ORAL ARGUMENT NOT YET SCHEDULED

No. 22-1081

(Consolidated with Nos. 22-1083, 22-1084, 22-1085)

UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

STATE OF OHIO et al.,

Petitioners,

v.

U.S. ENVIRONMENTAL PROTECTION AGENCY and MICHAEL S. REGAN, in his official capacity as Administrator of the U.S. Environmental Protection Agency,

Respondents.

On Petitions for Review of Final Action
by the U.S. Environmental Protection Agency

BRIEF OF AMICI CURIAE CALIFORNIA CLIMATE SCIENTISTS IN SUPPORT OF RESPONDENTS U.S. ENVIRONMENTAL PROTECTION AGENCY AND MICHAEL S. REGAN

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CERTIFICATE AS TO PARTIES, CONSENT TO FILE, RULINGS, RELATED CASES, AND SEPARATE BRIEFING

Pursuant to Circuit Rule 26.1, amici curiae state that they are seven individual academic experts who specialize in climate science and economics ("California Climate Scientists" or "Amici") and are not corporations, associations, joint ventures, syndicates, or any other similar entities.

All parties have consented to the participation of California Climate Scientists as amici curiae in this proceeding. All other parties and amici appearing before this Court are listed in the Brief of Petitioners State of Ohio, et al. (ECF No. 1969895) and the Brief of Respondents U.S. Environmental Protection Agency, et al. (ECF No. 1981480).

The ruling under review is the final action taken by Respondents Environmental Protection Agency and Michael S. Regan, Administrator, U.S. Environmental Protection Agency, entitled *California State Motor Vehicle Pollution Control Standards; Advanced Clean Car Program; Reconsideration of a Previous Withdrawal of a Waiver of Preemption; Notice of Decision*, published in the Federal Register at 87 Fed. Reg. 14,332 (Mar. 14, 2022).

There are no related cases within the meaning of Circuit Rule 28(a)(1)(C).

Pursuant to Circuit Rule 29(d), amici California Climate Scientists state that they came together to submit a single brief expressing their collective expertise and that, to their knowledge, no other amicus brief will address the same, unique facet of the consolidated cases.

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GLOSSARY

EPA	U.S. Environmental Protection Agency
GDP	Gross domestic product
GHG	Greenhouse gas
IPCC	Intergovernmental Panel on Climate Change
NAAQS	National Ambient Air Quality Standards
Private Pet'rs' Br.	Petitioners American Fuel & Petrochemical Manufacturers, et al., Initial Brief
State Pet'rs' Br.	Petitioners State of Ohio, et al., Proof Brief

INTERESTS OF AMICI

Amici are scientific experts who study the physical and economic effects of climate change on the people and places of California.[1] As such, they have an interest in sharing their expertise with the Court on technical issues relevant to California's climate policy decisions. In the decision challenged by these consolidated cases, the U.S. Environmental Protection Agency ("EPA") reinstated California's "waiver" of preemption under section 209(b) of the Clean Air Act.[2] This waiver has allowed California to target its climate policies to the extraordinary conditions and vulnerabilities it faces as a geographically and demographically diverse state of nearly 40 million residents. While climate change is a global problem, its impacts vary widely. In this brief, Amici explain how California's "compelling and extraordinary" conditions put its residents and resources at exceptional and unique risk from climate change.

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[1] Biographical information for Amici is set forth in the attached Appendix. Pursuant to Federal Rule of Appellate Procedure 29(a)(4)(E), the undersigned counsel represents that no party's counsel authored this brief in whole or in part and that no party, party's counsel, or other person funded any part of the preparation or submission of this brief.

[2] 42 U.S.C. § 7543(b).

SUMMARY OF ARGUMENT

The Earth's climate is warming, and it is unequivocal that human activity—primarily the burning of fossil fuels—is the dominant cause.[3] The Sixth Assessment of the Intergovernmental Panel on Climate Change has concluded that "human-induced climate change is already affecting many weather and climate extremes" around the world.[4] As warming continues, these extremes will likely produce severe impacts on human and natural systems—from destructive wildfires[5] to coastal flooding[6] to food system disruptions[7] and much more.

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[3] *See* Intergovernmental Panel on Climate Change ("IPCC"), *Climate Change 2021: The Physical Science Basis—Summary for Policymakers* 4 (2021) ("It is unequivocal that human influence has warmed the atmosphere, ocean, and land.").

[4] *Id.* at 8.

[5] Phillip Duffy et al., *Strengthened Scientific Support for the Endangerment Finding for Atmospheric Greenhouse Gases*, 363 Sci. 597, 605 (2019) (stating that "intensifying wildfires threaten facilities, transportation infrastructure, and utility lines.").

[6] *Id.* at 602 (projecting "a global average [sea level rise] rate unprecedented in the last 7000 years" that will put up to 13.1 million people at risk of inundation in the United States alone).

[7] *Id.* at 600 (explaining that "short periods of exposure to high growing-season temperatures" can cause crop losses and "warmer winter nights will also negatively affect perennial crops ... that require a certain amount of winter chill for high yields").

California is on the front line of these changes. Temperatures in some parts of the state have already risen by 2 degrees Fahrenheit.[8] California consistently loses more acres to wildfires than any other state,[9] and it has the most people living in high-risk wildfire zones.[10] The state's water supply relies heavily on highly vulnerable snowpack for seasonal water storage.[11] California's agricultural sector and seafood industry are impacted by rising temperatures on land and sea.[12]

Responding to these imminent threats, California has adopted a suite of policies to mitigate anthropogenic sources of climate change, including the transportation regulations at issue in this litigation.[13] These policies are intended to meaningfully reduce greenhouse gas

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[8] Leah Fisher and Sonya Ziaja, *California's Fourth Climate Change Assessment: Statewide Summary Report* 22 (2019).

[9] *See, e.g.,* Nat'l Interagency Fire Center, *National Report of Wildland Fires and Acres Burned by State* (2021), predictiveservices.nifc.gov/intelligence/2021_statssumm/fires_acres21.pdf.

[10] U.S. Fed. Emergency Mgmt. Admin., *Wildland-Urban Interface: A Look at Issues and Resolutions* 7 (2022).

[11] Fisher and Ziaja, *supra* note 8, at 56-57, 65.

