

**Testimony of Michael D. Shellenberger, President, Environmental Progress, to
the House Committee On Science, Space, and Technology, An Update on the
Science of Climate Change, January 15, 2020**

Good morning Chairman Johnson, Ranking Member Lucas and members of the committee.

My name is Michael Shellenberger, and I am Founder and President of Environmental Progress, an independent non-profit research organization funded by charitable philanthropies and individuals with no financial interest in our findings.¹ As background, I am an invited expert reviewer of the next assessment report by the Intergovernmental Panel on Climate Change (IPCC), a regular contributor to the *New York Times*, *Washington Post*, *Forbes*, and other publications, and a *Time Magazine* “Hero of the Environment.”²

I am honored to address the Committee on the state of climate science and opportunities to mitigate and adapt to climate change from the perspective of someone who has worked at the intersection of climate science, energy, and policy, for 20 years.

I. State of Climate Science

Climate change is an issue I care passionately about and have dedicated a significant portion of my life to addressing. In 2003 I co-founded the Apollo Alliance to advocate for a Green New Deal, which we called a “New Apollo Project.” Many of this proposal’s ideas for renewables, efficiency, and electric vehicles were funded under the 2009 America Recovery and Reinvestment Act. Since 2016, my organization, Environmental Progress, has worked with the world’s leading climate scientists to persuade lawmakers to keep nuclear plants operating in Illinois, New York, Connecticut, New Jersey, and Ohio, and preventing emissions from increasing the equivalent of adding 24 million cars to the road.

I also care about getting the facts and science right. Some scientists, journalists, and policymakers, have in recent months made a number of apocalyptic predictions about the impact of climate change, including that sea-level rise will be unmanageable, that farmers will not be able to grow enough

¹ Environmental Progress publicly discloses its donors on its web site:

<http://environmentalprogress.org/mission>.

² Michael Shellenberger, “Founder and President,” Environmental Progress, 2020, accessed December 8, 2020, <http://environmentalprogress.org/founder-president>.

food to support half the human population, and civilization will end unless radical action is taken immediately.³ The IPCC and other leading scientific assessments do not support these claims and yet some journalists, policymakers, and even some lead IPCC authors have repeated them.

Such claims may be contributing to rising levels of anxiety among adolescents. The American Psychological Association (APA) and the Climate Psychology Alliance (CMA) of the United Kingdom recently warned that a growing number of children are suffering from eco-anxiety.⁴ Seventy percent of American teenagers call anxiety and depression a major problem, which is significantly more than who name bullying, drug addiction, or gangs as major problems.⁵

Over the last year, I have interviewed many of the individuals making apocalyptic claims, re-reviewed the science with the staff and scientific advisors of Environmental Progress, and written a series of articles for *Forbes* on inaccurate and unscientific claims being made with regard to climate change, fires in the Amazon, Australia, and California, sea level rise, and species extinction.⁶

³ Robinson Meyer, "The Oceans We Know Won't Survive Climate Change," *Atlantic*, September 25, 2019, <https://www.theatlantic.com/science/archive/2019/09/ipcc-sea-level-rise-report/598765/>; Gaia Vince, "The Heat is On Over the Climate Crisis. Only Radical Measures Will Work," *The Guardian*, May 18, 2019, <https://www.theguardian.com/environment/2019/may/18/climate-crisis-heat-is-on-global-heating-four-degrees-2100-change-way-we-live>; Andrew Freedman, "Climate scientists refute 12-year deadline to curb global warming," *Axios*, January 22, 2019, <https://www.axios.com/climate-change-scientists-comment-ocasio-cortez-12-year-deadline-c4ba1f99-bc76-42ac-8b93-e4eaa926938d.html>.

⁴ Sonia Elks, "Children suffering eco-anxiety over climate change," Reuters, September 19, 2019, <https://www.reuters.com/article/us-britain-climate-children/children-suffering-eco-anxiety-over-climate-change-say-psychologists-idUSKBN1W42CF>; Susan Clayton et al., "Mental Health and Our Changing Climate," American Psychological Association, March 2017, 27, 36, <https://www.apa.org/news/press/releases/2017/03/mental-health-climate.pdf>.

⁵ J.M. Twenge et al., "Age, period, and cohort trends in mood disorder indicators and suicide-related outcomes in a nationally representative dataset, 2005-2017," *Journal of Abnormal Psychology* 128, no. 3 (March 14, 2019): 185-199, <https://doi.org/10.1037/abn0000410>; Juliana Menasce Horowitz and Nikki Graf, "Most U.S. Teens See Anxiety and Depression as a Major Problem Among Their Peers," Pew Research Center, February 20, 2019, accessed January 10, 2020, <https://www.pewsocialtrends.org/2019/02/20/most-u-s-teens-see-anxiety-and-depression-as-a-major-problem-among-their-peers/>.

⁶ Michael Shellenberger, "Why Everything They Say About The Amazon, Including That It's The 'Lungs Of The World,' Is Wrong," *Forbes*, August 26, 2019. Michael Shellenberger, "Why Everything They Say About California Fires — Including That Climate Matters Most — Is Wrong," *Forbes*, November 4, 2019, <https://www.forbes.com/sites/michaelshellenberger/2019/08/26/why-everything-they-say-about-the-amazon-including-that-its-the-lungs-of-the-world-is-wrong/>; Michael Shellenberger, "Why Apocalyptic Claims About Climate Change Are Wrong," *Forbes*,

No credible scientific body has ever claimed climate change threatens the collapse of civilization much less the extinction of the human species.

