

Naomi Oreskes

Henry Charles Lea Professor of the History of Science

Affiliated Professor of Earth and Planetary Sciences

Harvard University, Cambridge, Massachusetts

and

Visiting Fellow

Berggruen Institute

Los Angeles, California

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Federal Budget: The Causes and Costs of Climate Delay

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Introduction

In March 1969, the U.S. Senator from Washington State, Henry “Scoop” Jackson, received a letter from an angry constituent in Seattle. The constituent, Mr. Henry M. Watson, had watched a recent episode of the popular television show—the Merv Griffin Show—where the Beat poet Allen Ginsberg told an alarming story of planetary demise. Ginsberg claimed that “the current rate of air

¹ This testimony is adapted in part from Naomi Oreskes and Erik M. Conway, *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming*, (New York: Bloomsbury Press, 2010), and from Naomi Oreskes, Colleen Lanier-Christensen, Hannab Conway, and R. Ashton Macfarlane, “Climate Change and the Clean Air Act of 1970 Part I: the Scientific Basis, Ecology Law Quarterly,” in press.

pollution brought about by the proliferation of automobiles” could cause “the rapid build-up of heat on the earth.” This would “melt the polar ice caps, causing a flooding of the greater part of the globe.”

Describing Ginsberg as “one of America’s premier kooks,” Mr. Watson was sure that the eccentric poet was wrong, but he wanted the Senator to do something to stop Ginsberg from spreading disinformation.² “I would very much appreciate your efforts to throw light on this and recommend that a public statement by responsible public officials be made in refutation,” he wrote. “After all, quite a few million people watch this show, people of widely varying degrees of intelligence, and the possibility of this sort of charge—even from an Allen Ginsberg—being accepted even in part, is dangerous.”³ And there was one more thing; Ginsberg had attributed this information to a *presidential science advisor*.

Jackson did not know whether Ginsberg’s claims were true or false, so he forwarded the letter to Lee DuBridge—the former President of Caltech who had become science advisor to President Richard Nixon that year—asking for clarification. DuBridge replied with a long, detailed letter describing current knowledge of CO₂ and the greenhouse effect. He affirmed that Ginsberg was not, in fact, wrong. The “greenhouse effect”—caused by atmospheric CO₂—was real, and it was also true that “[w]e are indeed filling the atmosphere with a great many gases and in very large quantities from our automobiles, from industry, and from the burning of fossil fuels.”⁴

DuBridge was not quite ready to sound an alarm on the issue, explaining that “what effect this increased carbon-dioxide is having and will have on our atmosphere and our climate is by no means clear.” More research was needed. But echoing the University of California scientist Roger

² Henry M. Watson to Senator Henry Jackson, March 6, 1969, b.7, f. Jackson, sen. Henry, Senators and Representatives 1963-1973, Office of Science and Technology, Record Group 359, National Archives and Records Administration, College Park, Maryland, United States [*hereinafter* NARA-OST].

³ *Id.*

⁴ Lee DuBridge to Senator Henry Jackson, March 25, 1969, b.7, f. Jackson, sen. Henry, NARA-OST.

Revelle, he noted that it could be serious: “We are...performing a gigantic experiment on ourselves. It seems to me of great importance that we know the meaning of this experiment and its possible outcomes before discovering them too late and perhaps to our sorrow.”⁵

Later that year, DuBridge appeared on the CBS television program *Meet the Press*, where he discussed science and technology in relation to the needs of society. The greatest needs, which he felt “everybody recognizes,” had to do with “solving the problems of the environment.”⁶ One of those pollutants, people were increasingly realizing, was CO₂ from burning fossil fuels. He stated: “Any combustion process is bound at least to produce carbon dioxide and water and these may be regarded as pollutants.”⁷ But they could be reduced, he explained, through “regulations, practices and requirements which will reduce the amount of pollution that is being put into the air by automobiles [and] industrial combustion,”⁸ which could include a “polluter’s tax.”⁹

Were the scientists who raised this concern being alarmist? DuBridge didn’t think so. “I don’t like to be a calamity howler,” he said, “but sometimes it takes a few calamity howlers to wake people up to the fact that there are serious problems and to arouse people to the point where they are willing to do something about it. I think we are at that point now.”¹⁰

The Scientific Understanding of Man-Made Climate Change

DuBridge was one of America’s most distinguished post-war scientific leaders, but he had not done this scientific work himself. Rather, he was summarizing half a century of research by distinguished scientists in the United States and abroad, including Svante Arrhenius, Knut Ångström, Guy Stewart

⁵ *Id.*

⁶ Transcript: NBC’s *Meet the Press*, Prod. By Lawrence E. Spivak, guest: Dr. Lee A. DuBridge, science advisor to the President 2 (December 28, 1969), b. 7, f. 3: DuBridge, Daniel Patrick Moynihan papers (WHCF:SMOF), RNPL.

⁷ *Id.* at 19.

⁸ *Id.* at 3.

⁹ *Id.* at 17.

¹⁰ *Id.* at 6.

Callendar, Hans Suess, Charles David Keeling, Gilbert Plass, Roger Revelle, and others. Since Arrhenius's pioneering work of the late 19th century, scientists had understood that increased atmospheric CO₂, from burning fossil fuels had the potential to alter the planetary climate profoundly. But there were three major questions that needed to be answered before a consensus on the matter could emerge. First, would more atmospheric CO₂ have a significant effect on the climate, given the fact that the wavelengths at which carbon dioxide absorbed heat overlapped with water vapor, which was far more abundant in the atmosphere? Second, was atmospheric CO₂ in fact increasing? No one disputed that burning fossil fuels released CO₂ into the atmosphere, but did it stay there, or was it perhaps taken up by the oceans or plants? And if it did stay in the atmosphere and build up there, was it having a detectable effect? By the mid 1960s, scientists had shown that the answer to the first two questions was yes. By the late 1980s, they had shown that the answer to the third one was yes, too.

The first of these three questions was answered in the mid 1950s by physicist Gilbert Plass, the manager of the theoretical physics research group at Aeronutronic division for Ford Motor Company. Advances in spectroscopy permitted him to resolve the spectral lines CO₂ and water vapor to a fine greater degree than previously achieved; Plass showed that the spectral overlap was by no means complete. That meant that if atmospheric CO₂ did built up in the atmosphere, it would almost certainly warm the planet.

In the coming years, Plass communicated his work in both specialist and popular scientific journals, including *American Scientist* and *Scientific American*.¹¹ His findings—with their link to industrial activity—were also picked up by mainstream media. In 1953, for example, the *New York Times* featured his work in an article entitled “How Industry May Change Climate.”¹² In 1959 in

¹¹ Gilbert Plass, *Carbon Dioxide and the Climate*, 44 AMERICAN SCIENTIST 302, 305 (1956); Gilbert Plass, Carbon Dioxide and Climate, 201 SCIENTIFIC AMERICAN 41 (1959).

¹² W. K., *How Industry May Change Climate*, NEW YORK TIMES, May 24, 1953, at E11.

