

No. 18-36082

**UNITED STATES COURT OF APPEALS
FOR THE NINTH CIRCUIT**

KELSEY CASCADIA ROSE JULIANA, et al.,
Plaintiffs-Appellees,

v.

UNITED STATES OF AMERICA, et al.,
Defendants-Appellants.

ON INTERLOCUTORY APPEAL FROM THE UNITED STATES DISTRICT
COURT FOR THE DISTRICT OF OREGON (NO. 6:15-CV-01517-AA)

**BRIEF OF *AMICI CURIAE* PUBLIC HEALTH EXPERTS,
PUBLIC HEALTH ORGANIZATIONS, AND DOCTORS
IN SUPPORT OF PLAINTIFFS-APPELLEES' PETITION FOR
REHEARING EN BANC**

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CORPORATE DISCLOSURE STATEMENT

Pursuant to Federal Rules of Appellate Procedure 26.1 and 29(a)(4)(A), organizational *amici* state that they do not have any parent companies and no publicly-held company has a 10% or greater ownership interest in any of them.

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INTERESTS OF THE *AMICI CURIAE*¹

Amici are leading experts in public health and medicine and organizations representing thousands of health professionals. Through their research and/or clinical work, the *amici* observe and document the harmful impacts of greenhouse gas (GHG) emissions on people born in the United States since 1995—the Plaintiffs’ generation, the “Juliana Generation.” This generation is suffering—and will continue to suffer as they age—harms different from those of prior generations. *Amici* feel a special responsibility to safeguard the Juliana Generation’s health now.

Amicus Samantha Ahdoot is Assistant Professor of Pediatrics at Virginia Commonwealth University School of Medicine, Inova Campus. She provided expert consultation on the effects of climate change on children’s health to the President’s Task Force on Children’s Environmental Health in 2014. She co-authored the 2015 American Academy of Pediatrics (AAP) report on the effects of climate change on children’s health.

Amicus Eric Chivian is the Founder and Director Emeritus of the Center for Health and the Global Environment at Harvard Medical School (HMS). He is the

¹ Pursuant to Circuit Rule 29-2, *amici* state that all parties have consented to the filing of this brief. Pursuant to Federal Rule of Appellate Procedure 29(A)(4)(e), *amici* certify that no person or entity, other than *amici* or its counsel, made a monetary contribution to the preparation or submission of this brief or authored this brief in whole or in part.

co-founder of International Physicians for the Prevention of Nuclear War, which won the Nobel Peace Prize in 1985.

Amicus Sir Andrew Haines is Professor of Environmental Change and Public Health at and former Director of the London School of Hygiene & Tropical Medicine. He has chaired an international commission on the health impacts of environmental change and the policies needed to address these changes. He has been on the UN Intergovernmental Panel on Climate Change for three assessments.

Amicus Kim Knowlton is Assistant Professor of Environmental Health Sciences at Columbia University Mailman School of Public Health (CUMSPH), researching the health impacts of climate change and estimating their costs. She was the co-convening lead author on the human health chapter of the Third U.S. National Climate Assessment.

Amicus Frederica Perera is Professor of Public Health and the Founding Director of the Columbia Center for Children's Environmental Health at CUMSPH. She is internationally recognized for her research on the impacts on children's health of fossil fuel- related air pollution and climate change.

Amici also include numerous organizations and preeminent experts in children's health. They are listed in the Addendum.

INTRODUCTION AND SUMMARY OF ARGUMENT

The generation of today's youth (the "Juliana Generation"), represented by the Plaintiffs, was born into a world made hazardous to their health and well-being by greenhouse gases (GHGs) emitted by human activities. GHG emissions are causing major physical, chemical, and ecological changes to the planet, manifesting as extreme weather events, including heat waves, heavy precipitation, and droughts. The medical community agrees that children in the United States will face compounded health harms over the course of their lives if our current trajectory of GHG emissions continues; "[w]ithout significant intervention, this new era will come to define the health of an entire generation."²

Children are especially vulnerable to climate-related health effects because of their developing bodies; higher exposure to air, food, and water per unit body weight; unique behavior patterns; and dependence on caregivers.³ GHG emissions cause harmful impacts via extreme weather events, increased heat stress, decreased air quality, altered disease patterns, and food, water and nutrient insecurity.⁴

² Renee N. Salas et al., *The Lancet Countdown on Health and Climate Change, Policy Brief for the United States of America* 6 (2019), <https://static1.squarespace.com/static/5bdc9ff550a54fd70b355029/t/5dcca0db51433179dccc3bf8/1573691618304/Lancet+Countdown+Policy+Brief+for+the+US+2019.pdf>.

