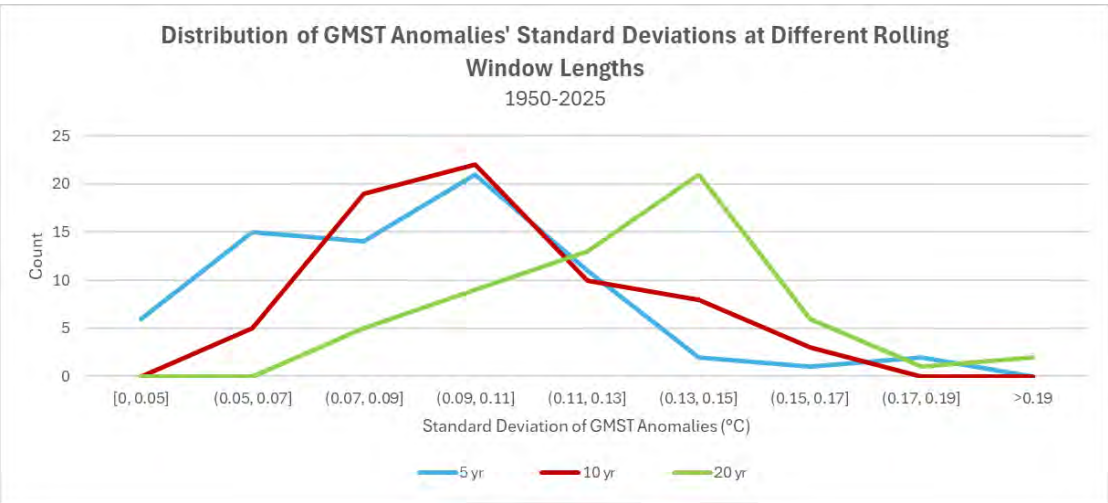


Figure 9. *Distribution of GMST anomalies' standard deviations (°C) at different rolling window lengths. Data is not detrended. GMST data was sourced from the NCEI Climate at a Glance: Global Time Series. The light blue line shows the distribution of standard deviation for rolling 5-year windows, while the red and green lines show the distributions for 10- and 20-year windows respectively. This shows how standard deviation is sensitive to window length.*

The same pattern holds for 5-year windows. Generally, the sample standard deviation for 5-year windows is smaller (Figure 9), but the most recent 5-year window of 2021–2025 has a sample standard deviation of 0.177°C, making it among the single most variable 5-year window in the 1950–2025 record (Figure 10). In other words, regardless of which interval length is used, EPA's choice of the most recent available window consistently produces one of the highest variability estimates in the historical record. The combination of an unjustified interval length and an unjustified window selection systematically biases EPA's variability estimate upward relative to what a different methodological choice would produce.

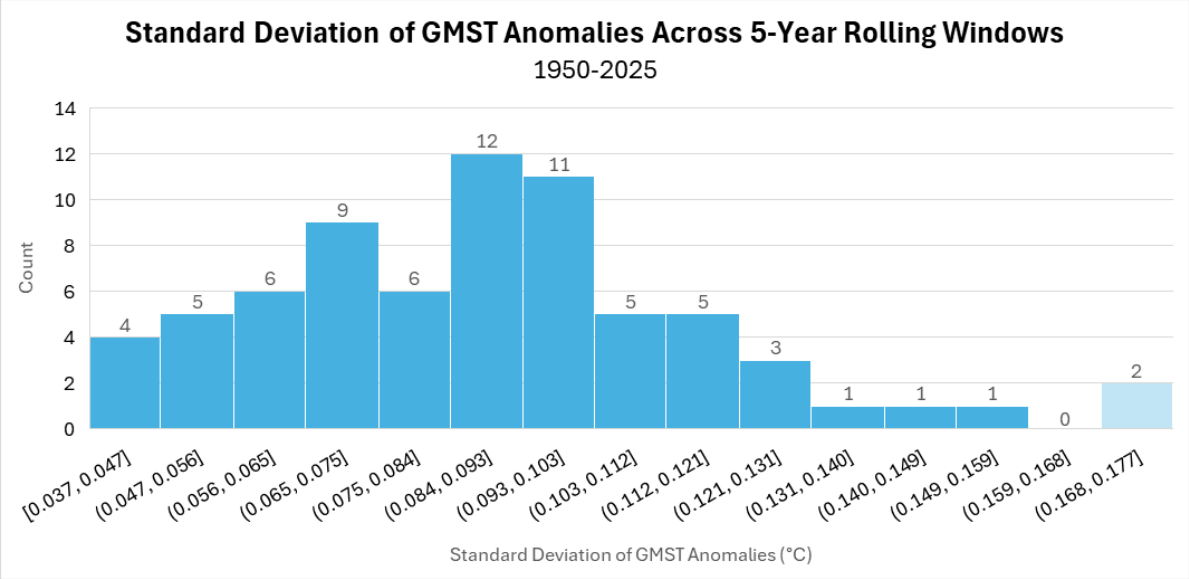


Figure 10. *Standard deviation of GMST anomalies (°C) across 5-year rolling windows from 1950–2025. GMST data was sourced from the NCEI Climate at a Glance: Global Time Series. The lightest-hued bin contains the standard deviation for 2021–2025: 0.177°C. The 2021-2025 window has the highest standard deviations in the 1950–2025 period.*

EPA provided no explanation for why a 10-year interval was selected, nor any sensitivity analysis demonstrating that the conclusions are robust to alternative interval lengths. Given that the choice of interval length shifts the center of the standard deviation distribution by as much as 0.04–0.05°C, this omission is significant.

II. Measurability

EPA asserts that global mean surface temperature and global sea level rise ranges of measurability are larger than the EPA's projected impacts. This assertion is completely unsupported and fundamentally arbitrary.

In the Supplemental Proposal, EPA says "[t]he predicted impacts by 2100 (0.035 °C as shown in Table 5) are below the range of measurability for GMST." 91 Fed. Reg. at 59,040. And a footnote for this point states:

> The EPA uses the term ''measurability'' here to refer to the uncertainty in reconstructing estimates of historical global mean surface temperature. The magnitude of the modeled change in GMST in 2100 associated with eliminating all U.S. CO_2 emissions from power plants (Table 5) is less than the level of uncertainty in GMST estimates for the year 2020, as calculated by several global products (e.g., Figure 4 in Lenssen, N. (2024) A NASA GISTEMPv4 Observational Uncertainty Ensemble, Journal of Geophysical Research: Atmospheres, 129, e2023JD040179. https://doi.org/ 10.1029/2023JD040179)."

Id. at 59,040, n.217. For global mean surface temperature, the source EPA cites does not include the information the Agency claims it does, and there are at least six global annual temperature

datasets with uncertainties at or below EPA's 0.035°C. For global sea level rise, EPA fails to provide any source or any number, and available estimates of measurement uncertainty are below the 1.37 cm of global sea level rise that EPA projects for U.S. power-plant emissions.

A. EPA's Use of Measurement Uncertainty as a Threshold for Establishing Futility is Arbitrary.

EPA's choice to use "measurability" as a threshold to determine futility is arbitrary. Measurement uncertainty for global mean surface temperature and global sea level rise arises from many components, including instrument precision, data coverage, and statistical methods to fill in data globally.[20] In practice, this means that global temperature estimates must account for the uneven distribution of weather stations and ocean buoys across the planet, gaps in historical records, differences in measurement techniques over time, and the challenge of converting thousands of local temperature readings into a single planetary average.[21] For GMST specifically, uncertainty stems from multiple independent sources across both land and ocean records. On land, these include station uncertainty (e.g., measurement errors, transcription errors, and adjustments to station records), bias uncertainty (e.g., changes in instrumentation methodology over time and urban heat island effects), and sampling uncertainty (from incomplete spatial and temporal coverage).[22] Over the ocean, uncertainty is further broken down into parametric uncertainty and reconstruction uncertainty, the latter of which "averages out to nearly zero at global scales."[23]

Over time, these uncertainties have generally declined as instruments have gotten more precise, data coverage has improved, and statistical methods have progressed.[24] EPA fails to explain why this trend would not continue leading to smaller measurement uncertainties by 2100.

B. EPA's Explanation of Global Mean Surface Temperature Measurability is Arbitrary and Inadequately Explained.

EPA barely uses 100 words to describe its understanding and position on GMST measurability, and 93 of those words are relegated to a footnote. This is both a robust area of significant scientific research and a seemingly essential component of EPA's determination that regulating U.S. power-sector greenhouse gas emissions is futile. To give it such cursory treatment is inexcusable and arbitrary.

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[20] Nat'l Aeronautics & Space Admin. [NASA], *This is How Scientists Measure Global Temperature* (Jan. 10, 2025), https://science.nasa.gov/earth/measuring_global_temperature/.

[21] *Id.*

[22] Nathan J. L. Lenssen et al., *Improvements in the GISTEMP uncertainty model*, 124 J. Geophysical Rsch.: Atmospheres 6307, 6312 (2019), https://doi.org/10.1029/2018JD029522.

[23] Lenssen et al., *at 6313*.

[24] NASA, *This is How Scientists Measure Global Temperature* (Jan. 10, 2025), https://science.nasa.gov/earth/measuring_global_temperature/.

i. EPA's Use of the Word "Several" Is Inaccurate.

In the Supplemental Proposal, EPA says that the measurement uncertainty for 2020 GMST is larger than the impact in 2100 from U.S. power plants "as calculated by several global products" and then references Figure 4 in a 2024 paper by Lenssen et al.[25] There are six global products plotted in Figure 4, and three of the plotted lines have values above 0.035°C in 2020: GISTEMP Ensemble, GISTEMP (Lenssen et al. 2019), and Berkeley Earth.[26] However, GISTEMP (Lenssen et al. 2019) and GISTEMP Ensemble should not be counted as separate products. The product at issue in the paper EPA references is GISTEMP Ensemble, which is an update of GISTEMP (2019); they are not separate products. Additionally, Berkeley Earth updated its product, which now has an uncertainty measurement of 0.032°C for 2020.

As a result, only one of the products plotted in the Lenssen 2024 paper has an uncertainty larger than 0.035°C; three have an uncertainty lower than 0.035°C; and one of the products, NOAAGlobalTemp, does not have a 2020 value plotted in the figure but has an uncertainty below 0.035°C for every year between 1986 and 2015, the last year data is available. It is very likely that NOAAGlobalTemp also has a measurement uncertainty less than 0.035°C. EDF was able to find one additional GMST dataset with uncertainty measurements, DCENT.[27] DCENT's 2020 measurement uncertainty is 0.01°C, well below 0.035°C.

This means, of the six global average temperature anomaly datasets with uncertainty measurements EDF could find, at least four and likely five have measurement uncertainties that are *smaller* than 0.035°C in 2020. For EPA to point to one supporting source and completely ignore four or five contradictory sources is the very definition of arbitrary.

ii. EPA's Choice to Use a Single Year of Data Is Arbitrary.

In addition to incorrectly characterizing the uncertainty for 2020 within the scientific literature, EPA also only considers the measurement uncertainty for a *single* year. EPA provides no explanation of why this year was the only one the Agency considered, nor does EPA justify using data from a year that saw unprecedented global events, the COVID19 pandemic. While the

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[25] *See* Nathan J. L. Lenssen et al., *A NASA GISTEMPv4 Observational Uncertainty Ensemble*, 129 J. Geophysical Rsch.: Atmospheres e2023JD040179, fig. 4 (2024), https://doi.org/10.1029/2023JD040179.

[26] The data for NOAA GlobalTemp, GISTEMP (Lenssen 2024), and DKRZ are from Lenssen et al. 2024 and correspondence with the authors for the underlying data for Figure 4 in the paper. Berkeley Earth data are from Robert A. Rohde & Zeke Hausfather, *The Berkeley Earth Land/Ocean Temperature Record*, 12 Earth Syst. Sci. Data (2020), https://doi.org/10.5194/essd-12-3469-2020, and data is available at: https://berkeley-earth-temperature.s3.us-west-1.amazonaws.com/Global/Land_and_Ocean_summary.txt. HadCRUT5 data is available at: https://www.metoffice.gov.uk/hadobs/hadcrut5/data/HadCRUT.5.1.0.0/download.html ("Global Annual Ensemble Means and Uncertainties").

[27] Dynamically Consistent Ensemble of Temperature (DCENT) data is available at: https://dcent-i.github.io/#access ("Global Annual Time Series"). The uncertainty values for all of the datasets except DCENT are 95% CI. DCENT only provides a 1 standard deviation confidence interval.

impact of the pandemic is not clearly visible in the figure EPA points to, there is a clear increase in the measurement uncertainty of GMST during World War II.[28] This indicates large global events can impact the measurement uncertainty of GMST. EPA seemingly failed to consider or explain why 2020 would be a suitable single year to use.

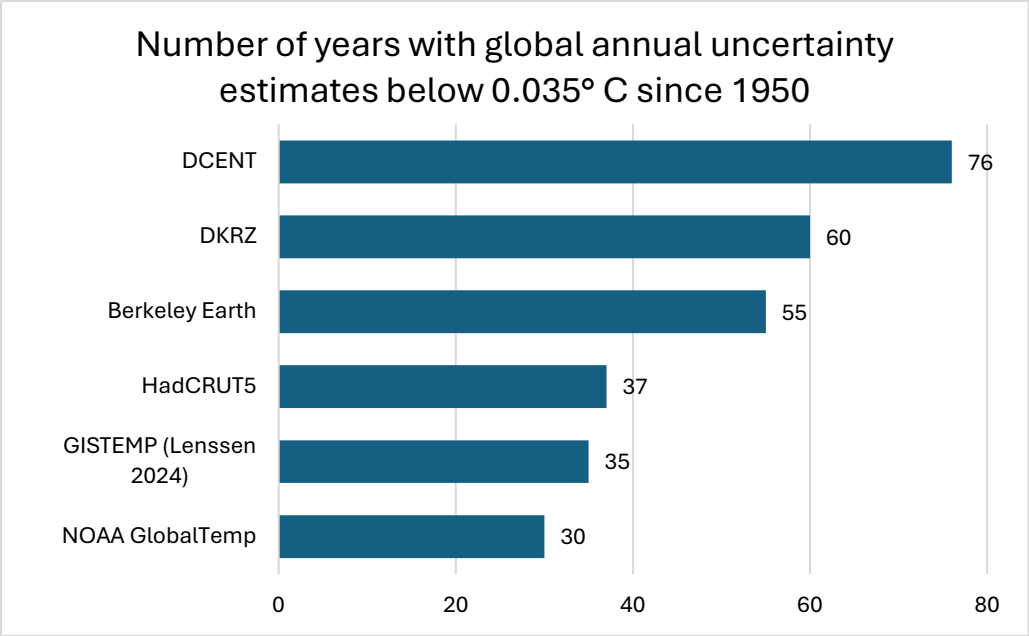


Figure 11. *Number of years with global annual uncertainties below 0.035° C since 1950 for six different datasets. Most of the uncertainties presented at 95% CI. DCENT only provides 1 standard deviation confidence intervals.*

[28] D. Chan & P. Huybers, *Correcting Observational Biases in Sea Surface Temperature Observations Removes Anomalous Warmth during World War II. J. Climate*, 34, 4585–4602 (2021), https://doi.org/10.1175/JCLI-D-20-0907.1.

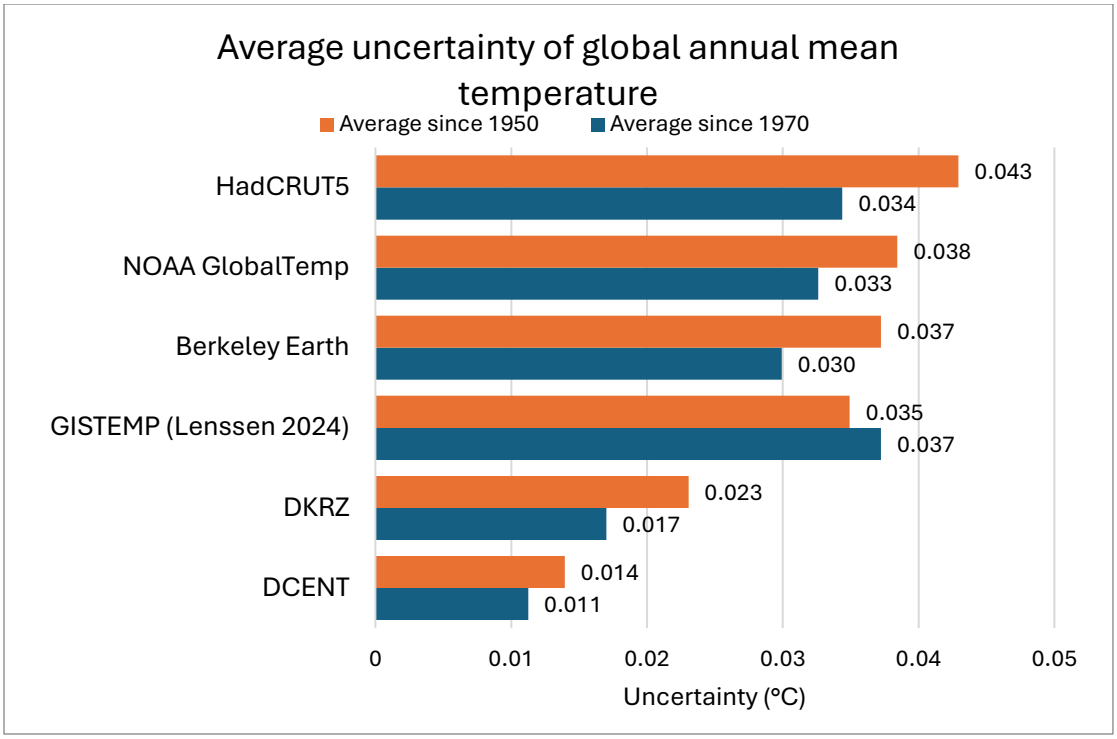


Figure 12. *Average uncertainty for global annual mean temperature for six different datasets. The averages are taken from 1950 to 2025 and from 1970 to 2025. Not all datasets have all of the recent years of data. Most of the uncertainties presented at 95% CI. DCENT only provides 1 standard deviation confidence intervals.*

EPA's use of a single year is also inherently arbitrary, regardless of which year EPA picked. As shown in Figure 11, the one dataset with a measurement uncertainty larger than 0.035°C, GISTEMP (Lenssen 2024), has measurement uncertainties lower than 0.035°C for 35 of the years between 1950 and 2020.

The arbitrariness of EPA's choice becomes even clearer when considering all of the datasets together. Of the products represented in Figure 4 of Lenssen 2024, every one had at least 30 years between 1950 and 2025 that had uncertainties less than 0.035°C and one of the products has an uncertainty less than 0.035°C for 60 of the years between 1950 and 2025.[29] An additional product not included in Lenssen 2024 Figure 4 is DCENT which has a measurement uncertainty below 0.035°C for *every* year between 1950 and 2025.

Figure 12 shows the average uncertainty of global annual mean temperature for each dataset since 1950 and 1970. For each dataset, either one or both of those averages are at or below 0.035°C and for some of them, the average is substantially below 0.035°C, for instance the

[29] Not all of the datasets include values through 2025. NOAAGlobalTemp only has data through 2015. DKRZ and GISTEMP (Lenssen et al. 2024) only have data through 2020.

average since 1970 for DKRZ is 0.017°C. EPA's selection of one year to consider GMST measurement uncertainty is clearly arbitrary and indefensible.

iii. EPA Should Have Considered the Uncertainty for Longer Time Frames.

The signal represented by the warming from U.S. power-plant greenhouse gas emissions is long-term; the temperature increase will not appear in 2100 and then suddenly disappear. As such, EPA should have considered the uncertainty for a longer time frame and not annual uncertainty. Since some of the uncertainty is uncorrelated and independent,[30] when the uncertainty over several years is calculated it is lower than the annual uncertainty. Berkeley Earth includes a five-year uncertainty that is, on average since 2000, 16% lower than their annual uncertainty and an average of 21% lower since 1975. Every year since 1966 has a five-year uncertainty lower than 0.035°C (Figure 13).[31]

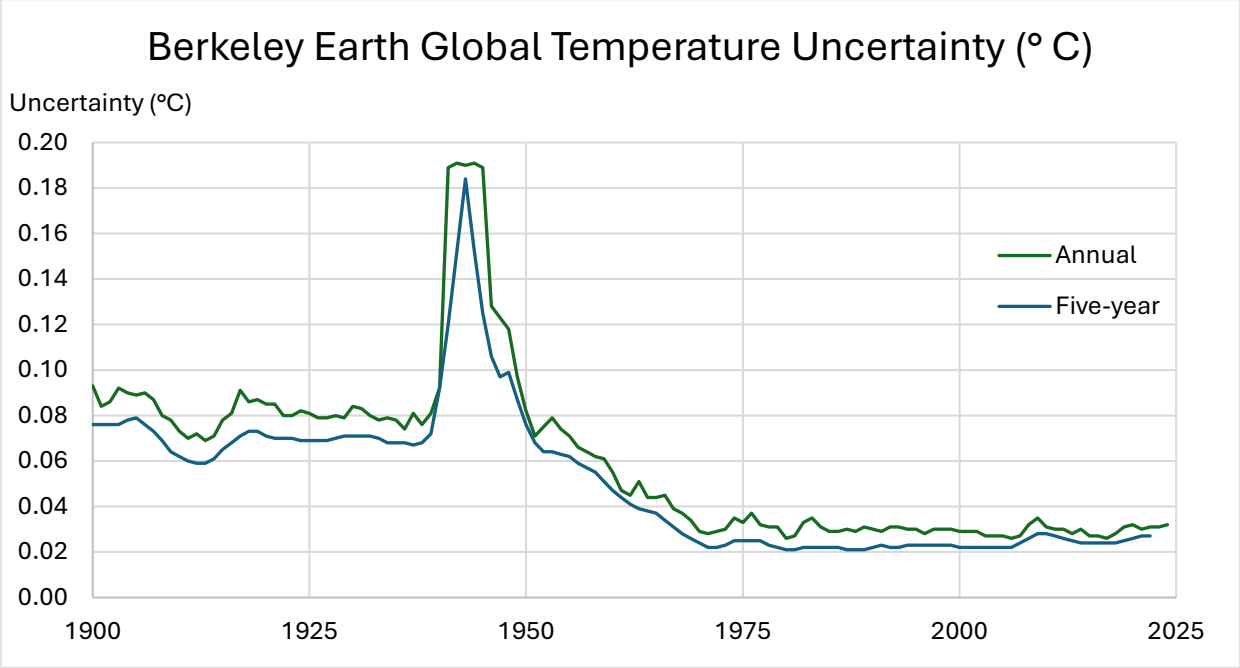


Figure 13. *Annual and five-year global temperature uncertainties from Berkeley Earth, 1900 to 2025.*

[30] This is not true for all of the components of the uncertainty; so, the reduction is not the square root of the number of values being averaged (root sum square), which would be the case if the uncertainty were purely independent.

[31] Robert A. Rohde & Zeke Hausfather, *The Berkeley Earth Land/Ocean Temperature Record*, 12 Earth Syst. Sci. Data (2020), https://doi.org/10.5194/essd-12-3469-2020.

C. For Sea Level Measurability, EPA Fails to Provide Any Value, and the Measurement Uncertainty Values We Identified Are Much Smaller Than 1.37 Centimeters.

For sea level measurability, EPA did not provide an uncertainty value or any source for its claim that the measurability is larger than 1.37 cm. In fact, the sources we found state a much lower uncertainty for global average sea level measurements. For more than three decades, satellite altimeters have used radar to precisely measure sea surface height. The measurements have an uncertainty of around 4mm or 0.4cm,[32] well below the 1.37cm EPA projected from U.S. power-plant emissions in 2100. This data represents uncertainty at the 90% confidence interval.

III. Conclusion

This memorandum demonstrates that EPA's futility analysis is fundamentally flawed in both its assessment of temperature variability and its claims regarding measurability. In each case, EPA's methodological choices systematically biased the analysis toward overstating the barriers to regulatory significance.

With respect to temperature variability, EPA committed multiple methodological errors: (1) failure to correct for the underlying increasing trend in global mean surface temperature; (2) use of inappropriately short annual averages to assess whether an increase in temperature would be inconsequential given the "variability" in the system; (3) the potentially erroneous calculation of population standard deviation and not sample standard deviation; (4) the arbitrary use of the selected time period, 2016–2025, which is particularly unsupportable if intended to represent "variability" in 1950–2025; and (5) the arbitrary use of a 10-year time interval to calculate variability. Each of these errors inflates EPA's variability estimate. Taken together, they cause EPA to overstate temperature variability by as much as 85%.

With respect to measurability, EPA's analysis is also flawed. EPA mischaracterized the current scientific literature researching GMST uncertainty measurements. EPA's assertion that GMST uncertainty is larger than 0.035°C in 2020 is only supported by one of six different datasets. And that one dataset has 35 years between 1950 and 2020 where the measurement uncertainty is below 0.035°C. Multiple independent global temperature datasets report annual measurement uncertainties that are, on average, below EPA's projected 0.035°C impact – and 5-year averaged uncertainties that are even lower. For global mean sea level, EPA provided no source for its measurability threshold said to be larger than 1.37-cm. The best available satellite altimetry data reports uncertainties of 0.4 cm, more than three times smaller.

In sum, EPA's conclusion that Section 111 greenhouse gas regulation is futile rests on a variability metric that overstates background temperature noise by as much as 85% and a

[32] NASA, *Global Indicators that Influence Sea Level Rise*, NASA Sea Level Change Portal (last visited Oct. 26, 2026), https://sealevel.nasa.gov/vital-signs/global-mean-sea-level/, J.K. Willis et al., NASA-SSH Global Mean Sea Level from Simple Gridded Sea Surface Height. Ver. 1. PO.DAAC (2025), https://doi.org/10.5067/NSIND-GMSV1; M. Ablain et al., *Uncertainty in satellite estimates of global mean sea-level changes, trend and acceleration*, 11 Earth Sys. Sci. Data 1189 (2019), https://doi.org/10.5194/essd-11-1189-2019.

measurability metric that is unsupported by the scientific sources EPA cites. Even accepting EPA's basic framework for assessing futility, the Agency's own projected policy impact of 0.035°C is not de minimis when properly evaluated against adjusted variability and measurability estimates. The Supplemental Proposal's futility determination therefore is fatally flawed and should be withdrawn.

APPENDIX D

Supplemental Scientific Evidence

Grace Hauser, Environmental Defense Fund

As a supplement to the scientific information in the comments filed by Public Health and Environmental Organizations on EPA's proposed rule "Rescission of the Greenhouse Gas Findings for Fossil Fuel-Fired Power Plants and Repeal of Regulations for Power Plant Greenhouse Gas Emission Under Clean Air Act Section 111," 91 Fed. Reg. 59,002 (Oct. 17, 2026) ("Supplemental Proposal"), we set forth this additional information on the harms associated with greenhouse gas pollution and the mountain of scientific evidence supporting the Greenhouse Gas Findings for Fossil Fuel-Fired Power Plants and the Regulations for Power Plant Greenhouse Gas Emissions Under Clean Air Act Section 111.

The addition of greenhouse gases to the atmosphere from the burning of fossil fuels is leading to more extreme temperatures and precipitation and a host of negative impacts including impacts on human health, ecosystems, infrastructure, settlements, agriculture, forestry, ocean fisheries, national security, and economic well-being. These impacts are pervasive and are already harming American lives and property. In our review of the latest scientific evidence, we found that documentation of the damage caused by climate change to people and ecosystems in the United States has only become more extensive and definitive. This appendix focuses on science since 2018, building from Duffy et al.'s 2019 review article finding that scientific literature since 2009 further supports EPA's conclusion that climate change and greenhouse gas emissions are a significant threat to human health and welfare. EPA's failure to consider this information is arbitrary and capricious.

