

Exhibit A

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Conservation Law Foundation

v.

Shell New Haven Terminal

Case No. 3:21-CV-00933-VDO

Expert Report of Naomi Oreskes

May 1, 2025

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Qualifications of the Expert Witness

My name is Naomi Oreskes. I am the Charles Henry Lea Professor of the History of Science and Affiliated Professor of Earth and Planetary Sciences at Harvard University in Cambridge, Massachusetts. I have been teaching at Harvard since 2013. Before that, over the course of a thirty-year academic career, I taught earth sciences and history of science at Dartmouth College; New York University; the University of California, San Diego; and the California Institute of Technology (Caltech).

I hold a Ph.D. from Stanford University in Geological Research and History of Science. Prior to attending Stanford, I earned a B.Sc. (First Class Honours) in mining geology from the Royal School of Mines, Imperial College, University of London, where I graduated first in my class. For three years after university, I was employed as a professional exploration geologist based in Adelaide, Australia.

Since receiving my Ph.D. in 1990, I have been employed as a university professor. My research focuses on the development of scientific methods and knowledge, particularly in the Earth and environmental sciences. I have a particular focus in scientific evidence and consensus in the Earth sciences: how do Earth scientists decide what methods are appropriate for answering a given question. How are the standards for scientific work established and maintained? How do they weigh and judge evidence? And how do they decide when there is sufficient evidence of sufficient quality to say that something is scientifically established? I have also studied resistance to scientific findings, including organized disinformation, anti-scientific propaganda, and industry-sponsored, amplified, and exaggerated dissent. Since the early 2000s, I have had a specialized research interest in the history of climate science, and the history of attempts by interested parties to downplay, disparage, and even reject entirely that science.

My interest in climate science emerged from work I was doing at the time on the history of oceanography. In the early 2000s, I discovered the work of a group of scientists who had been studying—and warning about the risks—of man-made climate change since the 1950s.¹ I soon learned that these

¹ See Chapter 9 (for more on ATOC) and Chapter 1–2 (for information about early scientific works) in Naomi Oreskes, *Science on a Mission: How Military Funding Shaped What We Do and Don't Know about the Ocean* (Chicago, Illinois: University of Chicago Press,

scientists had noted that burning fossil fuels releases carbon dioxide (CO₂) and other long-lived pollutants into the atmosphere, and they observed that the concentration of (CO₂) in the atmosphere was increasing as a result. They also warned that, left unabated, this CO₂ could build up to such an extent as to cause major changes in the planetary climate system, including substantive sea level rise due to thermal expansion of ocean water and melting of continental ice. In the 1960s, these claims were communicated to political and business leaders, including at conferences, in reports to the White House, in Congressional testimony, and even on television programs.²

This work led in turn to further research on the evolution and status of climate science from the 1960s to the 2000s. I observed that for more than 30 years—from the 1950s to the 1980s—scientists discussed man-made climate change as a prediction—something that they expected to happen but had not yet happened. In 1979, the US Academy of Sciences (1979) used the word “consensus” to refer to this state of opinion: that climate change would occur from increased atmospheric greenhouse gases (GHGs), but they did not yet know when.³ As early as 1979, Exxon employees were modeling energy scenarios that would limit CO₂ buildup.⁴ In 1980, the American Petroleum Institute and other companies assessed how renewables and other alternative energy sources might change the course of global warming. They admitted that moving away from fossil fuel sources would be necessary to do so.⁵

In 1988, the Intergovernmental Panel on Climate Change (IPCC) was created in part to answer the question as to whether man-made climate change was underway, and if so, what level of alteration would pose a danger to humans and to planetary systems.⁶ That same year, NASA climate modeler James Hansen

2021); *See also* Naomi Oreskes, “The Scientific Consensus on Climate Change,” *Science* 306, no. 5702 (December 3, 2004): 1686, <https://doi.org/10.1126/science.1103618>.

² *Ibid.*

³ Jule G. Charney, “Carbon Dioxide and Climate: A Scientific Assessment,” National Academy of Sciences, July 23, 1979. https://geosci.uchicago.edu/~archer/warming_papers/charney.1979.report.pdf.

⁴ Steve Knisely, “Controlling the CO₂ Concentration in the Atmosphere,” Exxon Research and Engineering Company, October 16, 1979. <https://www.industrydocuments.ucsf.edu/docs/#id=mqwl0228> (in Benjamin Andrew Franta, “Big Carbon’s Strategic Response to Global Warming, 1950-2020,” 2022, <https://purl.stanford.edu/hq437ph9153> (hereinafter referred to as “Franta, 2022”).

⁵ Jimmie J. Nelson (American Petroleum Institute), “The CO₂ Problem; Addressing Research Agenda Development,” Climate Investigations Center, March 18, 1980, <https://www.industrydocuments.ucsf.edu/docs/gffl0228> in Franta, 2022.

⁶ 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), <https://doi.org/10.1017/CBO9780511721731>.

published peer reviewed work—and testified to the U.S. Congress—that man-made climate change was underway. He also testified that it could be distinguished from other sources of climate change, such as variations in solar radiation. Hansen’s testimony was reported in media outlets, including on the front page of *the New York Times*.⁷ In 1995, the IPCC confirmed Hansen’s conclusion that man-made climate change was underway, and that it would have substantive impacts, including sea level rise.⁸ Based on the statement itself and the research that led to the statement, multiple academies ran an editorial in *Science* one year later:

In May 2000, at an InterAcademy Panel (IAP) meeting in Tokyo, 73 academies of science from all parts of the world issued a statement on sustainability in which they noted that “global trends in climate change ... are growing concerns” and pledged themselves to work for sustainability—meeting current human needs while preserving the environment and natural resources needed by future generations.⁹

They concluded: “It is now evident that human activities are already contributing adversely to global climate change. Business as usual is no longer a viable option.”¹⁰

In 2001, the IPCC conclusion was re-affirmed in the U.S. National Academy of Sciences report, *Climate Change Science: An Analysis of Some Key Questions*, which begins “Greenhouse gases are accumulating in Earth’s atmosphere as a result of human activities, causing surface air temperatures and subsurface ocean temperatures to rise.”¹¹ The National Academy of Sciences (NAS), founded in 1863 to recognize the nation’s most distinguished scientists and organize those scientists to offer advice to the U.S. President, is widely considered to be the most prestigious scientific organization in the United States, and

⁷ Philip Shabecoff and Special to the New York Times, “Global Warming Has Begun, Expert Tells Senate,” *The New York Times*, June 24, 1988, sec. U.S., <https://www.nytimes.com/1988/06/24/us/global-warming-has-begun-expert-tells-senate.html>.

⁸ The InterAcademy Partnership (IAP), “IAP Statement on Transition to Sustainability,” May 2000, <https://www.interacademies.org/statement/iap-statement-transition-sustainability>.

⁹ A joint statement issued by the Australian Academy of Sciences, Royal Flemish Academy of Belgium for Sciences and the Arts, Brazilian Academy of Sciences, Royal Society of Canada, Caribbean Academy of Sciences, Chinese Academy of Sciences, French Academy of Sciences, German Academy of Natural Scientists Leopoldina, Indian National Science Academy, Indonesian Academy of Sciences, Royal Irish Academy, Accademia Nazionale dei Lincei (Italy), Academy of Sciences Malaysia, Academy Council of the Royal Society of New Zealand, Royal Swedish Academy of Sciences, Turkish Academy of Sciences, and Royal Society (UK), “The Science of Climate Change,” *Science* 292, no. 5520 (May 18, 2001): 1261–1261, <https://doi.org/10.1126/science.292.5520.1261>.

¹⁰ *Ibid.*

¹¹ National Academy of Sciences Committee on the Science of Climate Change, *Climate Change Science: An Analysis of Some Key Questions* (National Academy Press, Washington, DC, 2001), p. 1.

one of the most prestigious scientific societies in the world.¹² The 2001 NAS report on Climate Change Science explicitly asked whether the IPCC assessment is a fair summary of professional scientific thinking, and they answered yes: “The IPCC’s conclusion that most of the observed warming of the last 50 years is likely to have been due to the increase in greenhouse gas concentrations accurately reflects the current thinking of the scientific community on this issue.”¹³ Similar statements were made by the American Meteorological Society (AMS), the American Geophysical Union (AGU), and the American Association for the Advancement of Science (AAAS). While stated in various ways, these expert communities agreed that the evidence for human modification of climate was scientifically persuasive.¹⁴ These were statements of both fact and attribution: the fact that the climate was warming and its attribution to human activities, particularly burning fossil fuels.

However, at the time I was doing this work—in the early 2000s—the press and many political leaders, particularly conservative ones—were presenting climate science very differently: as a matter that was quite unsettled. Some denied that warming was happening; others denied that we could attribute it to fossil fuels. In 2005, for example, ExxonMobil CEO Lee Raymond appeared on the Charlie Rose television show, where he challenged the scientific attribution, suggesting instead that the observed warming was caused by sunspots and the wobble of the Earth—factors that had nothing to do with human activity:

If we weren’t here, the climate would change. It has to do with sun spots, it has to do with the wobble of the Earth, and it has – there are all kinds of things that come and go. If you talk to a geologist, he will tell you the Earth, over its history, has been much warmer than it is now and much colder. There have been times in the Earth’s history where there has been no ice on the Earth. No ice on the Earth. Man didn’t have anything to do with it. So now, the question is, given that there is natural variability – that we know. That’s not an unknown. We don’t know what it is, but we know that it’s changing all the time. Now, the question is, is part of what’s happening related to something other than natural variability? And if so, how do you determine what that is? And the reality is, the science isn’t there to make that determination.¹⁵

¹² Jack Halpern, “The U.S. National Academy of Sciences—In Service to Science and Society,” *Proceedings of the National Academy of Sciences of the United States of America* 94, no. 5 (March 4, 1997): 1606–8.

¹³ *Climate Change Science: An Analysis of Some Key Questions*, p. 3.

¹⁴ American Meteorological Society, *Bull. Am. Meteorol. Soc.* 84, 508 (2003); American Geophysical Union, *Eos* 84(51), 574 (2003).

¹⁵ “The Power of Big Oil,” FRONTLINE, <https://www.pbs.org/wgbh/frontline/documentary/the-power-of-big-oil/>.

This claim flatly contradicted the scientists at the IPCC, the NAS, and the other scientific societies who had explicitly stated that the science was there to make that determination. Raymond then went further, comparing climate scientists—including those at the National Academy—to people who once believed the world was flat.¹⁶

In the face of these contrasting claims, I undertook what was, at the time, the first academic study intended to determine the state of climate science, and, in particular, to determine whether the views of rank-and-file scientists—as reflected in their peer-reviewed publication—were consistent with the IPCC and NAS claims. My study affirmed that they were: in fact, I found no evidence at all of substantive disagreement on this point. (There was still disagreement on the “tempo and mode” of climate change: how fast it was occurring and whether warming would proceed in linear fashion or whether there could be abrupt changes in the system.) I published these results in the leading peer-reviewed journal, *Science* magazine.

Since that time, I have continued to study and publish on the evolving scientific understanding of human impacts on the climate system, and to study and publish on the fossil fuel industry and other groups who have continued to challenge that scientific understanding.¹⁷ For more than a decade, I have studied groups who challenge climate science, including but not restricted to the fossil fuel industry, in order to better understand the motivations for rejecting climate science, the strategies and tactics that have been used to undermine public understanding of that science, and the role of the fossil fuel industry in opposing remedial action.

My work on climate change and climate denial led to an interest in trust in science. In my 2019 book, *Why Trust Science?*, published by Princeton University Press, I posed the question: Should lay people

¹⁶ Michael Fisher, “Lee Raymond,” *DeSmog* (blog), <https://www.desmog.com/lee-raymond/>.

¹⁷ 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*, 1st edition (Bloomsbury Press, 2010); Geoffrey Supran and Naomi Oreskes, “Assessing ExxonMobil’s Climate Change Communications (1977–2014),” *Environmental Research Letters* 12, no. 8 (August 2017): 084019, <https://doi.org/10.1088/1748-9326/aa815f>; John Cook et al., “Consensus on Consensus: A Synthesis of Consensus Estimates on Human-Caused Global Warming,” *Environmental Research Letters* 11, no. 4 (April 2016): 048002, <https://doi.org/10.1088/1748-9326/11/4/048002>.

trust science? If so, why? What is the principled basis for believing that scientific claims are likely to be true? I explained the character of scientific practice, with a focus on how scientific communities evaluate evidence and how communities come to consensus. I argue that scientific findings are generally trustworthy because of the well-developed and time-honored processes by which scientific experts evaluate evidence and adjudicate claims, particularly through academic workshops and conferences, and the process of journal peer-review. I also explored the conditions under which science might not be trustworthy, by reviewing some important episodes in the history of science in which, in hindsight, we would say that the expert community came to faulty conclusions. I show that, in these cases, we can identify specific problem areas that can also serve as criteria for evaluating contemporary scientific claims.

Why Trust Science? originated in an invitation to deliver the Tanner Lectures in Human Values at Princeton University, widely recognized as one of the most prestigious academic-invited lectures. Previous Tanner lecturers at Princeton have included Supreme Court Justice Antonin Scalia, Stanford Law Professor Michael McConnell, and Pulitzer-prize winning author Elizabeth Kolbert. The resulting book has been translated into nine languages and published in ten foreign editions and has sold over 17,000 copies. I consider this book to document my expertise on the nature of scientific practice.

In addition to *Why Trust Science?* I am the author, co-author, or editor of eight scholarly books on topics related to science, society, and the environment. These include *The Rejection of Continental Drift: Theory and Method in American Earth Science* (1990); *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming* (2010), *Discerning Experts: The Practices of Scientific Assessment for Environmental Policy* (2019), *Science on a Mission* (2021), and *The Big Myth* (2023). These books have been translated into more than a dozen languages; *Merchants of Doubt* was made into a documentary film. I have also authored or co-authored over 150 other publications, including both scholarly and popular articles on the history and current practices of science. For five years, I wrote a monthly column for *Scientific American* magazine.

My research has been supported by the U.S. National Science Foundation, the U.S. National Endowment for the Humanities, the American Philosophical Society, NASA, and NOAA, and private foundations.

My work in history of science and science and society has been recognized in numerous professional honors, fellowships, and awards. These include the Francis Bacon Medal in 2009, the American Geophysical Union Presidential Citation for Science and Society in 2014, the Herbert Feis Prize of the American Historical Association in 2015, the Public Service Award of the Geological Society of America in 2015, the Stephen Schneider Award for Outstanding Climate Science Communication in 2016, a John Simon Guggenheim Memorial Foundation Fellowship in 2018, the British Academy Medal in 2019, the 2024 Nonino Foundation “Master of our Time” award, and the 2024 Patrick Suppes Prize of the American Philosophical Society.

I am an elected fellow of the American Association for the Advancement of Science, the American Academy of Arts and Sciences, and the American Philosophical Society. I have served as a consultant to the U.S. Environmental Protection Agency, the U.S. National Academy of Sciences, and the Council of Canadian Academies, and I have testified as an expert to the U.S. Congress, the U.S. Nuclear Waste Technical Review Board, the California State Senate, and the Belgian House of Representatives. I currently serve as editor-in-chief for the Elsevier Major Reference Work, History of Science and Technology.

I hold honorary doctorates from seven universities: Clark (2021), ETH Zurich (2018), the University of British Columbia (2018); Roskilde University, Denmark (2016); Colgate (2015), the Université libre de Bruxelles, Belgium (2023), and Bard College (2024), as well as an honorary master’s degree from Harvard University (2013). I have been a visiting named professor at the California Institute of Technology (Caltech) and have given invited named lectures at universities and research institutes around the world.

I have served on the boards of several non-profit organizations, including the National Center for Science Education and the Climate Science Legal Defense Fund. I currently serve on the board of the non-profit Kann-Rasmussen Foundation, based in Copenhagen, Denmark.

My CV is attached as an appendix to this report.

Previous Expert Testimony and Fees

I have appeared in court as an expert witness in the case of Eastman Chemical Co. v Plastipure Incorporated,¹⁸ and in the case of Mann v. Competitive Enterprise Institute.¹⁹ On October 15, 2024, I was deposed as an expert witness in the case of Boggs v BP Exploration and Production, et al., at the offices of Kirkland & Ellis, LLP, in Boston, Massachusetts.²⁰ My fee for writing this report and providing testimony in this case is \$600/hour.

Methodology

As a professional historian of science, I study the development of scientific knowledge. In doing so, I rely on the explicit and specific methodologies of my profession. This includes analyzing and understanding both the factual claims that scientists make, the evidence upon which they make those claims, the techniques they use to collect and generate data, and the methods they use to evaluate competing claims and decide which, if any, of these claims may be accepted as true. As Lynn K. Nyhart, Professor at the University of Wisconsin, explained in the *Wiley Companion to the History of Science*, the historian's task "is to tease out how certain forms of knowledge and practice...came to be understood as "science"; what has sustained science socially, culturally, and materially; and who has benefitted and who has suffered in its formation."²¹ Historians also evaluate how and why specific knowledge claims have been accepted by scientists as factual and true, whereas other claims are rejected as uncertain, or perhaps true but not yet established. Historians of science also study scientific practice, and at times may pass judgment on whether certain activities are in fact science (as opposed to religion, propaganda, disinformation, pseudo-science,

¹⁸ "Eastman Chemical Company v. PlastiPure, Inc. et al, No. 1:2012cv00057 - Document 249 (W.D. Tex. 2013)," Justia Law, n.d.

¹⁹ "Mann v. Competitive Enterprise Institute," *Climate Change Litigation* (blog), <https://climatecasechart.com/case/mann-v-competitive-enterprise-institute/>.

²⁰ United States: United States District Court Eastern District of Louisiana et al., "Boggs v. BP Exploration & Production, Inc. et al. 2:16-Cv-13476" (Administrative Office of the United States Courts, November 27, 2024), https://www.govinfo.gov/app/details/USCOURTS-laed-2_16-cv-13476.

²¹ Lynn K. Nyhart, "Historiography of the History of Science," in *A Companion to the History of Science* (John Wiley & Sons, Ltd, 2016), 7, <https://doi.org/10.1002/9781118620762.ch1>.

etc.). Historians of science may also judge whether a certain work met the standards of its time, and whether or not it was good science.

History is an academic discipline, like physics, biology, classics, or economics, represented in universities by academic departments. Virtually all major universities and colleges around the world have History Departments. There are many peer-reviewed history journals, including specialized history of science journals. Historians of science publish in these journals, as well as books published by university presses. My own books have been published by the University of Chicago Press, the Oxford University Press, the Princeton University Press, and the MIT Press (as well as by trade presses).

History is one of the oldest and most well-established disciplines; the study of history can be traced back to classical antiquity.²² History of science, as a branch of history, can also be traced back to classical antiquity.²³ Like all scholarly disciplines, it has specific skills and methodologies that are developed through education, training, mentorship, and practice. There is some disagreement as to whether history is best understood as part of the humanities or as a branch of the social sciences, but, most often, history is classified as a social science, along with economics, sociology, and psychology, because of its reliance on the analysis of empirical evidence, as opposed to philosophy, languages, literature, art and music, which are interpretive but not empirical. At Harvard University, where I teach, history resides in the Social Science division of the university and is considered a social science.

Methodologically, historians do their work primarily through the critical reading and interpretation of original documents, referred to as “primary sources.” Historians may also make use of oral sources, including formal oral histories and interviews conducted by historians with participants or other observers. If those interviews were conducted at the time of the events in question, they are considered primary sources. To place historical events into context and accurately interpret their meaning and significance, historians may also consult other cultural records, including but not limited to film, literature,

²² Donald R. Kelley, *Versions of History from Antiquity to the Enlightenment* (Yale University Press, 1991).

²³ Leonid Zhmud, *The Origin of the History of Science in Classical Antiquity*, (De Gruyter, 2008), <https://doi.org/10.1515/9783110194326>.

advertisements, popular articles, public opinion surveys, and trial testimony.²⁴ Historians also consult “secondary sources,” by which we mean the work of other historians or individuals who have described, interpreted, or commented on matters after the fact.

The goal of any historian is to develop an account that is as close as possible to the actual historical events, and, as much as possible, avoids the problems of false memory, wishful thinking, assessing the past by the standards of the present, and other forms of bias. Sensitivity to, and professional training in identifying and avoiding these pitfalls are part of the methods of professional history and distinguish the field from other activities that might involve recounting or describing the past, such as journalism or historical fiction. Historians are at all times expected to meet professional standards for rigor, honesty, and systematic analysis.

Reaching historical conclusions is an academic endeavor whereby the historian uses available tools and resources to develop reliable narratives or chronologies of events and to reach conclusions based on those chronologies. Historical analysis is an exercise in compilation, review, categorization, and context-sensitive analysis of information. Historians work to understand events in context in order to answer the question: what does this document, or event, mean, in light of what we know about the context in which the document was created or the event occurred? Historical documents may also be inconsistent or contradictory; the professional historian uses his or her background knowledge and special skills to help understand, explain, and resolve such inconsistencies and contradictions.

Historians generally privilege documents that were made at the time in which events occurred, rather than ones made after the fact, and documents that were not expected to be made public, on the grounds that these are more likely than the alternatives to be accurate reflections of the events at issue. A

²⁴ Thomas Söderquist, “Using Interviews to Write the History of Science,” in *The Historiography of Contemporary Science and Technology* (Routledge, 2013), 51–68; For an example of the use of film as a source in history, see Stephen P. Safran, “The First Century of Disability Portrayal in Film: An Analysis of the Literature,” *The Journal of Special Education* 31, no. 4 (1998): 467–79, <https://doi.org/10.1177/002246699803100404>.

press release, for example, tells us what the authors of the press release wanted the press and public to know or believe; it does not tell us what the authors of that release believed, much less what actually occurred. For that, we would look to documents surrounding the planning and writing of that press release.

The job of the historian is to locate relevant historical documents, to judge their credibility, and to interpret their meaning by understanding the context in which they were produced. A good deal of historical training consists of special skills developed to enable historians to locate sources, judge their credibility, and interpret their meaning. This is an important reason for specialization: a historian typically specializes in a particular time, place, or topic in order to be able to judge the meaning and credibility of historical sources from that time or place and pertaining to that topic. A historian of science may also specialize in a particular science or group of sciences; I specialize in the earth and environmental sciences which includes understanding the history of environmental sciences, such as environmental chemistry and climate science, and the study and scientific understanding of environmental hazards, such as pesticides, benzene, and other harmful chemicals, as well as harmful natural materials such as mercury, asbestos and lead. Historians of science also use their knowledge and understanding of scientific terminology whose meanings may not be obvious to lay observers.

Evidence is crucial to historical interpretation. All historians seek to make judgements and form conclusions that adhere as closely as possible to the available historical documentation. As Allan M. Brandt, Professor of the History of Science at Harvard University, explained in testimony on behalf of the U.S. Department of Justice in the landmark case of *U.S. v Philip Morris*, historical understanding “requires the collection and evaluation of evidence and the development of careful conclusions that are fundamentally based on the substantiating materials.”²⁵

Because similar events may carry different connotations in different historical settings or at different historical periods, a key aspect of historical work is to situate events and claims in the specific time, place,

²⁵ *United States of America v. Philip Morris Incorporated: United States’ Written Direct Examination of Allan M. Brandt Ph.D., No. 99-CV-2496 (GK)* (United States District Court for the District of Columbia September 20, 2004), 26.

and cultural setting in which they occurred. This also applies to the interpretation of words and terms: because the same word or term may carry different connotations in different settings, historians must interpret the use of words and terms in context. This is a sensitive task: even at the same time and place, a word or term may carry different connotations to different individuals and groups, or to the scientific community versus the lay public.²⁶ Historians call this process of interpreting events and language in context “contextualization.” In principle, any literate person can read historical documents, but, in practice, a person lacking historical expertise is at substantial risk of misconstruing those documents. This is especially true in the history of science where specialized terms abound, and words are often used in ways that diverge from their vernacular meanings. Thus, many historians, including myself, have at least some professional training in the particular science under discussion, in order to understand the technical information involved and meaning of terms being used.

Contextualization is part of interpreting the meaning and significance of historical claims and events. Historians will sometimes praise work that they admire as “fully contextualized.” A great deal of historical training aims to help the historian to develop the necessary skills for contextualization. Yet, at the same time, the ideal of “full contextualization” is never achievable, since, on some level, the context for a historical event is everything that has come before it. The historian Herbert Butterfield put it this way:

Any action which any man has ever taken is part of that whole set of circumstances which at a given moment conditions the whole mass of things that are to happen next. To understand that action is to recover the thousand threads that connect it with other things, to establish it in a system of relations; in other words, to place it in its historical context.²⁷

The professional historian must therefore reduce the elements under consideration to a manageable quantity, which involves professional judgements about what aspects of the historical context are most relevant to the case at hand, as well as practical constraints regarding financial resources and the time available to complete the project.

²⁶ Richard C. J. Somerville and Susan Joy Hassol, “Communicating the Science of Climate Change,” *Physics Today* 64, no. 10 (October 2011): 48–53, <https://doi.org/10.1063/PT.3.1296>.

²⁷ Herbert Butterfield, “The Whig Interpretation of History,” 1931, Part 2: The Underlying Assumption http://www.eliohs.unifi.it/testi/900/butterfield/chap_2.html.

Historical Documents as Evidence: Like most historians, my methodology relies primarily on the finding, reading, and interpretation of historical documents. My methodology is consistent with the standards and practice of my discipline, and my academic work is published in peer-reviewed scholarly journals and in academic presses.

History of science as a specialized branch of history: History of science is a branch of history. In this regard, its practices are comparable with other branches of history, and it frequently overlaps in subject matter with these other branches. History of science differs from other areas of history, however, in that its focus is on science. Therefore, the types of documentary materials that historians of science study are often technical, and historians of science typically have at least some, and sometimes extensive, training in the scientific fields that they study. Historians of science must understand that science, in terms of its factual claims, in terms of the particular methods of that science (and how they may have evolved over time), and in terms of the historical development of scientific understanding that it represents. In my case, I studied earth science at both the undergraduate and graduate levels and earned several grants and prizes for my academic work in geology and mineralogy. I worked for several years in industry as a professional earth scientist. I have also taught earth science at the college level and published peer-reviewed scientific papers in earth science. I continue to attend scientific meetings and to work with earth scientists in areas of mutual interest. This background forms an essential basis for my understanding, analysis, and interpretation of the scientific work that I study as a historian of science.

Like other branches of history, history of science relies primarily on historical documents for evidence. The type of documents historians of science rely on are primarily scientific documents or documents produced in the course of scientific work. In the history of science, relevant documents may include, but are not limited to, published scientific papers, unpublished field and laboratory notebooks, letters or other communications between scientists, drafts of scientific papers and peer review comments, drafts and final versions of grant proposals, personal letters between scientists or between scientists and other people in their lives, email correspondence, patent applications, and more. Typically, these materials

are preserved in the archives of universities, research institutions, government agencies, and/or the Library of Congress or U.S. national archives. They may also include documents generated in the private sector, such as correspondence between industry scientists and their supervisors, or between academic scientists and private sponsors of their research, and company reports. Where archival records are incomplete, they may be supplemented with formal or informal interviews and conversations with living scientists, their family members, or other associates. This is referred to as “oral history.”

The purpose of reading and analyzing documentary records is to understand how scientists generate scientific ideas, how they test those ideas, and how they come to agreement as to which of these ideas may be valid and which should be discarded. In this respect, history of science overlaps with the academic discipline of philosophy of science, insofar as historians of science attempt to answer epistemological questions about the reliability of scientific knowledge, including how the methods of science can yield truth about the natural world.

Historians of science as experts about scientific knowledge and practices: Historians of science are especially qualified to speak to state of knowledge—the facts of the matter—in scientific debates that become matters of public concern. It is appropriate to expect a historian of science, technology, medicine, or public health, to be able to explain the “state of the art” or the “consensus view” in a particular field or with respect to a particular question. A historian of science is qualified to judge whether a particular opinion was consistent with the mainstream science of the time, whether it represented a minority view, or whether it would have been at the time considered to be pseudo-science or the opinion of a crank. A historian is also able to determine whether a particular claim was paid attention to, and whether a particular document was widely read or generally ignored. Historians of science are also able to explain whether a particular claimant was working within the bounds of an acknowledged scientific discipline and using accepted methodologies, or not. A historian of science can explain if a particular claim was accepted or rejected by relevant experts, and, if rejected, why. For this reason, a historian of science can determine whether claims made by non-scientists are consistent with prevailing scientific knowledge at that time, or not.

A historian of science can also explain what it means to be a “relevant expert,” in terms of training, professional stature, and acceptance by fellow experts. A historian of science can explain how technical expertise is obtained and sustained and elucidate the difference between disagreement and dissent that is constitutive of the normal adjudication of scientific claims and other forms of non-scientific disagreement. A historian of science can offer historically based criteria to explain what distinguishes “experts” from non-experts, charlatans, and cranks, as well as what criteria distinguish science from other activities.

Historians as expert witnesses: Because of their special skills and abilities, historians have testified as experts in a large number and wide variety of legal cases in the United States and elsewhere.²⁸ Historians

²⁸ On memory in France: Nancy Wood, “Memory on Trial in Contemporary France: The Case of Maurice Papon,” *History and Memory* 11, no. 1 (1999): 41–76, <https://doi.org/10.2979/his.1999.11.1.41>; Richard Joseph Golsan, *The Papon Affair: Memory and Justice on Trial* (New York: Routledge, 2000); Elisabeth Bumiller, “A Historian Defends His Leap From Past To Present,” *The New York Times*, January 31, 1998, sec. Books, <https://www.nytimes.com/1998/01/31/books/a-historian-defends-his-leap-from-past-to-present.html>; Roger Cohen, “U.S. Historian Relates How Vichy France Served Nazis,” *The New York Times*, November 1, 1997, sec. World, <https://www.nytimes.com/1997/11/01/world/us-historian-relates-how-vichy-france-served-nazis.html>.

On deporting Holocaust survivors: *Naujalis v. INS*, 240 F.3d 642, 645 n.7 (7th Cir. 2001) (noting historian's testimony on deportee's links to Nazi regime); *United States v. Szehinskyj*, 104 F. Supp. 2d 480, 482-83 (E.D. Pa. 2000) (same); *United States v. Dailide*, 953 F. Supp. 192, 196 n.4 (N.D. Ohio 1997) (same).

On historians in gay rights cases: Daniel Hurewitz, “Sexuality Scholarship as a Foundation for Change: Lawrence v. Texas and the Impact of the Historians’ Brief,” *Health and Human Rights* 7, no. 2 (2004): 205–16, <https://doi.org/10.2307/4065355>; George Chauncey, “‘What Gay Studies Taught the Court’: The Historians’ Amicus Brief in Lawrence v. Texas,” *GLQ: A Journal of Lesbian and Gay Studies* 10, no. 3 (2004): 509–38; “Goodridge v. Dept. Public Health, 20011647A | Mass. Cmmw., Judgment, Law, Casemine.Com,” <https://www.casemine.com>, <https://www.casemine.com/judgement/us/5914b8d5add7b0493478792e>; John Finnis, “Shameless Acts” in Colorado: Abuse of Scholarship in Constitutional Cases, *Acad. Questions*, Fall 1994, at 10 (discussing expert testimony on ancient Greeks' stance toward homosexual relationships); Martha C. Nussbaum, *Platonic Love and Colorado Law: The Relevance of Ancient Greek Norms to Modern Sexual Controversies*, 80 *Va. L. Rev.* 1515 (1994) (same).

On voting rights: See, e.g., *NAACP v. City of Niagara Falls*, 65 F.3d 1002, 1020 (2d Cir. 1995) (noting historical testimony on discriminatory intent of laws and practices that allegedly infringe right to vote); *Irby v. Fitz-Hugh*, 693 F. Supp. 424, 427 (E.D. Va. 1988) (same); *Dillard v. Crenshaw County*, 640 F. Supp. 1347, 1356 (M.D. Ala. 1986) (same). See generally Peyton McCrary, “Yes, But What Have They Done to Black People Lately? The Role of Historical Evidence in the Virginia School Board Case,” 70 *Chi.-Kent L. Rev.* 1275 (1995) (examining historical evidence of discriminatory intent provided by plaintiffs in Virginia school board case); Peyton McCrary & J. Gerald Hebert, “Keeping the Courts Honest: The Role of Historians as Expert Witnesses in Southern Voting Rights Cases,” 16 *S.U. L. Rev.* 101 (1989) (surveying testimony provided by historians in voting rights cases).

On trademark disputes: See, e.g., *Harjo v. Pro-Football, Inc.*, 50 U.S.P.Q.2d (BNA) 1705, 1717-18 (1999) (noting testimony on historical connotations of word “redskin” in dispute over validity of trademarks held by Washington Redskins).

On gender discrimination: *EEOC v. Sears, Roebuck & Co.*, 628 F. Supp. 1264, 1314-15 (N.D. Ill. 1986) (noting competing testimony on history of American women's alleged lack of interest in nontraditional jobs such as commission sales). See generally Thomas Haskell & Sanford Levinson, *Academic Freedom and Expert Witnessing: Historians and the Sears Case*, 66 *Tex. L. Rev.* 1629 (1988).

have also been involved in legal cases as authors or co-authors of amicus briefs.²⁹ Historians of science have many of the same skills and abilities as other historians. In addition, they have special knowledge of science and the development of scientific knowledge. Because of this special knowledge, historians of science have served as expert witnesses in a large number and variety of legal cases in the United States in which scientific knowledge is a relevant factor in the case. These cases include, but are not limited to, disputes involving the teaching of “creationism” or “intelligent design” in science classrooms; the history of tobacco and knowledge of its dangers; the history of knowledge about asbestos, lead paint, and vinyl chloride and other hazardous materials to which workers and consumers may have been exposed and suffered damage; and more. As put by historian of science Robert Proctor, testimony in these cases often involves the matter of “who knew what when”; the state of scientific information at a particular moment or over a period of time; and the degree to which that scientific knowledge may also have been common knowledge.³⁰ They may also involve discrepancies between what certain actors claimed in public venues versus what they said or wrote in private, or between what was known scientifically at the time and what was publicly claimed by interested parties.

There is no one single methodology in history, any more than there is one single methodology in physics or geology. What all historians have in common, however, is the use of documentary evidence to produce evidence-based accounts of the past, and it is this use of documentary evidence that forms the basis for the use of historical expert judgment in legal settings.³¹ As Jonathan D. Martin, at the time a Law Clerk to the Honorable John G. Koeltl, United States District Court for the Southern District of New York, explained in 2003, “Historians are often called upon to give expert testimony at trial to help the jury understand the subject matter of the dispute in historical context. Just as scientists must adhere to the

²⁹ Michael Grossberg, “Friends of the Court: A New Role for Historians” *Perspectives on History*, November 1, 2010, <https://www.historians.org/publications-and-directories/perspectives-on-history/november-2010/friends-of-the-court-a-new-role-for-historians>.

³⁰ Affidavit: Robert N. Proctor (Santa Clara, California, Oct. 17, 2014), 6.

³¹ Jonathan D. Martin, “Historians at the Gate: Accommodating Expert Historical Testimony in Federal Courts,” *New York University Law Review* (1950) 78, no. 4 (2003): 1518–49.

scientific method, historians must conform their testimony to the historical method, requiring them to respect the pastness of the past by grappling with the complexity and inconsistency of the historical record and dealing appropriately with contrary evidence.”³² These are special skills in which all professional historians are trained.

By “the past,” historians mean all events that have occurred, including the very recent past. Because of the spectacular growth of science in the late 20th and early 21st centuries, both in scale and cultural significance, a good deal of academic history of science focuses on the recent past, up to and including contemporary work. (This is sometimes referred to as “contemporary history.”³³) Contemporary history seeks to explain how our present scientific knowledge of the world has come to be, and to understand the basis for current scientific conclusions, including politically controversial issues such as climate change and evolution. A good deal of my work involves the analysis of the recent past. In areas of recent and contemporary history, secondary sources may not be well developed, so a historian will rely primarily on primary sources. In most of my work on the development of scientific knowledge in climate science, I rely primarily on primary sources. In my work on other areas of science I rely on both primary and secondary source evidence.

Materials Considered

In writing this report, I relied on scientific papers, reports, newspaper articles, magazine articles, advertisements, and secondary sources that are available in the public domain. I also relied on archival materials which I consulted in doing the background research on which this report is based in-part, many or most of which are not available online. In addition, I relied on materials produced in this litigation. The materials on which I relied are listed in footnotes.

³² Martin argues that in order to ensure what he calls “intellectual due process,” historians should be appointed by the court rather than called by the parties when cases require expert historical testimony. That recommendation has not been generally taken up. Martin, "Historians at the Gate," 1518.

³³ Thomas Söderquist, *The Historiography of Contemporary Science and Technology* (Routledge, 2013).

Opinion One: Scientific consensus confirms that climate change is occurring and has caused, and will continue to cause, a rise in sea levels, more severe weather, increased precipitation, flooding, fires, and other serious consequences.

Scientists have been studying the question of fossil fuels and climate change for more than a century. The historical roots of scientific, governmental, and industry concern over global climate change are very deep. Most of this early work was done in the United States and Europe.

The earliest work (1890s-1930s) laid out man-made climate change (MCC) as a fact: that burning fossil fuels produces “greenhouse gases,” primarily carbon dioxide, which has the potential to warm the planet, but did not necessarily see this as a cause for concern. In the mid-20th-century (1930s-1970s), scientists began to discuss MCC as a cause for concern, particularly because of the risk that planetary warming could—and most likely would—lead to substantial sea level rise (SLR). From the late 1950s onwards, these facts and concerns were mooted in scientific literature, in reports to the government, in industry circles, and in mass media. However, scientists disagreed on how much this should be a cause for concern, primarily because of uncertainties about how soon effects might be felt. In the 1980s, some scientists, most notably NASA climate modeler James Hansen, concluded that MCC was underway. By the early-mid 1990s, a scientific consensus on that issue had emerged, expressed in the 1995 Second Assessment Report of the IPCC (AR2). Since the mid-1990s, tens of thousands of scientific reports and other materials have been produced outlining the predicted and actual effects of MCC, and the topic has been extensively mooted in mass media, popular culture, and society at large.

A. “Man as a Geological Agent”

Scientists have known since the mid-nineteenth century that carbon dioxide (CO₂) is a “greenhouse gas,” meaning that it is highly transparent to visible light but relatively opaque to infrared radiation.³⁴ The “greenhouse effect” refers to the fact that sunlight reaching the Earth penetrates the atmosphere and warms the planet, but when that warmth is re-radiated back to space, some of it is trapped by GHGs, the most

³⁴ See generally, Spencer R. Weart, *The Discovery of Global Warming* (Cambridge, MA: Harvard University Press, 2003); see James Rodger Fleming, *Historical Perspectives on Climate Change* (New York: Oxford University Press, 1998).

important of which are atmospheric water vapor and CO₂. The physical basis of the greenhouse effect was established in 1859 by Irish physicist John Tyndall.³⁵ Tyndall noted the implications of this discovery to climatic changes and, following this work, scientists deduced that changing atmospheric CO₂ concentrations could alter the planetary climate. In the late nineteenth century, America's most famous geologist, T. C. Chamberlin (1843–1928), invoked changing CO₂ from natural causes to explain the ice ages.³⁶ (More CO₂ would warm the planet; less would cool it.) Around the same time, the Nobel Laureate Svante Arrhenius—one of the founders of the science of chemical thermodynamics—suggested that there was an additional factor to consider: changing atmospheric CO₂ concentration might also occur from unnatural causes, specifically burning fossil fuels.³⁷ Such combustion—at the time primarily from coal—added CO₂ to the atmosphere, which would have a net warming effect.

Arrhenius produced the first quantitative estimate of the effect of increased CO₂, finding that doubling the atmospheric concentration would heat the planet by 1.5–4.5°C (2.7–8.1°F).³⁸ In other words, the planetary climate was highly sensitive to changes in CO₂. The effect of doubling its concentration (once the climate system had had time to equilibrate with the new conditions) would come to be called the “equilibrium climate sensitivity.”³⁹ In 1896, Arrhenius did not necessarily think that planetary warming would be detrimental. Moreover, at prevailing combustion rates the effects would not be discernible for several millennia (although a decade later rates had increased enough for him to revise that to centuries).⁴⁰

³⁵ See generally John Tyndall, *The Bakerian Lecture—On the Absorption and Radiation of Heat by Gases and Vapours, and on the Physical Connexion of Radiation, Absorption, and Conduction*, 151 PHIL. TRANS. 1 (1861).

³⁶ See generally, T.C. Chamberlin, *A Group of Hypotheses Bearing on Climatic Change*, 5 J. GEO 653 (1897); T.C. Chamberlin, *The Influence of Great Epochs of Limestone Formation upon the Constitution of the Atmosphere*, 6 J. GEO 609 (1898); T.C. Chamberlin, *An Attempt to Frame a Working Hypothesis of the Cause of Glacial Periods on the Atmospheric Basis*, 7 J. GEO. 545 (1899).

³⁷ Svante Arrhenius, *On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground*, 5 PHIL. MAG. & J. OF SCI. 237, 266, 270 (1896); See Henning Rodhe et al., *Svante Arrhenius and the Greenhouse Effect*, 26 AMBIO 2, 2–4 (1997); see also generally Svante Arrhenius, *Über die wärmeabsorption Durch Kohlensäure*, 58 FOR. SVEN. VETEN. 25 (1901); Svante Arrhenius, *Über die wärmeabsorption durch kohlensäure*, 309 ANNAL. DER PHY. 690 (1901). Svante Arrhenius, *Lehrbuch der komischen physik* 2 (1903). Both Chamberlain and Arrhenius were prominent, distinguished scientists, whose ideas were widely circulated, and in 1903 Arrhenius won the Nobel Prize. See Weart (2003), *supra* note 35.

³⁸ Arrhenius, *On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground*, at 237.

³⁹ *Id.*; see also See Weart (2003), *supra* note 35, at 5–6.