[12] *Id.* at 59.

[13] *See* Cal. Air Res. Bd., *Draft 2022 Scoping Plan Update* 151 (2022) (listing transportation policies as a part of the state's strategy for achieving carbon neutrality by 2045 or earlier).

emissions and drive the development of cost-effective new clean technologies. They also help California meet EPA's National Ambient Air Quality Standards ("NAAQS") for local criteria pollutants, standards that directly benefit the health of state residents.[14] EPA has repeatedly cited these rationales in granting California dozens of Clean Air Act waivers over the last several decades.[15]

In 2022, EPA reinstated its waiver for greenhouse gas emissions standards and a zero emission vehicle sales mandate under the Advanced Clean Cars program.[16] EPA did so out of appropriate deference to California's specific needs and policy judgments.[17] State governments and private industry representatives now challenge this

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[14] U.S. Envtl. Prot. Agency, *Criteria Air Pollutants*, https://www.epa.gov/criteria-air-pollutants (last updated Aug. 9, 2022).

[15] *See, e.g.,* Notice of Decision Granting a Waiver of Clean Air Act Preemption for California's 2009 and Subsequent Model Year Greenhouse Gas Emission Standards for New Motor Vehicles, 74 Fed. Reg. 32,744, 32,745 (July 8, 2009).

[16] Reconsideration of a Previous Withdrawal of a Waiver of Preemption, 87 Fed. Reg. 14,332 (Mar. 14, 2022).

[17] *Id.* at 14,342 ("[T]he text, structure, and history of the California waiver provision clearly indicate both congressional intent and appropriate EPA practice of leaving the decision on "ambiguous and controversial matters of public policy" to California's judgment.").

decision partly on the grounds that climate change does not uniquely endanger California.[18]

The Petitioners are incorrect. The Clean Air Act requires only that California demonstrate "compelling and extraordinary conditions"—not "unique" ones.[19] But California would meet either standard. A robust and growing body of research proves that the cumulative impacts of climate change pose compelling, extraordinary, and unique risks to California's communities and natural resources. With its extensive coastline, fire-prone ecosystems, mountainous topography, and water-intensive agriculture, California is already suffering exceptional and singular impacts from a warmer climate. Absent aggressive action under EPA's waiver, these impacts will only get worse, threatening the world's fourth-largest economy as well as the lives and livelihoods of 40 million Americans.

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[18] *See* Proof Brief of Petitioners State of Ohio, et al. ("State Pet'rs' Br.") 32 ("[T]he risks associated with climate change are not of unique or special concern for California."); *see also* Initial Brief of Private Petitioners ("Private Pet'rs' Br.") 14 ("The term "extraordinary" refers to unique local conditions in California.").

[19] 42 U.S.C. § 7543(b)(1)(B); *see also* Reconsideration of a Previous Withdrawal of a Waiver of Preemption 87 Fed. Reg. 14,332, 14,341 (Mar. 14, 2022).

ARGUMENT

I. California's distinctive features render state residents particularly vulnerable to the impacts of climate change.

A large and growing body of scientific evidence reveals that California is susceptible to climate change and already experiencing its extraordinary impacts. These impacts include, among others, increasingly deadly wildfires, highly variable precipitation patterns, the loss of snowpack on which the state's water systems depend, reduced yield of nationally important food crops, rising sea levels along California's 3,500-mile coastline,[20] changing ocean chemistry, and worsening local air pollution. While other states may face some of these threats, California's unique geography and population patterns combine to make the physical, social, and economic impacts of climate change uniquely devastating.

A. Climate change has increased wildfires in California.

Few natural disasters have grabbed as many headlines over the past several years as wildfires in California. The Camp Fire in 2018—

[20] U.S. Nat'l Oceanic and Atmospheric Admin., *Shoreline Mileage of the United States*, https://coast.noaa.gov/data/docs/states/shorelines.pdf (last visited Dec. 20, 2022).

the deadliest and most destructive wildfire in California history—burned 155,366 acres, destroyed 18,804 structures, and killed 85 people.[21] The fire effectively destroyed the town of Paradise; roughly 90 percent of its homes burned to the ground.[22]

California is uniquely vulnerable to wildfires.[23] It is the only U.S. state with a Mediterranean climate, which features a short rainy season yielding significant plant growth in the winter followed by dry periods that turn the plant growth into potential fuel sources.[24] Ecosystems in this climate type—like Northern California's forests and Southern California's chapparal scrublands—are highly fire-prone.[25] When they combine with hot and dry winds—like the offshore "Santa Ana" winds

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[21] Cal. Dep't of Forestry & Fire Protection, *Top 20 Most Destructive California Wildfires* (2022), https://www.fire.ca.gov/media/t1rdhizr/top20_destruction.pdf.

[22] Kurtis Alexander, *Reclaiming Paradise*, S.F. Chron. (May 3, 2019), https://projects.sfchronicle.com/2019/rebuilding-paradise/.

[23] Scott Stephens et al., *Prehistoric Fire Area and Emissions from California's Forests, Woodlands, Shrublands and Grasslands*, 251 Forest Ecology and Mgmt. 205, 205 (2007).

[24] Eric Kaufman, *Climate and Topography*, *in* ATLAS OF THE BIODIVERSITY OF CALIFORNIA 12 (2003).

[25] Jon Keeley, *Fire in Mediterranean Climate Ecosystems—A Comparative Overview*, 58 Isr. J. of Ecology & Evolution 123, 124 (2012).

that periodically buffet coastal Southern California—the resulting fires can be devastating.[26]

As a result of the current and ongoing effects of climate change, the average annual area burned across California is projected, under high greenhouse gas emission scenarios, to increase by approximately 77 percent.[27] By the end of the century, the worst years for wildfires could see burned area increases of more than 178 percent.[28]

The projected impacts on California from this increase in wildfire risk are severe. The places at highest risk lie in the Wildland-Urban Interface, "where houses and wildland vegetation meet or intermingle."[29] If a major wildfire sweeps through a community in these areas, as it did in Paradise, the destruction can be nearly total.[30]

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[26] Max Moritz et al., *Spatial Variation in Extreme Winds Predicts Large Wildfire Locations in Chaparral Ecosystems*, 37 Geophysical Res. Letters L04801, 1 (2010).