The National Academies of Science, Engineering and Medicine (NASEM) released a report on September 17, 2025, entitled "Effects of Human-Caused Greenhouse Gas Emissions on U.S. Climate, Health, and Welfare." The report reached conclusions very consistent with our review of the scientific literature. The report provided scientific evidence that emissions of greenhouse gases from human activities are increasing greenhouse gas concentrations in the atmosphere, and these emissions are warming Earth's surface and changing Earth's climate. Human-caused emissions result in climate changes that harms the health and welfare of people in the United States. The report concluded that "[c]ontinued emissions of greenhouse gases from human activities will lead to more climate changes in the United States, with the severity of expected change increasing with every ton of greenhouse gases emitted" (NASEM 2025 at 37).

I. PUBLIC HEALTH

Greenhouse gases added to the atmosphere are changing the climate, and in turn causing changes in the frequency and/or severity of extreme events and the underlying patterns of temperature and precipitation that have cascading effects on human health.

1. **Extreme Temperatures**

Increased concentrations of greenhouse gases in the atmosphere caused by human activity have led to increases in average temperatures and heatwaves (Sherwood et al. 2020; Jarvis & Forster 2024; Dunn et al. 2020; Dunn et al. 2024; NASEM 2025; WMO 2026). Extreme heat poses significant threats to human health and well-being (NASEM 2025 at 41-57). An estimated 21,518 Americans died from heat-related causes between 1999 to 2023 (Howard et al. 2024 at 2). Beyond premature mortality, heat exposure contributes to a broad spectrum of health problems including cardiovascular complications, respiratory illness, kidney dysfunction, and adverse pregnancy outcomes (Bell et al. 2024 at 1794). Vulnerable populations, such as children, are particularly at risk to the effects of extreme heat. (Bernstein et al., 2022 at 017001-4). From 2016 to 2018, extreme heat was associated with a 17% increase in all-cause emergency department visits across 47 United States children's hospitals relative to hospital-specific minimum morbidity temperature (Bernstein et al. 2022).

Extreme heat is also associated with adverse mental health impacts such as elevated rates of anxiety, depression, and suicidal behavior documented alongside increases in aggressive behavior and violence (Bell et al. 2024 at 1794-95). Extreme heat days were associated with 8% higher rates of mental health related emergency department visits (compared to days of optimal temperatures) in the United States during the summers of 2010 to 2019 (Nori-Sarma et al. 2022). Research demonstrates the substantial role of human-caused climate change in these heat-related health impacts: an estimated 34.7% of American heat-related deaths from 1991 to 2006 can be attributed to human-induced climate change (Vicedo-Cabrera et al. 2021).

Extreme heat events are becoming increasingly frequent and severe because of changing climate feedback mechanisms, such as land-atmosphere interactions, which amplify hot temperatures (Bartusek et al. 2022 at 1144; Bi et al., 2026 at 7). Already, heatwaves affect larger areas, are more intense, and are seven times more likely than they were forty years ago (Rogers et al. 2022 at 1063). The effects have been devastating. From 1987 to 2005, national mortality rates increased by 3.74% during heatwaves (defined as ≥ 2 days with temperature ≥ 95th percentile for the community from May through September) compared with non-heatwave days, with greatest risks exhibited in the Northeast and Midwest (Anderson & Bell 2011 at 214). More recently, there were about 72 more excess deaths per week during the unprecedented, 6-week-long Pacific Northwest (PNW) heat dome in June 2021 (White et al. 2023 at 1; WA DOH 2023 at 2). Climate studies estimate that increased temperatures from anthropogenic climate change made the 2021 PNW heatwave approximately 2 to 50 times more likely to occur (Leach et al. 2024 at 1, 6) and was 59% longer, 34% larger and 6% more intense than the same event would have been without background warming (Jain et al. 2024 at 3). At the current rate of global warming, the likelihood of an event like the 2021 PNW heatwave happening doubles every 10-50 years (Leach et al. 2024 at 1).

In addition to heat-related mortality, heatwaves pose broad risks to human health such as adverse birth effects. A study of 50 metropolitan areas across the United States found that heatwaves are associated with an increase in pre-term and early births, with the increases more pronounced for

heatwaves of longer duration and higher temperatures (Darrow et al. 2024 at 7). The relationship between heat and timing of birth was strongest amongst mothers under 30 years old, without a college education, and Hispanic or non-Hispanic Black mothers, highlighting the compounding effects of heatwaves on socioeconomically disadvantaged groups (Darrow et al. 2024 at 1, 6).

2. **Interactions with Air Pollution**

Increased air pollution due to anthropogenic activities severely harms public health, and increased heat from climate change can increase the formation of this pollution (NASEM 2025 at 46-48; Analitis et al. 2014). Anthropogenic climate change is projected to increase ozone and fine particulate matter ($PM_{2.5}$) concentrations and contribute to more air pollution mortality in every region except Africa by the end of the century (Silva et al. 2017 at 647). Researchers predict that there could be an increase of 1,000 to 4,300 premature deaths annually in the U.S. due to the combined effects of ozone and particulate matter (CDC 2026).

Climate change creates feedback loops that exacerbate air pollution problems. For example, elevated temperatures accelerate the formation of ground-level ozone. This worsens cardiovascular risks, particularly among older adults, racial and ethnic minority groups, and low-income communities (Kazi et al. 2024 at 8). Thus, climate change-induced air quality issues may compound existing health inequities caused by class and race. Another example can be seen in the western United States, where one study examined how extreme drought conditions associated with anthropogenic climate change forced electrical systems to increase fossil fuel power plant generation to compensate for reduced hydropower capacity (Qiu et al., 2023 at 1-2). The study found this switch in power generation composition accounted for 63% of fossil fuel generation increases in California, 44% of the increases in the Northwest, and almost all of the generation increase in the southwestern United States from 2001 to 2021, all of which increased $PM_{2.5}$, carbon dioxide (CO_2), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2) emissions (Qiu et al. 2023 at 3). The resulting health effects equated to health costs 1.2 to 2.5 times greater than the direct economic cost of the drought itself (Qiu et al. 2023 at 1).

3. **$PM_{2.5}$ Air pollution from Wildfires**

Anthropogenic climate change has significantly increased the frequency, intensity, and duration of wildfires (Jain et al. 2024; NASEM 2025). Between 2003 and 2019, "global burned area" rose by 15.8%, and more countries are now experiencing longer wildfire seasons because of shifting climate patterns (Burton et al. 2024 at 1188). In the 2000s, wildfires in the western U.S. accounted for less than 20% of Americans' total $PM_{2.5}$ exposure; by the 2010s, this proportion surged to nearly 50%, with smoke traveling long distances and affecting air quality across other parts of the country (Burke et al. 2021 at 3).

Exposure to wildfire smoke is associated with increased risk of respiratory and cardiovascular diseases (Reid et al. 2016; Liu et al. 2015). Long-term exposure to wildfire smoke increases mortality rates of lung and heart, digestive, endocrine, diabetes, mental, and chronic kidney diseases, which are estimated to contribute to over 11,400 deaths in the United States from 2007-2020 (Ma et al. 2024 at

3). Researchers attribute 68% to 88% of fire-conducive weather conditions in western states during the period 1970 to 2020 to anthropogenic warming (Zhuang et al. 2021 at 7). Globally, attribution studies show that fire-related $PM_{2.5}$ mortality attributed to climate change increased from 1.2% in the 1960s to 12.8% in the 2010s (Park et al. 2024 at 1195).

4. **Dust Air Pollution from Drought**

The southwestern United States and parts of the southeastern U.S. saw an increase in meteorological drought in the period from 1915-2011 (NASEM 2025 at 28). In addition, from 1960 to 2010, researchers observed an increase in concurrent droughts and heatwaves across most of the United States (Mazdiyasni & AghaKouchak 2015). Under a mid-range emissions scenario (SSP2-4.5), the frequency of two-year compound drought and heatwave events across the eastern United States is projected to more than double, and in the drier western United States, such events are expected to become more severe and longer lasting (Tripathy et al. 2023 at 3-4).

Drought conditions in the Southwest contribute to increased airborne dust by drying out soil and reducing vegetation cover, which can worsen air quality and pose serious respiratory health risks (NASEM 2025 at 49). Dust concentrations in the Southwest due to drought and human land use patterns have been associated with premature mortality and hospitalizations for cardiovascular and respiratory illnesses (Tong et al. 2023 at 1). One study found that under a low emissions scenario (RCP2.6), compared to 2018 rates, the rates of premature adult mortality attributable to dust exposure would increase by 24% by the end of the century, while the annual hospitalization rates for cardiovascular and respiratory illnesses would increase by 59% by the end of the century (Achakulwisut et al. 2018 at 6).

5. **Interactions with Infectious Diseases**

Anthropogenic climate change is increasingly contributing to the emergence and spread of infectious diseases (Mahon et al. 2024; NASEM 2025). It has been estimated that, globally, 58% of infectious diseases "have been at some point aggravated by climatic hazards sensitive to" greenhouse gases, highlighting the relationship between anthropogenic activities and greater risk of infectious diseases (Mora et al. 2022 at 869). As anthropogenic climate change and current human activities drive habitat degradation and biodiversity loss, populations around the world will be increasingly exposed to myriad infectious diseases (Mahon et al. 2024).

Shifts in temperature, precipitation, and drought frequency are altering the geographic range and seasonal behavior of diseases such as Valley fever, which is caused by inhaling dust containing coccidioidomycosis fungal spores (Gorris et al. 2019). Rising global temperatures and increased drought conditions have been correlated with spikes in Valley fever cases across the American Southwest (Head et al. 2022). In California alone, droughts have been linked to thousands of excess cases over the period 2000 to 2015, and climate models project a 50% increase in incidence by 2100, along with expansion into previously unaffected states (Gorris et al. 2019).

Climate change affects the transmission, spread, and ecosystem habitats of vector-borne diseases (Rocklöv & Dubrow 2020). Increased temperature and altered rainfall patterns are likely to increase

the incidence and range of both new and endemic vector-borne infectious diseases in North America (Greer et al. 2008; Edelson et al. 2023). For example, hotter and wetter summers will make larger swaths of the United States hospitable to mosquitos, and therefore mosquito-borne diseases such as Zika (Edelson et al. 2023 at 952). Already, milder winters and droughts are associated with an increased risk of West Nile Virus transmission in U.S. cities (Caminade et al. 2019 at 162).

Changes in humidity, rainfall, and temperature also influence the transmission of respiratory viruses such as respiratory syncytial virus (RSV) (Baker et al. 2019). Future climate scenarios for North America predict that increased humidity and extreme rainfall may shift epidemic patterns northward and intensify outbreaks (Baker et al. 2019). Climate change is also linked to rising antibiotic resistance, with warmer temperatures accelerating the spread of resistant pathogens across regions and threatening our ability to treat these diseases (MacFadden et al. 2018).

6. **Increased Exposure to Aeroallergens**

Human-caused climate change is the dominant driver in lengthening the pollen season and a significant contributor to increased pollen concentrations, worsening exposure periods for allergy sufferers (Anderegg et al. 2021; NASEM 2025). The effects are more pronounced at latitudes north of 44ºN in North America (roughly how far North Minneapolis is), where the ragweed pollen season has lengthened by 13 to 27 days on average since 1995 (Ziska et al. 2011). An estimated 35,000 to 60,000 annual asthma emergency department visits in the U.S. between 1994 to 2010 were linked to oak, birch, and grass pollen (Neumann et al. 2019).

Modeling studies project that climate change will exacerbate pollen-related health burdens. For example, oak pollen alone was linked to over 21,000 asthma emergency department visits in 2010 in the U.S., with nearly 70% affecting children under 18 (Anenberg et al. 2017). By 2090, under RCP4.5, oak pollen related asthma emergency department visits are expected to increase by 4% compared to the 1994 to 2010 baseline, correlating to a marginal net present value of $8.3 million (Anenberg et al. 2017 at 88). Grass pollen concentrations are expected to increase by approximately 200% due to rising atmospheric carbon dioxide, and despite simultaneous rises in ground-level ozone, which suppresses pollen and allergen production (Albertine et al. 2014).

Experimental studies also show that elevated CO_2 not only increases pollen biomass but may enhance pollen allergenicity, intensifying allergic responses (Rauer et al. 2021). Long-term analyses across the Northern Hemisphere reveal that pollen seasons are starting earlier and lasting longer, with annual pollen loads increasing by up to 46% in the United States over recent decades (Zhang et al. 2015; Ziska et al. 2019). Changes in plant phenology, the timing of seasonal events in plants such as flowering, are also linked to increased rates of hay fever and asthma (Sapkota et al. 2019). Adults living in United States counties with very early or very late spring onset had significantly higher odds of hay fever (Sapkota et al. 2019), and in Maryland, very early spring onset was associated with increased asthma hospitalizations, even after adjusting for air pollution and heat (Sapkota et al. 2020).

7. **Interactions with Mental Health**

Recent research documents the negative impacts of climate change on mental health through direct environmental stressors and indirect social and psychological pathways (NASEM 2025). Direct effects from extreme weather events such as cyclones, floods, and storms worsen mental health outcomes (Obradovich et al. 2018; Ridley et al. 2020). For example, exposure to Hurricane Katrina was linked to a 4% increase in mental health issues (Obradovich et al. 2018), and survivors of California's deadly 2018 wildfire named "Camp Fire" showed signs of chronic climate trauma including diminished cognitive processing and heightened neurological responses similar to post-traumatic stress disorder (Grennan et al. 2023). Vulnerable populations—including children, the elderly, pregnant women, and those living in poverty—are disproportionately affected due to limited resources for adaptation and recovery (Trombley et al. 2017). Heat is associated with adverse mental health outcomes: a recent meta-analysis found that each 1°C increase in temperature correlates with a 1.5–1.7% rise in suicide incidence, and heatwaves are associated with a nearly 10% increase in hospital admissions for mental illness (Thompson et al. 2023). Other studies found a link between higher temperatures and increased emergency department visits for mental health episodes and self-harm in the United States (Mullins & White 2019).

Air pollution, another consequence of fossil fuel-driven climate change, has also been associated with increased risks of depression and anxiety. Studies have found that exposure to $PM_{2.5}$ and ozone is linked to higher rates of depressive symptoms, particularly among older adults and individuals with lower socioeconomic status (Kioumourtzoglou et al. 2017; Pun et al. 2017). Additionally, infectious diseases influenced by climate change, such as West Nile virus, have been shown to cause long-term depression in a significant portion of patients, with effects lasting up to eight years post-infection (Murray et al. 2007; Nolan et al. 2012).

There are also indirect impacts from climate change that operate through broader social and environmental disruptions of determinates of psychological well-being, such as food insecurity, safety in homes, schools and recreational spaces (Crandon et al. 2022; Ridley et al. 2020). Reduced agricultural yields from altered rainfall and water supply patterns, more frequent weather-related disasters, and increased likelihood of violent conflict all contribute to poverty, depression, and anxiety (Ridley et al. 2020).

8. **Increased Risk of Population Displacement and Conflict**

Increased flooding due to sea level rise is expected to intensify outmigration in coastal cities (de Koning & Filatova, 2020). Under 1.8 meters of sea level rise by 2100—which is on the very high end of end-of-century sea level rise estimates—up to 13.1 million Americans could be displaced (Hauer et al. 2016 at 691). Hauer predicts that net migration would change in every state, 86% of United States Core Based Statistical Areas, and 56% of counties, with Florida projected to lose 2.5 million residents and Texas projected to gain 1.5 million residents (Haur 2017 at 323).

Changes in extreme events could also influence migration. For instance, increased migration out of Puerto Rico was noted after Hurricane Maria (Acosta et al. 2020), particularly out of regions more vulnerable to high water levels and substandard housing (DeWaard et al. 2020).

Climate variability and climate change may also influence the risk of war and conflict, in part because of displacement and mass migration. Hsiang et al. (2013), for instance, evaluated 60 different studies (45 different data sets covering more than 12,000 years), and found that for each standard deviation change in climate toward warmer temperatures or more extreme rainfall, the frequency of interpersonal violence rose 4% and the frequency of intergroup conflict rose 14%. Similarly, Ge et al. attribute 3.8% of conflict risk to long-term deviations from mean climate (Gao et al. 2022 at 5), and Hao et al. argue that there is an increasing impact of climate on armed conflict risk over recent decades in Sub-Saharan Africa, the Middle East, and South Asia (Hao et al. 2022 at 1). Other studies have linked the 2007-2010 Syrian drought—and resulting Syrian conflict—to anthropogenic warming (Kelley et al. 2015) and showed increased violence under growing-season drought in Asia and Africa for agriculturally dependent groups (von Uexkull et al. 2016). However, conflict risk is driven by a range of social and environmental factors, which makes it difficult to isolate the impact of climate. Thus, evidence is far from conclusive about the impact of climate on displacement and conflict, although experts generally agree that some (3-20%) of past conflict risk is attributable to climate (Mach et al. 2019 at 194).

II. PUBLIC WELFARE

1. Food Production and Agriculture

Agriculture is highly vulnerable to climate change, with crops responding directly to shifts in temperature, precipitation, and atmospheric CO_2 concentration (NASEM 2025). These responses vary by crop and location, but global evidence suggests that long-term trends in average temperature and precipitation have already reduced consumable food calories in the world's ten major crops by an estimated 1% (Ray et al. 2019).

A meta-analysis of 230 studies projects that each 1°C rise in global average temperature will reduce global maize yields by 7.5%, wheat by 6.0%, rice by 1.2%, and soybean by 6.8% (T. Hu et al. 2024 at 9). In the United States, maize yield losses are projected to be even larger, at 10.3% (Zhao et al. 2017 at 9327), and negative impacts have also been observed in sorghum and soybean yields (Kukal & Irmak 2018). A 2°C rise in global average temperature could cut maize exports from the top four exporting countries—including the United States—by 53 million tons, or 43% of global export volume (Tigchelaar et al. 2018 at 6646), and a 0.26% reduction in global gross domestic product (GDP) even when trade and production patterns are allowed to adjust (Costinot et al. 2016). Coupled climate–agriculture models estimate end-of-century United States maize productivity will decline by roughly 6% (SSP1-2.6). Under RCP4.5, climate penalties are expected to erase all productivity gains made between 1981 and 2010 by around 2035. Sustaining current levels would require a doubling of technological progress (Liang et al. 2017 at E2290).

Short-term extremes are also critical. Crops are sensitive to the frequency, duration, and intensity of weather events, not just long-term averages. In the Midwest, specialty crops are particularly affected by excessive rainfall (Kistner et al. 2018). Increasingly frequent heat waves expose crops to acute heat stress, which can stunt growth and reduce the nutritional quality of crops (e.g., Zhao et al. 2020; Kumar et al. 2022; Mishra et al. 2023).

Climate change also indirectly impacts crops by altering pest and pathogen dynamics. Each degree of warming is predicted to increase pest-driven losses of maize, wheat, and rice by 10 to 25% globally (Deutsch et al. 2018). In North America, a 2°C temperature rise is anticipated to cause 2.3%, 3.4%, and 2.3% reductions in maize, wheat, and rice yields from insect pests, respectively (Deutsch et al. 2023 at Table S3). Rising temperatures promote soil-borne fungal pathogens that can "spill over" into croplands, reducing yields (Delgado-Baquerizo et al. 2020 at 552).

Warming also threatens animal agriculture. In the northeastern United States, higher temperatures reduce dairy cattle fertility, while heat stress-induced inflammation lowers the energy available for milk production (Hristov et al. 2018). From 2000 to 2018, heatwaves and an average national temperature increase of 1.023°C led to a $1.2 billion United States dairy sector loss (Wankar et al. 2021 at 5). By 2030, domestic milk yields are projected to fall 0.6–1.35% relative to 2010, depending on the climate model scenario, with losses exceeding 2% in several southern states (Key et al. 2014).

Marine and freshwater food production face parallel challenges. Globally, warming oceans may reduce maximum catch potential by 6%, decreasing fisheries' revenues and affecting the livelihoods of those dependent upon them (Cheung et al. 2021). In the United States, suitable habitats for some fish may expand northward (e.g., in Alaska), but ocean acidification will increasingly threaten shellfish-growing regions (Froehlich et al. 2022 at 8). According to a recent study assessing 82 fish and invertebrate species, over 40 species are projected to suffer adverse impacts from warming and acidification (Hare et al. 2016).

Regional studies show steep declines in biomass and landings. In the North Atlantic Ocean, divisions with high landings are projected to see 5 to 40% biomass losses (Bryndum-Buchholz et al. 2020). By 2100, roughly 10% (SSP1-1.9) of species may face reproduction-threatening water temperatures (Dahlke et al. 2020). A specific case includes a loss of 8 to 31% of trout habitat under 1°C to 3°C warming in the Northwest United States (Isaak et al. 2018). Beyond long-term trends, acute marine heat waves (MHWs) amplify risks. By 2050, MHWs are projected to double the impact of climate warming on key fisheries, with biomass of 22 stocks in the northeast Pacific expected to fall 2.8% during MHW events (Cheung & Frölicher 2020).

2. **Forestry**

Forest ecosystems across the United States have continued to experience observable declines from both direct and indirect impacts of climate change (NASEM 2025). Much of the recent body of literature focuses on the western United States, where forestry inventory data from 1999 to 2020 shows that adverse effects of climate change tend to overwhelm any benefits (Hogan et al. 2024). A significant amount of the discussion focuses on increased fire risk to water-limited forest ecosystems. An eightfold increase was observed in the annual area burned at high severity across the western United States between 1985 and 2017, along with strong links between projected fire severity and maximum temperatures, vapor pressure deficit and climatic water deficit (Parks & Abatzoglou 2020). A California-specific study found nearly all the increase in burned area from 1996 to 2021 was attributable to anthropogenic climate change (Turco et al. 2023).

Climate change also affects the meteorological conditions, such as precipitation and vapor pressure deficit, that are primary drivers of increases in wildfire area burned (Holden et al. 2018). Additionally, as climate change causes decreases in snowpack and extends the length of fire seasons, wetter regions of the United States will see more frequent wildfires, and drier regions are expected to see increased fire severity (Wasserman & Mueller 2023 at 17). Paleoclimate records indicate that contemporary fires that have burned across the United States, especially in the West, were both widespread and of higher severity than in the past, driven partially by climate change (Margolis et al. 2025). Furthermore, climate change-driven increases in forest-fire area will not be substantially allayed even as fires remove available biomass fuel for subsequent fires (Abatzoglou et al. 2021).

Climate change is increasingly disrupting post-fire forest regeneration, with many regions projected to experience conditions that are unfavorable for tree recovery following wildfires (Coop et al. 2020). In addition to climate-related stressors, human fire management practices in the United States (i.e., an increase in fire exclusion practices) have contributed to an accumulation of fuel, increasing the risk of high-severity fires (Hagmann et al. 2021; Margolis et al. 2025). These intense fires often leave behind fewer seeds and depleted soil nutrients, further hindering post-fire forest regeneration (Hagmann et al. 2021; Margolis et al. 2025).

Increases in drought frequency and temperature, aside from increasing fire prevalence, can also directly affect forests, impacting both immediate forest health and long-term resiliency. Sudden tree mortality events have been documented in regions such as California, where tens of millions of trees died in association with a severe drought from 2012 to 2016, and New Mexico, where over 95% of one tree species died and old growth forest was converted to shrubland and grassland during an extremely hot drought between 2002 to 2004. These case studies exemplify that many of Earth's forests are vulnerable to die-off when drought and heat thresholds are reached (Hartmann et al. 2022). There is evidence that the impact of warming alone on subalpine species is particularly severe, with a significant decline of certain subalpine tree species across the western United States from 2001 to 2018, including a 32% decline in lodgepole pine (Stanke et al. 2021).

The compounding impacts of heat, temperature, and water scarcity also play an important role in overall forest health and ability to rebound from future extreme events. Liu et al. (2024) found that the primary productivity of forests in the United States was more sensitive to water stress after drought and fire disturbances, and Forzieri et al. (2022) observed global declines in temperate and arid forest resilience linked with water scarcity and changes in climate variability. Drought and warm temperatures are also associated with an increase in the frequency of plant pathogen outbreaks and with increase outbreaks of insect pests, such as the pine park beetle, with an observed 29.9% increase in ponderosa pine mortality during drought directly attributable to the pine park beetle (Jaime et al. 2024, Robbins et al. 2021, Baldrian et al. 2023). In general, the impact of warming and drying associated with climate change on forests is well-summarized by Hammond et al.: "Where the pace of climate change outruns the adaptive or acclimation capacities of historically-dominant tree individuals and species, additional die-off events are likely to occur and some forests may even cease to exist" (Hammond et al. 2002 at 7).

The impact of climate change on forests in the United States is projected to have important and detrimental economic impacts. Observational studies have shown a 1.64% decrease in forest-based employment in association with every 1% increase in temperature in the U.S. South (Lamica et al. 2025 at 311-12). Increasing climate change is expected to decrease species diversity, carbon sequestration capacity, and overall forest inventory, and to favor species with lower merchantable value, which will also negatively impact the forestry sector with some models projecting billions of dollars lost annually (Van Houtven et al. 2019; Baker et al. 2023).

3. **Water Resources**

Climate change has and will continue to worsen droughts and shrink available snowpack across the western United States and affect water quality (NASEM 2025). A hydrologic model of 1913 to 2017 discharge constrained by observations shows that the annual mean discharge in the Colorado River, which provides drinking water to roughly 40 million people, has been decreasing by 9.3% per °C of warming (Milly & Dunne 2020). The southwestern North America 2000 to 2021 drought, which reduced river flow and affected water resources for millions of Americans, was identified in the tree ring record to be the driest 22-year period since 800 CE, and anthropogenic trends in temperature and precipitation are estimated to have accounted for 42% to 46% of its severity (Williams et al. 2020; Williams et al. 2022). From 1980 to 2020, the western United States experienced a marked increase in evaporative demand, with at least 57% of this rise attributed to climate change (Albano et al. 2022 at 510). Current measurements of evapotranspiration already exceed the range of variability observed 20 to 40 years ago and drive drought conditions across the region (Albano et al. 2022 at 516).

Snowpack is generally considered to be the canary in the coalmine for declining water resources (Duffy et al. 2018, Mote et al. 2018, Cho et al. 2021, Musselman et al. 2021). An extended observational record of snowpack by Mote et al. (2018) found that 90% of snow monitoring sites with long records across the western United States now show evidence of decline, and the average decline in snow water equivalent on April 1, the typical peak snowpack date, is roughly 15 to 30%. Snowpack melt is also observed to occur earlier each decade, which has detrimental implications for seasonal water storage (Musselman et al. 2021).

Other forms of water storage and other regions are also at risk. From 1992 to 2020, satellite observations showed a decline in lake water storage across the conterminous United States, predominately attributed to changes in temperature and precipitation (Yao et al. 2023). Furthermore, paleoclimate records show that the 2000 to 2010 drought in the upper Missouri River basin "was potentially unprecedented over the last millennium" and that recent warming has corresponded to decreasing runoff and increasing drought severities (Martin et al. 2020). Although trends towards increased aridity are clearest in observations from the American West, greater aridity is expected to reach eastward with increased warming, and even in areas with predicted increases in precipitation, aridity will increase (Overpeck & Udall 2020).

Simulations predict this warming impact on water resources will continue and be enhanced under increased warming scenarios. Under 1.5°C and 3°C warming conditions, the increase in the water

gap (where water consumption exceeds available resources) is expected to be the third largest in the Mississippi-Missouri basin out of all major river basins globally (Rosa & Sangiorgio 2025). Reduced rainfall under 1.5˚C and 3˚C warming scenarios are modeled to threaten 10 to 18 million hectares of United States cropland, which would have the potential to affect food supply for 157 million Americans (He & Rosa 2023). Large reductions in extreme and average snow water equivalent in the western United States are projected by the middle of the century (Siirila-Woodburn et al. 2021) and increases in warm and dry snow droughts are predicted for the mountains and high latitudes of North America (Cowherd et al. 2023). This in turn is projected to pose a large risk to snowmelt fed irrigation in the American West (Qin et al. 2020). Terrestrial water storage more generally is predicted to decline by the late 21st century, with especially high confidence in declines in the eastern United States (Pokhrel et al. 2021).