While it is sometimes possible to discern the influence of climate change on natural disasters, that influence is often overshadowed by improved resilience, including by poor nations. The decadal death toll from natural disasters declined 92 percent from its peak in the 1920s. In that decade, 5.4 million people died from natural disasters. In the 2010s, just 0.4 million did.⁷ Moreover, that decline occurred over a period when the global population nearly quadrupled.⁸

A major study in the journal *Global Environmental Change* last year found that the rates of death and economic damage had dropped by 80 to 90 percent over the last four decades.⁹ The IPCC concludes that "Long-term trends in economic disaster losses adjusted for wealth and population increases have not been attributed to climate change, but a role for climate change has not been excluded."¹⁰

Sea levels rose 7.5 inches (0.19 meters) between 1901 and 2010 and IPCC estimates sea levels will rise as much as 2.2 feet (0.66 meters) by 2100 in its medium scenario. In the IPCC's high-end scenario, sea level rise tops out at 2.7

November 25, 2019, <https://www.forbes.com/sites/michaelshellenberger/2019/11/25/why-everything-they-say-about-climate-change-is-wrong/>. Michael Shellenberger, "Why Climate Alarmism Hurts Us All," *Forbes*, December 4, 2019, <https://www.forbes.com/sites/michaelshellenberger/2019/12/04/why-climate-alarmism-hurts-us-all/>.

⁷ I am using decadal averages to avoid the risk of cherry-picking outlier years.

5.4 million people died from natural disasters. Hannah Ritchie and Max Roser, "Global deaths from natural disasters," Our World in Data, accessed October 25, 2019, <https://ourworldindata.org/natural-disasters>. Data published by EM DAT (2019): OFDA/CRED International Disaster Database, Université catholique de Louvain – Brussels – Belgium. Data for individual years summed over ten year intervals from the first to last year of each calendar decade.

⁸ Global population in 2018: "Population Dynamics," United Nations Department of Economic and Social Affairs, 2019, accessed January 10, 2020, <https://www.un.org/development/desa/en/key-issues/population.html>; Estimate of global population in 1930: "The World at Six Billion," United Nations Department of Economic and Social Affairs, 1999.

⁹ Giuseppe Formetta et al., "Empirical evidence of declining global vulnerability to climate-related hazards," *Global Environmental Change* 57 (May 25, 2019): 1-9. <https://doi.org/10.1016/j.gloenvcha.2019.05.004>.

¹⁰ C.B. Field et al., *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*, Intergovernmental Panel on Climate Change, Cambridge and New York: Cambridge University Press, 2012, accessed January 10, 2020, https://www.ipcc.ch/site/assets/uploads/2018/03/SREX_Full_Report-1.pdf; Laurens M. Bouwer, "Observed and Projected Impacts from Extreme Weather Events: Implications for Loss and Damage," in *Loss and Damage from Climate Change*, eds. Reinhard Mechler et al. (Cham, Switzerland: Springer, 2019): 63-82.

feet (0.83 meters) by 2100.¹¹ Will societies will be able to adapt to such sea level rise? If they behave like the Netherlands then the answer is yes. It became one of the world's wealthiest nations while adapting to having one-third of its land mass below sea level, including some of its land laying seven meters below sea level.¹² And today, our capability for modifying environments is far greater than ever before. Experts from the Netherlands are already working with the government of Bangladesh to prepare for rising sea levels.¹³

In 2017 a large team of scientists modeled 37 different regions across the U.S. and found that "humans may not only influence fire regimes but their presence can actually override, or swamp out, the effects of climate."¹⁴ Of the 10 variables that influence fire, they wrote, "none were as significant... as the anthropogenic variables," such as building homes near, and managing fires and wood fuel growth within forests.¹⁵

The same may be true for what we have seen in Australia. "Bushfire losses can be explained by the increasing exposure of dwellings to fire-prone bushlands," wrote a leading scientist in 2013. "No other influences need be invoked. So even if climate change had played some small role in modulating recent bushfires, and we cannot rule this out, any such effects on risk to property are clearly swamped by the changes in exposure."¹⁶

¹¹ J.A. Church et al., "Sea Level Change." In: *Climate Change 2013: The Physical Science Basis*, eds. T.F. Stocker et al. (Cambridge and New York: Cambridge University Press, 2013).

¹² The Zuidplaspolder in the western Netherlands is 6.76m below sea level. The IPCC in its Medium scenario (RCP4.5) predicts 0.39m median sea level rise in 2191-2200.

¹³ "Bangladesh Delta Plan 2100," Dutch Water Sector, May 20, 2019, accessed January 10, 2020, <https://www.dutchwatersector.com/news/bangladesh-delta-plan-2100>; "Deltaplan Bangladesh," Deltares, accessed January 10, 2020, <https://www.deltares.nl/en/projects/deltaplan-bangladesh-2/>.

¹⁴ Alexandra D. Syphard et al., "Human presence diminishes the importance of climate in driving fire activity across the United States," *Proceedings of the National Academy of Sciences* 114, no. 52 December 2017: 13750-13755, accessed November 2019, <https://doi.org/10.1073/pnas.1713885114>.