³ Samantha Ahdoot & Susan E. Pacheco, *Global Climate Change and Children's Health*, 136 *Pediatrics* e1468, e1470 (2015).

⁴ *Id.* at e1468.

Children are already feeling these effects, which will continue to worsen as the Juliana Generation matures. Adverse public health impacts can be significantly mitigated if the federal government acts to reduce GHG emissions. The window of opportunity for such action, however, is rapidly closing. To avoid the most serious risks and harms we must reduce GHG emissions in half in the next decade and to zero by 2050.⁵ For these reasons, *amici* urge the Court to grant Plaintiffs' request for rehearing *en banc*.

ARGUMENT

I. GHG EMISSIONS ARE CAUSING ECOLOGICAL CHANGES AND EXTREME WEATHER EVENTS THAT THREATEN CHILDREN'S HEALTH IN THE UNITED STATES

There is scientific consensus that GHGs emitted by human activities are causing major physical, chemical, and ecological changes to the planet (climate change) including rising global temperatures, which are manifesting as extreme weather events. The federal government's Fourth National Climate Assessment details the serious effects that climate change is projected to have on public

⁵ Intergovernmental Panel on Climate Change, *Summary for Policymakers of IPCC Special Report on Global Warming of 1.5°C Approved by Governments* (Oct. 8, 2018), <https://www.ipcc.ch/2018/10/08/summary-for-policymakers-of-ipcc-special-report-on-global-warming-of-1-5c-approved-by-governments/>.

health.⁶ GHG emissions pose a threat to the health of all people, but will have especially severe impacts on children.⁷ The Juliana Generation faces an increasing burden of heat exposure, extreme weather events, infectious disease, and less nutritious, more expensive food.

A. Rising Temperatures and Increased Heat Exposure Threaten Children's Health

Global average temperature increased by about 1.8°F from 1901 to 2016; human activities, especially GHG emissions, are the dominant cause.⁸ Exposure to extreme heat is the leading cause of weather-related deaths in the United States.⁹ Heat exposure in the United States is increasing as hot days become more frequent and extreme heat waves become more prolonged. In San Francisco, for example,

⁶ U.S. Global Change Research Program, *Fourth National Climate Assessment* 512–71 (2018) [hereinafter NCA].

⁷ See Andy Haines & Kristie Ebi, *The Imperative for Climate Action to Protect Health*, 380 *New Eng. J. Med.* 263, 267 fig.3 (2019); see also Ahdoot & Pacheco, *supra* note 3; Rebecca Pass Philipsborn & Kevin Chan, *Climate Change and Global Child Health*, 141 *Pediatrics*, June 2018; Ying Zhang et al., *Climate Change and Disability-Adjusted Life Years*, 70 *J. Env'tl. Health* 32, 33 (2007) (estimating children will bear 88% of the burden of disease due to climate change).

⁸ NCA, *supra* note 6, at 73.

⁹ Ahdoot & Pacheco, *supra* note 3, at e1471.

the number of days with temperatures above 90°F will increase from ten currently to about fifty in 2050 and over 100 in 2100.¹⁰

Children are particularly susceptible to extreme heat.¹¹ For instance, the 2006 heat wave in California generated 16,166 excess visits to emergency departments over 2.5 weeks; children's visits to emergency departments exceeded those of adults.¹² Infant mortality increases 25% on extremely hot days, with the first seven days of life representing a period of critical vulnerability.¹³ Heat is a leading cause of death and illness in high school athletes; nearly 10,000 episodes occur annually.¹⁴ Emergency room visits for heat-related injuries increased 134% between 1997 and 2006 in the United States.¹⁵

¹⁰ S.F. Dep't Pub. Health, *San Francisco Climate and Health Profile* 9 (Nov. 2014), https://sfclimatehealth.org/wp-content/uploads/2018/12/SFDPH_ClimateHealthProfile_FinalDraft.pdf.

