ORAL ARGUMENT NOT YET SCHEDULED

No. 19-1140 and consolidated cases

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

AMERICAN LUNG ASSOCIATION, *et al.*,
Petitioners,

v.

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

On Petitions for Review of Final Agency Action of the
United States Environmental Protection Agency,
84 Fed. Reg. 32,520 (July 8, 2019)

BRIEF OF MAXIMILIAN AUFFHAMMER, PHILIP DUFFY, KENNETH GILLINGHAM, LAWRENCE H. GOULDER, JAMES STOCK, GERNOT WAGNER, AND THE UNION OF CONCERNED SCIENTISTS AS *AMICI CURIAE* IN SUPPORT OF PETITIONERS

SHAUN A. GOHO
JASON BELL, clinical law student
ASHTON MACFARLANE, clinical law student
Emmett Environmental Law & Policy Clinic
Harvard Law School
6 Everett Street, Suite 5116
Cambridge, MA 02138
(617) 496-5692
sgoho@law.harvard.edu

Dated: April 24, 2020

Counsel for Amici Curiae Maximilian Auffhammer, Philip Duffy, Kenneth Gillingham, Lawrence H. Goulder, James Stock, Gernot Wagner, and the Union of Concerned Scientists

CERTIFICATE OF COUNSEL AS TO PARTIES, RULINGS, AND RELATED CASES

Pursuant to D.C. Circuit Rule 28(a)(1) and Federal Rule of Appellate Procedure 26.1, counsel for *amici curiae* Maximilian Auffhammer, Philip Duffy, Kenneth Gillingham, Lawrence H. Goulder, James Stock, Gernot Wagner, and the Union of Concerned Scientists certify as follows:

All parties, intervenors, and amici appearing in this case are listed in the brief for State and Municipal Petitioners.

References to the rulings under review and related cases appear in State and Municipal Petitioners' brief.

Dated: April 24, 2020

/s/ Shaun A. Goho
Shaun A. Goho

CERTIFICATION REGARDING CONSENT TO FILE, SEPARATE BRIEFING, AUTHORSHIP, AND MONETARY CONTRIBUTIONS

All parties have consented to the filing of this brief. Counsel for *amici* filed a notice of intent to participate in this case on April 3, 2020. A single joint brief is not practicable because the other *amicus* briefs do not address the unique perspective of *amici* as experts on the science and economics of climate change and energy systems.

Under Federal Rule of Appellate Procedure 29(a)(4)(E), *amici* state that no party's counsel authored this brief in whole or in part, and no party or party's counsel contributed money intended to fund the preparation or submission of this brief. No person—other than the *amici* or their counsel—contributed money intended to fund the preparation or submission of this brief.

Dated: April 24, 2020

/s/ Shaun A. Goho
Shaun A. Goho

TABLE OF CONTENTS

Page

TABLE OF AUTHORITIES

Page(s)

Federal Register Notices

Other Authorities

*Authorities upon which we chiefly rely are marked with asterisks.

GLOSSARY

CO_2	Carbon Dioxide
FEIS	Final Environmental Impact Statement
EPA	Environmental Protection Agency
IPCC	Intergovernmental Panel on Climate Change
NASA	National Aeronautics and Space Administration
NHTSA	National Highway Traffic Safety Administration
NOAA	National Oceanic and Atmospheric Administration
PPM	Parts Per Million
RIA	Regulatory Impact Analysis
SAFE	Safer Affordable Fuel Efficient
UCS	Union of Concerned Scientists
°C	degrees Celsius

CIRCUIT RULE 26.1 DISCLOSURE STATEMENT

Pursuant to Federal Rules of Appellate Procedure 26.1 and 29(a)(4)(A), the Union of Concerned Scientists states that it does not have any parent company and no publicly-held company has a 10% or greater ownership interest in it.

Dated: April 24, 2020

/s/ Shaun A. Goho
Shaun A. Goho

INTERESTS OF *AMICI CURIAE*

Amici are scientists, economists, and a nonprofit organization who have made significant contributions to climate studies and energy policy. They are alarmed that EPA's approach to power sector emissions reductions ignores the scientific record. This brief shares their decades of collective experience.

Amicus Dr. Maximilian Auffhammer is the George Pardee Jr. Professor of International Sustainable Development at the University of California, Berkeley. He is currently a Research Associate at the National Bureau of Economic Research in the Energy and Environmental Economics group.

Amicus Dr. Philip Duffy is the President and Executive Director of the Woods Hole Research Center. He served as Senior Advisor to the White House National Science and Technology Council from 2013 to 2015.

Amicus Dr. Kenneth Gillingham is an Associate Professor of Environmental and Energy Economics at Yale University. From 2015 to 2016, he worked as the Senior Economist for Energy and Environment at the White House Council of Economic Advisers.

Amicus Dr. Lawrence H. Goulder is the Shuzo Nishihara Professor in Environmental and Resource Economics at Stanford University and Director of the Stanford Environmental and Energy Policy Analysis Center. He served as chair of

EPA's Science Advisory Board Review Panel for the Second Generation Climate Change Policy Model from 2004 to 2006.

Amicus Dr. James Stock is the Harold Hitchings Burbank Professor of Political Economy at Harvard University. He served as Chair of the Harvard Economics Department from 2007 to 2009. From 2013 to 2014, he was a member of the White House Council of Economic Advisers, where his portfolio included energy and environmental policy.

Amicus Dr. Gernot Wagner is a Clinical Associate Professor at New York University's Department of Environmental Studies and Associated Clinical Professor at New York University's Wagner School of Public Service. He was the founding Executive Director of Harvard's Solar Geoengineering Research Program.

Amicus Union of Concerned Scientists ("UCS") is a nonprofit organization that uses scientific analysis to advocate for solutions to urgent problems affecting humanity. Founded in 1969 by Massachusetts Institute of Technology scientists, UCS now has nearly 500,000 members and supporters. UCS has researched and warned of the grave dangers of climate change since the early 1990s.

PERTINENT STATUTES AND REGULATIONS

All applicable statutes and regulations are contained in State and Municipal Petitioners' addendum.

SUMMARY OF ARGUMENT

In promulgating the Affordable Clean Energy Rule (the "Rule"), the Environmental Protection Agency (EPA) ignored decades of science and its own conclusions regarding the perils of climate change. EPA recognizes that emissions of carbon dioxide (CO_2) and other greenhouse gases from the use of fossil fuels are accumulating in the atmosphere and warming the Earth. As global temperatures increase, sea levels are rising and changes in Earth systems are already contributing to floods, storms, wildfires, and droughts that have killed Americans and cost billions of dollars. Without dramatic emissions reductions, impacts will worsen. The next decade offers a critical opportunity to stabilize the climate and avoid irreparable harms to the people of the United States.