[27] Anthony Westerling, *Wildfire Simulations for the Fourth California Climate Assessment: Projecting Changes in Extreme Wildfire Events with a Warming Climate* 19 (2018).

[28] *Id.*

[29] Volker Radeloff et al., *Rapid Growth of the US Wildland-Urban Interface Raises Wildfire Risk*, 115 Proc. Nat'l Acad. Sci. 3314, 3314 (2018).

[30] *See* Alexander, *supra* note 22 (explaining that 90 percent of Paradise's residences were burned by the fire).

California has more homes in the Wildland-Urban Interface than any other state.[31] One study of the home insurance market projected that, in high-risk areas, the market share of insurers will drop by five percent, and insurance rates per $1,000 of coverage will rise by 18 percent.[32] Climate-driven shocks to insurance markets are not just theoretical: Since 2019, California has regularly banned insurers from dropping customers in ZIP codes impacted by wildfires.[33] While these regulations may provide a stop-gap, they cannot remedy the fact that California's wildfire risk is dramatically worsening, and its associated costs are dramatically rising for millions of homeowners.

The increase in severe wildfires, moreover, threatens more than residential structures and rural towns. It endangers electrical transmission and distribution assets in Northern California, where

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[31] U.S. Fed. Emergency Mgmt. Admin., *supra* note 10, at 7.

[32] Lloyd Dixon et al., *The Impact of Changing Wildfire Risk on California's Residential Insurance Market* vi (2018).

[33] *See* Cal. Dep't of Ins., *Mandatory One Year Moratorium on Non-Renewals*, https://www.insurance.ca.gov/01-consumers/140-catastrophes/MandatoryOneYearMoratoriumNonRenewals.cfm (last visited Nov. 28, 2022).

critical power lines cross highly fire-prone areas.[34] It also degrades air quality by producing large amounts of particulate matter hazardous to human health and disruptive to daily activities.[35] These effects are particularly significant in Northern and Central California, where wildfire smoke is causing the fastest degradations in air quality across the United States.[36] Finally, the increase in severe wildfires impedes education programs. Over one week in 2018, wildfire smoke forced 180 California school districts to cancel classes for 1.1 million students.[37] Even when children can attend school, wildfire smoke can lead to reduced test scores, which in turn reduce long-term future earnings.[38]

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[34] Larry Dale, *Assessing the Impact of Wildfires on the California Electricity Grid* iv (2018).

[35] Daniel Jacob and Darrel Winner, *Effect of Climate Change on Air Quality*, 43 Atmospheric Envtl. 51, 60 (2009).

[36] Marissa Childs et al., *Daily Local-Level Estimates of Ambient Wildfire Smoke PM2.5 for the Contiguous US*, 56 Envtl. Sci. & Tech. 13607, 13614-15 (2022).

[37] Ricardo Cano, *School Closures from California Wildfires This Week Have Kept More than a Million Kids Home*, CalMatters (Nov. 15, 2018), https://calmatters.org/environment/2018/11/school-closures-california-wildfires-1-million-students/.

[38] Jeff Wen & Marshall Burke, *Lower Test Scores from Wildfire Smoke Exposure*, 5 Nature Sustainability 947, 951-52 (2022).

B. Changing precipitation patterns put California at risk of severe flooding and severe drought simultaneously.

California's unique climate and topography makes it susceptible to both drought and flooding events. Climate change will make these events more frequent and more intense by exacerbating drought conditions and atmospheric rivers that create destructive storms.

Because of California's Mediterranean climate, the state's precipitation patterns vary significantly throughout the year. Indeed, California has the most extreme and unpredictable precipitation variation of any state in the country.[39] The resulting precipitation deficits, in combination with warm temperatures, render California exceptionally vulnerable to droughts, which have occurred more often in recent decades.[40] Between September 2019 and August 2022, California experienced the driest three-year stretch on record.[41]

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[39] Tapan Pathak et al., *Climate Change Trends and Impacts on California Agriculture: A Detailed Review*, 8 Agronomy 25, 25 (2018).

[40] Noah Diffenbaugh et al., *Anthropogenic Warming Has Increased Drought Risk in California*, 112 Proc. Nat'l Acad. Sci. 3931, 3931 (2014).

[41] U.S. Nat'l Oceanic and Atmospheric Admin., *Climate at a Glance Statewide Time Series: California Precipitation*, https://www.ncei.noaa.gov/access/monitoring/climate-at-a-glance/statewide/time-series/4/pcp/36/8/1895-2022?base_prd=true&begbaseyear=1895&endbaseyear=2022 (last

Droughts are inseparable from the floods that the state also experiences.[42] California's largest floods have resulted from "atmospheric rivers"—narrow, intense bands of moist air that transport large quantities of water vapor towards Earth's poles.[43] As atmospheric rivers approach the California coast, they typically exceed 2,000 kilometers in length but measure only a few hundred kilometers wide.[44] California's mountain ranges force the warm, moist air of these rivers upwards, causing vast amounts of water vapor to fall as rain.[45] Thus, it is California's unique topographic features, rather than large-scale

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visited Jan. 8, 2023); *see also* Rachel Becker, *Four in a Row: California Drought Likely to Continue*, CalMatters (Sep. 28, 2022), https://calmatters.org/environment/2022/09/california-drought-likely-to-continue/.

[42] Michael Dettinger, *Historical and Future Relations between Large Storms and Droughts in California*, 14 S.F. Estuary & Watershed Sci. 1, 2 (2016) ("The state's surfeits (and, eventually, its floods) and droughts are actually inseparable, so that planning and management of floods and droughts may never be completely disentangled.").

[43] Michael Dettinger, *Climate Change, Atmospheric Rivers, and Floods in California - A Multimodel Analysis of Storm Frequency and Magnitude Changes*, 47 J. Am. Water Res. Ass'n 514, 515 (2011).