Scientific American, Plass explained to readers that humans had burned enough fossil fuel to add about 360 billion tons of CO₂ to the atmosphere, which the theory predicted should warm the planet by one degree Fahrenheit, and that temperature change appeared to have already occurred: “This is almost exactly the average increase recorded all over the world during the past century!,”¹³ he exclaimed. He specifically called the heating effect of CO₂ “the greenhouse effect,” and reiterated that the effect would not be negated by water vapor.¹⁴ He argued that humans were now acting as a “new geological force...by burning fossil fuels,” and it was possible to predict quantitatively what impact this would have: “If fuel consumption continues to increase at the present rate, we will have sent more than a trillion tons of carbon dioxide into the air by the year 2000. This should raise the earth’s average temperature 3.6 degrees [F].”¹⁵

Meanwhile, Charles David Keeling had begun the work to answer the second question: was CO₂ in fact increasing? This was mooted, because it was possible that CO₂ produced by burning fossil fuels was absorbed by the oceans or taken up by plants. Keeling showed that the answer to this second question was yes, too.

In 1958, Keeling established an observatory at Mauna Loa, Hawaii, to begin the arduous task of accurately measuring the CO₂ content of the atmosphere—work for which, in 2001, he would be awarded the National Medal of Science by President George W. Bush.¹⁶ Within a year, Keeling had demonstrated that accurate, systematic measurement was possible.¹⁷ Within a few more years, he had

¹³ Gilbert Plass, “Carbon Dioxide and Climate” (1959), (*supra* note 11) at 46.

¹⁴ *Id.* at 41.

¹⁵ *Id.* at 46. Plass also noted the possibility of ocean acidification, but discounts it, on the grounds of the large volume of water in the ocean: “Meanwhile the carbon dioxide content of the oceans will have doubled. This raises an incidental question about the welfare of sea organisms. We know that an increase in carbon dioxide concentration increases the acidity of water, and that many marine animals are extremely sensitive to changes in acidity. However, if the carbon dioxide content of the air were to increase sevenfold, the acidity (pH) of sea water would not rise more than .5 above its present value. Thus, changes in carbon dioxide concentration, which have such a profound effect on climate, will probably not disturb future marine life. Perhaps only man will be uncomfortable” (at 47).

¹⁶ https://www.nsf.gov/od/nms/ recip_details.jsp? recip_id=191

¹⁷ See generally JOSHUA HOWE, BEHIND THE CURVE: SCIENCE AND THE POLITICS OF GLOBAL WARMING (2014), particularly *Introduction* and *Chapter 1*.

shown that CO₂ was on the rise. Scientists knew how much CO₂ was being released into the atmosphere from fossil fuel combustion—that was easily calculated from data on fossil fuel production—so once he had good annual measurements, it was a relatively easy task for Keeling to deduce how much was staying into the atmosphere and how much was being absorbed by plants and the ocean. By 1965, his analysis confirmed that about half of the released CO₂ was “missing” and presumed absorbed into the oceans or taken up by plants.¹⁸ The remainder was in the atmosphere, where its concentration was on an upward march.¹⁹

By the time DuBridge appeared on national television in 1969, many leading scientists were studying CO₂ and climate change, and a consensus was emerging that that unless CO₂ pollution was brought under control, sooner or later the planet would heat up, perhaps dramatically. And when that happened, many of the effects that Allan Ginsberg described would ensue. Scientists communicated this understanding in numerous government reports and scientific papers, and at important national and international conferences on air pollution. Let me give you a few examples.

The 1962 annual report of the National Science Foundation (released in 1963), cited a seminar in which Harry Wexler, a leading scientist at the U.S. National Weather Bureau, had analyzed a variety of factors that could modify Earth’s radiation balance, including the changing carbon dioxide content of the atmosphere.²⁰ The report explained that this was cause for concern, as Plass had suggested, because “man may already be inadvertently modifying the atmosphere at an alarming rate by burning ever-increasing amounts of fossilized fuel, thus releasing larger amounts of

¹⁸ *Id.* at 46.

¹⁹ J.C. Pales and C.D. Keeling, *The Concentration of Atmospheric Carbon Dioxide in Hawaii*, 70 J. GEOPHYS. RES. 6053, 6062 (1965); C.W. Brown and C.D. Keeling, *The concentration of atmospheric carbon dioxide in Antarctica*, 70 J. GEOPHYS RES. 6077 (1965); Charles D. Keeling, *Is Carbon Dioxide Fossil Fuel Changing Man’s Environment*, 114 PROC. AM. PHIL. SOCI. 10 (1970). In hindsight, the increase is visible even in the first year, but it is in the mid 1960s that Keeling and Revelle begin to speak publicly about the results, and that other scientists begin to take significant note.

²⁰ NATIONAL SCIENCE FOUNDATION, WEATHER MODIFICATION: FOURTH ANNUAL REPORT 19 (1962) citing Harry Wexler, Seminar on weather control, Dept. of Meteorology, UCLA (February 1962).

carbon dioxide than ever before in historical times.”²¹ Such modification, the report continued, could cause the icepack to “vanish from the frozen north and frozen tundra would thaw.”²²

In 1964, the Texas Water Commission released a report entitled *The Current Status of Weather Modification*. The report focused on the value of intentional weather modification to prevent damaging weather such as hail, floods, hurricanes and drought, as well as potential military uses, such as aiding civilian aviation.²³ But it also noted the risk of unintentional or “inadvertent” change caused by atmospheric pollution. Citing the NSF’s Fourth Annual Report on weather modification (1962), the Texas report stated: “[We] must consider and try to understand the effects of inadvertent artificial modification. ... [T]he atmosphere is polluted at all levels by industrial effluents, by rocket exhausts, and by the activity involved in living in a highly technological society. We suspect that such events affect the weather or climate or both.”²⁴

In 1969, Keeling attended a symposium on atmospheric air pollution sponsored by the American Philosophical Society, where he delivered a paper entitled: “Is Carbon Dioxide from Fossil Fuel Changing Man’s Environment?” His answer was perhaps not yet, but in the future, it almost certainly would. Keeling drew on theoretical calculations and newly developed climate models, particularly the work of Syukuro Manabe (who in 2021 would win the Nobel Prize in Physics for this work) suggesting a climate sensitivity of 2.8° C for doubling CO₂ (i.e. a 100% increase.) If there were no other factors involved, that might mean that the planet had already warmed somewhat.²⁵ Perhaps more important, Keeling noted, “no atmospheric scientist doubts that a sufficiently large change in atmospheric CO₂ would change the climate.”²⁶ Keeling did not think

²¹ *Id.* citing G.N. Plass, *The Influence of Infrared Absorptive Molecules on the Climate*, 95 ANN. NY. ACAD. SCI. 61-71 (1961).

²² *Id.* at 20.

²³ JOHN T. CARR, JR., TEXAS WATER COMMISSION, BULLETIN 6504, THE CURRENT STATUS OF WEATHER MODIFICATION: A SUMMARY (1964)

²⁴ *Id.* at 48 citing NATIONAL SCIENCE FOUNDATION, *supra* note 20.

²⁵ Charles D. Keeling, *Is Carbon Dioxide from Fossil Fuel Changing Man’s Environment?*, 114 PROC. AM. PHIL. SOC. 10, 14 (1970).