¹⁵ Alexandra D. Syphard et al., "Human presence diminishes the importance of climate in driving fire activity across the United States," *Proceedings of the National Academy of Sciences* 114, no. 52 December 2017: 13750-13755, accessed November 2019, <https://doi.org/10.1073/pnas.1713885114>.

¹⁶ John McAneney, "Climate change and bushfires - you're missing the point!," *The Conversation*, October 31, 2013, <https://theconversation.com/climate-change-and-bushfires-youre-missing-the-point-19649>.

Humans today produce enough food for 10 billion people, a 25 percent surplus.¹⁷ When it comes to food production, the Food and Agriculture Organization of the United Nations (FAO) anticipates crop yields will continue increasing even in high-warming scenarios. FAO projects farmers in sub-Saharan Africa could see crop yields increase 80 to 90 percent. Future food production will depend more on whether farmers get access to tractors, irrigation, and fertilizer than on climate change, just as it has done for the last century.¹⁸

In late November 2019, a group of scientists argued in an opinion comment at the journal *Nature* that “evidence is mounting” that the loss of the Amazon rainforest and West Antarctic ice sheet “could be more likely than was thought.”¹⁹ However, IPCC does not predict the ice sheets would slide off quickly and instead, if they melt off, would do at a rate of one meter a century for several centuries.²⁰

Humans are not on the precipice of a tipping point with regards to the melting of tundra in ways that would result in the rapid release of methane gas, concludes IPCC.²¹ While the Atlantic Meridional Overturning Circulation (AMOC) it is indeed weakening, the IPCC says, “There is only limited evidence linking the current anomalously weak state of AMOC to anthropogenic [human-caused] warming,” and that it has high confidence that is “very unlikely it will shut down before 2100.”²²

¹⁷ “The future of food and agriculture – Alternative pathways to 2050,” (Rome: Food and Agriculture Organization of the United Nations, 2018): 82.

¹⁸ “The future of food and agriculture – Alternative pathways to 2050,” (Rome: Food and Agriculture Organization of the United Nations, 2018): 76-77.

¹⁹ Timothy M. Lenton et al., “Climate tipping points — too risky to bet against,” *Nature*, November 27, 2019, <https://www.nature.com/articles/d41586-019-03595-0>.

²⁰ Ove Hoegh-Guldberg et al., “Impacts of 1.5°C Global Warming on Natural and Human Systems,” In *Global Warming of 1.5°C*, eds. Masson-Delmotte et al., (Intergovernmental Panel on Climate Change, 2019), https://www.ipcc.ch/site/assets/uploads/sites/2/2019/02/SR15_Chapter3_Low_Res.pdf.

²¹ Ove Hoegh-Guldberg et al., “Impacts of 1.5°C Global Warming on Natural and Human Systems,” In *Global Warming of 1.5°C*, eds. Masson-Delmotte et al., (Intergovernmental Panel on Climate Change, 2019), 262, https://www.ipcc.ch/site/assets/uploads/sites/2/2019/02/SR15_Chapter3_Low_Res.pdf.

²² Ove Hoegh-Guldberg et al., “Impacts of 1.5°C Global Warming on Natural and Human Systems,” In *Global Warming of 1.5°C*, eds. Masson-Delmotte et al., (Intergovernmental Panel on Climate Change, 2019), https://www.ipcc.ch/site/assets/uploads/sites/2/2019/02/SR15_Chapter3_Low_Res.pdf.

If the Greenland ice sheet were to completely disintegrate, sea levels would rise by seven meters, but over a 1,000-year period. And for that to happen, temperatures would have to rise far more than anyone imagines.²³

As for the Amazon, the IPCC says “the likelihood of a climate-driven forest dieback by 2100 is lower than previously thought.”²⁴ IPCC has medium confidence that climate change alone will not drive large-scale Amazon forest loss by 2100 “although shifts to drier forest types are predicted in the eastern Amazon.”²⁵

Does any of that mean we should not care about climate change? Of course not. *Most* of the action that policymakers take is to address problems that are not apocalyptic. It is a peculiar feature of climate policy that its advocates feel the need to exaggerate with so much severity and frequency.

Since I published my articles, some people have asked me if some amount of exaggeration isn’t required to address climate change. I give a very strong “no.”

First, it is a profound privilege and responsibility to be in a position to represent complex scientific questions to mass audiences and policymakers. Anyone in that position must strive to represent the science with a strong commitment to accuracy, even if that accuracy reduces the salience and urgency of the problem one believes should be addressed. For a journalist, scientist, or activist to knowingly exaggerate a problem is unethical.

Second, past apocalyptic claims resulted neither in a binding international treaty nor an economy-wide cap and trade system. In 1989 “a senior U.N. environmental official” told Associated Press “entire nations could be wiped off the face of the Earth,” “coastal flooding and crop failures would create an exodus of ‘eco-refugees,’ threatening political chaos” and “governments have a 10-year window of opportunity to solve the greenhouse effect before it goes beyond human control.”²⁶

The good news is that the world appears to be headed to temperatures closer to two degrees than four, and there is a strong public interest to take reasonable measures to prevent temperatures from rising too high, just as there

²³Even if temperatures rose 6° Celsius, the Greenland ice sheet would lose just 10 percent of its volume over 400 to 500 years. Ove Hoegh-Guldberg et al., “Impacts of 1.5°C Global Warming on Natural and Human Systems,” *Global Warming of 1.5°C*, eds. Masson-Delmotte et al., https://www.ipcc.ch/site/assets/uploads/sites/2/2019/02/SR15_Chapter3_Low_Res.pdf.