[44] *Id.*

[45] *See* U.S. Nat'l Weather Serv., *Orographic Lifting*, https://forecast.weather.gov/glossary.php?letter=o (last visited Oct. 31, 2022).

atmospheric dynamics affecting the entire continental United States, that renders atmospheric rivers so devastating to local communities within the state.[46] In 2017, a 5-day sequence of atmospheric storms caused catastrophic damage to California's second largest reservoir, resulting in the evacuation of nearly 200,000 people and ultimately over $1 billion in repairs.[47]

Both droughts and atmospheric rivers will become more intense as the earth warms. A warmer climate will cause more water to evaporate from plants, which, in combination with variable precipitation, leads to more frequent and severe droughts.[48] At the same time, a warmer climate will lead to a warmer atmosphere, causing the air to carry more water vapor and thereby intensifying atmospheric river storms.[49]

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[46] Thomas Corringham et al., *Atmospheric Rivers Drive Flood Damages in the Western United States*, 5 Sci. Advances 1, 3 (2019).

[47] Brian Henn et al., *Extreme Runoff Generation from Atmospheric River Driven Snowmelt During the 2017 Oroville Dam Spillways Incident*, 47 Geophysical Research Letters e2020GL088189, 1 (2020).

[48] Westerling, *supra* note 28, at 1.

[49] David Lavers et al., *Future Changes in Atmospheric Rivers and Their Implications for Winter Flooding in Britain*, 8 Envtl. Res. Letters 1, 7 (2013).

Moderate atmospheric rivers can have largely beneficial effects, providing rainfall that can help to replenish California's water supply with minimal flood damage.[50] However, even "modest increases in [atmospheric river] intensity" will significantly exacerbate storm damage.[51] If greenhouse gas emissions continue at their current rate, the frequency of the most intense atmospheric storms will double by the end of the century, even though there will be fewer atmospheric rivers overall.[52] As a result, beneficial atmospheric rivers will become less frequent, while extreme ones—causing widespread destruction—will become more common.[53]

C. Rising atmospheric temperatures melt Sierra Nevada snowpack and damage California's water supply.

In addition to creating more severe droughts, rising temperatures will also harm California's water supply, which relies heavily on snowpack for seasonal water storage.[54] Air temperature warming will

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[50] Corringham et al., *supra* note 46, at 3.

[51] *Id.*

[52] Vicky Espinoza et al., *Global Analysis of Climate Change Projection Effects on Atmospheric Rivers*, 45 Geophysical Res. Letters 4299, 4299 (2018).

[53] Dettinger, *supra* note 42, at 1.

[54] Fisher and Ziaja, *supra* note 8, at 56.

decrease snowpack, meaning that California's water security will be harmed by climate change, regardless of any precipitation changes.[55]

The state's water availability depends largely on mountain snowpack, in part because most precipitation in the state occurs as snow.[56] The Sierra Nevada snowpack builds up over the winter, thaws throughout the spring, and then drains into reservoirs, where it supplies approximately 30 percent of California's annual water demand.[57] The state's water management systems—which support aquatic ecosystems, agriculture, hydropower, and human consumption— have all been built around the "natural reservoir" that California's snowpack provides.

Higher temperatures will likely induce earlier and faster-than-normal snowmelt. In high-warming scenarios, California may lose 65

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[55] James Thorne et al., *The Magnitude and Spatial Patterns of Historical and Future Hydrologic Changes in California's Watersheds*, 6 Ecosphere 1, 17 (2015); *see also* Fisher and Ziaja, *supra* note 8, at 57.

[56] Moetasim Ashfaq et al., *Near-term Acceleration of Hydroclimatic Change in the Western U.S.*, 118 J. Geophysical Res.: Atmospheres 10,676, 10,676 (2013).

[57] Cal. Dep't of Water Res., *Early Winter Storms Provide Much-Needed Sierra Snowpack* (Dec. 30, 2021), https://water.ca.gov/News/News-Releases/2021/Dec-21/DWR-12-30-21-Snow-Survey.

percent loss of its by 2100.[58] Likewise, climate models project that under various emissions scenarios, carryover storage—the volume of water in reservoirs before the start of the wet season in late fall—in California's two largest reservoirs, Shasta and Oroville, will decline by about one-third by the end of the century.[59]

The impacts of drought and decreased snowpack on California communities cannot be overstated. California's people, economy, and natural systems rely on—and are integrally tethered to—a complex water storage and distribution network that stretches across the state.[60] Reductions in snowpack and river flow will require the state to invest in expensive new water resources.[61] Proposed alternatives like ocean water desalination have extremely high capital costs and energy requirements.[62]

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[58] Pathak et al., *supra* note 39, at 31.

[59] Fisher and Ziaja, *supra* note 8, at 57.

[60] *Id.* at 56.

[61] Patrick Gonzalez et al., *Ch. 25: Southwest*, *in* CLIMATE CHANGE IMPACTS IN THE UNITED STATES: THE FOURTH NATIONAL CLIMATE ASSESSMENT 1101, 1112 (D.R. Reidmiller et al. eds., 2018).

[62] *Id.*

D. Climate change threatens California's exceptionally significant agricultural sector.

Changing climate conditions and impacts to water supply will also negatively affect food production in California.[63] Extreme heat waves will lower crop yields; heat stress will increase the demand for water; and hotter temperatures will create new pest and disease threats.[64] Deficiencies in water supply are especially concerning because irrigation supports nearly 90 percent of California's harvested crops.[65]

While climate change may harm other states with large agriculture sectors, California is exceptional in two ways. First, it is extraordinary in the range of crops it produces. California is the nation's leading exporter of 75 types of crops and the sole producer of 17 types—including almonds, figs, raisins, garlic, olives, and walnuts.[66] As climate change alters water and temperature regimes, some of these crops may become unviable. For example, temperatures in the state are already at the upper threshold for corn and rice.[67]

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[63] Pathak et al., *supra* note 39, at 25.

[64] Fisher and Ziaja, *supra* note 8, at 59.

[65] Pathak et al., *supra* note 39, at 25.

[66] *Id.* at 7.

[67] Gonzalez et al., *supra* note 61, at 1145.