Instead of grappling with this scientific record and its own previous findings, EPA failed to consider the urgent need to reduce power sector emissions and did not provide a reasoned explanation for its policy choices. The Rule ignores the hazards ahead, the likelihood of irreversible changes to Earth's climate, and the limited time remaining to act.

Scientists, economists, and the federal government agree that decarbonizing electricity generation is the first step to stabilizing the climate. It is cheaper and easier to reduce emissions from the power sector than from transportation or industry. Moreover, for the rest of the economy to decarbonize, a greater supply of

zero-carbon electricity is needed to run our cars, heating systems, and industrial processes. Nevertheless, the Rule requires at best negligible emissions reductions from the power sector over the next decade—an abdication of EPA's duties that is contrary to law, science, and common sense.

ARGUMENT

I. THE RULE IRRATIONALLY DISREGARDS THE RISKS GREENHOUSE GAS EMISSIONS CREATE FOR THE AMERICAN PEOPLE

A. The Rule Is Irrational in Light of the Harms that Greenhouse Gas Emissions Inflict on the United States

The accumulation of greenhouse gases in the atmosphere is already causing ecological, public health, and economic harms across the United States. EPA promulgated the Rule pursuant to its recognition that it must regulate greenhouse gas emissions to address dangers to public health and welfare.[1] As the final Regulatory Impact Analysis (RIA) for the Rule explains, "adverse impacts" from "elevated concentrations of greenhouse gases . . . necessitate the EPA regulation of [greenhouse gases] from [Electric Generating Unit] sources."[2] But EPA offers no

[1] Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act, 74 Fed. Reg. 66,496, 66,496 (Dec. 15, 2009) [hereinafter "Endangerment Finding"].

[2] *See* EPA, *Regulatory Impact Analysis for the Repeal of the Clean Power Plan, and the Emission Guidelines for Greenhouse Gas Emissions from Existing Electric Utility Generating Units* 4-1 (June 2019), https://www.epa.gov/sites/production/files/2019-

explanation for how the Rule, which by EPA's own projections will result in virtually no emissions reductions,[3] is a reasonable policy given that continued emissions will intensify present-day risks and generate new hazards for the United States. Indeed, in light of the evidence before the agency, no such explanation is possible.

1. U.S. Power Sector Emissions Are Contributing to Climate Change and Harming Americans

Electricity generation in the United States is a substantial contributor to climate change. The United States in 2017 was responsible for about 15% of global CO_2 emissions.[4] According to EPA, 26.9% of those emissions came from the power sector.[5]

As a result of anthropogenic emissions, atmospheric concentrations of CO_2 have increased from pre-Industrial Revolution levels of 278 parts per million (ppm) to a global average of 407 ppm in 2018.[6] The "greenhouse effect" associated

---

06/documents/utilities_ria_final_cpp_repeal_and_ace_2019-06.pdf [hereinafter "Final RIA"].

[3] *Id.* at ES-6 (predicting minimal reductions).

[4] EPA, *Draft Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2018*, at ES-11 (2020), https://www.epa.gov/sites/production/files/2020-02/documents/us-ghg-inventory-2020-main-text.pdf.

[5] *Id.* at 2-24.

[6] NHTSA, Final Environmental Impact Statement, The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Year 2021–2026 Passenger Cars and Light Trucks S-11 (Mar. 2020),

with increasing levels of atmospheric CO_2 has warmed the planet, with average global temperatures in 2018 estimated to be 0.8°C to 1.2°C above pre-Industrial levels.[7] As the National Aeronautics and Space Administration (NASA) and the National Oceanic and Atmospheric Administration (NOAA) reported this January, 2016 and 2019 were the first- and second-hottest years ever recorded.[8]

This warming is already harming the United States. For example, the federal government acknowledges that sea level rise is reshaping American geography. Global mean sea level has risen "about [three] inches . . . since 1990," and between seven and eight inches since 1900.[9] Over the last 60 years, high tide floods have become "[five] to [ten] times more frequent . . . in several U.S. coastal cities, and flooding rates are accelerating in over [twenty-five] Atlantic and Gulf Coast

---

https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/safe_vehicles_rule_feis.pdf [hereinafter FEIS].

[7] IPCC, *Global Warming of 1.5°C, Summary for Policymakers* 6 (Valérie Masson-Delmotte et al. eds., 2018), https://report.ipcc.ch/sr15/pdf/sr15_spm_final.pdf.

[8] NASA, *NASA, NOAA Analyses Reveal 2019 Second Warmest Year on Record*, Global Climate Change: Vital Signs of the Planet (Jan. 15, 2020), https://climate.nasa.gov/news/2945/nasa-noaa-analyses-reveal-2019-second-warmest-year-on-record/.

[9] U.S. Global Change Research Program, *Fourth National Climate Assessment, Volume II: Impacts, Risks, and Adaptation in the United States* 107 (2018), https://nca2018.globalchange.gov/downloads/NCA4_2018_FullReport.pdf [hereinafter NCA].

cities."[10] Real estate in Miami is losing value.[11] Groups like the Biloxi-Chitimacha-Choctaw Tribe in Louisiana have started to abandon their homes to avoid inundation.[12]

Climate change is also intensifying precipitation, and as a result, flooding.[13] NOAA reported that 2019 was the second-wettest year ever recorded.[14] Low-lying areas in the Southeast and communities close to the Missouri and Mississippi rivers are particularly vulnerable.[15] A 2015 extreme rainfall event in South Carolina breached three dams, damaging 160,000 homes,[16] and a 2017 river flood shut down interstate highways in Missouri.[17]

Together, sea level rise and heightened precipitation have exacerbated destructive storms. Research has demonstrated that Hurricane Harvey, which struck Texas and Louisiana in 2017, probably produced more severe rainfall

---

[10] *Id.* at 99.

[11] *See, e.g.*, Philip B. Duffy et al., *Strengthened Scientific Support for the Endangerment Finding for Atmospheric Greenhouse Gases*, 363 Science 597, 601 (2019).

[12] NCA, *supra* note 9, at 761–62.

[13] *See, e.g.*, *id.* at 150, 485.

[14] NOAA, *2019 Was the 2nd Wettest Year on Record for the U.S.*, NOAA: News & Features (Jan. 21, 2020), https://www.noaa.gov/news/2019-was-2nd-wettest-year-on-record-for-us.