²⁴*AR5 Climate Change 2014 – Impacts, Adaptation and Vulnerability*, Intergovernmental Panel on Climate Change (Cambridge: Cambridge University Press, 2014), 309.

²⁵*AR5 Climate Change 2014 – Impacts, Adaptation and Vulnerability*, Intergovernmental Panel on Climate Change (Cambridge: Cambridge University Press, 2014), 309.

²⁶Peter James Spielmann, “U.N. Predicts Disaster if Global Warming Not Checked,” *Associated Press*, June 29, 1989, <https://apnews.com/bd45c372caf118ec99964ea547880cd0>.

is one for helping nations to develop and become more resilient to all extreme events. A new report by the International Energy Agency (IEA) forecasts carbon emissions in 2040 to be lower than in almost all of the IPCC scenarios.²⁷

Part of the reason for lower anticipated future emissions and warming is due to the far greater abundance, and lower prices, of natural gas, which produces half the carbon emissions of coal. The shale fracking revolution occurred over a decade ago and breakthroughs in deepwater drilling occurred before that, and yet many scientists, journalists, and activists report on projections of future warming based on a world where coal is used up to five times more than it will likely be used.

IPCC needs to improve how it conducts and communicates scenario planning to provide policymakers and journalists with a more accurate picture of likely future warming than it has in the past. In the past, IPCC has summarized the science in its Summary for Policymakers, and the news media has summarized the Summary, in ways that seem designed to grab the public's attention.

Because there are strong incentives for some scientists, journalists, activists, and policymakers to exaggerate the science, it is incumbent upon other scientists, journalists, activists, and policymakers to point them out.

Happily that is starting to happen. Stanford University atmospheric scientist Ken Caldeira, who has raised the alarm about ocean acidification, stresses that “while many species are threatened with extinction, climate change does not threaten human extinction.”²⁸ MIT climate scientist Kerry Emmanuel has expressed a similar point: “I don't have much patience for the apocalypse criers. I don't think it's helpful to describe it as an apocalypse.”²⁹ Another esteemed climate scientist I interviewed, Tom Wigley, who created one of the main models for predicting future temperatures, told me: “All these young people have been misinformed. It really does bother me because it's wrong.”³⁰

Said Emmanuel, “You've got to come up with some kind of middle ground where you do reasonable things to mitigate the risk and try at the same time to lift people out of poverty and make them more resilient.”

²⁷ “World Energy Outlook 2019,” (Paris: International Energy Agency, 2019), <https://www.iea.org/reports/world-energy-outlook-2019>.

²⁸ Liz Kalaugher, “Climate scientist or climate activist — where's the line?” *Physics World*, September 2019, <https://physicsworld.com/a/climate-scientist-or-climate-activist-wheres-the-line/>.

²⁹ Dr. Kerry Emanuel (climate scientist, MIT) in discussion with the author, November 2019.

³⁰ These interviews became the basis for one of my columns. See: Michael Shellenberger, “Why Apocalyptic Claims About Climate Change Are Wrong,” *Forbes*, November 25, 2019, <https://www.forbes.com/sites/michaelshellenberger/2019/11/25/why-everything-they-say-about-climate-change-is-wrong/#7b14f08d12d6>.

Happily, there is plenty of middle ground between climate apocalypse and climate denial.

II. Adaptation and Mitigation

Adaptation has been, and will likely remain, humankind's central response to changing climates for thousands of years. The fact that there are 7.5 billion humans, that most of us have escaped extreme poverty, and that rates of death and damage from natural disasters have declined 90 percent in a century, even in developing nations, is a testament to our species' extraordinary success.

Because the influence of climate change is largely overshadowed by economic development in developed and developing nations alike, it is a mistake for the United Nations developed nations to attempt to limit and direct foreign aid to address climate change specifically rather than resilience to extreme weather and economic development more broadly.³¹

I would urge you and your colleagues not to earmark development aid in such a way since doing so risks misdirecting financial aid to where it is needed most, and results in "false precision."³²

As for decarbonization, I do not believe human societies will ever transition from fossil fuels to renewables because of their inherent unreliability, large land use requirements, and large materials requirements. A typical large solar farm in sunny California requires 380 times more land than the state's last nuclear plant to produce the same amount of energy, due to the low energy-density of sunlight and the high energy density of uranium.³³

³¹ This framework has the additional disadvantage of leading representatives of some developing nations to exaggerate the role of climate change in disasters as a way to gain development aid from developed nations, which are disproportionately responsible for historic emissions and warming. For a personal account of how this happens, see: Richard Tol, "Why I resigned from the IPCCD WGII," Richard Tol, April 25, 2014, <http://richardtol.blogspot.nl/2014/04/ipcc-again.html>.

³² Scientists who in 2018 had claimed that Hurricane Florence would produce 50 percent more rainfall and be 80 kilometers larger due to "human induced climate change" last week acknowledged that their "our forecasted attribution statements fall outside broad confidence intervals of our hindcasted statements and are quite different from the hindcasted best estimates." K. A. Reed et al., "Forecasted attribution of the human influence on Hurricane Florence," *Science* 6, no. 1 (January 1, 2020): <https://doi.org/10.1126/sciadv.aaw9253>.