Climate change is also expected to impact water quality. Rising temperatures will directly alter the chemical composition of groundwater in many ways, including through warmer temperatures leading to more stratification and nutrient release from sediments (Shukla et al. 2023; Dao et al. 2024). There are also indirect impacts of climate on water quality, such as increased flooding in high-precipitation areas leading to increased groundwater salinity and pollution levels (Dao et al. 2024). There is also evidence that increasingly frequent wildfires serve as a watershed-level contamination source for pollutants, including nitrate and arsenic (Pennino et al. 2022; Robinne et al. 2021). Higher temperatures enhance the growth and survival of pathogens and increase harmful algal blooms (NASEM 2025), posing health and economic risks to people in places like Florida and elsewhere who are subjected to reoccurring blooms (van Vliet et al. 2023; Heil & Muni-Morgan 2021).

4. **Sea Level Rise and Coastal Areas**

Global mean sea level has increased by approximately 1.2 millimeters per year over the twentieth century, a rate which accelerated in recent years (Hay et al. 2015) and in 2023 is about 4.5 millimeters per year (NASEM 2025). Most of this rise can be attributed to thermal expansion of the ocean due to warming and glacier melt, with smaller contributions from Greenland and Antarctic ice melt (Frederikse et al. 2020). Ice sheet melt—the upper bounds of which are poorly constrained—is expected to play a much more prominent role in future sea level change (Chen et al. 2017), leading to a very likely projected total of 0.3 to 1.2 meters of global sea level rise by 2100, depending on concentration pathway and ice sheet physics (Kopp et al. 2014). Sea level change is highly spatially heterogeneous depending on the mechanism of change and can be exacerbated by local non-climate factors like land subsidence and groundwater depletion (NASEM 2025).

In North America, more frequent and extreme flooding has been attributed to human influence on the climate (Kirchmeier-Young & Zhang 2020). Sea level rise portends significant consequences for coastal communities which, as of 2020, comprised 40% of the United States population and include the most economically productive areas in the country (NOAA 2026). Scientists warn that Americans' exposure to floods is inevitable over the next thirty years across the continental United States and that this risk may continue to increase depending on greenhouse gas emissions trajectories (Swain et al. 2020). Accounting for population changes, a sea level rise of 0.9 meters is

predicted to put 4.2 million people at risk of inundation, and a rise of 1.8 meters would put 13.1 million people at risk (Hauer et al. 2016).

Flood risk maps are a tool that prospective homebuyers can use to assess their risk of flooding. Current estimates of flood risk are underestimated. The Federal Emergency Management Agency (FEMA) does not account for the effects of climate change in their current flood risk maps (Marsooli et al. 2019).

Sea level rise has doubled the frequency of high-tide flooding in the continental U.S. over the past few decades (NASEM 2025). Globally, based on wave, tide, and storm surge models, coastal flooding is expected to double in the coming decades, and potentially as early as 2030 in much of the tropics (Vitousek et al., 2017). Along the east coast of the United States, sea level is projected to rise by 0.25 to 0.3 meters by 2050 (Vitousek et al., 2017). The Atlantic coast is particularly susceptible to sea level rise because of subsidence; between 58% to 100% of coastal marshes, which is the dominant land type on the Atlantic coast, are losing elevation relative to sea level (Ohenhen et al. 2023). By 2050, and even with flood mitigation infrastructure, sea level rise under a moderate climate change scenario (SSP2-4.5) is projected to raise the flood risk of 55,000 to 273,000 people across thirty-two coastal cities, primarily along the Gulf and Atlantic coasts (Ohenhen et al. 2024). Minor high-tide flooding, already "routinely exceeded" along the Atlantic coast, will quickly increase on the Pacific coast; under an intermediate estimate of sea level rise, by the 2040s, the frequency of high-tide flooding is projected to increase eight-fold in Boston (from 6 to 46 days per year), 49-fold in La Jolla (from 1 to 49 days per year), and eleven-fold in St. Petersburg (from 6 to 67 days per year) (Thompson et al. 2021). Some impacts of sea level rise are already being felt. In Miami Beach, for example, tide-induced flooding was more than 400% higher in the 2006 to 2013 period relative to the 1998 to 2006 period. Over these two periods, sea level rise in the region has also accelerated from 3 millimeters per year (mm/yr) to 9 ± 4 mm/yr (Wdowinski et al. 2016).

However, it is not only residential flooding that poses a risk but flooding of essential services and infrastructure. Combining storm surge and road data, 25 of 78 metropolitan statistical areas on the United States Atlantic and Gulf Coasts have half or more of their hospitals at risk of flooding from relatively weak hurricanes (Tarabochia-Gast et al. 2022). With 0.82 meters of sea level rise, a measure well within the bounds of sea level rise expected within this century from climate change, the odds of those hospitals flooding increases by 22% (Tarabochia-Gast et al. 2022). Accounting for the risk of isolation (the inundation of transportation networks that isolates individuals from critical services like hospitals, supermarkets, and schools) increases the population exposed to rising sea levels by 30% to 90% (Logan et al. 2023), with disadvantaged groups being disproportionately at risk of isolation (Best et al. 2023).

Finally, frequent tidal inundation due to sea level rise will allow saltwater to intrude into freshwater coastal systems (Heiss et al. 2022; O'Donnell et al. 2024). Sea level rise in the United States is expected to convert at least 12,000 to 49,000 square kilometers of dry land into intertidal land (Haer et al. 2013). Saltwater intrusion has led to forest mortality (Kirwan and Gedan, 2019), crop failure (Tully et al. 2019), and drinking water degradation (Vineis et al. 2011). It also influences coastal

infrastructure and may have played a role in the 2021 collapse of the Champlain Towers South condominium in Miami, Florida (Parkinson et al. 2021). Other impacts include coastal erosion under rising sea level. For example, in Hawaii, a doubling of coastal erosion is expected by 2050 (Anderson et al. 2015).

5. **Extreme Precipitation and Storms**

Human emissions have contributed to the rise in frequency and intensity of extreme precipitation events in North America (Kirchmeier-Young & Zhang 2020; NASEM 2025). Extreme precipitation events have become the "new normal" which over three-fourths of Americans are likely to experience during their lifetimes (J. Kim et al. 2023). Rising average temperatures in the Gulf Coast have increased the intensity of extreme precipitation in that region by 12% to 22% since 1880 (van Oldenborgh et al. 2017). Up to one-third of Americans are now expected to experience a previously "once-in-100-year" storm up to three times in their lifetimes (J. Kim et al. 2023). In the western United States, the effects of extreme precipitation are worsened by the alternation between drought and intense rainfall, a phenomenon referred to as "whiplash events" which can amplify hazards such as flash floods, wildfires, landslides and disease outbreak (Swain et al. 2025; NASEM 2025). In the winter of 2022 to 2023, after multiple years of drought, California experienced nine consecutive atmospheric rivers in three weeks, causing flooding, property damage, landslides, and prompting disaster declarations in forty counties (Swain et al. 2025). The southeastern United States is predicted to experience a 25% to 60% increase in whiplash events by the late twenty first century (Swain et al. 2025).

Researchers have also observed an increase in the probability of major hurricanes (Categories 3, 4, and 5) in the North Atlantic by 42% per decade from 1979 to 2017 (Kossin et al. 2020). The East Coast, Florida, and the coasts of Texas and Louisiana are especially vulnerable to hurricanes (Balaguru et al. 2023). Reed et al. (2022) estimated that extreme three-hour rainfall rates increased by 11% during the 2020 hurricane season due to anthropogenic climate change. Researchers have begun to determine how climate change has contributed to the devastation wrought by hurricanes. For example, Hurricane Harvey caused $90 billion in damages in 2017, with up to $67 billion of these attributable to anthropogenic climate change (Frame et al. 2020). Researchers estimate that climate change made Hurricane Harvey three times more likely (van Oldenborgh et al. 2017) and made Hurricane Harvey's rainfall 15% to 20% more intense than it would have been otherwise (van Oldenborgh et al. 2017; Risser & Wehner 2017).

6. **Energy, Infrastructure and Settlements**

Rising temperatures, sea level rise, and changing hydrological regimes will further burden energy and infrastructure systems (NASEM 2025). Since 2018, a growing body of research documents these negative effects. Warming is projected to increase global energy demand in 2050 by 11% to 27% under moderate emissions scenarios (RCP4.5) (van Ruijven et al. 2019). Heat extremes further increase energy demands for cooling (NASEM 2025), while reducing heating demand, as observed in electricity trends across the United States (Amonkar et al. 2023). As energy demand rises, climate change is also increasingly impacting energy generation. For example, smoke from wildfires reduces

solar photovoltaic output, and the 2020 wildfires were estimated to have cut monthly photovoltaic generation by 8% to 9% during significant wildfire activity and increased energy reserve requirements by over 50% (Cai et al. 2023). New evidence indicates that drought conditions shift energy generation from hydropower to fossil fuel plants. In a retrospective analysis of the 2012 to 2016 California drought, the increased cooling demands cost nearly twice as much as the lost hydropower generation (Kern et al. 2020). Hydropower capacity is also declining. Two thirds of domestic hydropower plants show reductions in capacity, with changes in water availability explaining over 20% of the losses (Turner et al. 2024). Transmission and distribution systems are also vulnerable to weather-related events that are exacerbated by climate change. U.S. infrastructure costs due to climate-attributable changes in the performance and longevity of physical infrastructure are projected to increase by $6 to $13 billion this century under a moderate emissions scenario (RCP4.5) (Fant et al. 2020).

Other types of United States infrastructure also face systematic threats from climate change (NASEM 2025). Rail, roads, and coastal property damages could reach tens of billions of dollars by 2050 under a moderate emissions scenario (RCP4.5), though adaptation can reduce costs significantly (Neumann et al. 2021). Systematic reviews of literature document the widespread climate-driven risks of inundation, overflow, and corrosion to wastewater systems (Hyde-Smith et al. 2022; Li et al. 2023). Along the coasts of the U.S., wastewater treatment plants are particularly vulnerable to sea level rise. In one estimate, the number of people at risk of losing wastewater services is over five times as high as the number of people at risk of direct flooding (Hummel et al. 2018). In Alaska, building and road losses from thawing permafrost are projected to cost $37 billion under a moderate (SSP2-4.5) emissions scenario (Manos et al. 2025). Furthermore, rising urban temperatures can warm the subsurface and cause the deformation of construction materials, with the potential to undermine building stability in cities such as Chicago (Rotta Loria 2023).

7. **Terrestrial Ecosystems and Wildlife**

A growing body of recent research reveals that terrestrial ecosystems and wildlife are already experiencing disruptions due to climate change. Rising temperatures, altered precipitation, and more frequent disasters are directly linked to observed global biodiversity loss (Habibullah et al., 2022) in addition to other human pressures such as habitat loss. Recent studies have documented measurable population declines, local extinctions, and signals of ecosystem destabilization. Climate change is pushing individual species beyond their physiological limit, while ecosystems are simultaneously losing their capacity to buffer disturbance.

Globally, biodiversity declined by 2% to 11% during the 20th century (Pereira et al. 2024) with climate change projected to drive 14% to 32% of macroscopic species to extinction within the next 50 years even under intermediate climate change scenarios (Wiens & Zelinka 2023). Using a different method with ecological community-level data, climate change was predicted to cause almost 20% loss of species by 2070 under a moderate emissions scenario (Newbold 2018), indicating that shifts in community composition are increasingly attributable to climate pressures whereas land-use change historically played a larger role (Newbold 2018; Jaureguiberry et al. 2022). The number of

vascular plant species expected to go extinct due to changes that have already happened, i.e., species "committed to extinction", has increased by 60% globally over the past century, with the impact of climate change projected to surpass the impact of land-use change under all future scenarios (Di Marco et al. 2018).

Evidence also indicates that species' adaptive capacity is limited. For example, observed adaptive responses in animals are generally insufficient to keep pace with current rates of warming (Radchuk et al. 2019). Globally, 57% of species will not be able to disperse quickly enough to track suitable climates under the RCP4.5 moderate emissions scenario (Román-Palacios & Wiens 2020) and the loss of mammals and birds has "already reduced the capacity of plants to track climate change by 60%" via limited seed dispersal (Fricke et al. 2022). Rising temperatures are shifting the seasonal timing of animal life cycles globally, increasing risks of ecological mismatches that disrupt predator-prey, host-parasite, and pollination networks (Cohen et al. 2018).

Several recent studies have focused on the potential for nonlinear, abrupt change. Species are increasingly at risk of being exposed to temperatures that exceed their physiological thermal limit, with over 50% of the increase in species' exposure is projected to occur in a single decade (Trisos et al. 2020; Pigot et al. 2023). By 2099, under intermediate emissions scenarios (SSP3-7.0 and SSP2-4.5), roughly 15% to 29% of all land vertebrates will be exposed to extreme temperatures exceeding historical levels in over half of their geographic range (Murali et al. 2023). Likewise, 9% of freshwater fish globally will be exposed to extreme temperatures in over half of their geographic range when global warming reaches 2°C under moderate emissions scenarios (Barbarossa et al. 2021). Climate change is also driving synchronous decreases in ecosystem resilience, or the ability of a system to withstand disturbances without drastically changing, across terrestrial biomes which could lead to rapid ecosystem transitions (Rocha 2022).

Within the United States, the decline and extinction of numerous species due to climate change is already underway and is most pronounced in the hotter and drier western regions (e.g., Riddell et al., 2019, 2021; Holzmann et al., 2023). Several examples are described below. Across the northern Rocky Mountains, warmer stream temperatures and decreased summer stream flow are reducing native trout habitat and driving the expansion of invasive trout species. Since 1993, the occupancy of native bull trout and cutthroat trout decreased by 18% and 6%, respectively, and are projected to decrease by another 39% and 16% by 2080 under a moderate emissions scenario (Bell et al., 2021). In the Mojave Desert, hotter temperatures and reduced rainfall are driving bird community collapse, with survey sites losing on average 43% of their species relative to the early 20th century (Iknayan & Beissinger, 2018). These local extinctions are linked to hotter and dryer climates, which require birds to expend greater amounts of energy to cool themselves, and thus are projected to worsen under future climate change (Riddell et al., 2019, 2021). In the mountains of Arizona, the local extinction rates for Yarrow's Spiny Lizard have tripled in the past 7 years relative to the previous 42 years and are "among the fastest ever recorded" due to rapidly rising temperatures (Holzmann et al., 2023).

Bumble bee populations in North America have also declined due to temperatures reaching or exceeding the species' thermal limit, and the probability of site occupancy decreased on average by

46% relative to 1901-1974 (Soroye et al., 2020). Across the southern Sierra Nevada, 30% of mature forest vegetation was lost between 2011 and 2020; drought, wildfires, and pest invasions reduced canopy cover and forest density, damaging ecosystems and exacerbating forest loss (Steel et al., 2023). Along the northern Pacific coastline from California to Alaska, common murre seabird populations experienced unprecedented mass mortality and 22 colonies failed to reproduce because of a 2014-2016 marine heatwave (Piatt et al., 2020).

III. ADDITIONAL SECTORS AND IMPACTS

1. Ocean Acidification, Deoxygenation, Marine Heatwaves, and Marine Ecosystem Impacts

The scientific community's understanding of the impacts of climate change on the ocean's physical, chemical, and biological systems has continued to increase. Three of the most observable phenomena that have been linked to climate change are ocean acidification, deoxygenation, and marine heatwaves, and each has subsequent impacts on the marine ecosystem.

Anthropogenic emissions have directly increased carbon uptake by the ocean, in turn decreasing the surface ocean pH by 0.1 pH units on average globally since 1770 in a phenomenon termed 'ocean acidification' (Garcia-Soto et al., 2021). In the last four decades, pH has declined globally at a rate of –0.0166 pH units per decade (Ma et al., 2023). Further observational records in the Pacific Ocean and California current system quantify acidification at roughly the same rate, with values of –0.0015 and –0.002 pH units per year, respectively (Wolfe et al., 2023; Feely et al., 2024). Ocean acidification dramatically changes the habitat range for marine calcifying organisms through promoting dissolution of their shells, and according to a 2025 review paper, by 2020, the suitable habitat worldwide declined by 43% for tropical and subtropical coral reefs and 13% since the pre-industrial for coastal bivalves (i.e., clams, oysters, mussels, and scallops) (Findlay et al., 2025). This in turn has impacts on aquaculture and fisheries, with losses of up to $400 million modeled for the United States economy by 2100 due to impacts on the bivalve industry (Doney et al., 2020). Notably, the average global ocean conditions have already crossed into the uncertainty range of the ocean acidification boundary, which is derived from a framework where unacceptable environmental change would occur (Findlay et al., 2025). Polar regions are the most rapidly acidifying (Feely et al., 2023), with observational evidence suggesting the Arctic Ocean is acidifying three to four times faster than other ocean basins (Qi et al., 2022). As a result of this and warming, polar ecosystems may be the most heavily impacted by climate-induced ocean changes (Du Pontavice et al., 2020).

The ocean itself is also warming (NASEM 2025). The mean surface warming rate over the last 120 years is 0.062˚C per decade, and during the last decade (2009 to 2019), this rate accelerated to 0.280˚C per decade (Garcia-Soto et al., 2021). Warmer water can hold less dissolved oxygen, so this in turn leads to deoxygenation of the ocean, and all studies summarized in a recent review agreed that the ocean is losing oxygen at an alarming rate of roughly 2% over 50 years (Garcia-Soto et al., 2021). This is projected to continue; under a high warming scenario, 72% of the global ocean is expected to experience deoxygenation at all depths before 2080 (Gong et al., 2021). Oxygen is necessary for marine life, and deoxygenation can lead to 'dead zones', or low oxygen zones,

compressing available habitat for marine species and changing fish distribution, which in turn impacts fisheries (H. Kim et al., 2023).

Furthermore, extreme warm ocean temperature events, often called marine heatwaves, have been increasing in frequency, with multiple studies finding a large increase in the frequency of occurrence of marine heatwaves over the 35-year satellite record (Hobday et al., 2018, Frölicher et al., 2018; NASEM 2025). Long-term warming trends have been found to be almost entirely responsible for these changes in frequency, as well as for observed increases in marine heat wave intensity (Capotondi et al., 2024; Laufkötter et al., 2020, Oliver, 2019). These marine heatwaves events have impacts on marine ecosystems, including fish and bird die-offs, impacts on foundational species like coral, sea grass, and kelp, and overall reductions in biodiversity (Smale et al., 2019; Capotondi et al., 2024). Examples of this include one study finding a two-to-fourfold increase in marine heatwaves in the North Atlantic coincided with high mortality in local kelp populations (Fillbee-Dexter et al., 2020). Marine heatwaves have a large impact on marine economic as well; modeled impacts on fish stocks are at least four times larger than decadal scale mean change, and there are significant projected impacts on fisheries revenues and biomass in climate-vulnerable areas, including up to a 30% decline in global fish biomass by 2100 (Carozza et al. 2019, Cheung and Frölicher, 2020, Cheung et al., 2021, Tittensor et al., 2021). There is also evidence of lagged ecosystem recovery after these marine heatwave events (Robertson et al., 2021), including an example from the 2014 to 2016 PNW heatwave suggesting that the response of ecosystems may persist for up to 5 years (Suryan et al., 2021).

All together, these three major climate impacts on the ocean also have compounding effects on the marine ecosystems. Fish biomass maximum sustainable yield has had an observed 4.1% decline from 1930 to 2010 (Free et al., 2019) and is projected to continue to decline under warming scenarios (Tittensor et al., 2021). There have been observed detrimental impacts on certain valuable species, including lobsters, oysters, salmon, and cod, which are all economically important to the seafood and shellfish industries in the United States (Le Bris, 2018; Oke et al., 2020; Sguotti et al., 2019).

2. **Violence and Social Instability**

Higher temperatures have historically been directly correlated with higher rates of violent crime (Corcoran and Zahnow, 2022). Here we discuss how rising temperatures, changing precipitation patterns, and more frequent extreme weather events associated with the climate crisis have been observed and are projected to alter patterns of violence.

On an individual behavior level, one recent meta-analysis documented a 9% rise in violent crime per 10ºC increase in daily temperatures (Choi et al., 2024). A United States-specific study found that violent crime was 3% higher at high versus moderate temperatures across 44 cities and that risk was higher in cities with 90th percentile temperature anomalies deviating from the previous 30-year average (Heo et al., 2025). In addition, when seasonal cycles were removed, a different study found temperature residuals had a positive correlation with assault and robbery in all eight United States cities studied (J. Hu et al., 2024), and in a study focusing on 100 United States cities, estimated risk of shootings increased nearly monotonically with temperature (Lyons et al., 2022). Recent studies of

Chicago and Cleveland also found that heat waves and high maximum daily temperatures were correlated with an observed increase in crime (Hou et al., 2023, Cruz et al., 2020). There is also emerging evidence that drought may also be correlated with an increase in violent crime (Cohen 2025).

However, there are also more indirect ways that climate change can impact social instability. Here, like in national security frameworks, climate change acts as a threat multiplier, creating additional vulnerabilities and exacerbating hazards that already exist. For instance, climate change is especially likely to provoke instability and violence in regions that are dependent on agriculture or have high levels of political marginalization (Sellers et al., 2019, Koubi, 2019). Natural disasters, which have been increasingly tied to climate change, can also serve as threat multiplier and can lead to heightened negative impacts to mental health and increased levels of housing instability, especially among vulnerable populations even within the United States (Benevolenza and DeRigne, 2019). Natural disasters and other climate impacts also cause post-traumatic stress disorder, stress, and disruptions to daily life, which over time are linked in an increase in violent behavior (Amin 2025; Miles-Novelo and Anderson, 2019).

3. **National Security**

The assertion that "climate change is a direct threat to the national security of the United States" made by the 115th Congress remains true today (National Defense Authorization Act, 2018). Hazards driven by climate change threaten military infrastructure and hinder military readiness, while intensifying geopolitical competition, fueling migration and instability, and straining fragile states. Collectively, climate change is amplifying threats to United States national security at home and abroad.

These threats have been articulated and analyzed in numerous reports by the United States Department of Defense since 2018, with the most salient reports summarized below. In the 2022 National Defense Strategy, the Department of Defense recognized climate change as a transboundary challenge that is altering the security landscape by degrading readiness and installations, opening new strategic arenas such as the Arctic, driving greater demands for disaster response, and heightening instability and conflict risks that will increasingly tax United States forces and partners (Department of Defense, 2022). The United States Army War College released a report in 2019 which detailed these threats, emphasizing regional instability due to reduced water and food security, increased geopolitical competition in the Arctic, and raised operational burdens, all of which elevate national security risks (Brosig et al., 2019). In the report "Climate Change and International Responses Increasing Challenges to United States National Security Through 2040," the National Intelligence Council (NIC) concluded that climate change is likely to "exacerbate cross-border geopolitical flashpoints" and the effects of climate change will be most felt by developing countries with the least adaptation ability, thus increasing the "potential for instability and possibly internal conflict in these countries, in some cases creating additional demands on United States diplomatic, economic, humanitarian, and military resources" (NIC, 2021a). The NIC emphasizes these threats from climate change in their broader "Global Trends 2040" report (NIC, 2021b).

Chapter 17 of the Fifth National Climate Assessment also states with high confidence that climate change can contribute to conflict abroad and that climate change "impacts the operations and missions of defense, diplomacy, and development agencies critical to US national security" (Hellmuth et al., 2023). Alongside these official reports, an independent study revealed that "Department of Defense leadership considers climate change to be a security threat of strategic importance" and climate security researchers within the defense community "believe the U.S. Department of Defense prioritizes climate security as a near-term threat" (Burnett & Mach, 2021).

Since 2018, new research has substantially strengthened the evidence that climate change is impairing United States military readiness and degrading critical infrastructure. Epidemiological studies at Army installations reveal that rising temperatures have already translated into measurable impacts. A 1°F increase in average summertime temperature was associated with a 16% increase in heat stress rates among soldiers (Lewandowski et al., 2022). There has been a marked increase in "black flag" hours at Basic Combat Training installations, when temperatures are high enough for physical exertion to cause heat illness and training may require adaptation measures for safety (Patton & Doyle, 2024). Overall, extreme heat has become a persistent "noncombat threat" to training and military operations which directly threatens preparedness (Moran et al., 2023). Coastal military installments face additional vulnerabilities from rising sea level. An assessment of readiness in the southwestern United States documented the near-term risk of "worsening erosion due to waves and high tides" at the Naval Base Coronado (Garfin et al., 2021). Tidal dynamics are expected to further exacerbate flooding risks for coastal infrastructure across the United States (Li et al., 2021). Abroad, Pacific atoll installations will cross thresholds of habitability and freshwater availability within decades, making annual wave-driven flooding a likely operational disruption (Storlazzi et al., 2018). Additional hazards compound these risks: wildfire-smoke exposure at Joint Base Lewis-McChord has significantly increased respiratory and behavioral health visits among service members (Robinson et al., 2025), while thawing permafrost in Alaska undermines runways, roads, and building foundations – all infrastructure that is critical to defense missions (Douglas et al., 2021; Hjort et al., 2022).

Arctic sea ice has continued to decline since 2018, increasing geopolitical tension as the United States, China, and Russia vie for control over forthcoming shipping routes and new oil and gas extraction opportunities. The spring of 2025 set the record lowest sea ice maximum (NSIDC, 2025) and the first ice-free day in the Arctic could now occur within 10 years (Heuzé & Jahn, 2024) with Arctic shipping routes projected to be navigable in all but the spring by 2065 (Zhao et al., 2024). Already, shipping in the Polar Code area, where most Arctic ship traffic occurs, has increased by 8.7% between 2013 and 2022 (Sander & Mikkelsen, 2025). China and Russia have begun increasing their military presence at a rapid pace, with the Kremlin placing the militarization of the Arctic as a state priority (Uryupova, 2023). These developments underscore that the United States must treat the Arctic as an emerging theater of strategic competition by investing in sustained military and coast guard presence to safeguard national security in an increasingly contested region.

As described in the previous section, climate change should also be viewed as a threat multiplier that exacerbates conditions that already contribute to social instability, armed conflict, and violence (e.g.,

Schleussner et al., 2016; Mach et al., 2019; Sellers et al., 2019; Koubi, 2019; Daoudy et al., 2022). Immigration from El Salvador, Guatemala, and Honduras to the United States between 2012 and 2018 increased 70.7% during growing seasons in Central America that were drier than the historical average (Linke et al., 2023). Droughts in Central America are projected to worsen under climate change (Anderson et al., 2023), making migration and its inherent instability a growing concern. There is also a growing link between climate change and terrorism, with climate change exacerbating existing social vulnerability that enables and drives terrorism (Asaka, 2021). From a hybrid warfare perspective, instability induced by climate change may also be leveraged by our adversaries to increase insurgency and conflict potential (Briggs, 2020). Taken together, this body of evidence demonstrates that climate change not only intensifies existing drivers of instability but also creates strategic openings that can be exploited by adversaries, thereby multiplying threats and amplifying risks to United States national security.

4. **Economic Well-Being**

Climate change drives substantial domestic and global economic losses related to damage across sectors—agriculture, crime, coastal storms, energy, human mortality, and labor (Hsiang et al., 2017). Global warming has disproportionately impacted the Global South, increasing global inequality by 25% from 1961 to 2010 (Diffenbaugh and Burke 2019).

The negative impact of anthropogenic warming on the United States economy is also consequential; based on seasonal data from 1957 to 2012, it is estimated that average summer and fall temperatures will decrease United States gross state product growth by 0.2% to 0.4% with the greatest effects in southern states (Colacito et al. 2019).