⁴⁰ See Weart (2003), *supra* note 35, 5–8; Luke Skinner, *A Long View on Climate Sensitivity*, 337 SCI. 917, 918 (2012).

In 1900, fellow Swedish scientist Knut Johan Ångström published findings that challenged Arrhenius' central assertions. Ångström was a pioneer in the field of spectroscopy: the study of how gases absorb and emit heat and light at specific wavelengths known as spectral absorption bands.⁴¹ In a simple laboratory experiment, he determined that a small amount of CO₂ appeared sufficient to saturate its heat absorption bands, so further additions would have little or no effect. Moreover, infrared radiation is also absorbed by water vapor, and the CO₂ absorption bands appeared to overlap with those of water vapor. Since there is far more water vapor in Earth's atmosphere than there is CO₂, Ångström concluded that any effect of small changes in CO₂ would be overwhelmed by the much larger effect of water vapor. Therefore, he argued, increased atmospheric CO₂ from burning fossil fuels would have little climatic effect.⁴²

Arrhenius disagreed and the following year published an attempted refutation of Ångström's work. The problem, Arrhenius argued, was that Ångström had treated the atmosphere as if it were homogenous, when available evidence suggested that it was layered and that the upper atmosphere was very dry. If this was so, then additional CO₂ in the upper atmosphere would have a climatic impact since there was little or no water vapor there. But the dispute was not resolved, in part because only scant data were available on the structure and composition of the upper atmosphere. More work was needed to understand the structure of the atmosphere and distribution of heat-absorbing gases in it.⁴³

Arrhenius' work was replicated in 1930 by U.S. Naval Research Lab physicist E.O. Hulburt, who concluded that the temperature effect of increased CO₂ was sufficiently great as to offer a plausible mechanism of major planetary climatic change. Hulburt noted that "an increase or decrease in world-wide average atmospheric temperatures of a few degrees would give rise to other changes", including increasing atmospheric water vapor, which would further increase the greenhouse effect, affecting vegetation, snow

⁴¹ He was also the son of Anders Jonas Ångström, for whom the angstrom, a unit of length used to describe wavelengths, is named. *Anders Jonas Ångström*, Britannica.com, <https://www.britannica.com/biography/Anders-Jonas-Angstrom> (last updated Jun 17, 2023).

⁴² Knut Ångström, *Über die bedeutung des wasserdampfes und der kohlenäures bei der absorption der erdatmosphäre*, 308 *Annal. Der Phy.* 720, 724 (1900); see Weart (2003), *supra* note 35, at 7–8.

⁴³ James Fleming, *T.C. Chamberlin, Climate Change, and Cosmogony*, 31 *STUD. HIST. PHIL. MOD. PHYS.* 293, 299–300 (2000).

fields, and the CO₂ content of the ocean.⁴⁴ However, he shared Angström's concern about the spectral overlap with water vapor. He presented data that suggested the spectral overlap was only partial, but concluded more work was needed on this issue. Further study was also needed on the question of how much CO₂ would be absorbed by the oceans or taken up by plants.⁴⁵

By the turn of the century there was additional scientific support for the idea that increased atmospheric CO₂ would impact the earth's temperature, but debates continued over what the effects would be, and, particularly, when they would occur. In 1923, British geologist R. L. Sherlock published *Man as a Geological Agent*.⁴⁶ The book's thesis was that humans were changing the planetary environment on a scale that rivalled geological processes. He discussed a wide variety of human impacts, including afforestation and deforestation, farming, erosion, mining and quarrying, dams and harbors, and climate change. Drawing on Chamberlin and Arrhenius, Sherlock devoted his final chapter to CO₂-induced climate change. Chamberlin had theorized that CO₂ removal from the atmosphere by natural causes could have caused the Permian glaciation; if this were true, then a "reversal of the process" by unnatural (i.e., human) causes—as suggested by Arrhenius—could lead to global warming.⁴⁷ Moreover, that warming would not be uniform: some areas might warm far more than the global average."⁴⁸

In the 1930s, the topic was also taken up by British engineer Guy Stewart Callendar. Compiling existing data on atmospheric CO₂ and global temperatures, Callendar concluded that coal combustion was adding CO₂ to the atmosphere and that a modest warming trend was already underway.⁴⁹ In a 1940 paper he noted the observed CO₂ increase—about 30 parts per million (ppm) since the late nineteenth century—was consistent with the known amount of coal and oil burned, about 50,000 million tons.⁵⁰ This suggested that the oceans had not absorbed much of the CO₂ released to the atmosphere; he attributed this to the slow

⁴⁴ E.O. Hulburt, *The Temperature of the Lower Atmosphere of the Earth*, 38 PHYS. REV. 1876, 1890 (1931).

⁴⁵ *Id.* at 1890.

⁴⁶ See generally R. L. Sherlock, *Man as Geological Agent: An Account of His Action on Inanimate Nature* (1922).

⁴⁷ *Id.* at 302–305.

⁴⁸ *Id.* at 302.

⁴⁹ G. S. Callendar, *The Artificial Production of Carbon Dioxide and its Influence on Temperature*, 64 Q.J. Roy. Met. Soc. 223, 327 (1938); G.S. Callendar, *Can Carbon Dioxide Influence Climate?*, 4 Weather 310, 312 (1949).

⁵⁰ G.S. Callendar, *Variations of the Amount of Carbon Dioxide in Different Air Currents*, 66 Q.J. Roy. Met. Soc. 395, 399 (1940).

rate of vertical ocean circulation and concluded that it would “doubtless take many centuries” before ocean CO₂ absorption would have an appreciable mitigating effect.⁵¹ For the present, the CO₂ released to the atmosphere appeared mostly or entirely to stay in the atmosphere, where it would have a warming effect.⁵² In the coming years, the relationship between CO₂ and climate was often called the “Callendar question” and the impact of CO₂ on climate “the Callendar effect.”⁵³

B. Post-War Work at the Ford Motor Company, the Scripps Institution of Oceanography, & the Oak Ridge National Laboratory

American scientists turned to the Callendar question in the 1950s, when increased post-war funding for both basic and applied research made it possible to address the question in a sustained and rigorous way. A key figure in advancing understanding of CO₂ and climate was physicist Gilbert Plass, because his work resolved the dispute between Arrhenius and Angström over spectral absorption and established that increased atmospheric CO₂ would, in time, warm the planet with potentially serious adverse effects.⁵⁴

Plass was a Harvard-trained scientist who began his career working for the Manhattan Project at the University of Chicago from 1942 to 1945, after which he took an instructor position at Johns Hopkins University; he received his PhD in physics from Princeton University in 1947.⁵⁵ His specialty was infrared radiation; his work at Johns Hopkins was funded by the U.S. Office of Naval Research.⁵⁶

Infrared radiation was of interest to the defense industry for its significance to weather forecasting, imaging in the infrared spectrum, and heat-seeking missiles, and so both the U.S. military and the aerospace industry actively sought to understand CO₂ theory. In 1955, Plass left academia for industry—first, as a staff scientist at Lockheed Aircraft Corporation and then as a member of the advanced research staff at the

⁵¹ *Id.* at 400.

⁵² *Id.* at 395. Callendar continued publishing on this topic for the next decade: a paper on the spectral absorption issue, a 1942 note on the relation of air temperature and the growth and retreat of glaciers, and a 1945 paper on variation in winter temperatures.

⁵³ James Rodger Fleming, *The Callendar Effect: The Life and Work of Guy Stewart Callendar* xiii–xv (2007).

⁵⁴ See Weart (2003), *supra* note 35, at 23–24.

⁵⁵ Gilbert Plass, Atomic Heritage Found., “Gilbert Plass - Nuclear Museum,” *Ahf.Nuclearmuseum.Org* (blog), <https://ahf.nuclearmuseum.org/ahf/profile/gilbert-plass/>.

⁵⁶ See Weart (2003), *supra* note 35, at 22.

Aeronutronic division for Ford Motor Company.⁵⁷ By 1960, Plass was the manager of the theoretical physics research group at Ford, where he had the laboratory facilities to continue his work on infrared physics, carbon dioxide theory, and computer modelling.⁵⁸

In a set of papers published in the mid-1950s, Plass replicated Arrhenius and Hulburt's calculations and found that doubling CO₂ would warm the planet by 3.6° C, a magnitude sufficient to explain past ice ages.⁵⁹ He noted a key difference between past planetary changes, which were oscillatory, and the present steadily warming trend caused by human activity the Earth was now experiencing: "The extra CO₂ released into the atmosphere by industrial processes and other human activities may have caused the temperature rise during the present century. In contrast with other theories of climate, the CO₂ theory predicts that this warming trend will continue, at least for several centuries."⁶⁰ A temperature change of "perhaps only four degrees" would be sufficient to "bring a tropical climate to most of the Earth's surface."⁶¹ While Plass was unclear on whether or not industrial CO₂ had already had an effect, he concluded there was "no doubt" that it would in time have a "profound influence on our climate."⁶²

Plass resolved the dispute between Arrhenius and Angström over the potential effect of added CO₂ in the atmosphere. Advances in spectroscopy permitted him to resolve the spectral lines to a greater degree than previously achieved and show that the spectral overlap was not complete.⁶³ That meant that

⁵⁷ Gilbert Plass, *supra* note 64.

⁵⁸ James Rodger Fleming et al., *Carbon Dioxide and the Climate*, 98 AM. SCI. 58 (2010), <https://www.americanscientist.org/article/carbon-dioxide-and-the-climate>. Plass was not the only scientist in the 1950s to study CO₂ absorption bands. See generally L.D. Kaplan & D.F. Eggers Jr., *Intensity and Line-Width of the 15-Micron CO₂ Band, Determined by a Curve-of-Growth Method*, 25 J. Chem. Phys. 876 (1956); H.J. Kostkowski & L.D. Kaplan, *Absolute Intensities of the 721 and 742 cm⁻¹ Bands of CO₂*, 26 J. Chem. Phys. 1252 (1959); and H.J. Kostkowski et al., *Vibrational Intensities. XI. CO₂ and the Wilson-Wells Method*, 30 J. Chem. Phys. 532 (1959).

⁵⁹ Gilbert Plass, *The Influence of the 9.6 Micron Ozone Band on the Atmospheric Infra-red Cooling Rate*, 82 Q.J. ROY. MET. SOC. 30, 42 (1956); see generally Gilbert Plass, *A Method for the Determination of Atmospheric Transmission Functions from Laboratory Absorption Measurements*, 42 J. Opt. Soc. Am. 677 (1952); Gilbert Plass, *Parallel-Beam and Diffuse Radiation in the Atmosphere*, 9 J. Atmo. Sci. 429 (1952); Gilbert Plass & D.I. Fivel, *Influence of Doppler Effect and Damping on Line-Absorption Coefficient and Atmospheric Radiation Transfer* 117 *Astrophysics J.* 225 (1953); Gilbert Plass, *Regions of Validity of Various Absorption-Coefficient Approximations*, 11 J. of Meteorology 163 (1954); Gilbert Plass & D.I. Fivel, *The Influence of Variable Mixing Ratio and Temperature on the Radiation Flux*, 81 Q.J. Roy. Met. Soc. 48 (1955).

⁶⁰ Gilbert Plass, *The Carbon Dioxide Theory of Climatic Change*, 8 *Tellus* 140, 140 (1956).

⁶¹ Gilbert Plass, *Carbon Dioxide and the Climate*, 44 *Am. Sci.* 302, 305 (1956).

⁶² *Id.* at 312. Plass wrote a popular version of this work. Gilbert Plass, *Carbon Dioxide and Climate*, 201 *Sci. Amer.* 41, 44 (1959).

⁶³ See generally James Rodger Fleming et al., *supra* note 58.

Angström's objection was wrong: increased CO₂ would warm the planet. The question was, how much and how soon?

Plass's work—and its link to industrial activity—was picked up by the *New York Times* in an article entitled “How Industry May Change Climate.”⁶⁴ In the coming years, Plass communicated his work in both specialist and popular scientific journals, including *American Scientist* and *Scientific American*.⁶⁵ In 1959 in *Scientific American*, he explained 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. “This is almost exactly the average increase recorded all over the world during the past century!”⁶⁶ Plass specifically called the heating effect of CO₂ “the greenhouse effect,” and reiterated that it would not be negated by water vapor.⁶⁷ As Sherlock had earlier, Plass 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].”⁶⁸ The evidence suggested that that the oceans took up at most “about half of any carbon dioxide added to the air.”⁶⁹ The oceans would slow global warming, but they would not stop it.

At the Scripps Institution of Oceanography, oceanographer Roger Revelle and physicist Hans Suess—a pioneer in carbon-14 dating—were also analyzing the link between CO₂, climate, and fossil fuel combustion. Building on Suess' previous work on C-14, they confirmed Plass's estimate, stating that most of the excess CO₂ released from burning fossil fuels since the industrial revolution may now be in the

⁶⁴ W. K., *How Industry May Change Climate*, N.Y. TIMES, May 24, 1953, at E11.

⁶⁵ Plass, *Carbon Dioxide and Climate* (1959); Plass, *Carbon Dioxide and the Climate* (1956): 302–16.

⁶⁶ Plass, *Carbon Dioxide and Climate* (1959), at 46.

⁶⁷ *Id.* at 41.

⁶⁸ *Id.* at 46. Plass also noted the possibility of ocean acidification, but discounted it, one 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” *Id.* at 47.

⁶⁹ *Id.* at 46.

oceans.⁷⁰ But that meant that the other half was accumulating in the atmosphere or taken up by plants that would return the CO₂ when they died. In other words, the buildup of atmospheric CO₂ was happening very quickly—on the scale of years to decades, dramatically contrasting with the amount of time it had taken to accumulate the source carbon in fossil fuels. Revelle and Suess thus observed that by “returning to the atmosphere and oceans the concentrated organic carbon stored in sedimentary rocks over hundreds of millions of years,” humans were performing “a large-scale geophysical experiment” on the planet. Revelle did not think the results of this experiment were likely to be good.⁷¹ According to an interview in *TIME* magazine, he believed that the added carbon dioxide pollution from burning fossil fuels could have “a violent effect on the earth’s climate.”⁷²

Two years later, in 1958, Revelle’s colleague Charles David Keeling began what would become the icon of climate change science: the systematic measurement of atmospheric carbon dioxide and documentation of its steadily rising concentration that today bears his name: the Keeling Curve. As part of the International Geophysical Year (IGY), Revelle helped to obtain the funding that enabled Keeling to begin the detailed measurements of atmospheric carbon dioxide that became the Keeling Curve and won him the National Medal of Science. Revelle and others had also begun to publish serious scientific papers on CO₂ and climate, and to talk to the media about its potential implications.

By the late 1950s, many oceanographers and geophysicists were aware of the scientific work suggesting that increased carbon dioxide from burning fossil fuels could alter the climate and considered how they might contribute to scientific understanding. In 1957, for example, the director of the Woods Hole Oceanographic Institution, Columbus Iselin, discussed the matter in a speech to the Newcomen Society for the History of Engineering and Technology. He mentioned it only in passing, in a section of the speech addressing radioactive waste disposal, but his manner suggested that the basic

⁷⁰ Roger Revelle & Hans E. Suess, *Carbon Dioxide Exchange Between Atmosphere and Ocean and the Question of an Increase of Atmospheric CO₂ during the Past Decades*, 9 *Tellus* 18, 19 (1957).

⁷¹ *Id.* at 19–20.

⁷² *Science: One Big Greenhouse*, *TIME* (May 28, 1956), https://content.time.com/time/subscriber/article/0,33009,937403,0_0.html. See also, Lloyd Norman, *Fumes Seen Warming Arctic Seas*, *The Washington Post and Times Herald*, Mar. 19, 1956, at 3.

facts were scarcely scientifically controversial. “In the case of carbon dioxide in the atmosphere, man went ahead and began burning fossil fuels at a prodigious rate before he considered the possibility that he might be altering the climate on Earth in an unfavorable manner.”⁷³

Perhaps because of these public discussions, or perhaps because of wide-spread public attention to the International Geophysical Year, the threat of Sea Level Rise from global warming even made it into a popular film about climate change by Frank Capra.

Frank Capra was one of America’s most famous and successful filmmakers. The three-time Oscar winner’s films included *Mr. Smith Goes to Washington* (1939), *Arsenic and Old Lace* (1944), *It’s a Wonderful Life* (1946), and *Pocketful of Miracles* (1961). They were some of the most popular films ever made and featured many of Hollywood’s most bankable stars.⁷⁴ In 1958, he produced a film for The Bell System Science Series, entitled *The Unchained Goddess*.

The film was about weather, weather modification, and climate change. It featured a “Dr. Research” (Frank Baxter, a professor at the University of Southern California) explaining recent advances in weather prediction and modification and including a discussion of pollution and particulates in the atmosphere. At one point, Dr. Research’s interlocutor asks whether future scientists would be able to control not just local weather, but even the global climate, such as reversing the jet stream. These were “extremely dangerous questions,” Dr. Research explains, because “with our present knowledge we have no idea what would happen...” Even a few degrees of temperature rise could melt the polar ice caps, creating a future in which sea level rise was so great that an “inland sea would fill a good portion of the Mississippi Valley [and] tourists in glass bottom boats would be viewing the drowned towers of Miami through 150 feet of tropical water.” This could happen because of industrial CO₂:

Even now, man may be unwittingly changing the world’s climate through the waste products of his civilization. Due to our release through factories and automobiles every year of more than six billion

⁷³ Speech to the Newcomen Society, 1957, “Matthew Fontaine Maury (1806–1873) Pathfinder of the Seas, Newcomen Society Meeting, 6 June 1957, Falmouth and Woods Hole, MA, AC-09.4, Box 24, Folder 19, “Personnel, Iselin COD, 1949–1959,” WHOI-ODR.

⁷⁴ See Lary May, *The Big Tomorrow: Hollywood and the Politics of the American Way* 87 (2002).

tons of carbon dioxide, which helps air absorb heat from the sun, our atmosphere seems to be getting warmer.⁷⁵

The issue was profoundly important, Dr. Research concluded, because when it came to weather and climate, scientists were dealing not only with forces more complex than even the atomic physicists dealt with, but with “life itself.”⁷⁶ The Bell Science Series has been described as “among the best known and remembered educational films ever made,” and *The Unchained Goddess* was broadcast on television and shown in classrooms around the country.⁷⁷ Historian James Burkhard Gilbert estimates that by the mid-1960s the series had been watched by almost five million schoolchildren and half a million college students.⁷⁸

Revelle’s concern was shared by the director of Oak Ridge National Laboratory, Alvin Weinberg. The two worked together on the President’s Scientific Advisory Council (PSAC) panel, *Scientific Progress, the Universities, and the Federal Government* in 1959–1960,⁷⁹ and the following year, Weinberg gave an after-dinner talk at the Ninth Southern Appalachian Science Fair at the University of Tennessee entitled *The Problem of Big Problems*. Weinberg made clear that he considered the issue one of profound concern: he defined these “big problems” as ones “on whose solution the entire future of the human race depends.” Global warming was one of these big problems, particularly because of the threat that warming would melt the ice caps and flood many coastal areas.

[A] fundamental problem is the deterioration of our atmosphere by the accumulation of CO₂. As we burn more and more coal and oil, we throw more and more CO₂ into the atmosphere. Now CO₂ effectively absorbs infra-red energy. Its presence in the atmosphere converts the earth into an enormous greenhouse; the sun’s energy remains partially trapped; and the temperature of the earth increases. It is estimated that, as a result of the current burden of CO₂ in the atmosphere, the average temperature of the earth is increasing about 1° C per century. *This is enough to melt the ice caps in a fairly short time with the result that the sea would rise and flood many inhabited areas.*⁸⁰

⁷⁵ *Unchained Goddess* (Warner Bros. Pictures, 1958), <https://www.youtube.com/watch?v=sqCISPWVnNE>. Discussion of weather modification begins around 47:30.

⁷⁶ *Ibid.*

⁷⁷ Geoff Alexander, *Academic Films for the Classroom: A History* 66–67, 69 (2010).

⁷⁸ James Gilbert, *Redeeming Culture: American Religion in an Age of Science* 367, n. 62 (1997).

⁷⁹ President’s Sci. Advisory Comm., *Scientific Progress, the Universities, and the Federal Government* 32 (1960).

⁸⁰ Alvin M. Weinberg, “Problem of big problems” Ninth Southern Appalachian Science Fair Banquet Talk (Apr. 7, 1961) (on file at Alvin Weinberg Papers, MPA.0332, b. 106, f. 6, University of Tennessee Libraries, Knoxville, Special Collections) (emphasis added).

1962 also saw the publication of what would become a very famous and widely cited paper by the petroleum geologist, M. King Hubbert. This paper focused on the question of finite oil resources and predicted that U.S. oil resources would soon peak—an idea that came to be known as the “Hubbert pimple.” But Hubbert also noted that burning oil produced waste products, including waste heat and CO₂. He wrote: “When we burn oil or coal...the energy content, after various degradations during use, degenerates to unusable heat at the lowest ambient temperature, and then leaves the earth as long-wavelength radiation. The material content is reduced to common inorganic chemicals such as H₂O and CO₂, and a residue of mineral ash.”⁸¹ According to his NAS biographical memoir, Hubbert worked for Shell for around 20 years, a time he dubbed “the most productive period” of his life.⁸²

By 1962, global warming was being sufficiently widely discussed that, in a letter to Plass, Guy Callendar complained that the subject was one at which “everyone likes to ‘have a go.’”⁸³ The same year, the International Panel of the PSAC—on which Roger Revelle, among others, served—drafted a report recognizing that the “alteration of our environment has reached the point of requiring intensive study and understanding on an urgent basis.” In particular, they said, “never before has man had the power he now has to bring about changes, some of them irreversible, on a scale that can affect people in all parts of the world and that can cause major but indeterminate environmental changes.”⁸⁴ Among the examples provided was the continuous release of CO₂ into the atmosphere from burning fossil fuels.

Thus, we see that by the 1960s, leading scientists considered global warming to be an issue of profound concern.

⁸¹ National Research Council. 1962. *Energy Resources*. Washington, DC: The National Academies Press. <https://doi.org/10.17226/21066>, p. 33.

⁸² Steven E. Ingebritsen and Michael Manga, “M. King Hubbert 1903-1989” (National Academy of Sciences, 2023), <https://www.nasonline.org/wp-content/uploads/2024/06/hubbert-m-king.pdf>.

⁸³ Letter from G.S. Callendar to Gilbert Plass (Feb. 5, 1962) (on file at the Niels Bohr Library & Archives, American Institute of Physics).

⁸⁴ E.B. Skolnikoff, Int’l Sci. Panel, The President’s Sci. Advisory Comm. The Problem of Large-Scale Experimentation with Possible Environmental Effects 3 (1962) (on file at b. 46, f. 4, I. I. Rabi Papers, Manuscript Division, Library of Congress); *see also* Audrey Lara Loetscher, A History of Unsustainability: The U.S. Government, the Fossil Fuel Industry, and Climate Change (1957–1992) 50-51 (2022) (Ph.D. Dissertation, Université de Lausanne). Lloyd Bernker, one of the main architects of the IGY, was also on the panel.

C. The U.S. Air Force and Air Pollution

While Revelle and Weinberg were particularly concerned about sea level rise, other scientists associated with the U.S. military were studying CO₂ and climate particularly in the context of military preparedness and weather prediction, as well as air pollution and health. Key work was undertaken at the Geophysics Research Division of the Air Force Cambridge Research Center (AFCRC). In 1951, scientists there commissioned the American Meteorological Society to publish a *Compendium of Meteorology* appraising the state of the field.⁸⁵ The compendium was organized by a committee that included Helmut Landsberg, a geophysicist at the AFCRC and expert on cloud formation, and Harry Wexler, the director of the U.S. Weather Bureau and a developer of the world's first weather satellite.⁸⁶ The compendium was edited by Thomas Malone, at the time an assistant professor at MIT and later a scientific leader in the establishment of the National Center for Atmospheric Research (NCAR).⁸⁷ Several chapters of this compendium discussed CO₂, and two chapters, “The Composition of Atmospheric Air” and “Geological and Historical Aspects of Climatic Change”—directly discussed CO₂ and planetary climatic change.⁸⁸

E. Wendell Hewson, an engineering professor at the University of Michigan, contributed a chapter on air pollution that did not discuss CO₂, but two years later he submitted a follow-up report produced under contract to the AFCRC that did.⁸⁹ Hewson began his “Scientific Report No. 1” with a discussion of “pollution and climate” and the “radiational effects [of] carbon dioxide”, which placed CO₂ in the context of substances that were unequivocally understood as air pollutants.⁹⁰

Drawing on Callendar's 1940 paper, Hewson included a table summarizing CO₂ levels from 1866–

⁸⁵ The 1300-page assessment included 102 international authors. *See generally* H.R. Byers et al., *Compendium of Meteorology* (Thomas F. Malone ed., 1951).

⁸⁶ TIROS-1, Wexler was also a commissioned officer of the Army Air Corps serving as a captain to lieutenant colonel from 1942–1946. G. de Q. Robin, *Harry Wexler 1911–1962*, 4 J. of Glaciology 496 (1963).

⁸⁷ W. W. Vaughan, NASA, *Compendium of Meteorology: Scientific Issues of 1950 Still Outstanding* 1167 (1986). 1958, Malone helped prepare and write the “Blue Book” agenda for NCAR and later served as one of its trustees. *See* David T. Malone, Thomas F. Malone, 1917–2013 3 (2014). On the Blue Book, *see* Joshua P. Howe. 2015. *Behind the Curve: Science and the Politics of Global Warming*. Seattle: University Of Washington Press, at 31–32.

⁸⁸ E. Glueckauf, *The Composition of Atmospheric Air*, in *Compendium of Meteorology* 3 (Thomas F. Malone ed., 1951) and C. E. P. Brooks, *Geological and Historical Aspects of Climatic Change*, in *Compendium of Meteorology* 1004 (Thomas F. Malone ed., 1951).

⁸⁹ E. Wendell Hewson, *Atmospheric Pollution*, in *Compendium of Meteorology* 1139 (Thomas F. Malone ed., 1951).

⁹⁰ Hewson, *infra* note 171, at 1, 2.

1935 and observed that there “seems to be no doubt that surface concentrations of CO₂ have increased significantly since the beginning of the present century.”⁹¹ While he debated the source of that carbon dioxide—noting that the correlation between a rise in atmospheric CO₂ and industrial production did not prove causation—he concluded that changes in atmospheric CO₂ levels could “modify the climate in various ways.”⁹² In the third section of the report, Hewson compared CO₂ to other kinds of air pollution including pollen, smoke, dust, and sulfur dioxide (SO₂) and their relations to pneumonia, bronchitis, asthma, cancer, and other diseases. Unlike these conventionally understood forms of pollution, which did not remain in the atmosphere for long, he noted that the “evidence was clear” that CO₂ was removed from the atmosphere slowly and that, if atmospheric CO₂ levels were indeed tied to industrial releases, we could anticipate continued warming “concurrent” with those releases.⁹³ His conclusion echoed this concern: “Industrial pollution of the atmosphere by CO₂ may be modifying world climate, causing a temperature rise.”⁹⁴

Another important scientist in this regard was Christian Junge, a pioneer in the study of the upper atmosphere. His research at the AFCRC focused on aerosols—mixtures of gases and particles in the atmosphere that could affect both local weather and global climate. In 1958, an article entitled “Atmospheric Chemistry,” published in *Advances in Geophysics*, addressed conventional pollutants such as sulfur dioxide, nitrogen oxides, ozone, and carbon monoxide, but also included a section on carbon dioxide.⁹⁵ Junge argued CO₂ was important because of its “increase during the last fifty years” and its role “in the heat budget of our atmosphere.” The observed increase in CO₂ should “raise the average temperature of the atmosphere by a small, though measurable, amount”, and such a “phenomenon has actually been observed in various parts of the world; the problem of a CO₂ increase, therefore, is of basic

⁹¹ *Id.* at 3.

⁹² *Id.* at 4-5. Sadly, the rest of page 5 is missing from the historical record.

⁹³ *Id.* at 28-37.

⁹⁴ *Id.* at 39. In his acknowledgments, Hewson also thanked Gilbert Plass. *Id.* at 41.

⁹⁵ Robert A. Duce et al., *Christian Junge—a Pioneer in Global Atmospheric Chemistry*, 79 *J. Atmos. Chem.* 219, 221, 247-48 (2022). From 1953-1961, Junge worked for the AFCRC, before returning to Germany to become a Professor of Meteorology at the University of Mainz and later the Director of the Max Planck Institute for Chemistry. In 1960, he discovered the Junge layer, a zone of aerosol particles, which, by screening sunlight, has a major impact on planetary heat balance. *Id.* at 223-225.

importance for meteorology.”⁹⁶ Two years later, Junge presented a paper at the U.S. Public Health Service-sponsored Third Air Pollution Research Seminar in which he argued that “the concentrations of two atmospheric constituents, carbon dioxide and sulfur dioxide, have increased on a global scale as a result of human activity”, and that the fluctuations in atmospheric CO₂ would have a “profound influence on world climate.”⁹⁷

The Air Force interest in and support for this work demonstrates that scientific knowledge of the potential impact of increased atmospheric CO₂ was not restricted to academic specialists and was considered to be of broad concern. It also shows that the problem was understood not so much as an “environmental issue,” as it has come to be known in our time, but as an issue with potentially profound implications for military preparedness and operations, and also for air pollution and human health.

D. IGY and the Establishment of Mauna Loa CO₂ Measurements

The International Geophysical Year (IGY) was a massive, international collaborative scientific effort to collect geophysical data from around the globe. It was also widely publicized, inspiring countless newspaper and magazine articles, films, and television series, and even a pop song.⁹⁸ The “year” lasted for eighteen months, from 1957 to 1958, and one of its scientific leaders was Roger Revelle, who arranged for atmospheric CO₂ measurement to be an IGY project.⁹⁹

Revelle wanted this scientific work to answer two questions: was atmospheric CO₂ increasing, and if so, was the increase having a discernible impact on the global climate? The systematic measurement of atmospheric CO₂ became the life work of his colleague, geochemist (and 2001 National Medal of Science winner) Charles David Keeling.¹⁰⁰ In 1958, Keeling established an observatory at Mauna Loa, Hawaii, to

⁹⁶ Christian E. Junge, *Atmospheric Chemistry*, 4 Adv. In Geophys. 1, 45 (1958).

⁹⁷ *Research in Air Pollution: Conference Report*, 75 Pub. Health Rep. 1173, 1173 (1960). Junge later participated in the 1971 Study of Man’s Impact on Climate (SMIC) Report on Inadvertent Climate Modification. *See generally* Inadvertent climate modification: Report of the Study of man’s impact on climate (SMIC) (Study of Man’s Impact on Climate (SMIC) ed., 1971).

⁹⁸ Fae L. Korsmo, *Shaping Up Planet Earth: The International Geophysical Year (1957–1958) and Communicating Science Through Print and Film Media*, 26 Sci. Comm. 162, 162-68 (2004).

⁹⁹ *Id.* at 174; Walter H. Munk, *Tribute to Roger Revelle and his Contribution to Studies of Carbon Dioxide and Climate Change*, 94 Proc. Of the Nat’l Acad. of Sci. 8275, 8276 (1997).

¹⁰⁰ *See* Charles D. Keeling, *Rewards and Penalties*, 23 Ann. Rev. Energy & env’t 25, 26 (1998); *Scientists, Engineers Honored with National Medals*, 55 Physics Today 71, 71 (2002); Munk, *supra* note 100, at 8276.

make precise daily measurements; within a year, Keeling had demonstrated that accurate, systematic measurement of CO₂ in the atmosphere was possible.¹⁰¹ By 1965, he had the answer to the first question: CO₂ was increasing, and his analysis confirmed that about half of the released CO₂ was “missing” and presumed absorbed into the oceans or taken up by plants. The remainder was in the atmosphere, where its concentration was on an upward march.¹⁰² This led scientists to focus on the second question: was this increase affecting the planetary climate?

E. Studies of Weather Modification

A major area of interest in CO₂ and climate appeared in the context of deliberate or purposeful weather modification.¹⁰³ This term refers to the deliberate attempt to change the weather, typically by adding components to the atmosphere that could alter weather patterns, such as cloud seeding.

Shortly after World War II, the U.S. government funded projects to study techniques of weather modification, including cloud seeding and hurricane weakening (Projects Cirrus and Stormfury). Much of this work was undertaken by a research group at the General Electric Corporation, led by Nobel Laureate Irving Langmuir, Vincent Schaefer, and Bernard Vonnegut (brother of novelist Kurt).¹⁰⁴ Study reports from this domain contained discussions of a concept their authors termed “inadvertent weather modification”—what scientists today would call anthropogenic (man-made, or human-caused) climate change.¹⁰⁵ In other words, weather modification projects sought to change the weather deliberately, but scientists involved in this work pointed out that humans could also change the weather by accident, because of the effects of

¹⁰¹ See generally Howe, *Behind the Curve*, *supra* note 88, particularly *Introduction* and *Chapter 1*.

¹⁰² 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. See J.C. Pales & C.D. Keeling, *The Concentration of Atmospheric Carbon Dioxide in Hawaii*, 70 J. Geophys. Res. 6053, 6062 (1965); see also C.W. Brown & C.D. Keeling, *The concentration of atmospheric carbon dioxide in Antarctica*, 70 J. Geophys. Res. 6077, 6077 (1965); Charles D. Keeling, *Is Carbon Dioxide Fossil Fuel Changing Man's Environment*, 114 Proc. Am. Phil. Soc'y 10, 10-13 (1970).

¹⁰³ See Howe, *Behind the Curve*, *supra* note 88, at 25–27; WEART *supra* note 35, at 20–22; Paul N. Edwards. 2010. *A Vast Machine: Computer Models, Climate Data, and The Politics of Global Warming*, Mass.: Mit Press, at 359–361; Chunglin Kwa, *The Rise and Fall of Weather Modification: Changes in American Attitudes Toward Technology, Nature, and Society*, in *Changing the Atmosphere: Expert Knowledge and Environmental Governance* 135 (Clark A. Miller & Paul N. Edwards eds., 2001).

¹⁰⁴ James R. Fleming, *Fixing the Sky: The Checkered History of Weather and Climate Control*, 137–57, 165–87 (2012).

¹⁰⁵ Vincent R. Schaefer, *Inadvertent Modification of the Atmosphere by Air Pollution*, 50 Bull. Am. Meteorological Soc'y 199, 205 (1969). For recent use of this terminology, see Philip B. Duffy et al., *Strengthened Scientific Support for the Endangerment Finding for Atmospheric Greenhouse Gases*, 363 SCIENCE 597, 600 (2019) (“One area of scientific progress since the [Endangerment Finding] is the attribution of extreme weather events . . . to human-caused climate change.”).

some of the component of air pollution, particularly particulates and CO₂.

During the Cold War, many scientists argued that purposeful weather modification was possible: Hewson mentioned weather modification in the introduction to his 1953 report; Schaefer induced cloud seeding in a small-scale laboratory experiment using dry ice; and the U.S. military was intensely interested in the prospects of deliberate weather modification in warfare.¹⁰⁶ Discussions and research into the effects of atmospheric pollutants such as carbon dioxide led some scientists to assert that accidental alterations of weather and climate might not just be theoretically possible, but might be occurring.

In 1958, President John F. Kennedy approved PL 85-510, which authorized government funding of weather modification research through the National Science Foundation (NSF). In the early to mid-1960s, the NSF reviewed the existing scientific research projects on weather modification and released annual reports (ten in total) in accordance with that funding.¹⁰⁷ The National Academy of Sciences also released several reports on the topic at this time, suggesting the importance with which both the scientific community and the federal government viewed the topic. It is in discussions of deliberate weather modification that we see the emergence of the language of “inadvertent weather modification” to refer to what scientists now call anthropogenic climate change, and the explicit recognition that such change could be highly consequential.

In 1964, the NSF director announced the creation of a Special Commission on Weather Modification to review the state of knowledge and respond to a 1963 request from the federal government Council for Science and Technology to analyze potential purposes of weather modification and control. The Commission was chaired by Colorado State University Dean A.R. Chamberlain; its final report was issued in 1965. The Commission discussed CO₂ and the problem of “inadvertent” climate change, which might be

¹⁰⁶ Hewson, *infra* note 171, at 1, 2; Fleming, *supra* note 104, at 142–44, 170–88.

¹⁰⁷ National Science Foundation Act of 1950, Pub. L. No. 85–510, § 72 Stat. 353 (1958). This amendment to the National Science Foundation Act of 1950 made NSF the official coordinating agency for weather modification research projects and required that the agency report annually. For a summary of federal laws governing U.S. federal weather modification programs; see Rachel Hauser, *Using Twentieth-Century U.S. Weather Modification Policy to Gain Insight into Global Climate Remediation Governance Issues*, 5 *Weather Climate & Soc’y* 180, 185 (2013).

either “transient or permanent,” local or global, and desirable or undesirable. The report concluded that weather and climate modifications—whether deliberate or accidental—were already underway, and not merely as local effects:

Weather and climate modification is becoming a reality. . . [T]he inadvertent modification of the weather and climate by such influences as the products of urban development, surface modification for agriculture and silviculture, [and] compositional changes through the combustion of fossil fuels and other exhausts are becoming of sufficient consequence to affect the weather and climate of large areas and ultimately the entire planet.¹⁰⁸

The report called for further research “to understand the factors involved in climatic change and thus to be able to predict inadvertent changes in weather and climate produced by present and future activities of man. Some beginnings in this direction are. . .an attempt to assess consequences of the increasing carbon dioxide content of the atmosphere caused by the burning of fossil fuels. . . ‘the implications [for climate stability] cannot be ignored.’” It continued: “the future welfare of mankind” was at stake.¹⁰⁹

The U.S. National Academy of Sciences also addressed the issue through its research arm, the National Research Council (NAS-NRC). In 1963, the Academy created a panel on weather and climate modification “to undertake a deliberate and thoughtful review of the present status and activities in this field, and of its potential and limitations for the future.”¹¹⁰ Central to much of their work was geophysicist Gordon J.F. MacDonald, who chaired the panel and later served on the Council on Environmental Quality in the Nixon Administration. The NAS-NRC panel released their two-volume final report, “Weather and Climate Modification Problems and Prospects”, in 1966; it gave particular attention to inadvertent, carbon dioxide-fueled weather modification. A full section of the report’s second volume was devoted to “Inadvertent Modification of Atmospheric Processes”, which began with a detailed discussion of the

¹⁰⁸ Nat’l Sci. Found. Special Comm. On Weather Modification, *Weather and Climate Modification* 8 (1965).

¹⁰⁹ *Id.* at 42 (quoting National Research Council Committee on Atmospheric Sciences, *Weather and Climate Modification Problems and Prospects: Final Report of the Panel on Weather and Climate Modification Vols. I and II* (NAS 1966), which had not yet been publicly released but evidently had been shared with the NSF).

¹¹⁰ Gordon J.F. MacDonald, *Preface to Nat’l Rsch. Council Comm. on Atmospheric Sci., Weather and Climate Modification Problems and Prospects: Final Report of the Panel on Weather and Climate Modification, Vols. I and II* (1966).

potential effects of increased carbon dioxide in the atmosphere.¹¹¹ The panel listed as among its “highest priority” studies that investigated the “meteorological effects of atmospheric pollution (including carbon dioxide).”¹¹²

These reports focused on research efforts to deliberately modify and control weather and climate for military and civilian purposes, but they also addressed inadvertent modification. The NSF’s 1962 annual report (released in 1963), for example, cited a 1962 seminar in which the Weather Bureau’s Harry Wexler had analyzed a variety of factors that could modify Earth’s radiation balance, including changing the carbon dioxide content of the atmosphere.¹¹³ The report suggested that this was cause for concern, as Plass had “suggested that 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 carbon dioxide than ever before in historical times.”¹¹⁴ Such warming, it continued, could cause the icepack to “vanish from the frozen north and frozen tundra would thaw.”¹¹⁵ The framing of the project in terms of Plass’s work—as well as the reference to the Arctic icepack, frozen north, and tundra—made clear that the scientists were addressing planetary-scale effects of CO₂-induced global warming.

Weather and climate modification was also addressed by the U.S. Interdepartmental Committee on Atmospheric Sciences (ICAS), which issued a report in 1966. Authored by NASA assistant Administrator Homer Newell, the report mirrored the language of Volume I of the 1966 NAS-NRC report in its

¹¹¹ *Id.* Vol. II at 82–83.

¹¹² *Id.* Vol. I at 25. MacDonald explored this issue further in a 1968 book chapter entitled “How to Wreck the Environment.” He suggested that the deliberate addition or subtraction of atmospheric components could alter the climate so much as to be a potentially potent instrument of war; he called this “geophysical warfare.” The “key to geophysical warfare” he explained, was “the identification of the environmental instabilities in which the addition of a small amount of energy would release vastly greater amounts of energy.” MacDonald’s paper was highly speculative, including discussion of using nuclear weapons to alter ice sheets and change global reflectivity, but he did note that if a nation thought it to their advantage, it could alter the climate by adding CO₂ to the atmosphere: “If a nation’s meteorologists calculated that a general warming or cooling of the earth was in their national interest, improving their climate while worsening others, the temptation to release materials from high-altitude rockets might exist.” Gordon MacDonald, *How to Wreck the Environment, in Unless Peace Comes: A Scientific Forecast of New Weapons* 181, 190 (Nigel Calder ed., 1968).

¹¹³ National Science Foundation, *Weather Modification: Fourth Annual Report* 19 (1962), citing Harry Wexler, Seminar on weather control, Dept. of Meteorology, UCLA (Feb. 1962).

¹¹⁴ *Id.*, citing G.N. Plass, *The Influence of Infrared Absorptive Molecules on the Climate*, 95 *Annals of the N.Y. Acad. Sci.* 61, 61–71 (1961). [113]

¹¹⁵ *Nat’l Sci. Found.*, *supra* note 114, at 20.

discussions of “inadvertent modifications of weather and climate.” But it also specifically identified as a research priority “new and comprehensive studies of the meteorological effects of atmospheric pollution (including carbon dioxide)” and referred to carbon dioxide as “atmospheric pollution.”¹¹⁶ This report was transmitted by the Assistant Secretary of Commerce for Science and Technology and chair of ICAS, J. Herbert Hollomon, to Presidential Science Advisor Donald Hornig.