²⁶ *Id.*

this was an immediate threat, but concluded that in time it could become serious: “If the human race survives into the twenty-first century with the vast population increase that now seems inevitable, the people [still] living... may also face the threat of climatic change brought about by an uncontrolled increase in atmospheric CO₂ from fossil fuels.”²⁷

These scientific concerns were also known to the petroleum industry. In 1965, the President’s Science Advisory Committee issued a now-famous report in which they predicted that “[b]y the year 2000 there will be about 25% more CO₂ in our atmosphere than at present. This will modify the heat balance of the atmosphere to such an extent that marked changes in climate, not controllable through local or even national efforts, could occur.”²⁸ Three days after the PSAC report’s publication, Frank Ikard, president of the American Petroleum Institute (API), discussed it at the organization’s annual meeting, specifically noting that addressing the CO₂ problem might necessitate major economic and technological changes, such as finding alternatives to internal combustion engines in automobiles:

One of the most important predictions of the [PSAC] report is that carbon dioxide is being added to the Earth’s atmosphere by the burning of coal, oil, and natural gas at such a rate that by the year 2000 the heat balance will be so modified as possibly to cause marked changes in climate beyond local or even national efforts. The report further states, and I quote: “... the pollution from internal combustion engines is so serious, and is growing so fast, that an alternative nonpolluting means of powering automobiles, buses, and trucks is

²⁷ *Id.* at 17. Keeling underestimated the threat, suggesting “most of us today will, every likely, live out our lives without perceiving that a problem may exist” (at 14). He died in 2005, well after the IPCC had declared climate change to be “discernible” and significant effects had been documented.

²⁸ *Restoring the Quality of Our Environment, Report of the Environmental Pollution Panel*, Presidents Science Advisory Committee, The White House, December 1965, on p. 9

likely to become a national necessity.”²⁹

Ikard emphasized that the “substance of the report is that there is still time to save the world’s peoples from the catastrophic consequence of pollution, but time is running out.”³⁰

The relation between CO₂ pollution and potential climate change was also well known to political leaders. One of them was the Honorable Jennings Randolph, Senator from West Virginia. Randolph—the chair of the Senate Public Works Committee, where the 1970 Clean Air Act would soon originate—offered the keynote speech at the International Clean Air Congress, in December 1969, in Washington DC. Randolph spoke at length about carbon dioxide from burning fossil fuels, its character as a global problem, and the need for global monitoring.

There is a need for a coordinated worldwide system to monitor pollution in the total environment. ... For example, such a system would be invaluable in adding to our knowledge of the worldwide increase in carbon dioxide resulting from the burning of fossil fuels. There are many theoretical implications of higher concentrations of carbon dioxide, but they cannot be verified unless there is more information of the kind that can be obtained only by global monitoring. Scientists need to know to what extent and where carbon dioxide concentrations are increasing, the interaction of carbon dioxide with the oceans, and its effect on weather and climate.³¹

²⁹ F.N. Ikard, *Meeting the Challenges of 1966*, 45 PROCEEDINGS OF AM. PETROLEUM INST. 12, 13, (1965). *See also*, Benjamin Franta, *Early Oil Industry Knowledge of CO₂ and Global Warming*, 8 NAT. CLIM. CHAN. 1024 (2018).

³⁰ F.N. Ikard, *Meeting the Challenges of 1966*, *supra* note 29.

³¹ Jennings Randolph, *A Worldwide Commitment*, 21 J. APCA 57, 58 (1971). The conference took place in December 1969, but the full proceedings were not published until 1971: THE AIR POLLUTION CONTROL ADMINISTRATION, PROCEEDINGS OF THE SECOND INTERNATIONAL CLEAN AIR CONGRESS (H.M. Englund and W.T. Beery, eds., 1971).

Another political leader concerned about the impacts of rising atmospheric concentrations of CO₂ was the Honorable Russell E. Train, who served as the Chairman of President-elect Nixon's Task Force on Environment, as Under Secretary of the Department of the Interior from 1969 to 1970, and as the first Chairman of the Council on Environmental Quality (He was also the second administrator of the Environmental Protection Agency under Presidents Nixon and Ford.) In April 1969, the US released an official statement expressing support a proposed international conference on the Environment, to be held in Stockholm in 1972. "The United States wished to reiterate that it considers this United Nations Conference on Human Environment to be held in 1972 as of great importance, dealing as it will with a broad range of highly critical problems." The statement detailed "objectives" and "problem areas" that should be addressed at the conference; under the latter it identified CO₂ as among the issues that "cover problems of international significance, transcending national boundaries and calling for international action; e.g. the nitrogen cycle, carbon dioxide, the oceans, capacity of the biosphere to support the population, etc."³² The same month, Train, by then Nixon's Undersecretary of the Interior, spoke about fossil fuel combustion and atmospheric CO₂ levels and their implications for global climate in the context of the upcoming Stockholm conference on the global environment, which would take place in 1972.³³

These examples are by no means exhaustive, but they serve to explain how and why, by 1969, Americans from the Presidential Science Advisor to a famous bohemian poet were discussing the potential threat posed by that CO₂ pollution from fossil fuel combustion. Ten years later, in 1979, the U.S. National Academy of Sciences study group felt confident enough in the state of the science to state that "[i]f carbon dioxide continues to increase, the study group finds no reason to

³² US Dept. of State to USUN NY, USUN Ref. No. A-150, United States Response to United Nations Concerning 1972 United Nations Conference on Human Environment, 4, (April 7, 1969) b. 3 f. 12 NARA-NAPCA.

³³ Russel Train, Speech to American Museum of Natural History: Man's Survival in a world worth living in (April 9, 1969) b. 69, f. 5, LOC-RET.

doubt that climate changes will result and no reason to believe that these changes will be negligible.”³⁴

In a press release accompanying the report, the Academy made clear that this finding reflected the consensus of expert opinion, writing: “A plethora of studies from diverse sources indicates a consensus that climate changes will result from man’s combustion of fossil fuels and changes in land use.”³⁵ In a preface to the report, Verner E. Suomi, chairman of the National Academy’s Climate Research Board, underscored what this meant in terms of policy: that even though the effects might be in the future, action to prevent them would need needed soon. “A wait-and-see policy may mean waiting until it is too late.”³⁶

Suomi was savvy enough to realize that this conclusion might be “disturbing to policymakers.”³⁷ Yet, so long as man-made climate change remained a prediction, both policy-makers and the fossil fuel industry broadly accepted the science, and industry in fact contributed to its advancement.³⁸ Matters changed in the 1980s, however, when man-made climate change went from prediction to fact.

From Prediction to Fact

In the mid 1980s, James E. Hansen, director of the Goddard Institute for Space Studies, and his team at NASA published a series of papers in leading scientific journals concluding that

³⁴ Jule Charney *et al.*, *Carbon Dioxide and Climate: A Scientific Assessment, Report of an Ad-Hoc Study Group on Carbon Dioxide and Climate*, Woods Hole, Massachusetts, July 23–27, 1979, to the Climate Research Board, National Research Council (Washington, D.C.: National Academies Press, 1979), 2.

³⁵ National Academy of Sciences Archives, An Evaluation of the Evidence for CO₂-Induced Climate Change, Assembly of Mathematical and Physical Sciences, Climate Research Board, Study Group on Carbon Dioxide, 1979, Film Label: CO₂ and Climate Change: Ad Hoc: General.

³⁶ Verner E. Suomi in *Charney et al.*, *Carbon Dioxide and Climate*, viii. (*supra* note 34).

³⁷ Verner E. Suomi in *Charney et al.*, *Carbon Dioxide and Climate*, viii (*Supra* note 34).