¹¹ Philipsborn & Chan, *supra* note 7, at 2.

¹² Kim Knowlton, *The 2006 California Heat Wave: Impacts on Hospitalizations and Emergency Department Visits*, 117 *Env't'l Health Persp.* 61, 63, 63 tbl.1 (2009).

¹³ Xavier Basagaña et al., *Heat Waves and Cause-Specific Mortality at All Ages*, 22 *Epidemiology* 765, 765 (2011).

¹⁴ J. Gilchrist et al., *Heat Illness Among High School Athletes—United States, 2005–2009*, 59 *Morbidity & Mortality Wkly. Rep.* 1009, 1009 (2010).

¹⁵ Nicolas G. Nelson et al., *Exertional Heat-Related Injuries Treated in Emergency Departments in the U.S., 1997–2006*, 40 *Am. J. Preventive Med.* 54, 56 (2011).

GHG emissions also exacerbate allergies. 7.2% of U.S. children suffer from allergic rhinitis (hay fever),¹⁶ a syndrome of sneezing, stuffy nose, runny nose, watery eyes, and itching of the nose, eyes, or mouth triggered by airborne pollen.¹⁷ Many asthma attacks in children are allergy-associated. When exposed to warmer temperatures and higher carbon dioxide levels, plants produce more pollen.¹⁸ The ragweed pollen season in North America has increased thirteen to twenty-seven days since 1995 because of higher temperatures and greater carbon dioxide levels.¹⁹

¹⁶ Table C-2, Summary Health Statistics: National Health Interview Survey, 2018, Ctrs. for Disease Control & Prevention (2019), https://ftp.cdc.gov/pub/Health_Statistics/NCHS/NHIS/SHS/2018_SHS_Table_C-2.pdf.

¹⁷ *Allergy Facts*, Am. C. Allergy, Asthma, & Immunology (Jan. 9, 2018), <https://acaai.org/news/facts-statistics/allergies>.

¹⁸ Yong Zhang et al., *Allergenic Pollen Season Variations in the Past Two Decades Under Changing Climate in the United States*, 21 *Global Change Biology* 1581 (2015); Lewis H. Ziska & Paul J. Beggs, *Anthropogenic Climate Change and Allergen Exposure: The Role of Plant Biology*, 129 *J. Allergy & Clinical Immunology* 27 (2012).

¹⁹ Lewis Ziska et al., *Recent Warming by Latitude Associated with Increased Length of Ragweed Pollen Season in Central North America*, 108 *Proc. Nat'l Acad. Sci.* 4248, 4248 (2011).

Evidence also demonstrates a link between hotter temperatures and mental health impairments in children;²⁰ antibiotic resistance among bacteria that cause human infection;²¹ and adverse pregnancy outcomes and congenital heart defects.²²

B. Extreme Weather Events Pose Direct and Indirect Threats to Children's Health

Extreme weather events in the United States, including heat waves, droughts, wildfires, and floods, have steadily increased since 1980 and are projected to become even more frequent.²³ These events cause destruction, injuries, infectious diseases, and death.²⁴ In 2012, Hurricane Sandy caused 234 deaths, \$50 billion in property damage, the destruction of 375,000 housing units in New York and New Jersey, the loss of power for 8.5 million people, and the evacuation of

²⁰ Nick Obradovich et al., *Empirical Evidence of Mental Health Risks Posed by Climate Change*, 115 Proc. Nat'l Acad. Sci. 10,953 (2018); Jose Guillermo Cedeño Laurent et al., *Reduced Cognitive Function During a Heat Wave Among Residents of Non-Air-Conditioned Buildings: An Observational Study of Young Adults in the Summer of 2016*, 15 PLOS Medicine e1002605 (July 10, 2018); Diana Younan et al., *Long-Term Ambient Temperature and Externalizing Behaviors in Adolescents*, 187 Am. J. Epidemiology 1931 (2018).