In this history, we see awareness of the potential for air pollution, including CO₂, to affect both weather and climate, across a wide swath of science and government. A few more examples, described below, will demonstrate this wide awareness.

F. CO₂ and Basic Science Research at the National Center for Atmospheric Research (NCAR)

Much of the work we have been describing can be understood as “applied science”, related to military operations, weather forecasting, and the possibility of deliberate or inadvertent weather modification. The potential importance of CO₂ in relation to climate was also focus of basic science research, particularly at NCAR, established in 1960 by the National Science Foundation as a central facility to consolidate and strengthen basic research in atmospheric science and be a focal point for analyzing data from the IGY.¹¹⁷ In later years, NCAR would become a leading scientific center for climate modelling.¹¹⁸

Historian Joshua Howe describes early NCAR research as organized around four themes: “radiation budget modeling, general circulation modeling, the study of weather and climate control, and the CO₂ question.”¹¹⁹ While the motivation was to advance basic science—in a field that had been heavily oriented towards applied science, particularly weather forecasting—the scientists involved in establishing NCAR recognized that the impact of human activities on the environment demanded attention, too. One of these

¹¹⁶ HOMER E. NEWELL, A RECOMMENDED NATIONAL PROGRAM IN WEATHER MODIFICATION I-4 (1966). ICAS, which was established by and reported to the Federal Council for Science and Technology, Executive Office of the President, coordinated atmospheric research across disparate federal government offices.

¹¹⁷ On the history of NCAR, see Howe, *Behind the Curve*, *supra* note 88, at 27–32; see also Joshua Howe, Making Climate Change History: Documents from Global Warming’s Past 77–84 (2017); see generally Walter Orr Roberts, *Atmospheric Research: A Powerful Concept Emerges*, 5 *Sci.* 1093 (1965); James Rodger Fleming, *Inventing atmospheric science: Bjerknes, Rossby, Wexler, and the foundations of modern meteorology* 203–207 (2016).

¹¹⁸ Howe, *Behind the Curve*, *supra* note 88, at 27–32.

¹¹⁹ *Id.*, at 32–33.

impacts involved fossil fuels and CO₂. In a report prepared for the National Science Foundation in 1959 arguing the case for establishing NCAR, scientists explained, “[M]an’s activities in consuming fossil fuels during the past hundred years, and in detonating nuclear weapons in the last decade, have been on a sufficient scale to make it worthwhile to examine the effects these activities have had upon the atmosphere. Reference is made here to the still unsolved question of whether the carbon dioxide content of the atmosphere is increasing as a result of combustion processes...”¹²⁰

Within a few years, Keeling’s Mauna Loa measurements had convinced most scientists that the question of increasing CO₂ was no longer “unsolved”; the research had moved to its effects. With NCAR firmly established, the April 1965 issue of the NCAR quarterly linked their basic science to air pollution and climate control.¹²¹ That same year, NCAR staff chemist James P. Dixon co-authored a paper in *Science* magazine reporting on the work of the Air Conservation Commission of the American Association for the Advancement of Science.¹²² The paper began by noting that, in quantity, CO₂ was the most important waste product of using fuels, second only to water, and that its global atmospheric content had already increased by 5 percent. This increase was of potential concern because “carbon dioxide is intimately involved in the mechanism that maintains the overall temperature of the earth...[and] it is possible that a continued increase over a long period would change the global climate.”¹²³

G. Broader Scientific Discussion: The Air Conservation Commission of the American Association for the Advancement of Science

In 1962, the American Association for the Advancement of Science (AAAS) created an Air Conservation Commission, which in 1965 issued what would become a landmark report on air pollution.¹²⁴

¹²⁰ Howe, *Behind the Curve*, *supra* note 88, at 83.

¹²¹ *See generally* NCAR, NCAR Quarterly, April 1965, (1965) (on file at Edmund S. Muskie Papers, Edmund S. Muskie Archives and Special Collections Library, Bates College [*hereinafter* BC-ESM] at s. V.A.5, b. 373, f. 13).

¹²² *See infra* Section G of Opinion One.

¹²³ James P. Dixon & James P. Lodge, *Air Conservation Report Reflects National Concern*, 148 *Science* 1060, 1060 (1965) (on file at s. V.A.5, b. 373, f. 13, BC-ESM). We discuss this report in depth below.

¹²⁴ *See generally* Air Conservation Comm’n of the AAAS, *Air Conservation* (1965). The AAAS Committee on Science in the Promotion of Human Welfare convened the Air Conservation Commission in 1962. After two years’ work, the Commission released its report in 1965. *See generally* AAAS Comm. on Sci. in the Promotion of Human Welfare, *Air Conservation*, 137 *Sci.* 9 (1962).

This report, as with others from the period, was not limited to local air pollution; it also considered the global effects of air pollution including carbon dioxide.

The commission was chaired by James Dixon, President of Antioch College, and included prominent figures in the air pollution field such as James P. Lodge, Jr. of the NCAR and Caltech professor Arie J. Haagen-Smit.¹²⁵ The report was written for a wide readership and was reprinted in 1968. In his introduction, Dixon emphasized that the Commission had to condense or omit “a considerable amount of material.”¹²⁶ Yet, despite this constraint, the Commission devoted considerable space to carbon dioxide.

Part 1 of the report, “Air Conservation and Public Policy”, aimed for the widest audience. Here, the Commission offered four major recommendations, of which the third was “that air pollution be viewed as a problem that transcends political boundaries and as one that has global significance.” Just as nuclear weapons testing resulted in pollution around the world, “Other pollutants also have global significance.” Specifically, the report highlighted, the “gradually increasing concentration of carbon dioxide in the earth’s atmosphere may cause a slow increase in world temperature, and it may cause glacial melting and higher sea levels. Such a change, if it is occurring, or if it should occur, would be difficult or impossible to stop.”¹²⁷

Part 2 of the report, “Summary of the Facts,” emphasized that while there were a great number of pollutants, only a small number of substances made up the majority of industrial emissions and were therefore “singled out for special attention.” CO₂ was one of them. While the scientists did not think that effects were yet evident, they stressed the potential for major future impacts, including economic ones:

Carbon dioxide is intimately involved in the mechanism that maintains the overall temperature of the earth. Although. . . it is impossible to evaluate the effect of any given increase in atmospheric carbon dioxide, a continued increase over a long period could possibly change the global climate. And, if such a change were to involve an increase of the earth’s temperature, thereby causing a large portion of the global ice caps to melt and the oceans to rise, available land area would be reduced at precisely the time when more land is needed for an increasing population. In the light of this possibility, the use of fossil fuels as the principal source of our energy should be continually

¹²⁵ The interdisciplinary committee included public officials and professors from diverse fields (e.g., biology, economics, city planning). Notable members included John W. Bodine, President of Penjerdel (the Pennsylvania-New Jersey-Delaware Project, Inc); Arie J. Haagen-Smit (professor of biology, California Institute of Technology); James P. Lodge, Jr. (staff chemist, NCAR); and Norton Nelson (director, Institute of Industrial Medicine, New York University Medical Center). *Scientists in the News*, 137 *Science* 27, 27 (1962).

¹²⁶ Air Conservation Comm’n of the AAAS, *supra* note 124, at x.

¹²⁷ *Id.* at 7.

evaluated.¹²⁸

One of the reasons for uncertainty about CO₂ and climate involved the ocean. It was known that some of the CO₂ released by burning fossil fuels released to the atmosphere would be absorbed by the oceans, which would slow or perhaps even prevent planetary warming. However, human production of CO₂ appeared to be “outstripping the ocean’s ability to remove it from the atmosphere.” They estimated that about one-third of CO₂ emissions were remaining in the atmosphere, less than Plass and Keeling’s estimate of about half of all emissions, but it was still substantial.¹²⁹ This was why CO₂ should be viewed as a pollutant: the “atmosphere has tremendous powers to dilute, disperse, and destroy a large variety of substances that man, for one reason or another, elects to discharge into it,” but a substance became a pollutant when “these processes cannot keep up with the rate of discharge.”¹³⁰ That appeared to be happening now with CO₂.

Part 3 of the AAAS report, “Background Reports,” included an extensive section on “Pollutants and Their Effects,” including a section on CO₂.¹³¹ The report found that CO₂ could and probably should be viewed as an air pollutant, for two reasons. First, it was rising because of *industrial activity*, which made it comparable to other substances conventionally recognized as pollutants: “[S]ince about the middle of the 19th century, worldwide atmospheric concentrations of carbon dioxide have been rising steadily because of the increasing dependence of our industrial era on fossil fuels.”¹³² Second, it had the potential, like other air pollutants, to cause harm: “the extra amounts of atmospheric carbon dioxide ... from the combustion of fossil fuel” could affect the earth’s “heat balance, and hence on the climate of the whole earth.”¹³³ The Commission concluded that “the fear seems legitimate that an unchecked increase in the rate of combustion of carbon fuels may eventually extend carbon dioxide levels to meteorological and physical significance, and

¹²⁸ *Id.* at 26–27.

¹²⁹ *Id.* at 35.

¹³⁰ *Id.* at 36.

¹³¹ The eleven sections covered: “Sulfur and Its Compounds, Carbon Monoxide, Carbon Dioxide, Oxides of Nitrogen, Photochemicals, Particulate Matter, Lead and Other Metals, Fluorides, Environmental Carcinogenesis, Economic Poisons, and Radioactive Pollution.” Air Conservation Comm’n of the AAAS, *supra* note 124, at xi.

¹³² *Id.*

¹³³ *Id.* at 79.

that carbon dioxide concentrations may become great enough to cause climatic changes.”¹³⁴

An important feature of this discussion is that the scientists recognized that controlling CO₂ could require major changes to prevailing patterns of power generation.¹³⁵ The scientists on the AAAS commission wrote, in the event of undesirable climatic changes, humans “may be forced to turn to new sources of energy in order to reestablish a viable carbon dioxide equilibrium.”¹³⁶

The Commission’s report was summarized in articles in *Science* and the *Bulletin of the Atomic Scientists*.¹³⁷ In the *Science* article, co-authored by Commission member and NCAR staff chemist James Lodge, particularly emphasized CO₂ and climate; this article was sent to U.S. Senator Edmund Muskie at least twice in 1965, including by NCAR’s Walter Orr Roberts.¹³⁸ In correspondence with Lodge in October 1965, Muskie wrote that he had read the paper and was looking forward to reading the report.¹³⁹

Regulatory and public health discussions of air pollution in the subsequent years often cited the Commission’s report.¹⁴⁰ Physicist and *Science* editor Philip Abelson drew on the Commission’s report in a 1968 article on “Man-made environmental hazards” published in the *American Journal of Public Health*, citing it as an example of “air pollution ... getting the considerable attention [it] deserve[s].”¹⁴¹ Abelson reminded readers that “today man is changing his environment on a planetary scale,” repeating the prediction—made by the 1965 PSAC report—of a 25 percent increase in atmospheric CO₂ by the year 2000 and warning of its potential to increase global temperature.¹⁴²

¹³⁴ *Id.* at 81.

¹³⁵ *West Virginia et al. v. Environmental Protection Agency* (Supreme Court of the United States June 30, 2022).

¹³⁶ Air Conservation Comm’n of the AAAS, *supra* note 124, at 81.

¹³⁷ Dixon & Lodge, *supra* note 123, at 1060, 1063; James P. Dixon, *For Air Conservation*, 21 *Bull. of the Atomic Sci.* 7, 6–9 (1965).

¹³⁸ Correspondence from Walter Orr Roberts to Muskie, Aug. 20, 1965 (on file at s. V.A.5, b. 373, f. 13, BC-ESM); Dixon & Lodge, *supra* note 123. Reprint sent from Gene Malecki to Muskie, May 24, 1965 (on file at BC-ESM, s.V.A.5, b. 375, f. 8, BC-ESM).

¹³⁹ Correspondence from Muskie to James Lodge, Oct. 1, 1965 (on file at BC-ESM, s. V.A.5, b. 376, f. 2).

¹⁴⁰ *See, e.g., Clean Air Act Amendments of 1966: Hearings before the Subcomm. on Pub. Health and Welfare of the H. Comm. on Interstate and Foreign Com.*, 89th Cong. 69 (1966); US Dep’t of Health, Educ., and Welfare, *A Strategy for a Livable Environment: A Report to the Secretary of Health, Education, and Welfare by The Task Force on Environmental Health and Related Problems* 67 (1967); Council on Env’t Quality, *infra* 173, at 93; EPA, *Guide for Air Pollution Episode Avoidance* 43 (1971).

¹⁴¹ Abelson, *infra* note 155, at 2044.

¹⁴² *Id.* at 2046. Abelson cited the 1965 PSAC report for the statistic on carbon dioxide increases. He also discussed the counterargument for the effects of particulate matter. *See also generally* Philip H. Abelson, *Social Responsibilities of Scientists*, 167 *Science* 241 (1970).

H. The 1965 Report of the President's Scientific Advisory Committee

Roger Revelle and David Keeling served on the Environmental Pollution Panel of the President's Scientific Advisory Committee (PSAC) under President Lyndon Johnson. The Panel was led by Princeton professor John Tukey, one of America's (and the world's) leading mathematicians and statisticians.¹⁴³ During its tenure (1957–1973), the President's Science Advisory Committee was (as its name suggests) the most important conduit by which scientific information and advice was transmitted to the White House.¹⁴⁴

In 1965, the PSAC issued a major report entitled “Restoring the Quality of our Environment.” The panel included a subpanel on “Atmospheric Carbon Dioxide,” and its concern over carbon dioxide made it to the first page of the report's introduction: “pollutants have altered on a global scale the carbon dioxide content of the air and the lead concentrations in ocean waters and human populations.”¹⁴⁵ The issue was raised again throughout the report. In examining the climatic effects of pollution, the authors asserted, “By 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...”¹⁴⁶ The report placed CO₂ into context with other conventionally understood pollutants:

The combustion of coal, oil, and gas in our homes, vehicles, and factories results in the discharge into the air of sulfur dioxide, carbon dioxide, carbon monoxide, oxides of nitrogen, and partially burned hydrocarbons. Some of these gases, together with gasoline and natural gas vapors, undergo chemical change in air and in sunlight, and become the noxious constituents of smog; others, like carbon dioxide, are accumulating in such large quantities that they may eventually produce marked climatic change. Large amounts of lead are dispersed into the atmosphere from motor vehicle exhausts.¹⁴⁷

¹⁴³ Among other things, Tukey was known for the invention of the Fast Fourier transform algorithm, a major tool in modern signal processing, digital recording, and computer science. Tukey also served on numerous government and NAS committees and panels on air pollution, weather modification, and other matters as well as on an American Statistical Association review of Alfred Kinsey's path-breaking work on human sexuality. *See generally* David R. Brillinger, John W. Tukey 1915–2000 (2018).

¹⁴⁴ *See generally* Zuoyue Wang, In Sputnik's Shadow: The President's Science Advisory Committee and Cold War America (2009); *see United States. President's Science Advisory Committee*, Am. Inst. of Physics, <https://history.aip.org/phn/21612015.html#:~:text=This%20committee%20operated%20between%201957,in%201973%20by%20President%20Nixon> (last visited July 18, 2023).

¹⁴⁵ Env't Pollution Panel of the President's Science Advisory Comm., “Restoring the Quality of Our Environment,” at 1 (1965), <https://nsarchive.gwu.edu/document/31937-document-2-white-house-report-restoring-quality-our-environment-report-environmental>.

¹⁴⁶ *Id.* at 9.

¹⁴⁷ *Id.* at 12.

The panel recommended investments in baseline measuring programs under the Environmental Science Services Administration (ESSA, part of the Commerce Department) to determine precise levels of CO₂ in the atmosphere “where its effects on our climate are likely to be significant,” as well as to expand research into the mechanisms by which the ocean or biological processes might remove CO₂ from the atmosphere.¹⁴⁸ The full findings of the subpanel were transmitted over twenty-two pages in Appendix Y4, where the authors discussed possible effects of increased atmospheric CO₂ such as global temperature increases, sea water warming, melting of the Antarctic ice cap, and sea level rise.¹⁴⁹

One source of potential disagreement over the impact of added atmospheric CO₂, the panel noted, involved the complication of natural climate variability and the countervailing effects of other forms of pollution, particularly particulate matter. For example, worldwide cooling appeared to have taken place between 1940 and 1960, a period when more than 40 percent of the total CO₂ increase from fossil fuels took place. This enigma led the panel to posit that “climatic ‘noise’” from other processes had at least partially “masked any effects on climate due to past increases in atmospheric CO₂ content.”¹⁵⁰

One such process included particulate pollution: dust, soot, sulfuric acid aerosols, and other substances that could block the sun. These particulates did not change the effect of CO₂ emissions, but they could have a cooling effect that might mask the CO₂ warming effect.¹⁵¹ If this were true, then it might be the case that the warming effect was actually greater than it appeared and would increase further if particulates were controlled by air pollution regulation that was being developed at that time. Other reports at this time also noted the potential cooling effect of particulates; in coming years scientists would conclude that the mid-century cooling was largely due to particulate matter and that the warming effect of CO₂ had indeed in part been masked.¹⁵²

¹⁴⁸ *Id.* at 26.

¹⁴⁹ *Id.* at 121–124.

¹⁵⁰ *Id.* at 123.

¹⁵¹ *Id.* at 127; see generally Robert A. McCormick & John H. Ludwig, *Climate Modification by Atmospheric Aerosols*, 156 *Science* 1358 (1967); Walter Munk et al., Gordan James Fraser Macdonald 1930–2002 (2004).

¹⁵² See generally Martin Wild et al., *Impact of Global Dimming and Brightening on Global Warming*, 34 *Geophysical Resch. Letters* L04702 (2007); P.V. Forster et al., *Changes in Atmospheric Constituents and in Radiative Forcing*, in *CLIMATE CHANGE 2007: The Physical*

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 in 1965, specifically noting that addressing the CO₂ problem might include 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 likely to become a national necessity."¹⁵³

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."¹⁵⁴ In the years to come, this report—including its prediction of rising CO₂—was repeatedly referenced and cited.¹⁵⁵

I. Early Industry Knowledge of the Problem

Because industry documents are less likely to be in the public domain than government documents or scientific papers, we have less detailed information on industry knowledge and discussions of the issue than we do of scientific and government knowledge. However, industry knowledge of the threat of global warming has been investigated in detail by Dr. Benjamin Franta in his PhD dissertation at Stanford University and research he has continued at Oxford University. Franta has documented that in 1954, scientists at Caltech met with members of the American Petroleum Institute to discuss their conclusion that

Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change 131 (2007); Thomas C. Peterson et al., *The Myth of the 1970s Global Cooling Scientific Consensus*, 89 *Bull. Am. Meteorological Soc'y* 1325, 1328 (2008).

¹⁵³ F.N. Ikard, *Meeting the Challenges of 1966*, 45 *Proc. of Am. Petroleum Inst.* 12, 13 (1965); *see also*, Benjamin Franta, *Early Oil Industry Knowledge of CO₂ and Global Warming*, 8 *Nat. Climate Change* 1024, 1024-1025 (2018).

¹⁵⁴ Ikard, *Meeting the Challenges of 1966*, at 13; Franta, *Early Oil Industry Knowledge of CO₂ and Global Warming*, at 1025.

¹⁵⁵ *See, e.g.*, Leon Green, *Energy Needs versus Environmental Pollution: A Reconciliation?: A Power Generation Concept by Which Pollution of Air and Water Can Be Reduced Is Proposed.*, 156 *SCI.* 1448, 1448 (1967); Philip H. Abelson, *Man-Made Environmental Hazards. I. How Man Shapes His Environment*, 58 *Am. J. Pub. Health & Nat. Health* 2043, 2043-44 (1968); Fred Sargent, *Man-Environment-Problems for Public Health.*, 62 *Am. J. of Pub. Health* 628 (1972). It was also frequently referenced and excerpted in congressional materials. *See, e.g.*, *Air Pollution—1966, Hearing on S. 3112 and H.R. 13199 Before the Subcommittee on Air & Water Pollution of the S. Comm. on Public Works*, 89th Cong. (1966); *Subcomm. on Sci., Rsch. and Dev.* at 51 (summary of the 1965 PSAC report, which specifically noted the CO₂ subpanel, the recommendation for baseline CO₂ measurements, and the recommendation for research on CO₂ flows to and from atmosphere).

“fossil fuels were likely causing a buildup of carbon dioxide in the atmosphere.”¹⁵⁶ At an API conference in 1959, the famous physicist Edward Teller one of the “fathers” of the Hydrogen bomb—warned the industry about the increased greenhouse effect from burning fossil fuels, noting that it had the potential to raise sea levels if that burning continued unfettered.¹⁵⁷

Frank Ikard’s comment, already noted, demonstrates that industry leaders were aware of the 1965 report to President Johnson on the threat of climate change from burning fossil fuels, and did not suggest that the science was too uncertain to be taken seriously. Franta notes that three years later, in 1968, the API received this same warning from its own private consultants, who advised that it was time to develop “air pollution technology” to bring CO₂ emissions under control.¹⁵⁸

In 1968, the API commissioned scientists at the Stanford Research Institute (“SRI”) to examine the 1965 PSAC report. The report prepared for API, “Sources, Abundance and Fate of Gaseous Atmospheric Pollutants,” stated that among various known pollutants, carbon dioxide was “the only air pollutant which has been proven to be of global importance to man's environment on the basis of a long period of scientific investigation..”¹⁵⁹ Referring back to the PSAC report, the SRI scientists noted that given present trends, atmospheric CO₂ could reach 400 ppm by 2000, leading to global temperature increase, melting ice caps, rising seas, and worldwide environmental damage. Citing PSAC member Roger Revelle, the SRI scientists wrote, “Revelle makes the point that man is now engaged in a vast geophysical experiment with his

¹⁵⁶ Benjamin Franta, “How the most important fact of global warming has been obscured,” Chapter 2 in *Ignorance Unmasked: Essays in the New Science of Anthology*, edited by Robert N. Proctor and Londa Schiebinger (Stanford University Press, 2025).

¹⁵⁷ Benjamin Andrew Franta, “Big Carbon’s Strategic Response to Global Warming, 1950-2020,” 2022, <https://purl.stanford.edu/hq437ph9153>, at 8-10. See also Benjamin Franta, “On Its 100th Birthday in 1959, Edward Teller Warned the Oil Industry about Global Warming,” *The Guardian*, January 1, 2018, sec. Environment, <https://web.archive.org/web/20250424180144/https://www.theguardian.com/environment/climate-consensus-97-percent/2018/jan/01/on-its-hundredth-birthday-in-1959-edward-teller-warned-the-oil-industry-about-global-warming>.

¹⁵⁸ Benjamin Franta, “A Future Foreseen and Transition Delayed: The American Petroleum Industry and Global Warming, 1959–1986,” in *Energy Transitions*, ed. Stephen G. Gross and Andrew Needham (Pittsburgh: University of Pittsburgh Press, 2023); Chapter 2 (“How the most important fact of global warming has been obscure”) at 55–58, in Franta, *Ignorance Unmasked*, *supra* 157.

¹⁵⁹ E. Robinson & R.C. Robbins. “Sources, abundance, and fate of atmospheric pollutants,” *Smoke & Fumes*, <https://www.smokeandfumes.org/documents/16>.

environment, the earth. Significant temperature changes are *almost certain to occur by the year 2000...*¹⁶⁰ They concluded: "...there seems to be no doubt that potential damage to our environment could be severe."¹⁶¹

Shell has long been a member of API, which it describes today as "the only national industry association that represents members from across all parts of the oil and natural gas industry in the US."¹⁶²

Historical evidence shows that various individual companies were also well aware of this situation, and some were doing research of their own. The most well-studied is ExxonMobil. In the late 1970s and early 1980s, scientists at Esso (later ExxonMobil) were investigating the relationship between CO₂ and planetary climate, building climate models, and co-authoring scientific papers on it.¹⁶³ These scientists explained to their managers that there was a limit to how much carbon the world could burn without risking catastrophic damage. They even suggested that their company might have to consider a different business model, one that was not so dependent on fossil fuels. Shell would have had the same public and industry-wide scientific information as its fellow API member.

Apart from in-house work, scientists and engineers in the private sector would also have been aware of the issue from presentations given at professional meetings of petroleum geologists and engineers. For example, in 1969, Victor Erickson from the U.S. Department of Commerce spoke at the annual meeting of the American Institute of Mining, Metallurgical and Petroleum Engineers (AIME), where he noted the potential severity of climate change caused by CO₂ pollution. He stated: if we are "faced with the problem of a warming of the earth from the 'hot house' effect of carbon dioxide in the upper atmosphere ...entirely

¹⁶⁰ E. Robinson, & R.C. Robbins. 1968. "Sources, abundance, and fate of gaseous atmospheric pollutants." Final report and supplement. (United States: Stanford Research Institute, Menlo Park, CA), <https://www.osti.gov/biblio/6852325>. Excerpted in Smoke and Fumes, <https://web.archive.org/web/20250316232727/https://www.smokeandfumes.org/documents/16>, at 3 (emphasis added).

¹⁶¹ *Id.* at 4 on "Smokes and Fumes" excerpt page.

¹⁶² "American Petroleum Institute (API), "Shell Climate and Energy Transition Lobbying Report 2022." Shell has implicitly acknowledged that API's past activities have not been entirely constructive. It's web site currently states: "We believe that API is advocating more constructively on climate than previously, especially on carbon pricing and methane regulation... We will remain a member of API at the current time. We will continue to track alignment between API's climate and energy transition-related positions and our own and will be transparent about where we find differences."

¹⁶³ Geoffrey Supran and Naomi Oreskes, "Assessing ExxonMobil's Climate Change Communications (1977–2014)," *Environmental Research Letters* 12, no. 8 (August 2017): 084019, <https://doi.org/10.1088/1748-9326/aa815f>; "Exxon: The Road Not Taken," *Inside Climate News* (blog), <https://insideclimatenews.org/book/exxon-the-road-not-taken/>.

new approaches may be needed. . . . [This] will raise major economic issues, and it is not too early to be thinking about them.”¹⁶⁴

The issue was discussed again at the AIME annual meetings in 1970 and 1971. In 1970, the conference program included a discussion of planning a transition to a low-carbon energy economy by 2000. The 1971 program included a representative of the U.S. Treasury Department, who observed that future energy demands might need to be met by “systems which are not dependent on fossil fuels.”¹⁶⁵ The AIME is America’s largest professional organization of mining and petroleum engineers, so it is almost certain that many or even most Shell petroleum engineers were members, and at least some of them would have attended its annual meetings.

Additional evidence shows that scientists and engineers at other oil and gas companies were aware of the CO₂, climate, and energy nexus in the 1970s. In 1971, the French oil giant Total published an article titled “Atmospheric Pollution and Climate” in its magazine *Total Information*, which noted that since the 1800s, the burning of fossil fuel had resulted in the release of “enormous quantities of carbon dioxide” and that if fossil fuel use continued to grow, CO₂ concentrations would reach four hundred parts per million (ppm) around 2010 (a forecast that proved quite accurate). The article characterized the predicted global warming as “quite worrying” and warned of modified atmospheric circulation, melting of polar ice, and significant sea level rise, stating, “The catastrophic consequences are easy to imagine.”¹⁶⁶

J. Summary of Scientific, Government, and Industry Knowledge Before the 1970s

The information presented here shows that, already by the year 1970, the scientific basis for concern over GHG warming was established and known to political and industry leaders. In the 1950s, highly

¹⁶⁴ Victor Erickson, 1969, Potential Effects of Air Pollution Regulation on Manufacturing, *Proceedings of the American Institute of Mining, Metallurgical and Petroleum Engineers*, Geology Library, University of Wyoming, Laramie in Franta (2022).

¹⁶⁵ William A. Vogely, 1971, The Future of Mineral Supplies, *Proceedings of the American Institute of Mining, Metallurgical and Petroleum Engineers*, Geology Library, University of Wyoming, Laramie in Franta, 2022.

¹⁶⁶ Christophe Bonneuil, Pierre-Louis Choquet, and Benjamin Franta, “Early Warnings and Emerging Accountability: Total’s Responses to Global Warming, 1971–2021,” *Global Environmental Change* 71 (2021): 102386; Chapter 2 (“How the most important fact of global warming has been obscure”) at 19, in Franta, *Ignorance Unmasked*, *supra* 157.

respected scientists in government and academics had begun a serious conversation about the threat of increased GHG emissions from burning fossil fuels, and its potential adverse impacts. By the 1960s, this conversation included reports of high-level panels, including members of the President’s Science Advisory Committee. These concerns were communicated in a wide-ranging conversation between leading scientists, high-level administrators at federal agencies, members of Congress, White House staff under Presidents Lyndon Johnson and Richard Nixon, the Council on Environmental Quality, and the President’s Science Advisory Committee.¹⁶⁷ It also included leading members of Congress.¹⁶⁸

Scientists testified to the potential adverse effects of increased atmospheric carbon dioxide on weather and climate, including the potential for catastrophic outcomes. An important feature of this discussion is that the scientists recognized that controlling CO₂ could require major changes to prevailing patterns of power generation, including phasing out fossil fuels. They wrote, “Significant effects may occur in the coming centuries ... if the combustion of fossil fuels continues to increase—and it will keep rising if the fuel and power requirements of our worldwide industrial civilization continue to rise exponentially, and if these needs are met only to a limited degree by the development of tidal, solar, and nuclear power.”¹⁶⁹ In the event of undesirable climatic changes, humans “may be forced to turn to new sources of energy in order to reestablish a viable carbon dioxide equilibrium.”¹⁷⁰

As early as the 1950s, scientists referred to CO₂ as “industrial pollution” and compared it with other industrial pollutants including particulate matter and sulfur dioxide.¹⁷¹ Many members of the federal government, including legislators involved in the passage of the Clean Air Act, were aware of the potential

¹⁶⁷ Naomi Oreskes et al., “Climate Change and the Clean Air Act of 1970 Part I: The Scientific Basis,” *Ecology Law Quarterly*, 2023, <https://doi.org/10.15779/Z38DV1CP99>, §§ II.B, III.B, III.G, IV.A, V.C, V.D.

¹⁶⁸ *Id.* at §§ III.B, IV.A and notes 181–82, 214, 218, 221, 226, 255, 349, 351, 361–63 with accompanying text.

¹⁶⁹ Air Conservation Comm’n of the AAAS, *Air Conservation* (1965). The AAAS Committee on Science in the Promotion of Human Welfare convened the Air Conservation Commission in 1962. After two years’ work, the Commission released its report in 1965. *See generally* AAAS Comm. on Sci. in the Promotion of Human Welfare, *Air Conservation*, 137 *Sci.* 9 (1962), at 80 in Naomi Oreskes et al., “Climate Change and the Clean Air Act of 1970 Part I: The Scientific Basis,” *Ecology Law Quarterly*, 2023, <https://doi.org/10.15779/Z38DV1CP99>, at 844.

¹⁷⁰ *Id.* at 81, in Oreskes et al. (2023).

¹⁷¹ *See, e.g.*, E. Wendall Hewson, *Sci. Rep. No. 1: Some Aspects of the Dispersion of Pollens and Industrial Contaminants in Relation to Micrometeorology* 39 (1953).

for CO₂ to adversely alter both local weather and global climate.¹⁷² While they would learn much more in the decades to come, already by the late 1960s scientists knew that GHG, derived from fossil fuel combustion, could alter the global climate with potentially serious and deleterious ensuing effects. By the early 1970s, there was an emerging consensus among leading scientists—including members of the President’s Science Advisory Committee—that planetary-scale climate change was likely to occur from increased CO₂ released into the atmosphere from burning fossil fuels, and that the impacts were significant, even potentially catastrophic. They also recognized that addressing the problem could have wide-ranging physical implications, including sea level rise, which in turn would have major economic implications, including on energy production and automobiles. The historical facts also show that these scientific concerns and conclusions were discussed by the President of the American Petroleum Institute and members of the American Institute of Mining and Metallurgy.

Given this, I conclude that industry had abundant notice of the issue and could have begun to take steps at that time to address the challenge in an orderly yet timely manner.

K. Evolving Knowledge in the 1980s

In the 1970s and 1980s, scientific knowledge of climate change developed further, and scientists’ confidence in their forecasts increased. By the end of the 1980s, some scientists had concluded that man-made climate change was underway. That is to say, man-made climate change went from being a prediction to a fact.

By the 1970s, a number of scientists were building models to try to predict when a detectable climate signal might occur. In 1978, *Oceanus*, the official journal of the Woods Hole Oceanographic Institution, released a special issue, “Oceans and Climate.” It began with an introduction by Robert M.

¹⁷² See, e.g., 116th Cong. Rec. 32,901 (1970) (statement of Sen. Edmund Muskie) (warning that air pollution, if not controlled, would “threaten irreversible atmospheric and climatic changes”); *Report of the Council on Environmental Quality: Hearing Before the Senate Subcomm. on Air and Water Pollution of the S. Comm. On Pub. Works*, 91st Cong. 5 (1970) (statement of Russell Train, Chairman, Council of Env’t Quality) (testifying that the “international dimensions of the air pollution problem should not be overlooked . . . [as] discharge of particulates and carbon dioxide to the atmosphere could have dramatic and long-term effects on the world’s temperature with many major consequences”).

White (1923–2015), who had just stepped down as the first NOAA administrator and was serving as chairman of the NRC’s Climate Research Board. White wrote:

We now understand that industrial wastes, such as carbon dioxide released during the burning of fossil fuels, can have consequences for climate that pose a considerable threat to future society. The Geophysics Research Board of the National Research Council in its recent report, “Energy and Climate,” foresees the possibility of a quadrupling of the CO₂ content of the atmosphere in the next two centuries with a possible increase of 6 degrees Celsius in global surface temperatures. Changes of such magnitude accompany climatic shifts from glacial to interglacial epochs.... Experiences of the past decade have demonstrated the consequences of even modest fluctuations in climatic conditions [and] lent a new urgency to the study of climate... The scientific problems are formidable; the technological problems, unprecedented; and the potential economic and social impacts, ominous.¹⁷³

Several of the papers in the *Oceanus* volume cited the climate modeling work of National Center for Atmospheric Research scientist Stephen Schneider, and Princeton scientists Syukuro “Suki” Manabe and R. T. Wetherald, which predicted that doubling atmospheric carbon dioxide could increase average global temperature by 1.5° C to 3° C.¹⁷⁴ (In 2021, Manabe would win the Nobel Prize for this work.)

In 1979, the World Meteorological Organization (WMO) held the first World Climate Conference to address the question of anthropogenic climate change; 350 specialists from 53 countries and 24 international organizations attended. Robert White served as the chair, as scientists from a wide range of disciplines including agriculture, water resources, fisheries, energy, environment, ecology, biology, medicine, sociology and economics gathered in Geneva for the world’s first international conference on “climate and mankind.”¹⁷⁵ The conference report called on the nations of the world to “foresee and prevent potential man-made changes in climate that might be adverse to the well-being of humanity.” Following this meeting, the World Meteorological Organization (WMO) established the World Climate Programme, an umbrella for scientific and educational activities, recognizing the “all-pervading influence of climate on society.”¹⁷⁶

¹⁷³ Robert M. White, “Oceans and Climate: An Introduction,” *Oceanus* (1978).

¹⁷⁴ Stephen Schneider, “On the Carbon Dioxide-Climate Confusion,” *Journal of Atmospheric Sciences* 32, 11 (1975): 2060-2066; Syukuro “Suki” Manabe and R. T. Wetherald, “The Effects of Doubling the CO₂ Concentration on the climate of a General Circulation Model,” *J. Atmos. Sci.*, 32, 3–15.

¹⁷⁵ John W. Zillman, “A History of Climate Activities,” World Meteorological Organization, October 1, 2009, <https://wmo.int/media/magazine-article/history-of-climate-activities>; White, R.M., 1979: The World Climate Conference: Report by the Conference Chairman. *WMO Bulletin*, 28, 3, 177-178.

¹⁷⁶ Zillman, “A History of Climate Activities.”

The WMO acknowledged that the causes of climate change were diverse, but one stood out as particularly concerning: “the burning of fossil fuels, deforestation, and changes in land use [that] have increased the amount of carbon dioxide in the atmosphere.”¹⁷⁷ It was likely that further increases would contribute to a gradual warming of the planet as a whole, which would in turn affect the distribution of temperature and precipitation. The scientists called on world governments to increase efforts to collect high-quality climate data and to support research to better understand climate change and its impacts.

Meanwhile in the United States, the US Department of Energy had asked the JASONS—the reclusive group of scientific advisers established in the early 1960s to advise on scientific questions relevant to national security—to consider the long-term impact of atmospheric carbon dioxide on climate. The study was led by Gordon MacDonald, a geophysicist and former of the Council on Environmental Quality (CEQ) under President Richard Nixon. The panel concluded that at current rates of fossil-fuel use, atmospheric carbon dioxide was likely to double by 2035 and significantly perturb the climate system. They also built two models, one numerical and one analytic, and both suggested that doubling atmospheric carbon dioxide would most likely produce a mean global temperature rise of 2–3° C.¹⁷⁸

These might seem like small numbers, but they were comparable to the “altithermal” period of four thousand to eight thousand years ago, when sea level rose dramatically around the globe, leading to the various cultural accounts of major floods and drowned civilizations that developed at that time. Such seemingly small changes could produce large social and economic impacts, including far more recently. “The Sahelian drought [1968] and the Soviet grain failure [1972],” they noted, “illustrate the fragility of the world’s crop producing capacity, particularly in those marginal areas where small alterations in temperature and precipitation can bring about major changes in total productivity.” Changes of this magnitude would “have significant demographic effect.”¹⁷⁹

¹⁷⁷ *Id.* at 2.

¹⁷⁸ Gordon MacDonald, *Long-Term Impacts of Atmospheric Carbon Dioxide on Climate* Technical Report, SRI International, 1979, at §§ I–III, <https://irp.fas.org/agency/dod/jason/co2.pdf>.

¹⁷⁹ *Id.* at 1–2.

Moreover, 2–3° C was the expected *average* change. It could be as high as 10–12° C warming at the poles, because of polar amplification: the feedback loop in which melting ice exposes bare land and water, which then absorbs more heat (because they are darker and less reflective than ice), which leads to more warming, and so on. Manabe had identified this effect in climate models, and the JASON committee agreed that it would occur. Changes on this scale were potentially disastrous: “Any change would produce stress and possibly disaster in some parts of the world since so many aspects of society have adapted, with very large investments in their infra-structures, to the [present] climate.”¹⁸⁰

The JASON report reached the White House, where President Carter’s science adviser Frank Press asked the National Academy of Sciences, on behalf of the White House Office of Science and Technology Policy, for a second opinion. The academy, through its National Research Council, enlisted renowned MIT meteorologist Jule Charney to lead a committee to study the issue further.

Unlike the JASON report, the Charney report, “Carbon Dioxide and Climate: A Scientific Assessment,” was freely available to the public. It affirmed that carbon dioxide was rising, that it would almost certainly continue to rise, and that this would in time have significant physical, social, and economic impacts. The scientists stated clearly that the chemistry of the atmosphere was changing because of human activities, particularly the use of fossil fuels, and that these changes would manifest themselves in part through changes in the climate. The report made clear that there was, by this time, a scientific consensus that increasing atmospheric CO₂—from burning fossil fuels and deforestation, would change the climate, if it was not already doing so. In the foreword, oceanographer Verner Suomi wrote:

For more than a century, we have been aware that changes in the composition of the atmosphere could affect its ability to trap the sun's energy We now have incontrovertible evidence that the atmosphere is indeed changing and that we ourselves contribute to that change. Atmospheric concentrations of carbon dioxide are steadily increasing, and these changes are linked with man's use of fossil fuels and exploitation of the land. Since carbon dioxide plays a significant role in the heat budget of the atmosphere, it is reasonable to suppose that continued increases would affect climate. These concerns have prompted a number of investigations of the implications of increasing carbon dioxide. *Their consensus has been that increasing carbon dioxide will lead to a warmer earth with a different distribution of climatic regimes.*¹⁸¹

¹⁸⁰ *Id.* at 25.

¹⁸¹ Charney (NAS), “Carbon Dioxide and Climate” (1979), *supra* 3, at vii (italics added.)

Suomi continued:

If carbon dioxide continues to increase, the study group finds no reason to doubt that climate changes will result and no reason to believe that these changes will be negligible. *The conclusions of prior studies have been generally reaffirmed.*¹⁸²

In other words, scientists had reached a consensus that planetary climate change, from increased atmospheric CO₂ from burning fossil fuels and land use changes, would occur.

Suomi highlighted one complication, which was either good news or bad depending on how one looked at it. On the one hand, “the ocean, the great and ponderous flywheel of the global climate system, may be expected to slow the course of observable climatic change.” That was the good news. The bad news was that by the time the warming was observed, a great deal of heat would have already been absorbed by the ocean, and that warming would be essentially irreversible. Therefore, he concluded, “A wait-and-see policy may mean waiting until it is too late.”¹⁸³

The body of the report was consistent with Suomi’s summary. Following existing scientific practices, the study group simplified the problem modelling the equilibrium effect of doubling CO₂ and, like earlier studies, found that it would produce global warming of 2–3.5° C, with a probable error of 1.5° C (so the actual value could be as low as 0.5° C or as high as 5° C). Again, following precedent, they considered only “the direct climatic effects of steadily rising atmospheric concentrations of CO₂... lead[ing] to a doubling of airborne concentrations by some time in the first half of the twenty-first century.”¹⁸⁴

Most of the known feedback mechanisms, or indirect effects, involved in the climate system—such as atmospheric moisture—generally had the effect of making the warming worse. The known “negative feedbacks,” that is to say, factors that might lessen the warming, they explained, could reduce the warming, but “they do not appear to be so strong as the positive moisture” that would increase the warming. The

¹⁸² *Id.* at viii (emphasis added).