³³ Diablo Canyon's facilities cover about 0.74 square kilometers, while the plant produced 18.3 terawatt-hours of electricity in 2018. Topaz Solar Farm covers 20 square kilometers, while the plant produced 1.3 terawatt-hours in 2018.

For those reasons, solar and wind farms make electricity more expensive everywhere they are deployed at scale.

Renewables contributed to electricity prices rising 50 percent in Germany since 2007, the first year it got more than 10% of its power from subsidized wind, solar, and biomass. By 2019, German household electricity prices were 45 percent higher than the European average.³⁴

Renewables contributed to electricity prices rising seven times more in California than in the rest of the US since 2011, the state's "take-off" year for rapid growth in wind and solar, a price rise that occurred despite the state's reliance during the same years on persistently-low-priced natural gas.³⁵

"All in all," wrote economists from the University of Chicago last year, "consumers in the 29 states [with renewable mandates] had paid \$125.2 billion more for electricity than they would have in the absence of the policy."³⁶

Neighboring France and Germany are illustrative. Nuclear-heavy French electricity produces one-tenth the carbon emissions as renewables-heavy German electricity at nearly half the price.

Despite investing nearly a half-trillion dollars, Germany still generates just 42 percent of its electricity from non-hydro renewables, as compared to the 72 percent France generates from nuclear.

Germany spent 32 billion euros on renewables every year between 2014 and 2018, or about one percent of its GDP a year, which would be like the United States spending \$200 billion dollars annually, but only increased its share of electricity from solar and wind by 11 percentage points.³⁷

³⁴ Fridolin Pflugmann et al., "Energy Transition Index," McKinsey & Company, November 2019, accessed January 10, 2020, <https://www.mckinsey.com/industries/electric-power-and-natural-gas/our-insights/germanys-energy-transition-at-a-crossroads#>.

³⁵ Eurostat, "Electricity prices for household consumers - bi-annual data (from 2007 onwards)" December 1, 2019, accessed January 20, 2020, https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_pc_204&lang=en; "Electricity Data Browser: Retail Sales of Electricity Annual." United States Energy Information Administration, accessed January 10, 2020, <https://www.eia.gov/electricity/data/browser/>.

³⁶ Michael Greenstone and Ishan Nath, "Do Renewable Portfolio Standards Deliver?" Energy Policy Institute at the University of Chicago 62 (May 2019): 1-45, <https://epic.uchicago.edu/wp-content/uploads/2019/07/Do-Renewable-Portfolio-Standards-Deliver.pdf>.

³⁷ Frank Dohmen, "German Failure on the road to a renewable future," *Spiegel*, May 13, 2019, <https://www.spiegel.de/international/germany/german-failure-on-the-road-to-a-renewable-future-a-1266586.html>; Conversions made using OECD data for Purchasing Power Parity. "Annual Electricity Generation in Germany," Fraunhofer ISE, January 10, 2020, accessed January 10, 2020, <https://www.energy-charts.de/energy.htm>.

And the eight percent of Germany's electricity produced from burning biomass and energy crops is typically counted as renewable. If Germany didn't count emissions-producing and land-intensive fuels like these as renewable, which most environmental groups, including Greenpeace, believes it shouldn't, the share of its electricity from non-emitting, non-hydro renewables is just 34 percent.³⁸

Nuclear plants are cost-competitive with both coal and natural gas in almost every part of the world. The United States is the major exception. The main reason nuclear is more expensive than it should be is its rigid and disruptive over-regulation, due to unfounded public fears. Nuclear is not only the safest way to make electricity, it has actually saved two million lives, according to the best available research.³⁹

Only nuclear can substitute for fossil fuels while maintaining and increasing levels of energy consumption required for universal human prosperity. As such, one of the most important things policymakers can do for climate mitigation is to support the continued operation of existing, and building of nuclear plants.

Fears of nuclear power plants appear to be a form of psychological displacement, or scapegoating, stemming from fears of nuclear weapons. Anti-nuclear activists since the 1960s have implied that a nuclear accident would have

³⁸ Fridolin Pflugmann et al., "Energy Transition Index." *Mckinsey & Company*, November 2019, <https://www.mckinsey.com/industries/electric-power-and-natural-gas/our-insights/germanys-energy-transition-at-a-crossroads>; "BP Statistical Review of World Energy," British Petroleum, June 2019, <https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2019-full-report.pdf>.

³⁹ A selection of the literature on public health benefits of nuclear energy, and the consequences of its closure: Anil Markandya and Paul Wilkinson, "Electricity Generation and Health," *Lancet* 370, no. 9591 (September 2007): 979-990, [https://doi.org/10.1016/S0140-6736\(07\)61253-7](https://doi.org/10.1016/S0140-6736(07)61253-7); Anthony J. McMichael, Rosalie E. Woodruff, and Simon Hales, "Climate change and human health: present and future risks," *Lancet* 367, no. 9513 (March 2006): 859-869, [https://doi.org/10.1016/S0140-6736\(06\)68079-3](https://doi.org/10.1016/S0140-6736(06)68079-3); "Ambient Air Pollution: a global assessment of exposure and burden of disease," World Health Organization, 2016, <https://apps.who.int/iris/handle/10665/250141>; "Nuclear Waste State-of-the-Art Report 2016: Risks, uncertainties and future challenges," *Swedish National Council for Nuclear Waste*, 2016, <https://www.government.se/49bbd2/contentassets/ecdec2ee26c498c95aaea073d6bc095/sou-2016-16-eng-webb.pdf>; Pushker Kharecha and James E. Hansen, "Prevented Mortality and Greenhouse Gas Emissions from Historical and Projected Nuclear Power," *Environmental Science and Technology* 47, no. 9 (March 2013): 4889-4895, <https://doi.org/10.1021/es3051197>; Edson R. Severnini, "Impacts of nuclear plant shutdown on coal-fired power generation and infant health in the Tennessee Valley in the 1980s," *Nature Energy* 2 (April 2017), doi:10.1038/nenergy.2017.51

the same impact as a nuclear weapon,⁴⁰ a myth repeated by the 2019 HBO mini-series, “Chernobyl.”⁴¹

