

[ORAL ARGUMENT NOT YET SCHEDULED]
No. 22-1139

**UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT**

CONCERNED HOUSEHOLD ELECTRICITY CONSUMERS COUNCIL, *ET AL.*,
Petitioners,

v.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY,
Respondent.

On Consolidated Petitions for Review of EPA Final Order
Consolidated with Case No. 22-1140

**BRIEF OF CLIMATE CHANGE SCIENTISTS CHRISTOPHER FIELD,
MICHAEL OPPENHEIMER, AND SUSAN SOLOMON AS
AMICI CURIAE IN SUPPORT OF RESPONDENT AND DENIAL**

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CERTIFICATE AS TO PARTIES, RULINGS, AND RELATED CASES

Pursuant to D.C. Circuit Rule 28(a)(1), *amici curiae* certify as follows:

A. Parties And *Amici*

Except for the *amici* joining this brief and any other *amici* who had not yet entered an appearance in this case as of the filing of this brief, all parties, intervenors, and *amici* appearing before this Court are listed in the Corrected Brief for Petitioners.

B. Rulings Under Review

The rulings at issue are listed in the Corrected Brief for Petitioners.

C. Related Cases

The related cases are listed in the Corrected Brief for Petitioners.

/s/ Thomas G. Sprankling
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CORPORATE DISCLOSURE STATEMENT

Pursuant to Federal Rule of Appellate Procedure 26.1 and D.C. Circuit Rule 26.1, *amici curiae* certify that they are all individuals—i.e., none of them is a publicly held corporation, no *amici* has a parent company, and no publicly held corporation owns a 10% or more ownership interest in any of the *amici*.

/s/ Thomas G. Sprankling

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GLOSSARY

EPA	Environmental Protection Agency
IPCC	Intergovernmental Panel on Climate Change
NOAA	National Oceanic & Atmospheric Administration
PLOS	Public Library of Science
USGCRP	U.S. Global Change Research Program

INTEREST OF *AMICI CURIAE*

Amici curiae are individual climate scientists who have dedicated their careers to studying changes to the Earth's climate—including those that have been caused by human activities—and the broader effects of these changes.¹

Amicus Christopher B. Field is the Melvin and Joan Lane professor for Interdisciplinary Environmental Studies at Stanford University and the Perry L. McCarty Director of the Stanford Woods Institute for the Environment. He co-chaired the Intergovernmental Panel on Climate Change's ("IPCC") Working Group II from 2008 to 2015, where he led the effort to draft materials on climate change impacts and adaptation.

Amicus Michael Oppenheimer is the Albert G. Milbank Professor of Geosciences and International Affairs at Princeton University. He is a long-time participant in the IPCC, which won the Nobel Peace Prize in 2007. He served most recently as a coordinating lead author on IPCC's *Special Report on the Ocean and Cryosphere in a Changing Climate* (2019), and he served as a Review Editor of its Sixth Assessment Report.

¹ All parties have consented to the filing of this brief. No counsel for any party authored this brief in whole or in part, and no counsel or party other than *amici* or their counsel made a monetary contribution intended to fund the preparation or submission of this brief.

Amicus Susan Solomon is the Lee and Geraldine Martin Professor of Environmental Studies at Massachusetts Institute of Technology. She is particularly well known for having pioneered the theory explaining why the ozone hole occurs in Antarctica and obtaining some of the first chemical measurements that helped to establish the chlorofluorocarbons as its cause. She co-chaired the IPCC Working Group I from 2002 to 2008, where she co-led the effort to draft materials assessing the physical science basis for climate change.

The central issue in this case—the continuing validity of EPA’s Endangerment Finding—is of great importance to *amici* because it goes to the heart of the United States’ ability to combat climate change at the federal level at a critical time. It is unequivocal that human influence has warmed the atmosphere, ocean and land. Indeed, widespread and rapid changes have already occurred to the atmosphere, ocean, and land as well as to the frozen parts of the Earth, affecting many ecosystems and life itself. While Americans have already felt, and will continue to feel, the impacts of climate change, regulatory action by EPA can still mitigate future danger—assuming EPA retains authority to act.

SUMMARY OF ARGUMENT

Fifteen years ago, the U.S. Supreme Court concluded both that “[a] well-documented rise in global temperatures has coincided with a significant increase in carbon dioxide in the atmosphere,” and that “[t]he harms associated with climate

change are serious and well recognized.” *Massachusetts v. EPA*, 549 U.S. 497, 504-505, 521 (2007). The Supreme Court’s ruling “spurred a cascading series of greenhouse gas-related rules and regulations,” including EPA’s 2009 Endangerment Finding at issue here—i.e., that ““greenhouse gases ... cause global climate change ... which is reasonably anticipated to endanger public health and welfare.”” *Coalition for Responsible Regulation, Inc. v. EPA*, 684 F.3d 102, 114-115 (D.C. Cir. 2012), *rev’d in part on other grounds sub nom. Util Air. Regul. Grp. v. EPA*, 573 U.S. 302 (2014).

The evidence undergirding *Massachusetts v. EPA* and the Endangerment Finding was already strong when those decisions were issued and has only grown stronger with time. It is now “unequivocal that human influence has warmed the atmosphere, ocean, and land.” IPCC, *Sixth Assessment Report: The Physical Science Basis*, Headline Statements at 1 (Aug. 2021) (“*IPCC Sixth Assessment: Physical Science*”).² And there is “[e]xtensive evidence[] ... that human activities, especially emissions of greenhouse gases, are the dominant cause” of global warming since the 1950s. See U.S. Global Change Research Program (“USGCRP”), *Climate Science Special Report: Fourth National Climate*

² Available at <https://tinyurl.com/5n878suk>.