Second, California has the largest agricultural economy in the country.[68] It produces nearly 15 percent of America's agricultural output and nearly a fifth of the nation's dairy supply.[69] Thus, even small declines in the state's yield could cause large disruptions to U.S. agricultural production, which produces $134.7 billion in output every year and supports sectors that account for 5 percent of overall GDP.[70]

E. California's 3,500-mile coastline is particularly susceptible to the dangers of sea-level rise.

Sea levels have risen along the California coast, and there is broad scientific consensus that they will continue to do so. Over the 20th century, sea levels rose more than 15 cm (5.9 inches) along the Central and Southern California coast.[71] As a result, even typical tides and storms have produced extreme high-water events. In November, 2015,

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[68] U.S. Dep't. of Agric., *Cash Receipts by Commodity: State Ranking*, https://data.ers.usda.gov/reports.aspx?ID=17844 (last visited Nov. 7, 2022)

[69] Cal. Dep't of Food & Agric., *California Agricultural Statistics Review: 2020-2021* 2 (2022).

[70] U.S. Dep't of Agric., *Ag and Food Sectors and the Economy*, https://www.ers.usda.gov/data-products/ag-and-food-statistics-charting-the-essentials/ag-and-food-sectors-and-the-economy/ (last updated Oct. 31, 2022).

[71] Fisher and Ziaja, *supra* note 8, at 31.

La Jolla, a San Diego suburb, reached its all-time highest sea level during a moderate storm.[72]

Sea level rise will likely cause severe economic disruption and damage to coastal residents. Nearly 27 million Californians live in a coastal county, the most in the nation.[73] Rising sea levels increase the frequency and probability of coastal inundation, or high-tide flooding.[74] Eroding cliffs and bluffs have already made many coastal homes precarious and unsafe.[75] High-tide flooding of homes, roads, and business districts may eventually render many coastal properties unlivable.[76] Whole communities could ultimately be physically and financially lost to the sea.[77] State agencies and seaside towns—like Del

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[72] *Id.*

[73] U.S. Nat'l Oceanic and Atmospheric Admin., *Fast Facts: Economics and Demographics*, https://coast.noaa.gov/states/fast-facts/economics-and-demographics.html (last visited Oct. 31, 2022).

[74] William Sweet & Joseph Park, *From the Extreme to the Mean: Acceleration and Tipping Points of Coastal Inundation from Sea Level Rise*, 2 Earth's Future 579, 580 (2014).

[75] Rosanna Xia, *The California Coast is Disappearing under the Rising Sea. Our Choices Are Grim*, L.A. Times (Jul. 7, 2019), https://www.latimes.com/projects/la-me-sea-level-rise-california-coast/.

[76] Union of Concerned Sci., *Underwater: Rising Seas, Chronic Floods, and the Implications for US Coastal Real Estate* 2 (2018).

[77] *Id.*

Mar in Southern California and Pacifica in Northern California—are already engaged in heated debates over "managed retreat," which would essentially surrender existing infrastructure to the rising tides.[78]

Persistent coastal inundation will simultaneously erode iconic California beaches. Projections show that 31 to 67 percent of Southern California beaches may be completely lost by 2100, effectively eliminating their recreational and tourism value without large-scale intervention.[79] Damages from the inundation of residential and commercial buildings under 20 inches of sea level rise could reach nearly $17.9 billion, and these costs would double if a 100-year coastal flood occurred on top of this sea level rise.[80] In a worst-case scenario—6.6 feet of sea level rise combined with a 100-year storm—the resultant flooding in Southern California could affect 250,000 people, $50 billion worth of property, and $39 billion worth of buildings.[81]

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[78] Lindsey Smith, *California's Radical Plan to Defend Homes from Sea Level Rise: Move Them*, S.F. Chron. (Apr. 21, 2022), https://www.sfchronicle.com/travel/article/California-coast-sea-level-rise-17091737.php; *see also* A.R. Siders et al., *The Case for Strategic and Managed Retreat*, 365 Sci. 761, 761 (2019).

[79] Fisher and Ziaja, *supra* note 8, at 9.

[80] *Id.*

[81] *Id.*

F. Warmer, more acidic oceans imperil California's fishing industry and pose a public health risk.

California's coastal waters support economic sectors that produce nearly $45 billion in annual GDP and employ over half a million people.[82] Climate change directly threatens these sectors by changing the chemistry of California's coastal oceans.

Water temperatures increased by 0.7 degrees Celsius between 1900 and 2016, and they may increase by as much as 4 degrees Celsius by the end of this century.[83] Higher temperatures have already precipitated harmful algal blooms, which can cause substantial economic losses by impeding seafood production.[84] For example, one bloom in 2015 prevented a normally prolific Dungeness crab fishery from opening for five months.[85] These blooms are also a public health risk since they produce domoic acid, which can be fatal to humans who eat tainted shellfish.[86] As warming continues, harmful algal blooms

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[82] Jennifer Phillips and Leila Sievanen, *California's Fourth Climate Change Assessment: California's Coast and Oceans Summary Report* 12-13 (2018).

[83] *Id.* at 19.

[84] Fisher and Ziaja, *supra* note 8, at 66.

[85] *Id.* at 30.

[86] *Id* at 66.

will become more frequent and more intense,[87] further endangering the economic and public health of California's coastal communities.

At the same time, California's coastal waters are acidifying twice as quickly as the global average.[88] This is the result of upwelling, which occurs when wind patterns push surface waters away from the shore, causing colder water from deeper in the ocean to rise up and replace the water pushed offshore.[89] Because California's coastal waters have higher rates of upwelling than other locations, a higher volume of acidic water from the ocean's depths comes to the surface of its coasts.[90]

These changes have grave implications for both marine life and the communities that depend on them. Acidification causes the shells of iconic species—like Olympia oysters and Dungeness crabs—to become thinner and smaller[91] while simultaneously influencing the behavior of

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[87] Phillips and Sievanen, *supra* note 82, at 36.

[88] Emily Osborne et al., *Decadal variability in twentieth-century ocean acidification in the California Current Ecosystem*, 13 Nature Geoscience 43, 43 (2020).

[89] U.S. Nat'l Oceanic and Atmospheric Admin., *What is Upwelling?*, https://oceanservice.noaa.gov/facts/upwelling.html (last updated Sep. 9, 2022).

[90] Osborne, *supra* note 88, at 43.

[91] Phillips and Sievanen, *supra* note 82, at 21.

non-shell-forming species like fish.[92] Overall, about half of all fisheries revenues on the West Coast derives from species vulnerable to ocean acidification impacts.[93] Ocean acidification could thus decimate California's fishing industry if left unaddressed.

G. Climate change exacerbates local smog, a problem EPA has already deemed a "compelling and extraordinary condition" in California.