[15] NCA, *supra* note 9, at 763, 901.

[16] *Id.* at 764.

[17] *Id.* at 901.

because of greenhouse gas emissions.[18] Oceanic and atmospheric warming since the 1980s likely increased the storm's cumulative precipitation by 20% and contributed to its destructive stall over Houston.[19] Hurricane Harvey directly killed sixty-eight people and inflicted an estimated $125 billion in damage.[20] Climate change also increased the likelihood of a 2016 storm in Louisiana that dumped more than two feet of rain on the city over a two-day period.[21] NOAA has estimated that the total damage from extreme weather events between 2016 and 2018 exceeded $450 billion in the United States.[22]

Rising temperatures have brought heat waves that reduce economic productivity and hotter, drier conditions that contribute to longer and more severe wildfire seasons. From 2000 to 2018, extreme temperatures cost American workers

---

[18] *See* Mark D. Risser & Michael F. Wehner, *Attributable Human-Induced Changes in the Likelihood and Magnitude of the Observed Extreme Precipitation During Hurricane Harvey*, 44 Geophysical Research Letters 12,457, 12,457 (2017).

[19] S-Y Simon Wang et al., *Quantitative Attribution of Climate Effects on Hurricane Harvey's Extreme Rainfall in Texas*, 13 Envtl. Research Letters 1, 8 (2018).

[20] NOAA, *Service Assessment: August-September 2017 Hurricane Harvey* iv (June 2018), https://www.weather.gov/media/publications/assessments/harvey6-18.pdf.

[21] Karin van der Wiel et al., *Rapid Attribution of August 2016 Flood-Inducing Extreme Precipitation in South Louisiana to Climate Change*, 21 Hydrology and Earth Sys. Sci. 897, 897 (2017).

[22] NOAA, *Billion-Dollar Weather and Climate Disasters: Time Series*, NOAA: National Centers for Environmental Information (2020), https://www.ncdc.noaa.gov/billions/time-series.

over a billion labor hours.[23] Warming also dries organic forest matter.[24] This "warming-driven fuel drying" then contributes to wildfires like those that ravaged California in the summer of 2018, burning approximately 1.6 million acres of land across the state.[25]

Climate change is also causes adverse public health impacts, which will worsen in the coming decades. People's health will be harmed by extreme weather, increased heat stress, decreased air quality, altered disease patterns, and food, water, and nutrient insecurity.[26] More than 200 cities in the United States face heightened mortality risk from extreme heat caused by climate change.[27] Disease vectors like the *Aedes aegypti* mosquito, which carries the Zika and dengue

---

[23] Renee N. Salas et al., *2019 Lancet Countdown on Health and Climate Change Policy Brief for the United States of America* 2 (2019).

[24] *See* John T. Abatzoglou & A. Park Williams, *Impact of Anthropogenic Climate Change on Wildfire Across Western US Forests*, 113 Proc. Nat'l Acad. Sci. 11,770, 11,770 (2016).

[25] *See* A. Park Williams et al., *Observed Impacts of Anthropogenic Climate Change on Wildfire in California*, 7 Earth's Future 892, 892 (2019); California Department of Forestry and Fire Protection, *Stats and Events*, Cal Fire (2019), https://www.fire.ca.gov/stats-events/ (open "Fire Statistics" tab under "2018 Statistics and Events").

[26] Samantha Ahdoot & Susan E. Pacheco, *Global Climate Change and Children's Health*, 136 Pediatrics e1468, e1468 (2015).

[27] Joel D. Schwartz et al., *Projections of Temperature-Attributable Premature Deaths in 209 U.S. Cities Using a Cluster-Based Poisson Approach*, 14 Envtl. Health 85, 85 (2015).

viruses, are expected to expand their ranges, placing more Americans at risk.[28] "Without significant intervention, this new era will come to define the health of an entire generation."[29]

2. *The Federal Government Recognizes that Climate Change Impacts Will Significantly Worsen Before the End of the Century*

Current levels of emissions will cause striking physical and economic damage to the United States in the coming decades. According to the "climate trajectory" assumed in the Final Environmental Impact Statement (FEIS) for the Safer Affordable Fuel Efficient (SAFE) Vehicles Rule—an analysis for which EPA acted as a cooperating agency—CO_2 concentrations are anticipated to increase to at least 479 ppm by 2040, 565 ppm by 2060, and 789 ppm by 2100.[30] Such atmospheric CO_2 concentrations have not occurred in millions of years[31] and

[28] *See* Sadie J. Ryan et al., *Global Expansion and Redistribution of* Aedes*-Borne Virus Transmission Risk with Climate Change*, 13 PLOS Neglected Tropical Disease 1, 7 (2019).

[29] Salas et al., *supra* note 23, at 6.

[30] FEIS, *supra* note 6, at 5-40.

[31] IPCC, *Climate Change 2013: The Physical Science Basis* 385 (Thomas F. Stocker et al. eds., 2013) https://www.ipcc.ch/site/assets/uploads/2018/02/WG1AR5_all_final.pdf (noting "atmospheric CO_2 concentrations between 350 ppm and 450 ppm" were last seen "3.3 to 3.0 million years ago").

would fall within a "very high [greenhouse gas] emissions" scenario.[32] The FEIS projects that global surface air temperature will rise alongside these greenhouse gas concentrations and "increase . . . by [at least] 1.29°C [by 2040] . . . 2.01°C [by 2060] . . . and 3.48°C [by 2100]."[33] A world with 3.5°C of warming will be profoundly different from the one in which we live today.

The FEIS projects that under this scenario, sea levels will rise by more than two and a half feet by the end of the century.[34] Similarly, the federal government's Fourth National Climate Assessment indicates that one to four feet of sea level rise is "very likely" by 2100, and cites research demonstrating that rise in excess of eight feet is "physically plausible."[35] At the six-foot mark, almost all of New Orleans, more 30% of Miami, and 10% of Oakland and New York City will be lost.[36] The Norfolk Naval Base, the largest in the world, may be completely submerged by 2100.[37] Water damage and impending floods threaten to displace

---

[32] IPCC, *Climate Change 2014: Synthesis Report* 8 (Core Writing Team et al. eds., 2014), https://ar5-syr.ipcc.ch/ipcc/ipcc/resources/pdf/IPCC_SynthesisReport.pdf.

[33] FEIS, *supra* note 6, at 5-43.

[34] *Id.* at 5-49.

[35] NCA, *supra* note 9, at 85.