Happily, fears of nuclear have proven to be unfounded. For a nation to get nuclear energy, it must submit to an extremely rigorous and invasive inspection regime. If there is a causal relationship between nuclear energy and weapons, it is in the opposite direction of what many believe. North Korea wanted nuclear energy, couldn’t get it, but got nuclear weapons. South Korea has nuclear energy and no nuclear weapons.

Because of its inherently dual military-civilian nature, Congress and most presidential administrations have long viewed America’s nuclear power plants, and our involvement in the nuclear energy programs of other nations, as top national security priorities. And yet today, the US nuclear industry is in a state of managed decline.

The U.S. has prematurely shut down six gigawatts of nuclear capacity since 2013 and another eight gigawatts are set to close over the next seven years. If this decline continues, China will surpass the U.S. in installed nuclear capacity by 2030 and by 2034 Russia may as well. These two nations are set to build over three-quarters of all new nuclear globally by 2025.⁴²

As of early 2020, over 50 percent of nuclear power under construction today is in Russia or China, or is a project being built by Russia and China in third countries. And more than 80 percent of near-term nuclear projects likely to be in operation by 2030 are Chinese and Russian large light-water nuclear reactors. Argentina, Bangladesh, Belarus, Belgium, Bolivia, Brazil, Bulgaria, the Czech Republic, Egypt, Finland, France, Ghana, Hungary, India, Jordan, Kazakhstan, Kenya, Mexico, Nigeria, Poland, Saudi Arabia, Slovakia, South Africa, Sudan, Turkey, U.A.E., U.K., Ukraine, Uzbekistan, Zambia, and other nations are today seeking nuclear energy to meet their needs.

Are Congress and the White House really ready to stand by and let the above nations become tightly bound to China and Russia’s through the world’s most important dual-use technology? If so, then such a decision should at least be debated and formalized as it represents a significant break from U.S. national

⁴⁰ Spencer Weart, *The Rise of Nuclear Fear* (Cambridge: Harvard University Press, 2012).

⁴¹ I covered this inaccuracy along with others in: Michael Shellenberger, “Why HBO’s Chernobyl Got Nuclear So Wrong,” *Forbes*, June 6, 2019, <https://www.forbes.com/sites/michaelshellenberger/2019/06/06/why-hbos-chernobyl-gets-nuclear-so-wrong/>.

⁴² Mark Nelson and Madison Czerwinski, “GlobalOverview,” *Environmental Progress*, 2020, accessed January 10, 2020, <http://environmentalprogress.org/global-overview>.

security policy for the last 75 years. If not, then it is incumbent upon both branches of the U.S. government to significantly increase American competitiveness in new nuclear plant building abroad.

For America to be competitive in selling nuclear plants abroad, we must be competitive in building nuclear plants at home. That's because nations seeking to build new nuclear power plants want to hire firms with significant construction expertise. And yet the opposite is happening now in the U.S.

The good news is that nations trust the United States more than China and Russia when it comes to nuclear energy, and with good reason. The US operates the most nuclear plants in the world and has the largest industry to draw upon. Our independent Nuclear Regulatory Commission is still considered the gold standard when it comes to safety regulation. And adopting American nuclear means benefitting from the US's unsurpassed safety record and excellent operational record.

Historically, Congress has been a crucial champion of nuclear energy. In the 1950s and 1960s, Congress pressured subsequent presidential administrations to make civilian nuclear energy a greater priority. I hope Congress will play a leadership role once again.

I am attaching an open letter to President Trump from leading energy, environmental, security and other experts and advocates, urging him and Congress to work together to protect and expand America's fleet of nuclear power plants.

Thank you again for the opportunity to testify. I look forward to your questions.

January 15, 2020

President Donald J. Trump

The White House

1600 Pennsylvania Ave NW

Washington, DC 20500

Dear President Trump,

We are writing as nuclear energy advocates and industry leaders to express our support for your goal of American energy dominance, offer our ideas and support for achieving that goal, and request a meeting to discuss them.

Every American president has made nuclear energy a high priority for national security, economic, and environmental reasons. In 1953, President Dwight D. Eisenhower gave his famous “atoms for peace” speech at the United Nations. There, Eisenhower pledged that the US would help nations use nuclear for energy, research, agriculture, and medicine to lift themselves out of poverty.

Atoms for Peace was remarkably effective. Since 1945, nuclear energy has been used solely for peaceful purposes. Nuclear has proven to be an affordable and reliable electricity source for the United States and other nations, including developing, vulnerable, and energy-poor ones. Nuclear has proven to be safe and clean. And today there is a strong consensus that nuclear must play a central role in any effort to reduce pollution including carbon emissions.