¹⁸³ *Id.* at vii.

¹⁸⁴ *Id.* at 1.

most important negative feedback was ocean heat absorption, particularly if a large amount of heat was transferred to the deep ocean. The scientists felt this effect had likely been seriously under-estimated; if this was so, then warming would proceed at a slower rate than otherwise assumed, perhaps for decades. But, as Suomi had noted, this was not necessarily good.

This delay implies that the actual warming at any given time will be appreciably less than that calculated on the assumption that thermal equilibrium is reached quickly. One consequence may be that perceptible temperature changes may not become apparent nearly so soon as has been anticipated. We may not be given a warning until the CO₂ loading is such that appreciable climate change is inevitable. The equilibrium warming will eventually occur; it will merely have been postponed. In other words, the ocean's heat absorption might create the false impression that less warming was occurring than was in fact the case.

Many aspects of the problem, they noted, such as changing patterns in the world economy, were problems for social scientists, and so they did not address them. They did, however, try to address the uncertainties in the natural science, which they concluded could affect the rate of warming, but did not alter the overall finding that sooner or later, global warming would occur, and its socioeconomic consequences were likely to be "significant." It was also significant, they noted, that the uncertainties in the physical science did not alter the central finding, that "none of the model calculations predicts negligible warming."¹⁸⁵

The planetary changes that could be expected from warming of 1.5–3° C included changes in rainfall, evaporation, and soil moisture, and the magnitude of the changes "with latitude, longitude, and season will be at least as great as the globally averaged change." In other words, they would not be negligible. The report summary concluded:

To summarize, we have tried but have been unable to find any overlooked or underestimated physical effects that could reduce the currently estimated global warmings due to a doubling of atmospheric CO₂ to negligible proportions or reverse them altogether. However, we believe it quite possible that the capacity of the intermediate waters of the oceans to absorb heat could delay the estimated warming by several decades. It appears that the warming will eventually occur, and the

¹⁸⁵ *Id.* at 1.

associated regional climate changes so important to the assessment of socioeconomic consequences may well be significant, but unfortunately the latter cannot yet be adequately projected.¹⁸⁶

There were uncertainties, but none led to the conclusion that warming would not occur.

The Charney Report was covered by *Science* under the headline *CO₂ in Climate: Doomsday Predictions Have No Faults*.¹⁸⁷ According to a 2009 report in *Le Monde*, and a 2018 article in the *New York Times*, the report circulated widely in scientific and business circles.¹⁸⁸ In the 2018 *New York Times* article, reporter Nathaniel Rich described the Charney Report as a document which “would come to have the authority of settled fact” for both “the scientific community and the oil-and-gas-industry.”¹⁸⁹ As a result of the report, he concluded, Exxon created its own CO₂ research program. I have been unable to confirm this claim. However, an Exxon document prepared in 1982, “CO₂ Greenhouse Effect,” explicitly refers to the Charney report, and its discussion of ocean heat uptake. The Exxon document also notes that “some scientists suggest that there could be considerable adverse impact, including the flooding of some coastal land masses as a result of sea level rise...”¹⁹⁰ While the Exxon document was not in the public domain, its discussion of the Charney report underscores the fact that the report itself was in the public domain, salient to fossil companies’ core concerns, and at least one major oil and gas company was discussing its implications.

In 1979, the same year as the release of the Charney report, the First World Climate Conference was held in Geneva, Switzerland, sponsored by the World Meteorological Organization (WMO), the United Nations Environment Programme (UNEP), and the International Council of Scientific Unions (ICSU). The

¹⁸⁶ *Id.* at 3.

¹⁸⁷ Alice Bell, “Sixty Years of Climate Change Warnings: The Signs That Were Missed (and Ignored),” *The Guardian*, July 5, 2021, sec. Science, <https://www.theguardian.com/science/2021/jul/05/sixty-years-of-climate-change-warnings-the-signs-that-were-missed-and-ignored>.

¹⁸⁸ Stéphane Foucart, “Dès 1979, le rapport Charney annonçait le réchauffement climatique,” December 28, 2009, https://www.lemonde.fr/planete/article/2009/12/28/des-1979-le-rapport-charney-annoncait-le-rechauffement-climatique_1285427_3244.html; Nathaniel Rich, “Losing Earth: The Decade We Almost Stopped Climate Change,” *The New York Times*, August 1, 2018, sec. Magazine, <https://www.nytimes.com/interactive/2018/08/01/magazine/climate-change-losing-earth.html>.

¹⁸⁹ *Ibid.*

¹⁹⁰ “Exxon Primer on CO₂ ‘Greenhouse’ Effect,” 1982, <https://insideclimatenews.org/wp-content/uploads/2015/09/1982-Exxon-Primer-on-CO2-Greenhouse-Effect.pdf>. While highlighting the ocean heat uptake uncertainties, the Exxon report also states that “if the earth is on a warming trend, we’re not likely to detect it before 1995.” But that date was only 13 years away!

conveners called on governments around the world "to foresee and prevent potential man-made changes in climate that might be adverse to the well-being of humanity."¹⁹¹

In 1985, the WMO, together with UNEP and the International Council of Scientific Unions, convened in Villach, Austria for what in retrospect could be considered the first international scientific assessment of the climate impact of GHG. The report of this meeting predicted that, unless steps were taken to control GHG emissions, rising global temperatures would yield a wide range of adverse social, political and economic impacts.

The conference also recommended that a standing committee be formed to review evolving science; this committee, the Advisory Group on Greenhouse Gases, was formed in 1986 as a joint venture of International Council of Scientific Unions, UNEP, and the WMO.¹⁹² In 1988, this group would form the core of the newly created Intergovernmental Panel on Climate Change (IPCC).

Meanwhile, media attention increased. For example, in 1982, Roger Revelle had summarized the issue in the popular magazine, *Scientific American*. The carbon dioxide question was really a set of questions, he argued. One was how much carbon dioxide would be added to the atmosphere in the coming years. This was a question of human activity, primarily clearing forests and burning fossil fuels; there was little reason to suspect that those activities would end any time soon. A second was whether this increase would change the global climate; the consensus of scientific opinion was that it would. The third was whether changes were already occurring. This, he argued, was the question of the hour: "Mathematical models of the world's climate indicate that the answer is probably yes, but an unambiguous climate signal has not yet been detected."¹⁹³

¹⁹¹ Intergovernmental Panel on Climate Change, "16 Years of Scientific Assessment in Support of the Climate Convention," December 2004, <https://www.ipcc.ch/site/assets/uploads/2019/03/16th-anniversary-brochure.pdf>.

¹⁹² Thomas D. Potter (Winter 1986). "Advisory Group on Greenhouse Gases Established Jointly by WMO, UNEP, and ICSU." *Environmental Conservation*. 13 (4): 365. [doi:10.1017/S0376892900035505](https://doi.org/10.1017/S0376892900035505). [S2CID 84551617](https://www.scribd.com/document/84551617); David Kemp (October 1994). "Global Environmental Issues: A Climatological Approach." [ISBN 041510310X](https://www.amazon.com/dp/041510310X). To ensure the follow-up of the recommendations of that conference, an Advisory Group on Greenhouse Gases (AGGG) was established; T. Skodvin (October 2000). *Structure and Agent in the Scientific Diplomacy of Climate Change*. Springer. [ISBN 0792366379](https://www.amazon.com/dp/0792366379). Each of these bodies nominated two experts. The panel consisted of seven members.

¹⁹³ Roger Revelle. 1982. "Carbon Dioxide and World Climate." *Scientific American* 247 (2):35–43, 33.

L. Specific Knowledge Within the Shell Corporation

The scientific work described in previous sections did not necessarily receive widespread media or public attention, but the historical evidence nevertheless shows that the fossil fuel industry in general, and Shell in particular, were aware of these developments in scientific understanding. For example:

In 1989, Royal Dutch Shell developed its own confidential scenarios describing possible global warming futures. In one scenario, called “sustainable world,” greenhouse gas emissions would peak around the year 2000 and decline rapidly thereafter, with total CO₂ in the atmosphere limited to four hundred ppm. In another scenario, “global mercantilism,” emissions would continue to rise with dire outcomes, including “more violent weather—more storms, more droughts, more deluges. Mean sea level would rise at least 30 cm. Agricultural patterns would be most dramatically changed. Something as simple as a moderate change in rainfall pattern disrupts eco-systems, and many species of trees, plants, animals, and insects would not be able to move and adapt.”¹⁹⁴

The Shell report stressed that the anticipated changes would have major impacts on human systems, particularly because of sea level rise, and because it would not be easy or cheap to alter the built environment. The report explained: “In earlier times, man was able to respond with his feet. Today, there is no place to go because people already stand there. Perhaps those in industrial countries could cope with a rise in sea level (the Dutch example) but for poor countries such defenses are not possible... The potential refugee problem in global mercantilism could be unprecedented. Africans would push into Europe, Chinese into the Soviet Union, Latins into the United States, Indonesians into Australia. Boundaries would count for little—overwhelmed by the numbers. Conflicts would abound. Civilization could prove a fragile thing.” This report shows that Shell understood that preventing serious, if not catastrophic, impacts would require an immediate rapid transition from fossil fuels to other forms of energy. That same year, Shell Oil announced that it was raising a natural gas platform in the North Sea to account for rising sea levels. This demonstrates that Shell not only understood the problem conceptually, but in some contexts was taking action to address it.¹⁹⁵

¹⁹⁴ Royal Dutch Shell, Scenarios: 1989–2010; Challenge and Response (London: Shell Confidential Group Planning, Oct. 1989), 36, <https://s3.documentcloud.org/documents/23735737/1989-oct-confidential-shell-group-planning-scenarios-1989-2010-challenge-and-response-disc-climate-refugees-and-shift-to-non-fossil-fuels.pdf>; see Chapter 2 (“How the most important fact of global warming has been obscure”) at 19, in Franta, *Ignorance Unmasked*, *supra* 157.

¹⁹⁵ “Smoke and Fumes: The Legal and Evidentiary Basis for Holding Big Oil Accountable for the Climate Crisis (Nov 2017) - Center for International Environmental Law,” accessed March 10, 2025, <https://www.ciel.org/reports/smoke-and-fumes/>.

Internal Shell documents reveal the company not only knew about the effect of carbon dioxide on the warming of the planet but was evaluating what its response should be. One internal document, entitled “The Greenhouse Effect,” produced by the “Greenhouse Effect Working Group” for the “Shell Environmental Conservation Committee” in 1988, makes clear that the Shell employees involved in this working group are fully aware of the scientific evidence and concerns.

Among other things, they discuss the 1983 NRC report, *Changing Climate*, which built onto and amplified the Charney report.¹⁹⁶ The 1983 report was longer than the 1979 report, and presented a wider range of views on the severity of potential future warming. However, the Shell report does not downplay or disparage the emerging scientific consensus. On the contrary, the report summary clearly and accurately explains the state of the science:¹⁹⁷

Man-made carbon dioxide, released into and accumulated in the atmosphere, is believed to warm the earth through the so-called greenhouse effect. The gas acts like the transparent walls of a greenhouse and traps heat in the atmosphere that would normally be radiated back into space. Mainly due to fossil fuel burning and deforestation, the atmospheric CO₂ concentration has increased some 15% in the present century to a level of about 340 ppm. If this trend continues, the concentration will be doubled by the third quarter of the next century. The most sophisticated geophysical computer models predict that such a doubling could increase the global mean temperature by 1.3-3.3°C. The release of other (trace) gases, notably chlorofluorocarbons, methane, ozone and nitrous oxide, which have the same effect, may amplify the warming by predicted factors ranging from 1.5 to 3.5°C.

Mathematical models of the earth's climate indicate that if this warming occurs then it could create significant changes in sea level, ocean currents, precipitation patterns, regional temperature and weather. These changes could be larger than any that have occurred over the last 12,000 years. Such relatively fast and dramatic changes would impact on the human environment, future living standards and food supplies, and could have major social, economic and political consequences.

The discussion includes quantitative specificity, and, while highlighting the scientific uncertainty as to specific details, the authors accept that CO₂ will cause warming, and that the main source of atmospheric

¹⁹⁶ National Research Council, et al., *Changing Climate: Report of the Carbon Dioxide Assessment Committee* (Washington, D.C.: National Academies Press, 1983), <https://doi.org/10.17226/18714>. This report presented conflicting views on the severity of the threat, with the Panel Chair, Bill Nierenberg, taking the view that the Charney report had overstated the threat. Others on the panel, however, including George Woodwell and Roger Revelle, disagreed. See Oreskes and Conway, *Merchants of Doubt*, Chapter 6.

¹⁹⁷ SOPUS_NHVN02463863.

CO₂ is fossil fuel combustion:

Mainly due to fossil fuel burning and deforestation, the atmospheric CO₂ concentration has increased some 15% in the present century to a level of about 340 ppm. If this trend continues, the concentration will be doubled by the third quarter of the next century ... Such relatively fast and dramatic changes would impact on the human environment, future living standards and food supplies, and could have major social, economic and political consequences ... There is reasonable scientific agreement that increased levels of greenhouse gases would cause a global warming. However, there is no consensus about the degree of warming and no very good understanding what the specific effects of warming might be. But as long as man continues to release greenhouse gases into the atmosphere, participation in such a global “experiment” is guaranteed ... With fossil fuel combustion being the major source of CO₂ in the atmosphere, a forward looking approach by the energy industry is clearly desirable, seeking to play its part with governments and others in the development of appropriate measures to tackle the problem.”¹⁹⁸

This 1988 Shell report makes clear that the authors understand that the threat of planetary warming, caused by fossil fuels, could have a major impact on future demand for fossil fuels.¹⁹⁹ For example, they write:

...it is possible that perception of a serious environmental threat could swing opinion away from fossil fuel combustion and lead to a revival of interest in conservation, renewable sources and particularly in nuclear energy ...²⁰⁰ “An overall reduction in fossil fuel use would of course reduce CO₂ production and could be achieved by constraint on energy consumption, by improved thermal efficiency and by replacing fossil fuels with e.g. nuclear power. But such a course of action would imply a major shift in world energy supply and use...”²⁰¹

The report included specific discussion of sea level rise, including the prospect that “more than 30% of the world’s population,” could be impacted, and that low lying areas, such as Bangladesh, as well as shallow seas, lagoons, bays and estuaries, could become permanently inundated, and, in the case of Bangladesh, “might have to be abandoned...”²⁰²

Sea level rise would also have operational consequences, particularly in Shell’s coastal and offshore installations:²⁰³

¹⁹⁸ Ibid.

¹⁹⁹ SOPUS_NHVN02463869.

²⁰⁰ SOPUS_NHVN02463861 at -881.

²⁰¹ *Id.* at -890.

²⁰² *Id.* at -888.

²⁰³ *Id.* at -889.

Direct operational consequences can be expected from a rising sea level, impacting offshore installations, coastal facilities and operations (e.g. platforms, harbours, refineries, depots) with an uncertain magnitude. Costs of defending against a sea level rise will depend on the local situation (levels of security demanded for contingencies like extreme ocean storms, flooding, etc.) and national policies to compensate industry for the extra costs incurred.

The authors also acknowledged that the potentially long-time scale for warming to occur should not be taken as cause for delay or inaction:

It is estimated that any climatic change relatable to CO₂ would not be detectable before the end of the century. With the very long time scale involved, it would be tempting for society to wait until then before doing anything. The potential implications for the world are, however, so large that policy options need to be *considered much earlier*. And the energy industry need to consider how it should play its part.²⁰⁴

What would the responsibility of Shell and other companies be?

The energy industry will clearly need to work out the part it should play in the development of policies and programmes to tackle the whole problem. It will not be appropriate to take the main burden, for the issues are ones that ultimately only governments can tackle, and users have an important role. But it has very strong interests at stake and much expertise to contribute, particularly on energy supply and usage. It also has its own reputation to consider, there being much potential for public anxiety and pressure group activity.²⁰⁵

Three years later, in 1991, Royal Dutch Shell produced “Climate of Concern,” a documentary film detailing the effects of anthropogenic climate change on the world. “Our planet is changing,” the narrator says. “Some of these changes are natural, but other may be the result of human activity.”²⁰⁶ The narrator continues: “The greenhouse effect is essential to life on Earth. Without it, the planet would be too cold to support us. But now, by burning fossil fuels and adding carbon dioxide to the atmosphere, we may be enhancing this natural process and causing global warming.”²⁰⁷

The narrator explains that CO₂ and other GHGs have been accumulating in the atmosphere. “Has this started to make the Earth warmer?” he asks. The film then shifts to scientists discussing the evidence and showing the results that reveal a “small but significant warming trend.” This could be due to natural

²⁰⁴ SOPUS_NHVN02463868 (emphasis added).

²⁰⁵ SOPUS_NHVN02463890.

²⁰⁶ *Climate of Concern - Royal Dutch Shell*, 1991, <https://www.youtube.com/watch?v=0VOWi8oVXmo>.

²⁰⁷ Ibid.

variability, the narrator explains, but it was consistent with what the climate models predicted. More concerning was not the warming that had happened to date, but the warming that could happen by 2050—at least a degree and a half, maybe as much as four degrees.²⁰⁸ The film is explicit about the connection between climate change and fossil fuel combustion. It presents graphs showing rising atmospheric CO₂ if fossil fuels continue to be used. The graphs also model temperature increases and sea level rise. The solutions, the narrator says, are to switch to “cleaner sources of energy,” and invest in “renewables like solar and wind.”²⁰⁹

In the later 1980s, Shell established an initiative called the Shell TINA_Group Scenarios 1998-2020.²¹⁰ The 1998 report authors described the project as a “collection of initiatives and developments within the Shell Group that are designed to help us position ourselves to shape and meet the challenges and opportunities of the future ...”²¹¹ Echoing British Prime Minister Margaret Thatcher, TINA stood for “There is no alternative,” but the document in fact outlines a variety of potential futures regarding energy, climate change, politics, and even the risk of legal action against the fossil fuel industry.²¹² One scenario, called People Power, imagines broad outrage against the fossil fuel industry:

...although the EU ratifies the Kyoto agreements, the US does not. Angry about local pollution, congestion, and health issues, people target oil, coal, and car companies through increasingly more effective NGOs. Outrage spills over into boycotts and other actions against polluters, including the drivers of gas-guzzling cars. Corporations, under intense media scrutiny, are held to higher standards of social accountability.²¹³

Similarly, in a scenario called “The New Game”:

The courts deal with any firm found acting irresponsibly with its shareholders’ money or

²⁰⁸ Ibid.

²⁰⁹ Ibid.

²¹⁰ Shell, “Group Scenarios 1998-2020” (1998); see also Jenny Andersson, “Ghost in a Shell: The Scenario Tool and the World Making of Royal Dutch Shell,” *Business History Review* 94, no. 4 (December 2020): 729–51, <https://doi.org/10.1017/S0007680520000483>; Madison Condon, “Corporate Scenarios: Drawing Lessons from History,” SSRN Scholarly Paper (Rochester, NY: Social Science Research Network, December 12, 2024), <https://doi.org/10.2139/ssrn.5053413>.

²¹¹ Shell, “Group Scenarios 1998-2020” (1998), at 1.

²¹² Often interpreted to mean “There is no alternative to globalization and liberalization.” In the Shell context, see Angela Wilkinson and Roland Kupers. “The Essence of the Shell Art” in *The Essence of Scenarios: Learning from the Shell Experience*, at 105 (Amsterdam University Press, 2014). <https://doi.org/10.2307/j.ctt6wp7mz.9>.

²¹³ Shell TINA_Group Scenarios 1998-2020 (1998), at 20–21, <https://www.climatefiles.com/shell/1998-shell-internal-tina-group-scenarios-1998-2020-report/>.

selling new products that have not been tested to the highest standards. Companies become increasingly worried about the possibility that they may be exposing themselves to future liability...

While the public might view this as a good thing, the scenario paints it as a problem because “this fear slows down innovation and the introduction of new products.”²¹⁴

With prescience, the scenario accurately predicts that the US would fail to ratify the Kyoto protocol to the UN Framework Convention on Climate Change (UNFCCC), which would lead to unfolding climate impacts. Meanwhile “two successive IPCC reports since 1995 have reinforced the human connection to climate change.” Then...

In 2010, a series of violent storms causes extensive damage to the eastern coast of the US.... Following the storms, a coalition of environmental NGOs brings a class-action suit against the US government and fossil-fuel companies on the grounds of neglecting what scientists (including their own) have been saying for years: that something must be done. A social reaction to the use of fossil fuels grows, ... in the same way, a generation earlier, they had become fiercely anti-tobacco. Direct-action campaigns against companies escalate. Young consumers, especially, demand action....²¹⁵

[C]ompanies are also subject to increasing pressure from legal actions. Even large companies can be brought down if their mistakes generate sufficient interest from class-action lawyers, who behave like piranhas when they sense blood in the water.”²¹⁶

The TINA document demonstrates that 1) Shell was aware of the state of the science; 2) that Shell was aware of its own role as a major source of the fossil fuels that led to atmospheric warming; 3) that people might in time become angry with the fossil fuel industry; and 4) that their own actions, and resulting storms with damage to the East Coast, could lead to lawsuits, such as the one for which this report has been prepared.

M. 1988: A Key Year for Both the Science and the Industry Response

The late 1980s witnessed a shift in the industry position from accepting the scientific evidence, as laid out by scientists in peer-reviewed publications and government testimony and reports, to challenging it.

²¹⁴ *Id.* at 39.

²¹⁵ *Id.* at 118.

²¹⁶ *Id.* at 127.

This shift corresponds to a shift in the scientific perspective, from presenting man-made climate change as a prediction to presenting it as a fact.

In their proposal for the 1979 Charney report, the National Academy of Sciences had stressed that “the close linkage between man’s welfare and the climatic regime within which his society has evolved suggests that such climatic changes would have profound impacts on human society.”²¹⁷ They also encapsulated the state of the science: “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.”²¹⁸ But an unresolved question was this: when would these changes occur? While there was a consensus that man-made climate change would occur—and that they would be largely adverse—there was not as yet consensus on when. Many scientists at the time talked of effects becoming evident by the end of the century, but one person suggested that changes were perhaps already under way: meteorologist John Perry, the chief staff officer for the academy’s Climate Research Board. In an article in *Climatic Change*, he suggested that scientists might be underestimating the problem.

In their models and analyses, most scientists focused on doubling carbon dioxide, but Perry pointed out that this was just a convenient point of comparison. “Physically, a doubling of carbon dioxide is no magic threshold . . . If we have good reason to believe that a 100 percent increase in carbon dioxide will produce significant impacts on climate, then we must have equally good reason to suspect that even the small increase we have already produced may have subtly altered our climate,” he concluded. “Climate change is not a matter for the next century; we are most probably doing it right now.”²¹⁹

In June 1988, James E. Hansen, the director of the NASA Goddard Institute for Space Studies, confirmed that this was true. In testimony presented to the U.S. Senate, based on analyses undertaken at

²¹⁷ National Academy of Sciences, “An Evaluation of the Evidence for CO₂-Induced Climate Change,” 1979, Film label: CO₂ and Climate Change: Ad Hoc, National Academy of Sciences Archives, Washington, DC.

²¹⁸ Ibid.

²¹⁹ John S. Perry. 1981. “Energy and Climate: Today’s, Problem, Not Tomorrow’s.” *Climatic Change* 3 (3): 223–25, 228 <https://doi.org/10.1007/bf02423215>.

NASA and published in a peer-reviewed journal, he stated that he and his team were 99% certain that man-made climate change was now underway and could be differentiated from natural variability.²²⁰

Hansen's testimony was widely reported in the mass media, including on the front page of the *New York Times* under the headline "Global Warming Has Begun, Expert Tells Senate."²²¹

The *Times*' distinguished science writer, John Noble Wilford, characterized the testimony as transformative, quoting Environmental Defense Fund scientist Michael Oppenheimer saying that Hansen had added "an air of scientific respectability and immediacy to the environmental movement's longstanding warnings about the build-up of carbon dioxide in the atmosphere."²²²

That same year, the Intergovernmental Panel on Climate Change (IPCC) was assembled to advise governments what to do about the challenge of man-made climate change. As noted above, the IPCC was created as a joint venture between the WMO and the UNEP, based on the core group of scientists who had been brought together two years earlier as the Advisory Group on Greenhouse Gases. The new group brought together many of the world's leading climate scientists, including Swedish meteorologist Bert Bolin, who had played a major role in the understanding and regulation of the pollutants that caused acid precipitation,²²³ and British atmospheric chemist, Robert Watson, who had led work on the scientific basis for the Montreal Protocol to protect stratospheric ozone.²²⁴ Its task, as articulated in UN General Assembly Resolution 43/53, was to prepare a comprehensive review of the science of climate change, its likely social

²²⁰ J. Hansen et al., "Global Climate Changes as Forecast by Goddard Institute for Space Studies Three-Dimensional Model," *Journal of Geophysical Research: Atmospheres* 93, no. D8 (1988): 9341–64, <https://doi.org/10.1029/JD093iD08p09341>; "Statement of Dr. James E. Hansen, Head of NASA Goddard Institute for Space Studies before the Committee on Energy and Natural Resources of the United States Senate," Pulitzer Center, 1988, https://www.pulitzercenter.org/sites/default/files/june_23_1988_senate_hearing_1.pdf.

²²¹ Philip Shabecoff and Special To the New York Times, "Global Warming Has Begun, Expert Tells Senate," *The New York Times*, June 24, 1988, sec. U.S., <https://www.nytimes.com/1988/06/24/us/global-warming-has-begun-expert-tells-senate.html>.

²²² John Noble Wilford. 1988. "His Bold Statement Transforms the Debate on Greenhouse Effect." *The New York Times*, August 23, 1988. <https://www.nytimes.com/1988/08/23/science/his-bold-statement-transforms-the-debate-on-greenhouse-effect.html>.

²²³ Bob Watson, "Bert Bolin (1925–2008)," *Nature* 451, no. 7179 (February 2008): 642–642, <https://doi.org/10.1038/451642a>.

²²⁴ "Robert Watson - Tyndall Centre for Climate Change Research," accessed April 8, 2025, <https://tyndall.ac.uk/people/robert-watson/>; see also Michael Oppenheimer et al., *Discerning Experts: The Practices of Scientific Assessment for Environmental Policy* (Chicago, IL: University of Chicago Press, 2019), <https://press.uchicago.edu/ucp/books/book/chicago/D/bo33765378.html>.

and economic impact of climate change, and suggest “potential response strategies and elements for inclusion in a possible future international convention on climate.”²²⁵

The fact that the IPCC was created as a joint venture between a scientific organization—the World Meteorological Organization—and a political one—the United Nations—underscores the fact that scientists had already for some time recognized the potential severity of this challenge, and had communicated it to political leaders, who were starting to respond. The fact that the original task included suggesting “potential response strategies” shows that the UN understood that response strategies were warranted and was asking the scientific experts to make recommendations based on their understanding of the problem.

The “future meeting” referred to in the General Assembly resolution was the 1992 Earth Summit in Rio de Janeiro, where U.S. President George H.W. Bush signed the United Nations Framework Convention on Climate Change (UNFCCC), which committed its nearly 200 signatories to global action to prevent “dangerous anthropogenic interference” with the climate system and keep warming temperatures below 2° C. In signing this convention, President Bush promised to translate the promises made in Rio “into concrete action to protect the planet.”²²⁶ Nine years later, President George W. Bush awarded the National Medal of Science to University of California geochemist Charles David Keeling for the CO₂ measurements that by this time bore his name: the Keeling Curve.²²⁷

In the summary of their first report, issued in 1990, the IPCC stated that they were “certain” that the natural greenhouse effect makes the planet warmer than it would otherwise be, and that emissions from human activities—including carbon dioxide, methane, chlorofluorocarbons (CFCs) and nitrous oxide—were “substantially increasing the atmospheric concentrations of the greenhouse gases.” They were also

²²⁵ “History — IPCC,” IPCC, <https://web.archive.org/web/20250317083143/https://www.ipcc.ch/about/history/>.

²²⁶ The Associated Press, “THE EARTH SUMMIT; Excerpts From Speech By Bush on ‘Action Plan,’” *The New York Times*, June 13, 1992, sec. World, <https://www.nytimes.com/1992/06/13/world/the-earth-summit-excerpts-from-speech-by-bush-on-action-plan.html>.

²²⁷ “NMS Recipient Charles D. Keeling,” US National Science Foundation, <https://www.nsf.gov/honorary-awards/national-medal-science/recipients/charles-d-keeling>.

certain that these “increases will enhance the greenhouse effect, resulting on average in an additional warming of the Earth's surface.”²²⁸ And it was “their judgment” that the Earth’s planet had already heated “by 0.3° C to 0.6° C over the last 100 years, with the five global average warmest years being in the 1980s. Over the same period global sea level has increased by 10- 20 cm.”

However, the scientists at the IPCC were not yet prepared to conclude that the observed warming was definitely caused by the increase in atmospheric GHG concentrations, because, while the “size of this warming is broadly consistent with predictions of climate models, ... it is also of the same magnitude as natural climate variability. Thus, the observed increase could be largely due to this natural variability; alternatively, this variability and other human factors could have offset a still larger human-induced greenhouse warming. The unequivocal detection of the enhanced greenhouse effect from observations is not likely for a decade or more.”²²⁹ Despite this uncertainty over whether the human signal could yet be differentiated from the noise, they nevertheless predicted that:

...under the IPCC Business-as-Usual (Scenario A) emissions of greenhouse gases, a rate of increase of global-mean temperature during the next century of about 0.3°C per decade (with an uncertainty range of 0.2°C to 0.5°C per decade); this is greater than that seen over the past 10,000 years. This will result in a likely increase in global-mean temperature of about 1°C above the present value by 2025 and 3°C before the end of the next century.

This change would lead to sea-level rise:

...under the IPCC Business-as-Usual emissions scenario, an average rate of global mean sea-level rise of about 6 cm per decade over the next century (with an uncertainty range of 3—10 cm per decade), mainly due to thermal expansion of the oceans and the melting of some land ice. The predicted rise is about 20 cm in global-mean sea level by 2030, and 65 cm by the end of the next century.²³⁰

They also stated, “with confidence,” that “long-lived [greenhouse] gases would require immediate reductions in emissions from human activities of over 60% to stabilize their concentrations at today's levels; methane would require a 15-20% reduction.”

²²⁸ “IPCC Policymaker Summary of Working Group I (Scientific Assessment of Climate Change),” IPCC, 1990, https://www.ipcc.ch/site/assets/uploads/2018/05/ipcc_90_92_assessments_far_wg_I_spm.pdf.

²²⁹ Ibid.

²³⁰ Ibid.

Although the IPCC in 1990 was not yet prepared to affirm Hansen's conclusion that man-made warming was underway, they predicted that man-made warming would be underway soon, it would increase the planetary temperature by 1° C by 2025, and solving the problem would require immediate and substantive reductions in GHG emissions. In a pattern that would repeat, the IPCC would soon conclude that it had under-estimated the rate at which warming would occur. In its Second Assessment Report (AR2), issued just five years later (in 1995), the IPCC concluded that man-made climate change was indeed underway and could be differentiated from natural variability. In AR2, the IPCC stated that "the balance of evidence suggests a discernible human influence on global climate."²³¹

Sea level rise was a particular focus on both of these reports, in part because it was one of the potentially most serious of consequences, and because it was one of the most certain of likely impacts: the basic physics of thermal expansion of sea water and melting of continental ice were not disputed. Both the first and second assessment reports addressed sea level rise as an expected consequence of global warming. The First Assessment Report's (AR1) Working Group I included an entire chapter, Chapter 9, on "Sea Level Rise."²³² AR1 projected about 20 cm of global mean sea-level rise by 2030 and ~65 cm by 2100 under a business-as-usual scenario, mainly due to thermal expansion of the oceans and melting land ice.

The Second Assessment Report's Working Group I also had a dedicated chapter on the issue: Chapter 7: "Changes in Sea Level." This chapter updated sea-level observations and projections, predicting ~50 cm of rise from 1990 to 2100 under a mid-range (or business-as-usual) emissions scenario.²³³ This was an "average" expected level; it could be significantly higher. They explained:

Average sea level is expected to rise as a result of thermal expansion of the oceans and melting of glaciers and ice-sheets. ... [M]odels project an increase in sea level of about 50 cm from the present to 2100. ... The corresponding projection for the highest emission scenario (IS92e) combined with "high" climate and ice-melt sensitivities gives a sea-level rise of about 95 cm from the present to 2100. Sea level would continue to

²³¹ "IPCC Second Assessment: Climate Change 1995. A Report of the Intergovernmental Panel on Climate Change," IPCC, 1995, <https://www.ipcc.ch/site/assets/uploads/2018/05/2nd-assessment-en-1.pdf>.

²³² R. Warrick and J. Oerlemans, "'Sea Level Rise' in IPCC First Assessment Report's Working Group I," IPCC, 1990, https://www.ipcc.ch/site/assets/uploads/2018/03/ipcc_far_wg_I_chapter_09.pdf.

²³³ "Climate Change 1995: The Science of Climate Change. Contribution of Working Group I to the Second Assessment Report of the Intergovernmental Panel on Climate Change," IPCC, 1995, https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_sar_wg_I_full_report.pdf.

rise at a similar rate in future centuries beyond 2100, even if concentrations of greenhouse gases were stabilized by that time, and would continue to do so even beyond the time of stabilization of global mean temperature.²³⁴

In sum: in 1995, the expert consensus moved beyond the Charney report's conclusion that global warming *would* occur, to Hansen's team's conclusion that it was, now, occurring. The IPCC affirmed that the expert consensus was now consistent with Hansen's conclusions: that man-made global warming was underway, that it could be differentiated from natural variability, and that it would likely have major impacts, chief among which was sea level rise, which in turn would lead to diverse problems related to coastal erosion, coastal flooding, and increased storm surge. And Shell acknowledged this in both internal and public facing communications.

N. Scientific Developments Since 2000

1. Role of NAS and Affirmation of IPCC Findings

The U.S National Academy of Sciences is America's most prestigious scientific society.²³⁵ Membership is by election only, and no more than 120 new members may be admitted in any year.²³⁶ In 2001, the IPCC conclusion was re-affirmed in the U.S. National Academy of Sciences report, *Climate Change Science: An Analysis of Some Key Questions*, which begins "Greenhouse gases are accumulating in Earth's atmosphere as a result of human activities, causing surface air temperatures and subsurface ocean temperatures to rise."²³⁷ The report explicitly asks whether the IPCC assessment is a fair summary of professional scientific thinking, and answers yes: "The IPCC's conclusion that most of the observed warming of the last 50 years is likely to have been due to the increase in greenhouse gas concentrations accurately reflects the current thinking of the scientific community on this issue."²³⁸

²³⁴ "IPCC Second Assessment: Climate Change 1995. A Report of the Intergovernmental Panel on Climate Change," IPCC, 1995, <https://www.ipcc.ch/site/assets/uploads/2018/05/2nd-assessment-en-1.pdf>.

²³⁵ Frederick Seitz. "The National Academy of Sciences." *Journal of the Washington Academy of Sciences* 57, no. 2 (1967): 38–41. <http://www.jstor.org/stable/24535220>; "History - NAS," National Academy of Sciences, accessed April 8, 2025, <https://www.nasonline.org/about-the-nas/history/>.

²³⁶ "Membership Overview - NAS," <https://www.nasonline.org/membership/membership-overview/>.

²³⁷ National Academy of Sciences Committee on the Science of Climate Change, *Climate Change Science: An Analysis of Some Key Questions* (National Academy Press, Washington, DC, 2001), at 1.

²³⁸ National Academy of Sciences Committee on the Science of Climate Change, *Climate Change Science: An Analysis of Some Key Questions* (National Academy Press, Washington, DC, 2001), at 3.

Also in 2001, 17 national scientific academies from around the globe—including the UK, India, Australia, Canada—issued an unprecedented statement declaring that they endorsed the conclusions of the IPCC, and that substantive doubts were unwarranted:²³⁹

The work of the Intergovernmental Panel on Climate Change (IPCC) represents the consensus of the international scientific community on climate change science. We recognize the IPCC as the world's most reliable source of information on climate change and its causes, and we endorse its method of achieving this consensus. Despite increasing consensus on the science underpinning predictions of global climate change, doubts have been expressed recently about the need to mitigate the risks posed by global climate change. We do not consider such doubts justified...

[I]t is at least 90% certain that temperatures will continue to rise, with average global surface temperature projected to increase by between 1.4° and 5.8°C above 1990 levels by 2100. This increase will be accompanied by rising sea levels; more intense precipitation events in some countries and increased risk of drought in others; and adverse effects on agriculture, health, and water resources.

They further concluded that the science was sufficiently robust as to justify action:

The balance of the scientific evidence demands effective steps now to avert damaging changes to Earth's climate.

As time went on, additional IPCC assessments and special reports continued to confirm the risk of sea level rise. With each report the IPCC produced, the science supporting global warming and sea-level rise continued to strengthen, with the conclusions more grounded in measurements of actual increases. This did not necessarily mean that the IPCC concluded that there would be more warming, or higher levels of sea level rise, or that its estimates became more precise. On the contrary, in some cases the spread of estimates increased, as the IPCC scientists took seriously the various uncertainties, both in planetary warming itself, and its impacts on the cryosphere. However, in no case did the IPCC ever state or suggest that sea level rise would not occur or would not be a cause for concern.

²³⁹ A joint statement issued by the Australian Academy of Sciences, Royal Flemish Academy of Belgium for Sciences and the Arts, Brazilian Academy of Sciences, Royal Society of Canada, Caribbean Academy of Sciences, Chinese Academy of Sciences, French Academy of Sciences, German Academy of Natural Scientists Leopoldina, Indian National Science Academy, Indonesian Academy of Sciences, Royal Irish Academy, Accademia Nazionale dei Lincei (Italy), Academy of Sciences Malaysia, Academy Council of the Royal Society of New Zealand, Royal Swedish Academy of Sciences, Turkish Academy of Sciences, and Royal Society (UK), “The Science of Climate Change,” *Science* 292, no. 5520 (May 18, 2001): 1261–1261, <https://doi.org/10.1126/science.292.5520.1261>.

The 2001 Third Assessment Report's Working Group I devoted a chapter to "Changes in Sea Level," where the authors assessed contributions to sea-level change (citing thermal expansion and glaciers and ice sheets) using past trends and model projections. The report reported with high confidence that 20th-century-sea-level rise had accelerated and projected a rise of 0.09 m to 0.88 m by 2100, depending on emission scenarios.²⁴⁰ This same report concluded that the human influence on the climate system, from burning GHGs, and deforestation, was "unequivocal," a conclusion that was reaffirmed twenty years later in the 2021 Sixth Assessment Report.²⁴¹

By 2007, the IPCC report was discussing sea-level rise throughout multiple chapters. Working Group I predicted that sea level would rise 0.18-0.59 m by 2100. Working Group II also had a chapter devoted to coastal regions. Citing research from the early 2000s, the authors noted that "spatial variability of sea-level rise has become better defined" since the Third Assessment Report (AR3).²⁴²

2. Shell's Role in the 2010 IPCC Special Report on Emissions Scenarios

In 2010, the IPCC issued a Special Report on Emissions Scenarios. This is an important milestone, as its second lead author, Gerald Davis, was a former Shell employee, and the report drew on scenarios developed by Shell and shared with the IPCC.²⁴³

Davis had spent 30 years at Shell (he joined in 1972) and had served as Vice President of Global Business Environment at Shell International from 1999 to 2003 and its head of Scenarios, Strategy, and Business Development.²⁴⁴ After leaving the company, he served as a managing director at the World Economic Forum.²⁴⁵ A book published in 2014, "The Essence of Scenarios: Learning from the Shell

²⁴⁰ J.A. Church and J.M. Gregory, "'Changes in Sea Level' in IPCC Third Assessment Report Working Group I," IPCC, 2001, <https://www.ipcc.ch/site/assets/uploads/2018/03/TAR-11.pdf>.

²⁴¹ "Chapter 1: Framing, Context and Methods in IPCC Sixth Assessment Report," IPCC, 2021, <https://www.ipcc.ch/report/ar6/wg1/chapter/chapter-1/>.

²⁴² Christopher B. Field and Linda D. Mortsch, "'North America' in IPCC Fourth Assessment Report Working Group II," IPCC, 2007, <https://www.ipcc.ch/site/assets/uploads/2018/02/ar4-wg2-chapter14-1.pdf>.

²⁴³ "Emissions Scenarios — IPCC," IPCC, <https://web.archive.org/web/20250308214034/https://www.ipcc.ch/report/emissions-scenarios/>.

²⁴⁴ "Gerald (Ged) Davis | World Energy Council," World Energy <https://web.archive.org/web/20241108043843/https://www.worldenergy.org/about-us/our-people/entry/gerald-ged-davis>.

²⁴⁵ "40 Years of Shell Scenarios," Shell, 2013, https://www.shell.com/news-and-insights/scenarios/what-are-shell-scenarios/_jcr_content/root/main/section_509167378/promo/links/item0.stream/1652289755448/a0e75f042fee5322b72780ee36e5ba17c35a4fc6/shell-scenarios-40yearsbook080213.pdf.

Experience,” posed the question of how Shell had managed to be successful over more than 100 years, when during that time so many companies had seen a rise and fall.²⁴⁶ A key element of that success, they argued, was Shell’s use of scenarios. These strategies, developed since the 1970s, helped Shell to “make big decisions, and to develop long-term strategies and plans, without all the information they need, and without certainty that the desired outcomes will be achieved,” Peter Ho wrote in the preface.²⁴⁷ Uncertainty was not a reason for inaction. On the contrary, it was a reason to develop scenarios to explore options and anticipate outcomes.

The book summarizes how the scenario work was selectively shared with some governments, oil and gas companies, and the IPCC:

From the beginning through the 1990s, the scenarios were widely but not openly shared with select groups of outsiders, often at the highest level of governments and business. ... including Exxon and the US Federal Energy Agency... The 2005 Global Scenarios were the most widely disseminated of all the published scenarios, having been made available for purchase to the public.