[36] Jeremy L. Weiss et al., *Implications of Recent Sea Level Rise Science for Low-Elevation Areas in Coastal Cities of the Coterminous U.S.A.*, 105 Climatic Change 635, 640 (2011).

[37] NCA, *supra* note 9, at 48.

thirteen million Americans by the end of the century.[38] Without emissions reductions or costly adaptation, $66 billion to $106 billion in U.S. real estate will likely be below sea level by 2050.[39] By 2100, these numbers rise to $238 to $507 billion.[40]

As these examples indicate, for every degree Celsius that the Earth warms, the United States incurs additional, significant economic losses. Agricultural productivity decreases by 9%, electricity demand rises by 5.3%, and violent crime rates increase 0.88%.[41] Mortality rates rise 5.4 deaths per 100,000.[42] If emissions continue at their current rate, sea level rise and tropical storms will cost 0.5% of Gross Domestic Product annually in 2100.[43] Cumulatively, climate impacts will cost roughly 1.2% of Gross Domestic Product per degree Celsius.[44] Assuming that

---

[38] Mathew E. Hauer et al., *Millions Projected To Be at Risk from Sea-Level Rise in the Continental United States*, 6 Nature Climate Change 691, 691–695 (2016) (including projected population changes).

[39] *See* NCA, *supra* note 9, at 330; *see also* UCS, *Underwater: Rising Seas, Chronic Floods, and the Implications for US Coastal Real Estate* 2 (2018), https://www.ucsusa.org/resources/underwater#ucs-report-downloads (finding $136 billion in at-risk properties by 2045).

[40] NCA, *supra* note 9, at 330.

[41] Solomon Hsiang et al., *Estimating Economic Damage from Climate Change in the United States*, 356 Science 1362, 1362–69 (2017).

[42] *Id.*

[43] *Id.*

[44] *Id.*

emissions continue without reductions, the net effects of unabated climate change will cost the U.S. economy $5 trillion by 2050.[45]

The federal government understands the extent of these extraordinary economic burdens.[46] Thirteen agencies, including EPA, surveyed the best scientific research in the Fourth National Climate Assessment and concluded that "continued growth in emissions at historic rates" will lead to annual losses in some sectors in the "hundreds of billions of dollars by the end of the century."[47]

3. Despite Acknowledging Current and Projected Harms from Climate Change, EPA Takes No Meaningful Steps to Reduce Emissions

Despite recognizing the immense dangers of unabated greenhouse gas emissions, EPA has adopted a rule that does virtually nothing to reduce them. EPA's own models indicate that the Rule could decrease CO_2 emissions from the energy sector by only 0.7% in 2025, 0.7% in 2030, and 0.5% in 2035 compared to a baseline of no government action at all.[48] These less-than-a-percentile reductions

---

[45] *See Examining the Macroeconomic Impacts of a Changing Climate: Hearing Before the Subcomm. on Nat'l Sec., Int'l Dev., & Monetary Policy of the H. Comm. on Fin. Servs.*, 116th Cong. (2019) (written testimony of Marshall Burke, Assistant Professor of Earth Systems, Stanford University).

[46] *See* Council of Economic Advisers, *The Cost Of Delaying Action To Stem Climate Change* 4 (2014), https://obamawhitehouse.archives.gov/sites/default/files/docs/the_cost_of_delaying_action_to_stem_climate_change.pdf.

[47] NCA, *supra* note 9, at 26.

[48] Final RIA, *supra* note 2, at ES-6.

lack a rational connection to EPA's acknowledgement—in the same document—that "elevated concentrations of greenhouse gases in the atmosphere may reasonably be anticipated to endanger public health and to endanger public welfare."[49]

The Rule is not a logical response to the evidence before the agency. The administrative record is replete with evidence of the harms described above.[50] EPA has acknowledged those impacts for the past decade. Recognizing a serious problem and then choosing to do virtually nothing about it is the definition of an arbitrary and capricious action.

B. EPA Entirely Fails to Consider the Likelihood of Climate Catastrophe

Not only does the Rule represent a failure to address the climate impacts that EPA acknowledges, but it also neglects entirely another aspect of the problem: that there is a realistic prospect that continued emissions could lead to much more serious consequences than those described above. These climate disaster scenarios are well-founded in the scientific literature,[51] and yet EPA did not consider their likelihood in the rulemaking process.

---

[49] *Id.* at 4-1 (citing Endangerment Finding, *supra* note 1, at 66,496).

[50] *See, e.g.*, UCS Comments (Oct. 31, 2018), https://www.regulations.gov/document?D=EPA-HQ-OAR-2017-0355-24059.

[51] *See, e.g.*, Gernot Wagner & Martin L. Weitzman, *Climate Shock: The Economic Consequences of a Hotter Planet* 48–80 (2015); Timothy M. Lenton et al., *Climate Tipping Points—Too Risky to Bet Against*, 575 Nature 592, 594 (2019); Katharina

Scientists think about the atmosphere's sensitivity to greenhouse gases and the extremity of environmental impacts in probabilistic terms. For any particular concentration of greenhouse gases in the atmosphere, there is a range of possible temperature increases. For any particular temperature increase, there is in turn a range of possible impacts. Sensitivity and extremity can be visualized as distributions of probabilities, with the likelihood of less sensitive, milder worlds located on the left side of the graph and more sensitive, extreme worlds on the right. *See* Figure 1.

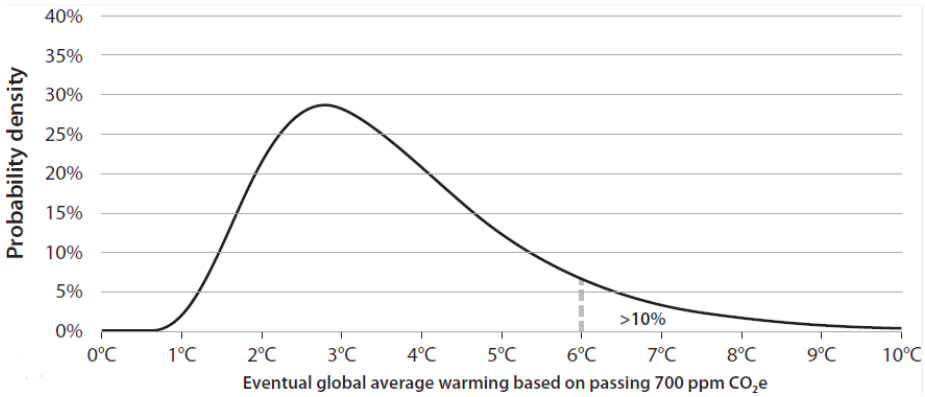

Figure 1. Probability distribution of climate sensitivity to 700 ppm CO_2, showing the "fat tail" of scenarios above 6°C that have a greater than 10% probability. Source: Wagner & Weitzman, supra *note 51, at 53.*

One might expect the odds that temperature will increase sharply or extreme impacts will occur to be vanishingly small, with the right end of the distribution

---

Meraner et al., *Robust Increase in Equilibrium Climate Sensitivity Under Global Warming*, 40 Geophysical Research Letters 5,944, 5,944 (2013).

flattening into a skinny tail. Instead, the sensitivity and extremity distributions have what scientists call "fat tails"[52]: the likelihood of catastrophe is substantial.