California's topography, climate, and population size combine to make state residents exceptionally vulnerable to local air pollution, particularly photochemical "smog"—a combination of airborne particles and ground-level ozone. When vehicles and power plants burn fossil fuels, they create nitrogen oxides and volatile organic compounds, which react to form ground-level ozone and then combine with particulate pollution to create smog.[94] Because light is necessary for the reaction that initially forms ozone, the sunniest days tend to have the most smog.[95] Smog concentrations are most likely to become hazardous

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[92] *Id.* at 30.

[93] Fisher and Ziaja, *supra* note 8, at 67.

[94] Jacob and Winner, *supra* note 35, at 51.

[95] Nat'l Geographic, *Resource Library: Smog*, https://education.nationalgeographic.org/resource/smog (last visited Nov. 1, 2022).

when meteorological and topographical conditions allow air pollutants to accumulate in stagnant air.[96] Thus, the ideal conditions for smog formation exist in locations where fossil fuels burn, the sun shines, and air stagnates. California—with its large population, sunny weather, and cities sited in bowl-shaped depressions—provides perfect smog-forming conditions.[97]

Despite air-quality improvements over the last few decades, California continues to have the worst air quality in the country.[98] Six of the nation's ten most ozone-polluted cities are located in California, including Los Angeles, which has the worst air quality in the United States.[99] Meanwhile, the San Joaquin Valley is home to the country's worst particle pollution, both short-term (Fresno) and year-round

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[96] Daniel Horton et al., *Occurrence and Persistence of Future Atmospheric Stagnation Events*, 4 Nature Climate Change, 698, 698 (2014).

[97] U.S. Envtl. Prot. Agency, *Ground-Level Ozone Basics*, https://www.epa.gov/ground-level-ozone-pollution/ground-level-ozone-basics#formation (last updated June 14, 2022); *see also* Emily Guerin, *LA Explained: Smog*, LAist (Oct. 3, 2018), https://laist.com/news/climate-environment/la-explained-smog.

[98] *See* Am. Lung Ass'n, *2022 State of the Air Report* 16 (2022) ("California retains its historic distinction of having the most cities on the list, with 11 of the 25 most-polluted cities.").

[99] *Id.* at 17.

(Bakersfield).[100] Decades after Congress passed the Clean Air Act, over half of California's 40 million residents live in places out of compliance with EPA's limits on surface-level ozone concentrations.[101]

Climate change will worsen smog formation in two ways. First, higher temperatures promote ozone formation.[102] The emissions of many volatile organic compounds are temperature dependent, which means that more ozone forms when temperatures increase.[103] This is in part why summer has the greatest number of days when ozone concentration exceeds air quality standards.[104] Likewise, hotter summers have more of these days than colder summers, sometimes by as much as a factor of ten.[105] As climate change causes temperatures to

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[100] *Id.* at 11.

[101] Cal. Air Res. Bd., *State Strategy for the State Implementation Plan* 1-2 (2022).

[102] Lu Shen et al., *Impact of Increasing Heat Waves on U.S. Ozone Episodes in the 2050s: Results from a Multimodel Analysis Using Extreme Value Theory*, 43 Geophysical Res. Letters 7 (2016).

[103] Clara Nussbaumer & Ronald Cohen, *The Role of Temperature and NO_x in Ozone Trends in the Los Angeles Basin*, 54 Envtl. Sci. & Tech. 15652, 15652 (2020).

[104] Jacob and Winner, *supra* note 35, at 52.

[105] *Id.*; *see also* William Cox & Shao-Hang Chu, *Assessment of Interannual Ozone Variation in Urban Areas from a Climatological Perspective*, 30 Atmospheric Envtl. 2615, 2624 (1995).

climb further, the number of days with dangerous concentrations of smog will increase.[106]

The second way that climate change promotes smog formation is by increasing the number of air stagnation events. Such events occur when a lack of wind or rain means that "an air mass remains in place over a geographic region for an extended period of time."[107] Stagnation events help pollutants accumulate in a single air mass in the near-surface atmosphere, close to emission sources.[108] A warming planet will make the global climate more stagnant "due to a weaker global circulation and a decreasing frequency of mid-latitude cyclones."[109] As a result, stagnation events are predicted to increase by up to 40 days in many areas, and impacts in the Western United States are expected to be particularly acute.[110]

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[106] Shen et al., *supra* note 102, at 7.

[107] Bob Yirka, *New Study Suggests More and Longer Atmospheric Stagnation Events due to Global Warming*, PHYS.ORG (June 23, 2014), https://phys.org/news/2014-06-longer-atmospheric-stagnation-events-due.html.

[108] Horton et al., *supra* note 96, at 698.

[109] Jacob and Winner, *supra* note 35, at 51.

[110] Horton et al., *supra* note 96, at 698.

Multiple studies spell out the consequence of a warming climate for local air pollution: "The climate penalty for ozone air quality implies the need for more stringent emission controls to attain a given air quality objective."[111] Study results showing increases in the number of days with ground-level ozone episodes "point to the need for ambitious emissions controls to offset this penalty."[112] EPA has long recognized that California is uniquely exposed to air pollution,[113] as the state's ongoing local air quality problems attest.[114] Climate change will require even more stringent emissions controls just to prevent any further degradation in air quality. Rather than wait for that scenario, California has chosen to take an affirmative approach that directly attacks the problem.

II. The Advanced Clean Cars program is necessary to mitigate local air pollution that EPA has long recognized as a compelling and extraordinary condition.

Even if California residents were not uniquely vulnerable to the

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[111] Jacob and Winner, *supra* note 35, at 60.

[112] Shen et al., *supra* note 102, at 7.

[113] *See e.g.*, Waiver of Federal Preemption Notice of Decision, 9 Fed. Reg. 18,887, 18,890 (May 3, 1984).