The US has for 60 years been the global leader in the development and building of nuclear plants around the world. Nine out of every ten gigawatts of global nuclear capacity today is descended from designs invented and commercialized by America. American nuclear reactor designs today operate in leading nuclear countries like China, France, South Korea, Japan, and the U.K. American reactors operated in the U.S. are the best in the world, operating 93 percent of the time.

Today, however, the US is building just one nuclear plant at home and none abroad, which is allowing China and Russia to dominate the market for nuclear. Nations seeking nuclear energy today who will be in need of a nuclear supplier include Argentina, Bangladesh, Belarus, Bolivia, Brazil, Bulgaria, the Czech Republic, Egypt, Finland, Ghana, Hungary, India, Jordan, Kazakhstan, Kenya, Mexico, Nigeria, Pakistan, Poland, Saudi Arabia, Slovakia, South Africa, Sudan, Turkey, U.A.E., U.K., Uzbekistan, and Zambia, among others.

Several of these countries are already getting reactors from China or Russia but have expressed a desire to explore all options for subsequent plants. Others are looking for reliable and friendly long-term partners for first plant projects, which

can cost \$10 to \$20 billion dollars each and produce decades-long working relationships.

That is why nuclear is good business and could result in significant, durable revenue for American workers and industry. Russia currently has a nuclear plant order book valued at \$134 billion, with about \$100 billion of this outside of Russia itself. China's order book is similar, and although largely based on domestic projects, is poised to expand rapidly after it completes its first full-size exported plant next year in Pakistan.

The likely retirement of one-third to two-thirds of all US nuclear reactors over the next two decades exacerbates the threat to American nuclear leadership. Some US nuclear plants that could operate safely and reliably for another 40 years or more are at risk of being closed within in the next five years due to market distortions created by state and federal policies.

If the US nuclear energy fleet declines from 20 percent of today's electricity mix to 15 or 10 percent or less, the US will effectively cede nuclear abroad to China and Russia and undermine the future of nuclear at home. While novel advanced nuclear reactors promise to deliver even cheaper electricity than today's reactors, they will not be developed or deployed in the US if nuclear declines.

Military leaders and national security experts agree that it would be dangerous for the US to cede global nuclear construction to China and Russia. Nuclear power plants are more than large construction projects. No country is as committed to preventing the spread of nuclear weapons as the United States. The US is unusual among nuclear-building nations in imposing special restrictions to prevent proliferation as part of Section 123 of the Atomic Energy Act.

The US Navy and thus national security could be negatively affected by the decline of the US nuclear industry. Navy ships and submarines depend on a US-based nuclear industry supply chain. Many Navy officers who operate US submarines and aircraft carriers create good post-service careers working in the US nuclear industry. If those post-service employment opportunities decline, so too may the appeal of the Navy's nuclear program, which is so vital to national security.

Now is the time to rejuvenate nuclear in the United States and American nuclear competitiveness abroad. America needs to be reminded of Eisenhower's "atoms for peace" vision. That vision is crucial to advancing US national security, spurring economic growth, and creating thousands of high-paying jobs at home and abroad. While the US is rich in natural gas resources, so too are Russia, UAE, and Saudi Arabia, all of which are building nuclear plants at home, with an eye to selling natural gas abroad. As such, abundant natural gas and nuclear can work together to achieve your vision of American energy dominance.

The history of nuclear since 1953 shows that every successful nuclear program in the world relies on three fundamental principles.

First, to be competitive abroad nations must be building nuclear plants at home. Nations seeking to build new nuclear power plants seek partners with significant construction expertise. And such experience comes from a national commitment to, at a minimum, replacing retiring nuclear power plants with equivalent amounts of new nuclear power and, more ambitiously, expanding nuclear energy's share of national electricity.

We should not be scared away from building new nuclear plants simply because of construction delays. History shows that almost all first-of-a-kind (FOAK) designs, including Framatome's EPR and Westinghouse's AP1000, experience construction delays. The good news is that plant construction accelerates as construction crews gain experience.

What matters more than design type is that the US commit itself to replacing the plants it has so it can properly compete abroad. While the US should pursue nuclear plant building with American workers and firms, it may also benefit from partnering with a nuclear-building ally like France, Japan, or South Korea, in order to build efficiently at home, and compete effectively abroad.

Second, nuclear nations must have an "all of the above" approach to technology. Competitive nuclear nations are both building tried-and-true plant designs while developing and demonstrating experimental designs. Over 80 percent of the global market is for large light-water plants being built by the Chinese and Russians. The US must offer a competitive nuclear power plant in every category including large light water plants, small modular plants, and high-temperature designs. In addition to developing and demonstrating novel new designs, the US should accelerate the development, demonstration, and deployment of advanced nuclear fuels, which promise improved performance and lower costs.

Third, successful nuclear nations have the strong support of their federal governments. In the late 1950s, after the US Navy built the first civilian nuclear plant, President Eisenhower and the chairman of the Atomic Energy Commission, who played the role of today's Secretary of Energy, marketed and sold US nuclear reactors around the world. The heads of state of China and Russia do the same today, and any rejuvenated US program must enjoy strong support both from the president as well as from Congressional leaders.

National governments help their nuclear industries win new nuclear plant construction contracts abroad by providing technical and other assistance to the nuclear industry and providing low-cost financing of nuclear plants to buyer nations and utilities. Your administration's successful creation of the Development Finance Corporation has allowed for a minimum of \$60 billion in financing for nuclear projects.