Much of the body of literature linking economic damages to future climate relies on historical relationships between GDP and mean temperature. However, there is evidence that changes in variability or changes in other non-temperature variables also must be considered to arrive at an accurate damage estimate. Waidelich et al. (2024) used changes in the mean and variance of temperature and precipitation to predict that with 3°C global warming, global average losses reach 10% of GDP. Precipitation data also suggests that future hydrologic changes will drive more inequality in the United States (Palagi et al., 2022). There is also evidence that global climate models underestimate impacts from climate extremes, which could bias projections of future economic losses low (Schewe et al., 2019). Sea level rise by itself may cause GDP to decline by $70 to $289 billion (Haer et al., 2013).

There is evidence that climate change is already causing economic damage. Since the 1970s, there has been a sevenfold increase in the reported disaster losses from extreme events, much of which is attributable to climate change; from 2000 to 2019, anthropogenic climate change costs related to extreme weather were estimated to be $2.86 trillion globally (Newman and Noy 2023). From 1988-2017, it is estimated that one-third ($73 billion) of the cost of flood damages is a result of historical precipitation increases, which will continue to intensify due to climate change (Davenport et al., 2021). The most damaging hurricanes have increased by 330% per century from 1900 to 2018 (Grinsted et al., 2019).

Another uncertainty is the human response to the economic damages inflicted by climate change, which could potentially exacerbate GDP losses. Lamperti et al. (2019) used an agent-based climate-macroeconomic model and found that climate change will increase the frequency of banking crises by between 26% to 248%, and that rescuing insolvent banks will cause an additional fiscal burden of approximately 5% to 15% of GDP per year. The stability of the housing market could also be impacted, for example through overvaluations of residential properties exposed to flooding (Gourevitch et al., 2023).

REFERENCES

Abatzoglou, J. T., Battisti, D. S., Williams, A. P., Hansen, W. D., Harvey, B. J., & Kolden, C. A. (2021). Projected increases in western US forest fire despite growing fuel constraints. *Communications Earth & Environment*, *2*(1), 227. https://doi.org/10.1038/s43247-021-00299-0

Achakulwisut, P., Mickley, L. J., & Anenberg, S. C. (2018). Drought-sensitivity of fine dust in the US Southwest: Implications for air quality and public health under future climate change. *Environmental Research Letters*, *13*(5), 054025. https://doi.org/10.1088/1748-9326/aabf20

Acosta, R. J., Kishore, N., Irizarry, R. A., & Buckee, C. O. (2020). Quantifying the dynamics of migration after Hurricane Maria in Puerto Rico. *Proceedings of the National Academy of Sciences*, *117*(51), 32772–32778. https://doi.org/10.1073/pnas.2001671117

Albano, C. M., Abatzoglou, J. T., McEvoy, D. J., Huntington, J. L., Morton, C. G., Dettinger, M. D., & Ott, T. J. (2022). A Multidataset Assessment of Climatic Drivers and Uncertainties of Recent Trends in Evaporative Demand across the Continental United States. *Journal of Hydrometeorology*, *23*(4), 505–519. https://doi.org/10.1175/JHM-D-21-0163.1

Albertine, J. M., Manning, W. J., DaCosta, M., Stinson, K. A., Muilenberg, M. L., & Rogers, C. A. (2014). Projected Carbon Dioxide to Increase Grass Pollen and Allergen Exposure Despite Higher Ozone Levels. *PLoS ONE*, *9*(11), e111712. https://doi.org/10.1371/journal.pone.0111712

Amin, S. (2025). Climate change and lethal violence: A global analysis. *International Journal of Climate Change Strategies and Management*, *17*(1), 216–245. https://doi.org/10.1108/IJCCSM-12-2023-0159

Amonkar, Y., Doss-Gollin, J., Farnham, D. J., Modi, V., & Lall, U. (2023). Differential effects of climate change on average and peak demand for heating and cooling across the contiguous USA. *Communications Earth & Environment*, *4*(1), 402. https://doi.org/10.1038/s43247-023-01048-1

Analitis, A., Michelozzi, P., D'Ippoliti, D., de'Donato, F., Menne, B., Matthies, F., Atkinson, R. W., Iñiguez, C., Basagaña, X., Schneider, A., Lefranc, A., Paldy, A., Bisanti, L., & Katsouyanni, K. (2014). Effects of Heat Waves on Mortality: Effect Modification and Confounding by Air Pollutants. *Epidemiology*, *25*(1), 15–22. https://doi.org/10.1097/EDE.0b013e31828ac01b

Anderegg, W. R. L., Abatzoglou, J. T., Anderegg, L. D. L., Bielory, L., Kinney, P. L., & Ziska, L. (2021). Anthropogenic climate change is worsening North American pollen seasons. *Proceedings of the National Academy of Sciences*, *118*(7), e2013284118. https://doi.org/10.1073/pnas.2013284118

Anderson, G. B., & Bell, M. L. (2011). Heat Waves in the United States: Mortality Risk during Heat Waves and Effect Modification by Heat Wave Characteristics in 43 U.S. Communities. *Environmental Health Perspectives*, *119*(2), 210–218. https://doi.org/10.1289/ehp.1002313

Anderson, T. G., McKinnon, K. A., Pons, D., & Anchukaitis, K. J. (2023). *How exceptional was the 2015-2019 Central American Drought?* Preprints. https://doi.org/10.22541/essoar.168987131.17335510/v2

Anderson, T. R., Fletcher, C. H., Barbee, M. M., Frazer, L. N., & Romine, B. M. (2015). Doubling of coastal erosion under rising sea level by mid-century in Hawaii. *Natural Hazards*, *78*(1), 75–103. https://doi.org/10.1007/s11069-015-1698-6

Anenberg, S. C., Weinberger, K. R., Roman, H., Neumann, J. E., Crimmins, A., Fann, N., Martinich, J., & Kinney, P. L. (2017). Impacts of oak pollen on allergic asthma in the United States and potential influence of future climate change. *GeoHealth*, *1*(3), 80–92. https://doi.org/10.1002/2017GH000055

Asaka, J. O. (2021). Climate Change—Terrorism Nexus? A Preliminary Review/Analysis of the Literature. Perspectives on Terrorism, 15(1), 81–92.

Baker, J. S., Van Houtven, G., Phelan, J., Latta, G., Clark, C. M., Austin, K. G., Sodiya, O. E., Ohrel, S. B., Buckley, J., Gentile, L. E., & Martinich, J. (2023). Projecting U.S. forest management, market, and carbon sequestration responses to a high-impact climate scenario. *Forest Policy and Economics*, *147*, 102898. https://doi.org/10.1016/j.forpol.2022.102898

Baker, R. E., Mahmud, A. S., Wagner, C. E., Yang, W., Pitzer, V. E., Viboud, C., Vecchi, G. A., Metcalf, C. J. E., & Grenfell, B. T. (2019). Epidemic dynamics of respiratory syncytial virus in current and future climates. *Nature Communications*, *10*(1), 5512. https://doi.org/10.1038/s41467-019-13562-y

Balaguru, K., Xu, W., Chang, C.-C., Leung, L. R., Judi, D. R., Hagos, S. M., Wehner, M. F., Kossin, J. P., & Ting, M. (2023). Increased U.S. coastal hurricane risk under climate change. *Science Advances*, *9*(14), eadf0259. https://doi.org/10.1126/sciadv.adf0259

Baldrian, P., López-Mondéjar, R., & Kohout, P. (2023). Forest microbiome and global change. *Nature Reviews Microbiology*, *21*(8), 487–501. https://doi.org/10.1038/s41579-023-00876-4

Barbarossa, V., Bosmans, J., Wanders, N., King, H., Bierkens, M. F. P., Huijbregts, M. A. J., & Schipper, A. M. (2021). Threats of global warming to the world's freshwater fishes. *Nature Communications*, *12*(1), 1701. https://doi.org/10.1038/s41467-021-21655-w

Bartusek, S., Kornhuber, K., & Ting, M. (2022). 2021 North American heatwave amplified by climate change-driven nonlinear interactions. *Nature Climate Change*, *12*(12), 1143–1150. https://doi.org/10.1038/s41558-022-01520-4

Bell, D. A., Kovach, R. P., Muhlfeld, C. C., Al-Chokhachy, R., Cline, T. J., Whited, D. C., Schmetterling, D. A., Lukacs, P. M., & Whiteley, A. R. (2021). Climate change and expanding invasive species drive widespread declines of native trout in the northern Rocky Mountains, USA. *Science Advances*, *7*(52), eabj5471. https://doi.org/10.1126/sciadv.abj5471

Bell, M. L., Gasparrini, A., & Benjamin, G. C. (2024). Climate Change, Extreme Heat, and Health. *New England Journal of Medicine*, *390*(19), 1793–1801. https://doi.org/10.1056/NEJMra2210769

Benevolenza, M. A., & DeRigne, L. (2019). The impact of climate change and natural disasters on vulnerable populations: A systematic review of literature. *Journal of Human Behavior in the Social Environment*, *29*(2), 266–281. https://doi.org/10.1080/10911359.2018.1527739

Bernstein, A. S., Sun, S., Weinberger, K. R., Spangler, K. R., Sheffield, P. E., & Wellenius, G. A. (2022). Warm Season and Emergency Department Visits to U.S. Children's Hospitals. *Environmental Health Perspectives*, *130*(1), 017001. https://doi.org/10.1289/EHP8083

Best, K., He, Q., Reilly, A. C., Niemeier, D. A., Anderson, M., & Logan, T. (2023). Demographics and risk of isolation due to sea level rise in the United States. *Nature Communications*, *14*(1), 7904. https://doi.org/10.1038/s41467-023-43835-6

Bi, P., Chen, X., Pan, Z., Huang, N., Gao, R., Men, J., Wu, C., Zhang, F., Huang, Z., Gao, E. Yao, Y., & Long, B. (2026). Increasing global heatwave occurrence associated with land-atmosphere interactions. *npj Clim Atmos Sci*, 9(89), https://doi.org/10.1038/s41612-026-01356-1.

Briggs, C. M. (2020). Climate Change and Hybrid Warfare Strategies. *Journal of Strategic Security*, *13*(4), 45–57. https://doi.org/10.5038/1944-0472.13.4.1864

Brosig, M., Frawley, P., Hill, A., Jahn, M., Marsicek, M., Paris, A., Rose, M., Shambaljamts, A., & Thomas, N. (2019). *Implications of Climate Change for the U.S. Army*. United States Army War College. https://climateandsecurity.org/wp-content/uploads/2019/07/implications-of-climate-change-for-us-army_army-war-college_2019.pdf

Bryndum-Buchholz, A., Boyce, D., Tittensor, D., Christensen, V., Bianchi, D., & Lotze, H. (2020). Climate-change impacts and fisheries management challenges in the North Atlantic Ocean. *Marine Ecology Progress Series*, *648*, 1–17. https://doi.org/10.3354/meps13438

Burke, M., Driscoll, A., Heft-Neal, S., Xue, J., Burney, J., & Wara, M. (2021). The changing risk and burden of wildfire in the United States. *Proceedings of the National Academy of Sciences*, *118*(2), e2011048118. https://doi.org/10.1073/pnas.2011048118

Burke, M., González, F., Baylis, P., Heft-Neal, S., Baysan, C., Basu, S., & Hsiang, S. (2018). Higher temperatures increase suicide rates in the United States and Mexico. *Nature Climate Change*, *8*(8), 723–729. https://doi.org/10.1038/s41558-018-0222-x

Burnett, M., & Mach, K. J. (2021). A "precariously unprepared" Pentagon? Climate security beliefs and decision-making in the U.S. military. *Global Environmental Change*, *70*, 102345. https://doi.org/10.1016/j.gloenvcha.2021.102345

Burton, C., Lampe, S., Kelley, D. I., Thiery, W., Hantson, S., Christidis, N., Gudmundsson, L., Forrest, M., Burke, E., Chang, J., Huang, H., Ito, A., Kou-Giesbrecht, S., Lasslop, G., Li, W., Nieradzik, L., Li, F., Chen, Y., Randerson, J., … Mengel, M. (2024). Global burned area increasingly explained by climate change. *Nature Climate Change*, *14*(11), 1186–1192. https://doi.org/10.1038/s41558-024-02140-w

Cai, M., Lin, C.-A., Ravi, V., Zhang, Y., Lu, C.-H., & Sengupta, M. (2023). Final Technical Report: Impact of Wildfires on Solar Generation, Reserves, and Energy Prices. *Renewable Energy*.

Caminade, C., McIntyre, K. M., & Jones, A. E. (2019). Impact of recent and future climate change on vector-borne diseases. *Annals of the New York Academy of Sciences*, *1436*(1), 157–173. https://doi.org/10.1111/nyas.13950

Capotondi, A., Rodrigues, R. R., Sen Gupta, A., Benthuysen, J. A., Deser, C., Frölicher, T. L., Lovenduski, N. S., Amaya, D. J., Le Grix, N., Xu, T., Hermes, J., Holbrook, N. J., Martinez-Villalobos, C., Masina, S., Roxy, M. K., Schaeffer, A., Schlegel, R. W., Smith, K. E., & Wang, C. (2024). A global overview of marine heatwaves in a changing climate. *Communications Earth & Environment*, *5*(1), 701. https://doi.org/10.1038/s43247-024-01806-9

Carozza, D. A., Bianchi, D., & Galbraith, E. D. (2019). Metabolic impacts of climate change on marine ecosystems: Implications for fish communities and fisheries. *Global Ecology and Biogeography*, *28*(2), 158–169. https://doi.org/10.1111/geb.12832

Chen, X., Zhang, X., Church, J. A., Watson, C. S., King, M. A., Monselesan, D., Legresy, B., & Harig, C. (2017). The increasing rate of global mean sea-level rise during 1993–2014. *Nature Climate Change*, *7*(7), 492–495. https://doi.org/10.1038/nclimate3325

Cheung, W. W. L., & Frölicher, T. L. (2020). Marine heatwaves exacerbate climate change impacts for fisheries in the northeast Pacific. *Scientific Reports*, *10*(1), 6678. https://doi.org/10.1038/s41598-020-63650-z

Cheung, W. W. L., Frölicher, T. L., Lam, V. W. Y., Oyinlola, M. A., Reygondeau, G., Sumaila, U. R., Tai, T. C., Teh, L. C. L., & Wabnitz, C. C. C. (2021). Marine high temperature extremes amplify the impacts of climate change on fish and fisheries. *Science Advances*, *7*(40), eabh0895. https://doi.org/10.1126/sciadv.abh0895

Cho, E., McCrary, R. R., & Jacobs, J. M. (2021). Future Changes in Snowpack, Snowmelt, and Runoff Potential Extremes Over North America. *Geophysical Research Letters*, *48*(22), e2021GL094985. https://doi.org/10.1029/2021GL094985

Choi, H. M., Heo, S., Foo, D., Song, Y., Stewart, R., Son, J., & Bell, M. L. (2024). Temperature, Crime, and Violence: A Systematic Review and Meta-Analysis. *Environmental Health Perspectives*, *132*(10), 106001. https://doi.org/10.1289/EHP14300

Cohen, J. M., Lajeunesse, M. J., & Rohr, J. R. (2018). A global synthesis of animal phenological responses to climate change. *Nature Climate Change*, *8*(3), 224–228. https://doi.org/10.1038/s41558-018-0067-3

Cohen, N. D. (2025). Dry Aggression: The Impact of Drought on Violent Crime Trends in California Counties. *American Journal of Criminal Justice*, *50*(2), 360–382. https://doi.org/10.1007/s12103-025-09793-z

Colacito, R., Hoffmann, B., & Phan, T. (2019). Temperature and Growth: A Panel Analysis of the United States. *Journal of Money, Credit and Banking*, *51*(2–3), 313–368. https://doi.org/10.1111/jmcb.12574

Coop, J. D., Parks, S. A., Stevens-Rumann, C. S., Crausbay, S. D., Higuera, P. E., Hurteau, M. D., Tepley, A., Whitman, E., Assal, T., Collins, B. M., Davis, K. T., Dobrowski, S., Falk, D. A., Fornwalt, P. J., Fulé, P. Z., Harvey, B. J., Kane, V. R., Littlefield, C. E., Margolis, E. Q., … Rodman, K. C. (2020). Wildfire-Driven Forest Conversion in Western North American Landscapes. *BioScience*, *70*(8), 659–673. https://doi.org/10.1093/biosci/biaa061

Corcoran, J., & Zahnow, R. (2022). Weather and crime: A systematic review of the empirical literature. *Crime Science*, *11*(1), 16. https://doi.org/10.1186/s40163-022-00179-8

Costinot, A., Donaldson, D., & Smith, C. (2016). Evolving Comparative Advantage and the Impact of Climate Change in Agricultural Markets: Evidence from 1.7 Million Fields around the World. Journal of Political Economy, 124(1). https://doi.org/10.1086/684719

Cowherd, M., Ruby Leung, L., & Girotto, M. (2023). Evolution of global snow drought characteristics from 1850 to 2100. *Environmental Research Letters*, *18*(6), 064043. https://doi.org/10.1088/1748-9326/acd804

Crandon, T. J., Dey, C., Scott, J. G., Thomas, H. J., Ali, S., & Charlson, F. J. (2022). The clinical implications of climate change for mental health. *Nature Human Behaviour*, *6*(11), 1474–1481. https://doi.org/10.1038/s41562-022-01477-6

Crozier, L. G., McClure, M. M., Beechie, T., Bograd, S. J., Boughton, D. A., Carr, M. Cooney, T. D., Dunham, J. B., Greene, C. M., Haltuch, M. A., Hazen, E. L., Holzer, D. M., Huff, D. D., Johnson, R. C., Jordan, C. E., Kaplan, I. C., Lindley, S. T., Mantua, N. J., Moyle, P. B., Myers, J. M., Nelson, M. W., Spence, B. C., Weitkamp, L. A., Williams, T. H., & Willis-Norton, E. (2019). Climate vulnerability assessment for Pacific salmon and steelhead in the California Current Large Marine Ecosystem. *PLOS ONE 14*(7), 1-49. https://doi.org/10.1371/journal.pone.0217711

Cruz, E., D'Alessio, S. J., & Stolzenberg, L. (2020). The Effect of Maximum Daily Temperature on Outdoor Violence. *Crime & Delinquency*, *69*(6–7), 1161–1182. https://doi.org/10.1177/0011128720926119

Dahlke, F. T., Wohlrab, S., Butzin, M., & Pörtner, H.-O. (2020). Thermal bottlenecks in the life cycle define climate vulnerability of fish. *Science*, *369*(6499), 65–70. https://doi.org/10.1126/science.aaz3658

Dangendorf, S., Hendricks, N., Sun, Q., Klinck, J., Ezer, T., Frederikse, T., Calafat, F. M., Wahl, T., & Törnqvist, T. E. (2023). Acceleration of U.S. Southeast and Gulf coast sea-level rise amplified by internal climate variability. *Nature Communications*, *14*(1), 1935. https://doi.org/10.1038/s41467-023-37649-9

Dao, P. U., Heuzard, A. G., Le, T. X. H., Zhao, J., Yin, R., Shang, C., & Fan, C. (2024). The impacts of climate change on groundwater quality: A review. *Science of The Total Environment*, *912*, 169241. https://doi.org/10.1016/j.scitotenv.2023.169241

Daoudy, M., Sowers, J., & Weinthal, E. (2022). What is climate security? Framing risks around water, food, and migration in the Middle East and North Africa. *WIREs Water*, *9*(3), e1582. https://doi.org/10.1002/wat2.1582

Darrow, L. A., Huang, M., Warren, J. L., Strickland, M. J., Holmes, H. A., Newman, A. J., & Chang, H. H. (2024). Preterm and Early-Term Delivery After Heat Waves in 50 US Metropolitan Areas. *JAMA Network Open*, *7*(5), e2412055. https://doi.org/10.1001/jamanetworkopen.2024.12055

Davenport, F. V., Burke, M., & Diffenbaugh, N. S. (2021). Contribution of historical precipitation change to US flood damages. *Proceedings of the National Academy of Sciences*, *118*(4), e2017524118. https://doi.org/10.1073/pnas.2017524118

De Koning, K., & Filatova, T. (2020). Repetitive floods intensify outmigration and climate gentrification in coastal cities. *Environmental Research Letters*, *15*(3), 034008. https://doi.org/10.1088/1748-9326/ab6668

Delgado-Baquerizo, M., Guerra, C. A., Cano-Díaz, C., Egidi, E., Wang, J.-T., Eisenhauer, N., Singh, B. K., & Maestre, F. T. (2020). The proportion of soil-borne pathogens increases with warming at the global scale. *Nature Climate Change*, *10*(6), 550–554. https://doi.org/10.1038/s41558-020-0759-3

Deutsch, C. A., Tewksbury, J. J., Tigchelaar, M., Battisti, D. S., Merrill, S. C., Huey, R. B., & Naylor, R. L. (2018). Increase in crop losses to insect pests in a warming climate. *Science*, *361*(6405), 916–919. https://doi.org/10.1126/science.aat3466

DeWaard, J., Johnson, J. E., & Whitaker, S. D. (2020). Out-migration from and return migration to Puerto Rico after Hurricane Maria: Evidence from the consumer credit panel. *Population and Environment*, *42*(1), 28–42. https://doi.org/10.1007/s11111-020-00339-5

Di Marco, M., Harwood, T. D., Hoskins, A. J., Ware, C., Hill, S. L. L., & Ferrier, S. (2019). Projecting impacts of global climate and land-use scenarios on plant biodiversity using

compositional-turnover modelling. *Global Change Biology*, *25*(8), 2763–2778. https://doi.org/10.1111/gcb.14663

Diffenbaugh, N. S., & Burke, M. (2019). Global warming has increased global economic inequality. *Proceedings of the National Academy of Sciences*, *116*(20), 9808–9813. https://doi.org/10.1073/pnas.1816020116

Doney, S. C., Busch, D. S., Cooley, S. R., & Kroeker, K. J. (2020). The Impacts of Ocean Acidification on Marine Ecosystems and Reliant Human Communities. *Annual Review of Environment and Resources*, *45*(1), 83–112. https://doi.org/10.1146/annurev-environ-012320-083019

Douglas, T. A., Hiemstra, C. A., Anderson, J. E., Barbato, R. A., Bjella, K. L., Deeb, E. J., Gelvin, A. B., Nelsen, P. E., Newman, S. D., Saari, S. P., & Wagner, A. M. (2021). Recent degradation of interior Alaska permafrost mapped with ground surveys, geophysics, deep drilling, and repeat airborne lidar. *The Cryosphere*, *15*(8), 3555–3575. https://doi.org/10.5194/tc-15-3555-2021

Du Pontavice, H., Gascuel, D., Reygondeau, G., Maureaud, A., & Cheung, W. W. L. (2020). Climate change undermines the global functioning of marine food webs. *Global Change Biology*, *26*(3), 1306–1318. https://doi.org/10.1111/gcb.14944

Duffy, P. B., Field, C. B., Diffenbaugh, N. S., Doney, S. C., Dutton, Z., Goodman, S., Heinzerling, L., Hsiang, S., Lobell, D. B., Mickley, L. J., Myers, S., Natali, S. M., Parmesan, C., Tierney, S., & Williams, A. P. (2019). Strengthened scientific support for the Endangerment Finding for atmospheric greenhouse gases. *Science*, *363*(6427), eaat5982. https://doi.org/10.1126/science.aat5982

Dunn, R. J. H., Alexander, L. V., Donat, M. G., Zhang, X., Bador, M., Herold, N., Lippmann, T., Allan, R., Aguilar, E., Barry, A. A., Brunet, M., Caesar, J., Chagnaud, G., Cheng, V., Cinco, T., Durre, I., De Guzman, R., Htay, T. M., Wan Ibadullah, W. M., … Bin Hj Yussof, M. N. (2020). Development of an Updated Global Land In Situ-Based Data Set of Temperature and Precipitation Extremes: HadEX3. *Journal of Geophysical Research: Atmospheres*, *125*(16), e2019JD032263. https://doi.org/10.1029/2019JD032263

Dunn, R. J. H., Herold, N., Alexander, L. V., Donat, M. G., Allan, R., Bador, M., Brunet, M., Cheng, V., Ibadullah, W. M. W., Ibrahim, M. K. I. B., Kruger, A., Kubota, H., Lippmann, T. J. R., Marengo, J., Mbatha, S., McGree, S., Ngwenya, S., Pabon Caicedo, J. D., Ramos, A., … Zhang, X. (2024). Observed Global Changes in Sector-Relevant Climate Extremes Indices—An Extension to HadEX3. *Earth and Space Science*, *11*(4), e2023EA003279. https://doi.org/10.1029/2023EA003279

Edelson, P. J., Harold, R., Ackelsberg, J., Duchin, J. S., Lawrence, S. J., Manabe, Y. C., Zahn, M., & LaRocque, R. C. (2023). Climate Change and the Epidemiology of Infectious Diseases in the United States. *Clinical Infectious Diseases*, *76*(5), 950–956. https://doi.org/10.1093/cid/ciac697

Eriksson, M., Del Valle, A., & De La Fuente, A. (2025). Droughts worsen air quality and health by shifting power generation. *Nature Communications*, *16*(1), 4774. https://doi.org/10.1038/s41467-025-60090-z

Fant, C., Boehlert, B., Strzepek, K., Larsen, P., White, A., Gulati, S., Li, Y., & Martinich, J. (2020). Climate change impacts and costs to U.S. electricity transmission and distribution infrastructure. *Energy*, *195*, 116899. https://doi.org/10.1016/j.energy.2020.116899

Feely, R. A., Carter, B. R., Alin, S. R., Greeley, D., & Bednaršek, N. (2024). The Combined Effects of Ocean Acidification and Respiration on Habitat Suitability for Marine Calcifiers Along the West Coast of North America. *Journal of Geophysical Research: Oceans*, *129*(4), e2023JC019892. https://doi.org/10.1029/2023JC019892

Feely, R.A., L.-Q. Jiang, R. Wanninkhof, B.R. Carter, S.R. Alin, N. Bednaršek, and C.E. Cosca. (2023). Acidification of the global surface ocean: What we have learned from observations. *Oceanography*, 36(2–3), 120–129, https://doi.org/10.5670/oceanog.2023.222.

Filbee-Dexter, K., Wernberg, T., Grace, S. P., Thormar, J., Fredriksen, S., Narvaez, C. N., Feehan, C. J., & Norderhaug, K. M. (2020). Marine heatwaves and the collapse of marginal North Atlantic kelp forests. *Scientific Reports*, *10*(1), 13388. https://doi.org/10.1038/s41598-020-70273-x

Findlay, H. S., Feely, R. A., Jiang, L., Pelletier, G., & Bednaršek, N. (2025). Ocean Acidification: Another Planetary Boundary Crossed. *Global Change Biology*, *31*(6), e70238. https://doi.org/10.1111/gcb.70238

Forzieri, G., Dakos, V., McDowell, N. G., Ramdane, A., & Cescatti, A. (2022). Emerging signals of declining forest resilience under climate change. *Nature*, *608*(7923), 534–539. https://doi.org/10.1038/s41586-022-04959-9

Frame, D. J., Wehner, M. F., Noy, I., & Rosier, S. M. (2020). The economic costs of Hurricane Harvey attributable to climate change. *Climatic Change*, *160*(2), 271–281. https://doi.org/10.1007/s10584-020-02692-8

Frederikse, T., Landerer, F., Caron, L., Adhikari, S., Parkes, D., Humphrey, V. W., Dangendorf, S., Hogarth, P., Zanna, L., Cheng, L., & Wu, Y.-H. (2020). The causes of sea-level rise since 1900. *Nature*, *584*(7821), 393–397. https://doi.org/10.1038/s41586-020-2591-3

Free, C. M., Thorson, J. T., Pinsky, M. L., Oken, K. L., Wiedenmann, J., & Jensen, O. P. (2019). Impacts of historical warming on marine fisheries production. *Science*, *363*(6430), 979–983. https://doi.org/10.1126/science.aau1758

Fricke, E. C., Ordonez, A., Rogers, H. S., & Svenning, J.-C. (2022). The effects of defaunation on plants' capacity to track climate change. *Science*, *375*(6577), 210–214. https://doi.org/10.1126/science.abk3510

Froehlich, H.E., Koehn, J. Z., Holsman, K. K., & Halpern, B. S. (2022). Emerging trends in science and news of climate change threats to and adaptation of aquaculture. *Aquaculture 549(737812), 1-10.* https://doi.org/10.1016/j.aquaculture.2021.737812 .