This shift in public dissemination of the scenarios, however, should not be confused with the more discreet sharing of scenario-derived insights – for example, sharing the Iraq war scenarios Shell created with UK Prime Minister Tony Blair’s senior advisors, or the extended learning arena and relationship-building Shell has created in lending its in-house scenarios expertise to the IPCC, ... oil producer governments... and others.²⁴⁸

Climate change was an important subject of scenario development; and the book credits Shell with shifting the IPCC’s approach to climate modeling. “[T]his practice also helped inform the shift from the first generation of probabilistic, model-based scenarios developed by the Intergovernmental Panel on Climate Change towards the stories and simulation approach that characterizes the current generation of socio-economic scenarios.”²⁴⁹

²⁴⁶ The authors were Angela Wilkinson of the World Energy Council (<https://www.worldenergy.org/about-us/our-people/entry/angela-wilkinson/>) and Roland Kupers, a former Shell employee, energy consultant, and professor of Practice at Arizona State University (<https://www.rolandkupers.com/>). On the Shell scenarios, see “What are the previous Shell Scenarios?” Shell, <https://www.shell.com/news-and-insights/scenarios/what-are-the-previous-shell-scenarios.html>, which includes links to several of specific energy scenarios.

²⁴⁷ Peter Ho, Wilkinson and Kupers, “Preface by Peter Ho” in *The Essence of Scenarios*, *supra* note 213, at 9–12.

²⁴⁸ Wilkinson and Kupers, “The Essence of the Shell Art” in *The Essence of Scenarios*, *supra* note 213, at 105.

²⁴⁹ Wilkinson and Kupers, “A Unique Legacy” in *The Essence of Scenarios*, *supra* note 213, at 22.

The book also credits Shell with positioning natural gas as a cleaner fuel than oil, and confirms that it was in the late 1980s that Shell began to be concerned about climate change as a threat:

The organization and culture of Shell was very well adapted to the nationalistic sentiments and the rise in power of the National Oil Companies (NOCs) that characterized the oil business in the 1980s. These companies also began to invest in natural gas recovery when the commercial prospects for natural gas in high-efficiency power generation started to be realized. In the late 1980s, as concerns about climate change and greenhouse gas emissions began to emerge, natural gas was also positioned as the cleaner fossil fuel, compared to coal and oil...²⁵⁰

[T]he 1987 energy scenarios had included only a passing mention of climate change because many senior managers believed that the subject was irrelevant. Introducing the broader frame of sustainability allowed issues such as climate change to be less directly threatening.²⁵¹

The Shell scenarios not only helped to shape responses, but through those responses, to shape reality:

... the 2013 “New Lens” scenarios have included the uncomfortable statement that avoiding climate change impacts, such as a global temperature increase of less than 2° C, is implausible. This presents an awkward dilemma for the scenarist: on the one hand such a message from a fossil fuel company will carry weight as it touches the very core of the enterprise; on the other scepticism. The content of the scenarios are not merely statements about the future, but create an impact in the context of the present.²⁵²

Shell continued to build scenarios throughout the early 2000s. One set of scenarios, called Scramble and Blueprints, “contained a deeper and more comprehensive model of the world’s energy system,” and was released to the public in 2007.²⁵³ It presented “Three Hard Truths,” all related to energy.²⁵⁴ These truths were: 1) a steep change increase in global energy use, 2) supply struggles to keep pace, and 3) increasing environmental stresses.²⁵⁵

The “hard truths” were elaborated in a report released in 2011, with a foreword by Shell CEO Peter Voser. The third truth—increasing environmental stress—involved the acknowledgement that CO₂ emissions could become a constraint on fossil fuel use:

²⁵⁰ Wilkinson and Kupers, “Shell Scenarios – A History, 1965-2013” in *The Essence of Scenarios*, *supra* note 213, at 45.

²⁵¹ Wilkinson and Kupers, “The Essence of the Shell Art” in *The Essence of Scenarios*, *supra* note 213, at 83

²⁵² *Id.* at 83–84.

²⁵³ Wilkinson and Kupers, “Shell Scenarios – A History, 1965-2013” in *The Essence of Scenarios*, *supra* note 213, at 69.

²⁵⁴ *Id.* at 72.

²⁵⁵ “Signals & Signposts: Shell Energy Scenarios to 2050,” Shell, at 73, 2011, https://www.shell.com/news-and-insights/scenarios/what-are-the-previous-shell-scenarios/_jcr_content/root/main/section_745060082/promo_copy_717248746/links/item0.stream/1652289218851/787285b3524a8522519a5708558be86cd71a68b2/shell-scenarios-2050signalssignposts.pdf.

Even if it were possible for fossil fuels to maintain their current share of the energy mix and respond to increased demand, CO₂ emissions would then be on a pathway that could severely threaten human well-being. Even with the moderation of fossil fuel use and effective CO₂ management, the path forward is still highly challenging. Remaining within desirable levels of CO₂ concentration in the atmosphere will become increasingly difficult.²⁵⁶

The language of hard truths makes clear that these scenarios were not just factual, but also evaluative and normative, and that among the goals that Shell accepted in the early 2000s was the goal of stabilizing the planetary climate. One example of normative scenario practice is found in the 2012 Global Energy Assessment. Led by former Shell scenario head Davis and the lead author of the UNDP World Energy Assessment, Jose Goldenberg, it defines four goals that the scenarios will deliver, including, “stabilizing global climate change to 2° C above pre-industrial levels to be achieved in the 21st century.”²⁵⁷

Similarly, the 2013 scenario, *Mountains and Oceans*, addresses the inevitability of climate change impacts not as a matter of strategic preference, but as the conclusion of a combination of new analyses. First, developments in global climate change science suggested a lower ‘safe limit’ (closer to pre-industrial levels) than previously thought for avoiding irreversible and catastrophic climate change impacts. Second, developments in Shell’s in-house world energy model led to new insights about the inertia of the global energy system and the slower than previously expected process of technological transition.

Shell historian Keetie Sluyterman characterizes Shell as being more sensitive than some other companies to emerging topics such as climate change, the rise of China, or the boom in the development of the massive unconventional gas resources in the US.²⁵⁸ Whether or not this assessment is correct, the scenario development work demonstrates that Shell was both aware of and contributing to the evolving science. Already by the 1980s, Shell scenarios presented climate change as a serious threat, and by the 2010s, in at least one scenario, Shell employees acknowledged that climate change of at least 2° C was inevitable.

²⁵⁶ Ibid.

²⁵⁷ Wilkinson and Kupers, “Shell Scenarios – A History, 1965-2013” in *The Essence of Scenarios*, *supra* note 213, at 86 (italics added).

²⁵⁸ *Id.* at 89.

3. Further IPCC Reports on Climate Change and Sea Level Rise

In 2013, the IPCC's Fifth Assessment Report had a dedicated chapter, Chapter 13: "Sea Level Change." It concluded that global mean sea level rise *very likely* would accelerate in the 21st century, projecting, for example, 0.52 to 0.98 m of rise by 2100 under a high-emission scenario. This chapter provided a comprehensive update on observed sea-level rise and projected future rise under the new emissions scenarios. It concluded that the global mean sea level rise *very likely* will accelerate in the 21st century, projecting, for example, 0.52 to 0.98 m of rise by 2100 under a high-emission scenario (RCP8.5). The chapter also addressed the long-term trajectory of sea level rise (sea level will continue to rise for centuries).²⁵⁹

In 2019, the IPCC issued a special report about the "Ocean and Cryosphere in a Changing Climate," again with a dedicated chapter on sea-level rise. It assessed observed and projected changes in global and regional sea levels, including extreme sea level events, and the vulnerabilities of coastal zones and small islands.²⁶⁰

The latest IPCC report, The Sixth Assessment, released in 2021-22, again had a chapter dedicated to "Ocean, Cryosphere and Sea Level Change." The chapter concluded that global mean sea level rose about 20 cm from 1901–2018 (an unprecedented rate in at least 3000 years) and that the rise has accelerated in recent decades.

A review of IPCC reports shows that:

- IPCC SLR projections have generally increased over time due to better understanding of ice-sheet dynamics.

²⁵⁹ Church, J.A., P.U. Clark, A. Cazenave, J.M. Gregory, S. Jevrejeva, A. Levermann, M.A. Merrifield, G.A. Milne, R.S. Nerem, P.D. Nunn, A.J. Payne, W.T. Pfeffer, D. Stammer and A.S. Unnikrishnan. "Sea Level Change. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change" [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. (Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA 2013).

²⁶⁰ "Summary for Policymakers — Special Report on the Ocean and Cryosphere in a Changing Climate," IPCC, <https://www.ipcc.ch/srocc/chapter/summary-for-policymakers/>.

- The IPCC has repeatedly recognized the potential threat to coastal zones and coastal installations from sea level rise.
- The IPCC has taken steps to document its scientific confidence in the relation between global warming, extreme weather and coastal flooding, and this confidence increased substantially from AR1 (1990) to AR6 (2021).
- Special reports significantly contributed to clarity regarding impacts at lower warming thresholds (1.5° C), the importance of adaptation, and revised upward sea level rise estimates.
- Shell contributed to at least one of these special reports, in part based on its own in-house energy and climate scenario development.

At no point has the IPCC ever suggested that warming would not occur, or that its impacts would not be significant. Every report had extensive discussions of sea level rise, sometimes in stand-alone chapters, sometimes integrated with other issues, such as extreme weather risks. Despite disputes as to how bad future sea level rise might be, and how best to forecast it, sea level rise has always been one of the adverse impacts of global warming that has been articulated.²⁶¹ And I have found no evidence to suggest that Shell rejected the IPCC findings.

In preparing this report, I directed the use of artificial intelligence as an additional means to observe how often the words sea level, sea level rise, or related term (such as coastal flood, coastal erosion, and extreme weather) appeared in IPCC and Shell documents.

Across 39 IPCC reports, from 1990 to 2023, the terms “sea level rise” or “sea-level rise” occurs 4,645 times. The term “coastal flooding” appears 181 times (Appendix 2).

In Shell documents produced through discovery, we similarly found sea level, sea level rise, coastal flooding, and extreme weather mentioned many thousands of times. While this analysis does not provide

²⁶¹ J. O'Reilly, N. Oreskes, & M. Oppenheimer. 2012. “The rapid disintegration of projections: The West Antarctic Ice Sheet and the Intergovernmental Panel on Climate Change.” *Social Studies of Science* 42(5), 709–731, <https://doi.org/10.1177/0306312712448130> (Original work published 2012); J. O'Reilly, K. Brysse, M. Oppenheimer, and N. Oreskes. 2011. “Characterizing uncertainty in expert assessments: ozone depletion and the West Antarctic ice sheet.” *WIREs Clim Change*, 2: 728-743. <https://doi.org/10.1002/wcc.135>.

the context in which these the terms were discussed, the quantity of mentions further confirms that Shell has been well aware of sea level rise as a climate risk and its relation to coastal flooding, coastal erosion, and extreme weather events. It is also consistent with the conclusion that the attention to these issues in the Shell scenario work reflected a broad awareness of climate change, sea level rise, and coastal flooding.

4. Inclusiveness and Credibility of IPCC Work

Over time, more scientists have also participated in the IPCC process, which has become more capacious, particularly including more scientists from the global south. According to the IPCC, 782 scientists (and hundreds more contributing authors) contributed to its most recent report, analyzing more than 66,000 peer-reviewed studies.²⁶² While industry groups and libertarian think tanks with links to industry have sought to cast doubt on the validity of IPCC work,²⁶³ the IPCC is the pre-eminent source of scientific information on climate change. As of the writing of this report, the U.S. government affirms that “The Intergovernmental Panel on Climate Change (IPCC) is the leading international body for the assessment of climate change.”²⁶⁴ The European Union states that “[t]he IPCC has been instrumental in creating a broad, evidence-based consensus on the link between human activity and climate change, and its impacts, future risks, and options for adaptation and mitigation.”²⁶⁵ The reputation of the IPCC has also been affirmed by The Royal Society [UK], one of the world’s oldest and most distinguished scientific honor

²⁶² “IPCC Climate Change Reports - Findings, Purpose, Report History,” April 14, 2023, <https://www.nrdc.org/stories/ipcc-climate-change-reports-why-they-matter-everyone-planet>.

²⁶³ See for example, David Hasemyer and John H. Cushman Jr, “Exxon Sowed Doubt About Climate Science for Decades by Stressing Uncertainty,” *Inside Climate News* (blog), October 22, 2015, <https://web.archive.org/web/20250326195056/https://insideclimatenews.org/news/22102015/exxon-sowed-doubt-about-climate-science-for-decades-by-stressing-uncertainty/>; Mat Hope and Karem Savage, “Secretive Fossil Fuel Lobby Group Manipulated UN Climate Programs,” *Truthout*, April 29, 2019, <https://web.archive.org/web/20250210034702/https://truthout.org/articles/secretive-fossil-fuel-lobby-group-manipulated-un-climate-programs/>; Andrew C. Revkin, “Industry Ignored Its Scientists on Climate,” *The New York Times*, April 23, 2009, <https://web.archive.org/web/20250313011343/https://www.nytimes.com/2009/04/24/science/earth/24deny.html>; Ian Sample and science correspondent, “Scientists Offered Cash to Dispute Climate Study,” *The Guardian*, February 2, 2007, sec. Environment, <https://web.archive.org/web/20250424065139/https://www.theguardian.com/environment/2007/feb/02/frontpagenews.climatechange>; 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*, 1st edition (Bloomsbury Press, 2010), chapter 6.

²⁶⁴ “Intergovernmental Panel on Climate Change (IPCC) - European Commission,” December 14, 2022, https://research-and-innovation.ec.europa.eu/research-area/environment/climate-change-science/intergovernmental-panel-climate-change-ipcc_en; “Internet Resources on Climate Change | U.S. Department of the Interior,” July 1, 2015, <https://www.doi.gov/library/internet/climate>.

²⁶⁵ “Letter from The Royal Society, Select Committee on Economic Affairs,” April 13, 2005, <https://web.archive.org/web/20250129045956/https://publications.parliament.uk/pa/ld200506/ldselect/ldeconaf/12/12we24.htm>.

societies. In a 2005 report to the UK Parliament they affirmed: “The IPCC is the world's leading authority on climate change and its impacts.... [Its] work ... is backed by the worldwide scientific community. A joint statement of support was issued in May 2001 by the science academies of Australia, Belgium, Brazil, Canada, the Caribbean, China, France, Germany, India, Indonesia, Ireland, Italy, Malaysia, New Zealand, Sweden and the UK. It stated: “We recognise the IPCC as the world's most reliable source of information on climate change and its causes, and we endorse its method of achieving consensus.”²⁶⁶

O. The Scientific Consensus on Climate Change

The IPCC is widely recognized as the most important gathering of scientific experts working on climate change and its impacts. However, other scientific societies representing specialized fields relevant to the question have also issued statements corroborating the IPCC reports.

Climate change statements were made over the years by the American Meteorological Society (AMS), the American Geophysical Union (AGU), and the American Association for the Advancement of Science (AAAS). While stated in various ways, these expert communities have agreed and publicly stated on numerous occasions that the evidence for human modification of climate was scientifically persuasive.²⁶⁷ These were statements of both fact and attribution: the fact that the climate was warming and its attribution to human activities, particularly burning fossil fuels. In many instances, these expert bodies specifically noted sea level rise as one of the least uncertain of the consequences of global warming.

I became aware of these scientific statements in 2004, when I published a paper in *Science* on “The Scientific Consensus on Climate Change.” Seeking to test whether the statements of the IPCC, the NAS, and these scientific societies were consistent with the conclusions of rank-and-file scientists, as reflected in their scientific papers, I used the online database, Web of Science, to download all paper published between 1993 and 2003, identified by the key word phrase “global climate change.”²⁶⁸

²⁶⁶ Ibid.

²⁶⁷ American Meteorological Society, *Bull. Am. Meteorol. Soc.* 84, 508 (2003); American Geophysical Union, *Eos* 84(51), 574 (2003).

²⁶⁸ Naomi Oreskes, “The Scientific Consensus on Climate Change,” *Science* 306, no. 5702 (December 3, 2004): 1686–1686, <https://doi.org/10.1126/science.1103618>.

The search yielded 928 relevant papers, in which there was essentially complete consensus that anthropogenic global warming was underway. This contrasted with the prevailing public narrative at the time, particularly the narrative promoted by the fossil fuel industry, that climate science was highly unsettled, and there was a great deal of disagreement among scientists. According to *Science*, this paper has been downloaded over 71,000 times.²⁶⁹ According to Google Scholar, it has been cited more than 3,300 times.

In 2016, I collaborated with colleagues to follow up on this 2004 work. Since that time, other scholars have undertaken similar studies, some of which had larger samples than my 2004 study and therefore might be more accurate. We examined what was now a significant body of work on the question and concluded that there was a “consensus on consensus.” Excluding studies that were not restricted to experts in climate science, we found that the conclusion of 97% consensus in published climate research was robust and consistent with other surveys of climate scientists and peer-reviewed studies.”²⁷⁰ According to Google Scholar, this paper has been cited over 2,000 times. The paper also received extensive coverage in the mass media.²⁷¹

Meanwhile, in 2005, the Royal Society of the United Kingdom, one of the world’s oldest and most prestigious scientific societies, addressed the growing disinformation, misinformation, and confusion about climate change.²⁷² They wrote:

It has become fashionable in some parts of the UK media to portray the scientific evidence that has been collected about climate change and the impact of greenhouse gas emissions from human activities as an exaggeration. Some articles have claimed that scientists are ignoring uncertainties in our understanding of the climate and the factors that affect it. Some have questioned the motives of the scientists who have presented the most authoritative assessments of the science of climate change, claiming that they have a vested interest in “playing up” the potential effects that climate change is likely to have.²⁷³

²⁶⁹ Ibid.

²⁷⁰ John Cook et al., “Consensus on Consensus: A Synthesis of Consensus Estimates on Human-Caused Global Warming,” *Environmental Research Letters* 11, no. 4 (April 1, 2016): 048002, <https://doi.org/10.1088/1748-9326/11/4/048002>.

²⁷¹ “Media Coverage of Consensus Paper,” Skeptical Science, <https://skepticalscience.com/graphics.php?g=94>.

²⁷² “Letter from The Royal Society, Select Committee on Economic Affairs,” *supra* note 266.

²⁷³ Ibid.

The Society enumerated 12 misleading arguments and explained why they were misleading. These included the claim that the IPCC did not accurately reflect the views of the scientific community and did not adequately represent the scientific uncertainty; that there was very little evidence that warming was underway, or that if it was, it could be attributed to urbanization, or solar variability; that there was no way to predict what would happen in the future; that scientists had exaggerated the threat, particularly of extreme weather events; that even if climate change was occurring, it wouldn't be very dangerous, and might even be good for some people; and that the science was too uncertain to warrant action; it would be better to wait to act until the science was more certain.

The Society characterized all these claims as “extreme” and “misleading,” and noted that the last of them—that it would be better to wait and see—directly contradicted the findings of the 2001 IPCC report, which stated that “reducing emissions of greenhouse gases to stabilise their atmospheric concentrations would delay and reduce damages caused by climate change,” and recommended that, “The Parties [to the UNFCCC] should take precautionary measures to anticipate, prevent, or minimise the causes of climate change and mitigate its adverse effects. Where there are threats of serious irreversible damage, lack of full scientific certainty should not be used as a reason for postponing such measures....”²⁷⁴

The Society also noted that some of these misleading claims emanated from the fossil fuel industry, or its allies: “There are some individuals and organisations, some of which are funded by the US oil industry, that seek to undermine the science of climate change and the work of the IPCC. They appear motivated in their arguments by opposition to the United Nations Framework Convention on Climate Change and the Kyoto Protocol, which seek urgent action to tackle climate change through a reduction in greenhouse gas emissions.”²⁷⁵

P. Additional Affirmation of the Scientific Consensus and the Risk of Climate Change

²⁷⁴ Ibid.

²⁷⁵ Ibid.

Since 2005, many leading organizations and prominent individuals have further spoken out on the threat that climate change poses. Various states, provinces, and countries have passed laws and resolutions related to the problem, including the California Global Warming Solutions Act (passed in 2006).²⁷⁶

Space does not permit a full enumeration of these activities, but one is particularly notable: the two statements from the late Pope Francis. In 2015, Pope Francis issued an Encyclical letter, *Laudato Si': On Care for Our Common Home*. This letter, which was (and is) freely available on the Vatican website and elsewhere, has been reprinted in numerous editions and received extensive media coverage. In it, the Holy Father calls on all people—from world leaders to everyday citizens—to act to address the inter-related problems of climate change and inequality. He writes:

A very solid scientific consensus indicates that we are presently witnessing a disturbing warming of the climatic system. In recent decades this warming has been accompanied by a constant rise in the sea level and, it would appear, by an increase of extreme weather events,... Humanity is called to recognize the need for changes of lifestyle, production and consumption, in order to combat this warming ... The problem is aggravated by a model of development based on the intensive use of fossil fuels, which is at the heart of the worldwide energy system.²⁷⁷

If present trends continue, this century may well witness extraordinary climate change and an unprecedented destruction of ecosystems, with serious consequences for all of us. A rise in the sea level, for example, can create extremely serious situations, if we consider that a quarter of the world's population lives on the coast or nearby, and that the majority of our megacities are situated in coastal areas.²⁷⁸

We know that technology based on the use of highly polluting fossil fuels... needs to be progressively replaced without delay. ... In recent decades, environmental issues have given rise to considerable public debate and have elicited a variety of committed and generous civic responses. Politics and business have been slow to react in a way commensurate with the urgency of the challenges facing our world. Although the post-industrial period may well be remembered as one of the most irresponsible in history, nonetheless there is reason to hope that humanity at the dawn of the twenty-first century will be remembered for having generously shouldered its grave responsibilities.²⁷⁹

²⁷⁶ “AB 32 Global Warming Solutions Act of 2006 | California Air Resources Board,” September 28, 2018, <https://ww2.arb.ca.gov/resources/fact-sheets/ab-32-global-warming-solutions-act-2006>.

²⁷⁷ “Laudato Si': Encyclical Letter... On Care For Our Common Home (24 May 2015) | Francis,” June 18, 2015, ¶ 23, https://www.vatican.va/content/francesco/en/encyclicals/documents/papa-francesco_20150524_enciclica-laudato-si.html.

²⁷⁸ *Id.* at ¶ 24.

²⁷⁹ *Id.* at ¶ 165.

Businesses, Pope Francis concludes, must recognize, accept, and bear the full “economic and social costs of using up shared environmental resources...”²⁸⁰

The Pope followed up with a second statement, *Laudate Deum*, which restates the main arguments, identifies fossil fuels as the key driver of climate change, and calls on oil and gas companies to stop developing fossil fuel resources.²⁸¹ It calls for the abandonment of fossil fuels.²⁸² And it calls out those, including industry leaders, who have misrepresented the science:

In recent years, some have chosen to deride these facts. They bring up allegedly solid scientific data, like the fact that the planet has always had, and will have, periods of cooling and warming. They forget to mention another relevant datum: that what we are presently experiencing is an unusual acceleration of warming, at such a speed that it will take only one generation – not centuries or millennia – in order to verify it. The rise in the sea level and the melting of glaciers can be easily perceived by an individual in his or her lifetime, and probably in a few years many populations will have to move their homes because of these facts.²⁸³

Q. Industry Pushback: Denial and Disparagement of Climate Science

In previous sections, I have documented how the scientific consensus emerged—and was broadly communicated—from the 1950s to the present. However, action on that consensus has been lacking, in part because of the role that the fossil fuel industry and its allies have played in casting doubt on the relevant science and the integrity of the relevant scientists.

As already discussed, already in the 1950s, credible scientific evidence had emerged—and been communicated to business and political leaders—that man-made climate change was likely to be a cause for concern. In 1979, the US National Academy of Sciences affirmed this conclusion: that there was no reason to doubt that in due course the climatic effects of increased atmospheric CO₂ would become evident. In 1988, NASA climate scientist James Hansen and his team concluded that man-made climate change was, in

²⁸⁰ *Id.* at ¶ 195.

²⁸¹ “Laudate Deum: Apostolic Exhortation... to All People of Good Will on the Climate Crisis (4 October 2023) | Francis,” https://www.vatican.va/content/francesco/en/apost_exhortations/documents/20231004-laudate-deum.html.

²⁸² David Gelles, “The Pope’s Warning to a Warming World,” *The New York Times*, October 5, 2023, sec. Climate, <https://www.nytimes.com/2023/10/05/climate/the-popes-warning-to-a-warming-world.html>.

²⁸³ “Laudate Deum,” ¶ 6.

fact, now evident. That same year, the IPCC was created to advise governments on the issue, including on potential policies and actions.

In my research, I found no evidence of industry attempts to cast doubt on climate science prior to 1988. However, in that year, things began to change. When scientists began to state that climate change was no longer a prediction about the future, but something that was now underway, the industry position toward the science shifted. Industry leaders, including Shell, began to challenge the scientific evidence that, until this point, they had accepted and even in some cases, such as the North Sea gas platform, acted upon. Much of this resistance was expressed not by the companies directly but by their trade associations, or by organizations that they created for the purpose, such as the Global Climate Coalition (GCC). In 1989, ExxonMobil, Chevron, Shell, and BP helped to create the GCC, which lobbied internationally to raise doubt about the true role of GHGs on climate change and, in the United States in the 1990s, to prevent the ratification of the Kyoto Protocol to the UNFCCC.²⁸⁴

Internally, members of the GCC acknowledged the role of burning fossil fuels on a warming planet. As documented by researchers at the Center for International Environmental Law, a 17-page “primer on global climate change science” distributed to GCC members in 1996 acknowledged that, “[t]he scientific basis for the Greenhouse Effect and the potential impact of human emissions of greenhouse gases such as CO₂ on climate is well established and cannot be denied.”²⁸⁵ However, despite this internal acknowledgement, members of the GCC, both collectively and individually, worked to cast doubt on that science.

Brown University Professor Robert J. Brulle has documented the activities of the GCC, which he described as a “key coalition” in efforts to oppose carbon emissions reductions. He identifies four distinct

²⁸⁴ Robert J. Brulle, “Advocating Inaction: A Historical Analysis of the Global Climate Coalition,” *Environmental Politics* 32, no. 2 (February 23, 2023): 185–206, <https://doi.org/10.1080/09644016.2022.2058815>; Aaron M. McCright, Riley E. Dunlap, and Sandra T. Marquart-Pyatt, “Political Ideology and Views about Climate Change in the European Union,” *Environmental Politics* 25, no. 2 (March 3, 2016): 338–58, <https://doi.org/10.1080/09644016.2015.1090371>.

²⁸⁵ Gregory J. Dana, “Global Climate Coalition (GCC) - Primer on Climate Change Science - Final Draft,” January 18, 1996, https://www.ucs.org/sites/default/files/attach/2015/07/Climate-Deception-Dossier-7_GCC-Climate-Primer.pdf as mentioned in Andrew C. Revkin, “Industry Ignored Its Scientists on Climate,” *The New York Times*, April 23, 2009, <https://www.nytimes.com/2009/04/24/science/earth/24deny.html>.

activities that they undertook to obstruct climate action: 1) monitoring and contesting climate science, 2) commissioning and utilizing economic studies to amplify and legitimize their arguments, 3) shifting the cultural understanding of climate change through public relations campaigns, and 4) conducting aggressive lobbying of political elites.²⁸⁶ Brulle concludes that the GCC, and groups like it (for example, the Cooler Heads Coalition, operated by the Competitive Enterprise Institute),²⁸⁷ have “acted to enhance the collective political capacity of individual corporations by fulfilling two key functions. The first is to constitute and promote the industry’s social identity as a legitimate actor in the political system and thereby manage reputational risks to avoid regulation. To carry out this role (or function), these coalitions engage in extensive public relations efforts. The second function is to pool economic and political resources from across the industry sectors to advocate for the coalition’s collective interests.”²⁸⁸ Shell was a member of the GCC from its founding until 1998 when it withdrew, citing “irreconcilable differences...over emissions reduction targets.”²⁸⁹

The International Petroleum Industry Environmental Conservation Association (IPIECA) is an organization that facilitated coordination between different fossil fuel companies. It was originally created in the 1970s to assist the industry in interacting with the UN Environment Programme.²⁹⁰ In his dissertation, Benjamin Franta interviewed Bernard Tramier, Environmental Director of French oil brand, Elf Aquitaine, from 1983–2003, who said that, at an IPIECA meeting in 1984, Exxon led the charge in warning other oil companies of the dangers of global warming.²⁹¹

²⁸⁶ Brulle, “Advocating Inaction,” *supra* note 285, at 185.

²⁸⁷ Robert O’Harrow Jr, “A Two-Decade Crusade by Conservative Charities Fueled Trump’s Exit from Paris Climate Accord,” *The Washington Post*, September 5, 2017, https://www.washingtonpost.com/investigations/a-two-decade-crusade-by-conservative-charities-fueled-trumps-exit-from-paris-climate-accord/2017/09/05/fcb8d9fe-6726-11e7-9928-22d00a47778f_story.html.

²⁸⁸ Brulle, “Advocating Inaction,” *supra* note 285, at 185–206.

²⁸⁹ “Shell Withdraws from Global Climate Coalition,” *Oil & Gas Journal*, May 4, 1998, <https://www.ogj.com/home/article/17225828/shell-withdraws-from-global-climate-coalition>.

²⁹⁰ Christophe Bonneuil, Pierre-Louis Choquet, and Benjamin Franta, “Early Warnings and Emerging Accountability: Total’s Responses to Global Warming, 1971-2021,” *Global Environmental Change* 71 (October 22, 2021): 102386 in Franta, 2022, <https://doi.org/10.1016/j.gloenvcha.2021.102386>.

²⁹¹ Interview with Bernard Tramier, Nov. 5, 2020. *See* Bonneuil, Choquet, and Franta, “Early Warnings and Emerging Accountability,” 102386 in Franta, 2022.

In 1987, IPIECA held an industry symposium to review the current state of climate science and discuss future policies. A year later, they created a “Working Group on Climate Change,” Franta writes.²⁹² The working group contained representatives from Exxon, Elf, Mobil, API, BP, Shell, Texaco (now Chevron), and Saudi Aramco.²⁹³ By the early 1990s, IPIECA was urging its members to “insist that fossil fuel controls be delayed until there was a clear ‘verification of climate change.’”²⁹⁴ Duane LeVine, then Chairman of Exxon, developed an industry plan to ensure that an effort to control fossil fuels would fail, urging members to focus on uncertainties surrounding climate science as well as “promot[ing] industry-friendly policies that would keep the fossil fuel business intact.”²⁹⁵

Another important group in casting doubt on climate science, in part by foregrounding and exaggerating the scientific uncertainties, was the American Petroleum Institute (API). From 1988 throughout the 1990s, with Shell as a member, the API worked to develop a comprehensive strategy on climate denial, encompassed within their “Global Climate Science Communications Plan” (1998). Campaign documents note that, “‘Victory Will Be Achieved When... Average citizens ‘understand’ (recognize) uncertainties in climate science; recognition of uncertainties becomes part of the ‘conventional wisdom,’ and [t]hose promoting the Kyoto treaty on the basis of extant science appear to be out of touch with reality.’”²⁹⁶

R. Corporate Obfuscation of Science Through Strategies to Create or Exaggerate Uncertainty and Doubt

²⁹² Interview with Brian P. Flannery, Feb. 1, 2021 in Franta, 2022.

²⁹³ LeVine, D. (Exxon), chairman, Mal-Shari, A. (Saudi Aramco), Bernstein L. (Mobil), Flannery B. (Exxon), Graham-Bryce I. (Shell), Henderson U.V. (Texaco), Kraweld H. (Shell), McKay J. (BP), Tramier B. (Elf Aquitaine), Yosie, T. (API) and Lemlin J. (IPIECA), “Potentially Enhanced Greenhouse Effect: A Briefing Document for IPIECA Membership Prepared by the Working Group on Global Climate Change,” Feb. 1990 (document kindly provided by Nathaniel Rich) in Franta, 2022.

²⁹⁴ LeVine, D. (Exxon), chairman, Mal-Shari, A. (Saudi Aramco), Bernstein L. (Mobil), Flannery B. (Exxon), Graham-Bryce I. (Shell), Henderson U.V. (Texaco), Kraweld H. (Shell), McKay J. (BP), Tramier B. (Elf Aquitaine), Yosie, T. (API) and Lemlin J. (IPIECA), “Potentially Enhanced Greenhouse Effect: A Briefing Document for IPIECA Membership Prepared by the Working Group on Global Climate Change,” Feb. 1990 (document kindly provided by Nathaniel Rich) in Franta, 2022.

²⁹⁵ *Id.* at 391; Duane G. LeVine, 1989, “The Potential Greenhouse Effect: Status and Outlook,” Exxon Corporation, at 16, <https://www.documentcloud.org/documents/3024140-1989-Presentation-to-Exxon-Board-of-Directors-on/> in Franta, 2022.

²⁹⁶ Carroll Muffett and Steven Feit, “Smoke and Fumes: The Legal and Evidentiary Basis for Holding Big Oil Accountable for the Climate Crisis,” ed. Amanda Kistler and Marie Mekosh (Center for International Environmental Law, 2017), <https://www.ciel.org/wp-content/uploads/2019/01/Smoke-Fumes.pdf>.

In 2006, I became interested in why some individuals and groups were reluctant to accept the scientific conclusion that man-made climate change was occurring. This led to the publication of my 2010 book, co-authored with historian of technology Erik M. Conway, *Merchants of Doubt*. The key finding of the book was that, with rare exceptions, leading “skeptics” of climate change had not found problems or identified inadequacies in climate science but were reacting negatively to climate science for political, ideological, and economic reasons. We also found that many of the strategies and tactics that industry groups used to cast doubt on climate science followed patterns established by the tobacco industry, and in some cases the same group and individuals were involved in both.²⁹⁷

Other scholars have documented comparable examples of “science denial” and disinformation campaigns motivated by ideological, political, or economic interests.²⁹⁸

As the Royal Society statement discussed in Section I notes, a key tactic of these disinformation strategies was to exaggerate the degree of uncertainty surrounding the relevant science. No science is ever proven absolutely; it is always possible to identify gaps, anomalies, and uncertainties in the state of prevailing knowledge. This is particularly true in many environmental and health sciences, in which, for practical or ethical reasons, it may not be possible to do controlled experiments or double-blind randomized clinical trials, or where effects may manifest long after the events or exposures that caused them. Disinformation campaigns often operate by identifying examples of minor disagreement or rare dissenting scientists and exaggerating their intellectual significance or prevalence. Where scientific consensus does prevail—as it has in climate science since the mid-1990s—interested parties may falsely assert otherwise or recruit non-experts to allege that the consensus—or the evidence on which it is based—is for some reason

²⁹⁷ Oreskes and Conway, *Merchants of Doubt*; see also Seth Shulman, Kate Abend, and Alden Meyer, “Smoke, Mirrors & Hot Air: How ExxonMobil Uses Big Tobacco’s Tactics to Manufacture Uncertainty on Climate Science,” Union of Concerned Scientists, 2007, https://www.ucs.org/sites/default/files/2019-09/exxon_report.pdf.

²⁹⁸ Allan M. Brandt, *The Cigarette Century: The Rise, Fall, and Deadly Persistence of the Product That Defined America* (New York: Basic Books, 2007); Robert Proctor, *Golden Holocaust: Origins of the Cigarette Catastrophe and the Case for Abolition* (Berkeley: University of California Press, 2011); Gerald E. Markowitz, *Deceit and Denial: The Deadly Politics of Industrial Pollution*, California/Milbank Books on Health and the Public 6 (Berkeley, CA: University of California Press, 2002); David Michaels, *Doubt Is Their Product: How Industry’s Assault on Science Threatens Your Health* (Oxford ; New York: Oxford University Press, 2008); David Michaels, *The Triumph of Doubt: Dark Money and the Science of Deception* (New York, New York: Oxford University Press, 2020); Mark Fainaru-Wada, *League of Denial: The NFL, Concussions, and the Battle for Truth*, First Ed. (New York: Crown Archetype, 2013).

invalid. Thus, in evaluating the state of scientific knowledge, it is important to recognize the existence of strategies designed to undermine public understanding of, and trust in, science, and to be able to distinguish actual science from pseudo-science, disinformation, and denial, as well as the role of the third parties who aid and abet these strategies.

Since the 1950s, various actors have realized that they can defend themselves in toxic tort and other cases related to environmental pollution, occupational exposure to hazardous chemicals, and the harms of dangerous products and practices by casting doubt on the scientific evidence that demonstrates those harms.²⁹⁹ This approach was developed by the tobacco industry and used for decades to postpone legal liability for mortality and morbidity caused by tobacco use; since then it has been used by other parties and industries.³⁰⁰ It has also been used by private firms, often referred to as “product defense” firms, who defend clients accused of causing harm through their products or practices by misrepresenting and/or casting doubt on scientific evidence, including with tobacco.³⁰¹

As former Assistant Secretary of Labor for Occupational Safety and Health David Michaels explains in his book, *Triumph of Doubt*, a responsible corporation would use scientific evidence to assess risk objectively—and then alter its products or adjust its practices as that evidence indicates may be appropriate. Sadly, this is not what many corporations do. Instead, many corporations view scientific information as a threat, and work to “manage” that information—to make it seem less certain or less damaging than it is—or to try to deny and discredit it entirely. Often this involves the use of “experts for hire” from product

²⁹⁹ David Michaels, *Doubt Is Their Product: How Industry's Assault on Science Threatens Your Health* (Oxford; New York: Oxford University Press, 2008); David Michaels, *The Triumph of Doubt: Dark Money and the Science of Deception* (New York, New York: Oxford University Press, 2020); Naomi Oreskes, *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming*, Paperback Ed. (New York: Bloomsbury Press, 2011); Carl F. Cranor, *Toxic Torts: Science, Law, and the Possibility of Justice*, 2nd edition (Cambridge University Press, 2016).

³⁰⁰ On tobacco, see Allan M. Brandt, *The Cigarette Century: The Rise, Fall, and Deadly Persistence of the Product That Defined America* (New York: Basic Books, 2007); Robert Proctor, *Golden Holocaust: Origins of the Cigarette Catastrophe and the Case for Abolition* (Berkeley: University of California Press, 2011); on other industries and product defense firms see David Michaels, *Doubt Is Their Product: How Industry's Assault on Science Threatens Your Health* (Oxford; New York: Oxford University Press, 2008); David Michaels, *The Triumph of Doubt: Dark Money and the Science of Deception* (New York, New York: Oxford University Press, 2020). On the distortion of science by product defense firms and other sources of bias see Glenn Suter and Susan Cormier, “Bias in the Development of Health and Ecological Assessments and Potential Solutions,” *Human and Ecological Risk Assessment: An International Journal* 22 (June 24, 2015), <https://doi.org/10.1080/10807039.2015.1056062>; David Michaels, “Manufactured Uncertainty,” *Annals of the New York Academy of Sciences* 1076, no. 1 (2006): 149–62, <https://doi.org/10.1196/annals.1371.058>.

defense firms, to try to give credibility to claims that go against mainstream science or even misrepresent it.

Michaels explains:

These [corporations] have on their payrolls (or can bring in on a moment's notice) toxicologists, epidemiologists, biostatisticians, risk assessors, and any other professionally trained, media-savvy experts deemed necessary ... These useful "experts" produce impressive-looking reports and publish the results of their studies in peer-reviewed scientific journals (reviewed, of course, by peers of the hired guns writing the articles).³⁰²

These "impressive-looking reports" typically fly in the face of mainstream science, often by exaggerating small uncertainties or over-emphasizing details that do not, in fact, undermine the consensus scientific conclusion.

Michaels has characterized these tactics as "manufacturing uncertainty."³⁰³ My view is slightly different. I believe that all science involves uncertainties that can never be entirely resolved, but product defense firms exaggerate and unethically exploit these uncertainties to undermine valid scientific evidence, and thereby undermine legal, moral, and financial accountability by their clients.

Recent work by legal scholars has confirmed that these patterns are widespread and on-going. For example, University of Michigan Law Professor Rachel Rothschild has shown how the fossil fuel industry sought to discredit the scientific evidence of the reality and harms of acid precipitation, and how both the petroleum and chemical industries have worked to cast doubt on the harmful nature of toxic petrochemicals, such as benzene, a chemical of concern in many industrial settings and oil spills.³⁰⁴

In *Merchants of Doubt*, we focused attention on how a small group of scientists worked to cast doubt on scientific consensus from tobacco to climate change. The historical evidence suggested that these men were not so much motivated by money as by political ideology. However, we showed that the playbook of obscuring the truth to cast doubt upon scientific truth, developed by the tobacco industry, was replicated by

³⁰² David Michaels, *The Triumph of Doubt: Dark Money and the Science of Deception* (New York, New York: Oxford University Press, 2020), 3–4.

³⁰³ David Michaels, "Manufactured Uncertainty," *Annals of the New York Academy of Sciences* 1076, no. 1 (2006): 149–62, <https://doi.org/10.1196/annals.1371.058>.

³⁰⁴ Rachel Emma Rothschild, *Poisonous Skies: Acid Rain and the Globalization of Pollution*, First Ed. (The University of Chicago Press, 2019); Rachel Rothschild, "Juristocracy and Administrative Governance: From Benzene to Climate," SSRN Scholarly Paper (Rochester, NY, October 15, 2023), <https://doi.org/10.2139/ssrn.4602927>.

the fossil fuel industry, and that the industry funded numerous supposedly independent groups to cast doubt on scientific findings that indicated the need for government policies or industry action designed to reduce GHG emissions or mitigate their impacts.

In this book, my co-author Erik M. Conway and I detailed how, despite overwhelming scientific evidence, the fossil fuel industry used scientists and scientific research to change public opinion on climate change. They explained the facts with varying explanations — acid rain was not linked to the burning of fossil fuels but could instead be explained by volcanic eruptions. Volcanic eruptions were also used to explain the depletion of the ozone layer. Climate change was blamed on natural variability in the climate, as discussed above.