³⁸ Supran, Geoffrey, Stefan Rahmsdorf and Naomi Oreskes, 2023. “Assessing ExxonMobil’s Global Warming Projections,” *Science* 379 (6628): 153-162. <https://doi.org/10.1126/science.abk0063>

anthropogenic climate change was likely underway.³⁹ In 1988, his team reiterated the conclusion in the *Journal of Geophysical Research*: that changes that were underway, that they would likely accelerate in the 1990s, and that they would be “sufficiently large to have major impacts on people and other parts of the biosphere, as shown by computed changes in the frequency of extreme events and by comparison with previous climate trends.”⁴⁰

As it happened, in 1987 a drought was setting in across the United States, and in November Hansen testified in Congress stating that “the scientific evidence for the greenhouse effect is overwhelming.” He continued: “The green house effect is real, [its effects are] coming soon, and it will have major effects on all peoples.”⁴¹ By the following summer, the nation was in crisis. 1988 proved to be one of the hottest and driest on record at that time. As 40% of the nation’s counties were affected, crops failed, livestock died, and food prices rose. Hansen testified again, this time telling Congress that it was “99% certain” that the warming trend that he and his team had measured was “not a natural variation but was caused by a build-up of carbon dioxide and other artificial gases in the atmosphere.”⁴²

Major newspapers across the country covered Hansen’s work. On June 24th, 1988, *The New York Times* placed the story on its front page, under a headline that read: “Global Warming Has

³⁹ Hansen, J. et al., “Climate Impact of Increasing Atmospheric Carbon Dioxide,” *Science* (28 August 1981): 963. See also Hansen, J. and S. Lebedoff, “Global surface air temperatures: Update through 1987,” *Geophysical Research Letters* 92 (D11): 13,345-13,372 1987. <https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/JD092iD11p13345> and Hansen, J. et al., “Global climate changes as forecast by the Goddard Institute for Space Studies three-dimensional model,” *Journal of Geophysical Research: Atmospheres*, 20 August 1988, <https://doi.org/10.1029/JD093iD08p09341>

⁴⁰ Hansen, J. et al., Global climate changes as forecast by Goddard Institute for Space Studies three-dimensional model, *supra* note 39, quotation in Abstract.

⁴¹ Committee on Energy and Natural Resources, Hearing on Green house Effect and Global Climate Change, 100th Congress, 1st sess., November 9, 1987 (Washington, D.C.: U.S. Government Printing Office, 1987), 53; also see J. Hansen et al., “Global Climate Changes as Forecast by Goddard Institute for Space Studies Three- Dimensional Model,” *supra* note 39.

⁴² <https://www.nytimes.com/1988/06/24/us/global-warming-has-begun-expert-tells-senate.html?searchResultPosition=1>

Begun, Expert Tells Senate.”⁴³ As the heat wave and drought continued into the summer, on August 23rd, the *Times* reported further: “The issue of an overheating world has suddenly moved to the forefront of public concern.”⁴⁴

As far as the NASA team were concerned, global warming was no longer just a prediction; it was an observed fact.

To be sure, not all scientists were convinced at that time. Bert Bolin, the man who had first warned Europe about acid rain, thought that Hansen’s temperature data hadn’t been “scrutinized well enough,” and, as part of the newly created Intergovernmental Panel on Climate Change, took on the task of doing just that.⁴⁵ He divided his panel of scientists into three working groups. The first would produce a report reflecting the state of climate science. The second would assess the potential environmental and socio-economic impacts. The third would formulate a set of possible responses. The scientists set themselves a deadline of 1990 for their first assessment: a very short time given their intent to involve more than three hundred scientists from twenty- five nations.⁴⁶

Meanwhile, Presidential candidate and sitting vice president, George H. W. Bush made a campaign promise to counter the “green house effect with the White House effect” by bringing the power of the presidency to bear on the problem.⁴⁷ After his inauguration in January 1989, President Bush sent his secretary of state, James Baker, to the first meeting of the IPCC. He also had the Federal Coordinating Council for Science, Engineering, and Technology’s Committee on Earth

⁴³ <https://www.nytimes.com/1988/06/24/us/global-warming-has-begun-expert-tells-senate.html?searchResultPosition=1>

⁴⁴ <https://www.nytimes.com/1988/08/23/science/his-bold-statement-transforms-the-debate-on-greenhouse-effect.html>, see discussion in <https://link.springer.com/article/10.1007/s10584-015-1472-5>

⁴⁵ Bert Bolin, *A History of the Science and Politics of Climate Change: The Role of the Intergovernmental Panel on Climate Change* (Cambridge: Cambridge University Press, 2007), 49.

⁴⁶ Bolin, *A History of the Science and Politics of Climate Change*, 50–51; see also J. T. Houghton, G. J. Jenkins, and J. J. Ephraums, eds., *Climate Change: The IPCC Scientific Assessment* (New York: Cambridge University Press, 1990), iii and v.

⁴⁷ John Balzar, “Bush Vows ‘Zero Tolerance’ of Environmental Polluters,” *Los Angeles Times*, September 1, 1988, sec. A.

Sciences outline a proposed U.S. Global Climate Change Research initiative for the fiscal year 1990 budget.⁴⁸ It was welcomed in the U.S. Senate, where the Committee on Commerce, Science, and Transportation had prepared a bill proposing the same thing: the National Global Change Research Act of 1989.⁴⁹ The United States was preparing to deal with anthropogenic climate change. As Gus Speth, chair of the Council on Environmental Quality under President Jimmy Carter, later recalled, “We thought we were on track to make real changes.”⁵⁰

Speth wasn’t wrong: the United States and the world *were* on track to act. In 1992, political leaders, including President Bush, met in Rio de Janeiro, Brazil, to sign the United Nations Framework Convention on Climate Change, which committed its signatories to “preventing dangerous anthropogenic interference” with the climate system. When he signed the document, President Bush called on world leaders to “join in translating the words spoken here into concrete action to protect the planet.”⁵¹

This brief review of the historical facts—by no means exhaustive—shows that by 1992, the scientific basis for concern was firmly established *and* the political will to act on that knowledge had developed. But our country never took that concrete action to protect the planet from dangerous anthropogenic interference in the climate system that President Bush had called for. In fact, each time there was an opportunity to do so—each time there was political momentum to develop meaningful climate policy—the opportunity was missed. When Dave Keeling first started measuring atmospheric CO₂, its concentration was 316 ppm; today it is 423 and rising.⁵² This is an increase of 34%, far more than the 25% that worried the President’s Science Advisory Committee in 1965.

⁴⁸ *Committee on Earth Sciences, Our Changing Planet: A U.S. Strategy for Global Change Research* (Washington, D.C.: U.S. Government Printing Office, 1989).

⁴⁹ Senate Committee on Commerce, Science, and Transportation, National Global Change Research Act of 1989, 101st Congress, 1st sess., February 22, 1989 (Washington, D.C.: U.S. Government Printing Office, 1989), 1–4.

⁵⁰ Gus Speth, interview with Naomi Oreskes, August 3, 2007.

⁵¹ <https://www.nytimes.com/1992/06/13/world/the-earth-summit-excerpts-from-speech-by-bush-on-action-plan.html>

⁵² <https://www.co2.earth/1958-background-co2-and-the-keeling-curve>

What happened? Why didn't we take the concrete action that President Bush had promised us? Why haven't we acted on this deep foundation of scientific knowledge?

The role of and impact of disinformation

For the past twenty years, my students, my post-doctoral fellows, and I—first at the University of California and then at Harvard University—have tried to answer this question. The answer is of course a complicated one—social problems always are—and it is never possible to prove why something did *not* happen. Yet, the evidence is clear that an important part of the answer is the role of the fossil fuel industry in undermining public understanding of science, as a means to undermine public support for action. It was a strategy intended to prevent the adoption of the sorts of regulations that DuBridge (and others) had acknowledged back in 1969 would likely be needed.