First, there is a significant possibility that the atmospheric CO_2 levels EPA predicts will result in much more extreme warming than projected. For example, if pre-Industrial Revolution CO_2 concentrations double to approximately 560 ppm,[53] Intergovernmental Panel on Climate Change (IPCC) modeling estimates a likely range of warming between 1.5°C and 4.5°C.[54] However, models also include less likely but possible risks of severe warming. In the IPCC models for 560 ppm, average temperatures could increase beyond the 4.5-degree mark, with the likelihood of a temperature increase greater than 6°C between zero and ten percent.[55] Economists have estimated the chance as three percent.[56]

At the 789 ppm concentration projected in the SAFE Vehicles FEIS,[57] the probability of extreme warming is much greater. Given a 700 ppm concentration,

---

[52] *See, e.g.*, Martin L. Weitzman, *Fat-Tailed Uncertainty in the Economics of Catastrophic Climate Change*, 5 Rev. Envtl. Econ. & Pol'y 275, 277–80, 286 (2011).

[53] Because there is a time lag between greenhouse gas emissions and the climate system's response to those emissions, scientists have developed the concept of Equilibrium Climate Sensitivity, which identifies the total warming that eventually results from a doubling of atmospheric greenhouse gases. *Id.* at 278.

[54] IPCC, *Climate Change 2014*, *supra* note 32, at 62.

[55] IPCC, *Climate Change 2014*, *supra* note 32, at 37, 62.

[56] *See* Wagner & Weitzman, *supra* note 51, at 54.

[57] FEIS, *supra* note 6, at S-14.

economists Martin Weitzman and Gernot Wagner estimate the probability of warming greater than 6°C as about ten percent.[58] The last time the Earth warmed so much, so rapidly—during the end-Permian mass extinction event 252 million years ago[59]—up to 95% of all species went extinct.[60] Therefore, under the agency's 789 ppm premise, there is a "roughly 10 percent chance of near-certain disaster."[61] A ten-percent chance of an event is meaningful; if someone's home had a ten-percent chance of suffering catastrophic loss, it would likely be uninsurable in the private market. Yet EPA completely failed to consider this intolerable risk of catastrophe in adopting the Rule.

As mentioned above, there is a second kind of uncertainty in climate models: for a given amount of warming, there might be greater impacts. Specifically, there is a significant risk of irreversible events that would have major negative consequences for natural and human systems. These events are commonly characterized as "tipping points."[62] "Exceeding one or more tipping points" could

---

[58] *See* Wagner & Weitzman, *supra* note 51, at 55.

[59] Mark Lynas, *Six Degrees: Our Future on a Hotter Planet* 252 (2008).

[60] Michael J. Benton & Richard J. Twitchett, *How to Kill (Almost) All Life: The End-Permian Extinction Event*, 18 Trends Ecology & Evolution 358, 358 (2003).

[61] Wagner & Weitzman, *supra* note 51, at 55.

[62] FEIS, *supra* note 6, at 5-33 (defining "tipping point" as points beyond which Earth's climate will experience "disproportionately large or singular response[s] . . . as a result of a moderate additional change in the inputs to [the climate system]").

lead to climate change that occurs "so quickly and unexpectedly that human systems would have difficulty adapting to [it]."[63] Tipping points are not separate and discrete; rather, one can feed into another. Recent studies suggest both that "cascading effects" leading to a "less habitable 'hothouse' climate . . . might be common,"[64] and that they pose "an existential threat to civilization."[65]

As the effects of climate change have manifested more rapidly in recent years than previously anticipated,[66] a tipping point cascade seems increasingly possible. Consider the West Antarctic Ice Sheet, which has been showing signs of structural weakness as warming ocean waters push at its base.[67] Measurements of melting processes show them outpacing theoretical predictions by two orders of magnitude.[68] Should the ocean erode the sheet's support, it could disintegrate, triggering meters of sea level rise in the coming centuries.[69] Other possible tipping

---

[63] *Id.*

[64] Lenton et al., *supra* note 51, at 594.

[65] *Id.* at 595.

[66] *See, e.g.*, Lijing Cheng et al., *How Fast Are the Oceans Warming?*, 363 Science 128, 128 (2019).

[67] Johannes Feldmann et al., *Stabilizing the West Antarctic Ice Sheet by Surface Mass Deposition*, 5 Sci. Advances 1, 1 (2019).

[68] D.A. Sutherland et al., *Direct Observations of Submarine Melt and Subsurface Geometry at a Tidewater Glacier*, 365 Science 369, 369 (2019).

[69] Feldmann et al., *supra* note 68, at 1.

points include massive ice loss in Greenland and the Arctic[70] and the release of methane from warming permafrost and tundra.[71]

The federal government has affirmed the scientific consensus that "the further and faster Earth's climate system is changed, the greater the risk of unanticipated changes"[72] that could lead to extreme climate impacts. Indeed, EPA itself has acknowledged the possibility of "low probability, high impact" events.[73]

According to the IPCC, the difference between 1.5°C and 3°C of warming could significantly increase the likelihood of passing a tipping point.[74] With warming of 1.5°C or less, it is "likely" that Arctic summer sea ice could continue to exist; however, 3°C of warming would "very likely" result in ice free summers in the Arctic.[75] Similarly, warming of 1.5°C or less carries a risk of "17-44% reduction in permafrost," but 3°C of warming may lead to "[p]otential . . . permafrost collapse."[76] Because the federal government projects 3.48 degrees of

---

[70] FEIS, *supra* note 6, at 8-74.

[71] *Id.* at 8-78.

[72] NCA, *supra* note 9, at 102.

[73] Endangerment Finding, *supra* note 1, at 66,524.

[74] *See* IPCC, *Global Warming of 1.5ºC* 261 (Valérie Masson-Delmotte et al. eds., 2018), https://www.ipcc.ch/site/assets/uploads/sites/2/2019/06/SR15_Full_Report_Low_Res.pdf (listing differences).