Assessment, Volume I at 10 (2017) (“*Fourth National Climate Assessment, Vol. I*”).³

This brief addresses three basic points about the science of climate change. First, it explains the scientific principles underlying human-caused changes to Earth’s climate, and the ever-increasing volume of data showing how those changes have affected the planet. Second, the brief explains why the body of scientific evidence supporting the core conclusions of EPA’s Endangerment Finding has become even more compelling as our field has advanced over the past decade. Finally, it briefly addresses specific assertions that petitioners have raised regarding the 2009 Endangerment Finding and the underlying science.

ARGUMENT

I. IT IS UNEQUIVOCAL THAT HUMAN ACTIVITY IS THE CAUSE OF UNPRECEDENTED GLOBAL WARMING

A. The Greenhouse Effect Controls The Earth’s Temperature, Which Has Been Rising At An Unprecedented Rate

The basic physics of the greenhouse effect are well-understood. The Earth’s atmosphere contains not just nitrogen and the oxygen we breathe, but also greenhouse gases like water vapor, carbon dioxide, methane, and nitrous oxide. *Fourth National Climate Assessment, Vol. I* at 74-80. As the U.S. Supreme Court has summarized, “greenhouse gases are so named because they ‘trap ... heat that

³ Available at <https://tinyurl.com/yc5kb6bt>.

would otherwise escape from the [Earth's] atmosphere.” *American Electric Power Co. v. Connecticut*, 564 U.S. 410, 416 (2011). The resulting ““greenhouse effect ... helps keep the Earth warm enough for life.” *Id.*

Much of the difference in surface temperature between the Earth and other planets in our solar system—such as fiery Venus and frigid Mars—can be explained by their respective greenhouse gas levels. *See Climate Change, Part I: House Committee Hearing Before the Subcommittee on Environment* at 3 (Apr. 9, 2019) (Testimony of Dr. Michael Oppenheimer) (“Oppenheimer 2019 Testimony”).⁴ Without greenhouse gases, for example, the Earth’s average surface temperature would drop to as low as 0 degrees Fahrenheit. National Aeronautic & Space Administration, Earth Observatory, *Effects of Changing the Carbon Cycle* (June 16, 2011).⁵

It is similarly well-established that the Earth is warming at an unprecedented rate. *See IPCC Sixth Assessment: Physical Science, Summary for Policymakers* at 8⁶; *see also Fourth National Climate Assessment, Vol. I* at 10 (“This period is now the warmest in the history of modern civilization.”). It can be stated with high confidence that the Earth’s global average surface temperature has risen more

⁴ Available at <https://tinyurl.com/2rxv2pfh>.

⁵ Available at <https://tinyurl.com/yckmw4a5>.

⁶ Available at <https://tinyurl.com/y45v8mjj>.

rapidly since 1970 than it has in any other 50-year period since the days of Julius Caesar. *IPCC Sixth Assessment: Physical Science*, Summary for Policymakers at 8. As a result, “the six warmest years on record have all occurred since 2012,” including 2021. See National Oceanic & Atmospheric Admin. (“NOAA”), *U.S. saw its 4th-warmest year on record, fueled by a record-warm December* (Jan. 10, 2022).⁷ And while the full data for 2022 is not yet in, “there is a greater than 99% chance that 2022 will rank among the 10-warmest years on record.” NOAA, *Earth had its 4th-warmest October on Record* (Nov. 15, 2022).⁸

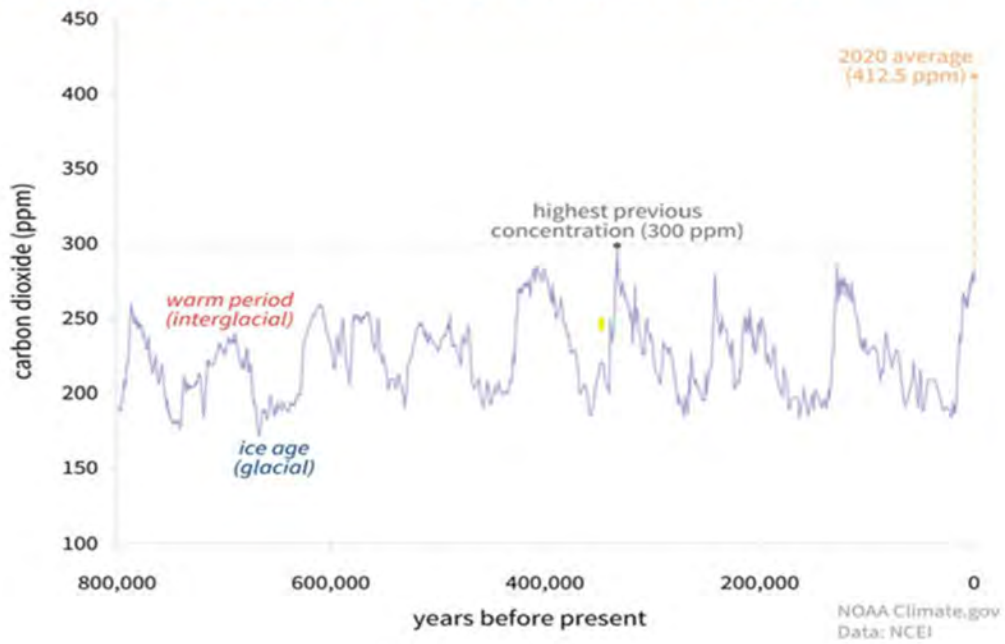
We can state with high confidence that as temperatures have risen, the concentrations in the Earth’s atmosphere of the greenhouse gases have also increased and now are higher than they have been in at least hundreds of thousands of years. *IPCC Sixth Assessment: Physical Science*, Summary for Policymakers at 8. Carbon dioxide alone makes up a higher percentage of the atmosphere than it has in millions of years. *Id.* Data published by the NOAA, pictured in the charts below, demonstrate how the concentration of carbon dioxide in the atmosphere has skyrocketed in the last sixty years.⁹

⁷ Available at <https://tinyurl.com/2p8tt93x>.