Third-Party Allies

A large part of the industry strategy involved funding and working with third parties—sometimes called “third party allies,” to create the impression of a widespread scientific debate and widespread public concern. This included funding existing organizations aligned with the industry’s interest in resisting government regulation, such as the Cato Institute and the Competitive Enterprise Institute. Fossil fuel groups also created new an industry-funded organizations that were designed to appear to be independent but were in fact created and funded by the fossil fuel industry, such as the Information Council on the Environment (ICE), created by a group of U.S. coal producers. According to internal documents, the purpose of this group was to “reposition global warming as theory (not fact).”³⁰⁵ Others included the Global Climate Coalition, the Cooler Heads Coalition, Informed Citizens for the Environment, and the Greening Earth Society.

As already noted, in 1989, leading industrial producers of carbon, including Shell, ExxonMobil and British Petroleum, created the Global Climate Coalition, whose stated purpose was to oppose GHG

³⁰⁵ Letter from Dr. Patrick Michaels, *Information Council on the Environment* 9 (May 15, 1991), https://www.ucsusa.org/sites/default/files/attach/2015/07/Climate-Deception-Dossier-5_ICE.pdf; David Adam, “Royal Society Tells Exxon: Stop Funding Climate Change Denial,” *The Guardian*, September 20, 2006, sec. Environment, <https://www.theguardian.com/environment/2006/sep/20/oilandpetrol.business>.

emission reductions and prevent the United States from signing the Kyoto Protocol—at the time the principal available policy instrument for addressing climate change. For more than a decade, the Global Climate Coalition led an aggressive lobbying and advertising campaign aimed at achieving these goals by sowing doubt about the integrity of the IPCC and the scientific evidence that heat-trapping emissions from burning fossil fuels drive global warming. When the Global Climate Coalition disbanded in 2002, it stated that it had achieved its goals.³⁰⁶

Think tanks, including the Cato Institute, the Competitive Institute, the Heartland Institute and the George G. Marshall Institute, played a major in promoting doubt about the findings of climate science, in part by creating pseudo-scientific documents that they presented as if they were scientific documents. The Cato Institute, for example, issued a report in 2009 that mimicked the format, layout, and structure of the U.S. National Climate Impact Assessment (NCIA) but contradicted the key findings of the NCIA report.³⁰⁷ The fossil fuel industry has also used its trade associations, such as the Western Fuels Association, to run media campaigns to undermine public support for climate action.³⁰⁸

Another important third-party ally in climate disinformation has for many years been the American Legislative Exchange Council (ALEC), a group that provides state legislators with briefings by climate deniers and misleadingly describes climate change as “a historical phenomenon for which debate will continue over the significance of natural and [human-caused] contributions.” ALEC promotes “model legislation” aiming to repeal state renewable energy standards and roll back other climate and energy

³⁰⁶ Andrew C. Revkin, “Industry Ignored Its Scientists on Climate,” April 23, 2009, <https://www.nytimes.com/2009/04/24/science/earth/24deny.html>; Chris Mooney, “Some Like It Hot,” *Mother Jones*, June 2005, <https://www.motherjones.com/environment/2005/05/some-it-hot/>; Ross Gelbspan, *The Heat Is On: The Climate Crisis, The Cover-up, The Prescription* (Basic Books, 1997); Stephen H. Schneider, *Science as a Contact Sport: Inside the Battle to Save Earth's Climate* (National Geographic, 2009).

³⁰⁷ Benjamin Franta, “Early Oil Industry Knowledge of CO₂ and Global Warming,” *Nature Climate Change* 8, no. 12 (December 2018): 1024–25, <https://doi.org/10.1038/s41558-018-0349-9>.

³⁰⁸ Naomi Oreskes, “My Facts Are Better Than Your Facts: Spreading Good News about Global Warming,” in *How Well Do Facts Travel?: The Dissemination of Reliable Knowledge*, ed. Mary S. Morgan and Peter Howlett (Cambridge: Cambridge University Press, 2010), at 136–66, <https://doi.org/10.1017/CBO9780511762154.008>. See also Ruth E. McKie, “The Climate Change Counter Movement How the Fossil Fuel Industry Sought to Delay Climate Action,” Palgrave MacMillan 2023, at 26. * Dunlap, Riley E.; McCright, Aaron M. (2015). "Chapter 10: Challenging Climate Change: The Denial Countermovement." in Dunlap, Riley E.; Brulle, Robert J. (eds.). *Climate Change and Society: Sociological Perspectives*. Oxford University Press. at 300–332, 310. ISBN 978-0-19-935611-9; Ross Gelbspan, *The Heat Is On: The Climate Crisis, The Cover-up, The Prescription* (Basic Books, 1997).

policies; it also funds activities to ensure that debate does indeed continue at the expense of meaningful action. Shell had been a prominent funder of ALEC, along with BP, Chevron, and ExxonMobil, before withdrawing in 2015.³⁰⁹

Exactly how much fossil fuel companies have spent to support disinformation is difficult to determine, in part because they are not required to report their political and public relations spending. Professor Brulle estimates that hundreds of millions of dollars have flowed from corporations, ideological foundations, and groups that oppose climate policy in an effort to sow doubt about mainstream climate science.³¹⁰

Climate scientists have also been on the receiving end of the industry's attacks. Third-party groups sponsored by the industry, including the Cato Institute, falsely accused scientist Benjamin Santer (the lead author of AR2 of the IPCC, responsible for the 1995 conclusion that "the balance of evidence suggests a discernible human impact on the climate system."³¹¹) of scientific fraud.³¹² The contrarian positions promoted by third party allies were at odds not only with mainstream science, but with the science being done within the Shell corporation.

As noted above, in 1989, Shell developed its own scenarios describing possible global warming futures in which it noted that, absent emission reductions, global temperature would continue to rise with dire outcomes, including "more violent weather—more storms, more droughts, more deluges. Mean sea level would rise at least 30 cm. Agricultural patterns would be most dramatically changed. Something as

³⁰⁹ Peter C. Frumhoff, Richard Heede, and Naomi Oreskes, "The Climate Responsibilities of Industrial Carbon Producers," *Climatic Change* 132, no. 2 (September 1, 2015): 157–71, <https://doi.org/10.1007/s10584-015-1472-5>. Shell withdrew from ALEC shortly after Frumhoff et al. was published. Karl Mathiesen and Ed Pilkington, "Royal Dutch Shell Cuts Ties with ALEC over Rightwing Group's Climate Denial," *The Guardian*, August 7, 2015, <https://www.theguardian.com/business/2015/aug/07/royal-dutch-shell-alec-climate-change-denial>.

³¹⁰ "Corporate Promotion and Climate Change: An Analysis of Key Variables Affecting Advertising Spending by Major Oil Corporations, 1986–2015 | Climatic Change," <https://link.springer.com/article/10.1007/s10584-019-02582-8>.

³¹¹ CSLDF, "Perspectives of Scientists Who Become Targets: Ben Santer," *Climate Science Legal Defense Fund* (blog), December 26, 2017, <https://www.csldf.org/2017/12/26/perspectives-scientists-become-targets-ben-santer/>.

³¹² The attack was primarily laid out in the *Wall Street Journal* but then repeated elsewhere. Frederick Seitz, "A Major Deception on 'Global Warming,'" *Wall Street Journal*, June 12, 1996, Op-Ed, Eastern edition, A16. See my discussion in Naomi Oreskes and Erik M. Conway, "The Relentless Attack on Climate Scientist Ben Santer," *BillMoyers.com*, May 16, 2014, <https://billmoyers.com/2014/05/16/the-relentless-attack-of-climate-scientist-ben-santer/>. For an example of a CATO institute portrayal of Santer as dishonest, see Michaels, Patrick J. "Holes in the Greenhouse Effect." *Cato Institute*, July 13, 2000. <https://www.cato.org/commentary/holes-greenhouse-effect>.

simple as a moderate change in rainfall pattern would disrupt eco-systems, and many species of trees, plants, animals, and insects would not be able to move and adapt.”³¹³ Yet these conclusions were disputed by a network of think-tanks. Documents show that Shell was engaged with many of these think-tanks, tracking their activities, and in some cases funding them.

For example, one document attests to contributions of \$50,000 to the American Enterprise Institute (AEI).³¹⁴ AEI is one of the many organizations that the Royal Society concluded had promoted claims that were at odds with the best available science. In 2007, AEI offered a cash award, plus travel expenses, to any scientist willing to try to find fault with and emphasize the shortcomings of the recently released IPCC Fourth Assessment report. The AEI letter accused the IPCC—without evidence—of being “resistant to reasonable criticism and dissent and prone to summary conclusions that are poorly supported by the analytical work.”³¹⁵ The Vice Chair of the AEI’s board at that time was ExxonMobil CEO Lee Raymond, who had repeatedly disputed the IPCC claim that observed warming was due to GHGs and suggested instead that it was natural variability that had “nothing to do with man.”³¹⁶ Climate scientists at the time described the AEI effort as “as an attempt to cast doubt over the ‘overwhelming scientific evidence’ on global warming.”³¹⁷

In preparing this report, I directed the use of AI to examine Shell’s relations with a set of think tanks which have been involved in activities that scientific organizations, such as the Royal Society, have identified as being anti-scientific, that have disparaged scientists and/or scientific findings, or that have actively lobbied against climate policies. Many mentions of these organizations in Shell documents are in newsletters or other materials that do not establish what relationship Shell may have had with these groups.

³¹³ Royal Dutch Shell, Scenarios: 1989–2010; Challenge and Response (London: Shell Confidential Group Planning, Oct. 1989), at 36, <https://s3.documentcloud.org/documents/23735737/1989-oct-confidential-shell-group-planning-scenarios-1989-2010-challenge-and-response-disc-climate-refugees-and-shift-to-non-fossil-fuels.pdf>. See Chapter 2 (“How the most important fact of global warming has been obscure”) at 19, in Franta, *Ignorance Unmasked*, *supra* 157.

³¹⁴ SOPUS_NHVN01805211.

³¹⁵ Ian Sample, “Scientists Offered Cash to Dispute Climate Study,” *The Guardian*, February 2, 2007, <https://www.theguardian.com/environment/2007/feb/02/frontpagenews.climatechange>.

³¹⁶ “The Power of Big Oil,” Frontline, <https://www.pbs.org/wgbh/frontline/documentary/the-power-of-big-oil/>.

³¹⁷ Sample, “Scientists Offered Cash to Dispute Climate Study,” *supra* note 316.

(For example, one document is just a Google Alert.³¹⁸) However, a number of documents show that Shell was making financial contributions to several of these organizations, including the AEI,³¹⁹ the Annapolis Center for Science Based Policy,³²⁰ the Institute for Energy Research,³²¹ and the Mountain States Legal Foundation.³²² The Annapolis Center, while now defunct, was heavily funded by ExxonMobil,³²³ and, for many years, “produced publications and hosted conferences suggesting the risks of climate change, particulate matter from coal power plants, and other environmental concerns pose a lower risk than popularly believed.”³²⁴ The Mountain States Legal Foundation was a co-signer on an amicus brief, along with the CATO Institute, that sought to overturn the EPA endangerment finding in the case of *West Virginia et al. v. U.S. Environmental Protection Agency, et al.* Thus, while Shell understood that climate change presented a scientifically documented danger, particularly to its coastal facilities, it contributed funds to organizations that argued otherwise in public and in court.

S. Summary of Opinion One

Historical evidence demonstrates that the issue of global warming has been widely mooted in both the scientific community and in civil society for more than half a century. A particular topic of discussion

³¹⁸ SOPUS_NHVN01952118.

³¹⁹ SOPUS_NHVN01494898 (and many near identical duplicates such as SOPUS_NHVN01805211).

³²⁰ SOPUS_NHVN02052283.

³²¹ SOPUS_NHVN01419096 (2014, \$100,000; and many near identical duplicates like SOPUS_NHVN01848610 (2015, \$50,000 + \$50,000).

³²² SOPUS_NHVN0141080; *see also* Cato Institute and Mountain States Legal Foundation. *Brief of the Cato Institute and Mountain States Legal Foundation as Amici Curiae in Support of Petitioners, West Virginia v. Environmental Protection Agency*, No. 20-1530 (U.S. Supreme Court, December 16, 2021), https://www.supremecourt.gov/DocketPDF/20/20-1530/205351/20211216122320892_WV%20v%20EPA%20merits.pdf.

³²³ Greenpeace. “ExxonSecrets: Organization Factsheet.” *ExxonSecrets.org*. Archived July 9, 2016. <https://web.archive.org/web/20160709120831/http://www.exxonsecrets.org/html/orgfactsheet.php?id=13>. *See also* “Annapolis Center for Science-Based Public Policy.” *DeSmog*. Last Modified April 4, 2016. <https://www.desmog.com/annapolis-center-science-based-public-policy/>.

³²⁴ “The Annapolis Center: Promoting responsible environmental, health and safety decision-making.” The Annapolis Center. Retrieved from Philip Morris public documents archive and on file at DeSmog (Bates No. 2065243818-3825). Board members include the Science and Economic Advisor (Sallie Baliunas, who was also associated with the Global Climate Coalition and the George C. Marshall Institute and received substantial monies from ExxonMobil for work raising doubts about the human causes of climate change).

See also Union of Concerned Scientists, “Smoke, Mirrors & Hot Air: How ExxonMobil Uses Big Tobacco’s Tactics to Manufacture Uncertainty on Climate Science,” at 15, 34 January 2006, https://www.ucs.org/sites/default/files/2019-09/exxon_report.pdf; S.L. Baliunas, *Are Human Activities Causing Global Warming?* (Washington, DC: George C. Marshall Institute, January 1, 1995), <http://www.marshall.org/article>. *See also* S.L. Baliunas, *Uncertainties in Climate Modeling: Solar Variability and Other Factors*, (Washington, DC: George C. Marshall Institute, September 17, 1996), <http://www.marshall.org/article.php?id=1>

throughout this period has been the threat of sea level rise. Indeed, it has long been considered to be one of the most certain of risks, because—while the details depend on many factors, from local topography to variations in planetary gravity—the basic physics are clear: in a warmer world, ocean water expands and continental ice melts, yielding water that runs into the sea, both of which contribute to sea level rise.

No responsible company could have been unaware of this. And indeed, documents show that Shell was aware of it, was discussing it internally, and was contributing to the scientific work undertaken by the IPCC. However, the scientific evidence was challenged by third parties, many of which were funded by the fossil fuel industry, including Shell. Shell’s knowledge of climate change is developed further in Opinion Two.

Opinion Two: Shell knows and has admitted the reality of climate change.

Throughout the late 1980s to the present, Shell has been well aware of climate change and its impacts, including the significant hazards created for its coastal facilities, like the New Haven Oil Terminal, which are vulnerable to sea level rise and other climate effects.

As early as 1981, Shell was tracking scientific developments. In 1981, Shell commissioned a study from the Climate Research Unit (CRU) in the United Kingdom, for which it paid £10,000. The study, led by climate scientist Thomas Wigley, was published by the UK Department of the Environment in 1984.³²⁵ The 1988 Shell report on “The Greenhouse Effect,” discussed in Section L of Opinion One, includes an Appendix discussing Wigley’s work, and a visit that Shell employees made to Wigley’s lab in 1985.

³²⁵ See discussion in Mike Small and Chloe Farand, “What 30 Years of Documents Show Shell Knew About Climate Science,” *DeSmog*, May 17, 2018, <https://www.desmog.com/2018/05/17/shell-knew-charting-thirty-years-corporate-climate-denialism/>; SOPUS_NHVN02463861.

APPENDIX 8

Visit to Climate Research Unit, 27.11.1985

Meeting with Dr. T.G. Wigley, Director.

The CRU made a study of the greenhouse effect for Shell in about 1981 on the basis of a grant for £10000. This was subsequently extended for the US DOE and was published by them in August 1984 (I was given a copy of the report).

I found Wigley very much had his feet on the ground and was at great pains to emphasise the uncertainties that still exist in this area and the time needed before which it will be possible to reach any very definite conclusions about the greenhouse effect. Having said that, he was prepared to stick his neck out and say that there has been a global warming over the last 100 years, that the 0.5 degrees (range 0.3-0.7) increase is a result of CO₂ build-up, that we will see a further 1-2 degree warming over the next 40 years and that the warming will be greater in higher latitudes and more in winter than in summer. Such a rise would be greater than any change in the last 1000 years - at the peak of the last ice age (18000 years ago) the global mean temperature was 4 degrees lower than at present.

This appendix makes clear that Shell is aware of Wigley's conclusion that the planet has already warmed 0.5° C, that the cause of this warming is increased atmospheric CO₂, and that an additional warming of 1–2° C is to be expected over the next forty years.

The 1988 Greenhouse Effect report, as well as the Shell scenarios already discussed, leave no doubt that Shell was aware of, understood, and broadly accepted the climate science in the 1980s, '90s, and 2000s, including the expected impacts of global warming on coastal installations and facilities.

Publicly available and internal documents establish that Shell not only should have known but did actually know that climate change was occurring and that it would impact its industrial facilities. These impacts included sea level rise, more severe/frequent weather events, storm surge, precipitation changes, and flooding.

Numerous public and internal company documents support this conclusion. In addition to materials already discussed, consider the following examples.

In 1989, *The New York Times* reported on Shell making plans to take climate change into account in its North Sea installations. The article, "Greenhouse Effect: Shell Anticipates A Sea Change," explained that Shell was already anticipating the effects of climate change and planning accordingly:

Whether global warming will raise the level of the world's oceans is still being debated [sic], but engineers who build natural-gas production platforms at Shell Oil do not want to take chances. In what is considered the first major project that takes account of the changes the greenhouse effect is

expected to bring, the engineers are designing a huge platform that anticipates rising water in the North Sea.³²⁶

The proposed change was to raise the oil platform level from 30 meters to 31 or 32 meters, in order to account for higher waves that might in the future be expected as a result of global warming driven by increased atmospheric GHGs.

In 1994, Shell employee Peter Langcake reviewed the “scientific aspects” of “The Enhanced Greenhouse Effect.” That term refers specifically to the increase (or “enhancement”) of the natural planetary greenhouse effect by additional greenhouse gases, such as carbon dioxide from burning fossil fuels. The report stated:

The threat of climate change remains the environmental concern with by far the greatest significance for the fossil fuel industry, having major business implications ... The consequences of global warming could be dramatic, as could the economic effects of ill-advised policy measures.³²⁷

Langcake affirmed that the IPCC represented the “mainstream” of scientific opinion and described IPCC as providing “the essential underpinning for government positions at the Rio [Earth Summit] conference...” While stressing that there was a “range of view among IPCC scientists about the magnitude of the threat from global warming and its causes,” including some who felt that the expressed concerns were “exaggerated and misguided,” he concluded that there was “complete agreement on the following well-known scientific fundamentals.”³²⁸

- Natural Atmospheric Greenhouse Gases affect the retention of energy in the global system by re-reflecting part of the outgoing infra-red radiation from the Earth (so called “radiative forcing”).
- This maintains the average global temperature approximately 3° C higher than it would be in the absence of atmospheric greenhouse gases and reduces diurnal variation (This is the natural “greenhouse effect”).
-
- Human activities have contributed to the increase in atmospheric greenhouse gas concentrations (AGGCs) ...³²⁹

³²⁶ Peter Passell, “Greenhouse Effect: Shell Anticipates a Sea Change,” *The New York Times*, December 20, 1989, <https://www.nytimes.com/1989/12/20/business/greenhouse-effect-shell-anticipates-a-sea-change.html>.

³²⁷ SOPUS_NHVN02463952.

³²⁸ SOPUS_NHVN02463953.

³²⁹ SOPUS_NHVN02463954.

He noted that some of the stated objections to the “global warming hypothesis” might seem to “favour a healthy scepticism,” but the skeptics did not in fact “offer convincing alternative positions.” Rather, he noted, they mainly pointed to uncertainties, which, as IPCC scientists responded, could cut both ways: the effects might be less than predicted but they could also “be larger than predicted.”³³⁰ Langcake was not advocating for an immediate, large response from Shell; on the contrary, he expressed the concern that “policies to curb greenhouse gas emissions beyond ‘no regrets’ measures could be premature...”³³¹ But he did not suggest that the IPCC was wrong, that climate change would not occur, or even that the correct industry response was inaction. On the contrary, he suggested that “no regrets” measures would be appropriate. (Langcake did not offer a specific example, but a “no regrets” strategy is one that offers benefits, even if the anticipated problem does not arrive. The International Union for the Conservation of Nature, for example, argues that protecting ecosystems offers benefits to communities, “regardless of how the climate changes.”³³²)

In 1995, a Shell management brief, “Climate Change,” reiterated the arguments made by Peter Langcake the previous year, that while an aggressive approach to the problem might be premature, there was a case for a “no regrets” policy, and that there was “enough indication of the potential risk for governments to address the issue.”³³³

That same year, Langcake authored another report, “Is Climate Change Occurring Already?” The IPCC Second Assessment report, issued that year, concluded that the answer was yes. The IPCC had stated that “the best evidence to-date suggests that global mean temperature changes over the last century are unlikely to be due to natural causes and that a pattern of climate response to human activities is identifiable in the climate records.” Langcake noted that the IPCC was not alone in this conclusion: “a number of claims have

³³⁰ SOPUS_NHVN02463964.

³³¹ SOPUS_NHVN02463965.

³³² See, for example, Ali Raza Rizvi et al., *Ecosystem Based Adaptation: Building on No Regret Adaptation Measures*, IUCN Technical Paper Presented at the 20th Session of the Conference of the Parties to the UNFCCC and the 10th Session of the Conference of the Parties to the Kyoto Protocol, Lima, Peru, December 1–12, 2014, International Union for Conservation of Nature, <https://iucn.org/sites/default/files/2022-07/iucn-eba-technical-paper-no-regret-actions-20-lima.pdf>.

³³³ Shell International Petroleum Company, “Climate Change” Internal Management Brief, Feb. 1995, <https://www.documentcloud.org/documents/4411100-Document12/>.

been made that the climate signal is now being detected,” including news reports in *The Economist* and *The New York Times*.³³⁴

While Langcake expressed skepticism about the IPCC, he nevertheless noted that its conclusions had been supported by the insurance industry, who were seeing increased damage claims related to storms and floods:

In recent months parts of the insurance industry have espoused the view that the climate signal has arrived and is evident from the mounting compensation claims from severe storms and floods. “Munich Re Feels Global Warming Impact on Growth” ran a headline in the *Financial Times* on the 9th November 1994. According to the article, Mr Wolff Otto Bauer, a director, is convinced the global trend to more frequent and damaging catastrophes would continue in the long term. “The signs that we are experiencing such a change in climate are increasing.”³³⁵

In 1997, a Shell presentation, entitled “Sustainable Development—the Challenge for Energy,” suggested that Shell had a commitment to sustainable development, and was trying to determine how that commitment should be best pursued. The presentation, by John Jennings, Chairman of the Shell Transport and Trading Company, acknowledged:

The process of extracting and transporting fossil fuels carries risks. Burning these fuels creates emissions which can contaminate the air we breath [sic]. And, in recent years, we have begun to appreciate the potential impact on the earth’s climate system of the carbon dioxide emitted to the atmosphere when we burn them.³³⁶

Given this, it was “clearly prudent to”

- develop alternative ways of economically generating energy
- learn to use energy more efficiently and
- reduce the environmental impact of burning fossil fuels.³³⁷

Indeed, he went further to suggest that it was crucial to do the latter:

Suggestions that emissions from fossil fuels could continue growing at current rates throughout next century – such as the International Panel on Climate Change’s business as usual’ scenario – are unrealistic and do not take into account the inevitable evolution of energy markets ... Given the

³³⁴ Shell International Petroleum Company. *Is Climate Change Occurring Already?* Internal Report, 1995. <https://www.documentcloud.org/documents/4411102-Document14/>.

³³⁵ Ibid.

³³⁶ Ibid.

³³⁷ Ibid.

continuing role that fossil fuels must play in supplying the world's energy needs, it is essential to reduce the environmental impact of their production, distribution, manufacture and use³³⁸

1997 was an important year for industry conversation about climate change, in part because of the public position taken by British Petroleum CEO John (later Lord) Browne. In a speech at Stanford University, Browne signaled the prospect that his company would take a different approach than they had in the past, and different from how the rest of the industry was reacting. Pledging to move BP to a new business model—one that went “beyond petroleum”—and invoking the scientific consensus on climate change—Browne said:

[W]e are all citizens of one world, and we must take shared responsibility for its future and for its sustainable development. We must do that in all our various roles: as business people with capital to invest, as legislators with the power to make law, as individual citizens with the right to vote, and as consumers with the power of choice... I believe that we've now come to an important moment in our consideration of the environment.... It is a moment for change and for a rethinking of corporate responsibility.

...[I]here is now an effective consensus among the world's leading scientists and serious and well-informed people outside the scientific community that there is a discernible human influence on the climate and a link between the concentration of carbon dioxide and the increase in temperature. [I]t would be unwise and potentially dangerous to ignore the mounting concern. The time to consider the policy dimensions of climate change is ... when the possibility ...is taken seriously by the society of which we are part. We in BP have reached that point.

As a company...our actions alone could not resolve the problem. But that does not mean we should do nothing. ...We have a responsibility to act...BP accepts that responsibility...³³⁹

Browne's high-profile acceptance of the scientific consensus on climate change and, therefore, of his company's responsibility to act, was a major departure from public statements on climate by others in the fossil industry. As James Gerstenzang reported in the *Los Angeles Times*, it was akin to the Liggett Group's

³³⁸ Ibid.

³³⁹ “Climate Change Speech By John Browne, Group Chief Executive, British Petroleum (BP America) Stanford University,” May 19, 1997, <https://www.climatefiles.com/wp-content/uploads/1997/05/bp-john-browne-stanford-1997-climate-change-speech-1.pdf>.

acknowledgment earlier that year that smoking caused cancer and heart disease, making it the first major tobacco company to do so.³⁴⁰

Following the 1997 speech, BP and several other companies took initial steps in the direction of corporate responsibility that Browne called for.³⁴¹ In 1997, BP became the first company to leave the Global Climate Coalition; Shell Oil (U.S.) left the following year. In 2001, it was reported in *The New York Times* that Shell, along with BP, recognized that “some form of greenhouse-gas limits” were needed, and were prepared to support the U.S. government to “embrace” such limits.³⁴²

In 1998, Cor Herkströter, Chairman of the Committee of Managing Directors of Royal Dutch/Shell Group and President of Royal Dutch Petroleum Company, spoke at the World Economic Forum in Davos, Switzerland. Here, he stated that, while the issue was complicated, Shell “welcomed” the Kyoto Protocol to the UNFCCC, and that:

Shell companies will ... continue wherever possible to increase energy efficiency and to reduce emissions of greenhouse gases, both in their own operations and in those of customers who are willing to be helped to do the same.

...the balance of scientific evidence suggests a link between climate change and human activity, we have a responsibility to take prudent precautionary action ... the burning of fossil fuels, together with other human activities such as deforestation, undoubtedly releases greenhouse gases – especially carbon dioxide – into the air. And that has increased the natural greenhouse effect ... precautionary measures such as the emission limits for greenhouse gases set in train by the Kyoto agreement are necessary.³⁴³

In short, by 1998, Shell knew that action was needed and stated publicly that it supported such action. And yet, in other contexts, it sent a different message, in some cases denying this knowledge and denying the evidence on which it was based.

³⁴⁰ James Gerstenzang, “Global Warming Ad Series: Ultimate Target Seems Clear,” *Los Angeles Times*, March 6, 2019, <https://www.latimes.com/archives/la-xpm-1997-dec-09-mn-62170-story.html>.

³⁴¹ Ans Kolk and David L. Levy, “Winds of Change: Corporate Strategy, Climate Change and Oil Multinationals,” *European Management Journal* 19, no. 5 (2001): 501–512, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=291719.

³⁴² Andrew C. Revkin and Neela Banerjee, “Some Energy Executives Urge U.S. Shift on Global Warming,” *The New York Times*, August 1, 2001, <https://www.nytimes.com/2001/08/01/business/some-energy-executives-urge-us-shift-on-global-warming.html>.

³⁴³ Cor Herkströter. “Reflections on Kyoto.” Speech presented at the World Economic Forum, Davos, Switzerland, February 2, 1998. DocumentCloud. Accessed April 28, 2025. <https://www.documentcloud.org/documents/4411123-Document29/>.

In 1999, Shell issued a report reviewing its advertisements, entitled “Listening and Responding: The Profits and Principles Advertising Campaign,” reviewing an advertisement entitled “Cloud the Issue or Clean the Air?” The advertisement rejected the idea that concern over global warming was “just a lot of hot air,” and affirmed Shell’s commitment not only to reducing GHG emissions, but to social responsibility more broadly:

The issue of global warming has given rise to heated debate. Is the burning of fossil fuels and increased concentration of carbon dioxide in the air a serious threat or just a lot of hot air?

Shell believes that action need to be taken now, both by companies and their customers. So last year, we renewed our commitment not only to meet the agreed Kyoto target to reduce greenhouse gas emissions, but to exceed them. ... It’s all part of our commitment to sustainable development, balancing economic progress with environmental care and social responsibility. Solutions to the future won’t come easily, particularly in today’s business climate, but you can’t find them if you don’t keep looking.³⁴⁴

This report also explains Shell’s withdrawal from the Global Climate Coalition, stating that “[t]he GCC is actively campaigning against legally binding targets and timetables” for CO₂ emissions reductions. The Shell view, in contrast, was that “prudent precautionary measures are called for...”³⁴⁵

Documents also make clear that Shell was conscious that climate change might require the company to take steps to protect and strengthen coastal facilities. A number of documents from the 2000s discuss the domain of “metocean.” Metocean—a contraction of meteorology and oceanography—refers to the combined study of these two fields in the context of coastal and offshore design and engineering.³⁴⁶ A 2015 document entitled *Metocean design and operating conditions for offshore and onshore structures—Adaption to climate change* was produced for Shell with the goal of facilitating “good design and engineering practices to be applied by Shell companies.”³⁴⁷ The plan was:

...intended to ensure that new facilities and structures (both onshore, coastal and offshore), include appropriate ‘anticipatory’ design adaptation for climate change ..such that expensive ‘reactive’ adaptation are not required during Operat[ing] phase”³⁴⁸

³⁴⁴ SOPUS_NHVN02464012 at -013.

³⁴⁵ Shell International. 1998. *Profits and Principles—Does There Have to Be a Choice? Shell Report 1998*. <https://www.documentcloud.org/documents/24359055-shell-sustainability-report-1998-post-gcc-membership-version>.

³⁴⁶ International Association of Oil and Gas Producers (IOGP). 2024. “Metocean.” Accessed April 27, 2025. <https://www.iogp.org/workstreams/environment/metocean/>.

³⁴⁷ SOPUS_NHVN02449001 at -002.

³⁴⁸ *Id.* at -004.

...While there remains uncertainty in projecting future changes in climate and its associated impacts, changes to the earth's climate, including both natural and those that may result from anthropogenic causes, already pose a risk to Shell's operations and assets. ...³⁴⁹

Climate change is projected to increase the frequency and intensity of some extreme weather events and/or change the average conditions experienced³⁵⁰

The report recognized several specific hazards, including flooding, drought, increases in sea (surface) temperature, intense tropical cyclone activity, increased coastal erosion, sea level change, wildfires, lightning occurrence, and more.³⁵¹

In 2012, a draft sustainability report made clear that, while Shell recognized the need for "reducing the impact of energy use on a planet threatened by climate change...", this included both "operating safely,"³⁵² and cutting carbon dioxide (CO₂) emissions from the use of fossil fuels "significantly if the planet is to avoid the most serious effects of global warming and climate change ..."³⁵³ The report suggested a carbon price of \$40/tonne as one way that emissions might be substantially cut.³⁵⁴

Another document, prepared in 2017, METOCEAN DATA ACQUISITION, DATA REQUIREMENTS FOR PROJECTS AND REAL-TIME SYSTEMS, further discusses standards for "good design and engineering practice to be applied by Shell companies in oil and gas production, oil refining, ... or any such facility..."³⁵⁵ While this document does not specifically discuss threats from sea level rise, it does note the need for "the acquisition of meteorological, oceanographic, ice and hydrological data for use in the design, construction and operation of offshore and onshore structures of all types used in the petroleum and natural gas industries."³⁵⁶

Many of these documents have been made public because of inquiries and investigations by academics and journalists. In 2014, a set of company documents were found by a Ph.D. student at Erasmus

³⁴⁹ *Id.* at -008 (italics in original).

³⁵⁰ *Id.* at -010.

³⁵¹ *Id.* at -011.

³⁵² SOPUS_NHVN01552638.

³⁵³ SOPUS_NHVN01552640.

³⁵⁴ *Ibid.*

³⁵⁵ SOPUS_NHVN00049494.

³⁵⁶ SOPUS_NHVN00049497.

University in Rotterdam, Netherlands. One document, from 1987, entitled “Air Pollution: an Oil Industry Perspective,” explained that “[i]t is feared that a further rise in carbon dioxide levels in the atmosphere could lead to a higher average surface temperature on Earth, which could have far-reaching environmental, social and economic consequences.”³⁵⁷ These and other documents have been analyzed by a number of groups and media outlets.³⁵⁸ So far as I am aware, Shell has never argued or provided evidence that these documents are not authentic.

In April 2018, the news group *Inside Climate News* reported on Shell’s early awareness of the threat of climate change, as well as its participation in the Global Climate Coalition.³⁵⁹ Company documents showed that, in the 1980s, “as the company pondered its responsibility to act, Shell’s scientists urged it to heed the early warnings, even if, as they said, it might take until the 2000s for the mounting evidence to prove GHGs in the atmosphere were causing unnatural climate change.”³⁶⁰

Also in 2018, *The Guardian* newspaper reported on Shell’s internal study of the question of climate change, including the 1988 Greenhouse Effect primer. The paper noted that Shell’s research, like ExxonMobil’s, “projected similar effects [as ExxonMobil] but also found that CO₂ could double even earlier, by 2030. Privately, these companies did not dispute the links between their products, global warming, and ecological calamity. On the contrary, their research confirmed the connections....” The Guardian report continued:

Shell’s assessment foresaw a one-meter sea-level rise, and noted that warming could also fuel disintegration of the West Antarctic Ice Sheet, resulting in a worldwide rise in sea level of “five to six meters.” That would be enough to inundate entire low-lying countries.

Shell’s analysts also warned of the “disappearance of specific ecosystems or habitat destruction,” predicted an increase in “runoff, destructive floods, and inundation of low-lying farmland,” and said

³⁵⁷ Sharon Kelly McNamara. 2024. “New ‘Shell Files’ Could Aid Climate Cases, Attorneys Say.” *DeSmog*, January 17, 2024. <https://www.desmog.com/2024/01/17/new-shell-files-could-aid-climate-cases-attorneys-say/>.

³⁵⁸ Benjamin Franta. 2018. “Shell Knew: The Corporation’s Secret Climate Change Knowledge Charted Over 30 Years.” *DeSmog*, May 17, 2018. <https://www.desmog.com/2018/05/17/shell-knew-charting-thirty-years-corporate-climate-denialism/>.

³⁵⁹ John H. Cushman Jr. 2018. “Shell Knew Fossil Fuels Created Climate Change Risks Back in 1980s, Internal Documents Show.” *Inside Climate News*, April 5, 2018. <https://insideclimatenews.org/news/05042018/shell-knew-scientists-climate-change-risks-fossil-fuels-global-warming-company-documents-netherlands-lawsuits/>.

³⁶⁰ John H. Cushman Jr. 2018. “Shell Knew Fossil Fuels Created Climate Change Risks Back in 1980s, Internal Documents Show.” *Inside Climate News*, April 5, 2018. <https://insideclimatenews.org/news/05042018/shell-knew-scientists-climate-change-risks-fossil-fuels-global-warming-company-documents-netherlands-lawsuits/>.

that “new sources of freshwater would be required” to compensate for changes in precipitation. Global changes in air temperature would also “drastically change the way people live and work.” All told, Shell concluded, “the changes may be the greatest in recorded history.”³⁶¹

An important venue for a company to communicate risks is in its annual reports. Shell’s annual reports since 2001, which are available online, confirm that Shell was aware of climate risks, and communicated at least some of this understanding in its annual reports.³⁶²

In 2007, for example, Shell acknowledged climate risks, stated that those risks could get worse given their own plans to develop more unconventional sources, and that these risks could have operational and financial consequences. (Unconventional in this context would mean tar sands, oil in shale, or ultra-deepwater oil that would be harder to extract and refine). In a section headed, “IMPACT OF CLIMATE CHANGE CONCERNS,” the company stated:

Emissions of greenhouse gases and associated climate change are real risks to the company and society in general. In the future, in order to help meet the world’s energy demand, we will produce more oil from unconventional sources. Therefore, in the long term, it is expected that the CO₂ intensity of our production will increase. If we are unable to find CO₂ solutions for new and existing projects, future government regulation or challenges from society could lead to project delays, additional costs as well as compliance and operational risks. These risks if realised could affect our operational performance and financial position.³⁶³

In the same report, Shell boasted that they were “one of the first energy companies to acknowledge the threat of climate change, to call for action, and to take action ourselves. In 1998, we set ourselves voluntary targets for reducing GHG emissions from our operations.”³⁶⁴

³⁶¹ Sandra Laville. 2018. “Shell and Exxon’s Secret 1980s Climate Change Warnings.” *The Guardian*, September 19, 2018. <https://www.theguardian.com/environment/climate-consensus-97-per-cent/2018/sep/19/shell-and-exxons-secret-1980s-climate-change-warnings>.

³⁶² Shell plc. 2024. “Annual Reports Archive.” Accessed April 27, 2025. <https://www.shell.com/investors/results-and-reporting/annual-report-archive.html#tab-2007>.

³⁶³ Royal Dutch Shell plc. 2008. *Annual Report and Form 20-F for the Year Ended December 31, 2007* (The Hague: Royal Dutch Shell plc), at 17, https://www.shell.com/investors/results-and-reporting/annual-report-archive/jcr_content/root/main/section_812377294/tabs/tab_1465303738_copy/text_copy.multi.stream/1658487530355/80ca45fdec23cc4e0f292222d91dbb64f8da391e/annual-report-and-form-20-f-2007.pdf.

³⁶⁴ *Id.* at 73.

In 2013, Shell mentioned risks to its own facilities: "... in our own operations, we are working to understand the potential physical impact of climate change in the future on our facilities and new projects."³⁶⁵

In 2015, Shell stressed that the company had "long recognised that the use of fossil fuels contributes to climate change." Referring to the November 2015 Paris Agreement, Shell stated that they "welcome[d] the efforts made by governments to reach a global climate agreement." The report also noted that "current oil, gas and CO₂ prices are too low to stimulate the fossil fuel substitution necessary to meet the Paris Agreement goal of limiting the average global temperature increase to well below 2° C."³⁶⁶ Indeed, they stated: "Accordingly, we have also evaluated the resilience of our portfolio using our own business-case model that assumes an average global temperature increase of 2-3° C by 2100."³⁶⁷ In other words, Shell was expecting warming to reach 2-3° C, and not to be limited to 2° C, much less 1.5. The 2015 report noted that their assessments were based on reporting from the IPCC.³⁶⁸

The 2018 annual report noted the risk of sea level rise: "In addition, physical effects of climate change such as, but not limited to, rise in temperature, sea-level rise and fluctuations in water levels could adversely impact both our operations and supply chains."³⁶⁹

The 2019 report noted that concerns over climate change had increased: "Rising climate change concerns have led and could lead to additional legal and/or regulatory measures which could result in project delays or cancellations, a decrease in demand for fossil fuels, potential litigation and additional compliance obligations." And it repeated the language of the previous year's report: "In addition, the

³⁶⁵ Royal Dutch Shell plc. 2014. *Annual Report and Form 20-F for the Year Ended December 31, 2013*, (The Hague: Royal Dutch Shell plc), at 54, https://www.shell.com/investors/results-and-reporting/annual-report-archive/jcr_content/root/main/section_812377294/tabs/tab_55706488_copy/text_copy.multi.stream/1742905707925/973768aed60d90ad2e20728f27170d1222208b5/shell-annual-report-2013.pdf.

³⁶⁶ Royal Dutch Shell plc. 2016. *Annual Report and Form 20-F for the Year Ended December 31, 2015* (The Hague: Royal Dutch Shell plc), at 54, https://www.shell.com/investors/results-and-reporting/annual-report-archive/jcr_content/root/main/section_812377294/tabs/tab_61705099_copy_234306435/text_copy.multi.stream/1742905718142/f5446aa830443e923e6bba2090ffdc92d5c04b5/shell-annual-report-2015.pdf.

³⁶⁷ *Id.* at 57.

³⁶⁸ *Id.* at 55.

³⁶⁹ Royal Dutch Shell plc. *Annual Report and Form 20-F 2018* (The Hague: Royal Dutch Shell plc, 2019), at 20. <https://reports.shell.com/annual-report/2018/>.

physical effects of climate change such as, but not limited to, rise in temperature, sea-level rise and fluctuations in water levels could adversely impact both our operations and supply chains.”³⁷⁰

The 2020, 2021, and 2022 annual reports repeated this exact language: “In addition, the physical effects of climate change such as, but not limited to, rise in temperature, sea-level rise and fluctuations in water levels could adversely impact both our operations and supply chains.”³⁷¹

In 2023, the wording was ever-so-slightly modified: “The physical effects of climate change such as, but not limited to, increases in temperature and sea levels and fluctuations in water levels could also adversely affect our operations and supply chains.”³⁷² In 2024, the most recent year for which an annual report is available, the company expanded the statement to say:

The impact of physical risks comes from both acute and chronic climate hazards. Acute hazards, such as flooding and droughts, wildfires and more severe tropical storms, and chronic hazards, such as rising temperatures and rising sea levels, could potentially impact some of our facilities, operations and supply chains. The frequency of these hazards and impacts is expected to increase in certain locations. Extreme weather events, whether or not related to climate change, could have a negative impact on our earnings, cash flows and financial condition. Mitigation of physical risks, whether or not related to climate change, is considered and embedded in the design and construction of our projects, and/or operation of our assets to help minimise the risk of adverse incidents to our employees and contractors, the communities where we operate, and our equipment.³⁷³

Various other documents attest to the specific issue of strengthening facilities in the face of climate change, particularly the metocean documents already discussed.³⁷⁴ For example, the draft 2012 “Sustainability Report” states: “Adaptation. In our own operations, we are working to understand the potential physical impact of climate change in the future on facilities and new projects.”³⁷⁵

³⁷⁰ Royal Dutch Shell plc, *Annual Report and Accounts 2019* (The Hague: Royal Dutch Shell plc, 2020), at 29, <https://reports.shell.com/annual-report/2019/>.