²¹ Derek R. MacFadden, *Antibiotic Resistance Increases with Local Temperature*, 8 Nature Climate Change 510 (2018).

²² Wangjian Zhang et al., *Projected Changes in Maternal Heat Exposure During Early Pregnancy and the Associated Congenital Heart Defect Burden in the United States*, 8 J. Am. Heart Ass'n, Feb. 5, 2019, at 5–6, 10.

²³ NCA, *supra* note 6, at 97.

²⁴ *Id.*

1,000 hospital patients.²⁵ In 2017, Hurricane Maria disrupted medical services to 31% of households in Puerto Rico, displaced 10,600 people, and resulted in an estimated 5,740 excess deaths.²⁶

A series of expert reports published by the American Meteorological Society since 2012 has identified many extreme weather events that have been made more likely because of GHG emissions. The reports for 2016 and 2017 identified for the first time several extreme weather events that could not have happened without human-induced climate change, including the Northern Great Plains drought and a marine heat wave off Alaska.²⁷ The 2018 report identified the Four Corners drought and exceptional precipitation in the Mid-Atlantic states as two U.S. extreme weather events made more likely by human-caused climate change.²⁸

²⁵ John Manuel, *The Long Road to Recovery: Environmental Health Impacts of Hurricane Sandy*, 121 *Envtl. Health Persp.* A153, A153–54 (2013).

²⁶ Renee N. Salas et al., *2018 Lancet Countdown on Health and Climate Change: Brief for the United States of America* 13 (2018); Nishant Kishore et al., *Mortality in Puerto Rico After Hurricane Maria*, 379 *New Eng. J. Med.* 162, 166 (2018).

²⁷ *Explaining Extreme Events of 2017 from a Climate Perspective*, 100 *Bull. Am. Meteorological Soc’y*, Supp. Jan. 2019, at S1; *Explaining Extreme Events of 2016 from a Climate Perspective*, 99 *Bull. Am. Meteorological Soc’y*, Supp. Jan. 2018, at Sii.

²⁸ *Explaining Extreme Events of 2018 from a Climate Perspective*, 101 *Bull. Am. Meteorological Soc’y*, Supp. Jan. 2020, at S5, S11.

GHG emissions are linked to longer, more intense, and geographically broader droughts now than occurred in the twentieth century, especially in the western United States.²⁹ Droughts have depleted groundwater supplies in the United States, including the High Plains and Dakota Aquifers, jeopardizing access to drinking water for some communities.³⁰ Droughts impair human health by increasing wildfires and dust storms, exacerbating particulate matter air pollution, increasing the risk of certain infectious diseases,³¹ and increasing food insecurity.³²

GHG emissions have increased the likelihood of wildfires in the United States. They were one factor contributing to the 2018 California wildfires, which were among the most destructive ever recorded in the state.³³ In addition to the

²⁹ U.S. Global Change Research Program, *The Impacts of Climate Change on Human Health in the United States* 102 tbl.1 (2016) [hereinafter *Impacts on Health*]; NCA, *supra* note 6, at 155; Noah S. Diffenbaugh et al., *Anthropogenic Warming has Increased Drought Risk in California*, 112 Proc. Nat'l Acad. Sci. 3931 (2015).

³⁰ NCA, *supra* note 6, at 148.

³¹ *Id.* at 154; *Impacts on Health*, *supra* note 29, at 108, 110. Warmer, more stagnant waters provide favorable conditions for certain disease-carrying pathogens and insects. Jesse E. Bell et al., *Changes in Extreme Events and the Potential Impacts on Human Health*, 68 J. Air & Waste Mgmt. Ass'n 265, 274 (2017).

³² NCA, *supra* note 6, at 150; Neil S. Grigg, *The 2011–2012 Drought in the United States: New Lessons from a Record Event*, 30 Int'l J. Water Res. Development 183, 190 (2014).