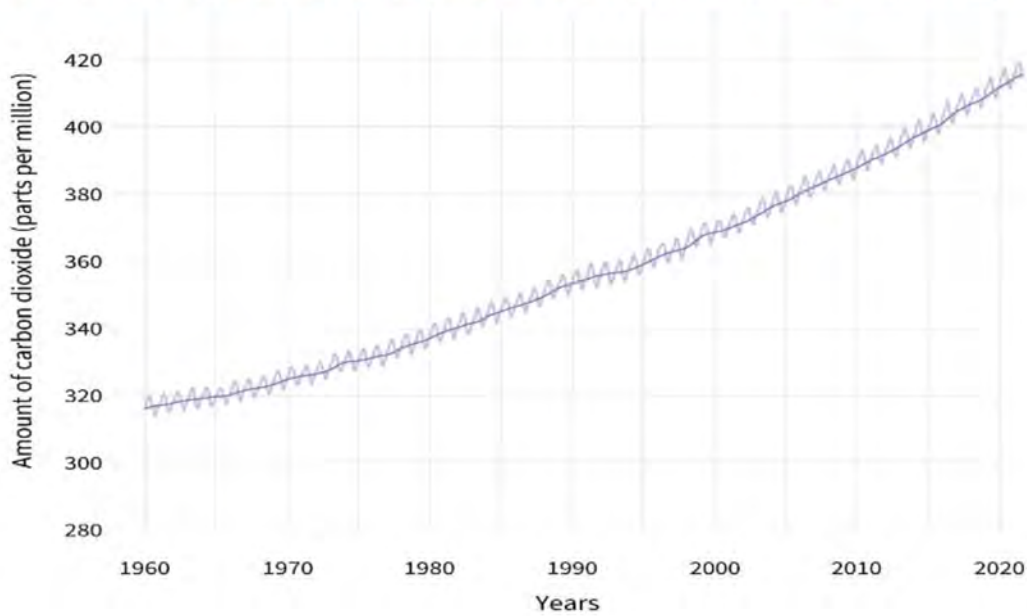
⁸ Available at <https://tinyurl.com/ye28nxx6>.

⁹ The first chart can be found at <https://tinyurl.com/2p9c6cy2> (visited Dec. 23, 2022); the second at <https://tinyurl.com/3rr7xmeu> (visited Dec. 23, 2022). The charts’ reference to “parts per million” or “ppm” refers to how many parts of carbon dioxide are in one million parts of air.

CARBON DIOXIDE OVER 800,000 YEARS



ATMOSPHERIC CARBON DIOXIDE (1960-2021)



B. The Only Convincing Explanation For The Rapid Rise In Global Temperature Is That Human Activity Has Altered The Makeup Of The Earth's Atmosphere

The observation of both a warming Earth and the skyrocketing levels of carbon dioxide in the modern era is not coincidental. Rather, the evidence is now “unequivocal that human influence has warmed the atmosphere, ocean, and land” and that “[w]idespread and rapid changes in the atmosphere, ocean, ... and biosphere have occurred.” *IPCC Sixth Assessment: Physical Science, Summary for Policymakers* at 4. The average surface temperatures both globally and in the United States have increased by about 2 degrees Fahrenheit since the late 19th century, with the majority of that increase occurring in the last 35 years. See Lindsey & Dahlman, *Climate Change: Global Temperature* (June 28, 2022)¹⁰; EPA, *Climate Change Indicators: U.S. and Global Temperature* (figs. 1-2) (updated Aug. 1, 2022)¹¹; *Fourth National Climate Assessment, Vol. I* at 14. “Greenhouse gas emissions from human activities are the only factors that can account for the observed warming over the last century; there are no credible alternative human or natural explanations.” USGCRP, *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* at

¹⁰ Available at <https://tinyurl.com/2xw9nfzn>.

¹¹ Available at <https://tinyurl.com/4jtcknad>.

39-40 (2018) (“*Fourth National Climate Assessment, Vol. II*”)¹²; see also, e.g., Mann et al., *Record temperature streak bears anthropogenic footprint*, 44 *Geophys. Res. Lett.* 7936, 7936 (2017) (“th[e] sequence of record-breaking temperatures [between 2014-2016] had a negligible (<.003%) likelihood of occurrence in the absence of ... warming” caused by human activity).¹³

A new set of observations from robotic thermometers (called “floats”) that measure temperatures within the world’s oceans provides a demonstration of the connection between the rise in greenhouse gas concentrations in the atmosphere and global warming. See Destin, NOAA, *The Argo revolution*, Climate.gov (Dec. 5, 2014).¹⁴ Data collected from these machines show the deep ocean is slowly warming across the globe, a predictable consequence of rising greenhouse gas levels in Earth’s atmosphere. See Johnson & Lyman, *Warming trends increasingly dominate global ocean*, 10 *Nature Climate Change* 757, 757, 760 (2020); Lyman et al., *Robust warming of the global upper ocean*, 465 *Nature* 334, 334, 336 (2010); IPCC, *Special Report on the Ocean and Cryosphere in a Changing Climate*, Summary for Policymakers at 7, 9 (2019) (“*IPCC Ocean and Cryosphere*”).¹⁵ This

¹² Available at <https://tinyurl.com/ymhr5dcb>.

¹³ Available at <https://tinyurl.com/yfs2ahyv>.

¹⁴ Available at <https://tinyurl.com/2x7d85d3>.

¹⁵ Available at <https://tinyurl.com/mswryzap>.

sustained warming of the ocean cannot be explained by any process other than the rise of greenhouse gases.