The good news is that nuclear brings Americans together. A majority of Americans support nuclear energy. They often do so for different reasons. Some support nuclear because it is affordable and reliable. Others because it produces no air or water pollution. And still others support it for national security reasons. What makes nuclear special is that it has many benefits that a diversity of Americans, and their elected representatives in Congress, have recognized as very important to the US and to the world.

The US should take advantage of its strengths. Nations trust the US more than any other nation when it comes to nuclear energy, and with good reason. The US operates the most nuclear plants in the world and has the largest industry to draw upon. The highly independent Nuclear Regulatory Commission is the gold standard when it comes to government safety regulation, and adopting US nuclear means benefitting from the US's unsurpassed safety record.

The US nuclear industry needs your leadership to grow nuclear at home and sell American nuclear plants abroad. Many things are required and many obstacles need to be overcome. We may need legislation to create incentives for American utilities to build new nuclear reactors, free up capital for financing the construction of American reactors abroad, accelerate the deployment of more efficient fuels, transform the regulatory environment, and demonstrate new reactor designs. But most of all we need your leadership and energy as America's chief nuclear officer.

Now is a critical time for American nuclear power and we thus seek to support your leadership in making America number one again in nuclear energy. We are grateful for your attention and look forward to discussing these ideas with you soon.

Sincerely,

Dr. William J. Madia, Former Director, Oak Ridge National Laboratory and Pacific Northwest National Laboratory

Hermann Grunder, Director Emeritus, Argonne National Laboratory

U. S. Ambassador C. Paul Robinson, Director Emeritus of Sandia National Laboratories

Billy D. Shipp, Ph.D, Laboratory Director, Idaho National Engineering and Environmental Laboratory (Retired)

Charles Casto, Presidential Distinguished Executive, former Regional Administrator (Region III), Nuclear Regulatory Commission

Richard Rhodes, Pulitzer Prize winning author, *The Making of the Atomic Bomb*

John Christensen, President & CEO, Utilities Service Alliance

Daniel Stoddard, Chief Nuclear Officer, Dominion Energy

Paul Fessler, Chief Nuclear Officer, Enrico Fermi Nuclear Generating Station, DTE Energy

William Grover Hettel, Chief Nuclear Officer, Columbia Generating Station, Energy Northwest

Joel P. Gebbie, Chief Nuclear Officer, Donald C. Cook Nuclear Plant, American Electric Power

Jeffrey Wadsworth, Former Director, Oak Ridge National Laboratory, Former CEO, Battelle

Brad Berryman, Chief Nuclear Officer, Susquehanna Steam Electric Station

Andrew Klein, Former President, American Nuclear Society, Oregon State University

Gene Grecheck, Former President, American Nuclear Society

Seth Grae, President and CEO, Lightbridge

Bob Freeman, Framatome, Fuels Division

Heather Matteson and Kristin Zaitz, founders, Mothers for Nuclear

Michael Shellenberger, President, Environmental Progress

Michael Shellenberger is a Time Magazine "Hero of the Environment," Green Book Award winner, and the founder and president of Environmental Progress.

Michael is considered a "climate guru," "North America's leading public intellectual on clean energy," and "high priest" of the environmental humanist movement.

He is an invited reviewer of the next Assessment Report for the Intergovernmental Panel on Climate Change and advises policymakers around the world, including in the U.S., Japan, Taiwan, South Korea, the Philippines, Australia, United Kingdom, the Netherlands, and Belgium.

Michael has helped save nuclear reactors around the world, from Illinois and New York to South Korea and Taiwan, thereby preventing an increase in air pollution equivalent to adding over 24 million cars to the road.

He is a regular contributor to Forbes, The New York Times, The Wall Street Journal, and The Washington Post, and his TED talks ("How Fear of Nuclear Hurts the Environment," "Why I Changed My Mind About Nuclear Power" and "Why Renewables Can't Save the Planet") have been viewed over four million times.

Michael was featured in "Pandora's Promise," an award-winning film about environmentalists who changed their minds about nuclear, and appeared on "The Colbert Report." He debated Ralph Nader on CNN's "Crossfire" and Stanford University's Mark Jacobsen at UCLA .

He is co-founder of Breakthrough Institute, where he was president from 2003 - 2015, and served as an advisor to MIT's "Future of Nuclear Energy" task force.

He is coauthor of visionary books and essays including "An Ecomodernist Manifesto," "The Death of Environmentalism," Love Your Monsters, and Break Through: From the Death of Environmentalism to Politics of Possibility, which was called "prescient" by Time Magazine, and "the best thing to happen to environmentalism since Rachel Carson's Silent Spring" by Wired Magazine. He has been profiled in the New York Times, San Francisco Chronicle, National Review, New Republic, and NPR.

Michael's research and writing have appeared in The Harvard Law and Policy Review, Democracy Journal, Scientific American, Nature Energy, PLOS Biology, The New Republic, and cited by the New York Times, Slate, USA Today, Washington Post, New York Daily News, The New Republic.

Michael has been an environmental and social justice advocate for over 25 years. In the 1990s he helped save California's last unprotected ancient redwood forest, and inspire Nike to improve factory conditions in Asia. In the 2000s, Michael advocated for a "new Apollo project" in clean energy, which resulted in a \$150 billion public investment in clean tech between 2009 and 2015.

Michael lives in Berkeley, California and travels widely.