³³ *Explaining Extreme Events of 2018*, *supra* note 28, at S1.

stress, direct trauma, and deaths associated with wildfires, wildfire smoke increases air-pollution levels and is associated with respiratory disease. Children exposed to wildfires suffer substantial eye symptoms, as well as upper and lower respiratory symptoms.³⁴ Emerging evidence suggests an association between exposure to wildfire smoke and heart attacks, strokes, and death from all causes.³⁵

Extreme weather events have severe negative effects on children's mental health. The trauma often leaves psychological scars that cause lasting damage, interfering with emotional growth and development and leaving child victims vulnerable to chronic mental disabilities.³⁶ More than 200,000 children were evacuated and relocated during Hurricane Katrina;³⁷ these children have suffered long-lasting and profound mental health impacts. Displaced students experienced problems related to school attendance, academic performance, behavior, and

³⁴ Nino Künzli et al., *Health Effects of the 2003 Southern California Wildfires on Children*, 174 *Am. J. Respiratory & Critical Care Med.* 1221, 1224 (2006).

³⁵ Wayne E. Cascio, *Wildland Fire Smoke and Human Health*, 624 *Sci. Total Env't* 586, 586 (2018).

³⁶ Daniel Martinez Garcia & Mary C. Sheehan, *Extreme Weather-Driven Disasters and Children's Health*, 46 *Int'l J. Health Services* 79 (2016).

³⁷ Kristie L. Ebi & Jerome A. Paulson, *Climate Change and Child Health in the United States*, 40 *Current Prob. Pediatric & Adolescent Health Care* 2, 8 (2010).

mental health.³⁸ Post-traumatic stress disorder was identified in 50% of preschool-age children and 71% of sixth- and seventh-graders following Hurricane Katrina.³⁹

Extreme weather events also affect children's health indirectly through disaster-related healthcare system failures. For example, disruption of the medical supply chain or loss of electric power during intense storms threatens vaccination programs and the availability of medications. In 2017, Hurricane Maria interrupted the production of essential drugs and intravenous fluid manufactured in Puerto Rico, resulting in nationwide shortages.⁴⁰

³⁸ See Alice Fothergill & Lori Peek, *Children of Katrina* (2015).

³⁹ Lauren Hensley & R. Enrique Varela, *PTSD Symptoms and Somatic Complaints Following Hurricane Katrina: The Roles of Trait Anxiety and Anxiety Sensitivity*, 37 *J. Clinical Child & Adolescent Psych.* 542, 546 tbl.2 (2008); Michael S. Scheeringa & Charles H. Zeanah, *Reconsideration of Harm's Way: Onsets and Comorbidity Patterns of Disorders in Preschool Children and Their Caregivers Following Hurricane Katrina*, 37 *J. Clinical Child & Adolescent Psych.* 508 (2008).

⁴⁰ Katie Thomas, *U.S. Hospitals Wrestle With Shortages of Drug Supplies Made in Puerto Rico*, *N.Y. Times* (Oct. 23, 2017), <https://www.nytimes.com/2017/10/23/health/puerto-rico-hurricane-maria-drug-shortage.html>; Press Announcement, *Statement by FDA Commissioner Scott Gottlieb, M.D., Updating on Puerto Rico Related Medical Product Shortages*, U.S. Food & Drug Admin. (Nov. 30, 2017), <https://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm587290.htm>.

C. GHG Emissions Are Altering and Increasing the Burden of Infectious Disease

Vector-borne infections in the United States are principally transmitted by mosquitoes or ticks. Rising temperatures and increased precipitation affect the biology and behavior of mosquitoes and ticks, leading to expanded and altered geographic distributions, prolonged transmission seasons, and the emergence of new human pathogens. Between 2004 and 2016, annual reports of vector-borne diseases in the United States more than doubled and the areas reporting diseases expanded.⁴¹

Lyme disease, the most common tick-borne disease in the United States,⁴² can lead to arthritis and diseases of the heart, nervous system, and skin.⁴³ Children between the ages of five and nine have the highest incidence of Lyme disease in the United States.⁴⁴ Cases of Lyme disease have increased steadily since 1991.⁴⁵

⁴¹ Ronald Rosenberg et al., *Vital Signs: Trends in Reported Vectorborne Disease Cases—United States and Territories, 2004–2016*, 67 *Mortality & Morbidity Weekly Rep.* 496, 497 (2018).