Frölicher, T. L., Fischer, E. M., & Gruber, N. (2018). Marine heatwaves under global warming. *Nature*, *560*(7718), 360–364. https://doi.org/10.1038/s41586-018-0383-9

Garcia-Soto, C., Cheng, L., Caesar, L., Schmidtko, S., Jewett, E. B., Cheripka, A., Rigor, I., Caballero, A., Chiba, S., Báez, J. C., Zielinski, T., & Abraham, J. P. (2021). An Overview of Ocean Climate Change Indicators: Sea Surface Temperature, Ocean Heat Content, Ocean pH, Dissolved Oxygen Concentration, Arctic Sea Ice Extent, Thickness and Volume, Sea Level and Strength of the AMOC (Atlantic Meridional Overturning Circulation). *Frontiers in Marine Science*, *8*, 642372. https://doi.org/10.3389/fmars.2021.642372

Garfin, G., Falk, D. A., O'Connor, C. D., Jacobs, K., Sagarin, R. D., Haverland, A. C., Haworth, A., Baglee, A., Weiss, J., Overpeck, J., & Zuñiga-Terán, A. A. (2021). A new mission: Mainstreaming climate adaptation in the US Department of Defense. *Climate Services*, *22*, 100230. https://doi.org/10.1016/j.cliser.2021.100230

Ge, Q., Hao, M., Ding, F. et al. Modelling armed conflict risk under climate change with machine learning and time-series data. *Nature Communications* 13, 2839 (2022). https://doi.org/10.1038/s41467-022-30356-x

Gong, H., Li, C., & Zhou, Y. (2021). Emerging Global Ocean Deoxygenation Across the 21st Century. *Geophysical Research Letters*, *48*(23), e2021GL095370. https://doi.org/10.1029/2021GL095370

Gorris, M. E., Cat, L. A., Zender, C. S., Treseder, K. K., & Randerson, J. T. (2018). Coccidioidomycosis Dynamics in Relation to Climate in the Southwestern United States. *GeoHealth*, *2*(1), 6–24. https://doi.org/10.1002/2017GH000095

Gorris, M. E., Treseder, K. K., Zender, C. S., & Randerson, J. T. (2019). Expansion of Coccidioidomycosis Endemic Regions in the United States in Response to Climate Change. *GeoHealth*, *3*(10), 308–327. https://doi.org/10.1029/2019GH000209

Gourevitch, J. D., Kousky, C., Liao, Y., Nolte, C., Pollack, A. B., Porter, J. R., & Weill, J. A. (2023). Unpriced climate risk and the potential consequences of overvaluation in US housing markets. *Nature Climate Change*, *13*(3), 250–257. https://doi.org/10.1038/s41558-023-01594-8

Greer, A.G., Ng, V., Fisman, D. (2008). Climate Change and Infectious Diseases in North America: the Road Ahead. *Canadian Medial Association Journal,* 178(6), 715-722. https://doi.org/10.1503/cmaj.081325.

Grennan, G. K., Withers, M. C., Ramanathan, D. S., & Mishra, J. (2023). Differences in interference processing and frontal brain function with climate trauma from California's deadliest wildfire. *PLOS Climate*, *2*(1), e0000125. https://doi.org/10.1371/journal.pclm.0000125

Grinsted, A., Ditlevsen, P., & Christensen, J. H. (2019). Normalized US hurricane damage estimates using area of total destruction, 1900−2018. *Proceedings of the National Academy of Sciences*, *116*(48), 23942–23946. https://doi.org/10.1073/pnas.1912277116

Habibullah, M. S., Din, B. H., Tan, S.-H., & Zahid, H. (2022). Impact of climate change on biodiversity loss: Global evidence. *Environmental Science and Pollution Research*, *29*(1), 1073–1086. https://doi.org/10.1007/s11356-021-15702-8

Haer, T., Kalnay, E., Kearney, M., & Moll, H. (2013). Relative sea-level rise and the conterminous United States: Consequences of potential land inundation in terms of population at risk and GDP loss. *Global Environmental Change*, *23*(6), 1627–1636. https://doi.org/10.1016/j.gloenvcha.2013.09.005

Hagmann, R. K., Hessburg, P. F., Prichard, S. J., Povak, N. A., Brown, P. M., Fulé, P. Z., Keane, R. E., Knapp, E. E., Lydersen, J. M., Metlen, K. L., Reilly, M. J., Sánchez Meador, A. J., Stephens, S. L., Stevens, J. T., Taylor, A. H., Yocom, L. L., Battaglia, M. A., Churchill, D. J., Daniels, L. D., … Waltz, A. E. M. (2021). Evidence for widespread changes in the structure, composition, and fire regimes of western North American forests. *Ecological Applications*, *31*(8), e02431. https://doi.org/10.1002/eap.2431

Hammond, W. M., Williams, A. P., Abatzoglou, J. T., Adams, H. D., Klein, T., López, R., Sáenz-Romero, C., Hartmann, H., Breshears, D. D., & Allen, C. D. (2022). Global field observations of tree die-off reveal hotter-drought fingerprint for Earth's forests. *Nature Communications*, *13*(1), 1761. https://doi.org/10.1038/s41467-022-29289-2

Hao, M., Ding, F., Xie, X. et al. Varying climatic-social-geographical patterns shape the conflict risk at regional and global scales. *Humanit Soc Sci Commun* 9, 276 (2022). https://doi.org/10.1057/s41599-022-01294-2

Hare, J. A., Morrison, W. E., Nelson, M. W., Stachura, M. M., Teeters, E. J., Griffis, R. B., Alexander, M. A., Scott, J. D., Alade, L., Bell, R. J., Chute, A. S., Curti, K. L., Curtis, T. H., Kircheis, D., Kocik, J. F., Lucey, S. M., McCandless, C. T., Milke, L. M., Richardson, D. E., … Griswold, C. A. (2016). A Vulnerability Assessment of Fish and Invertebrates to Climate Change on the Northeast U.S. Continental Shelf. *PLOS ONE*, *11*(2), e0146756. https://doi.org/10.1371/journal.pone.0146756

Hartmann, H., Bastos, A., Das, A. J., Esquivel-Muelbert, A., Hammond, W. M., Martínez-Vilalta, J., McDowell, N. G., Powers, J. S., Pugh, T. A. M., Ruthrof, K. X., & Allen, C. D. (2022). Climate Change Risks to Global Forest Health: Emergence of Unexpected Events of Elevated Tree Mortality Worldwide. *Annual Review of Plant Biology*, *73*(1), 673–702. https://doi.org/10.1146/annurev-arplant-102820-012804

Hauer, M. E. (2017). Migration induced by sea-level rise could reshape the US population landscape. *Nature Climate Change*, *7*(5), 321–325. https://doi.org/10.1038/nclimate3271

Hauer, M. E., Evans, J. M., & Mishra, D. R. (2016). Millions projected to be at risk from sea-level rise in the continental United States. *Nature Climate Change*, *6*(7), 691–695. https://doi.org/10.1038/nclimate2961

Hay, C. C., Morrow, E., Kopp, R. E., & Mitrovica, J. X. (2015). Probabilistic reanalysis of twentieth-century sea-level rise. *Nature*, *517*(7535), 481–484. https://doi.org/10.1038/nature14093

He, L., & Rosa, L. (2023). Solutions to agricultural green water scarcity under climate change. *PNAS Nexus*, *2*(4), pgad117. https://doi.org/10.1093/pnasnexus/pgad117

Head, J. R., Sondermeyer-Cooksey, G., Heaney, A. K., Yu, A. T., Jones, I., Bhattachan, A., Campo, S. K., Wagner, R., Mgbara, W., Phillips, S., Keeney, N., Taylor, J., Eisen, E., Lettenmaier, D. P., Hubbard, A., Okin, G. S., Vugia, D. J., Jain, S., & Remais, J. V. (2022). Effects of precipitation, heat, and drought on incidence and expansion of coccidioidomycosis in western USA: A longitudinal surveillance study. *The Lancet Planetary Health*, *6*(10), e793–e803. https://doi.org/10.1016/S2542-5196(22)00202-9

Heil, A. H., Muni-Morgan, A. L. (2021). Florida's Harmful Algal Bloom (HAB) Problem: Escalating Risks to Human, Environmental and Economic Health With Climate Change. *Frontiers in Ecology and Evolution 9*(646080). https://doi.org/10.3389/fevo.2021.646080.

Heiss, J. W., Mase, B., & Shen, C. (2022). Effects of Future Increases in Tidal Flooding on Salinity and Groundwater Dynamics in Coastal Aquifers. *Water Resources Research*, *58*(12), e2022WR033195. https://doi.org/10.1029/2022WR033195

Hellmuth, M.E., F.H. Akhtar, A.H. Cameron, C.A. Corner-Dolloff, G.D. Dabelko, T. Dinku, J.L. Koh, D. Mason, R.S. Pulwarty, L.I. Sperling, and M.F. Zermoglio (2023). Ch. 17, Climate effects on US international interests. In: *Fifth National Climate Assessment*. https://nca5.climate.us/chapter/17.

Heo, S., Choi, H. M., D. Berman, J., & Bell, M. L. (2025). Temperature, violent crime, climate change, and vulnerability factors in 44 United States cities. *Environment International*, *195*, 109246. https://doi.org/10.1016/j.envint.2024.109246

Heuzé, C., & Jahn, A. (2024). The first ice-free day in the Arctic Ocean could occur before 2030. *Nature Communications*, *15*(1), 10101. https://doi.org/10.1038/s41467-024-54508-3

Hjort, J., Streletskiy, D., Doré, G., Wu, Q., Bjella, K., & Luoto, M. (2022). Impacts of permafrost degradation on infrastructure. *Nature Reviews Earth & Environment*, *3*(1), 24–38. https://doi.org/10.1038/s43017-021-00247-8

Hobday, A., Oliver, E., Sen Gupta, A., Benthuysen, J., Burrows, M., Donat, M., Holbrook, N., Moore, P., Thomsen, M., Wernberg, T., & Smale, D. (2018). Categorizing and Naming Marine Heatwaves. *Oceanography*, *31*(2). https://doi.org/10.5670/oceanog.2018.205

Hogan, J. A., Domke, G. M., Zhu, K., Johnson, D. J., & Lichstein, J. W. (2024). Climate change determines the sign of productivity trends in US forests. *Proceedings of the National Academy of Sciences*, *121*(4), e2311132121. https://doi.org/10.1073/pnas.2311132121

Holden, Z. A., Swanson, A., Luce, C. H., Jolly, W. M., Maneta, M., Oyler, J. W., Warren, D. A., Parsons, R., & Affleck, D. (2018). Decreasing fire season precipitation increased recent western US

forest wildfire activity. *Proceedings of the National Academy of Sciences*, *115*(36). https://doi.org/10.1073/pnas.1802316115

Holzmann, K. L., Walls, R. L., & Wiens, J. J. (2023). Accelerating local extinction associated with very recent climate change. *Ecology Letters*, *26*(11), 1877–1886. https://doi.org/10.1111/ele.14303

Hou, K., Zhang, L., Xu, X., Yang, F., Chen, B., Hu, W., & Shu, R. (2023). High ambient temperatures are associated with urban crime risk in Chicago. *Science of The Total Environment*, *856*, 158846. https://doi.org/10.1016/j.scitotenv.2022.158846

Howard, J. T., Androne, N., Alcover, K. C., & Santos-Lozada, A. R. (2024). Trends of Heat-Related Deaths in the US, 1999-2023. *JAMA*, *332*(14), 1203. https://doi.org/10.1001/jama.2024.16386

Hristov, A. N., Degaetano, A. T., Rotz, C. A., Hoberg, E., Skinner, R. H., Felix, T., Li, H., Patterson, P. H., Roth, G., Hall, M., Ott, T. L., Baumgard, L. H., Staniar, W., Hulet, R. M., Dell, C. J., Brito, A. F., & Hollinger, D. Y. (2018). Climate change effects on livestock in the Northeast US and strategies for adaptation. *Climatic Change*, *146*(1–2), 33–45. https://doi.org/10.1007/s10584-017-2023-z

Hsiang, S., Kopp, R., Jina, A., Rising, J., Delgado, M., Mohan, S., Rasmussen, D. J., Muir-Wood, R., Wilson, P., Oppenheimer, M., Larsen, K., & Houser, T. (2017). Estimating economic damage from climate change in the United States. *Science*, *356*(6345), 1362–1369. https://doi.org/10.1126/science.aal4369

Hsiang, S. M., Burke, M., & Miguel, E. (2013). Quantifying the Influence of Climate on Human Conflict. *Science*, *341*(6151), 1235367. https://doi.org/10.1126/science.1235367

Hu, J., Hu, X., Han, X., Lin, Y., Wu, H., & Shen, B. (2024). Exploring the correlation between temperature and crime: A case-crossover study of eight cities in America. *Journal of Safety Science and Resilience*, *5*(1), 13–36. https://doi.org/10.1016/j.jnlssr.2023.11.001

Hu, T., Zhang, X., Khanal, S., Wilson, R., Leng, G., Toman, E. M., Wang, X., Li, Y., & Zhao, K. (2024). Climate change impacts on crop yields: A review of empirical findings, statistical crop models, and machine learning methods. *Environmental Modelling & Software*, *179*, 106119. https://doi.org/10.1016/j.envsoft.2024.106119

Hummel, M. A., Berry, M. S., & Stacey, M. T. (2018). Sea Level Rise Impacts on Wastewater Treatment Systems Along the U.S. Coasts. *Earth's Future*, *6*(4), 622–633. https://doi.org/10.1002/2017EF000805

Hyde-Smith, L., Zhan, Z., Roelich, K., Mdee, A., & Evans, B. (2022). Climate Change Impacts on Urban Sanitation: A Systematic Review and Failure Mode Analysis. *Environmental Science & Technology*, *56*(9), 5306–5321. https://doi.org/10.1021/acs.est.1c07424

Ide, T. (2018). Climate War in the Middle East? Drought, the Syrian Civil War and the State of Climate-Conflict Research. *Current Climate Change Reports*, *4*(4), 347–354. https://doi.org/10.1007/s40641-018-0115-0

Iknayan, K. J., & Beissinger, S. R. (2018). Collapse of a desert bird community over the past century driven by climate change. *Proceedings of the National Academy of Sciences*, *115*(34), 8597–8602. https://doi.org/10.1073/pnas.1805123115

Isaak, D. J., Luce, C. H., Horan, D. L., Chandler, G. L., Wollrab, S. P., & Nagel, D. E. (2018). Global Warming of Salmon and Trout Rivers in the Northwestern U.S.: Road to Ruin or Path Through Purgatory? *Transactions of the American Fisheries Society*, *147*(3), 566–587. https://doi.org/10.1002/tafs.10059

Jacobson, M. Z. (2008). On the causal link between carbon dioxide and air pollution mortality. *Geophysical Research Letters*, *35*(3), 2007GL031101. https://doi.org/10.1029/2007GL031101

Jaime, L., Batllori, E., & Lloret, F. (2024). Bark beetle outbreaks in coniferous forests: A review of climate change effects. *European Journal of Forest Research*, *143*(1), 1–17. https://doi.org/10.1007/s10342-023-01623-3

Jain, P., Sharma, A. R., Acuna, D. C., Abatzoglou, J. T., & Flannigan, M. (2024). Record-breaking fire weather in North America in 2021 was initiated by the Pacific northwest heat dome. *Communications Earth & Environment*, *5*(1), 202. https://doi.org/10.1038/s43247-024-01346-2

Janni, M., Maestri, E., Gullì, M., Marmiroli, M., & Marmiroli, N. (2024a). Plant responses to climate change, how global warming may impact on food security: A critical review. *Frontiers in Plant Science*, *14*, 1297569. https://doi.org/10.3389/fpls.2023.1297569

Janni, M., Maestri, E., Gullì, M., Marmiroli, M., & Marmiroli, N. (2024b). Plant responses to climate change, how global warming may impact on food security: A critical review. *Frontiers in Plant Science*, *14*, 1297569. https://doi.org/10.3389/fpls.2023.1297569

Jarvis, A., & Forster, P. M. (2024). Estimated human-induced warming from a linear temperature and atmospheric CO2 relationship. *Nature Geoscience*, *17*(12), 1222–1224. https://doi.org/10.1038/s41561-024-01580-5

Jaureguiberry, P., Titeux, N., Wiemers, M., Bowler, D. E., Coscieme, L., Golden, A. S., Guerra, C. A., Jacob, U., Takahashi, Y., Settele, J., Díaz, S., Molnár, Z., & Purvis, A. (2022). The direct drivers of recent global anthropogenic biodiversity loss. *Science Advances*, *8*(45), eabm9982. https://doi.org/10.1126/sciadv.abm9982

Kazi, D. S., Katznelson, E., Liu, C.-L., Al-Roub, N. M., Chaudhary, R. S., Young, D. E., McNichol, M., Mickley, L. J., Kramer, D. B., Cascio, W. E., Bernstein, A. S., & Rice, M. B. (2024). Climate Change and Cardiovascular Health: A Systematic Review. *JAMA Cardiology*, *9*(8), 748. https://doi.org/10.1001/jamacardio.2024.1321

Kelley, C. P., Mohtadi, S., Cane, M. A., Seager, R., & Kushnir, Y. (2015). Climate change in the Fertile Crescent and implications of the recent Syrian drought. *Proceedings of the National Academy of Sciences*, *112*(11), 3241–3246. https://doi.org/10.1073/pnas.1421533112

Kern, J. D., Su, Y., & Hill, J. (2020). A retrospective study of the 2012–2016 California drought and its impacts on the power sector. *Environmental Research Letters*, *15*(9), 094008. https://doi.org/10.1088/1748-9326/ab9db1

Key, N., Sneeringer, S., & Marquardt, D. (2014). Climate Change, Heat Stress, and U.S. Dairy Production. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2506668

Kim, H., Franco, A. C., & Sumaila, U. R. (2023). A Selected Review of Impacts of Ocean Deoxygenation on Fish and Fisheries. *Fishes*, *8*(6), 316. https://doi.org/10.3390/fishes8060316

Kim, J., Porter, J., & Kearns, E. J. (2023). Exposure of the US population to extreme precipitation risk has increased due to climate change. *Scientific Reports*, *13*(1), 21782. https://doi.org/10.1038/s41598-023-48969-7

Kioumourtzoglou, M.-A., Power, M. C., Hart, J. E., Okereke, O. I., Coull, B. A., Laden, F., & Weisskopf, M. G. (2017). The Association Between Air Pollution and Onset of Depression Among Middle-Aged and Older Women. *American Journal of Epidemiology*, *185*(9), 801–809. https://doi.org/10.1093/aje/kww163

Kirchmeier-Young, M. C., & Zhang, X. (2020). Human influence has intensified extreme precipitation in North America. *Proceedings of the National Academy of Sciences*, *117*(24), 13308–13313. https://doi.org/10.1073/pnas.1921628117

Kirwan, M. L., & Gedan, K. B. (2019). Sea-level driven land conversion and the formation of ghost forests. *Nature Climate Change*, *9*(6), 450–457. https://doi.org/10.1038/s41558-019-0488-7

Kistner, E., Kellner, O., Andresen, J., Todey, D., & Morton, L. W. (2018). Vulnerability of specialty crops to short-term climatic variability and adaptation strategies in the Midwestern USA. *Climatic Change*, *146*(1–2), 145–158. https://doi.org/10.1007/s10584-017-2066-1

Kopp, R. E., Horton, R. M., Little, C. M., Mitrovica, J. X., Oppenheimer, M., Rasmussen, D. J., Strauss, B. H., & Tebaldi, C. (2014). Probabilistic 21st and 22nd century sea-level projections at a global network of tide-gauge sites. *Earth's Future*, *2*(8), 383–406. https://doi.org/10.1002/2014EF000239

Kossin, J. P., Knapp, K. R., Olander, T. L., & Velden, C. S. (2020). Global increase in major tropical cyclone exceedance probability over the past four decades. *Proceedings of the National Academy of Sciences*, *117*(22), 11975–11980. https://doi.org/10.1073/pnas.1920849117

Koubi, V. (2019). Climate Change and Conflict. *Annual Review of Political Science 22*, 343-360. https://doi.org/10.1146/annurev-polisci-050317-070830.

Kruft Welton, R. A., Hoppit, G., Schmidt, D. N., Witts, J. D., & Moon, B. C. (2024). Reviews and syntheses: The clam before the storm – a meta-analysis showing the effect of combined climate change stressors on bivalves. *Biogeosciences*, *21*(1), 223–239. https://doi.org/10.5194/bg-21-223-2024

Kukal, M. S., & Irmak, S. (2018). Climate-Driven Crop Yield and Yield Variability and Climate Change Impacts on the U.S. Great Plains Agricultural Production. *Scientific Reports*, *8*(1), 3450. https://doi.org/10.1038/s41598-018-21848-2

Kumar, L., Chhogyel, N., Gopalakrishnan, T., Hasan, M. K., Jayasinghe, S. L., Kariyawasam, C. S., Kogo, B. K., & Ratnayake, S. (2022). Climate change and future of agri-food production. In *Future Foods* (pp. 49–79). Elsevier. https://doi.org/10.1016/B978-0-323-91001-9.00009-8

Lamica, A., Parajuli, R., & Mihiar, C. (2025). Forest-Based Employment in the Southern United States Under Climate Change: Historical Impacts and Future Projections. *Forest Science*, *71*(3), 303–320. https://doi.org/10.1007/s44391-025-00015-x

Lamperti, F., Bosetti, V., Roventini, A., & Tavoni, M. (2019). The public costs of climate-induced financial instability. *Nature Climate Change*, *9*(11), 829–833. https://doi.org/10.1038/s41558-019-0607-5

Laufkötter, C., Zscheischler, J., & Frölicher, T. L. (2020). High-impact marine heatwaves attributable to human-induced global warming. *Science*, *369*(6511), 1621–1625. https://doi.org/10.1126/science.aba0690

Le Bris, A., Mills, K. E., Wahle, R. A., Chen, Y., Alexander, M. A., Allyn, A. J., Schuetz, J. G., Scott, J. D., & Pershing, A. J. (2018). Climate vulnerability and resilience in the most valuable North American fishery. *Proceedings of the National Academy of Sciences*, *115*(8), 1831–1836. https://doi.org/10.1073/pnas.1711122115

Leach, N. J., Roberts, C. D., Aengenheyster, M., Heathcote, D., Mitchell, D. M., Thompson, V., Palmer, T., Weisheimer, A., & Allen, M. R. (2024). Heatwave attribution based on reliable operational weather forecasts. *Nature Communications*, *15*(1), 4530. https://doi.org/10.1038/s41467-024-48280-7

Lelieveld, J., Klingmüller, K., Pozzer, A., Burnett, R. T., Haines, A., & Ramanathan, V. (2019). Effects of fossil fuel and total anthropogenic emission removal on public health and climate. *Proceedings of the National Academy of Sciences*, *116*(15), 7192–7197. https://doi.org/10.1073/pnas.1819989116

Lewandowski, S. A., Kioumourtzoglou, M.-A., & Shaman, J. L. (2022). Heat stress illness outcomes and annual indices of outdoor heat at U.S. Army installations. *PLOS ONE*, *17*(11), e0263803. https://doi.org/10.1371/journal.pone.0263803

Li, J., Li, X., Liu, H., Gao, L., Wang, W., Wang, Z., Zhou, T., & Wang, Q. (2023). Climate change impacts on wastewater infrastructure: A systematic review and typological adaptation strategy. *Water Research*, *242*, 120282. https://doi.org/10.1016/j.watres.2023.120282

Li, S., Wahl, T., Talke, S. A., Jay, D. A., Orton, P. M., Liang, X., Wang, G., & Liu, L. (2021). Evolving Tides Aggravate Nuisance Flooding Along the U.S. Coastline. *Science Advances, 7*(10), eabe2414. https://doi.org/10.1126/sciadv.abe2412.

Liang, X.-Z., Wu, Y., Chambers, R. G., Schmoldt, D. L., Gao, W., Liu, C., Liu, Y.-A., Sun, C., & Kennedy, J. A. (2017). Determining climate effects on US total agricultural productivity. *Proceedings of the National Academy of Sciences*, *114*(12). https://doi.org/10.1073/pnas.1615922114

Linke, A., Leutert, S., Busby, J., Duque, M., Shawcroft, M., & Brewer, S. (2023). Dry growing seasons predicted Central American migration to the US from 2012 to 2018. *Scientific Reports*, *13*(1), 18400. https://doi.org/10.1038/s41598-023-43668-9

Liu, J. C., Pereira, G., Uhl, S. A., Bravo, M. A., & Bell, M. L. (2015). A systematic review of the physical health impacts from non-occupational exposure to wildfire smoke. *Environmental Research 136*, 120-132. https://doi.org/10.1016/j.envres.2014.10.015.

Liu, M., Trugman, A. T., Peñuelas, J., & Anderegg, W. R. L. (2024). Climate-driven disturbances amplify forest drought sensitivity. *Nature Climate Change*, *14*(7), 746–752. https://doi.org/10.1038/s41558-024-02022-1

Logan, T. M., Anderson, M. J., & Reilly, A. C. (2023). Risk of isolation increases the expected burden from sea-level rise. *Nature Climate Change*, *13*(4), 397–402. https://doi.org/10.1038/s41558-023-01642-3

Lyons, V. H., Gause, E. L., Spangler, K. R., Wellenius, G. A., & Jay, J. (2022). Analysis of Daily Ambient Temperature and Firearm Violence in 100 US Cities. *JAMA Network Open*, *5*(12), e2247207. https://doi.org/10.1001/jamanetworkopen.2022.47207

Ma, Y., Zang, E., Liu, Y., Wei, J., Lu, Y., Krumholz, H. M., Bell, M. L., & Chen, K. (2024). Long-term exposure to wildland fire smoke $PM_{2.5}$ and mortality in the contiguous United States. *Proceedings of the National Academy of Sciences*, *121*(40), e2403960121. https://doi.org/10.1073/pnas.2403960121

Ma, D., Gregor, L., Gruber, N. (2023). Four Decades of Trends and Drivers of Global Surface Ocean Acidification. *Global Biogeochemical Cycles*, 37, e2023GB007765. https://doi.org/10.1029/2023GB007765.