As one of us has summarized, “the broad outlines of [this] problem bearing high risk for humans and society” have been apparent for over thirty years, “even if many important details remained to be fleshed out.” Oppenheimer 2019

Testimony at 3. By the late 1980s, it was known that (1) “atmospheric carbon dioxide ... was increasing and the only plausible explanation was fossil fuel combustion along with a lesser contribution from deforestation,” (2) “[c]limate models projected a significant warming due to the increasing greenhouse effect,” and (3) “it was ... understood that the warming could bring Earth to temperatures not experienced in several million years by the end of the 21st century.” *Id.* at 5. These findings led the United Nations to create the IPCC in 1988 and the United States (under the leadership of President George H.W. Bush) to create the USGCRP shortly thereafter. *Id.* at 5-6 (discussing the founding of the IPCC); USGCRP, *Legal Mandate* (visited Dec. 23, 2022).¹⁶

Since its inception, the IPCC has released six full assessments of the basic science of climate change, the most recent of which is cited throughout this brief.

¹⁶ Available at <https://tinyurl.com/2s3akhrx> (visited Dec. 23, 2022).

Each report has provided increasingly strong evidence that human activity is responsible for the changes in the global climate:

- The Second Assessment concluded “[t]he balance of evidence suggests a discernable human influence on global climate.” Oppenheimer 2019 Testimony at 6 (quoting IPCC, *Second Assessment: Climate Change 1995* (1996) at 22¹⁷).¹⁸
- The Third Assessment found “[t]here is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities.” *Id.* (quoting IPCC, *Third Assessment: Climate Change 2001* at 5 (first published 2001)¹⁹).
- The Fourth Assessment “strengthened this finding further: ‘Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in [human] greenhouse gas concentrations.’” *Id.* (quoting IPCC, *Fourth Assessment: Climate Change 2007*, Summary for Policymakers at 5 (first published 2007)²⁰).
- The Fifth Assessment concluded “[i]t is extremely likely that more than half of the observed increase in global average surface temperature from 1951 to 2010 was caused by [humanity’s] increase in greenhouse gas concentrations

¹⁷ Available at <https://tinyurl.com/yckv5mtb>.

¹⁸ Petitioners’ *amici* rely on a nearly 30-year-old opinion piece in order to cast doubt on the Second Assessment’s findings. Happer Amicus Br. 20-21. Not only was the author of that piece not a participant in IPCC assessments (or even a climate scientist), but the statements in the piece were rapidly debunked. *See, e.g.,* Edwards & Schneider, *Self-Governance and Peer Review in Science-for-Policy: The Case of the IPCC Second Assessment Report* in Miller & Edwards eds., CHANGING THE ATMOSPHERE 224 (2001) (discussing contemporary *Nature* article that “included explanations of the revision and review process” for the Second Assessment and argued that the allegations were “politically motivated and generally false”).

¹⁹ Available at <https://tinyurl.com/32su34ku>.

²⁰ Available at <https://tinyurl.com/2p8dn2ze>.

and other' human activity.” *Id.* (quoting IPCC, *Fifth Assessment: Climate Change 2014*, Summary for Policymakers at 5 (first published 2013)²¹).

- And, as noted, the Sixth Assessment—the relevant portion of which was published in August 2021—concluded the evidence “unequivocal[ly]” shows that human activity has led to climate change. *See supra* p. 3.

The USGCRP’s reports—which are jointly authored by thirteen federal agencies pursuant to the Global Change Research Act of 1990—have followed a similar trajectory as the IPCC’s.

- The first National Assessment, published in 2000, acknowledged that “[h]umans are exerting a major and growing influence on some of the key factors that govern climate” and that “[t]he intensity and pattern of temperature changes within the atmosphere implicates human activities as a cause.” *See* USGCRP, *Climate Change Impacts On The United States*, Report Overview at 12-13.²²
- The second National Assessment, published in 2009, stated that “[t]he global warming observed over the past 50 years is due *primarily* to human-induced emissions of heat-trapping gases.” *See* USGCRP, *Climate Change Impacts in the United States* at 9 (2009) (emphasis added).²³
- The third National Assessment, published in 2014, found “observations *unequivocally* show that ... the warming of the past 50 years is primarily due to human-induced emissions of heat-trapping gases.” USGCRP, *Climate Change Impact in the United States* at 5 (emphasis added).²⁴
- And the fourth National Assessment, first published in 2017, stated there is “no convincing alternative explanation” for the global increase in

²¹ Available at <https://tinyurl.com/2p8djehj>.

²² Available at <https://tinyurl.com/5e3z3tka>.

²³ Available at <https://tinyurl.com/2e7dc9d2>.

²⁴ Available at <https://tinyurl.com/3mj4m7ef>.

temperature beyond human activity. *Fourth National Climate Assessment, Vol. I* at 10.

In sum, after decades of study, the U.S. domestic and the international scientific communities have arrived at the same, unequivocal conclusion: Human activity—in particular, the emission of greenhouse gases—has increased the Earth’s temperature. *See, e.g., Fourth National Climate Assessment, Vol. II* at 36 (“[T]he evidence of human-caused climate change is overwhelming and continues to strengthen.”).

The relationship between future warming and future greenhouse gas emissions is clear. The unavoidable conclusion is that more emissions lead to more warming. Based on direct observations and a range of climate models of varying degrees of complexity, there is an approximately linear and robust relationship between total carbon dioxide emissions since the beginning of the industrial revolution and Earth’s average warming. Emissions from 1850 to 2019 were 2390 (± 240) billion tons of carbon dioxide, resulting in warming of 1.9 degrees Fahrenheit. If humans emit that amount in the future, warming can be expected to approximately double. *IPCC Sixth Assessment: Physical Science, Summary for Policymakers* at 28-29.

II. EPA CORRECTLY FOUND IN 2009 THAT CLIMATE CHANGE ENDANGERS PUBLIC HEALTH AND WELFARE, AND SUPPORT FOR THAT FINDING HAS ONLY STRENGTHENED OVER TIME

A. The 2009 Endangerment Finding Was Based On A Thorough, Transparent Review Of The Available Evidence

In 2009, EPA issued the Endangerment Finding at issue in this appeal. The Finding concluded that (1) human-caused air pollution “contribute[s] to the total greenhouse gas air pollution, and thus to the climate change problem,” (2) “greenhouse gases taken in combination endanger both the public health and the public welfare of current and future generations,” and (3) the threat to the public from various climate-change-caused disasters “is likely to increase over time.” 74 Fed. Reg. 66496, 66497-66499 (2009).