⁴² Aaron S. Bernstein & Samuel S. Myers, *Climate Change and Children’s Health*, 23 *Current Opinion Pediatrics* 221, 222 (2011).

⁴³ Amy L. Ross Russell et al., *Lyme Disease: Diagnosis and Management*, 18 *Prac. Neurology* 455, 457 (2018).

⁴⁴ Bernstein & Myers, *supra* note 42, at 222.

⁴⁵ CDC annual reports contain data for each year. *See Notifiable Infectious Diseases and Conditions Data Tables*, Ctrs. Disease Control & Prevention, <https://www.cdc.gov/nndss/infectious-tables.html> (last visited Mar. 11, 2020).

Warmer winter and spring temperatures, resulting from GHG emissions, are projected to lead to an earlier annual onset of Lyme disease cases in the eastern United States and to a more prolonged season.⁴⁶ The geographic distribution of the ticks that transmit Lyme disease is also expanding.⁴⁷

The United States is expected to experience a climate-driven increase in the percentage of people exposed to the mosquito *Aedes aegypti* over the twenty-first century.⁴⁸ This mosquito transmits disease-causing viruses—including dengue and Zika. Zika virus causes fever, headache and rash; infection during pregnancy can cause serious brain defects and stillbirth. The United States experienced a large outbreak of Zika virus in 2015–2016, with local transmission in Florida, Texas, and Puerto Rico.⁴⁹ These regions subsequently experienced a 21% increase in birth defects strongly linked to Zika virus.⁵⁰

⁴⁶ Sean M. Moore et al., *Meteorological Influences on the Seasonality of Lyme Disease in the United States*, 90 *Am. J. Tropical Med. & Hygiene* 486 (2014).

⁴⁷ John S. Brownstein et al., *Effect of Climate Change on Lyme Disease Risk in North America*, 2 *EcoHealth* 38, 38 (2005); Rosenberg et al., *supra* note 41, at 497.

⁴⁸ Salas et al., *supra* note 26, at 15.

⁴⁹ Augustina Delaney et al., *Population-Based Surveillance of Birth Defects Potentially Related to Zika Virus Infection—15 States and U.S. Territories, 2016*, 67 *Morbidity & Mortality Wkly. Rep.* 91, 92 n.** (2018).

⁵⁰ *Id.* at 92.

Changes in temperature and precipitation due to GHG emissions are affecting the spread of infections related to soil and water exposure.

Coccidioidomycosis, also known as “valley fever,” is caused by a fungus found in hot, dry areas, including Arizona and California.⁵¹ Manifestations include rash, fever, lung disease, nervous system disease, and occasionally death.⁵² Over 9,000 cases of valley fever occurred in California in 2019, an increase of over 60% since 2016.⁵³ Cases have also been newly observed in Washington State.⁵⁴

Vibrio, a family of bacteria, can cause bloodstream infections, diarrhea, and skin infections,⁵⁵ with an estimated 80,000 illnesses and 100 deaths in the United

⁵¹ *Valley Fever (Coccidioidomycosis)*, Ctrs. Disease Control & Prevention (Jan. 2, 2019), <https://www.cdc.gov/fungal/diseases/coccidioidomycosis/index.html>.

⁵² *Symptoms of Valley Fever (Coccidioidomycosis)*, Ctrs. Disease Control & Prevention (Jan. 2, 2019), <https://www.cdc.gov/fungal/diseases/coccidioidomycosis/symptoms.html>.

⁵³ Cal. Dep’t Pub. Health, *Coccidioidomycosis in California Provisional Monthly Report 3* (Jan. 31, 2020), <https://www.cdph.ca.gov/Programs/CID/DCDC/CDPH%20Document%20Library/CocciinCAProvisionalMonthlyReport.pdf>; Cal. Dep’t Pub. Health, *Epidemiologic Summary of Coccidioidomycosis in California, 2018*, at 6 (2019), <https://www.cdph.ca.gov/Programs/CID/DCDC/CDPH%20Document%20Library/CocciEpiSummary2018.pdf>.