In the United States, this disinformation played out in three main domains. The first involved attacks on science and scientists by people we have called “merchants of doubt”—because they peddled doubt about climate change. The second involved fossil fuel industry duplicity and disinformation. The third involved the society-wide promotion of “free market” ideology by American business interests seeking to prevent the recognition of climate change (and other social harms) as market failures, and thereby prevent meaningful government action to address it.

1. Attacks on science by “Merchants of Doubt.”

In our 2010 book, *Merchants of Doubt*, Erik Conway and I showed how, in the late 1980s—as the scientific consensus on climate change was coalescing—a small group of Cold War physicists set out to challenge the scientific evidence related to a set of environmental and public health harms: mortality and morbidity from tobacco use, acid rain caused by air pollution, the depletion of stratosphere ozone, and, most important, the reality and likely impacts of anthropogenic climate

change. We showed that several of these men had worked with the tobacco industry—specifically the Philip Morris and R.J. Reynolds corporations—to cast doubt on the scientific evidence of the harms of tobacco use. They also worked with industry to frame the question of tobacco mortality not as a market failure, or a failure of government regulation, but as a matter of “freedom” and “personal choice.” The industry argued that government should not regulate tobacco marketing, advertising, or use, but that the matter should be left to the individual consumer. This, despite the fact that the industry knew that its product was addictive and had endeavored to make it more so.

The merchants of doubt adopted the tobacco strategy and applied it to a variety of domains, including climate change. In our work, we showed that the primary motivation for their activities was not so much financial as ideological. These men were market fundamentalists. By that, we mean that they believed that nearly all problems were best addressed not by government, but by the marketplace. They believed this not so much for economic reasons as for political ones: they believed that government action in the marketplace—even to address a threat as serious as tobacco use, which killed (and still does kill) millions of people every year, or the destruction of stratospheric ozone, which threatened the very existence of life on Earth—that such action was a threat to freedom, as it served as a step on a slippery slope towards tyranny.

In promoting and acting on this view, they were not alone, but in fact were accompanied by conservative American political leaders who accepted the argument that regulation as economically damaging, politically damaging, or both. In 2003, for example, the influential Republican pollster, Frank Luntz, argued in the *Wall Street Journal* that Republicans should not support climate policies, because “[o]nce Republicans concede that greenhouse gases must be controlled, it will only be a matter of time before they end up endorsing more economically damaging regulation.”⁵³ (In 2019,

⁵³ Frank Luntz, *The Wall Street Journal*, 8 April 2003. On the famous Luntz memo, which articulated the “no consensus” strategy see <https://www.theguardian.com/environment/2003/mar/04/usnews.climatechange>

Luntz admitted that he was wrong on climate change, and that the federal government needs to “do more, right now, to address it.”⁵⁴

2. *Fossil fuel industry duplicity and disinformation*

In 2015 a group of investigative journalists at the *Los Angeles Times* and the independent media outlet, *Inside Climate News*, revealed a powerful story about the fossil fuel giant, ExxonMobil, the world’s largest non-governmental oil and gas company, with a market capitalization of over 350 billion dollars.⁵⁵ Using internal company documents, interviews with former employees, and published scientific papers, the journalists showed that, as early as the 1970s, Exxon management were aware of the scientific evidence that the normal use of their products was likely to alter the planetary climate in adverse ways.⁵⁶ The journalists also showed that ExxonMobil had internal research programs in the 1970s and ‘80s dedicated to understanding the climate challenge, and that the results of this research were communicated to management. However, in the 1980s, Exxon phased out most of this research, and, in the late 1980s, made the decision to develop a public stance questioning the scientific basis for concern and insisting that that science was too “uncertain” to warrant action. As *Inside Climate News* put it, “We found that decades ago, Exxon conducted cutting-edge climate research and then worked at the forefront of climate denial, manufacturing doubt about the scientific consensus that its own scientists had confirmed.”⁵⁷

In 2019, two climate scientists previously employed by Exxon testified in Congress that the journalistic account was substantively correct.⁵⁸ One was former Exxon scientist Dr. Ed Garvey,

⁵⁴ <https://www.politico.com/story/2019/08/21/frank-luntz-wrong-climate-change-1470653>

⁵⁵ <https://www.statista.com/statistics/272709/top-10-oil-and-gas-companies-worldwide-based-on-market-value/#:~:text=ExxonMobil%20has%20the%20highest%20market,of%20352.79%20billion%20U.S.%20dollars.>

⁵⁶ <https://insideclimatenews.org/project/exxon-the-road-not-taken/>
<https://www.latimes.com/business/la-na-adv-exxon-arctic-20151011-story.html>

See also <https://www.congress.gov/event/116th-congress/house-event/110126>

⁵⁷ <https://insideclimatenews.org/project/exxon-the-road-not-taken/>

⁵⁸ <https://www.congress.gov/event/116th-congress/house-event/110126>

who worked for the company for five years, from 1978 to 1983. The other was NYU professor emeritus Martin Hoffert, who worked as a paid consultant to Exxon Research and Engineering from 1981 to 1987, and then continued to collaborate with Exxon (and, after 1999, ExxonMobil) scientists throughout the 1990s and into the early 2000s.

Both Dr. Garvey's and Dr. Hoffert's testimonies are readily available; I would like to quote briefly from each:

Dr. Garvey stated:

“[T]he importance of my testimony is to note that Exxon knew [in the 1970s] of the anthropogenic climate change issue and considered it a sufficiently important problem to the company, and perhaps to society, that it funded and undertook a major research investigation of the world's atmospheric and oceanic CO₂ levels.”

When Exxon discontinued the research in which Dr. Garvey was involved, the data he and his colleagues collected “became part of the scientific work published by Columbia scientists, further expanding the understanding of the ocean's role in CO₂ cycling and climate change.” The corporation also “continued to fund climate modeling research for at least several years after...”

Dr. Garvey concluded: “Exxon's [research] efforts were intended to reduce the uncertainties associated with climate change forecasts and CO₂ cycling. In both instances, the corporation was well aware of the potential problem caused by rising CO₂ levels.”⁵⁹

Dr. Hoffert also corroborated the journalists' account. Over more than two decades, Dr. Hoffert worked closely with ExxonMobil scientists. He published eight scientific papers co-authored by Exxon scientists: three papers in the mid 1980s, four in the 1990s and one more in

⁵⁹ <https://www.congress.gov/116/meeting/house/110126/witnesses/HHRG-116-GO02-Wstate-GarveyE-20191023.pdf>

2002. These papers were published in leading scientific journals, such as *Science* and the *Journal of Geophysical Research*; one was a report published by the Lawrence Livermore National Laboratory.