EPA did not arrive at these conclusions lightly. Rather, after years of consideration, the agency issued a lengthy explanation—accompanied by a “Technical Support Document” with 163 pages of analysis—that surveyed the available “body of scientific evidence” and found that it “compellingly supports th[e] finding” that humanity has contributed to climate change and that climate change is a threat to the public. *See* 74 Fed. Reg. 66497 & n.1; *see also* EPA, *Technical Support Document for Endangerment and Cause or Contribute Findings* (Dec. 7, 2009) (“*Technical Support Document*”).²⁵ This evidence included both

²⁵ Available at <https://tinyurl.com/yc62f2pr>.

the contemporaneous overall assessments from the IPCC and the USGCRP and the thousands of scientific studies underlying those assessments, which reviewed historical climate data, analyzed the existing impacts of climate change, and provided data-based projections for the future. *See Technical Support Document at 4-5; 74 Fed. Reg. 66511.* EPA's ultimate conclusions were also subjected to prolonged scrutiny from a variety of sources, ranging from other agencies to the general public, which provided over 380,000 comments. *Technical Support Document at 4; 74 Fed. Reg. 66500.*

In sum, EPA's approach rested on the same fundamental bases that we and other members of the scientific community have adopted when studying climate change: “[B]road participation, rigorous oversight, and transparent, thorough adherence to carefully designed procedures.” *See IPCC, Statement on IPCC Principles and Procedures at 1 (Feb. 2, 2010).*²⁶ While no “human endeavor can ... be completely error-free,” EPA—like the IPCC—rightly strove to “come as close to this goal” as possible. *Id.*

For the same basic reasons, we disagree with the suggestion of petitioners and their *amici* that scientific research that is peer-reviewed—or conducted on behalf of a national or international government entity—is inherently unreliable.

²⁶ Available at <https://tinyurl.com/yfs2ahyv>.

See Corrected Brief of Petitioners (“Pet. Br.”) 41-42; Happer Amicus Br. 7-8, 16-17. To the contrary, submitting one’s work to the careful scrutiny of learned colleagues and/or expert regulators helps hold us accountable and ensures that the scientific method is scrupulously observed. Peer review, for example, allows subject-matter experts to perform a screening and refining role before findings are published to the broader community of scientists—who may be less capable of discerning irregularities in matters outside of their area of expertise. And the kinds of overarching assessments performed by entities like IPCC and the USGCRP add value by putting the work done by individual scientists into a broader context—asking which papers have stood the test of time, remain consistent with the raw data, and cannot be otherwise rejected based on the totality of evidence. Further, IPCC is also subject to international scrutiny by nations worldwide, guaranteeing that its outcomes do not reflect the views of a single government or region. Such efforts are nothing less than essential to the evolution of scientific understanding on complex issues of international importance.

B. Current Evidence Only Strengthens EPA’s Overall Conclusion And Underlying Findings

The Endangerment Finding rested on EPA’s judgment that climate change endangers both public health (i.e., by making more likely increases in temperature, decreases in air quality, extreme weather, and the spread of climate-sensitive pathogens and allergens) and public welfare (i.e., by impacting agriculture,

forestry, water, sea level rise, energy supplies and infrastructure, and natural ecosystems). 74 Fed. Reg. at 66524, 66531-66534. In the years since the Finding issued, EPA’s conclusions have become ever more prescient. As one of us wrote, “the amount, diversity, and sophistication” of scientific evidence supporting these particular bases for the Endangerment Finding has “increased markedly.” Duffy, Field, & Diffenbaugh et al., *Strengthened scientific support for the Endangerment Finding for atmospheric greenhouse gases*, 363 Science (Feb. 8, 2019), at 1 (“*Strengthened Scientific Support*”).²⁷ Indeed, new evidence indicates that the risks climate change poses to the public health and welfare are even more severe or widespread than those anticipated in 2009. *Id.* Put simply, the “evidence published since the [Endangerment Finding] shows that the case for endangerment, which was already overwhelming in 2009, is even more strongly justified” today. *Id.* at Abstract.

1. Public health

Increasingly Extreme Heat. In 2009, EPA found that the occurrence of unusually hot days and heat waves was becoming more frequent as a result of climate change, a matter of great concern because “[h]eat [was] already the leading cause of weather-related deaths” in the U.S. and—based on available data from

²⁷ <https://tinyurl.com/y4jnnsbv>.

1989 to 2000—had already “triggered a 5.7 percent increase in [heat-related] death rates.” 74 Fed. Reg. 66524-66525.

Today, according to the federal government’s recent estimates, the frequency and duration of heatwaves across major cities in the U.S. have significantly increased. The average heatwave season “is about 49 days longer now than it was in the 1960s.” See EPA, *Climate Change Indicators: Heat Waves* (July 2022).²⁸ Additionally, the number of heatwaves is up from approximately 2 per year in the 1960s to 6 per year in the 2010s and 2020s. *Id.* This is no coincidence, as historical warming has made the hottest days of the year both more likely and hotter between 1961 and 2010. Diffenbaugh et al., *Quantifying the influence of global warming on unprecedented extreme climate events*, 114 *Proceedings of the National Academy of the Sciences* 4881, 4882-4883 (2017).²⁹

Moreover, in recent years, new evidence has confirmed that “[e]xtreme heat is the most direct health impact” of climate change and that in view of projected future warming, inhabitants of more than 200 American cities will face an increased risk of premature death caused by exposure to excessive temperatures. *Strengthened Scientific Support* at 2. Newer studies have also linked extreme heat

²⁸ Available at <https://tinyurl.com/ye23jv82>.