⁵⁴ Wash. State Dep’t Health, *Washington State Communicable Disease Report 2017*, at 26 (Nov. 2018), <https://www.doh.wa.gov/Portals/1/Documents/5100/420-004-CDAnnualReport2017.pdf>.

⁵⁵ Nick Watts et al., *The 2018 Report of the Lancet Countdown on Health and Climate Change: Shaping the Health of Nations for Centuries to Come*, 392 *Lancet* 2479, 2488 (2018).

States each year.⁵⁶ Warmer sea temperatures due to GHG emissions have been associated with an observed 7% annual increase in U.S. *Vibrio* infections from 1999 to 2014.⁵⁷ *Vibrio* infections are expected to increase further as sea temperatures warm.

D. Rising Temperatures and Extreme Weather Will Increase Food Insecurity and Malnutrition

Climate change reduces both the availability of crops and their nutrient content. Children are at particular risk of adverse consequences of undernutrition, including poor growth, nutritional deficiencies, and worsened school performance.

Weather extremes and water scarcity increase crop losses.⁵⁸ Crop yields are projected to decline by about 1% per decade at a time when demands for food are increasing.⁵⁹ Increased levels of carbon dioxide in the atmosphere have been directly linked to reductions in nutrients in food. Protein content will decline in

⁵⁶ *Vibrio Species Causing Vibriosis*, Ctrs. Disease Control & Prevention (Sept. 28, 2018), <https://www.cdc.gov/vibrio/>.

⁵⁷ Chloë Logar-Henderson et al., *Effects of Large-Scale Oceanic Phenomena on Non-Cholera Vibriosis Incidence in the United States: Implications for Climate Change*, 147 *Lancet* E243 (2019).

⁵⁸ Bernstein & Myers, *supra* note 42, at 224.

⁵⁹ John R. Porter et al., *Food Security and Food Production Systems*, in *Climate Change 2014: Impacts, Adaptation, and Vulnerability* 485, 505 (Christopher B. Field et al. eds., 2014).

wheat, rice, and barley; iron and zinc content will decline in rice, soybeans, wheat, and peas; and vitamin B and micronutrient content will decline in rice and wheat.⁶⁰

II. BURNING FOSSIL FUELS CAUSES AND EXACERBATES ALREADY DANGEROUS LOCALIZED AIR POLLUTION

The production and use of fossil fuels not only emit GHGs, but also emit other air pollutants that pose hazards to children's health.⁶¹ One such pollutant is ozone.⁶² Exposure to ozone pollution may increase children's risk of developing asthma,⁶³ and also increases emergency room visits and pediatric intensive care unit admissions for asthma.⁶⁴ Exposure to fine particulate matter (PM_{2.5}), which is also released in fossil fuel combustion, is associated with increased exacerbation of

⁶⁰ Ahdoot & Pacheco, *supra* note 3, at e1476; Haines & Ebi, *supra* note 7, at 266; Jonathan A. Patz et al., *Climate Change: Challenges and Opportunities for Global Health*, 312 J. Am. Med. Ass'n 1565, 1570 (2014).

⁶¹ Ebi & Paulson, *supra* note 37, at 9; Frederica P. Perera, *Multiple Threats to Child Health from Fossil Fuel Combustion: Impacts of Air Pollution and Climate Change*, 125 *Envtl. Health Persp.* 141 (2017) [hereinafter Perera, *Multiple Threats*]; F. Perera et al., *Towards a Fuller Assessment of Benefits to Children's Health of Reducing Air Pollution and Mitigating Climate Change due to Fossil Fuel Combustion*, 172 *Envtl. Res.* 55 (2019).

⁶² Kent E. Pinkerton et al., *An Official American Thoracic Society Workshop Report: Climate Change and Human Health*, 9 *Proc. Am. Thoracic Soc'y* 3, 4–5 (2012).

⁶³ See U.S. *Envtl. Prot. Agency*, EPA 600/R-10/076F, *Integrated Science Assessment for Ozone and Related Photochemical Oxidants 7-31 to -36* (2013).