[114] *See* discussion, *supra* notes 98 - 101.

myriad climate impacts discussed above, targeted transportation regulations would still be necessary to ameliorate the state's continuing local air pollution violations, which will inevitably worsen as the climate warms. EPA has previously granted some 50 waivers to address the "compelling and extraordinary conditions" posed by California's localized air pollution problems,[115] yet the state still struggles to meet federal NAAQS requirements. The Advanced Clean Cars program—specifically, the greenhouse gas emissions standards and zero emission vehicle sales mandate adopted pursuant to EPA's waiver—will reduce the emission of criteria air pollutants and facilitate substantial improvements in California's air quality.[116]

A. The Advanced Clean Cars program is necessary to address local air pollution conditions.

Although technologies like the catalytic converter have lowered

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[115] Notice of Decision Granting a Waiver of Clean Air Act Preemption for California's 2009 and Subsequent Model Year Greenhouse Gas Emission Standards for New Motor Vehicles, 74 Fed. Reg. 32,744, 32,745 (July 8, 2009).

[116] *See* Christina Zapata et al., *Low-carbon Energy Generates Public Health Savings in California*, 18 Atmosphere Chemistry and Physics 4817, 4828 (2018) ("Measures to reduce GHG emissions to 80% below 1990 levels. . . .generally brought nearly all regions of California into compliance with the O_3 NAAQS.").

emissions of nitrogen oxides from gasoline and diesel engines,[117] it is impossible to create an internal combustion engine that produces no nitrogen oxides.[118] This fact, combined with California's population increase from 15.8 million in 1960[119] to 39.2 million today,[120] makes clear that air quality improvements inevitably plateau when gasoline and diesel-powered vehicles constitute the dominant mode of transportation. For California to fully address its local air pollution conundrum, the state must implement vehicle emission regulations that promote the use of alternatives to internal combustion engines. Zero emission vehicles are therefore integral to California's program for achieving NAAQS compliance.[121]

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[117] Brian McDonald et al., *Long-Term Trends in Motor Vehicle Emissions in U.S. Urban Areas*, 47 Envtl. Sci. & Tech. 10022, 10022 (2013).

[118] Int'l Council on Clean Transp., *Vehicle NOx Emissions: The Basics* (July 19, 2021), https://theicct.org/stack/vehicle-nox-emissions-the-basics/.

[119] Angie Marcos, *California Named State With the Worst Air Quality (Again)*, ScienceDaily (June 19, 2017), https://www.sciencedaily.com/releases/2017/06/170619092749.htm.

[120] U.S. Census Bureau, *Quickfacts: California*, https://www.census.gov/quickfacts/CA (last visited Nov. 7, 2022).

[121] *See* Zapata et al., *supra* note 116, at 4823-26 (demonstrating that if the state achieved its economy-wide decarbonization goals,

California's greenhouse gas regulations also have important distributional benefits. While carbon dioxide is well mixed and has a long lifespan in the atmosphere, the location of greenhouse gas emissions still matters because reduced emissions produce the co-benefit of local air quality improvements.[122] These localized public health benefits are particularly significant and important for residents of low-income and minority communities in urban Los Angeles and the rural southern San Joaquin Valley, who have long been disproportionately burdened by poor air quality.[123]

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including vehicle electrification, the state would achieve NAAQS attainment in 19 of the 23 counties currently in violation of federal ozone standards).

e.g., Cal. Air Res. Bd., *Advanced Clean Cars Program*, https://ww2.arb.ca.gov/our-work/programs/advanced-clean-cars-program (last visited Nov. 11, 2022) ("Advanced Clean Cars combines the control of smog-causing (criteria) pollutants and greenhouse gas (GHG) emissions into a single coordinated package of regulations.").

[122] Gregory Nemet et al., *Implications of Incorporating Air-Quality Co-Benefits into Climate Change Policymaking*, 5 Envtl. Res. Letters 014007, 4 (2010).

[123] Cresencio Rodriguez-Delgado, *California Has Some of the Worst Air Quality in the Country. The Problem is Rooted in the San Joaquin Valley*, PBS Newshour (June 16, 2022), https://www.pbs.org/newshour/nation/california-has-some-of-the-worst-air-quality-in-the-country-the-problem-is-rooted-in-the-san-joaquin-valley.

B. The Advanced Clean Cars Program would lead to tangible reductions in greenhouse gas emissions.

In addition to localized benefits within the state, the transportation regulations adopted pursuant to California's Clean Air Act waiver would sharply reduce the greenhouse gas emissions of the world's fourth largest economy. If California were a country, it would be the fifteenth-largest emitter on the planet, in between Brazil and Australia.[124] At the same time, California's transportation sector accounts for about half of the state's greenhouse gas emissions, as well as about 80 percent of its air pollutants.[125] Regulations targeting the transportation sector, like the Advanced Clean Cars Program, would

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[124] *Compare* Cal. Air Res. Bd., *California Greenhouse Gas Emissions for 2000 to 2020: Trends of Emissions and Other Indicators* 28 (Oct. 26, 2022), https://ww2.arb.ca.gov/sites/default/files/classic/cc/inventory/2000-2020_ghg_inventory_trends.pdf (noting that California emitted 404.5 MMT of carbon dioxide equivalent in 2019) *with* Union of Concerned Sci., *Each Country's Share of CO_2 Emissions,* https://www.ucsusa.org/resources/each-countrys-share-co2-emissions (last updated Jan. 14, 2022) (stating that Australia and Brazil emitted .38 GT and .41 GT of carbon dioxide equivalent, respectively).

[125] Cal. Air. Res. Bd., *California Moves to Accelerate to 100% New Zero-Emission Vehicle Sales by 2035* (Aug. 25, 2022), https://ww2.arb.ca.gov/news/california-moves-accelerate-100-new-zero-emission-vehicle-sales-2035.

therefore make a material and tangible difference in global efforts to slow the pace of warming worldwide.

Arguments that California's greenhouse gas regulations provide only *de minimis* reductions in the face of global climate change are misplaced. Section 177 of the Clean Air Act empowers states to adopt California's emissions standards.[126] As of May, 2022, 17 states, as well as the District of Columbia, had implemented or were in the process of implementing components of the Advanced Clean Cars program under Section 177, a group that accounts for 40 percent of new vehicle sales in the United States.[127] While California's transportation regulations are thus designed to address the state's unique geographic conditions, Section 177 amplifies their impact by reducing greenhouse gas emissions across the American transportation sector, which accounts for more than a quarter of the nation's greenhouse gas emissions.[128]

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[126] 42 U.S.C. § 7507.

[127] *Id.*

[128] U.S. Envtl. Prot. Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks*, https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks (last visited Nov. 3, 2022).