²⁹ Available at <https://tinyurl.com/n3dd85ak>.

to a wide range of health-related problems, ranging from sleep loss and kidney stones to low birth weight and suicide. *Id.*

Deteriorating Air Quality. In 2009, EPA projected that climate change would increase ozone pollution (i.e., smog), which would in turn cause an increase in respiratory illnesses and have “significant adverse effects on crop yields, pasture and forest growth, and species composition.” 74 Fed. Reg. 66525. New studies both (1) support the link between increased exposure to ozone and other air pollutants and various adverse health impacts and (2) suggest that, without intervention to reduce emissions, America will experience longer periods of peak ozone pollution (i.e., extending from the summer “into spring and/or fall”).

Strengthened Scientific Support at 2, 3. If the Earth continues to warm rapidly and greenhouse gas emissions are not reduced, the country could suffer “hundreds to thousands of deaths per year from poor air quality” that could be avoided under a lower emissions scenario. *Fourth National Climate Assessment, Vol. II* at 1359.

Storms and Hurricanes. EPA’s Endangerment Finding also projected that climate change would cause “more frequent extreme weather,” pointing to the potential for the increasing intensity of tropical cyclones and frequency of heavy precipitation events—both of which would increase the risk of death and injuries to affected populations. 74 Fed. Reg. at 66525.

In more recent years, studies have found that the unusual intensity of a number of “record-setting ... wet events” (e.g., the deluge of heavy precipitation during Hurricane Harvey) “can confidently be attributed to historical [greenhouse gas] emissions.” *Strengthened Scientific Support* at 2. For example, the exceptionally heavy precipitation and flooding events that occurred in the mid-Atlantic states including Pennsylvania, New Jersey, Maryland, and Washington, D.C. in 2018 were made 1.1 to 2.3 times more likely by human-caused climate change. See Winter et al., *Anthropogenic Impacts on the Exceptional Precipitation of 2018 in the Mid-Atlantic United States*, 101 Bull. Am. Meteorological Soc’y 5, 5 (2020).³⁰

Increased Spread of Pathogens and Allergens. EPA projected in 2009 that shifting environmental conditions as a result of climate change would likely cause an increase in both (1) pathogens in food and water and (2) animal disease carriers (such as ticks) that can infect humans, as certain organisms in both categories can thrive more easily with rising temperatures and increased flooding. 74 Fed. Reg. at 66498, 66525. EPA also found that there was “some evidence” that climate change “could increase the potential for allergenic illnesses” due to the

³⁰ Available at <https://tinyurl.com/2exx26wk>.

proliferation of allergens, but noted that then-current science was not clear on that issue. *Id.*

More recent studies have confirmed that “[c]hanges in temperature, precipitation and soil moisture” spurred by climate change have “alter[ed] habitats, life cycles, and feeding behaviors of vectors for most vector-borne diseases,” which in turn have increased exposure rates to diseases such as malaria, dengue, West Nile virus, and Lyme disease. *Strengthened Scientific Support* at 2. Similarly, “[r]ecent work also reinforces the evidence that increased outbreaks of waterborne and foodborne illnesses are likely to follow increasing temperatures and extreme participation.” *Id.* Finally, additional research has confirmed EPA’s statements about the allergy-amplifying effects of climate change—specifically, studies indicate that “rising temperatures and carbon dioxide ... levels will increase pollen production and lengthen the pollen season for many allergenic plants, leading to increased allergic respiratory disease.” *Id.*

2. Public welfare

Disruption of Agriculture and Food Production. In 2009, EPA projected that climate change could have a significant negative effect on agriculture. Specifically, the agency found that while climate change might have an initial positive effect on crop yields (due to, among other things, “modest temperature increases and a longer growing season”), it could be cancelled out by “enhance[d]

pest and weed growth” and, more broadly, “higher temperature increases, changing precipitation patterns ... and any increases in ground-level ozone.” 74 Fed. Reg. at 66531. Overall, “[t]he body of evidence points towards increasing risk of net adverse impacts ... with the potential for significant disruptions and crop failure in the future.” *Id.* at 66498.

More recent “[r]esearch has since confirmed [this] conclusion”—i.e., that any “positive effects are likely to be outweighed by negative impacts, especially in the long term.” *Strengthened Scientific Support* at 3. For example, there is “substantial new evidence” documenting “crop yield losses that result from short periods of exposure to high growing-season temperatures” (i.e., above 86 degrees Fahrenheit). *Id.* Similarly, “warmer winter nights” “will negatively affect” specific crops like cherries and apples that need “a certain amount of winter chill for high yields.” *Id.*³¹

Forestry and Wildfires. EPA noted that “[m]ore prevalent wildfire disturbances have recently been observed in the United States,” and concluded that while “elevated carbon dioxide concentrations and temperature increases” caused by climate change could “in the near term ... [have a] beneficial impact on forest

³¹ Petitioners’ *amici*’s suggestion that the increase in carbon dioxide in the atmosphere is an unmitigated good for agriculture, *see* Happer Amicus Br. 10, 32, is thus an oversimplification of a complex issue.

growth and productivity,” any such benefit was “offset by the clear risk from the observed increases in wildfires.” 74 Fed. Reg. at 66532, 66498; *see also id.* at 66530 (highlighting IPCC’s 2007 finding that there is “very high confidence that in North America, disturbances like wildfires are increasing and are likely to intensify in a warmer future”).