³⁷¹ Royal Dutch Shell plc, *Annual Report and Accounts 2020* (The Hague: Royal Dutch Shell plc, 2021), at 29 <https://reports.shell.com/annual-report/2020/>; Royal Dutch Shell plc, *Annual Report and Accounts 2021* (The Hague: Royal Dutch Shell plc, 2022), at 23, <https://reports.shell.com/annual-report/2021/>; Shell plc, *Annual Report and Accounts 2022* (The Hague: Shell plc, 2023), at 16 <https://reports.shell.com/annual-report/2022/>.

³⁷² Shell plc, *Annual Report and Accounts 2023* (The Hague: Shell plc, 2024), at 15, <https://reports.shell.com/annual-report/2023/>.

³⁷³ Shell plc, *Annual Report and Accounts 2024* (The Hague: Shell plc, 2025), at 83 <https://www.shell.com/investors/results-and-reporting/annual-report.html>.

³⁷⁴ See also Am. Compl. ¶ 173, *Conservation Law Foundation v. Shell, et al.*, No. 3:21-cv-00933 (D. Conn. Feb. 11, 2022).

³⁷⁵ SOPUS_NHVN01552635. See also Royal Dutch Shell PLC. “Sustainability Report,” 2012. https://www.shell.com/sustainability/reporting-centre/reporting-centre-archive/jcr_content/root/main/section_2106585602/tabs/tab_1645439879_copy_1694950103/text_copy_copy_copy_1589128498/links/item0.stream/1742906402534/c2e481e4e338e35121eabf18cd563f67d772301b/shell-sustainability-report-2012.pdf.

Another Metocean Design document, prepared in 2015, clearly recognizes that past experience may no longer be an adequate guide to current and future risks, and that design criteria need to respond to this:

Due to climate change, historical data is no longer a reliable predictor of future impacts, and where required, metocean criteria shall be supplemented by the requirements in this DEP [Design and Engineering Practice] to take into account climate change hazards severity.³⁷⁶

There have in fact already been problems caused by “insufficient understanding” of changes already taking place:

This DEP provides guidance on the processes for including climate change . . . in the metocean design criteria for all types of offshore and onshore installations. Failure of structures have occurred in instances where incomplete metocean assessments have been conducted which include insufficient understanding of changes in means, extremes or variability in design criteria, which has caused loss of structural integrity.³⁷⁷

The importance of design and engineering criteria in managing climate risks was underscored in the deposition of Shell senior ice and metocean engineer Paul Verlaan, who has worked for Shell since 2002.³⁷⁸ Verlaan has expertise in climate science, climate variability, and the physics of global warming.³⁷⁹ In 2018, he served on the organizing committee for a joint industry-science workshop, sponsored by the International Association of Oil and Gas Producers, the World Climate Research Programme, and the Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM) of the World Meteorological Organization, *Our Future Climate: Understanding the Spread of Physical Risk for the Oil and Gas Industry*, held at the BP Upstream Learning Centre in the UK.³⁸⁰ The conference programme stressed the need to understand both the social impacts and the “physical risks, for example, increased flood levels, sea level rise, and changing storm patterns” related to climate change.³⁸¹

³⁷⁶ See SOPUS_NHVN02449001 at -009 (DEP Specification. METOCEAN DESIGN AND OPERATING CONSIDERATIONS FOR OFFSHORE AND ONSHORE STRUCTURES – ADAPTION TO CLIMATE CHANGE. DEP 37.00.10.14-Gen. (Feb. 2015) (not final approved)).

³⁷⁷ SOPUS_NHVN02448985 at -999.

³⁷⁸ "Paul Verlaan." LinkedIn. Accessed April 28, 2025. <https://www.linkedin.com/in/paul-verlaan-173997ab/>.

³⁷⁹ "Paul Verlaan." ResearchGate. Accessed April 27, 2025. <https://www.researchgate.net/profile/Paul-Verlaan>.

³⁸⁰ International Association of Oil & Gas Producers (IOGP). *Our Future Climate: Understanding the Spread of Physical Risk for the Oil and Gas Industry – Workshop Programme*. IOGP/JCOMM/WCRP Workshop, September 25–27, 2018, BP Upstream Learning Centre, Sunbury, UK. Accessed April 27, 2025. https://www.iogp.org/wp-content/uploads/2018/10/Presentation00_WorkshopProgramme.pdf.

³⁸¹ IOGP, *Our Future Climate*, *supra* note 381.

In his deposition, Verlaan confirmed that the IPCC is a credible source of climate science, that Shell was aware of and broadly accepted IPCC findings, that Shell understood that climate change created risks for fossil fuel facilities, that Shell maintains risk registers, and that risk management is an essential part of Shell's asset management, including risks to refineries and liquid natural gas (LNG) facilities.³⁸² He also confirmed that Shell design and engineering practices had to take into account hurricane risk, and that 2004 Hurricane Ivan, a category 4 storm as it passed through the Gulf of Mexico, had produced "waves and winds that matched or exceeded the 100-year design criteria of many installations," including one wave at a nearby weather buoy measured at 83 feet.³⁸³ Seven platforms were destroyed in the storm and five rigs suffered major damage.³⁸⁴

Later in the deposition, Verlaan confirmed that, in 2015, Shell produced a document "Metocean Design and Operating Considerations for Offshore and Onshore Structures—Adaptation to Climate Change."³⁸⁵ This document discussed damage from hurricanes Katrina and Rita, stating: "We cannot be certain global warming intensified Katrina per se [but i]t clearly has created circumstances under which powerful storms are more likely to occur than they were in the past."³⁸⁶ Verlaan also responded to questions regarding 2017 Hurricane Harvey, which caused severe damage, including explosions and fires at Arkema chemical plants (Arkema is a company, created in 2004, through a reorganization of the chemicals branch of Total oil and gas.)³⁸⁷ Verlaan acknowledged and did not dispute a Shell document that links the Harvey damage to climate change, particularly because of the extremely heavy precipitation and flooding that was associated with that event. The document explains: "the major climate change signal impacting hurricanes is

³⁸² Deposition of Paul Verlaan (Shell Global Solutions), March 20, 2025, 20:1–25:9.

³⁸³ Verlaan Dep., 48:20–25. Hurricane Ivan actually peaked as a Category 5 storm over the Cayman Islands. National Centers for Environmental Information (NCEI), "On This Day: Hurricane Ivan Made Its First U.S. Landfall," National Oceanic and Atmospheric Administration (NOAA), accessed April 28, 2025, <https://www.ncei.noaa.gov/news/on-this-day-hurricane-ivan-2004>.

³⁸⁴ Verlaan Dep., 49:1–2.

³⁸⁵ Verlaan Dep., 52:4–11; SOPUS_NHVN02448985.

³⁸⁶ Verlaan Deposition 53:11–25. While the document was marked "Not final approved," it clearly indicates the understanding that climate change was increasing the risk of severe hurricanes like Katrina, Ivan, and Rita.

³⁸⁷ "The Arkema group was created in October 2004, following the reorganization of Total's Chemicals branch," ARKEMA, <https://www.arkema.com/global/en/arkema-group/profile/history/>.

a significant increase (30%) and an even larger increase in runoff and considered one of the major causes of high rainfall.”³⁸⁸ Verlaan also acknowledged damage associated with Superstorm Sandy. An email dated November 1, 2012 detailed a spill of 336,000 gallons of diesel fuel from the Motiva oil tank facility as a result of storm surge; the spill had prompted extensive media coverage. Verlaan explained how such a spill could occur: the storm surge could lift and rupture the storage tanks.³⁸⁹ (Later scientific studies confirmed that the impacts of Superstorm Sandy were “significantly worsened by sea level rise attributable to climate change.”³⁹⁰) Later in the deposition, Verlaan again acknowledged that climate change can increase maximum rainfall intensity in tropical cyclones, including more rainfall over shorter periods and more severe cyclones reaching higher latitudes.³⁹¹

Verlaan was asked about whether Shell shared information about flooding risk to fossil fuel facilities with other companies; he affirmed that they did, as for, example, in a 2013 IPIECA document discussing the oil and gas industry's awareness of climate change-related risks, including floods and sea level rise.³⁹² Another example was the 2018 workshop, mentioned above, that Verlaan helped to organize; participants included representatives from ExxonMobil, Chevron, BP, Conoco-Phillips, Equinor, BHP Billiton, and Petrobras, as well as government and scientific groups. The conference primarily focused on climate change adaptation and risk management.³⁹³

Verlaan also acknowledged industry sharing of data and information in the context of a 2010 report, “Adaptation in the Oil and Gas Industry to Projected Impacts of Climate Change,” which was referred to in

³⁸⁸ Verlaan Dep., 67: 1–22.

³⁸⁹ Verlaan Dep., 70:1–85:2. See Verlaan Dep., 81:17–19 for the discussion of the lifting of tanks. See also “Sandy Responsible for 300,000 Gallon Oil Spill on U.S. East Coast,” *The Maritime Executive*, November 1, 2012, accessed April 28, 2025, <https://maritime-executive.com/article/sandy-responsible-for-300-000-gallon-oil-spill-on-u-s-east-coast> for industry coverage.

³⁹⁰ U.S. Global Change Research Program. 2021. “Modeling Study Shows That Hurricane Sandy Damages Were Worsened by Climate Change.” Last modified May 18, 2021. [https://www.globalchange.gov/highlights/modeling-study-shows-hurricane-sandy-damages-were-worsened-climate-change-#8203:contentReference\[oaicite:1\]{index=1}](https://www.globalchange.gov/highlights/modeling-study-shows-hurricane-sandy-damages-were-worsened-climate-change-#8203:contentReference[oaicite:1]{index=1}); see Shindell, Drew, Greg Faluvegi, Karl Seltzer, and Cary Shindell. “Increased Mortality and the Value of Climate Services from 14 Years of NASA Satellite Data.” *Nature Communications* 12, no. 1 (2021): Article 2185. <https://doi.org/10.1038/s41467-021-22838-1> for the scientific details.

³⁹¹ Verlaan Dep., 217:10–223:5.

³⁹² Verlaan Dep., 103:2–109:3 (discussing Verlaan Exhibit No. 1256 (Report “Addressing Adaptation in the Oil and Gas Industry,” International Petroleum Industry Environmental Conservation Association (IPIECA), July 21, 2013, <https://www.ipieca.org/resources/addressing-adaptation-in-the-oil-and-gas-industry.>)).

³⁹³ Verlaan Dep., 115:2–121:2.

his 2020 Climate Adaptation report. The document emphasized the critical need for adaptation alongside emission reductions to mitigate climate change impacts. Another document, "Climate Risk Assessment: Pilot Project," created by the UK Met Office in collaboration with the Hadley Centre, indicated Shell's commitment to managing vulnerability to climate change since 2012. Verlaan acknowledged being familiar with both documents.³⁹⁴

When asked about his specific role in communicating climate risk and danger within the company, Verlaan estimated that he may have authored 10–15 presentations related to climate change or climate adaptation. He also discussed a specific Shell policy—DEP 37.00.10.10—that required the inclusion of climate change effects in certain design and operating criteria.³⁹⁵ Verlaan also testified that there was a PowerPoint presentation on the methodology he had developed to “do a physical climate change risk.”³⁹⁶ Verlaan used a tool developed by the reinsurance company, Munich Re. for obtaining data on natural hazards and their potential changes due to climate change.³⁹⁷

In 2020, Verlaan co-authored a report with Anveshan Chaudhary, a Shell Projects & Technology employee. The report, *Climate Change Impact and Adaptation*. Verlaan acknowledged that the report stated that “climate change is responsible for an increase in the hazard severity that leads to an increase in Shell’s risks to Shell’s assets.”³⁹⁸ The main risks discussed are higher air and sea temperature, rising sea levels, increased probability of flooding and drought and increased severity of tropical cyclones.”³⁹⁹ Drawing on the IPCC Fourth Assessment Report, Verlaan’s report offers a quantitative assessment of the sea level rise risk of 0.55–0.9 meters by 2100.⁴⁰⁰

Verlaan also acknowledged a report he had authored that suggested that the impacts of climate change could in the future exceed Shell’s design standards or may have already exceeded those standards.

³⁹⁴ Verlaan Dep., 187:3–193:1.

³⁹⁵ Verlaan Dep., 145:1–151:1. For comments on “10–15 presentations”, see Verlaan Dep., 146:3–6.

³⁹⁶ Verlaan Dep., 147:6–7.

³⁹⁷ Verlaan Dep., 169:1–175:1.

³⁹⁸ Verlaan Dep., 208:3–6 (*discussing* SOPUS_NHVN02407407).

³⁹⁹ Verlaan Dep., 209:22–25; 210:11.

⁴⁰⁰ Verlaan Dep., 209; 211: 9–14.

Shell's design standards are "conservative," he explained, meaning that while they are based on normal conditions they also build in a margin of error. However, these margins may be insufficient in the face of a rapidly changing climate. He wrote:

Designs are partly driven by metocean conditions in an area, and these conditions will change and/or will be subject to more uncertainty. In many cases, the design itself has a considerable degree of conservatism that can easily capture the relatively limited effect of a changing climate... However, in other cases, it may not be so straightforward.⁴⁰¹

Verlaan relied on the 2007 IPCC report to confirm that the physical impacts of climate change are underway and will worsen unless emissions are greatly reduced. He agreed with the IPCC statement that "the more severe future impacts are unavoidable unless we do succeed in reducing greenhouse gas emissions..."⁴⁰² In sum, after decades of acknowledging that climate change would produce future vulnerabilities in Shell facilities, by 2015 those vulnerabilities had in fact become present-day problems. Shell knew this, and in some cases took steps to incorporate climate risk into design and engineering criteria.

A. Shell Projections from the 2010s

In 2014, colleagues and I analyzed the projection of Shell, BP, and ExxonMobil regarding future energy use and GHG gas emissions. At that time, their vision of the future was one in which global emissions would rise *faster* than the most pessimistic business-as-usual scenario offered by the IEA—a scenario would put the world on track to bring temperatures towards or above 4° C by 2100. The various energy scenarios envisioned by BP, Shell, and ExxonMobil differed in their particulars, but all assumed that there would be no global price or cap on carbon, and no other strict regulatory limit on carbon emissions for decades. Thus, in these projections, rising emissions lead to warming well in excess of 2 °C (Figure 1). There is no expectation that climate change is brought under control, and therefore no reason to conclude that the impacts discussed over the previous decades would not, in fact, occur.

⁴⁰¹ Verlaan Dep., 230: 9–18 (discussing SOPUS_NHVN02407397 at -436 (Report "Climate Change Impact and Adaptation," Shell Global Solutions International B.V. (June 2020))). *See also* continuing discussion at 230:19–235:1.

⁴⁰² Verlaan Dep., 232:10–19.

In its 2013 projections, Shell was explicit that the energy futures they envisioned were ones in which carbon emissions would have dangerous consequences (Figure 1). Even the more optimistic of the two energy futures they considered would “overshoot the trajectory for a 2 °C goal.”⁴⁰³ (Indeed, Shell’s forecasts are more pessimistic than those produced by ExxonMobil at about the same time.) Yet, despite recognizing this, they offered no alternative to avoid that overshoot. And indeed, no meaningful global price or strict regulatory limit has been placed on carbon, and the IPCC considers that the world is now on track to overshoot the 2° C threshold for avoiding dangerous climate change.⁴⁰⁴

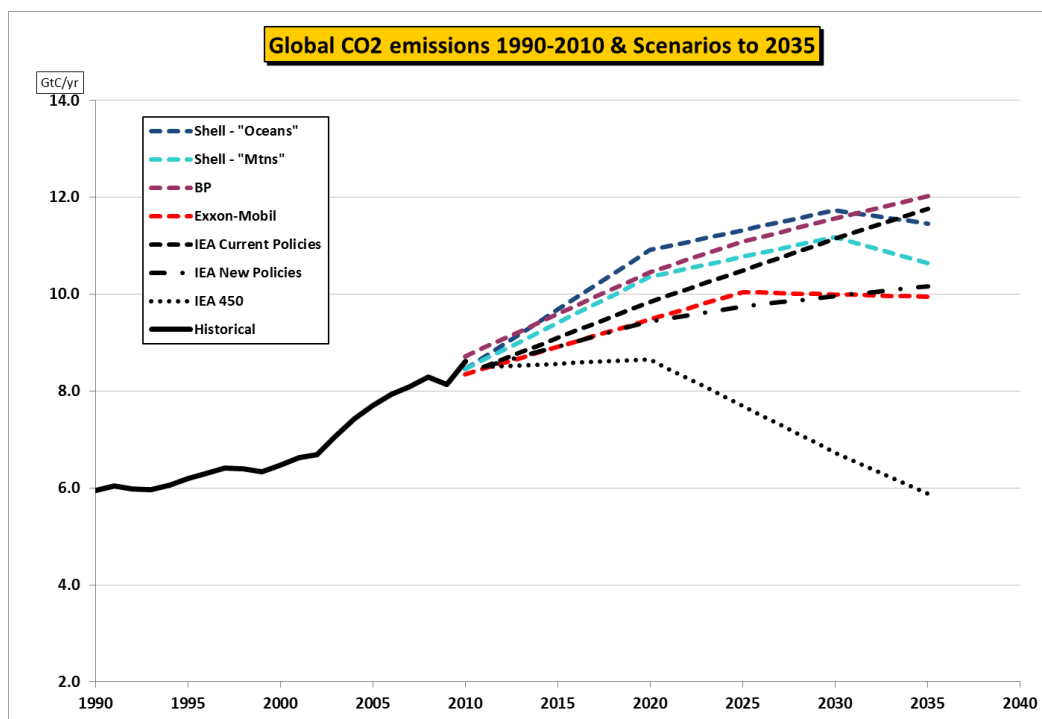


Figure 1. Scenarios of Carbon Emissions through 2035 by the International Energy Agency (IEA) and major fossil energy companies (International Energy Agency 2013; ExxonMobil 2014; BP 2014; Royal Dutch Shell plc 2013)

⁴⁰³ Royal Dutch Shell plc, *New Lens Scenarios: A Shift in Perspective for a World in Transition* (The Hague: Royal Dutch Shell plc, 2013), <https://www.shell.com/content/dam/royaldutchshell/documents/corporate/scenarios-newdoc.pdf3>.

⁴⁰⁴ Center for International Environmental Law (CIEL) and Heinrich Böll Stiftung, *Beyond the Limits: New IPCC Working Group II Report Highlights How Gambling on Overshoot is Pushing the Planet Past a Point of No Return*, February 28, 2022, https://www.ciel.org/wp-content/uploads/2022/02/CIEL_HBF_IPCC-WGII-Key-Messages-28Feb2022.pdf; Intergovernmental Panel on Climate Change, *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, ed. H.-O. Pörtner et al. (Cambridge, UK and New York, NY: Cambridge University Press, 2022), <https://www.ipcc.ch/report/ar6/wg2/>.

In these projections, BP, ExxonMobil and Shell all project a continued high reliance on fossil energy, well above the pathway (IEA 450) that would result in a 50% probability of keeping global temperatures from rising above the 2° C policy target.

In 2021, the IPCC concluded that keeping warming below 1.5° C, or even 2° C, is probably now beyond reach.⁴⁰⁵ Many have concluded that current policies and economic activity is likely to lead to 2.5–2.9 degrees of warming.⁴⁰⁶ The most recent U.S. National Climate assessment, released in 2023, stressed that “homes and property are at risk from sea level rise and more intense extreme events.”⁴⁰⁷

Based on the information Shell had, or had access to, Shell knew of, and sometimes acted on, the risks to its facilities and operations.

In my previous work, my colleagues and I have documented the specific and, in hindsight, accurate climate projections made by ExxonMobil.⁴⁰⁸ The data and information used by ExxonMobil were also available to Shell, and the materials discussed in this report make clear that Shell had a similar overall understanding of climate risks.

Shell had ample opportunity to act on this information, including to mitigate the risks to their facilities and operations. Moreover, the materials presented here show that in at least one case—the raising of the North Sea oil platform—they did take such steps. A 2015 report by *The Los Angeles Times* enumerated a number of additional cases in which oil and gas companies made changes to installations in light of climate-related concerns. In 1994, for example, a group of engineers involved in the design of Europipe, a

⁴⁰⁵ IPCC. “Climate change widespread, rapid, and intensifying – IPCC,” August 9, 2021. <https://www.ipcc.ch/2021/08/09/ar6-wg1-20210809-pr/#:~:text=Faster%20warming,and%20how%20we%20can%20prepare.%E2%80%9D>.

⁴⁰⁶ Climate Action Tracker. “Emissions Pathways to 2100.” November 2024. <https://climateactiontracker.org/global/emissions-pathways/>. See also U.S. Global Change Research Program, “Future Climate Change,” in *Climate Change Impacts in the United States: The Third National Climate Assessment* (2014), <https://nca2014.globalchange.gov/report/our-changing-climate/future-climate-change>.

⁴⁰⁷ U.S. Global Change Research Program. “Overview: Understanding Risks, Impacts, and Responses,” in *Fifth National Climate Assessment*, edited by Allison Crimmins et al., 1–47. Washington, DC: U.S. Global Change Research Program, 2023. <https://nca2023.globalchange.gov/#overview-section-3>.

⁴⁰⁸ Geoffrey Supran and Naomi Oreskes, “Assessing ExxonMobil’s Climate Change Communications (1977–2014),” *Environmental Research Letters* 12, no. 8 (August 2017): 084019, <https://doi.org/10.1088/1748-9326/aa815f>; G. Supran, S. Rahmstorf, and N. Oreskes, “Assessing ExxonMobil’s Global Warming Projections,” *Science* 379, no. 6628 (January 13, 2023): eabk0063, <https://doi.org/10.1126/science.abk0063>; Geoffrey Supran and Naomi Oreskes, “Rhetoric and Frame Analysis of ExxonMobil’s Climate Change Communications,” *One Earth* 4, no. 5 (May 21, 2021): 696–719, <https://doi.org/10.1016/j.oneear.2021.04.014>.

natural gas pipeline, noted that “sea levels had risen over the last century, and suggested there could be a “considerable increase of the frequency of storms as a result of a climate change,” and “concluded that although climate change was a ‘most uncertain parameter,’ their pipeline designs should include protections against its impact.”⁴⁰⁹ The Europipe project was a joint venture between Shell, Exxon, Conoco, Total, and Statoil.

In 1996, Mobil Oil changed the design of facilities in Nova Scotia, Canada, to account for anticipated sea level rise (Shell was a joint owner of the project.) In response to the article, a spokesperson for ExxonMobil acknowledged that the company had taken into account a variety of “short-term and long-term” risks, “some of which could be associated with climate change.”⁴¹⁰

By the early 2000s, the Canadian government was requiring companies to include climate change in their planning and operations. In a hearing on a proposed project in the Canadian Northwest Territory, an engineer for Imperial Oil, ExxonMobil’s Canadian affiliate, testified that the proposed project “generally accepts that climate warming is occurring and that’s generally included in the design calculations.”⁴¹¹

These examples demonstrate that the fossil fuel industry was broadly aware of the threats represented by climate change, considered already by the 1990s that some climate-driven changes were already underway, and in at least some cases took steps to incorporate such changes—and worsening future changes—into its design specifications. The information available and known to ExxonMobil, Total, Statoil and others was also available and known to Shell.

B. Summary Of Opinion Two

Shell has repeatedly acknowledged the reality of climate change, its potential severity, and the need for adaptation, but nevertheless failed to take steps to protect its facilities. Since the 1980s, Shell has repeatedly acknowledged the reality of man-made climate change, and the potential for serious damage, particularly in

⁴⁰⁹ Amy Lieberman and Susanne Rust. "Big Oil Braced for Global Warming While It Fought Regulations." *Los Angeles Times*, December 31, 2015. <https://graphics.latimes.com/oil-operations/>.

⁴¹⁰ Ibid.

⁴¹¹ Ibid.

relation to sea level rise. Shell publicly acknowledges both climate change and even that it needed to take steps to mitigate the risks from climate change. In some cases, design and engineering plans took anticipated sea level rise into account.

Opinion Three: Despite what it knew and should have known, Shell supported third party organizations that disparaged the credible scientific evidence of climate change and worked to block the meaningful policy that Shell publicly claimed to support.

The historical record clearly shows that, as early as the 1980s and through to the present, Shell corporate leaders and employees were aware of advances in climate science and sensitive to what climate change might mean both for its operations and installations, and for demand for its products. By and large, Shell appreciated, understood, and accepted that science and its implications. Like other fossil fuel companies, Shell at times highlighted scientific uncertainties, but crucially, they recognized that these uncertainties did not invalidate the core scientific findings, summarized and assessed by the IPCC and respected scientific bodies: that increasing atmospheric CO₂ and other GHGs were causing planetary-scale climate change, and various more local impacts of that change. These impacts included sea level rise and increased frequency or intensity of extreme weather events, both of which had direct and potentially severe consequences for Shell facilities and operations. The awareness and understanding were expressed both in internal company reports and in public statements by corporate engineers and officers. In general, Shell did not display a pattern of denying or disparaging climate science.

Yet, at the same time, Shell contributed substantial sums of money to third parties, particularly think-tanks, that did reject or disparage climate science. Various media outlets and citizen's groups have reported on this history, based in part on documents that have become available during legal proceedings in Europe.

In 2017, *The Guardian* newspaper reported on the 1991 film, *Climate of Concern*, which accurately summarized the state of climate science at that time and warned of potentially catastrophic risks. As we have seen, Shell repeatedly claimed to support reasonable measures to address climate change. Yet, in the early 2010s Shell successfully lobbied to undermine European renewable energy targets "ahead of a key

agreement,” that observers had expected to yield a system of binding emissions reductions. While a Shell spokesman had previously claimed that Shell supported the 40% emissions reduction target, achieved through an enforceable emissions trading program, observers now reported that Shell played a major role in blocking any binding target.⁴¹²

Inside Climate News reported in 2018 on the documents found by a Dutch journalist, Jelmer Mommer of the newspaper *De Correspondent*, stressing Shell’s participation in and funding of the Global Climate Coalition.⁴¹³ A more recent *Guardian* article, published in 2024, reported that the Shell USA Company Foundation, headed by Shell USA President Gretchin Watkins, had donated more than half a million dollars to organizations that denied the reality of climate change or disparaged climate science. One of these groups is the Heartland Institute, an organization that has long questioned climate science,⁴¹⁴ and in 2012 compared climate scientists to the terrorist, Ted Kaczynski (the “Unabomber”) and to mass murderer Charles Manson.⁴¹⁵ Another is the American Family Association, which claims that the “climate change agenda is an attack on God’s creation,” by “falsely blaming man for climate change.”⁴¹⁶

According to the NGO Influence Map, in 2015 Shell spent an estimating \$22 million lobbying against climate policies.⁴¹⁷ They note that these activities represent a “significant use of shareholder funds to obstruct ambitious climate policy.”⁴¹⁸ Using what it calls a conservative methodology, and not accounting for “dark money” contributions, InfluenceMap concludes that fossil fuel companies, together with API and

⁴¹² Arthur Neslen. "Shell Lobbied to Undermine EU Renewables Targets, Documents Reveal." *The Guardian*, April 27, 2015. <https://www.theguardian.com/environment/2015/apr/27/shell-lobbied-to-undermine-eu-renewables-targets-documents-reveal>.

⁴¹³ John H. Cushman, Jr. "Shell Knew Fossil Fuels Created Climate Change Risks Back in 1980s, Internal Documents Show." *Inside Climate News*, April 5, 2018. <https://insideclimatenews.org/news/05042018/shell-knew-scientists-climate-change-risks-fossil-fuels-global-warming-company-documents-netherlands-lawsuits/>. See also Climate Investigations Center, "Shell Climate Documents," <https://climateinvestigations.org/shell-oil-climate-documents/>.

⁴¹⁴ Katie Worth. "In Shift, Key Climate Denialist Group Heartland Institute Pivots to Policy." *Frontline*, November 2, 2018. <https://www.pbs.org/wgbh/frontline/article/in-shift-key-climate-denialist-group-heartland-institute-pivots-to-policy/>.

⁴¹⁵ NBC News. "Shell Oil Knew Climate Change Was Real in 1980s, Documents Show." *NBC News*, May 3, 2012. <https://www.nbcnews.com/id/wbna47297970>.

⁴¹⁶ Walker Wildmon. "Why Climate Change Agenda Is an Attack on God's Creation." *The Stand*, August 23, 2022. <https://afa.net/the-stand/culture/2022/08/why-climate-change-agenda-is-an-attack-on-god-s-creation/>.

⁴¹⁷ Oliver Milman. "Shell Accused of Backing Project 2025 Plans to Dismantle Climate Protections." *The Guardian*, August 15, 2024. <https://www.theguardian.com/us-news/article/2024/aug/15/shell-oil-project-2025-climate-crisis>; InfluenceMap. *How Much Big Oil Spends on Obstructive Climate Lobbying: March 2016 Report*. https://content.influencemap.org/site/data/000/173/Lobby_Spend_Report_March_2016.pdf.

⁴¹⁸ InfluenceMap. *How Much Big Oil Spends on Obstructive Climate Lobbying*, at 2.

other trade associations (for example the Western States Petroleum Association), spend almost \$155 million annually on obstructive climate policy lobbying. ExxonMobil and Shell account for the largest individual shares, at \$27 and \$22 million respectively. The API, funded in part by ExxonMobil and Shell, spent an estimated \$65 million.⁴¹⁹ Companies are of course legally entitled to lobby, but these activities fly in the face of Shell's expressed commitment to doing its share to responsibly address the problem.⁴²⁰

The documentary record makes clear that 1) scientific evidence has been available for decades that man-made climate change would cause sea-level rise, and ensuing damage thereby; 2) documentary evidence knows that Shell was well aware of and broadly accepted this scientific evidence; 3) Shell accepted, adopted, and in some cases acted upon the scientific evidence, while also working to disparage and undermine the scientific consensus.

⁴¹⁹ Ibid.

⁴²⁰ On what shell has promised to do, versus what it has actually done, *see* ClientEarth. "The Greenwashing Files: Shell." *ClientEarth*. Accessed April 28, 2025. <https://www.clientearth.org/projects/the-greenwashing-files/shell/>. For example, "Between 2010 and 2018, Shell was estimated to have dedicated of its long-term investments to sources of low-carbon energy like wind and solar, and in 2015-2017 only 0.4% of its revenue to low-carbon technology R+D."

I certify under penalty of perjury that the opinions expressed in this expert report are true and correct to the best of my knowledge and ability. My opinions are stated to a reasonable degree of certainty and consistent with prevailing and scientific standards of practice.

Submitted on this 1st day of May, 2025.

A handwritten signature in black ink, appearing to read "Naomi Oreskes", written in a cursive style.

Naomi Oreskes

Appendix 1. Naomi Oreskes Curriculum Vitae (CV)



Naomi Oreskes

Henry Charles Lea Professor of the History of Science
Affiliated Professor of Earth and Planetary Sciences
Harvard University, Cambridge MA

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<http://www.fas.harvard.edu/~hsdept/bios/oreskes.html>

Education

B.Sc. (First Class Honours) 1981 Royal School of Mines, Imperial College

Ph.D. 1990 Stanford University (Graduate Special Program: Geological Research and History of Science)

EMPLOYMENT

Current	Henry Charles Lea Professor of the History of Science, Affiliated Professor of Earth and Planetary Sciences, Harvard University. Columnist, <i>Scientific American</i> magazine, “The Observatory”
2005-2013	Professor, Department of History & Program in Science Studies Adjunct Professor of Geosciences (from 2007), University of California, San Diego
2008-2011	Provost, Sixth College, University of California, San Diego
2010	Francis Bacon Visiting Professor, California Institute of Technology (on leave from UCSD)
2003-2006	Director, Program in Science Studies, University of California, San Diego
1998- 2005	Associate Professor, Department of History & Program in Science Studies, UCSD
1996-1998	Associate Professor, History and Philosophy of Science Gallatin School of Individualized Study, New York University
1991-1996	Assistant Professor of Earth Sciences and Adjunct Asst. Professor of History Dartmouth College, Hanover, New Hampshire
1990-1991	Visiting Asst. Professor of Earth Sciences and Visiting Asst. Professor of History Dartmouth College, Hanover, New Hampshire
1984-1989	Research Assistant, Geology Department, and Teaching Assistant, Depts. of Geology, Philosophy, and Applied Earth Sciences Stanford University
1981-1984	Geologist, Western Mining Corporation, Adelaide, Australia

PUBLICATION SUMMARY

<https://scholar.google.com/citations?hl=en&user=UK9sjMAAAAJ>

>125 scholarly publications with >37,700 citations, H-index 63, I10 index 140. Includes > 100 articles in peer-reviewed journals, >25 chapters in edited volumes (several prize-winning and/or multiply reprinted articles), **nine books**, including *Merchants of Doubt* (>100,000 copies, nine foreign editions, History of Science Society Watson-Davis Prize, short-listed for *Los Angeles Times* book prize, made into a documentary film distributed by SONY Pictures Classics); *The Collapse of Western Civilization* (>50,000 copies, twelve foreign editions), *Why Trust Science?* (10 foreign editions); and *The Big Myth* (4 foreign editions); >75 opinion pieces in leading newspapers and magazines. Since 2020 a monthly column in *Scientific American*.

TED TALKS

TED talk 25 June 2014, with > 1.64 million views

https://www.ted.com/talks/naomi_oreskes_why_we_should_believe_in_science

TEDxBerkeley 6 March 2021 “How Diversity Helps Us Get the Right Answers”

https://www.ted.com/talks/naomi_oreskes_how_diversityhelps_usget_the_right_answers

HONORARY DEGREES

Bard College, Doctor of Science, 2024

Université Libre de Brussels, Doctor Honoris Causa, 2023

Clark University, Honorary Doctor of Humane Letters, 2021

ETH Zurich, Honorary Doctor of Philosophy, 2018

University of British Columbia, Juris Legum (LL.D), 2018

Roskilde University, Denmark, Honorary Doctor of Philosophy, 2016

Colgate University, Honorary Doctor of Science, 2015

Harvard University, Honorary Master of Arts, 2014

VISITING PROFESSORSHIPS

2012-2013 Professor-at-Large, Institute of Advanced Studies, University of Western Australia.

2010 Francis Bacon Visiting Professor of History, California Institute of Technology

2001 Visiting Associate Professor, Department of History of Science, Harvard University

MAJOR HONORS

John Tyndall Lecturer in Global Environmental Change, American Geophysical Union, 2024

Patrick Suppes Prize in History of Science, for *Science on a Mission*, American Philosophical Society, 2024.

Nonino Prize, “A Master of Our Time,” Nonino Foundation, Italy, 2024

TIME 100 inaugural climate leaders, 2023

<https://time.com/collection/time100-climate/6332960/naomi-oreskes/>

Apolitical 100 Most Influential People in Climate, 2022/23 <https://apolitical.co/list/en/most-influential-climate-100-2022>

Global Listening Centre Top 25 Outstanding Women Listeners in the World, 2021

Falling Walls Foundation, Breakthrough Science of the Year, 2021

Phi Beta Kappa Visiting Lecturer, 2020

Walter Channing Cabot Fellowship, Harvard University, 2020

The British Academy Medal, 2019

American Philosophical Society, elected 2018

Guggenheim Fellow, 2018-2019

American Academy of Arts and Sciences, elected 2017

American Association for the Advancement of Science, Annual Meeting Plenary Speaker, 2017

Tanner Lectures in Human Values, Princeton University, 2016.

Stephen H. Schneider Award for Outstanding Climate Science Communication, 2016

American Geophysical Union Ambassador and Fellow, 2016

Frederick Anderson Climate Change Award, Center for International Environmental Law, 2016

Convocation Speaker, The Evergreen State University, Olympia and Tacoma, Washington, 2016

Geological Society of America Public Service Award, 2015

William T. Patten Visiting Lectureship, Indiana University, March 2015

American Historical Association Herbert Feis Prize for Public History, 2014

History of Science Society, Forum for American Science Distinguished Lecture, 2014 American

Geophysical Union Presidential Citation for Science and Society, 2014

Commencement Speaker, University of California, Riverside, 2012

Climate Change Communicator of the Year, George Mason University Center for Climate Change Communication, 2011
Francis Bacon Medal for outstanding scholarship in the history of science and technology, Francis Bacon Foundation and Caltech, 2009
UCSD Chancellors Associates' Faculty Excellence Award for Community Service, 2008
National Science Foundation Young Investigator, 1994-1999
Society of Economic Geologists, Lindgren Prize (outstanding work by a young scientist) 1993

SCHOLARLY PRODUCTS: DOCUMENTARY FILM

Merchants of Doubt, 2015. A film by Robert Kenner, produced by Participant Media and distributed by SONY Pictures Classics, and based on the book, *Merchants of Doubt*. I appear in the film, consulted on all aspects of its production, and served as a liaison between the filmmaker and many of the people featured in the film.

Appearances at Screenings: Toronto Film Festival; NY Film Festival; Landmark Cinema, Cambridge, MA; Wheeler Opera House Aspen, CO; U.S. Congress, House Energy and Environment Caucus, Washington, DC; Bristol (UK) Festival of Ideas; and many community groups and NGOs.

SCHOLARLY PRODUCTS: BOOKS

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.

Foreign language editions:

- Greek, Editions Polis, in contract
- Simplified Chinese, Beijing Huazhang, in contract.
- Spanish, Capitan Swing Libros, 2024.
- French, Les Liens qui Liberent, 2024.

Excerpts and opinion pieces based directly on the book

2/21/23 Desmog / [Article & Excerpt](#)

2/28/23 [Time.com](#) / [Excerpt](#)

3/3/23 Harvard Gazette / [Excerpt](#)

3/9/23 Washington Post / Made by History / [Op-Ed](#) , reprinted at

<https://www.bunkhistory.org/resources/the-big-business-campaign-that-has-shaped-40-years-of-gop-rhetoric>

4/16/23 Times Higher Education / [Op-ed by Naomi](#)

5/1/23 Scientific American / [Bylined Piece](#) based on one book chapter

5/26/23 Boston Globe Magazine / [Op-Ed](#)

Oreskes, Naomi, 2021. *Science on a Mission: How Military Funding Shaped What We Do and Don't Know about the Ocean*. Chicago: The University of Chicago Press; paperback 2022.

- Excerpted in *American Scientist* <https://www.americanscientist.org/article/operational-oceanography>

- Winner, Patrick Suppes Prize in the history of science, American Philosophical Society

Oreskes, Naomi and Erik M. Conway, 2020. *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming*. 2nd edition, with a new introduction by Al Gore and a new postscript by the authors. New York: Bloomsbury Press.

- 2nd French edition, with a new introduction by Stefan Foucart, Le Pommier/Poche, 2021.

Oreskes, Naomi, 2019. *Why Trust Science?* Princeton University Press.

- Portuguese (Brazil), Bazar do Tempo, publication date 2024.
- Complex Chinese, Owl publishing House, Taiwan, publication date 2024.
- Japanese, Nasu-Satoyamasha, publication date 2024.
- Spanish, Grano de Sal (Latin America) publication date November 2023.
- Swedish, Stiftelsen Bokförlaget Thales, 2023.
- Turkish, Optimist Kitap, 2022.
- Spanish, Ediciones Universitarias de Valparaíso, 2022.
- Chinese (simplified), Shanghai Scientific & Technological Education Publishing, 2022.
- Italian, Bollati Boringhieri Editore, 2021.
- Portuguese, Gradiva (world, except Brazil) series editor Carlos Fiolhais, 2021.

Michael Oppenheimer, N. Oreskes, D. Jamieson, K. Brysse, J. O'Reilly & M. Shindell, 2019. *Discerning Experts: The Practices of Scientific Assessment for Environmental Policy*, Chicago: The University of Chicago Press.

Oreskes, Naomi and Erik M. Conway, 2014. *The Collapse of Western Civilization*, New York: Columbia University Press.

- Oreskes, Naomi and Erik M. Conway, 2014. *L'effondrement de la Civilisation Occidentale*, (Paris: *Les Liens qui Libèrent*), 2nd edition with expanded Introduction by Naomi Oreskes.
- Saad/Persian
- Planeta/Argentina
- Okto Publishing/Greece
- Piano B Edizioni/Italy
- Diamond Inc./Japan
- Galapagos/Korea
- Yeni Insan/Turkey
- Oekom Verlag/Germany
- EcoTrend/Complex Chinese
- Prah/Czech Republic
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- Oreskes, Naomi, 2015. "Exxon's climate concealment." *The New York Times*, October 9, 2015. http://www.nytimes.com/2015/10/10/opinion/exxons-climate-concealment.html?_r=0
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Reposted at Huffington Post, The Nation, [Salon.com](#), [alternet.com](#), [Truthdig.com](#), the UNZ Review, and many more.
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- Frumhoff, Peter and Naomi Oreskes 2015. "Fossil fuel firms are still bankrolling climate denial lobby groups." *The Guardian*. March 25, 2015. <http://www.theguardian.com/environment/2015/mar/25/fossil-fuel-firms-are-still-bankrolling-climate-denial-lobby-groups>

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Reposted on numerous web sites.
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<http://articles.latimes.com/2012/jan/22/opinion/la-oe-oreskes-judging-climatechange-20120122>

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Oreskes, Naomi, 2011. “Merchants of Doubt,” *Cosmos*, April/ May 2011, pp. 36-43.
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Frumhoff, Peter and Naomi Oreskes, 2011. “The limits of doubt-mongering,” *The Hill*, February 23, 2011. <http://thehill.com/blogs/congress-blog/energy-a-environment/145669-the-limits-of-doubt-mongering>

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Oreskes, Naomi and Erik M. Conway, 2010. “Distorting science while invoking science,” *Science Progress*, August 10, 2010. <http://www.scienceprogress.org/2010/08/distorting-science-while-invoking-science-2/>

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<http://articles.latimes.com/2010/jun/08/opinion/la-oe-oreskes-20100608>

Oreskes, Naomi and Erik M. Conway, 2010. "Climate Change Denial: A History," *The New Statesman*, June 1, 2010, online at <http://www.newstatesman.com/global-issues/2010/05/climate-scientists-science>

Oreskes, Naomi and Erik M. Conway, 2010. "Scientists Who Favor Ideology over Fact," *The Washington Post*, May 28 2010, on line at http://voices.washingtonpost.com/political-bookworm/2010/05/scientists_who_favor_ideology.html

Oreskes, Naomi, 2009. "The Scientific Consensus on Climate Change," *Climate Change: Picturing the Science*, edited by Gavin Schmidt and Joshua Wolfe, pp. 153-155.