MacFadden, D. R., McGough, S. F., Fisman, D., Santillana, M., & Brownstein, J. S. (2018). Antibiotic resistance increases with local temperature. *Nature Climate Change*, *8*(6), 510–514. https://doi.org/10.1038/s41558-018-0161-6

Mach, K. J., Kraan, C. M., Adger, W. N., Buhaug, H., Burke, M., Fearon, J. D., Field, C. B., Hendrix, C. S., Maystadt, J.-F., O'Loughlin, J., Roessler, P., Scheffran, J., Schultz, K. A., & Von Uexkull, N. (2019). Climate as a risk factor for armed conflict. *Nature*, *571*(7764), 193–197. https://doi.org/10.1038/s41586-019-1300-6

Maertens, R. (2020). Adverse Rainfall Shocks and Civil War: Myth or Reality? *Journal of Conflict Resolution*, 65(4), 701-728. https://doi.org/10.1177/0022002720969796

Mahon, M. B., Sack, A., Aleuy, O. A., Barbera, C., Brown, E., Buelow, H., Civitello, D. J., Cohen, J. M., De Wit, L. A., Forstchen, M., Halliday, F. W., Heffernan, P., Knutie, S. A., Korotasz, A., Larson, J. G., Rumschlag, S. L., Selland, E., Shepack, A., Vincent, N., & Rohr, J. R. (2024). A meta-analysis

on global change drivers and the risk of infectious disease. *Nature*, *629*(8013), 830–836. https://doi.org/10.1038/s41586-024-07380-6

Manos, E., Witharana, C., & Liljedahl, A. K. (2025). Permafrost thaw-related infrastructure damage costs in Alaska are projected to double under medium and high emission scenarios. *Communications Earth & Environment*, *6*(1), 221. https://doi.org/10.1038/s43247-025-02191-7

Margolis, E., Wion, A., Abatzoglou, J., Daniels, L., Falk, D., Guiterman, C., Johnston, J., Kipfmueller, K., Lafon, C., Loehman, R., Lonergan, M., Naficy, C., Parisien, M., Parks, S., Portier, J., Stambaugh, M., Whitman, E., Williams, A. P., & Yocom, L. (2025). Spatiotemporal Synchrony of Climate and Fire Occurrence Across North American Forests (1750–1880). *Global Ecology and Biogeography*, *34*(1), e13937. https://doi.org/10.1111/geb.13937

Marsooli, R., Lin, N., Emanuel, K., & Feng, K. (2019). Climate change exacerbates hurricane flood hazards along US Atlantic and Gulf Coasts in spatially varying patterns. *Nature Communications*, *10*(1), 3785. https://doi.org/10.1038/s41467-019-11755-z

Martin, J. T., Pederson, G. T., Woodhouse, C. A., Cook, E. R., McCabe, G. J., Anchukaitis, K. J., Wise, E. K., Erger, P. J., Dolan, L., McGuire, M., Gangopadhyay, S., Chase, K. J., Littell, J. S., Gray, S. T., St. George, S., Friedman, J. M., Sauchyn, D. J., St-Jacques, J.-M., & King, J. (2020). Increased drought severity tracks warming in the United States' largest river basin. *Proceedings of the National Academy of Sciences*, *117*(21), 11328–11336. https://doi.org/10.1073/pnas.1916208117

Mazdiyasni, O., & AghaKouchak, A. (2015). Substantial increase in concurrent droughts and heatwaves in the United States. *Proceedings of the National Academy of Sciences*, *112*(37), 11484–11489. https://doi.org/10.1073/pnas.1422945112

Miles-Novelo, A., & Anderson, C. A. (2019). Climate Change and Psychology: Effects of Rapid Global Warming on Violence and Aggression. *Current Climate Change Reports*, *5*(1), 36–46. https://doi.org/10.1007/s40641-019-00121-2

Milly, P. C. D., & Dunne, K. A. (2020). Colorado River flow dwindles as warming-driven loss of reflective snow energizes evaporation. *Science*, *367*(6483), 1252–1255. https://doi.org/10.1126/science.aay9187

Mishra S., Spaccarotella K., Gido J., Samanta I., & Chowdhary G. Effects of Heat Stress on Plant-Nutrient Relations: An Update on Nutrient Uptake, Transport, and Assimilation. (2023). *Int J Mol Sci.*, *24*(21):15670. https://doi.org/10.3390/ijms242115670.

Mora, C., McKenzie, T., Gaw, I. M., Dean, J. M., Von Hammerstein, H., Knudson, T. A., Setter, R. O., Smith, C. Z., Webster, K. M., Patz, J. A., & Franklin, E. C. (2022). Over half of known human pathogenic diseases can be aggravated by climate change. *Nature Climate Change*, *12*(9), 869–875. https://doi.org/10.1038/s41558-022-01426-1

Moran, D. S., DeGroot, D. W., Potter, A. W., & Charkoudian, N. (2023). Beating the heat: Military training and operations in the era of global warming. *Journal of Applied Physiology*, *135*(1), 60–67. https://doi.org/10.1152/japplphysiol.00229.2023

Morim, J., Wahl, T., Rasmussen, D. J., Calafat, F. M., Vitousek, S., Dangendorf, S., Kopp, R. E., & Oppenheimer, M. (2025). Observations reveal changing coastal storm extremes around the United States. *Nature Climate Change*, *15*(5), 538–545. https://doi.org/10.1038/s41558-025-02315-z

Mote, P. W., Li, S., Lettenmaier, D. P., Xiao, M., & Engel, R. (2018). Dramatic declines in snowpack in the western US. *Npj Climate and Atmospheric Science*, *1*(1), 2. https://doi.org/10.1038/s41612-018-0012-1

Mullins, J. T., & White, C. (2019). Temperature and mental health: Evidence from the spectrum of mental health outcomes. *Journal of Health Economics*, *68*, 102240. https://doi.org/10.1016/j.jhealeco.2019.102240

Murali, G., Iwamura, T., Meiri, S., & Roll, U. (2023). Future temperature extremes threaten land vertebrates. *Nature*, *615*(7952), 461–467. https://doi.org/10.1038/s41586-022-05606-z

Murray, K. O., Resnick, M., & Miller, V. (2007). Depression after Infection with West Nile Virus. *Emerging Infectious Diseases*, *13*(3), 479–481. https://doi.org/10.3201/eid1303.060602

Musselman, K. N., Addor, N., Vano, J. A., & Molotch, N. P. (2021). Winter melt trends portend widespread declines in snow water resources. *Nature Climate Change*, *11*(5), 418–424. https://doi.org/10.1038/s41558-021-01014-9

National Academies of Sciences, Engineering and Medicine (NASEM). (2025). Effects of Human-Caused Greenhouse Gas Emissions on U.S. Climate, Health, and Welfare. Washington, DC: National Academies Press. https://doi.org/10.17226/29239.

National Defense Authorization Act for Fiscal Year 2018, Pub. L. No. 115-91, 131 Stat. 1283 (2017).

National Intelligence Council. (2021a). Climate Change and International Responses Increasing Challenges to US National Security Through 2040 (No. NIC-NIE-2021-10030-A; National Intelligence Estimate). National Intelligence Council. https://www.dni.gov/files/ODNI/documents/assessments/NIE_Climate_Change_and_National_Security.pdf

National Intelligence Council. (2021b). Global Trends 2040: A More Contested World. National Intelligence Council. https://www.dni.gov/files/images/globalTrends/GT2040/GlobalTrends_2040_for_web1.pdf

National Snow and Ice Data Center. (2025, March 27). *Arctic Sea Ice Sets a Record Low Maximum in 2025*. https://nsidc.org/sea-ice-today/analyses/arctic-sea-ice-sets-record-low-maximum-2025

Neumann, J. E., Anenberg, S. C., Weinberger, K. R., Amend, M., Gulati, S., Crimmins, A., Roman, H., Fann, N., & Kinney, P. L. (2019). Estimates of Present and Future Asthma Emergency

Department Visits Associated With Exposure to Oak, Birch, and Grass Pollen in the United States. *GeoHealth*, *3*(1), 11–27. https://doi.org/10.1029/2018GH000153

Neumann, J. E., Chinowsky, P., Helman, J., Black, M., Fant, C., Strzepek, K., & Martinich, J. (2021). Climate effects on US infrastructure: The economics of adaptation for rail, roads, and coastal development. *Climatic Change*, *167*(3–4), 44. https://doi.org/10.1007/s10584-021-03179-w

Newbold, T. (2018). Future effects of climate and land-use change on terrestrial vertebrate community diversity under different scenarios. *Proceedings of the Royal Society B: Biological Sciences*, *285*(1881), 20180792. https://doi.org/10.1098/rspb.2018.0792

Newman, R., & Noy, I. (2023). The global costs of extreme weather that are attributable to climate change. *Nature Communications*, *14*(1), 6103. https://doi.org/10.1038/s41467-023-41888-1

NOAA Office for Coastal Management. (last modified October 28, 2026). *Economics and Demographics*https://coast.noaa.gov/states/fast-facts/economics-and-demographics.html.

Nolan, M. S., Hause, A. M., & Murray, K. O. (2012). Findings of Long-Term Depression up to 8 Years Post Infection From West Nile Virus. *Journal of Clinical Psychology*, *68*(7), 801–808. https://doi.org/10.1002/jclp.21871

Nori-Sarma, A., Sun, S., Sun, Y., Spangler, K. R., Oblath, R., Galea, S., Gradus, J. L., & Wellenius, G. A. (2022). Association Between Ambient Heat and Risk of Emergency Department Visits for Mental Health Among US Adults, 2010 to 2019. *JAMA Psychiatry*, *79*(4), 341. https://doi.org/10.1001/jamapsychiatry.2021.4369

Obradovich, N., Migliorini, R., Paulus, M. P., & Rahwan, I. (2018). Empirical evidence of mental health risks posed by climate change. *Proceedings of the National Academy of Sciences*, *115*(43), 10953–10958. https://doi.org/10.1073/pnas.1801528115

O'Donnell, K. L., Bernhardt, E. S., Yang, X., Emanuel, R. E., Ardón, M., Lerdau, M. T., Manda, A. K., Braswell, A. E., BenDor, T. K., Edwards, E. C., Frankenberg, E., Helton, A. M., Kominoski, J. S., Lesen, A. E., Naylor, L., Noe, G., Tully, K. L., White, E., & Wright, J. P. (2024). Saltwater intrusion and sea level rise threatens U.S. rural coastal landscapes and communities. *Anthropocene*, *45*, 100427. https://doi.org/10.1016/j.ancene.2024.100427

Ohenhen, L. O., Shirzaei, M., Ojha, C., & Kirwan, M. L. (2023). Hidden vulnerability of US Atlantic coast to sea-level rise due to vertical land motion. *Nature Communications*, *14*(1), 2038. https://doi.org/10.1038/s41467-023-37853-7

Ohenhen, L. O., Shirzaei, M., Ojha, C., Sherpa, S. F., & Nicholls, R. J. (2024). Disappearing cities on US coasts. *Nature*, *627*(8002), 108–115. https://doi.org/10.1038/s41586-024-07038-3

Oke, K. B., Cunningham, C. J., Westley, P. A. H., Baskett, M. L., Carlson, S. M., Clark, J., Hendry, A. P., Karatayev, V. A., Kendall, N. W., Kibele, J., Kindsvater, H. K., Kobayashi, K. M., Lewis, B., Munch, S., Reynolds, J. D., Vick, G. K., & Palkovacs, E. P. (2020). Recent declines in salmon body

size impact ecosystems and fisheries. *Nature Communications*, *11*(1), 4155. https://doi.org/10.1038/s41467-020-17726-z

Oliver, E. C. J. (2019). Mean warming not variability drives marine heatwave trends. *Climate Dynamics*, *53*(3–4), 1653–1659. https://doi.org/10.1007/s00382-019-04707-2

Overpeck, J. T., & Udall, B. (2020). Climate change and the aridification of North America. *Proceedings of the National Academy of Sciences*, *117*(22), 11856–11858. https://doi.org/10.1073/pnas.2006323117

Palagi, E., Coronese, M., Lamperti, F., & Roventini, A. (2022). Climate change and the nonlinear impact of precipitation anomalies on income inequality. *Proceedings of the National Academy of Sciences*, *119*(43), e2203595119. https://doi.org/10.1073/pnas.2203595119

Park, C. Y., Takahashi, K., Fujimori, S., Jansakoo, T., Burton, C., Huang, H., Kou-Giesbrecht, S., Reyer, C. P. O., Mengel, M., Burke, E., Li, F., Hantson, S., Takakura, J., Lee, D. K., & Hasegawa, T. (2024). Attributing human mortality from fire PM2.5 to climate change. *Nature Climate Change*, *14*(11), 1193–1200. https://doi.org/10.1038/s41558-024-02149-1

Parkinson, R. W. (2021). Speculation on the role of sea-level rise in the tragic collapse of the Surfside condominium (Miami Beach, Florida U.S.A.) was a bellwether moment for coastal zone management practitioners. *Ocean & Coastal Management*, *215*, 105968. https://doi.org/10.1016/j.ocecoaman.2021.105968

Parks, S. A., & Abatzoglou, J. T. (2020). Warmer and Drier Fire Seasons Contribute to Increases in Area Burned at High Severity in Western US Forests From 1985 to 2017. *Geophysical Research Letters*, *47*(22), e2020GL089858. https://doi.org/10.1029/2020GL089858

Patton, E. M., & Doyle, M. W. (2024). Observed Warming Trends at U.S. Army Basic Combat Training Installations and Implications for Future Recruit Training. *Military Medicine*, *189*(5–6), e1145–e1153. https://doi.org/10.1093/milmed/usad425

Pennino, M. J., Leibowitz, S. G., Compton, J. E., Beyene, M. T., & LeDuc, S. D. (2022). Wildfires can increase regulated nitrate, arsenic, and disinfection byproduct violations and concentrations in public drinking water supplies. *Science of The Total Environment*, *804*, 149890. https://doi.org/10.1016/j.scitotenv.2021.149890

Pereira, H. M., Martins, I. S., Rosa, I. M. D., Kim, H., Leadley, P., Popp, A., Van Vuuren, D. P., Hurtt, G., Quoss, L., Arneth, A., Baisero, D., Bakkenes, M., Chaplin-Kramer, R., Chini, L., Di Marco, M., Ferrier, S., Fujimori, S., Guerra, C. A., Harfoot, M., … Alkemade, R. (2024). Global trends and scenarios for terrestrial biodiversity and ecosystem services from 1900 to 2050. *Science*, *384*(6694), 458–465. https://doi.org/10.1126/science.adn3441

Piatt, J. F., Parrish, J. K., Renner, H. M., Schoen, S. K., Jones, T. T., Arimitsu, M. L., Kuletz, K. J., Bodenstein, B., García-Reyes, M., Duerr, R. S., Corcoran, R. M., Kaler, R. S. A., McChesney, G. J., Golightly, R. T., Coletti, H. A., Suryan, R. M., Burgess, H. K., Lindsey, J., Lindquist, K., …

Sydeman, W. J. (2020). Extreme mortality and reproductive failure of common murres resulting from the northeast Pacific marine heatwave of 2014-2016. *PLOS ONE*, *15*(1), e0226087. https://doi.org/10.1371/journal.pone.0226087

Pigot, A. L., Merow, C., Wilson, A., & Trisos, C. H. (2023). Abrupt expansion of climate change risks for species globally. *Nature Ecology & Evolution*, *7*(7), 1060–1071. https://doi.org/10.1038/s41559-023-02070-4

Pokhrel, Y., Felfelani, F., Satoh, Y., Boulange, J., Burek, P., Gädeke, A., Gerten, D., Gosling, S. N., Grillakis, M., Gudmundsson, L., Hanasaki, N., Kim, H., Koutroulis, A., Liu, J., Papadimitriou, L., Schewe, J., Müller Schmied, H., Stacke, T., Telteu, C.-E., … Wada, Y. (2021). Global terrestrial water storage and drought severity under climate change. *Nature Climate Change*, *11*(3), 226–233. https://doi.org/10.1038/s41558-020-00972-w

Pun, V. C., Manjourides, J., & Suh, H. (2017). Association of Ambient Air Pollution with Depressive and Anxiety Symptoms in Older Adults: Results from the NSHAP Study. *Environmental Health Perspectives*, *125*(3), 342–348. https://doi.org/10.1289/EHP494

Qi, D., Ouyang, Z., Chen, L., Wu, Y., Lei, R., Chen, B., Feely, R. A., Anderson, L. G., Zhong, W., Lin, H., Polukhin, A., Zhang, Y., Zhang, Y., Bi, H., Lin, X., Luo, Y., Zhuang, Y., He, J., Chen, J., & Cai, W.-J. (2022). Climate change drives rapid decadal acidification in the Arctic Ocean from 1994 to 2020. *Science*, *377*(6614), 1544–1550. https://doi.org/10.1126/science.abo0383

Qin, Y., Abatzoglou, J. T., Siebert, S., Huning, L. S., AghaKouchak, A., Mankin, J. S., Hong, C., Tong, D., Davis, S. J., & Mueller, N. D. (2020). Agricultural risks from changing snowmelt. *Nature Climate Change*, *10*(5), 459–465. https://doi.org/10.1038/s41558-020-0746-8

Qiu, M., Ratledge, N., Azevedo, I. M. L., Diffenbaugh, N. S., & Burke, M. (2023). Drought impacts on the electricity system, emissions, and air quality in the western United States. *Proceedings of the National Academy of Sciences*, *120*(28), e2300395120. https://doi.org/10.1073/pnas.2300395120

Radchuk, V., Reed, T., Teplitsky, C., Van De Pol, M., Charmantier, A., Hassall, C., Adamík, P., Adriaensen, F., Ahola, M. P., Arcese, P., Miguel Avilés, J., Balbontin, J., Berg, K. S., Borras, A., Burthe, S., Clobert, J., Dehnhard, N., De Lope, F., Dhondt, A. A., … Kramer-Schadt, S. (2019). Adaptive responses of animals to climate change are most likely insufficient. *Nature Communications*, *10*(1), 3109. https://doi.org/10.1038/s41467-019-10924-4

Rauer, D., Gilles, S., Wimmer, M., Frank, U., Mueller, C., Musiol, S., Vafadari, B., Aglas, L., Ferreira, F., Schmitt-Kopplin, P., Durner, J., Winkler, J. B., Ernst, D., Behrendt, H., Schmidt-Weber, C. B., Traidl-Hoffmann, C., & Alessandrini, F. (2021). Ragweed plants grown under elevated CO_2 levels produce pollen which elicit stronger allergic lung inflammation. *Allergy*, *76*(6), 1718–1730. https://doi.org/10.1111/all.14618

Ray, D. K., West, P. C., Clark, M., Gerber, J. S., Prishchepov, A. V., & Chatterjee, S. (2019). Climate change has likely already affected global food production. *PLOS ONE*, *14*(5), e0217148. https://doi.org/10.1371/journal.pone.0217148

Reed, K. A., Wehner, M. F., & Zarzycki, C. M. (2022). Attribution of 2020 hurricane season extreme rainfall to human-induced climate change. *Nature Communications*, *13*(1), 1905. https://doi.org/10.1038/s41467-022-29379-1

Reid, C. E., Brauer, M., Johnston, F. H., Jerrett, M., Balmes, J. R., & Elliott, C. T. (2016). Critical Review of Health Impacts of Wildfire Smoke Exposure. *Environmental Health Perspectives*, *124*(9), 1334–1343. https://doi.org/10.1289/ehp.1409277

Riddell, E. A., Iknayan, K. J., Hargrove, L., Tremor, S., Patton, J. L., Ramirez, R., Wolf, B. O., & Beissinger, S. R. (2021). Exposure to climate change drives stability or collapse of desert mammal and bird communities. *Science*, *371*(6529), 633–636. https://doi.org/10.1126/science.abd4605

Riddell, E. A., Iknayan, K. J., Wolf, B. O., Sinervo, B., & Beissinger, S. R. (2019). Cooling requirements fueled the collapse of a desert bird community from climate change. *Proceedings of the National Academy of Sciences*, *116*(43), 21609–21615. https://doi.org/10.1073/pnas.1908791116

Ridley, M., Rao, G., Schilbach, F., & Patel, V. (2020). Poverty, depression, and anxiety: Causal evidence and mechanisms. *Science*, *370*(6522), eaay0214. https://doi.org/10.1126/science.aay0214

Risser, M. D., & Wehner, M. F. (2017). Attributable Human-Induced Changes in the Likelihood and Magnitude of the Observed Extreme Precipitation during Hurricane Harvey. *Geophysical Research Letters*, *44*(24). https://doi.org/10.1002/2017GL075888

Robbins, Z. J., Xu, C., Aukema, B. H., Buotte, P. C., Chitra-Tarak, R., Fettig, C. J., Goulden, M. L., Goodsman, D. W., Hall, A. D., Koven, C. D., Kueppers, L. M., Madakumbura, G. D., Mortenson, L. A., Powell, J. A., & Scheller, R. M. (2022). Warming increased bark beetle-induced tree mortality by 30% during an extreme drought in California. *Global Change Biology*, *28*(2), 509–523. https://doi.org/10.1111/gcb.15927

Robertson, M. D., Gao, J., Regular, P. M., Morgan, M. J., & Zhang, F. (2021). Lagged recovery of fish spatial distributions following a cold-water perturbation. *Scientific Reports*, *11*(1), 9513. https://doi.org/10.1038/s41598-021-89066-x

Robinne, F., Hallema, D. W., Bladon, K. D., Flannigan, M. D., Boisramé, G., Bréthaut, C. M., Doerr, S. H., Di Baldassarre, G., Gallagher, L. A., Hohner, A. K., Khan, S. J., Kinoshita, A. M., Mordecai, R., Nunes, J. P., Nyman, P., Santín, C., Sheridan, G., Stoof, C. R., Thompson, M. P., … Wei, Y. (2021). Scientists' warning on extreme wildfire risks to water supply. *Hydrological Processes*, *35*(5), e14086. https://doi.org/10.1002/hyp.14086

Robinson, M. S., Fredericks, M. T., & Mease, L. E. (2025). Health Impacts of Acute Wildfire Smoke Exposure on the Active-Duty Military Population at Joint Base Lewis-McChord, Washington, USA. *Journal of Occupational & Environmental Medicine*. https://doi.org/10.1097/JOM.0000000000003514

Rocha, J. C. (2022). Ecosystems are showing symptoms of resilience loss. *Environmental Research Letters*, *17*(6), 065013. https://doi.org/10.1088/1748-9326/ac73a8

Rocklöv, J., & Dubrow, R. (2020). Climate change: An enduring challenge for vector-borne disease prevention and control. *Nature Immunology*, *21*(5), 479–483. https://doi.org/10.1038/s41590-020-0648-y

Rogers, C. D. W., Kornhuber, K., Perkins-Kirkpatrick, S. E., Loikith, P. C., & Singh, D. (2022). Sixfold Increase in Historical Northern Hemisphere Concurrent Large Heatwaves Driven by Warming and Changing Atmospheric Circulations. *Journal of Climate*, *35*(3), 1063–1078. https://doi.org/10.1175/JCLI-D-21-0200.1

Román-Palacios, C., & Wiens, J. J. (2020). Recent responses to climate change reveal the drivers of species extinction and survival. *Proceedings of the National Academy of Sciences*, *117*(8), 4211–4217. https://doi.org/10.1073/pnas.1913007117

Rosa, L., & Sangiorgio, M. (2025). Global water gaps under future warming levels. *Nature Communications*, *16*(1), 1192. https://doi.org/10.1038/s41467-025-56517-2

Rotta Loria, A. F. (2023). The silent impact of underground climate change on civil infrastructure. *Communications Engineering*, *2*(1), 44. https://doi.org/10.1038/s44172-023-00092-1

Sander, G., & Mikkelsen, E. (2025). Arctic shipping 2013–2022: The traffic has grown, with big variation between regions, seasons and ship types. *Polar Research*, *44*. https://doi.org/10.33265/polar.v44.10978

Sapkota, A., Dong, Y., Li, L., Asrar, G., Zhou, Y., Li, X., Coates, F., Spanier, A. J., Matz, J., Bielory, L., Breitenother, A. G., Mitchell, C., & Jiang, C. (2020). Association Between Changes in Timing of Spring Onset and Asthma Hospitalization in Maryland. *JAMA Network Open*, *3*(7), e207551. https://doi.org/10.1001/jamanetworkopen.2020.7551

Sapkota, A., Murtugudde, R., Curriero, F. C., Upperman, C. R., Ziska, L., & Jiang, C. (2019). Associations between alteration in plant phenology and hay fever prevalence among US adults: Implication for changing climate. *PLOS ONE*, *14*(3), e0212010. https://doi.org/10.1371/journal.pone.0212010

Schewe, J., Gosling, S. N., Reyer, C., Zhao, F., Ciais, P., Elliott, J., Francois, L., Huber, V., Lotze, H. K., Seneviratne, S. I., Van Vliet, M. T. H., Vautard, R., Wada, Y., Breuer, L., Büchner, M., Carozza, D. A., Chang, J., Coll, M., Deryng, D., … Warszawski, L. (2019). State-of-the-art global models underestimate impacts from climate extremes. *Nature Communications*, *10*(1), 1005. https://doi.org/10.1038/s41467-019-08745-6

Schleussner, C.-F., Donges, J. F., Donner, R. V., & Schellnhuber, H. J. (2016). Armed-conflict risks enhanced by climate-related disasters in ethnically fractionalized countries. *Proceedings of the National Academy of Sciences*, *113*(33), 9216–9221. https://doi.org/10.1073/pnas.1601611113

Schwarzwald, K., & Lenssen, N. (2022). The importance of internal climate variability in climate impact projections. *Proceedings of the National Academy of Sciences*, *119*(42), e2208095119. https://doi.org/10.1073/pnas.2208095119

Sellers, S., Ebi, K. L., & Hess, J. (2019). Climate Change, Human Health, and Social Stability: Addressing Interlinkages. *Environmental Health Perspectives*, *127*(4), 045002. https://doi.org/10.1289/EHP4534

Sguotti, C., Otto, S. A., Frelat, R., Langbehn, T. J., Ryberg, M. P., Lindegren, M., Durant, J. M., Chr. Stenseth, N., & Möllmann, C. (2019). Catastrophic dynamics limit Atlantic cod recovery. *Proceedings of the Royal Society B: Biological Sciences*, *286*(1898), 20182877. https://doi.org/10.1098/rspb.2018.2877

Sherwood, S. C., Webb, M. J., Annan, J. D., Armour, K. C., Forster, P. M., Hargreaves, J. C., Hegerl, G., Klein, S. A., Marvel, K. D., Rohling, E. J., Watanabe, M., Andrews, T., Braconnot, P., Bretherton, C. S., Foster, G. L., Hausfather, Z., Von Der Heydt, A. S., Knutti, R., Mauritsen, T., … Zelinka, M. D. (2020). An Assessment of Earth's Climate Sensitivity Using Multiple Lines of Evidence. *Reviews of Geophysics*, *58*(4), e2019RG000678. https://doi.org/10.1029/2019RG000678

Shukla, N., Gupta, S., & Rai, S. (2023). Potential Impacts of Climatic Changes and Human Activity on Water Quality. In P. Shukla, P. Singh, & R. M. Singh (Eds.), *Environmental Processes and Management* (Vol. 120, pp. 103–111). Springer International Publishing. https://doi.org/10.1007/978-3-031-20208-7_7

Siirila-Woodburn, E. R., Rhoades, A. M., Hatchett, B. J., Huning, L. S., Szinai, J., Tague, C., Nico, P. S., Feldman, D. R., Jones, A. D., Collins, W. D., & Kaatz, L. (2021). A low-to-no snow future and its impacts on water resources in the western United States. *Nature Reviews Earth & Environment*, *2*(11), 800–819. https://doi.org/10.1038/s43017-021-00219-y

Silva, R. A., West, J. J., Lamarque, J.-F., Shindell, D. T., Collins, W. J., Faluvegi, G., Folberth, G. A., Horowitz, L. W., Nagashima, T., Naik, V., Rumbold, S. T., Sudo, K., Takemura, T., Bergmann, D., Cameron-Smith, P., Doherty, R. M., Josse, B., MacKenzie, I. A., Stevenson, D. S., & Zeng, G. (2017). Future global mortality from changes in air pollution attributable to climate change. *Nature Climate Change*, *7*(9), 647–651. https://doi.org/10.1038/nclimate3354