More recent research “broadly confirm[s]” EPA’s concerns that “climate change would likely bring more harm than benefits for U.S. forests during the 21st century.” *Strengthened Scientific Support* at 4. In particular, “[a] large body of new evidence points to increasing risks of tree mortality or forest loss in the western United States from,” *inter alia*, wildfire. *Id.* Climate change plays a role in such wildfires, as higher temperatures dry out vegetation and make forests more likely to burn. *Fourth National Climate Assessment, Vol. I* at 243. Spurred in significant part by this “warming-induced fuel drying,” “[a]nnual western U.S. forest-fire area increased by [roughly] 1000% from 1984 to 2017.” *Strengthened Scientific Support* at 4. *accord* Zhuang et al., *Quantifying contributions of natural variability and anthropogenic forcings on increased fire weather risk over the western United States*, 118 *Proceedings of the National Academy of the Sciences* 1, 7 (2021) (explaining human-caused warming has contributed to at least two-thirds of the increase in wildfires). Indeed, during the summer of 2015 alone, “over 10.1 million acres—an area larger than the entire state of Maryland—burned

across the United States.” *Fourth National Climate Assessment, Vol. II* at 67-68. And in 2017 and 2020, a combined total of 20 million acres across the United States were burned. Congressional Research Service, *Wildfire Statistics* (Dec. 2, 2022).³² These wildfires have devastating impacts to human health and property. “By the 2050s,” for example, “increased wildfire activity could elevate the concentrations of organic particles across the West by 46 to 70% depending on the ecoregion, and the frequency of smoke episodes could double in California,” *Strengthened Scientific Support* at 3, both of which can pose health risks. And between 2018-2021, approximately 50,00 structures were destroyed by wildfire—the majority of which were homes. Congressional Res. Serv., *Wildfire Statistics*.

Dwindling Water Resources and Quality. In 2009, EPA found “climate change has already altered, and will likely continue to alter, the water cycle,” causing, among other things, (1) shrinking snowpack due to increasing temperatures, (2) earlier seasonal melting, (3) increased rates of flooding, (4) longer droughts, and (5) increased constraints of “already over-allocated water resources.” 74 Fed. Reg. 66532-66533. Additionally, EPA noted climate change exacerbates many forms of water pollution, which also has a detrimental effect on human health. *Id.* at 66533.

³² Available at <https://tinyurl.com/3tfv75ct>.

More recent studies have made “substantial progress in quantifying trends in snowpack and associated impacts on water availability,” which further support EPA’s findings. *Strengthened Scientific Support* at 4-5. “[C]limate change impacts on snow hydrology and water scarcity are especially pronounced in the western United States,” and are projected to result in “reduc[ed] snow cover and ... depth,” dramatic “losses in annual maximum water stored in snowpack,” and “erod[ed] water quality” caused by *inter alia*, algae blooms. *Id.* at 5. Even in other parts of the country, such as the Great Lakes, “[i]ncreased water temperatures and nutrient inputs [caused by global warming will] contribute to algal blooms, including harmful cyanobacterial algae that are toxic to people, pets and many native species.” *Fourth National Climate Assessment, Vol. II* at 895.

Rising Seas and Flooding. The Endangerment Finding concluded coastal areas are particularly susceptible to the risks of climate change due to rising sea levels, which exacerbate flooding and shoreline erosion resulting from storm surge and high tides. 74 Fed. Reg. 66533. It noted that coastal cities such as New Orleans, Miami, and New York “are particularly at risk, and could have difficulty coping with the sea level rise projected by the end of the century under a higher emissions scenario.” *Id.*

Today, it can be stated with high confidence that global sea levels have risen faster since 1900 than over any prior century in 3000 years. *IPCC Sixth*

Assessment: Physical Science, Summary for Policymakers at 8. Specifically, ocean levels rose 2.5 times faster between 2006-2015 (about 14 inches per century) than they did between 1901 and 1990 (about 6 inches per century). *IPCC Ocean and Cryosphere* at 7, 9. And the rate of sea level rise is only projected to increase. By 2050, it may be greater than 7 millimeters a year (i.e., 27.5 inches per century)—“a global average [] rate unprecedented in the last 7000 years.”

Strengthened Scientific Support at 5. Even under a scenario where sea rise is at an “intermediate low” level, NOAA has projected that, by 2100, much of the East Coast and Gulf of Mexico shoreline will face tidal flooding every other day. *Id.* The Northeast in particular faces a serious threat, especially in the historic districts of cities like Annapolis, Maryland, and Newport, Rhode Island, as well as portions of Washington D.C. near the tidal basin. *See Fourth National Climate Assessment, Vol. II* at 695-696 (noting the “historic districts” in coastal cities and towns—like Annapolis and Newport—already “face the threat of rising sea levels”).

Increased Pressure on Energy Supply and Infrastructure. In 2009, EPA found “clear evidence that temperature increases will change heating and cooling demand,” which “is expected to call for an increase in electricity production, especially supply for peak demand.” 74 Fed. Reg. 66533-66534. Additionally, EPA noted the extreme weather events associated with climate change “could threaten U.S. energy infrastructure (transmission and distribution), transportation

infrastructure (roads, bridges, airports and seaports), water infrastructure, and other built aspects of human settlements.” *Id.* at 66534.

The evidence since 2009 supporting EPA’s findings “has become stronger and broader.” *Strengthened Scientific Support*, at 5. Not only does recent research “document[] an increase in energy demand for cooling” and “a greater reliance on electricity relative to other energy sources,” but much of “America’s energy and transportation infrastructure is located in low-lying coastal and riverine areas,” meaning it “is vulnerable to flooding from extreme weather events.” *Id.*

Disruption of Ecosystems and Loss of Biodiversity. The Endangerment Finding concluded there was “clear evidence that climate change is exerting major influences on natural environments and biodiversity,” influences that “are generally expected to grow with increased warming.” 74 Fed. Reg. at 66534. These changes put land and sea creatures alike “at far greater risk of extinction than in the geological past.” *Id.* For example, increases in ocean surface temperatures “will likely” harm coral reefs, increased land temperatures “may lead to conversion of shrubland into desert and grassland,” and the disappearance of certain plant species “in response to climate change can increase ecosystem vulnerability to ... wildfires and insect outbreaks.” *Id.*