[75] *Id.*

[76] *Id.*

warming by the end of the century,[77] these IPCC projections for 3 degrees of warming are conservative. As temperatures rise, the probability of exceeding tipping points increases, along with the probability of disasters that could irreversibly damage the United States.[78]

For a decade, EPA has recognized the role of mitigating extreme risk in guiding rational approaches to climate regulation. But rather than consider catastrophic warming scenarios, the Rule does not discuss climate sensitivity or extreme impacts, let alone account for them in the regulation. A rational regulator would at least consider buying "'climate insurance' taken out against the most severe and irreversible potential consequences of climate change," as the Council of Economic Advisers has described it.[79]

C. EPA Arbitrarily Ignores the Urgency of Reducing Emissions

Every year that passes without adequate emissions reductions further jeopardizes the United States. The window to prevent immense health, ecological, and economic damage is narrow. Delaying action not only makes mitigating global warming more difficult, but will also increase the cost of the eventual response by

[77] FEIS, *supra* note 6, at S-14.

[78] NCA, *supra* note 9, at 1352 (acknowledging tipping point consequences "may be permanent").

[79] *See* Council of Economic Advisers, *supra* note 46, at 2.

billions of dollars. EPA has not provided a reason for its decision to delay a meaningful response to this urgent problem.

Delay creates two distinct risks. First, as the SAFE Vehicles FEIS acknowledges, it "results in a greater accumulation of CO_2 in the atmosphere, thereby increasing the risk of crossing tipping points and triggering abrupt changes."[80] Second, delay reduces the time remaining to achieve a particular target, making future action more costly than action in the present.[81] "[A]ny short run gains from delay tend to be outweighed by the additional costs arising from the need to adopt a more abrupt and stringent policy later."[82] A White House Council of Economic Advisers analysis estimated that the costs of addressing climate change increase 41% for each decade of delay.[83] Those cost increases are associated only with the timing of action, not the total amount of emissions reduced. They are the costs of making up for lost time.

The next two decades are critical. The IPCC has forecast that "[i]n model pathways with no or limited overshoot of 1.5°C, global net anthropogenic [CO_2]

---

[80] FEIS, *supra* note 6, at 8-76.

[81] Council of Economic Advisers, *supra* note 46, at 5; *see generally* Joeri Rogelj et al., *Probabilistic Cost Estimates for Climate Change Mitigation*, 493 Nature 79 (2013).

[82] Council of Economic Advisers, *supra* note 46, at 5.

[83] *Id.* at 18.

emissions decline by about 45% from 2010 levels by 2030 . . . reaching net zero around 2050."[84] All of the IPCC's pathways to avoid the worst impacts require substantial annual reductions in greenhouse gas emissions between 2020 and 2030.[85] The timeframe for stabilizing the climate shrinks as atmospheric greenhouse gas concentrations rise and the odds of passing a tipping point increase. Because "the reaction time to achieve net zero emissions is 30 years at best,"[86] the United States may be running out of time to change course.

EPA knows that action is imperative. In 2009, relying on assessments that "synthesize literally thousands of individual studies,"[87] EPA concluded that there was "good reason to act now."[88] As EPA wrote then in the Endangerment Finding, "[t]here continues to be no reason to expect that, without substantial and near-term efforts to significantly reduce emissions, atmospheric levels of greenhouse gases will not continue to climb, and thus lead to ever greater rates of climate change."[89] Ten years later, these arguments have only strengthened in force.[90] According to

---

[84] *See* IPCC, *Global Warming of 1.5ºC*, *supra* note 74, at 95.

[85] *Id.* at 119.

[86] Lenton et al., *supra* note 51, at 595.

[87] Endangerment Finding, *supra* note 1, at 66,511.

[88] *Id.* at 66,500.

[89] *Id.* at 66,518.

[90] *See*, *e.g.*, Duffy et al., *supra* note 11.

the Fourth National Climate Assessment, "early and substantial mitigation offers a greater chance of avoiding increasingly adverse impacts."[91]

In spite of the weight of scientific evidence that supports an immediate response to warming, the Rule chooses to defer action on power sector emissions without explanation. To help limit the worst impacts of climate destabilization, CO_2 emissions from the U.S. power sector must decline by an average of roughly thirty to fifty million metric tons per year to reach net zero emissions by 2050 or 2070.[92] By EPA's own projections, the Rule will reduce CO_2 emissions by an average of only four million metric tons per year until 2050, a number virtually indistinguishable from the "reference case" projection of no federal limits at all.[93] These minute reductions would have essentially no impact on United States greenhouse gas emissions.

---

[91] NCA, *supra* note 9, at 1348.

[92] These numbers result from scaling IPCC global emissions reductions pathways to the emissions levels of the U.S. power sector. *See* IPCC, *Global Warming of 1.5ºC*, *supra* note 75, at 119.

[93] EPA, *EPA IPM Summary Run Results, EPA Platform v6 Projections for Continental U.S., Reference Case* 1 (2019), https://www.epa.gov/sites/production/files/2019-06/epav6_november_2018_reference_case_0.zip (file "EPAv6_November_2018_Reference_Case SSR.xlsx"); EPA, *EPA IPM Summary Run Results, EPA Platform v6 Projections for Continental U.S., Illustrative ACE Scenario* 1 (2019), https://www.epa.gov/sites/production/files/2019-06/illustrative_ace_scenario_0.zip (file "Illustrative ACE Scenario SSR.xlsx").

EPA's projections for emissions reductions under the Rule fall far short of any rational policy to stabilize the climate. A comparison of the Rule reductions to what the IPCC concludes is necessary to limit warming to 1.5°C or 2°C, *see* Figure 2, shows that the Rule leads to emissions levels almost identical to the status quo.