Smale, D. A., Wernberg, T., Oliver, E. C. J., Thomsen, M., Harvey, B. P., Straub, S. C., Burrows, M. T., Alexander, L. V., Benthuysen, J. A., Donat, M. G., Feng, M., Hobday, A. J., Holbrook, N. J., Perkins-Kirkpatrick, S. E., Scannell, H. A., Sen Gupta, A., Payne, B. L., & Moore, P. J. (2019). Marine heatwaves threaten global biodiversity and the provision of ecosystem services. *Nature Climate Change*, *9*(4), 306–312. https://doi.org/10.1038/s41558-019-0412-1

Soroye, P., Newbold, T., & Kerr, J. (2020). Climate change contributes to widespread declines among bumble bees across continents. *Science*, *367*(6478), 685–688. https://doi.org/10.1126/science.aax8591

Stanke, H., Finley, A. O., Domke, G. M., Weed, A. S., & MacFarlane, D. W. (2021). Over half of western United States' most abundant tree species in decline. *Nature Communications*, *12*(1), 451. https://doi.org/10.1038/s41467-020-20678-z

Steel, Z. L., Jones, G. M., Collins, B. M., Green, R., Koltunov, A., Purcell, K. L., Sawyer, S. C., Slaton, M. R., Stephens, S. L., Stine, P., & Thompson, C. (2023). Mega-disturbances cause rapid

decline of mature conifer forest habitat in California. *Ecological Applications*, *33*(2), e2763. https://doi.org/10.1002/eap.2763

Storlazzi, C. D., Gingerich, S. B., Van Dongeren, A., Cheriton, O. M., Swarzenski, P. W., Quataert, E., Voss, C. I., Field, D. W., Annamalai, H., Piniak, G. A., & McCall, R. (2018). Most atolls will be uninhabitable by the mid-21st century because of sea-level rise exacerbating wave-driven flooding. *Science Advances*, *4*(4), eaap9741. https://doi.org/10.1126/sciadv.aap9741

Suryan, R. M., Arimitsu, M. L., Coletti, H. A., Hopcroft, R. R., Lindeberg, M. R., Barbeaux, S. J., Batten, S. D., Burt, W. J., Bishop, M. A., Bodkin, J. L., Brenner, R., Campbell, R. W., Cushing, D. A., Danielson, S. L., Dorn, M. W., Drummond, B., Esler, D., Gelatt, T., Hanselman, D. H., … Zador, S. G. (2021). Ecosystem response persists after a prolonged marine heatwave. *Scientific Reports*, *11*(1), 6235. https://doi.org/10.1038/s41598-021-83818-5

Swain, D. L., Prein, A. F., Abatzoglou, J. T., Albano, C. M., Brunner, M., Diffenbaugh, N. S., Singh, D., Skinner, C. B., & Touma, D. (2025). Hydroclimate volatility on a warming Earth. *Nature Reviews Earth & Environment*, *6*(1), 35–50. https://doi.org/10.1038/s43017-024-00624-z

Swain, D. L., Wing, O. E. J., Bates, P. D., Done, J. M., Johnson, K. A., & Cameron, D. R. (2020). Increased Flood Exposure Due to Climate Change and Population Growth in the United States. *Earth's Future*, *8*(11), e2020EF001778. https://doi.org/10.1029/2020EF001778

Tarabochia-Gast, A. T., Michanowicz, D. R., & Bernstein, A. S. (2022). Flood Risk to Hospitals on the United States Atlantic and Gulf Coasts From Hurricanes and Sea Level Rise. *GeoHealth*, *6*(10), e2022GH000651. https://doi.org/10.1029/2022GH000651

Thompson, P. R., Widlansky, M. J., Hamlington, B. D., Merrifield, M. A., Marra, J. J., Mitchum, G. T., & Sweet, W. (2021). Rapid increases and extreme months in projections of United States high-tide flooding. *Nature Climate Change*, *11*(7), 584–590. https://doi.org/10.1038/s41558-021-01077-8

Thompson, R., Lawrance, E. L., Roberts, L. F., Grailey, K., Ashrafian, H., Maheswaran, H., Toledano, M. B., & Darzi, A. (2023). Ambient temperature and mental health: A systematic review and meta-analysis. *The Lancet Planetary Health*, *7*(7), e580–e589. https://doi.org/10.1016/S2542-5196(23)00104-3

Tigchelaar, M., Battisti, D. S., Naylor, R. L., & Ray, D. K. (2018). Future warming increases probability of globally synchronized maize production shocks. *Proceedings of the National Academy of Sciences*, *115*(26), 6644–6649. https://doi.org/10.1073/pnas.1718031115

Tittensor, D. P., Novaglio, C., Harrison, C. S., Heneghan, R. F., Barrier, N., Bianchi, D., Bopp, L., Bryndum-Buchholz, A., Britten, G. L., Büchner, M., Cheung, W. W. L., Christensen, V., Coll, M., Dunne, J. P., Eddy, T. D., Everett, J. D., Fernandes-Salvador, J. A., Fulton, E. A., Galbraith, E. D., … Blanchard, J. L. (2021). Next-generation ensemble projections reveal higher climate risks for marine ecosystems. *Nature Climate Change*, *11*(11), 973–981. https://doi.org/10.1038/s41558-021-01173-9

Tong, D. Q., Gill, T. E., Sprigg, W. A., Scott Van Pelt, R., Baklanov, A. A., Barker, B. M., Bell, J. E., Castillo, J., Gasso, S. Gaston, C. J. Griffin, D. W., Huneeus, N., Kahn, R. A., Kuciauskas, A. P., Ladino, L. A., Li, J., Mayol-Bracero, O. L., McCotter, O. Z., Mendez-Lazaro, P. A. Mudu, P. Nickovic, S. Oyarzun, D., Prospero, J., Raga, G. B., Raysoni, A. U., Ren, L., Sarafoglou, N., Sealy, A., Sun, Z., & Vukovic Vimic, A. (2023). Health and Safety Effects of Airborne Soil Dust in the Americas and Beyond. *Reviews of Geophysics, 61,* https://doi.org/10.1029/2021RG000763.

Tripathy, K. P., Mukherjee, S., Mishra, A. K., Mann, M. E., & Williams, A. P. (2023). Climate change will accelerate the high-end risk of compound drought and heatwave events. *Proceedings of the National Academy of Sciences*, *120*(28), e2219825120. https://doi.org/10.1073/pnas.2219825120

Trisos, C. H., Merow, C., & Pigot, A. L. (2020). The projected timing of abrupt ecological disruption from climate change. *Nature*, *580*(7804), 496–501. https://doi.org/10.1038/s41586-020-2189-9

Trombley, J., Chalupka, S., & Anderko, L. (2017). Climate Change and Mental Health. *AJN, American Journal of Nursing*, *117*(4), 44–52. https://doi.org/10.1097/01.NAJ.0000515232.51795.fa

Tully, K. L., Weissman, D., Wyner, W. J., Miller, J., & Jordan, T. (2019). Soils in transition: Saltwater intrusion alters soil chemistry in agricultural fields. *Biogeochemistry*, *142*(3), 339–356. https://doi.org/10.1007/s10533-019-00538-9

Turco, M., Abatzoglou, J. T., Herrera, S., Zhuang, Y., Jerez, S., Lucas, D. D., AghaKouchak, A., & Cvijanovic, I. (2023). Anthropogenic climate change impacts exacerbate summer forest fires in California. *Proceedings of the National Academy of Sciences*, *120*(25), e2213815120. https://doi.org/10.1073/pnas.2213815120

Turner, S. W. D., Ghimire, G. R., Hansen, C., Singh, D., & Kao, S.-C. (2024). Hydropower capacity factors trending down in the United States. *Nature Communications*, *15*(1), 5445. https://doi.org/10.1038/s41467-024-49553-x

Uryupova, E. (2023). Global interest in the Arctic region: Naval operations impacting scientific-commercial activities. *Polar Record*, *59*, e8. https://doi.org/10.1017/S0032247422000419

U.S. Centers for Disease Control and Prevention (CDC). (August 11, 2026). *Air Pollution,* https://www.cdc.gov/climate-health/php/effects/air-pollution.html.

U.S. Department of Defense. (2022). *2022 National Defense Strategy of The United States of America.* https://media.defense.gov/2022/Oct/27/2003103845/-1/-1/1/2022-NATIONAL-DEFENSE-STRATEGY-NPR-MDR.pdf

U.S. Department of Energy. (2023). *Effects of Climate Change of Federal Hydropower* (Third Report to Congress). https://www.energy.gov/sites/default/files/2024-05/effects-of-climate-change-on-hydropower_2023-12.pdf

Van Houtven, G., Phelan, J., Clark, C., Sabo, R. D., Buckley, J., Thomas, R. Q., Horn, K., & LeDuc, S. D. (2019). Nitrogen deposition and climate change effects on tree species composition and

ecosystem services for a forest cohort. *Ecological Monographs*, *89*(2), e01345. https://doi.org/10.1002/ecm.1345

Van Oldenborgh, G. J., Van Der Wiel, K., Sebastian, A., Singh, R., Arrighi, J., Otto, F., Haustein, K., Li, S., Vecchi, G., & Cullen, H. (2017). Attribution of extreme rainfall from Hurricane Harvey, August 2017. *Environmental Research Letters*, *12*(12), 124009. https://doi.org/10.1088/1748-9326/aa9ef2

Van Ruijven, B. J., De Cian, E., & Sue Wing, I. (2019). Amplification of future energy demand growth due to climate change. *Nature Communications*, *10*(1), 2762. https://doi.org/10.1038/s41467-019-10399-3

Van Vliet, M. T. H., Thorslund, J., Strokal, M., Hofstra, N., Flörke, M., Ehalt Macedo, H., Nkwasa, A., Tang, T., Kaushal, S. S., Kumar, R., Van Griensven, A., Bouwman, L., & Mosley, L. M. (2023). Global river water quality under climate change and hydroclimatic extremes. *Nature Reviews Earth & Environment*, *4*(10), 687–702. https://doi.org/10.1038/s43017-023-00472-3

Vicedo-Cabrera, A. M., Scovronick, N., Sera, F., Royé, D., Schneider, R., Tobias, A., Astrom, C., Guo, Y., Honda, Y., Hondula, D. M., Abrutzky, R., Tong, S., Coelho, M. D. S. Z. S., Saldiva, P. H. N., Lavigne, E., Correa, P. M., Ortega, N. V., Kan, H., Osorio, S., … Gasparrini, A. (2021). The burden of heat-related mortality attributable to recent human-induced climate change. *Nature Climate Change*, *11*(6), 492–500. https://doi.org/10.1038/s41558-021-01058-x

Vineis, P., Chan, Q., & Khan, A. (2011). Climate change impacts on water salinity and health. *Journal of Epidemiology and Global Health*, *1*(1), 5. https://doi.org/10.1016/j.jegh.2011.09.001

Vitousek, S., Barnard, P. L., Fletcher, C. H., Frazer, N., Erikson, L., & Storlazzi, C. D. (2017). Doubling of coastal flooding frequency within decades due to sea-level rise. *Scientific Reports*, *7*(1), 1399. https://doi.org/10.1038/s41598-017-01362-7

von Uexkull N., Croicu M., Fjelde H., & Buhaug H. (2016). Civil conflict sensitivity to growing-season drought. *Proc Natl Acad Sci*, 113(44), 12391-12396. https://doi.org/10.1073/pnas.1607542113.

Waidelich, P., Batibeniz, F., Rising, J., Kikstra, J. S., & Seneviratne, S. I. (2024). Climate damage projections beyond annual temperature. *Nature Climate Change*, *14*(6), 592–599. https://doi.org/10.1038/s41558-024-01990-8

Wang, H., Zheng, X.-T., Cai, W., Han, Z.-W., Xie, S.-P., Kang, S. M., Geng, Y.-F., Liu, F., Wang, C.-Y., Wu, Y., Xiang, B., & Zhou, L. (2024). Atmosphere teleconnections from abatement of China aerosol emissions exacerbate Northeast Pacific warm blob events. *Proceedings of the National Academy of Sciences*, *121*(21), e2313797121. https://doi.org/10.1073/pnas.2313797121

Wankar, A. K., Rindhe, S. N., & Doijad, N. S. (2021). Heat stress in dairy animals and current milk production trends, economics, and future perspectives: The global scenario. *Tropical Animal Health and Production*, *53*(1), 70. https://doi.org/10.1007/s11250-020-02541-x

Washington State Department of Health (WA DOH) (September 2023). *Understanding the Washington Excess Mortality in 2020 and 2021 Report: Report Overview*, https://doh.wa.gov/sites/default/files/2023-09/422243-ExcessDeathsBrief.pdf.

Wasserman, T. N., & Mueller, S. E. (2023). Climate influences on future fire severity: A synthesis of climate-fire interactions and impacts on fire regimes, high-severity fire, and forests in the western United States. *Fire Ecology*, *19*(1), 43. https://doi.org/10.1186/s42408-023-00200-8

Wdowinski, S., Bray, R., Kirtman, B. P., & Wu, Z. (2016). Increasing flooding hazard in coastal communities due to rising sea level: Case study of Miami Beach, Florida. *Ocean & Coastal Management*, *126*, 1–8. https://doi.org/10.1016/j.ocecoaman.2016.03.002

White, R. H., Anderson, S., Booth, J. F., Braich, G., Draeger, C., Fei, C., Harley, C. D. G., Henderson, S. B., Jakob, M., Lau, C.-A., Mareshet Admasu, L., Narinesingh, V., Rodell, C., Roocroft, E., Weinberger, K. R., & West, G. (2023). The unprecedented Pacific Northwest heatwave of June 2021. *Nature Communications*, *14*(1), 727. https://doi.org/10.1038/s41467-023-36289-3

Wiens, J. J., & Zelinka, J. (2024). How many species will Earth lose to climate change? *Global Change Biology*, *30*(1), e17125. https://doi.org/10.1111/gcb.17125

Williams, A. P., Cook, B. I., & Smerdon, J. E. (2022). Rapid intensification of the emerging southwestern North American megadrought in 2020–2021. *Nature Climate Change*, *12*(3), 232–234. https://doi.org/10.1038/s41558-022-01290-z

Williams, A. P., Cook, E. R., Smerdon, J. E., Cook, B. I., Abatzoglou, J. T., Bolles, K., Baek, S. H., Badger, A. M., & Livneh, B. (2020). Large contribution from anthropogenic warming to an emerging North American megadrought. *Science*, *368*(6488), 314–318. https://doi.org/10.1126/science.aaz9600

Wing, O. E. J., Bates, P. D., Smith, A. M., Sampson, C. C., Johnson, K. A., Fargione, J., & Morefield, P. (2018). Estimates of present and future flood risk in the conterminous United States. *Environmental Research Letters*, *13*(3), 034023. https://doi.org/10.1088/1748-9326/aaac65

Wolfe, W. H., Martz, T. R., Dickson, A. G., Goericke, R., & Ohman, M. D. (2023). A 37-year record of ocean acidification in the Southern California current. *Communications Earth & Environment*, *4*(1), 406. https://doi.org/10.1038/s43247-023-01065-0

World Meteorological Organization (WMO). (2026, October 27). *Greenhouse gas levels once again reach record high.* https://wmo.int/news/media-centre/greenhouse-gas-levels-once-again-reach-record-high.

Yao, F., Livneh, B., Rajagopalan, B., Wang, J., Crétaux, J.-F., Wada, Y., & Berge-Nguyen, M. (2023). Satellites reveal widespread decline in global lake water storage. *Science*, *380*(6646), 743–749. https://doi.org/10.1126/science.abo2812

Zhang, Y., Bielory, L., Mi, Z., Cai, T., Robock, A., & Georgopoulos, P. (2015). Allergenic pollen season variations in the past two decades under changing climate in the United States. *Global Change Biology*, *21*(4), 1581–1589. https://doi.org/10.1111/gcb.12755

Zhao, C., Liu, B., Piao, S., Wang, X., Lobell, D. B., Huang, Y., Huang, M., Yao, Y., Bassu, S., Ciais, P., Durand, J., Elliott, J., Ewert, F., Janssens, I.A., Li, T., Lin, E., Liu, Q., Martre, P., Müller, C., Peng, S., Peñuelas, J., Ruane, A.C., Wallach, D., Wang, T., Wu, D., Liu, Z., Zhu, Y., Zhu, Z., & Asseng, S. (2017). Temperature increase reduces global yields of major crops in four independent estimates, *Proc. Natl. Acad. Sci., 114*(35), 9326-9331, https://doi.org/10.1073/pnas.1701762114.

Zhao, J., Lu, Z., Wang, L., & Jin, B. (2020). Plant Responses to Heat Stress: Physiology, Transcription, Noncoding RNAs, and Epigenetics. *International Journal of Molecular Sciences*, *22*(1), 117. https://doi.org/10.3390/ijms22010117

Zhao, P., Li, Y., & Zhang, Y. (2024). Ships are projected to navigate whole year-round along the North Sea route by 2100. *Communications Earth & Environment*, *5*(1), 407. https://doi.org/10.1038/s43247-024-01557-7

Zhuang, Y., Fu, R., Santer, B. D., Dickinson, R. E., & Hall, A. (2021). Quantifying contributions of natural variability and anthropogenic forcings on increased fire weather risk over the western United States. *Proceedings of the National Academy of Sciences*, *118*(45), e2111875118. https://doi.org/10.1073/pnas.2111875118

Ziska, L. H., Knowlton, K., Rogers, C., Dalan, D., Tierney, N., Elder, M. A., Filley, W., Shropshire, J., Ford, L. B., Hedberg, C., Fleetwood, P., Hovanky, K. T., Kavanaugh, T., Fulford, G., Vrtis, R. F., Patz, J. A., Portnoy, J., Coates, F., Bielory, L., & Frenz, D. (2011). Recent warming by latitude associated with increased length of ragweed pollen season in central North America. *Proc Natl Acad Sci, 108*(10), 4248-51. https://doi.org/10.1073/pnas.1014107108.

Ziska, L. H., Makra, L., Harry, S. K., Bruffaerts, N., Hendrickx, M., Coates, F., Saarto, A., Thibaudon, M., Oliver, G., Damialis, A., Charalampopoulos, A., Vokou, D., Heiðmarsson, S., Guðjohnsen, E., Bonini, M., Oh, J.-W., Sullivan, K., Ford, L., Brooks, G. D., … Crimmins, A. R. (2019). Temperature-related changes in airborne allergenic pollen abundance and seasonality across the northern hemisphere: A retrospective data analysis. *The Lancet Planetary Health*, *3*(3), e124–e131. https://doi.org/10.1016/S2542-5196(19)30015-4

APPENDIX E

Endangered Species Analysis

Center for Biological Diversity

Table 1. Using GIS analysis, we estimate that 434 federally listed species and subspecies have critical habitat within five miles of at least one fossil fuel power plant, listed in Table 1 below. Data sources are the U.S. EPA eGRID 2023 Revision 2 dataset (Emissions & Generation Resource Integrated Database) to map fossil fuel power plants, available at https://www.epa.gov/egrid. We used NMFS critical habitat data available at https://noaa.maps.arcgis.com/home/item.html?id=f66c1e33f91d480db7d1b1c1336223c3 and USFWS critical habitat data available at https://ecos.fws.gov/ecp/report/critical-habitat.

Scientific Name	Common Name
Abutilon sandwicense	No common name
Acaena exigua	Liliwai
Acanthomintha ilicifolia	San Diego thornmint
Achyranthes mutica	No common name
Achyranthes splendens var. rotundata	Round-leaved chaff-flower
Acipenser medirostris	Green sturgeon
Acipenser oxyrinchus (=oxyrhynchus) desotoi	Gulf sturgeon
Acipenser oxyrinchus oxyrinchus	Atlantic sturgeon
Acropora cervicornis	Staghorn coral
Acropora palmata	Elkhorn coral
Adenophorus periens	Palai la`au
Agelaius xanthomus	Yellow-shouldered blackbird
Alasmidonta raveneliana	Appalachian elktoe
Alectryon macrococcus	Mahoe
Amblema neislerii	Fat threeridge (mussel)
Ambrosia pumila	San Diego ambrosia
Ambystoma californiense	California tiger salamander
Ambystoma cingulatum	Frosted flatwoods salamander
Anaea troglodyta floridalis	Florida leafwing butterfly
Anaxyrus californicus	Arroyo (=arroyo southwestern) toad
Anolis roosevelti	Culebra Island giant anole
Antigone canadensis pulla	Mississippi sandhill crane
Arabis georgiana	Georgia rockcress
Arctostaphylos franciscana	Franciscan manzanita
Arenaria ursina	Bear Valley sandwort
Asplenium (=Diellia) dielfalcatum (=falcata)	No common name
Asplenium dielerectum	No common name
Asplenium peruvianum var. insulare	No common name
Asplenium unisorum	No common name
Astragalus ampullarioides	Shivwits milk-vetch

Astragalus brauntonii	Braunton's milk-vetch
Astragalus holmgreniorum	Holmgren milk-vetch
Astragalus lentiginosus var. coachellae	Coachella Valley milk-vetch
Astragalus pycnostachyus var. lanosissimus	Ventura Marsh milk-vetch
Atlantea tulita	Puerto Rican harlequin butterfly
Bidens amplectens	Ko`oko`olau
Bidens campylotheca ssp. pentamera	Ko`oko`olau
Bidens campylotheca ssp. waihoiensis	Ko`oko`olau
Bidens conjuncta	Ko`oko`olau
Bidens micrantha ssp. ctenophylla	Ko`oko`olau
Bidens micrantha ssp. kalealaha	Ko`oko`olau
Bombus affinis	Rusty patched bumble bee
Bonamia menziesii	No common name
Brachyramphus marmoratus	Marbled Murrelet
Branchinecta conservatio	Conservancy fairy shrimp
Branchinecta longiantenna	Longhorn fairy shrimp
Branchinecta lynchi	Vernal pool fairy shrimp
Branchinecta sandiegonensis	San Diego fairy shrimp
Brickellia mosieri	Florida brickell-bush
Brighamia insignis	Olulu
Brighamia rockii	Pua `ala
Brodiaea filifolia	Thread-leaved brodiaea
Bufo houstonensis	Houston toad
Calamagrostis hillebrandii	Hillebrand's reedgrass
Cambarus callainus	Big Sandy crayfish
Cambarus cracens	Slenderclaw crayfish
Canis lupus	Gray wolf
Caretta caretta	Loggerhead sea turtle
Castilleja campestris ssp. succulenta	Fleshy owl's-clover
Castilleja cinerea	Ash-grey paintbrush
Catostomus santaanae	Santa Ana sucker
Cenchrus agrimonioides	Kamanomano
Centrocercus minimus	Gunnison sage-grouse
Charadrius melodus	Piping plover
Charadrius nivosus nivosus	Western snowy plover
Chasiempis ibidis	Oahu elepaio
Chasmistes brevirostris	Shortnose sucker
Chasmistes liorus	June sucker
Chelonia mydas	Green sea turtle
Chorizanthe pungens var. pungens	Monterey spineflower
Chorizanthe robusta var. robusta	Robust spineflower
Cicindela nevadica lincolniana	Salt Creek tiger beetle
Cirsium hydrophilum var. hydrophilum	Suisun thistle
Clermontia drepanomorpha	`Oha wai
Clermontia oblongifolia ssp. mauiensis	`Oha wai
Clermontia peleana	`Oha wai
Clermontia samuelii	`Oha wai
Coccyzus americanus	Yellow-billed cuckoo

Colubrina oppositifolia	Kauila
Cordylanthus mollis ssp. mollis	Soft bird's-beak
Ctenitis squamigera	Pauoa
Cumberlandia monodonta	Spectaclecase (mussel)
Cyanea acuminata	Haha
Cyanea asplenifolia	Haha
Cyanea calycina	Haha
Cyanea copelandii ssp. haleakalaensis	Haha
Cyanea crispa	haha
Cyanea duvalliorum	haha
Cyanea glabra	Haha
Cyanea grimesiana ssp. grimesiana	Haha
Cyanea grimesiana ssp. obatae	Haha
Cyanea hamatiflora ssp. hamatiflora	Haha
Cyanea horrida	Haha nui
Cyanea humboldtiana	Haha
Cyanea koolauensis	Haha
Cyanea kunthiana	Haha
Cyanea lanceolata	Haha
Cyanea lobata	Haha
Cyanea longiflora	Haha
Cyanea magnicalyx	Haha
Cyanea maritae	Haha
Cyanea mceldowneyi	Haha
Cyanea obtusa	Haha
Cyanea pinnatifida	Haha
Cyanea purpurellifolia	Haha
Cyanea st.-johnii	Haha
Cyanea superba	Haha
Cyanea tritomantha	`aku
Cyanea truncata	Haha
Cyclonaias necki	Guadalupe orb
Cyperus pennatiformis	No common name
Cyprogenia aberti	Western fanshell
Cyprogenia sp. cf. aberti	Ouachita fanshell
Cyrtandra dentata	Ha`iwale
Cyrtandra ferripilosa	Ha`iwale
Cyrtandra filipes	Ha`iwale
Cyrtandra gracilis	Ha`iwale
Cyrtandra kaulantha	Ha`iwale
Cyrtandra munroi	Ha`iwale
Cyrtandra oxybapha	Ha`iwale
Cyrtandra polyantha	Ha`iwale
Cyrtandra sessilis	Ha`iwale
Cyrtandra subumbellata	Ha`iwale
Cyrtandra viridiflora	Ha`iwale
Cyrtandra waiolani	Ha`iwale
Deinandra (=Hemizonia) conjugens	Otay tarplant

Delissea rhytidosperma	No common name
Delissea subcordata	Oha
Delphinapterus leucas	Beluga whale
Deltistes luxatus	Lost River sucker
Dendrogyra cylindrus	Pillar coral
Dermochelys coriacea	Leatherback sea turtle
Desmocerus californicus dimorphus	Valley elderberry longhorn beetle
Dinacoma caseyi	Casey's june beetle
Dionda diaboli	Devils River minnow
Diplazium molokaiense	No common name
Dipodomys merriami parvus	San Bernardino Merriam's kangaroo rat
Dracaena forbesii	Hala pepe
Drosophila aglaia	Hawaiian picture-wing fly
Drosophila hemipeza	Hawaiian picture-wing fly
Drosophila montgomeryi	Hawaiian picture-wing fly
Drosophila ochrobasis	Hawaiian picture-wing fly
Drosophila substenoptera	Hawaiian picture-wing fly
Drosophila tarphytrichia	Hawaiian picture-wing fly
Dubautia herbstobatae	Na`ena`e
Dubautia plantaginea ssp. humilis	Na`ena`e
Elaphrus viridis	Delta green ground beetle
Elassoma alabamae	Spring pygmy sunfish
Eleutherodactylus cooki	Guajon
Eleutherodactylus juanariveroi	Llanero coqui
Elliptoideus sloatianus	Purple bankclimber (mussel)
Empidonax traillii extimus	Southwestern willow flycatcher
Enhydra lutris kenyoni	Northern sea otter
Epinephelus striatus	Nassau grouper
Epioblasma brevidens	Cumberlandian combshell
Epioblasma capsaeformis	Oyster mussel
Epioblasma metastriata	Upland combshell
Epioblasma othcaloogensis	Southern acornshell
Epioblasma triquetra	Snuffbox mussel
Eragrostis fosbergii	Fosberg's love grass
Eremophila alpestris strigata	Streaked horned lark
Erigeron decumbens	Willamette daisy
Erignathus barbatus nauticus	Bearded seal (Beringia DPS)
Erimonax monachus	Spotfin chub
Erimystax cahni	Slender chub
Eriogonum kennedyi var. austromontanum	Southern mountain wild-buckwheat
Eriogonum ovalifolium var. vineum	Cushenbury buckwheat
Erysimum capitatum var. angustatum	Contra Costa wallflower
Etheostoma osburni	Candy darter
Etheostoma trisella	Trispot darter
Eubalaena glacialis	North Atlantic right whale
Eucyclogobius newberryi	Tidewater goby
Eugenia koolauensis	Nioi
Eumetopias jubatus	Steller sea lion