More recent studies “have clarified and extended these findings,” making it “clear that prior global estimates *underestimated* the impacts of [human-caused]

climate change on ecosystems and wildlife.” *Strengthened Scientific Support* at 6 (emphasis added). For example, the scientific community has found “species are responding more slowly” to the changed timing of spring and other seasons than the rate at which changes are occurring—meaning the “bird and butterfly communities ... suffer a ‘climate debt’” (a term that refers to the gap between required and realized adaptations to a changing ecosystem). *Id.* More broadly, 21st-century climate change threatens the existence of “15% of all species,” such as those who have small geographical ranges or who live in habitats that are shrinking as a direct result of climate change (e.g., sea-ice ecosystems). *Id.* Indeed, climate change has already thinned some species’ populations and contributed to local extinction. *E.g.*, Wiens, *Climate-Related Local Extinctions are Already Widespread Among Plant and Animal Species*, 14 PLOS Biology 1, 1 (2016) (“[C]limate-related local extinctions have already occurred in ... 47% of the 976 species surveyed” and “will presumably become much more prevalent as global warming increases”).³³

³³ Available at <https://tinyurl.com/nhf2cptc>.

III. PETITIONERS' BRIEF MISUNDERSTANDS BOTH THE ENDANGERMENT FINDING AND CLIMATE CHANGE SCIENCE

Petitioners' brief makes a number of unfortunate errors in discussing EPA's 2009 finding and the underlying science. We briefly address several examples below.

As an initial matter, petitioners' repeated suggestion that EPA relied on just "three lines of evidence" to support the Endangerment Finding, *e.g.*, Pet. Br. 8, does not tell the whole story. To be sure, EPA relied on three broad *categories* of scientific evidence to support the Finding—i.e., the "basic physical understanding of the effects of changing concentrations of greenhouse gases, natural factors, and other human impacts," "historical estimates of past climate changes," and "the use of computer-based climate models to simulate" future conditions. *See* 74 Fed. Reg. at 66518. But this is no different from saying that, as a general matter, the Finding relied on evidence from the past, present, and (projected) future.

Petitioners' suggestion that each broad category of evidence is invalid because they have (in their view) disproven a few cherry-picked points, *see* Pet. Br. 10, makes little sense. Without addressing the significant weight of the data underpinning each category of evidence, petitioners cannot reasonably "invalidate" EPA's conclusions that human activity has increased the Earth's temperature and that climate change poses a threat to public health and welfare.

Petitioners' scientific arguments are also flawed. For example, petitioners rely heavily on a handful of reports authored by the same trio of authors. *See, e.g.*, Pet. Br. 40-43 (discussing the “Wallace 2016, April 2017, and 2018” articles). These articles do not appear to have gone through a formal peer review process or otherwise have been subject to the kind of rigorous oversight and transparent adherence to procedure that characterizes both EPA's and IPCC's work. To the contrary, petitioners' assertion (which relies on yet another Wallace article) that entities like the NOAA have manipulated global surface temperature data to artificially indicate a global warming trend, Pet. Br. 14-15, has long been proven false by other researchers worldwide, including an independent non-profit established to investigate historical surface temperature data. Specifically, in response to claims by climate skeptics, the independent Berkeley Earth Surface Temperature team determined years ago—through a peer-reviewed study investigating the validity of the data relied upon by EPA—that the data was fully reproducible and there was no indication of improper adjustments. Berkeley Earth, *Methodology*.³⁴

Petitioners are also mistaken that the Endangerment Finding 2009 is based on a “key assumption” known as “the Tropical Hot Spot Theory.” Pet. Br. 11, 23.

³⁴ Available at <https://tinyurl.com/yez5f395> (visited Dec. 23, 2022).

The Endangerment Finding itself does not reference the theory, and the accompanying Technical Support Document mentions it only in passing (on page 47 of a 163-page report). In any event, a discrete, historical challenge to climate modeling and satellite measurements of temperatures above the surface of a particular region does not undermine the entire body of temperature measurements demonstrating warming trends around the world. This is particularly so given that one possible explanation for historical challenges in modeling for the troposphere is that previous observational data has *underestimated* tropospheric warming. Santer, B. et al, *Using Climate Model Simulations to Constrain Observations*, 34 *J. of Climate*, 2021.³⁵

* * *

In sum, EPA's 2009 Endangerment Finding was appropriate and prescient. Its twin conclusions—that human behavior has caused climate change and that climate change poses a threat to public health and welfare—were supported by overwhelming evidence at the time and are even more strongly justified now, over a decade later. Petitioners have presented no colorable basis to reconsider any aspect of those findings, much less a reason to reverse course on the basic proposition on which the scientific community and governments across the globe

³⁵ Available at <https://tinyurl.com/uh272wd9>.

nearly unanimously agree: Human-caused climate change is real, it is harmful, and—unless our country and the world continue to take steps to mitigate greenhouse gas emissions—it will get much worse.

CONCLUSION

The Court should deny the petitions for review.

Respectfully submitted.

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December 23, 2022

CERTIFICATE OF COMPLIANCE

Pursuant to Fed. R. App. P. 32(g)(1), the undersigned hereby certifies that this brief complies with the type-volume limitation of Fed. R. App. P.

32(a)(7)(B)(i).

1. Exclusive of the exempted portions of the brief, as provided in Fed. R. App. P. 32(f), the brief contains 6473 words.

2. The brief has been prepared in proportionally spaced typeface using Microsoft Word 365 MSO in 14-point Times New Roman font. As permitted by Fed. R. App. P. 32(g)(1), the undersigned has relied upon the word count feature of this word processing system in preparing this certificate.

/s/ Thomas G. Sprankling

THOMAS G. SPRANKLING

December 23, 2022

CERTIFICATE OF SERVICE

I hereby certify that on this 23rd day of December, 2022, I electronically filed the foregoing with the Clerk of the Court for the United States Court of Appeals for the District of Columbia Circuit using the appellate CM/ECF system. Counsel for all parties to the case are registered CM/ECF users and will be served by the appellate CM/ECF system.

/s/ Thomas G. Sprankling

THOMAS G. SPRANKLING