⁶⁴ Robert A. Silverman & Kazuhiko Ito, *Age Related Association of Fine Particles and Ozone with Severe Acute Asthma in New York City*, 125 *J. Allergy & Clinical Immunology* 367 (2010).

bronchitis and asthma in children, as well as hospital admissions, mortality, school absenteeism,⁶⁵ and decreased lung function growth.⁶⁶ Combustion of coal at power plants was responsible for 44% of U.S. emissions of mercury, a potent neurotoxin, in 2014.⁶⁷ Even low prenatal exposure can lead to decreased motor and cognitive abilities.⁶⁸ As children age, low-level mercury exposures have been linked to higher risks of hypertension, heart disease,⁶⁹ and endocrine disturbances.⁷⁰

CONCLUSION

Continued significant GHG emissions will dramatically shape the world in which the Juliana Generation will live, exposing them to grave, new health hazards. Reducing emissions immediately will help alleviate the particular harms

⁶⁵ Perera, *Multiple Threats*, *supra* note 61, at 143; *see also* U.S. Env'tl. Prot. Agency, EPA/600/R-19/188, Integrated Science Assessment for Particulate Matter (2019).

⁶⁶ Edward L. Avol et al., *Respiratory Effects of Relocating to Areas of Differing Air Pollution Levels*, 164 Am. J. Respiratory Critical Care Med. 2067 (2001).

⁶⁷ A.C. (Thanos) Bourtsalas & Nickolas J. Themelis, *Major Sources of Mercury Emissions to the Atmosphere: The U.S. Case*, 85 J. Waste Mgmt. 90, 92 fig.2 (2019).

⁶⁸ *Id.*

⁶⁹ Comm. On the Toxicological Effects of Methylmercury, Nat'l Research Council, *Toxicological Effects of Methylmercury* 4 (2000), <https://www.nap.edu/read/9899/>; Henry A. Roman et al., *Evaluation of the Cardiovascular Effects of Methylmercury Exposures: Current Evidence Supports Development of a Dose-Response Function for Regulatory Benefits Analysis*, 119 Env'tl. Health Persp. 607, 607 (2011).

⁷⁰ Shirlee W. Tan et al., *The Endocrine Effects of Mercury in Humans and Wildlife*, 39 Critical Reviews Toxicology 228, 240 (2009).

they face. However, the window of time to take effective action is narrow. All of the Intergovernmental Panel on Climate Change’s pathways to avoid the worst impacts of climate change require substantial annual reductions in greenhouse gas emissions between 2020 and 2030. The timeframe for stabilizing the climate shrinks as more GHGs enter the atmosphere and the odds of passing a tipping point increase. As the federal government acknowledged in 2018, “delayed and potentially much steeper emissions reductions jeopardize achieving any long-term goal given uncertainties in the physical response of the climate system to changing atmospheric CO₂, mitigation deployment uncertainties, and the potential for abrupt consequences.”⁷¹ Instead, “early and substantial mitigation offers a greater chance of avoiding increasingly adverse impacts.”⁷²

For the foregoing reasons, *amici* respectfully request that the Court grant Plaintiffs’ request for rehearing *en banc*.

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⁷¹ NCA, *supra* note 6, at 1351.

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- American Pediatric Society;
- American Thoracic Society;
- International Society for Children's Health and the Environment;
- Medical Society Consortium on Climate and Health;
- National Association of County and City Health Officials;
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CERTIFICATE OF COMPLIANCE

Pursuant to Federal Rule of Appellate Procedure 29(a)(4)(G), I hereby certify that the foregoing brief complies with the type-volume limitation in Circuit Rule 29-2(c)(2). It was prepared using Microsoft Word 2016 in Times New Roman 14-point font, a proportionally spaced typeface, and contains 4159 words.

/s/ Shaun A. Goho
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CERTIFICATE OF SERVICE

I hereby certify that I electronically filed the foregoing brief with the Clerk of the Court for the United States Court of Appeals for the Ninth Circuit by using the appellate CM/EF system on March 12, 2020. I certify that all participants in the case are registered CM/ECF users and that service will be accomplished by the appellate CM/ECF system.

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