CONCLUSION

California is extraordinarily vulnerable to the impacts of climate change caused by greenhouse gas emissions. The state faces a devastating confluence of increasingly intense wildfires, declining food crop production, significant water system disruption, severe drought and flooding events, coastal community destruction, and deteriorating local air quality. These "compelling and extraordinary conditions" drove California to adopt vehicle emissions policies to reduce the state's carbon footprint and protect the physical security and well-being of its 40 million residents. The science supports both the continuing need for those policies and for the waiver that makes them possible.

January 18, 2023

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Maximilian Auffhammer is the George Pardee Jr. Family Professor of International Sustainable Development at the University of

California, Berkeley, where has been a professor in the Department of Agricultural & Resource Economics and the College of Letters and Sciences since 2003. Dr. Auffhammer currently serves as the Associate Dean of Interdisciplinary Social Sciences in the College of Letters and Sciences, and the Regional Associate Dean in Social Sciences, Arts and Humanities and the Undergraduate Division. He is also a research associate at the Energy Institute at Haas, a Fellow of the CESifo network, and a research associate at the National Bureau of Economic Research as well as a Humboldt Fellow. Dr. Auffhammer's research areas include environmental and energy economics, climate economics, regulation, and forecasting, with a geographic area of expertise focused on California, among other places. He served as a lead author on the Fifth Assessment Report of the Intergovernmental Panel on Climate Change and was appointed to serve on a National Academies of Sciences Panel to assess the social cost of carbon. Dr. Aufhammer received his B.S. in environmental science from the University of Massachusetts at Amherst, his M.S. in environmental and resource economics at the same institution, and his Ph.D. in economics from U.C. San Diego.

Marshall Burke is an associate professor in the Department of Earth System Science, deputy director at the Center on Food Security and the Environment, and center fellow at the Freeman Spogli Institute for International Studies (FSI) at Stanford University. He is also a faculty research fellow at the National Bureau of Economic Research, and a co-founder of AtlasAI, a remote sensing start-up. His research focuses on social and economic impacts of environmental change and on measuring and understanding economic development in emerging markets. His work has appeared in both economic and scientific journals, including recent publications in Nature, Science, The Quarterly Journal of Economics, and The Lancet. He holds a Ph.D. in agricultural and resource economics from the University of California, Berkeley, and a B.A. in international relations from Stanford University.

Allen Goldstein is a Professor in the Department of Civil and Environmental Engineering and in the Department of Environmental Science, Policy, and Management at the University of California, Berkeley, where he joined the faculty in 1996. Professor Goldstein currently serves as Associate Dean for the UC Berkeley Rausser College

of Natural Resources, and he previously served as co-Chair of the International Global Atmospheric Chemistry program (IGAC) from 2013-2016 and as the chair of his department from 2007 to 2010. Dr. Goldstein received his B.A. and B.S. degrees from the University of California, Santa Cruz in politics and chemistry, and his M.A. and Ph.D. degrees in chemistry from Harvard University. He has published more than 400 scientific papers related to air pollution and climate, and his honors include the American Geophysical Union Atmospheric Sciences Section Yoram J. Kaufman Unselfish Cooperation in Research Award (2019); the David Sinclair Award from the American Association for Aerosol Research (2018); and the Alexander von Humboldt Research Award in Germany (2017). He has also served as a Fulbright Senior Scholar in Italy (2018) and in Australia (2005), was elected a Fellow of the American Geophysical Union (2011) and of the American Association for the Advancement of Science (2018), and has been recognized as a Highly Cited Researcher by Clarivate Analytics (2017, 2018, 2019, 2020, & 2021 ranking in the top 1% Web of Science citations for the field).

John Harte is a Professor of the Graduate School at the University of California, Berkeley. Professor Harte has received a Guggenheim Fellowship, the Leo Szilard prize from the American Physical Society, and is a co-recipient of a 2006 George Polk award in investigative journalism. He is an elected Fellow of the California Academy of Sciences, the American Physical Society, the Ecological society of America, and the American Association for the Advancement of Science. He has also served on six National Academy of Sciences Committees and has authored over 240 scientific publications, including eight books, one of which, "Consider a Spherical Cow," is a widely used textbook on environmental modeling. His research focuses on climate change, biodiversity, and maintaining ecosystem services for humanity. Dr. Harte completed his undergraduate studies at Harvard University and his Ph.D. at the University of Wisconsin.

Michael Mastrandrea is an interdisciplinary scientist focused on managing climate risks and the design and implementation of energy and climate policy in California and beyond. He is Research Director of the Climate and Energy Policy Program and a Senior Research Scholar at the Stanford Woods Institute for the Environment.

He also serves as Chief Advisor for Energy and Climate Research at the California Energy Commission. Prior to joining Woods, he was Director of Near Zero and a Senior Research Associate at the Carnegie Institution for Science. He was part of the leadership team for the Intergovernmental Panel on Climate Change Fifth Assessment Report, where he helped lead the development of two international scientific assessments of climate change science and policy options. He has also served as an author for the Fourth U.S. National Climate Assessment and as an associate editor for the California Fourth Climate Change Assessment. Mastrandrea sits on the Editorial Board and is a Managing Editor for the journal Climatic Change. He holds a Ph.D. from Stanford's Emmett Interdisciplinary Program in Environment and Resources, and a B.S. in Biological Sciences from Stanford.

LeRoy Westerling is a Professor of Management of Complex Systems at the University of California at Merced. His research interests and publications are in applied climatology, climate-ecosystem-wildfire interactions, statistical modeling for seasonal forecasts, paleofire reconstructions, climate change impact assessments and resource management and policy. Professor

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CERTIFICATE OF COMPLIANCE

I certify that the foregoing brief is complies with the type-volume limitations of the Court's order filed September 22, 2022 (ECF Dkt No. 1965631) because, according to the Microsoft Word word-processing program on which it was created, it is proportionately spaced, has a Century Schoolbook typeface of 14 points, and contains 6,116 words, excluding those parts of the brief exempted under Federal Rule of Appellate Procedure 32(f) and Circuit Rule 32(e)(1).

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CERTIFICATE OF SERVICE

I hereby certify that, on January 18, 2023, 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, which served a copy of the document on all counsel of record in the case.

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