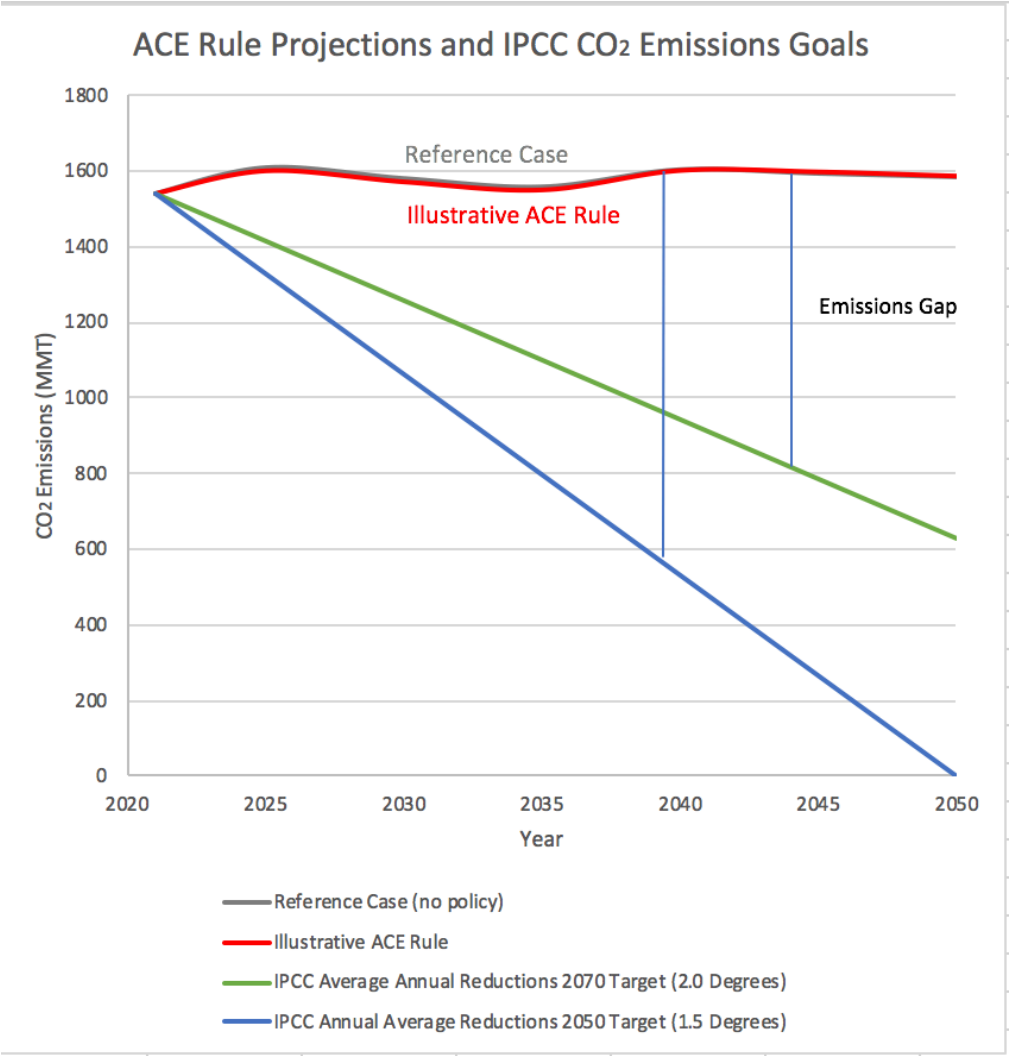

Figure 2. EPA's projections of CO_2 emissions (in million metric tons) under the Rule, superimposed over the emissions trajectory required to reach zero power sector emissions by 2050 or 2070.[94]

[94] The ACE Rule output curves represent EPA's raw data from the ACE Rule System Summary Report. *See* EPA, *Guide to IPM Output Files*,

This abdication comes at a critical juncture. Minor changes at the level of the source—selecting heat rate improvements rather than a broader best system of emission reduction—lead to major risks for the nation. EPA never explains, and cannot explain, why the Rule meanders around the emissions reduction problem when scientists warn that a direct path to immediate reductions is needed to escape disaster.

II. THE RULE IS NOT A REASONABLE POWER SECTOR EMISSIONS POLICY GIVEN THE DANGERS OF CLIMATE CHANGE

A. EPA Overlooks the Crucial Role the Power Sector Plays in Reducing Emissions Throughout the Economy

Power sector emissions reductions are the key to the decarbonization of the entire economy. A recent literature review concluded that "[t]he electric power sector is widely expected to be the linchpin of efforts to reduce greenhouse gas . . . emissions."[95] Electricity generation accounted for 26.9% of American greenhouse gas emissions in 2017,[96] and "[w]ith multiple low-carbon electricity generation

---

https://www.epa.gov/sites/production/files/2018-05/documents/epa_initial_run_v6_inputoutputguide_june_2018.pdf. The System Summary Report provides emissions output data across the power sector for the continental United States, as generated by the Integrated Planning Model, EPA's standard modeling software program.

[95] Jesse D. Jenkins et al., *Getting to Zero Carbon Emissions in the Electric Power Sector*, 2 Joule 2498, 2498 (2018).

[96] *Draft Inventory*, *supra* note 4, at 2-24.

options and the possibility of wider electrification, the power sector will invariably be central to . . . decarbonization efforts."[97] As a leading contributor to global emissions to date, the United States has a responsibility to lead in decarbonization. To keep global warming under 2°C,[98] the Deep Decarbonization Pathways Project expects that the U.S. power sector will need to be "almost fully decarbonized in 2050."[99]

First, the power sector is the lowest hanging fruit to abate greenhouse gas emissions. Electricity generation "offers the largest low-cost potential for emissions reductions"[100] because decarbonizing power is technologically easier and cheaper than decarbonizing other sectors of the economy. Already, "[t]here are a number of viable technology options for low-carbon electricity supply"[101] such as renewable energy, nuclear, and carbon capture and storage technologies.[102] The

---

[97] Peter J. Loftus et al., *A Critical Review of Global Decarbonization Scenarios: What Do They Tell Us About Feasibility?*, 6 WIREs Climate Change 93, 109 (2014).

[98] Deep Decarbonization Pathways Project, *Pathways to Deep Decarbonization 2015 Report* 3 (2015), http://deepdecarbonization.org/wp-content/uploads/2015/12/DDPP_2015_REPORT.pdf.

[99] *Id.* at 17.

[100] Gunnar Luderer et al., *Environmental Co-Benefits and Adverse Side-Effects of Alternative Power Sector Decarbonization Strategies*, 10 Nature Comm. 1, 2 (2019).

[101] *Id.*

[102] *Id.*

conclusion follows that a "cost-minimizing" policy would "spend [the] limited financial resources available for CO_2 emissions abatement in the power sector first."[103]

Second, decarbonizing transportation, industry, and building heating will require more clean electricity than is currently available. Electricity is a "low-carbon fuel"[104] for systems that have traditionally used high-carbon fossil fuels. End-use electrification is already underway in those sectors through technologies like electric vehicles and heat pumps.[105] But to electrify and decarbonize other sectors, the underlying source of electricity, the power sector, must decarbonize.[106]

The federal government agrees that the power sector is the key to economy-wide emissions reductions. The White House reported in 2016 that "the transition to a low-[greenhouse gas] economy will require substantial shifts in resources[,]" including "decarbonizing the electricity system and increasingly shift[ing] to using

---

[103] Bob van der Zwaan et al., *How to Decarbonize the Transport Sector?*, 61 Energy Pol'y 562, 562 (2013).