Dr. Hoffert testified:

Suffice it to say that our research was consistent with findings of the UN Intergovernmental Panel on Climate Change on human impacts of fossil fuel burning, which is that they are increasingly having a perceptible influence on Earth's climate.⁶⁰

Dr. Hoffert also noted that at the time Exxon had a large and respected engineering division, one of whose employees was M. Stanley Whittingham, the 2019 Nobel Prize chemistry laureate and “founding father” of rechargeable lithium batteries. Had ExxonMobil not chosen to take the path of disinformation and denial, it could have been a leader in the development of electric cars. Dr. Hoffert concluded: “Exxon with its billions in quarterly profits could certainly have afforded it.”⁶¹

In contrast with the scientists' testimonies, the company vehemently denied the journalists' charges. On its website ExxonMobil (the two oil giants had merged in 2019) issued a statement, that read in part: “We unequivocally rejected allegations that ExxonMobil suppressed climate change research contained in media reports that are inaccurate distortions of ExxonMobil's nearly 40-year history of climate research.”⁶² Strikingly, this was a misrepresentation of what the journalists had

⁶⁰ <https://www.congress.gov/116/meeting/house/110126/witnesses/HHRG-116-GO02-Wstate-HoffertM-20191023.pdf>

⁶¹ <https://www.congress.gov/116/meeting/house/110126/witnesses/HHRG-116-GO02-Wstate-HoffertM-20191023.pdf>

⁶² The original webpage appears to have been taken down, but the response is discussed in numerous media reports, including <https://www.nytimes.com/2015/11/06/science/exxon-mobil-under-investigation-in-new-york-over-climate-statements.html>; <https://www.washingtonpost.com/news/energy-environment/wp/2015/11/05/exxonmobil-under-investigation-for-misleading-the-public-about-climate-change/>; <https://www.kqed.org/science/1921232/what-exxon-knew-and-when-they-knew-it-climate-science-in-s-f-federal-court>

claimed: not that ExxonMobil had “suppressed” climate research, but rather that it had in fact *fostered* such research, but then misled the public about what that research had told them.

ExxonMobil insisted that the journalists’ conclusions were false, and they challenged the public to “Read the documents.”

So we did.

Between 2015 and 2023, my research associate, Geoffrey Supran, and I published five papers in peer-reviewed journals that document the discrepancy between what ExxonMobil scientists knew and communicated to their managers and what the company said in public about man-made climate change.⁶³ The details of our analytical methods are explained in our published work, all of which is publicly accessible. Here, I summarize our key findings.⁶⁴

1. The historical record offers clear and convincing evidence that by the early 1980s, ExxonMobil scientists understood the threat that using their product as intended—namely, oil and gas—represented.
2. They communicated this evidence to managers in internal company reports and memos, and to scientific colleagues in peer-reviewed scientific papers.

⁶³ Supran, Geoffrey, Stefan Rahmsdorf and Naomi Oreskes, 2023. “Assessing ExxonMobil’s Global Warming Projections,” *Science* 379 (6628): 153-162. <https://doi.org/10.1126/science.abk0063>; Supran, Geoffrey and Naomi Oreskes, 2021. “Rhetoric and frame analysis of ExxonMobil’s climate change communications.” *OneEarth* online, 13 May 2021 <https://www.sciencedirect.com/science/article/pii/S2590332221002335>; Supran, Geoffrey and Naomi Oreskes, 2020. “Addendum: ‘ExxonMobil’s climate change communications (1977-2014)’” *Environmental Research Letters*, <https://doi.org/10.1088/1748-9326/ab89d5>; Supran, Geoffrey and Naomi Oreskes, 2020. ExxonMobil’s climate change communications (1977–2014) Reply to comments on Supran and Oreskes (2017) *Environmental Research Letters* 12 084019). <https://iopscience.iop.org/article/10.1088/1748-9326/abbc91>; and Supran, Geoffrey and Naomi Oreskes, 2017. “Assessing ExxonMobil’s climate change communications (1977-2014),” *Environmental Research Letters* 12 084019 <http://iopscience.iop.org/article/10.1088/1748-9326/aa815f>

⁶⁴ For simplicity, we use ExxonMobil to refer to work done and activities undertaken both by Exxon Scientists, managers, and executives and by the same or equivalent groups after the ExxonMobil merger. However, because some people have claimed that Exxon can’t be considered responsible for the actions of Mobil, before the merger, we note that from a legal and moral standpoint, ExxonMobil became responsible for the actions of both Exxon and Mobil once the two companies merged. We also note that, while some of the most egregious examples of disinformation came from Mobil, before 1999, the company continued to make misleading statements and publish misleading materials after the merger.

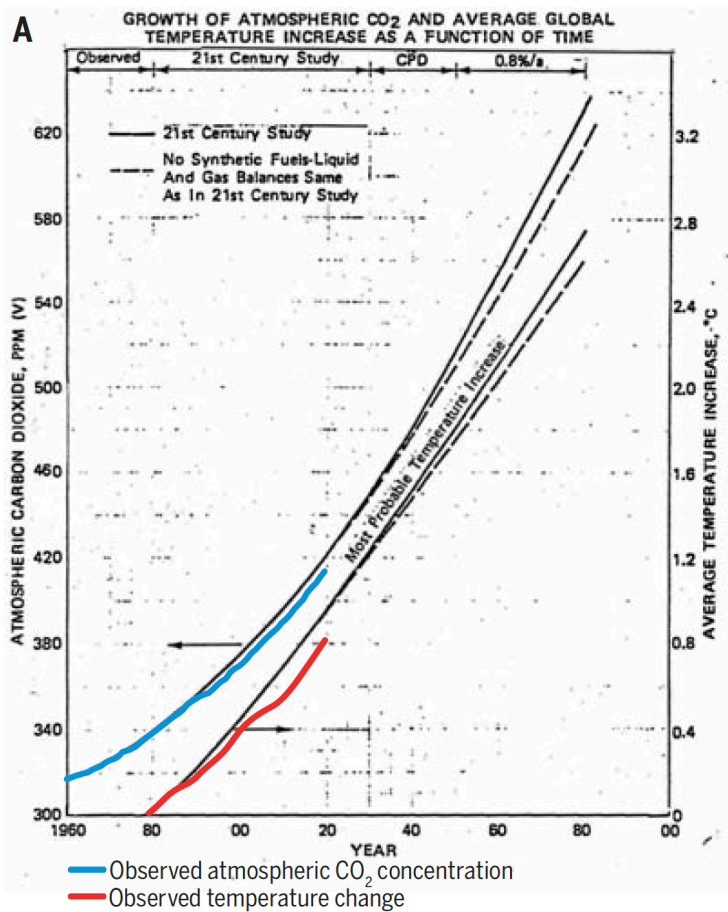
3. While they acknowledged scientific uncertainties, the overall message was that continued use of fossil fuels represented a major threat to human well-being, and this was the general view of most scientists.
4. They suggested that if governments acted to restrict GHG emissions, fossil fuel reserves could become stranded assets.

However, in public ExxonMobil executives told a very different story. In public, such as speeches to trade organizations and industry conferences, messages to investors, and advertisements, ExxonMobil claimed or insinuated that the underlying science was extremely uncertain, that there was no consensus among scientific experts, and therefore there was no basis for taking action to address the issue.

In our published papers, we document each example of this that we analyzed. Here, let me give you one powerful example.

In our most recent paper, co-authored with the world renowned climate scientist Stefan Rahmstorf, we compared climate models either made by ExxonMobil scientists or made by academics but reviewed by ExxonMobil scientists and reported to management in the years 1977-2003.⁶⁵ One particularly striking analysis was produced by ExxonMobil scientists in 1982, in which they forecast expected future levels of increased atmospheric concentrations of CO₂ and the mean global temperatures that would be expected for those levels of CO₂. We compared these projections with what has actually happened, both in terms of increased atmospheric concentrations of CO₂, and mean global temperature. (Figure A).