Eumops floridanus	Florida bonneted bat
Euphorbia celastroides var. kaenana	`Akoko
Euphorbia haeleeleana	`Akoko
Euphorbia herbstii	`Akoko
Euphorbia kuwaleana	`Akoko
Euphorbia rockii	`Akoko
Euphorbia skottsbergii var. skottsbergii	`Akoko
Euphydryas editha bayensis	Bay checkerspot butterfly
Euphydryas editha quino (=E. e. wrighti)	Quino checkerspot butterfly
Euphydryas editha taylori	Taylor's (=whulge) checkerspot
Eurycea tonkawae	Jollyville Plateau salamander
Eurycea waterlooensis	Austin blind salamander
Faxonius peruncus	Big Creek crayfish
Faxonius quadruncus	St. Francis River crayfish
Flueggea neowawraea	Mehamehame
Fremontodendron mexicanum	Mexican flannelbush
Fusconaia burkei	Tapered pigtoe
Fusconaia escambia	Narrow pigtoe
Fusconaia masoni	Atlantic pigtoe
Fusconaia mitchelli	False spike
Fusconaia subrotunda	Longsolid
Gardenia mannii	Nanu
Geranium hanaense	Nohoanu
Geranium hillebrandii	Nohoanu
Geranium multiflorum	Nohoanu
Gila elegans	Bonytail
Gila seminuda (=robusta)	Virgin River Chub
Glaucopsyche lygdamus palosverdesensis	Palos Verdes blue butterfly
Gopherus agassizii	Desert tortoise
Gouania hillebrandii	No common name
Gouania meyenii	No common name
Gouania vitifolia	No common name
Grus americana	Whooping crane
Gymnogyps californianus	California condor
Haliotis cracherodii	Black abalone
Hamiota altilis	Finelined pocketbook
Hamiota australis	Southern sandshell
Hamiota perovalis	Orangenacre mucket
Hamiota subangulata	Shinyrayed pocketbook
Hesperia dacotae	Dakota skipper
Hesperomannia arborescens	No common name
Hesperomannia arbuscula	No common name
Hibiscus brackenridgei	Ma`o hau hele
Hibiscus clayi	Clay's hibiscus
Hibiscus dasycalyx	Neches River rose-mallow
Holocarpha macradenia	Santa Cruz tarplant
Hybognathus amarus	Rio Grande silvery minnow
Hypomesus transpacificus	Delta smelt

Icaricia icarioides fenderi	Fender's blue butterfly
Ischaemum byrone	Hilo ischaemum
Isodendrion hosakae	Aupaka
Isodendrion laurifolium	Aupaka
Isodendrion longifolium	Aupaka
Isodendrion pyrifolium	Wahine noho kula
Kadua coriacea	Kio`ele
Kadua degeneri	No common name
Kadua laxiflora	Pilo
Kadua parvula	No common name
Korthalsella degeneri	Hulumoa
Labordia cyrtandrae	Kamakahala
Lampsilis bracteata	Texas fatmucket
Lampsilis rafinesqueana	Neosho mucket
Lasthenia conjugens	Contra Costa goldfields
Lepidium arbuscula	`Anaunau
Lepidium papilliferum	Slickspot peppergrass
Lepidurus packardi	Vernal pool tadpole shrimp
Lesquerella kingii ssp. bernardina	San Bernardino Mountains bladderpod
Limnanthes floccosa ssp. californica	Butte County meadowfoam
Linum carteri carteri	Carter's small-flowered flax
Lipochaeta lobata var. leptophylla	Nehe
Lipochaeta micrantha	Nehe
Lobelia koolauensis	No common name
Lobelia niihauensis	No common name
Lobelia oahuensis	No common name
Lupinus sulphureus ssp. kincaidii	Kincaid's lupine
Lycaena hermes	Hermes copper butterfly
Lynx canadensis	Canada lynx
Lysimachia lydgatei	No common name
Macrhybopsis tetranema	Peppered chub
Manduca blackburni	Blackburn's sphinx moth
Masticophis lateralis euryxanthus	Alameda whipsnake
Medionidus acutissimus	Alabama moccasinshell
Medionidus parvulus	Coosa moccasinshell
Medionidus penicillatus	Gulf moccasinshell
Medionidus simpsonianus	Ochlockonee moccasinshell
Medionidus walkeri	Suwannee moccasinshell
Megalagrion leptodemas	Crimson Hawaiian damselfly
Megalagrion nigrohamatum nigrolineatum	Blackline Hawaiian damselfly
Megalagrion oceanicum	Oceanic Hawaiian damselfly
Megaptera novaeangliae	Humpback whale
Melanthera tenuifolia	Nehe
Melicope balloui	Alani
Melicope christophersenii	Alani
Melicope cornuta var. cornuta	No common name
Melicope cornuta var. decurrens	No common name
Melicope haupuensis	Alani

Melicope hiiakae	Alani
Melicope lydgatei	Alani
Melicope makahae	Alani
Melicope ovalis	Alani
Melicope pallida	Alani
Melicope remyi	No common name
Melicope saint-johnii	Alani
Melozone crissalis eremophilus	Inyo California towhee
Mezoneuron kavaiense	Uhiuhi
Mucuna persericea	Sea bean
Mycetophyllia ferox	Rough cactus coral
Myotis sodalis	Indiana bat
Myrsine juddii	Kolea
Myrsine linearifolia	Kolea
Myrsine vaccinioides	Kolea
Navarretia fossalis	Spreading navarretia
Necturus alabamensis	Black warrior (=Sipsey Fork) waterdog
Necturus lewisi	Neuse River waterdog
Neomonachus schauinslandi	Hawaiian monk seal
Neraudia angulata	No common name
Neraudia sericea	No common name
Nototrichium humile	Kulu`i
Notropis girardi	Arkansas River shiner
Notropis topeka (=tristis)	Topeka shiner
Noturus furiosus	Carolina madtom
Noturus munitus	Frecklebelly madtom
Oarisma poweshiek	Poweshiek skipperling
Obovaria choctawensis	Choctaw bean
Obovaria subrotunda	Round hickorynut
Oenothera deltoides ssp. howellii	Antioch Dunes evening-primrose
Oncorhynchus keta	Chum salmon
Oncorhynchus kisutch	Coho salmon
Oncorhynchus mykiss	Steelhead
Oncorhynchus nerka	Sockeye salmon
Oncorhynchus tshawytscha	Chinook salmon
Orbicella annularis	Lobed star coral
Orbicella faveolata	Mountainous star coral
Orbicella franksi	Boulder star coral
Orcinus orca	Killer whale
Orcuttia inaequalis	San Joaquin Valley orcutt grass
Orcuttia pilosa	Hairy orcutt grass
Orcuttia viscida	Sacramento orcutt grass
Ovis canadensis nelsoni	Peninsular bighorn sheep
Oxytheca parishii var. goodmaniana	Cushenbury oxytheca
Palmeria dolei	`Akohekohe (crested honeycreeper)
Peperomia subpetiolata	`Ala `ala wai nui
Percina antesella	Amber darter
Percina aurora	Pearl darter

Peucedanum sandwicense	Makou
Phlegmariurus mannii	Wawae`iole
Phlegmariurus nutans	Wawae`iole
Phoca (=Pusa) hispida hispida	Ringed seal
Phyllostegia bracteata	No common name
Phyllostegia floribunda	No common name
Phyllostegia haliakalae	No common name
Phyllostegia hirsuta	No common name
Phyllostegia kaalaensis	No common name
Phyllostegia mannii	No common name
Phyllostegia mollis	No common name
Phyllostegia parviflora	No common name
Phyllostegia pilosa	No common name
Phyllostegia warshaueri	No common name
Piperia yadonii	Yadon's piperia
Pittosporum hawaiiense	Hoawa
Pituophis melanoleucus lodingi	Black pinesnake
Plagopterus argentissimus	Woundfin
Plantago princeps	Kuahiwi laukahi
Platanthera holochila	No common name
Plethobasus cyphyus	Sheepnose mussel
Pleurobema decisum	Southern clubshell
Pleurobema georgianum	Southern pigtoe
Pleurobema perovatum	Ovate clubshell
Pleurobema pyriforme	Oval pigtoe
Pleurobema strodeanum	Fuzzy pigtoe
Pleurocera foremani	Rough hornsnail
Pleuronaia dolabelloides	Slabside pearlymussel
Poa atropurpurea	San Bernardino bluegrass
Polioptila californica californica	Coastal California gnatcatcher
Polyscias gymnocarpa	`Ohe`ohe
Polyscias racemosa	No common name
Polysticta stelleri	Steller's eider
Pristis pectinata	Smalltooth sawfish
Procambarus econfinae	Panama City crayfish
Pseudonestor xanthophrys	Maui parrotbill (Kiwikiu)
Pseudorca crassidens	False killer whale
Psychotria hexandra var. oahuensis	Kopiko
Pteralyxia kauaiensis	Kaulu
Pteralyxia macrocarpa	Kaulu
Pteris lidgatei	No common name
Ptychobranchus greenii	Triangular kidneyshell
Ptychobranchus jonesi	Southern kidneyshell
Ptychobranchus subtentus	Fluted kidneyshell
Ptychocheilus lucius	Colorado pikeminnow
Quadrula cylindrica cylindrica	Rabbitsfoot
Quadrula cylindrica strigillata	Rough rabbitsfoot
Rana chiricahuensis	Chiricahua leopard frog

Rana draytonii	California red-legged frog
Rana muscosa	Mountain yellow-legged frog
Rana sevosa	Dusky gopher frog
Reginaia rotulata	Round ebonyshell
Remya mauiensis	Maui remya
Rhadine infernalis	No common name
Rostrhamus sociabilis plumbeus	Everglade snail kite
Salmo salar	Atlantic salmon
Salvelinus confluentus	Bull trout
Sanicula mariversa	No common name
Sanicula purpurea	No common name
Santalum haleakalae var. lanaiense	Lanai sandalwood (=`iliahi)
Scaphirhynchus suttkusi	Alabama sturgeon
Schenkia sebaeoides	Awiwi
Schiedea diffusa ssp. macraei	No common name
Schiedea hookeri	No common name
Schiedea jacobii	No common name
Schiedea kaalae	No common name
Schiedea kealiae	Ma`oli`oli
Schiedea nuttallii	No common name
Schiedea obovata	No common name
Schiedea salicaria	No common name
Schiedea spergulina var. leiopoda	No common name
Schiedea trinervis	No common name
Scutellaria ocmulgee	Ocmulgee skullcap
Sebastes paucispinis	Bocaccio
Sebastes ruberrimus	Yelloweye rockfish
Sesbania tomentosa	Ohai
Silene lanceolata	No common name
Silene perlmanii	No common name
Solanum sandwicense	`Aiakeakua, popolo
Somateria fischeri	Spectacled eider
Somatochlora hineana	Hine's emerald dragonfly
Sorex ornatus relictus	Buena Vista Lake shrew
Speoplatyrhinus poulsoni	Alabama cavefish
Spermolepis hawaiiensis	No common name
Sphaeralcea gierischii	Gierisch mallow
Stenogyne cranwelliae	No common name
Stenogyne kanehoana	No common name
Stenogyne kauaulaensis	No common name
Streptanthus bracteatus	Bracted twistflower
Streptocephalus woottoni	Riverside fairy shrimp
Strix occidentalis caurina	Northern spotted owl
Strix occidentalis lucida	Mexican spotted owl
Strymon acis bartrami	Bartram's hairstreak Butterfly
Taraxacum californicum	California taraxacum
Tetramolopium capillare	Pamakani
Tetramolopium filiforme	No common name

Tetramolopium lepidotum ssp. lepidotum	No common name
Tetramolopium remyi	No common name
Thaleichthys pacificus	Eulachon
Trematolobelia singularis	No common name
Trichomanes punctatum ssp. floridanum	Florida bristle fern
Trimerotropis infantilis	Zayante band-winged grasshopper
Urera kaalae	Opuhe
Ursus maritimus	Polar bear
Varronia rupicola	No common name
Vigna o-wahuensis	No common name
Villosa fabalis	Rayed Bean
Villosa perpurpurea	Purple bean
Viola chamissoniana ssp. chamissoniana	Pamakani
Viola oahuensis	No common name
Vireo bellii pusillus	Least Bell's vireo
Wikstroemia villosa	No common name
Xyrauchen texanus	Razorback sucker
Zanthoxylum hawaiiense	A`e
Zanthoxylum oahuense	A`e
Zapus hudsonius preblei	Preble's meadow jumping mouse

Table 2. These 258 federally listed species and subspecies have multiple fossil fuel power plants within 5 miles of their critical habitat, ranging from 2 to 72 power plants.

Scientific Name	Common Name	Number of power plants w/in 5 miles of critical habitat
Abutilon sandwicense	No common name	2
Acanthomintha ilicifolia	San Diego thornmint	11
Achyranthes splendens var. rotundata	Round-leaved chaff-flower	5
Acipenser medirostris	Green sturgeon	72
Acipenser oxyrinchus (=oxyrhynchus) desotoi	Gulf sturgeon	24
Acropora cervicornis	Staghorn coral	30
Acropora palmata	Elkhorn coral	30
Adenophorus periens	Palai la`au	2
Agelaius xanthomus	Yellow-shouldered blackbird	3
Alectryon macrococcus	Mahoe	4
Amblema neislerii	Fat threeridge	3
Ambrosia pumila	San Diego ambrosia	9
Ambystoma californiense	California tiger salamander	17
Ambystoma cingulatum	Frosted flatwoods salamander	3
Anaxyrus californicus	Arroyo (=arroyo southwestern) toad	3
Arabis georgiana	Georgia rockcress	3
Arctostaphylos franciscana	Franciscan manzanita	4
Asplenium (=Diellia) dielfalcatum (=falcata)	No common name	2
Asplenium dielerectum	No common name	2

Asplenium unisorum	No common name	2
Astragalus ampullarioides	Shivwits milk-vetch	2
Astragalus brauntonii	Braunton's milk-vetch	3
Astragalus holmgreniorum	Holmgren milk-vetch	5
Astragalus lentiginosus var. coachellae	Coachella Valley milk-vetch	3
Astragalus pycnostachyus var. lanosissimus	Ventura Marsh milk-vetch	4
Bidens amplectens	Ko`oko`olau	5
Bidens campylotheca ssp. pentamera	Ko`oko`olau	3
Bidens conjuncta	Ko`oko`olau	2
Bombus affinis	Rusty patched bumble bee	50
Bonamia menziesii	No common name	7
Brachyramphus marmoratus	Marbled murrelet	5
Branchinecta conservatio	Conservancy fairy shrimp	5
Branchinecta lynchi	Vernal pool fairy shrimp	18
Branchinecta sandiegonensis	San Diego fairy shrimp	29
Brighamia rockii	Pua `ala	2
Brodiaea filifolia	Thread-leaved brodiaea	9
Bufo houstonensis	Houston toad	2
Canis lupus	Gray wolf	4
Caretta caretta	Loggerhead sea turtle	14
Catostomus santaanae	Santa Ana sucker	15
Cenchrus agrimonioides	Kamanomano	3
Charadrius melodus	Piping plover	31
Charadrius nivosus nivosus	Western snowy plover	39
Chasiempis ibidis	Oahu elepaio	2
Chasmistes brevirostris	Shortnose sucker	2
Chasmistes liorus	June sucker	2
Cicindela nevadica lincolniana	Salt Creek tiger beetle	4
Cirsium hydrophilum var. hydrophilum	Suisun thistle	4
Clermontia oblongifolia ssp. mauiensis	`Oha wai	2
Coccyzus americanus	Yellow-billed cuckoo	7
Cordylanthus mollis ssp. mollis	Soft bird's-beak	9
Ctenitis squamigera	Pauoa	3
Cumberlandia monodonta	Spectaclecase	12
Cyanea acuminata	Haha	2
Cyanea asplenifolia	Haha	2
Cyanea calycina	Haha	2
Cyanea glabra	Haha	3
Cyanea grimesiana ssp. grimesiana	Haha	2
Cyanea grimesiana ssp. obatae	Haha	2
Cyanea kunthiana	Haha	3
Cyanea lobata	Haha	2
Cyanea magnicalyx	Haha	2
Cyclonaias necki	Guadalupe orb	6
Cyperus pennatiformis	No common name	2
Cyrtandra dentata	Ha`iwale	3
Cyrtandra filipes	Ha`iwale	2
Cyrtandra munroi	Ha`iwale	2

Deinandra (=Hemizonia) conjugens	Otay tarplant	9
Delphinapterus leucas	Beluga whale	10
Deltistes luxatus	Lost river sucker	2
Dendrogyra cylindrus	Pillar coral	34
Dermochelys coriacea	Leatherback sea turtle	5
Desmocerus californicus dimorphus	Valley elderberry longhorn beetle	2
Diplazium molokaiense	No common name	4
Dipodomys merriami parvus	San Bernardino Merriam's kangaroo rat	12
Dracaena forbesii	Hala pepe	2
Dubautia herbstobatae	Na`ena`e	2
Dubautia plantaginea ssp. humilis	Na`ena`e	2
Elaphrus viridis	Delta green ground beetle	3
Eleutherodactylus cooki	Guajon	3
Eleutherodactylus juanariveroi	Llanero coqui	6
Elliptoideus sloatianus	Purple bankclimber	5
Empidonax traillii extimus	Southwestern willow flycatcher	37
Enhydra lutris kenyoni	Northern sea otter	9
Epinephelus striatus	Nassau grouper	7
Epioblasma brevidens	Cumberlandian combshell	3
Epioblasma capsaeformis	Oyster mussel	3
Epioblasma triquetra	Snuffbox mussel	14
Eragrostis fosbergii	Fosberg's love grass	2
Eremophila alpestris strigata	Streaked horned lark	3
Erigeron decumbens	Willamette daisy	2
Erignathus barbatus nauticus	Bearded seal (Beringia DPS)	15
Erimonax monachus	Spotfin chub	3
Erimystax cahni	Slender chub	2
Erysimum capitatum var. angustatum	Contra Costa wallflower	6
Eubalaena glacialis	North Atlantic right whale	15
Eucyclogobius newberryi	Tidewater goby	11
Eumetopias jubatus	Steller sea lion	11
Eumops floridanus	Florida bonneted bat	2
Euphorbia celastroides var. kaenana	`Akoko	5
Euphorbia haeleeleana	`Akoko	5
Euphorbia herbstii	`Akoko	2
Euphorbia kuwaleana	`Akoko	2
Euphorbia skottsbergii var. skottsbergii	`Akoko	5
Euphydryas editha bayensis	Bay checkerspot butterfly	11
Euphydryas editha quino (=E. e. wrighti)	Quino checkerspot butterfly	6
Eurycea tonkawae	Jollyville Plateau salamander	4
Eurycea waterlooensis	Austin blind salamander	2
Faxonius peruncus	Big Creek crayfish	4
Faxonius quadruncus	St. Francis River crayfish	4
Flueggea neowawraea	Mehamehame	2
Fremontodendron mexicanum	Mexican flannelbush	3
Fusconaia escambia	Narrow pigtoe	3
Fusconaia mitchelli	false spike	6
Fusconaia subrotunda	Longsolid	8

Gardenia mannii	Nanu	2
Gila seminuda (=robusta)	Virgin River chub	6
Glaucopsyche lygdamus palosverdesensis	Palos Verdes blue butterfly	4
Gopherus agassizii	Desert tortoise	12
Gouania meyenii	No common name	5
Gouania vitifolia	No common name	7
Grus americana	Whooping crane	2
Gymnogyps californianus	California condor	2
Haliotis cracherodii	Black abalone	10
Hamiota altilis	Finelined pocketbook	2
Hamiota australis	Southern sandshell	3
Hamiota perovalis	Orangenacre mucket	2
Hamiota subangulata	Shinyrayed pocketbook	5
Hesperia dacotae	Dakota skipper	2
Hesperomannia arborescens	No common name	4
Hesperomannia arbuscula	No common name	3
Hibiscus brackenridgei	(=Native yellow hibiscus) ma`o hau hele	6
Holocarpha macradenia	Santa Cruz tarplant	3
Hybognathus amarus	Rio Grande silvery minnow	6
Hypomesus transpacificus	Delta smelt	30
Icaricia icarioides fenderi	Fender's blue butterfly	2
Isodendrion laurifolium	Aupaka	2
Isodendrion longifolium	Aupaka	3
Isodendrion pyrifolium	Wahine noho kula	8
Kadua coriacea	Kio`ele	2
Kadua degeneri	No common name	2
Kadua laxiflora	Pilo	2
Kadua parvula	No common name	2
Korthalsella degeneri	Hulumoa	2
Labordia cyrtandrae	Kamakahala	2
Lampsilis bracteata	Texas fatmucket	2
Lampsilis rafinesqueana	Neosho mucket	12
Lasthenia conjugens	Contra Costa goldfields	15
Lepidium arbuscula	`Anaunau	2
Lepidium papilliferum	Slickspot peppergrass	3
Lepidurus packardi	Vernal pool tadpole shrimp	16
Limnanthes floccosa ssp. californica	Butte County meadowfoam	3
Lipochaeta lobata var. leptophylla	Nehe	2
Lobelia niihauensis	No common name	2
Lobelia oahuensis	No common name	2
Lupinus sulphureus ssp. kincaidii	Kincaid's lupine	2
Lycaena hermes	Hermes copper butterfly	13
Lynx canadensis	Canada lynx	4
Lysimachia lydgatei	No common name	2
Macrhybopsis tetranema	Peppered chub	4
Masticophis lateralis euryxanthus	Alameda whipsnake (=striped racer)	18
Medionidus acutissimus	Alabama moccasinshell	2

Medionidus parvulus	Coosa moccasinshell	2
Medionidus penicillatus	Gulf moccasinshell	4
Megaptera novaeangliae	Humpback whale	19
Melanthera tenuifolia	Nehe	5
Melicope cornuta var. decurrens	No common name	2
Melicope makahae	Alani	2
Melicope saint-johnii	Alani	2
Mycetophyllia ferox	Rough cactus coral	32
Myotis sodalis	Indiana bat	12
Navarretia fossalis	Spreading navarretia	25
Necturus lewisi	Neuse River waterdog	3
Neomonachus schauinslandi	Hawaiian monk seal	17
Neraudia angulata	No common name	5
Nototrichium humile	Kulu`i	5
Notropis girardi	Arkansas River shiner	5
Notropis topeka (=tristis)	Topeka shiner	7
Oarisma poweshiek	Poweshiek skipperling	7
Obovaria choctawensis	Choctaw bean	3
Oenothera deltoides ssp. howellii	Antioch Dunes evening-primrose	6
Oncorhynchus tshawytscha	Chinook salmon	27
Orbicella annularis	Lobed star coral	34
Orbicella faveolata	Mountainous star coral	34
Orbicella franksi	Boulder star coral	34
Orcinus orca	Killer whale	11
Ovis canadensis nelsoni	Peninsular bighorn sheep	3
Palmeria dolei	`Akohekohe (crested honeycreeper)	3
Percina aurora	Pearl darter	3
Peucedanum sandwicense	Makou	5
Phlegmariurus mannii	Wawae`iole	3
Phoca (=Pusa) hispida hispida	Ringed seal	16
Phyllostegia bracteata	No common name	3
Phyllostegia hirsuta	No common name	2
Phyllostegia kaalaensis	No common name	2
Phyllostegia parviflora	No common name	2
Plagopterus argentissimus	Woundfin	6
Plantago princeps	Kuahiwi laukahi	6
Platanthera holochila	No common name	4
Plethobasus cyphyus	Sheepnose mussel	10
Pleurobema decisum	Southern clubshell	3
Pleurobema georgianum	Southern pigtoe	2
Pleurobema perovatum	Ovate clubshell	2
Pleurobema pyriforme	Oval pigtoe	5
Pleurobema strodeanum	Fuzzy pigtoe	3
Pleuronaia dolabelloides	Slabside pearlymussel	3
Polioptila californica californica	Coastal California gnatcatcher	56
Pseudonestor xanthophrys	Maui parrotbill (Kiwikiu)	3
Pseudorca crassidens	False killer whale	17
Pteralyxia macrocarpa	Kaulu	3

Pteris lidgatei	No common name	3
Ptychobranchus greenii	Triangular kidneyshell	2
Ptychobranchus jonesi	Southern kidneyshell	3
Ptychobranchus subtentus	Fluted kidneyshell	4
Ptychocheilus lucius	Colorado pikeminnow	4
Quadrula cylindrica cylindrica	Rabbitsfoot	15
Quadrula cylindrica strigillata	Rough rabbitsfoot	3
Rana draytonii	California red-legged frog	38
Rana sevosa	Dusky gopher frog	2
Reginaia rotulata	Round ebonyshell	3
Remya mauiensis	Maui remya	2
Salmo salar	Atlantic salmon	6
Salvelinus confluentus	Bull trout	20
Sanicula mariversa	No common name	2
Sanicula purpurea	No common name	2
Santalum haleakalae var. lanaiense	Lanai sandalwood (=`iliahi)	2
Schenkia sebaeoides	Awiwi	6
Schiedea hookeri	No common name	5
Schiedea kealiae	Ma`oli`oli	5
Schiedea nuttallii	No common name	2
Schiedea obovata	No common name	2
Schiedea trinervis	No common name	2
Scutellaria ocmulgee	Ocmulgee skullcap	4
Sebastes paucispinis	Bocaccio	6
Sebastes ruberrimus	Yelloweye rockfish	5
Sesbania tomentosa	Ohai	7
Silene lanceolata	No common name	2
Silene perlmanii	No common name	2
Somateria fischeri	Spectacled eider	6
Somatochlora hineana	Hine's emerald dragonfly	4
Spermolepis hawaiiensis	No common name	6
Sphaeralcea gierischii	Gierisch mallow	2
Streptanthus bracteatus	Bracted twistflower	3
Streptocephalus woottoni	Riverside fairy shrimp	6
Strix occidentalis lucida	Mexican spotted owl	6
Tetramolopium capillare	Pamakani	2
Tetramolopium filiforme	No common name	2
Tetramolopium lepidotum ssp. lepidotum	No common name	2
Ursus maritimus	Polar bear	24
Varronia rupicola	No common name	3
Vigna o-wahuensis	No common name	7
Villosa fabalis	Rayed bea	14
Villosa perpurpurea	Purple bean	4
Viola chamissoniana ssp. chamissoniana	Pamakani	2
Vireo bellii pusillus	Least Bell's vireo	16
Wikstroemia villosa	No common name	2
Xyrauchen texanus	Razorback sucker	2
Zapus hudsonius preblei	Preble's meadow jumping mouse	7

Table 3. These 23 federally listed species and subspecies have at least one fossil fuel power plant directly overlapping their critical habitat.

Scientific Name	Common Name
Astragalus holmgreniorum	Holmgren milk-vetch
Bombus affinis	Rusty patched bumble bee
Branchinecta lynchi	Vernal pool fairy shrimp
Bufo houstonensis	Houston toad
Canis lupus	Gray wolf
Caretta caretta	Loggerhead sea turtle
Charadrius melodus	Piping Plover
Erysimum capitatum var. angustatum	Contra Costa wallflower
Gopherus agassizii	Desert tortoise
Grus americana	Whooping crane
Gymnogyps californianus	California condor
Hypomesus transpacificus	Delta smelt
Lepidurus packardi	Vernal pool tadpole shrimp
Lynx canadensis	Canada lynx
Myotis sodalis	Indiana bat
Oenothera deltoides ssp. howellii	Antioch Dunes evening-primrose
Polioptila californica californica	Coastal California gnatcatcher
Pristis pectinata	Smalltooth sawfish
Rana draytonii	California red-legged frog
Salmo salar	Atlantic salmon
Somateria fischeri	Spectacled eider
Strix occidentalis caurina	Northern spotted owl
Ursus maritimus	Polar bear