[104] Richard G. Richels & Geoffrey J. Blanford, *The Value of Technological Advance in Decarbonizing the U.S. Economy*, 30 Energy Economics 2,930, 2,945 (2008).

[105] *See, e.g.*, Keith Dennis, *Environmentally Beneficial Electrification: Electricity as the End-Use Option*, 28 Electricity J. 100, 104 (2015) (describing adoption of heat pump technology).

[106] *See* Elmar Kriegler et al., *The Role of Technology for Achieving Climate Policy Objectives: Overview of the EMF 27 Study on Global Technology and Climate Policy Strategies*, 123 Climatic Change 353, 365 (2014).

electricity in the buildings, transportation, and industrial sectors over time."[107] The Fourth National Climate Assessment warns that "unless there is a very rapid decarbonization of the world's energy systems over the next few decades, stabilization at neither [1.5°C nor 2°C of warming] would be remotely possible."[108]

Yet the Rule never mentions the consensus view, shared by scientists and the federal government, that power sector decarbonization is essential to emissions reductions throughout the economy. Nor does EPA explain why it chose not to capitalize on the cheapest and easiest emissions reduction opportunity. In a rule designed to avert the dangers to public welfare from greenhouse gas concentrations,[109] a failure to grapple with the centrality of the power sector to emissions reductions is irrational.

B. The Rule Adopts a Do-nothing Approach When Power Sector Mitigation Is Possible and Necessary to Avoid Disaster

EPA fails to explain why it passed up the opportunity to achieve cost-effective reductions and has instead promulgated a rule that at best does almost nothing and at worst will increase emissions. EPA projects that its heat rate improvement regulations will lead to no more than one percentage point of

---

[107] The White House, *United States Mid-Century Strategy for Deep Decarbonization* 17 (2016), https://unfccc.int/files/focus/long-term_strategies/application/pdf/mid_century_strategy_report-final_red.pdf.

[108] NCA, *supra* note 9, at 83.

[109] Final RIA, *supra* note 2, at 4-1.

emissions reductions over the next 15 years.[110] The policy may even make dirty plants more efficient, increasing their operating hours and extending their lives.[111] As heavy polluters pollute more, a "rebound effect" may "lead to emissions increases at individual plants and for entire states."[112]

Cost-effective power sector reductions are available now. Among the many low-carbon options on the market, "[n]uclear energy, wind energy, solar PV, and geothermal are in wide commercial operation today and are readily scaleable."[113] Studies show that "100% renewable or low or zero carbon power system[s] . . . are feasible, under the condition that there is sufficient transmission, backup and storage capacity."[114] The power sector can be incentivized now to achieve "deep and immediate emissions reductions" because "there is a wide array of relatively low carbon generators currently operating in the United States and a diverse set of low and zero carbon technologies available that can provide new capacity."[115] The

---

[110] *Id.* at ES-6.

[111] Amelia T. Keyes et al., *The Affordable Clean Energy Rule and the Impact of Emissions Rebound on Carbon Dioxide and Criteria Air Pollutant Emissions*, 14 Envtl. Research Letters 1, 2 (2019).

[112] *Id.* at 9.

[113] Loftus et al., *supra* note 97, at 106.

[114] Bas van Zuijlen et al., *Cost-Optimal Reliable Power Generation in a Deep Decarbonisation Future*, 253 Applied Energy 1, 1 (2019).

[115] John Larsen et al., Rhodium Group, *Energy and Environmental Implications of a Carbon Tax in the United States* 18 (Noah Kaufman ed., 2018),

Energy Information Administration concurred as recently as January 2020: "changes in the fuel mix consumed by the electric power sector" suggest that emissions will "decrease until the mid-2020s."[116] There is no reasoned basis for EPA's decision to do nothing in spite of the chance to take a crucial step towards decarbonization.

CONCLUSION

For the foregoing reasons, *amici* urge the Court to vacate the Rule.

Dated: April 24, 2020

Respectfully submitted,

/s/ Shaun A. Goho
Shaun A. Goho
Jason Bell, clinical law student
Ashton Macfarlane, clinical law student
Emmett Environmental Law & Policy Clinic
Harvard Law School
6 Everett Street, Suite 5116
Cambridge, MA 02138
(617) 496-5692 (office)
(617) 384-7633 (fax)
sgoho@law.harvard.edu

Counsel for Amici Curiae Maximilian Auffhammer, Philip Duffy, Kenneth Gillingham, Lawrence H. Goulder, James Stock, Gernot Wagner, and the Union of Concerned Scientists

https://energypolicy.columbia.edu/sites/default/files/pictures/CGEP_Energy_Environmental_Impacts_CarbonTax_FINAL.pdf.

[116] U.S. Energy Information Administration, *Annual Energy Outlook 2020 with Projections to 2050* 143 (2020), https://www.eia.gov/outlooks/aeo/pdf/AEO2020%20Full%20Report.pdf.

CERTIFICATE OF COMPLIANCE WITH TYPE-VOLUME LIMIT

1. Pursuant to Federal Rule of Appellate Procedure 29(a)(4)(G), I hereby certify that this brief complies with the type-volume limitations of Fed. R. App. P. 32(a)(7)(B) and Fed. R. App. P. 29(a)(5) because it contains 6424 words, excluding the parts of the brief exempted by Fed. R. App. P. 32(f).

2. I further certify that this brief complies with the typeface requirements of Fed. R. App. P. 32(a)(5) and the type-style requirements of Fed. R. App. P. 32(a)(6) as it has been prepared in Microsoft Word 2016 using 14-point Times New Roman typeface and is double-spaced (except for headings, footnotes, and block quotations).

Dated: April 24, 2020

/s/ Shaun A. Goho
Shaun A. Goho

CERTIFICATE OF SERVICE

I hereby certify that on this 24th day of April, 2020, I electronically filed with the Clerk of the Court for the United States Court of Appeals for the District of Columbia Circuit via the CM/ECF System the foregoing Amicus Brief. All participants in the case are registered CM/ECF users, and service will be accomplished by the appellate CM/ECF system.

Dated: April 24, 2020

/s/ Shaun A. Goho
Shaun A. Goho