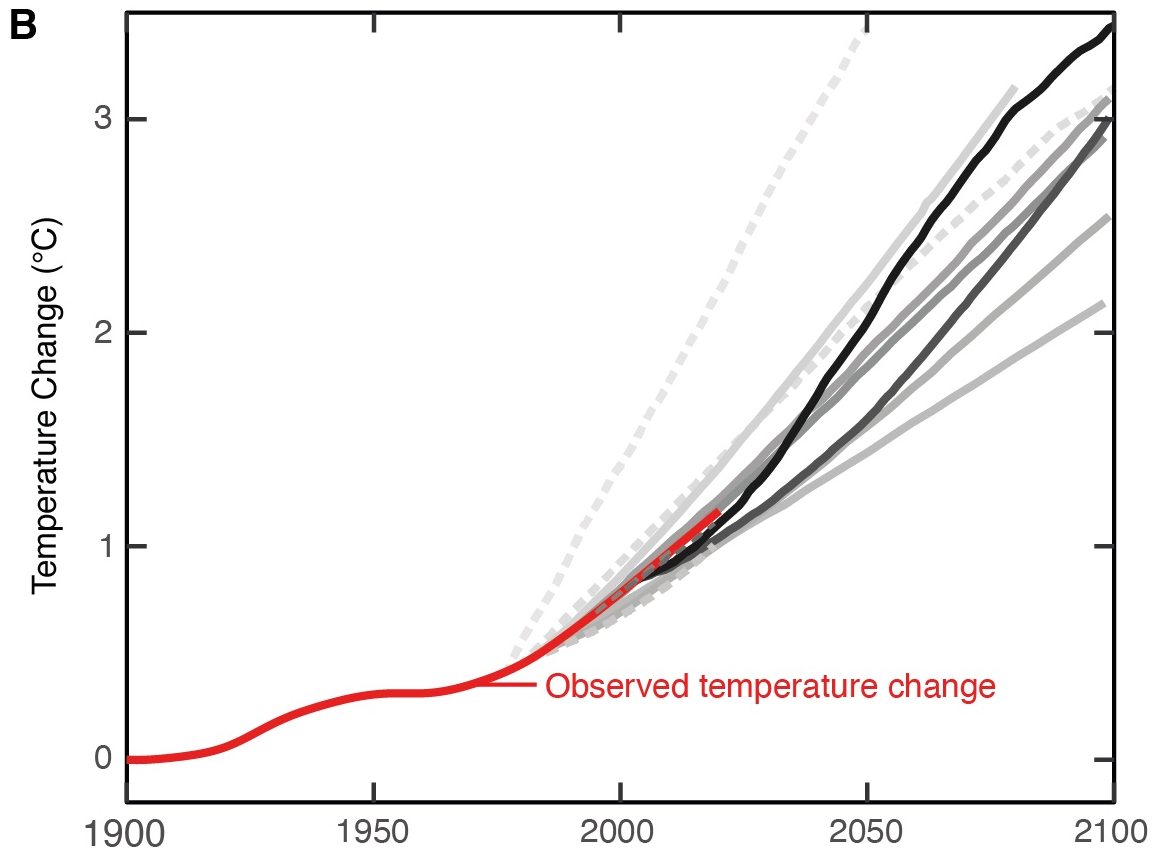
⁶⁵ Supran, Geoffrey, Stefan Rahmstorf and Naomi Oreskes, 2023. "Assessing ExxonMobil's Global Warming Projections," *Science* 379 (6628): 153-162. <https://doi.org/10.1126/science.abk0063>



Our analysis shows that the ExxonMobil forecasts were very close to what has transpired. In fact, ExxonMobil scientists projected that things would be a bit worse than they have turned out to be, a striking observation given that ExxonMobil and other climate change skeptics have often accused climate scientists of being “alarmist.”

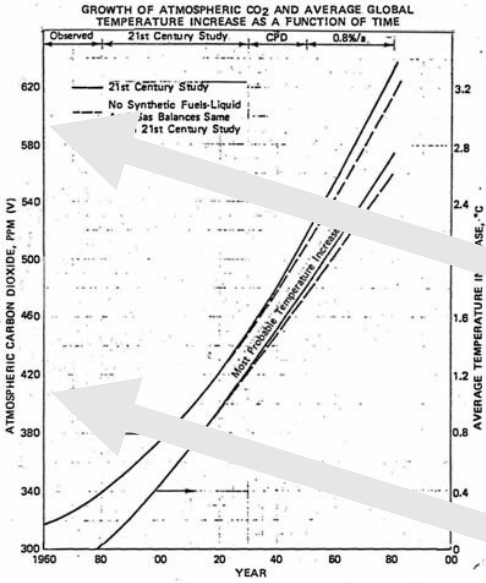
We also compiled all the global warming projects reported by ExxonMobil scientists in internal documents and peer-reviewed papers during the period 1977-2003 (figure B). In this compilation, solid grey-black lines represent internal work by ExxonMobil scientists, dashed lines represent work done by academic scientists and reviewed and reported by ExxonMobil scientists.

The darker the line, the more recent the model. In red, we superimposed the actual observed temperature changes. We see here that ExxonMobil climate modelling was highly accurate. In fact, it was more accurate than some contemporaneous academic models.



These results showed that ExxonMobil was using climate modelling to inform internal discussions, and that these models were, in fact, quite accurate. But this is not the message that ExxonMobil communicated in public. In public, company executives disparaged climate models. In 1999, for example, CEO Lee Raymond stated that climate “projections are based on completely unproven climate models, or, more often, sheer speculation.” In 2013, CEO Rex Tillerson stated that climate models were “not competent.” In 2015, Tillerson said, “We do not really know what the climate effects of 600 ppm versus 400 ppm will be because the models are simply not that good.” In fact,

their own climate models suggested otherwise. In Figure C, we see that 600 ppm produces approximately 1.3 degrees more warming than 400 ppm. It also pushes total global warming above 3°C, far above what scientists have long suggested would constitute a level of serious danger.



600 ppm produces 1.3°C more warming than 400 ppm. (It also pushes total warming to ~3°C)

In hindsight, we can understand why their models were so accurate: 1) because they were based on physics, 2) because they were informed by substantive quantities of historical temperature data, and 3) because ExxonMobil scientists were good scientists. But the public disparagement of climate models was part of a deliberate strategy, as one internal memo written in 1988 put it, to “emphasize the uncertainty in scientific conclusions regarding the potential enhanced greenhouse effect.”⁶⁶

⁶⁶ <https://www.climatefiles.com/exxonmobil/566/>

3. *Constructing a public narrative that denied the reality of market failure and the positive role that governance can and has played in addressing the social and environmental costs of unconstrained capitalism.*

In *Merchants of Doubt*, Erik Conway and I showed how the message of climate change denial was promoted by a set of think-tanks, including the now-defunct George C. Marshall Institute, that subscribed to libertarian and market fundamentalist principles. In our most recent work, we trace this story more deeply into corporate America, to show how, over the course of a century, American business leaders, their trade organizations, and the think-tanks that they helped to fund and foster, promoted a false narrative about American capitalism.⁶⁷ This false narrative was focused on the argument that markets were not simply an efficient means to deliver goods and services, but the only means that did not threaten political freedom.

The narrative was promoted through an astonishingly wide range of activities: by organized propaganda campaigns; by influencing radio, Hollywood films, television, and children's books; by bringing leading European market fundamentalist thinkers to the United States and working behind closed doors to obtain jobs for them at leading universities; by promoting simplified versions of their work, adapted to the American context, and by misrepresenting the work of Adam Smith; and crucially, by making the University of Chicago a center for the promotion of market fundamentalist ideas where they would obtain the veneer of academic legitimacy and then be promoted by a wide network of think tanks and other organizations, seemingly independent from their funders. The story they told was one in which markets were the hero, government the villain.

In time, and with the expenditure of hundreds of millions of dollars, if not far more, they managed to persuade both the American people and political leaders from Jimmy Carter to Ronald

⁶⁷ Oreskes, Naomi and Erik M. Conway. *The Big Myth: How American Business Taught us to Loathe Government and Love the Free Market*, Bloomsbury Press, 2023.

Reagan, Bill Clinton to George W. Bush, that the solutions to our problems lay in the ‘magic of the marketplace.’

The problem, as the economist Lord Nicolas Stern has aptly noted, is that climate change is a market failure, and market failures requires government action to address. In fact, Lord Stern—the former chief economist of the World Bank and the author of the influential Stern Report on the Economics of Climate Change, commissioned by the UK government—has called climate change “the greatest and widest-ranging market failure ever seen.”⁶⁸ In 2007 he noted: “The problem of climate change involves a fundamental failure of markets: those who damage others by emitting greenhouse gases generally do not pay” for that damage.⁶⁹

Lord Stern further noted—as nearly all climate scientists in the early 2000s had concluded—that the “evidence on the seriousness of the risks from inaction or delayed action is now overwhelming. We risk damages on a scale larger than the two world wars of the last century.”⁷⁰ But the window of opportunity that had been opened in 1992—when the science had coalesced and the so had the political will—had by 2007 already been closed by a decade of disinformation.

Already by the mid 1990s—in large part due to the duplicity and disinformation of the fossil fuel industry and its ideological allies—many American citizens and American political leaders had been persuaded that government was not—and could not be—the solution. They had been persuaded that matters should simply be left to the market to sort out, as indeed some of the skeptical witnesses here today have at times suggested. It was a way of downplaying the truth, and disparaging the scientific evidence that worrisome changes were already underway. Telling us to

⁶⁸ Nicolas Stern, *The Economics of Climate Change: The Stern Review* (London: Her Majesty’s Treasury, 2006) and reprinted by Cambridge University Press in 2007. See also

<https://www.lse.ac.uk/granthaminstitute/publication/the-economics-of-climate-change-the-stern-review/>

⁶⁹ <https://www.theguardian.com/environment/2007/nov/29/climatechange.carbonemissions>

⁷⁰ <https://www.theguardian.com/environment/2007/nov/29/climatechange.carbonemissions>

“trust the market” was just another way of saying that we didn’t need to do anything. It was a way of avoiding the regulations that President Nixon’s Science Advisor Lee DuBridge had recognized, back in 1969, would be required.

Today, the evidence of dangerous anthropogenic interference with the climate system is all around us. Numerous scientific studies have demonstrated beyond a reasonable doubt that extreme weather events have been exacerbated by man-made global warming. Numerous governmental and international agencies have placed the costs of that exacerbation at trillions of dollars every year. The International Monetary Fund, for example, has estimated the external cost of carbon—that is to say, the unpaid damages from using fossil fuels as intended—for the year 2017 at “a staggering \$5.2 trillion, or 6.5 percent of world GDP.”⁷¹ While it would be wrong to suggest that all of these costs could have been avoided if we had acted in 1992, it would be ridiculous to assert that early action would not have enabled us to avoid a goodly portion of them.

The costs, of course, are not just measured in money. They are measured as well in human suffering, and in lives. Anyone who has lost a home in a fire or flood or knows someone who has (as I do) knows that even when the house is rebuilt, the pain doesn’t go away. Even when people have insurance, the losses cannot entirely be recouped. People whose lives have been lost do not come back.

Many aspects of climate science have not changed fundamentally since the early 1990s, but one area that has advanced dramatically is the science of detection and attribution. Scientists can now point to specific extreme weather events—floods, fires, heat waves, droughts—that have been made worse—in some cases far worse—than they would otherwise have been. They can even now

⁷¹ <https://www.imf.org/external/pubs/ft/fandd/2019/12/pdf/fd1219.pdf>

point to some unprecedented events that very likely would not have happened but for climate change.⁷² In some of these events, people died.

The unprecedented 2017 wildfire season in British Columbia displaced 65,000 people;⁷³ over a million hectares (12,000 square miles) of valuable forests burned, at least 500 breeding livestock were killed.⁷⁴ One scientific estimate concludes that as much as eleven times more land burned than would have been the case without man-made climate change.⁷⁵ Miraculously, no one died in those fires, but the human toll—in pain, suffering and economic loss--was still great. In the Pacific Northwest in 2021, people were not so lucky. According to the U.S. Department of Agriculture, the 2021 heat dome that affected that region was one of the most extreme events ever recorded, and it caused over 250 deaths and hundreds more heat-related emergencies in Oregon, Idaho, Washington, and Alaska.⁷⁶ Scientists who have analyzed the data have concluded that the occurrence of a heat wave of that type in that region was “found to be virtually impossible without human-caused change.”⁷⁷

Conclusion: Their Lies Have Cost Lives

54 years have passed since Presidential Science Advisor Lee DuBridge explained the greenhouse effect to Senator Henry Jackson. Climate change is no longer a matter of scientific speculation or prediction, much less a question of personal opinion. It is a scientific fact. And the

⁷² <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9285568/>

⁷³ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9285568/>

⁷⁴ <https://www2.gov.bc.ca/gov/content/safety/wildfire-status/about-bcws/wildfire-history/remembering-2017;>
<https://www.theguardian.com/environment/2019/jul/20/death-broken-livelihoods-farmers-wildfires-british-columbia>

⁷⁵ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9285568/>

⁷⁶ <https://www.climatehubs.usda.gov/hubs/northwest/topic/2021-northwest-heat-dome-causes-impacts-and-future-outlook>; see also <https://esd.copernicus.org/preprints/esd-2021-90/esd-2021-90.pdf>

On the fatal 2022 Portland heat dome, see <https://www.multco.us/multnomah-county/news/news-release-medical-examiner-confirms-five-heat-deaths-during-summer-2022#:~:text=The%20Multnomah%20County%20Medical%20Examiner.and%20then%20in%20August%202022.>

⁷⁷ <https://esd.copernicus.org/preprints/esd-2021-90/esd-2021-90.pdf>

costs of delay have been great. They include damage to property; damage to communities; damage to ecosystems and to endangered and threatened species; emotional trauma; and above all, the loss of human life. Yet, while all this damage was unfolding over the past decades, the fossil fuel industry and its allies were disparaging the science and downplaying the risks.

The tragedy of this history is not, as DuBridge feared, that we discovered the outcomes of burning fossil fuels “too late and ... to our sorrow.”⁷⁸ The tragedy is that we failed to act on what we knew, in large part because of the actions of the fossil fuel industry and its allies.

At this point in history, I think it is fair to conclude that their lies have cost lives.

I thank you for your time, and I urge you to support strong and meaningful climate policy, before it truly is to our sorrow.

⁷⁸ Lee DuBridge to Senator Henry Jackson, March 25, 1969, b.7, f. Jackson, sen. Henry, NARA-OST.