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Oreskes, Naomi, 2007 "Things We Can All Do to Stop Global Warming," *The San Diego Union Tribune*, July 13, 2007

Oreskes, Naomi, 2007. "The Long Consensus on Climate Change," *The Washington Post*, Thursday, February 1, 2007; A15 <https://www.washingtonpost.com/wp-dyn/content/article/2007/01/31/AR2007013101808.html>

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Oreskes, Naomi, 2005. "Fear-mongering Michael Crichton is wrong," *The San Francisco Chronicle*, February 16, 2005, p. B11.

Oreskes, Naomi, 2004. "Undeniable Global Warming," *The Washington Post*, Sunday December 26, 2004, B07.

Oreskes, Naomi and Bjorn Lomborg, 2004 "Er klimaskeptikere nu domt ude?" [Have climate skeptics been ruled out of bounds?] A debate with Bjorn Lomborg, moderated by Morten Jastrup, *Politiken* (Copenhagen), Sunday, December 5, 2004, p. 2, section 4.

Oreskes, Naomi, 2004. "A Humanities Policy?" (Forum), *Issues in Science and Technology* Winter 2004: 17.

Oreskes, Naomi and James Fleming, 2003. "An ill wind blows toward an even more inhospitable climate," *The Los Angeles Times* Commentary Section, Thursday October 30: B17.

Oreskes, Naomi and Rebecca Oreskes, 2001. "Controlling Nature: Is Science to Blame?" *International Journal of Wilderness* 7 (1): 35-38.

Oreskes, Naomi, 1998. La lente plongée vers le fond des océans," *Science et Vie* March: 84-90.

COMPLETE LIST OF HONORS AND AWARDS

John Tyndall Lecturer in Global Environmental Change, American Geophysical Union, 2024

Patrick Suppes Prize in History of Science, for *Science on a Mission*, American Philosophical Society, 2024.

Nonino Prize, “A Master of Our Time,” Nonino Foundation, Italy, 2024

TIME 100 inaugural climate leaders, 2023

<https://time.com/collection/time100-climate/6332960/naomi-oreskes/>

Apolitical 100 Most Influential People in Climate, 2022/23 <https://apolitical.co/list/en/most-influential-climate-100-2022>

Global Listening Centre Top 25 Outstanding Women Listeners in the World, 2021

Falling Walls Foundation, Breakthrough Science of the Year, 2021

American Geophysical Unions [Spilhaus Ambassador Award grant, 2021](#)

Phi Beta Kappa Visiting Scholar, 2020

The British Academy Medal, 2019

Guggenheim Fellow, 2019

Geological Society of America Mary C. Rabbit Award (History and Philosophy of Geology Division) 2019

American Philosophical Society, Elected, 2019

AAAS Plenary Speaker, “The Scientist as Sentinel,” 2017

American Academy of Arts and Sciences, Elected, 2017

Stephen H. Schneider Award for Outstanding Climate Science Communication 2016

American Geophysical Union Ambassador and Fellow, 2016

Frederick Anderson Climate Change Award, Center for International Environmental Law, 2016

H. Burr Steinbach, Visiting Scholar, Woods Hole Oceanographic Institution, 2016.

Committee for Skeptical Inquiry, Fellow, 2015

Salem State University: Friend of the Earth, 2015

Indiana University, William F. Patten Lecturer, 2015 ((Previous Patten Professors include Herbert Feis and George Sarton).

National Center for Science Education: Friend of the Planet, 2015.

American Historical Association Herbert Feis Prize for Public History, 2014

American Geophysical Union Presidential Citation for Science and Society, 2014

Monfort Professor-in-Residence, Colorado State University 2013

John Muir Environmental Fellow, Muir College, UC San Diego, 2012

Max von Laue Lecture, Deutsche Physikalische Gesellschaft (German Physical Society), 2012

James Shea Award of the National Association of Geoscience Teachers for “exceptional contributions in the form of writing and/or editing of Earth Science information that is of interest to the general public and/or teachers of Earth Science,” 2011

Climate Change Communicator of the Year, George Washington University Center for Climate Change Communication, for “fearless work ...to expose the non-scientific pressures climate scientists have encountered during the course of their research. Her courage and persistence in communicating climate science to the wider public have made her a living legend amongst her colleagues,” 2011

Francis Bacon Medal in recognition of outstanding scholarship in the history of science and technology, Francis Bacon Foundation and Caltech, 2009

UCSD Chancellors Associates Faculty Excellence Award for Community Service, 2008

Finalist, Teacher of the Year, Scripps Institution of Oceanography, 2008

American Association for the Advancement of Science Fellow, 2007, “for distinguished scholarship in the history of earth sciences, and for leadership in relating science and technology studies to contemporary scientific policy debates.”

UCSD Humanities Center Fellowship, Autumn 2005

George Sarton Award Lecture, American Association for the Advancement of Science, 2004

American Philosophical Society, Sabbatical Fellowship, 2001-2002

History of Science Society, Women in Science Best Paper Prize, 2000

Forum for the History of Science in America, Best Paper Prize, 1997

National Science Foundation Young Investigator, 1994-1999

National Endowment for the Humanities, Fellowship for University Teachers, 1993-94

Society of Economic Geologists, Lindgren Prize (outstanding work by a young scientist) 1993

Ritter Memorial Fellowship in History of Marine Sciences, Scripps Institution of Oceanography

1994

Geological Society of America 29th International Geological Congress Travel Grant, 1992

Mellon Foundation New Directions Fellowship to “encourage fresh contributions of knowledge and curricular activities [in] the arts and sciences,” Stanford University, 1988-1989

Geological Society of America, Penrose Grant, 1987

Chevron Fellowship, Stanford University, 1984-1986

Imperial College, Watts Medal (Geology), 1981

University of London Sir Henry Miers Mineralogy Prize, 1981

Royal Society of Arts (London) Silver Medal for Scholarship and Service, 1981

Imperial College Geology Department Jonathan Callaghan First Year Prize, 1979

Who’s Who in America, Who’s Who in American Science & Engineering, Who’s Who in the West

EXPERT TESTIMONY

U.S. Senate Budget Committee, “Dollars and Degrees: Investigating Fossil Fuel Dark Money’s Systematic Threats to Climate and the Federal Budget: The Causes and Costs of Climate Delay.” Written and Oral Testimony, 21 June 2023.

U.S House of Representatives Staff Briefing, Sponsored by Rep. Lori Trahan (D-Ma), “Climate Disinformation and On-line Transparency.” 11 July 2022.

U.S. Senate, Special Committee on the Climate Crisis, 29 October 2019.

<https://www.youtube.com/watch?v=AxaICTiNKvY&feature=youtu.be>

<https://www.democrats.senate.gov/climate/hearings/climate-crisis-committee-to-hold-hearing-on-dark-money-and-climate-change>

U.S. House of Representatives, Committee on Oversight and Reform, Subcommittee on Civil Rights and Civil Liberties, 23 October 2019. “Examining the Oil Industry’s Efforts to Suppress the Truth about Climate Change” <https://www.youtube.com/watch?v=o9nfd0m95CM>

U.S. House of Representatives, Written testimony in rebuttal to hearing witnesses, “Climate Science: Assumptions, Policy, Implications, and Scientific Method, April 11, 2017, requested and submitted by Representative Donald S. Beyer, Jr. (D-Va).

U.S. Senate, Democratic Policy and Communications Center Luncheon, Lyndon B. Johnson Room, The Capitol, June 23, 2016.

U.S. House of Representatives Committee, Congressional Progressive Caucus and The Sustainable Energy and Environment Coalition (SEEC), Forum on the Fossil Fuel Industry Disinformation

Campaign, Sponsors Representative Keith Ellison and Raúl M. Grijalva, co-chairs, Rayburn Office Building, June 22, 2016.

U.S. House of Representatives Committee on Natural Resources, Subcommittee on Oversight and Investigations, Hearings: “*Zero Accountability: The Consequences of Politically Driven Science*,” 114th Congress, April 29 2015, Washington DC.

U.S. Senate Hearings, Bicameral Task Force on Climate Change, Senator Sheldon Whitehouse and Representative Henry Waxman, sponsors, September 18, 2014, Washington, D.C.

Belgian House of Representatives, Special Committee on Climate Change and Sustainable Development, June 29, 2012.

U.S. Senate, Committee on Environment and Public Works, Washington, D.C., December 6, 2006, <http://epw.senate.gov/epwmultimedia/epw120606.ram>

U.S. Nuclear Waste Technical Review Board, U.S. Nuclear Waste Technical Review Board, “Developing a Repository Safety Strategy with Special Attention to Model Validation” Washington, D.C., September 14, 1999. <http://www.nwtrb.gov/meetings/990914.pdf>.

California State Senate, Select Committee on Government Oversight, Sacramento, California., 31 January 2001, Hearings on Gender Equity in the University of California.

LEGAL EXPERT WITNESS

Expert Witness: Mann v. National Review, Inc et al., D.C. Super. Court, Deposited [on line] 15 October 2020; testified, US Superior Court, Washington DC, 22 January 2024.

Expert Witness: Eastman Chemical Company v. Plastipure Inc. and Certichem, Inc., 2013. <http://law.justia.com/cases/federal/district-courts/texas/txwdce/1:2012cv00057/529232/249/>

AMICUS BRIEFS

Brulle R., Center for Climate Integrity, The Chesapeake Climate Action Network, Farrell J., Franta B., Lewandowsky S., Oreskes N., Supran G., Union of Concerned Scientists [alphabetical order]. *Amicus Brief* submitted to United States Court of Appeals for the Third Circuit, in support of Delaware in Delaware v. BP America Inc. *et al.* (2022).

Brulle R., Center for Climate Integrity, The Chesapeake Climate Action Network, Farrell J., Franta B., Lewandowsky S., Oreskes N., Supran G., Union of Concerned Scientists [alphabetical order]. *Amicus Brief* submitted to United States Court of Appeals for the Fourth Circuit, in support of Baltimore in Baltimore v. BP P.L.C. *et al.* (2021).

Brulle R., Center for Climate Integrity., Farrell J., Franta B., Fresh Energy., Lewandowsky S., MN350, Minnesota Center for Environmental Advocacy, Oreskes N., Supran G., Union of Concerned Scientists [alphabetical order]. *Amicus Brief* submitted to United States Court of Appeals for the Eighth Circuit, in support of State of Minnesota v. American Petroleum Institute *et al.* (2021).

Brulle R., Center for Climate Integrity, The Chesapeake Climate Action Network, Farrell J., Franta B., Lewandowsky S., Oreskes N., Supran G., Union of Concerned Scientists [alphabetical order]. *Amicus Brief* submitted to United States Court of Appeals for the Fourth Circuit, in support of Baltimore in Baltimore v. BP P.L.C. *et al.* (2019).

Brulle R., Center for Climate Integrity, Farrell J., Franta B., Lewandowsky S., Oreskes N., Supran G., Union of Concerned Scientists [alphabetical order]. *Amicus Brief* submitted to United States Court of Appeals for the Ninth Circuit, in support of CA cities in Oakland and San Francisco v. BP P.L.C. *et al.* (2019).

Brulle R., Center for Climate Integrity, Farrell J., Franta B., Lewandowsky S., Oreskes N., Supran G., Union of Concerned Scientists [alphabetical order]. *Amicus Brief* submitted to United States Court of Appeals for the Ninth Circuit, in support of CA counties in San Mateo *et al.* v. Chevron Corporation *et al.* (2019).

BOARDS

Kann-Rasmussen Foundation, 2024- .

National Center for Science Education, 2017-2023.

ClimateCommunication.Org 2015- <http://www.climatecommunication.org/who-we-are/advisors/>

Climate Science Legal Defense Fund, Founding Board Member, 2014-

Protect Our Winters, Board Member, 2011-2020; Board Member Emerita.

Climate Accountability Institute, Co-Founder and Board Member 2011-2017

PROFESSIONAL SOCIETIES

Elected Fellow

American Academy of Arts and Sciences; American Association for the Advancement of Science; American Geophysical Union; Geological Society of America

Member

History of Earth Sciences Society; History of Science Society; International Commission for the History of Geology; Society for the Social Studies of Science, *Corresponding Member*, International Academy of the History of Science.

PROFESSIONAL ACTIVITIES (selected)

Advisory Board, World Economic Forum Global Risks Report, 2017- 2019.

Participant, World Economic Forum, Davos, Switzerland, 2015-2019, 2024.

Panel Member, IPCC Steering Committee on studies of the IPCC process, 2014-2015.

Panel Chair, MISTRA-FORMAS Proposal Evaluation, Environmental Humanities, December 5-8, 2014, Stockholm Sweden.

Panel Member, expert panel on *Harnessing Science and Technology to Understand the Environmental Impacts of Shale Gas Extraction*, Council of Canadian Academies, 2012-2014

Deputy Editor, *Climatic Change*, 2011-2013.

Panel Member, European Research Commission, Synergy Grant program, Peer Review Panel 2012.

President, History of Earth Sciences Society, 2007-2009

President-Elect, History of Earth Sciences Society, 2005-2007.

Member, American Meteorological Society History of the Atmospheric Sciences Committee, 2008-11.

Member, National Academy of Sciences/National Research Council Committee on the Use of Models in Regulatory Decision-Making, 2004-2007.

Member, Director's Review Committee, Energy and Environmental Directorate, Lawrence Livermore National Laboratory, 2006-2007.

Member, History of Science Society Executive Council, 2003-2006.
Editorial Boards ISIS, 2001- 2004 ; Reviews of Geophysics (Associate Editor) 2001-2003; Earth Sciences History 1998-2001, Economic Geology 1993-1998.
Councillor History of Earth Sciences Society, 1998-1999.
Consultant U.S. National Academy of Sciences, Workshop, “Principles and Operational Strategies for Repository Staging Systems,” September 2001; U.S. Nuclear Waste Technical Review Board, September 1999; U.S. Environmental Protection Agency, Lead Model Validation Project, 1996-1997.
Committees American Institute of Physics, Advisory Committee on History of Physics, 2008-2011; American Association for the Advancement of Science, History Committee, 1996-1999; American Geophysical Union, History Committee, 1996- present; U.S. National Committee on Geology, National Research Council, Member, 1994-96; U.S. National Committee for the History of Geology, National Research Council, Secretary, 1994-96; National Science Foundation, Education and Human Resources Committee of Visitors, 1994-95
Visiting Committee to review Harvard University History of Science Department, Spring 2003, and follow up panel, October 2007.
Panel Member, National Science Foundation *History of Science and Technology*, Spring 2000.
Consulting Historian WGBH, *Lives in Science*, 1999-2001; Oxford Companion to the History of Science 1999-2000; American Institute of Physics Collaboration Project, 1990-1999; WGBH Science Odyssey Series, 1997-1998.
External Examiner Melbourne
Seminar Leader Dibner Foundation for the History & Philosophy of Science, Summer Institute 1994.
President De la Beche Club (Imperial College Geological Society), 1979-1980.

CONFERENCES ORGANIZED

Climate Accountability, Public Opinion, and Legal Strategies Workshop,” co-organizer, with the [Climate Accountability Institute](#) and the [Union of Concerned Scientists](#) La Jolla, CA, June 2012.

Models and Prediction: A Workshop, Sponsored by UC San Diego Science Studies program with funding from the National Science Foundation, Organizers Naomi Oreskes and William Bechtel, May 26-27, 2006.
<https://mechanism.ucsd.edu/~bill/ModelsAndPrediction/workshopschedule.htm>

Geological Society of America Penrose Conference: “From the Inside and the Outside: Interdisciplinary Perspectives on the History of the Earth Sciences.” San Diego, CA, March 1994.

UNIVERSITY SERVICE (selected)

Harvard University Director of Graduate Studies, Department of the History of Science, 2013-2016; Climate Change Solutions Fund Committee, 2016-2019; Faculty Council, 2020-2023.

University of California Member, Search Committee for Senior Vice Chancellor for Academic Affairs (2010), Member, Office of Research Affairs Research Advisory Council (2009-); Member, Center for Marine Biodiversity and Conservation, (2006-) Director, Science Studies Program, (2003 -2006); University Search Committee, Vice Chancellor for Research (2006); UCSD Humanities Center, Executive Committee (2004-2006) ; History Department Representative, Faculty Senate (2003-04); Faculty co-chair, Chancellor’s Advisory Committee on the Status of Women (1999-2001); Member, Vice-Chancellor’s Task Force on Gender Equity (2001); Center for Environmental Research and

Training (1999-2003); Scripps Institution of Oceanography Heritage Committee (1999-), Scripps Institution of Oceanography Ritter Fellowship Selection Committee (1999-).

New York University Gallatin Curriculum Committee, 1996-97; Faculty of Arts and Sciences NSF initiative on undergraduate science and math education reform, 1997; Gallatin Dean Search Committee, 1997-98.

Dartmouth College Ethics Institute Faculty Advisor (1994-95); Women in Science Program Faculty Sponsor (1992-93); Women's Studies Steering Committee (1992-1994); University Seminars: Feminist Inquiry (1990-1995); Two Cultures (1990-1995); Teaching Science (1993-1995); Sloan Foundation Summer Science Teaching Institute (1994); Dartmouth College Committee on Organization and Policy (1996-97).

MANUSCRIPTS, GRANTS, AND PAPERS REVIEWED

Manuscripts, Presses: AGU Press; Johns Hopkins University Press; Blackwell Press; University of Chicago Press; University of California Press; Columbia University Press; MIT Press.

Manuscripts, Journals: Climatic Change; Ecological Modeling; Geology; Economic Geology; Global Environmental Change; ISIS; History of Earth Sciences; Hyle; Mineralium Deposita; International Association on the Genesis of Ore Deposits; Science; Nature; Science Communication; Science and Public Policy; Social Studies of Science; The Physics Teacher; and others.

Grants: National Science Foundation (Geochemistry and Petrology, Science and Technology Studies, Instrumentation and Facilities, and Education and Human Resources); National Endowment for the Humanities; National Environment Research Council (U.K.); Social Sciences and Humanities Research Council of Canada.

Papers for National Meetings: Geological Society of America.

SPONSORED RESEARCH

Title: AI-Powered Legal Document Analysis for Environmental Litigation: Leveraging Large Language Models

Funder: Rockefeller Family Fund, 2023- .

Duration: One year, renewable.

Title Exposing Fossil Fuel Industry Falsehoods and Revoking the Industry's Social License

Funder: Broadreach Foundation/Maine Community Fund, 2023- .

Duration: One year, renewable.

Title: Conference: Expert meeting at Harvard University hosted by Professor Naomi Oreskes and Dr. Geoffrey Supran, "Accountability for the deception industry: Aligning research with action"

Funding Agency: Children's International Fund Foundation

Duration of Support: 2022

Title: Leveraging Marketing Tools and Big Data to Advance Academic Understanding of Trust and Distrust in Science

Funding Agency: Dean's Competitive Fund for Promising Scholarship, Harvard University

Duration of Support: 2022

Title: Spilhaus Ambassador Award Grant

Funding Agency: American Geophysical Union

Duration of Support: 2021

Title: Doctoral Dissertation Research: “The Not-so-Inexhaustible Sea: Fisheries, Science, and Management: 1863-present.” [For Aaron van Neste]

Funding Agency: National Science Foundation

Duration of Support: 2021-23

Title: Doctoral Dissertation Research: “Making Laboratory Practice Good: Negotiating Transnational Toxicological Standards for Chemical Standards, 1971-2010.” [For Colleen Lanier-Christensen]

Funding Agency: National Science Foundation

Duration of Support: 2018-2019

Title: Envisaging the Fossil-Free Future

Funding Agency: Harvard Climate Change Solutions Fund

Duration of Support: 2017-2019

Title: Envisaging the Fossil-Free Future

Funding Agency: Wallace Global Threats Fund

Duration of Support: 2017-2019

Title: Assessing ExxonMobil’s climate change communications

Funding Agency: The Rockefeller Family Fund

Duration of Support: Summer 2016

Title: Assessing the origins of the words “weather and climate” in the Clean Air Act of 1970.

Funding Agency: The New York Community Trust

Duration of Support: 2015

Funding Agency: The Grantham Foundation

Duration of Support: 2015

Title: Assessing Assessments: Historical and Philosophical Study of Scientific Assessments for Environmental Policy in the Late 20th Century

Funding agency: National Science Foundation SES 09-57270

Duration of Support: 2010-13

Title: Climate, Technology and Culture: Providing Content and Context in Undergraduate Global Climate Education

Funding agency: NASA: Global Climate Change Education Program.

Duration of Support: 2009-2011.

Title: IGERT: Global Change, Marine Ecosystems, and society, Co-PI with Richard Norris (PI), Jeremy Jackson, Dale Squires, Joel Watson, co-PIs.

Funding agency: National Science Foundation DGE 09-03551

Duration of Support: 2009-2014

Title: Doctoral Dissertation Research: Harold Urey: Scientist, Atheist, and Defender of Religion (graduate student Matthew Shindell).

Funding Agency: National Science Foundation, SES 08-48435.

Duration of support: 2008-2010.

Title: Doctoral Dissertation Research: The Bravo Medical Program: Radiation Standards, Scientific Uncertainty, and the Legacy of the Cold War, 1954-the Present" (graduate student Laura Harkewicz).

Funding agency: National Science Foundation, SES 08-22480

Duration of Support: 2008-2010.

Title: Conference and Workshop Support: Models and Prediction: A Research Workshop, University of California, San Diego; May 26-28, 2006,

Funding agency: National Science Foundation, SES 05-51355

Duration of Support: 2006

Title: Proof, Persuasion, and Policy: A Research and Training Grant for the UCSD Science Studies Program

Funding agency: National Science Foundation: SES 03-49956

Duration of Support: 2004-2009

Title: A Historical Analysis of the Collapse of Pacific Groundfish: U.S. Fisheries Science, Development, And Management, 1945-1995

Funding agency: California Sea Grant/ National Oceanic and Atmospheric Agency

Duration of Support: 2004-2006

Title: The Military Roots of Basic Science: American Oceanography in the Cold War and Beyond

Funding agency: National Science Foundation, SBE 01-15260

Duration of Support: 2002-2004.

Title: Sabbatical Fellowship

Funding agency: American Philosophical Society

Duration of Support: Spring 2002.

Title: National Science Foundation Young Investigator Award for Geology and History of Science.

Funding agency: National Science Foundation EAR 93-57888, EAR 97-96022

Duration of Support: 1994-1999. (Awarded 1993).

Title: Acquisition of cathodoluminescence, spectrophotometry, and microsampling capabilities for the study of large-scale ore-forming systems.

Funding agency: National Science Foundation, EAR 93-17213.

Duration of support: 1994-1996.

Title: The Rejection of Continental Drift.

Funding agency: National Science Foundation, SBE 92-22597.

Duration of support: April 1994-June 1995.

Title: The Rejection of Continental Drift.

Funding agency: National Endowment for the Humanities, Fellowship for University Teachers

Duration of support: September 1993-April 1994.

Title: Origin of magnetite deposits at El Laco, Chile: An analogue for giant Fe-REE deposits of the Proterozoic? with Research Experience for Unders [REU] Supplements (1993, 1994)

Funding agency: National Science Foundation EAR 92-19887.

Duration of support: 1993-1995.

Title: Sphalerite geochronometry at the Lisheen Zn-Pb deposit, Ireland.

Funding agency: Chevron Corporation of Ireland.

Duration of support: 1992-1993.

Title: Reading materials for innovative approaches to introductory geology.

Funding Agency: New England Consortium for Undergraduate Science Education (NECUSE).

Duration of Support: 1990-1991.

TEACHING ACTIVITIES I. University Courses

Harvard University: *Undergraduate:* Controversy: Explorations at the Intersections of Science, Policy, and Politics; Science and Religion in America; Climate Science & Policy; Science, Technology and Social Change. *Graduate:* Agnotology: The Cultural Production of Ignorance; The History of the History of Science; Salon (An introductory seminar for first year graduate students in history of science); and Historiography of the History of Science.

University of California Controlling Life; Atomic Age, Atomic Angst (both in Sixth College general education sequence); Science and Technology in the 20th Century; Scientists and Atomic Age; The Darwinian Legacy; Introduction to Science Studies; Gender and Science; Science and Politics of Climate Change; and various graduate seminars in science studies and history of science, and guest lectures

in the Center for Marine Biodiversity and Conservation on science and public policy.

New York University The Quest for Knowledge; Origins of the Atomic Age; The Notion of Truth; The Darwinian Legacy; Fate of the Earth.

Dartmouth College *Earth Sciences:* Fate of the Earth; Materials of the Earth; Geochemistry of Ore Deposits; Philosophy of Natural Sciences; *History* Origins of the Atomic Age; *Women's Studies* Sex, Gender, and Scientific Discovery.

TEACHING ACTIVITIES II. Short courses and informal education

15th International Swiss Climate Summer School, Oeschger Centre for Climate Change Research, University of Berne, Grindelwald, Switzerland, August 2016.

<https://www.unisdr.org/we/inform/events/46284>

Vienna International Summer University “Consensus in Science (two-week intensive), Vienna Circle Institute, Vienna, Austria, July 2007.

UCSD Osher Institute (UCSD extension), Autumn 2006, “Climate Change.” (Five lectures)

Marine Biological Laboratory-Dibner Institute "Oceans and Atmospheres," May 17-24, 2006.

TEACHING ACTIVITIES III. Graduate Research Advising (Principal Advisor)

Ashton MacFarlane, Harvard University J.D./Ph.D. expected 2024. Dissertation topic TBD.

Aaron van Neste, Harvard University Ph.D., expected 2023. "Oceans of Ignorance: Free Markets, Overconfidence and Uncertainty in Fisheries Science from Inexhaustibility to Catch Shares, 1863-2019."

Gustave Lester, Harvard University Ph.D., expected 2022. "Mineral Lands, Mineral Empires: Geology and Capitalism in the Atlantic World, 1780-1880."

Hannah Conway, Harvard University Ph.D., expected 2022. "In the long shadows: Infrastructure Failure, Inequity, and Environmental Justice in the US Deep South."

Colleen Lanier Christensen, Harvard University Ph.D., expected 2022, "Making Laboratory Practice Good: Negotiating Transnational Toxicological Standards for Chemical Standards, 1971-2010."

Erik Baker, Harvard University Ph.D., 2022. "*Entrepreneurism: The Reinvention of the American Work Ethic in the Twentieth Century.*"

Danielle Hallett Inkpen, Harvard University Ph.D., 2018. "Glacial Tongues: Making North American Alpine Glaciers Speak, 1887-2000,"

Krystal Tribbett, UCSD Ph.D., 2014. "RECLAIMing Air, Redefining Democracy: A History of California's Regional Clean Air Incentives Market, Environmental Justice and Risk 1960 – present."

Minakshi Menon, UCSD Ph.D., 2013, "Imperial Nature, Imperial Culture: British Orientalism, Colonial Policy, and the Making of an Indian Natural History, 1784-1845"

Elena Aronova, UCSD Ph.D. 2012. "Studies of Science before "Science Studies": The Cold War and Politics of Science in the U.S., U.K., and U.S.S.R., 1950s-1970s

Matt Shindell, UCSD Ph.D., 2011. "Harold Urey and the Origins of Planetary Science."

Laura Harkewicz, UCSD Ph.D., 2010, "The Character of Radiation Standards: The Bravo Medical Program, Radiobiology, and American Nuclear Policy, 1954 - 2005

Jesse Richmond, UCSD Ph.D. 2009. "Experts and Australopithecines: Credibility and Controversy in the Study of Human Evolution, 1924-1959,"

Matthew Crawford, UCSD Ph.D. 2009, co-advised with Professor John Marino, European history. "Empire's Experts: The Politics of Knowledge in Spain's Royal Monopoly of *Quina* (1751-1808)"

M. Carmel Finley, UCSD Ph.D. 2008, "The Tragedy of Enclosure: Science, Politics, and Marine Fisheries Policy, 1945-1995."

Barbara DeFelice, Dartmouth College, Master of Arts, Liberal Studies, (2000) “Geological theory and arctic exploration in the early 20th century.”

Sossity Sheets, Dartmouth M.S. (1997) “Chemistry of fluid inclusions at El Laco, Chile: Implications for ore genesis.”

Maria Bundy, Dartmouth M.S. (1996) “REE content of apatites at Ophir, Colorado: A source of aqueous REEs in acid mine drainage?”

Melody Brown, Dartmouth M.S. (1995) “Geological and numerical analysis of paleofluid-flow in carboniferous Ireland: Developing a genetic model for the carboniferous carbonate-hosted Irish Zn-Pb ores.”

Katherine Bateman, Dartmouth M.A.L.S. (1994). “Built around a uterus: Historical Origins of the 'Limited Energy Theory' of Women's Physiology.”

Amy Larson, Dartmouth M.S. (1994), Ph.D. (1996). “Evidence of pneumatolytic processes in the genesis of magnetite deposits at El Laco, Chile.”

Helen Mango, Dartmouth Ph.D. (1992) “Origin of epithermal Ag-Au-Cu-Pb-Zn mineralization on the Veta Madre, Guanajuato, Mexico.”

Victoria Carlson-Foszcz, Dartmouth M.S. (1991) “Mobility of rare earth elements in the Ophir region, San Juan Mountains, Colorado.”

TEACHING ACTIVITIES III. Undergraduate Research Advising (Principal Advisor)

Roger Ashton MacFarlane, Harvard University, 2018. B.A. thesis advisor: “Wild Laboratories of Climate Change: Plants, Phenology, and Global Warming, 1955-1980.”

Carolyn Miao, Harvard University, 2018. B.A. thesis advisor: Climate Change and Human Health: A History of Erring on the Side of Least Drama.”

Randall Nicholson, UCSD B.A. Senior Honors thesis (2000). Advisor: “Creating a climate of public opinion in support of the bombings of Hiroshima and Nagasaki.”

Jessica Murray, Dartmouth B.A. Senior Honors thesis (1996). Advisor: “Controls on the use of cathodoluminescence in the study of apatite.” Published as:

- Murray, J. and Oreskes, N., 1997. “Uses and Limitations of Cathodoluminescence in the study of apatite paragenesis.” *Economic Geology* vol. 92, pp. 368-376.

Rachel Roisman, Dartmouth B.A. Senior Fellow Honors Program (1995-96). Advisor: “Victimizing choices? Prenatal sex determination and sex selective abortions in India.”

Rosalie Kaslowki, Dartmouth B.A. Senior Honors thesis (1995). Advisor: “Cathodoluminescence of apatite from El Laco, Chile.”

Sossity Sheets, Dartmouth B.A., Senior Honors thesis (1995) Advisor: “SEM analysis of apaites from El Laco, Chile.” Published as part of:

- Oreskes, N., Rhodes, A.L., Sheets, S. A., and Espinoza, S., 1995. “Evidence for formation of magnetite by metasomatic alteration of host rock andesite: El Laco, Chile, Part I: Field relations and alteration assemblages,” *Geological Society of America Abstracts with Programs*, vol. 27, no. 6, p. A-467.

Jessica Murray, Dartmouth B.A. Dartmouth Presidential Scholar (1994-95) Advisor: “Petrography of iron deposits at El Laco, Chile.”

Keith Rainville, Dartmouth B.A., Honors thesis (1994) Advisor: “Geothermometry of fluid inclusions at El Laco, Chile.” Published as part of:

- Oreskes, N., Rhodes, A.L., Rainville, K., Sheets S., Espinoza, S., and Zentilli, M., 1994. “Origins of magnetite deposits at El Laco, Chile: New evidence from field studies, fluid inclusions, stable isotopes, and fission track dating. *Geological Society of America Abstracts with Programs*, vol. 26, no. 7, p. A-379.

Jeffrey Furr, Dartmouth B.A., Honors thesis (1994) Co-advisor: “Gravity evidence for the sub-surface morphology of magnetite deposits at El Laco, Chile.”

Sossity Sheets, Dartmouth B.A., Dartmouth Presidential Scholar (1993-94) Advisor: “Characterization of fluid inclusions at El Laco, Chile.” Published as part of:

- Oreskes, N., Rhodes, A.L., Rainville, K., Sheets S., Espinoza, S., and Zentilli, M., 1994. “Origins of magnetite deposits at El Laco, Chile: New evidence from field studies, fluid inclusions, stable isotopes, and fission track analysis.” *Geological Society of America Abstracts with Programs*, vol. 26, no. 7, p. A-379.

David Kaiser, Dartmouth B.A. Waterhouse Research in history of science, published as:

- “More roots of complementarity,” *Studies in the History and Philosophy of Science*, 23: 213-239, 1992.
- “Neils Bohr's conceptual legacy in contemporary particle physics,” *Neils Bohr and Contemporary Philosophy*, Jan Faye and Henry Folse, eds., pp. 257-268.
- “Bringing the human actors back on stage: The personal context of the Einstein-Bohr debate.” *British Journal for the History of Science*, December 1994.

MEDIA APPEARANCES (Selected)

WGBH television, “A Science Odyssey: Origins,” aired nationwide on January 15, 1998.

UCSD television, “Guestbook” interview with Dr. Helen Caldicott, April 21, 1999.

KPBS radio, San Diego, “These Days,” with Tom Fudge, March 8, 2001.

InTeleCom Video, “The Endless Voyage: Exploring the Marine Environment,” A teleweb course on oceanography, 2003, aired on PBS affiliates in January 2004.

KLSD radio, San Diego, “Air America” with Craig Elsten, December 11, 2004; and October 23, 2005.

Voice of America, “Nightline Africa” with Joe DeCapua, January 2, 2005.

WCCO Radio (Minneapolis), Live with Jack Rice, June 9, 2005.

Voice of America, “Talk to America” with Doug Bernard, November 28, 2005.

UCSD Television Interview with Chris Mooney, May 2006.

BBC World Service, “The World Today,” taped interview, broadcast Thursday July 20, 2006.

Hawaii Public Radio, KIPO 89.3 FM, “ThinkTech” with Jay Fidell, Wednesday July 26, 2006, and Wednesday February 21, 2007.

Greenlex Town Meeting PodCast, Lexington, Kentucky, Thursday September 21, 2006.
“Ecotalk with Betsy Rosenberg,” KQKE-960AM San Francisco, CA and several dozen affiliates nationwide, September 26, 2006.
Wisconsin Public Radio, Conversations with Joy Cardin (90.7 and 09.9 FM, 970 AM), January 6, 2007
“For the record,” WISC-TV/ My Madison TV 14, CBS Affiliate, Madison, Wisconsin, February 11, 2007; on line at www.c3ktogo.com
BBC World Service, “The World Today,” brief interview, March 15, 2007.
KPBS radio, San Diego, “These Days,” with Tom Fudge, October 8, 2007, Full hour interview with listener calls.
www.ambiente.tv and www.arpacampania.it, link ‘revista’, Interview in Naples, Italy, October 23, 2008
Science Studio Podcast, Arizona State University, April 4, 2008.
Climate Change: Separating Fact from Fiction, WNNT-TV, Huntsville, Alabama, September 24, 2008.
KPBS Radio, San Diego, “These Days” with Tom Fudge, “Science and Politics,” September 29, 2008.
BBC World Service, “The World Today,” brief interview, January 26, 2009.
KGNU National Public Radio, Boulder, CO brief interview in conjunction with the World Affairs Conference, April 5, 2010.
WNYC Radio, The Leonard Lopate Show, May 26, 2010
KPCC, The Patt Morrison Show, June 1, 2010
WORT-FM Perpetual Notion Machine. June 3rd, 2010 also at www.wort-fm.org
Wisconsin Public Radio, The Joy Cardin Show, Interview and listener call-in, June 3, 2010
KSWB-TV Fox News, San Diego, Interview, June 7, 2010.
KPBS Radio “These Days” with Tom Fudge, Interview and listener call-in, June 7, 2010
CW 6- XETV, interview, June 8, 2010
The Bob Edwards Show, (Satellite Radio), June 29, 2010.

My work on climate science has been widely cited in print media, including *Newsweek*, *The Economist*, *The New Scientist*, *United Press International*, *The Seattle Times*, *The New Yorker*, *USA Today*, *Parade*, *The New York Times*, *La Recherche*, *Politiken* (Copenhagen), *Corriere della Sera* (Italy), *The Irish Times*, *The Daily Telegraph*, *The Guardian*, *The Times* (London), *Frankfurter Allgemeine*, *Le Monde*, *Le Soir* (Brussels), *La Libre* (Brussels), *Agence France-Presse*, *Reuters*, and *Ha’aretz*, and featured in the Academy-Award winning film, *An Inconvenient Truth*, and the Mockmentary, *Sixzle*. It is also cited by the lead character in Ian McEwan’s novel, *Solar*.

In 2010, I did approximately five dozen additional radio, newspaper, and internet interviews and podcasts, in association with the release of *Merchants of Doubt*. I did over a dozen interviews with Australian and New Zealand Press, including the widely-watch evening news program, *Lateline*, during an Australian tour in November 2010.

I have done dozens of podcasts with e-journalists across the country, and several of my lectures are now on YouTube. *The American Denial of Global Warming* has over 280,000 hits
http://www.youtube.com/watch?v=2T4UF_Rmlio

After 2010 I stopped keeping track...

Selected additional media appearances, 2011 onwards

Doug Fabrizio Radio West, 24 February 2011

[http://www.publicbroadcasting.net/kuer/news.newsmain/article/184/0/1767090/RadioWest.\(M-F..11AM..and..7PM\)/22411.Merchants.of.Doubt](http://www.publicbroadcasting.net/kuer/news.newsmain/article/184/0/1767090/RadioWest.(M-F..11AM..and..7PM)/22411.Merchants.of.Doubt)

Fourth Street Forum with Denise Calloway, Milwaukee Public Television, 10 March 2011

<http://www.milwaukeeeturners.org/fourth-street-forum/>

“State of Things” with Frank Stasio, North Carolina Public Radio, WUNC-FM, Raleigh-Durham, North Carolina.

“More Talk Radio” with Cecil Prescod and Celeste Carey, KBOO-FM, <http://kboo.fm/MoreTalkRadio>

“Virtually Speaking Science”, <http://www.blogtalkradio.com/virtuallyspeaking/2011/10/20/naomi-oreskes-tom-levenson-virtually-speaking-science-1>

"Talk of the Nation" with Neil Conan, National Public Radio, January 24, 2012

— <http://www.npr.org/2012/01/24/145732719/op-ed-the-verdict-is-in-on-climate-change>

National Public Radio, All Things Considered, February 22, 2012

<http://www.npr.org/2012/02/22/147263862/climate-scientist-admits-to-lying-leaking-documents>

French Public Radio, Science Publique, March 30, 2012.

“A Chronicler of Warnings Denied,” A profile by Claudia Dreifus, *New York Times*, October 28, 2014.

<http://www.nytimes.com/2014/10/28/science/naomi-oreskes-imagines-the-future-history-of-climate-change.html?ref=science& r=0>

<http://www.nytimes.com/2015/02/17/opinion/animated-life-pangaea.html? r=0>

TED TALK

Why we should trust scientists, presented May 2014, New York City.

https://www.ted.com/talks/naomi_oreskes_whywe_should_believe_in_science?language=en
As of late 2022, there were over 1,560,000 views.

INVITED LECTURES

“Geology of the Olympic Dam Copper-Uranium-Gold Deposit,”

- U.S. Geological Survey, Branch of Western Mineral Resources, Menlo Park, CA. Jan. 1986.
- U.S. Geological Survey Branch of Central Mineral Resources, Denver, CO. Feb. 1988.
- Peninsula Geological Society, Palo Alto, California, Nov. 1989.
- Geology Department Lecture Series, University of Vermont, Burlington, VT, Nov. 1990.
- Friends of Ore Deposits Lecture Series, U.S. Geological Survey, Reston, VA Nov. 1990.
- Gold Geology of Maar Diatremes, Randol at MinExpo '92, Las Vegas, NV Oct. 1992.

“The Rejection of Continental Drift: Theory and Method in American Earth Science.”

- History of Science Society Annual Meeting, Pittsburgh, PA, October 1989.
- Department of Geology, University of Maryland, August 1990.

- Ritter Memorial Lecture, Scripps Institution of Oceanography, March 1994.
- University of California, San Diego, screened on UCSD television station, March 1994.
- University of Washington, Department of Geological Sciences, March 1995.
- University of Oklahoma, Department of History of Science, March 1995.
- Princeton University, Department of Geological Sciences, March 1996.
- Five Colleges Lecture, Smith College, Northampton Massachusetts, February 1999.
- Cascade Volcano Observatory, Portland, Washington, May 2001
- U.S. Air Force Research Laboratory, Hanscom Air Force Base, MA, January 2002.
- Quay-Hebrew Endowed Lecture, Brigham Young University, March 2006.
- 15th Herbert Morowetz Lecture, Polytechnic University, Brooklyn, New York, March 2007.

“From Fact to Theory: American Geological Practice, 1922-1933,”

- Department of History, University of California at Los Angeles, March 1991.
- Department of Earth and Planetary Sciences, Harvard University, May 1991.

“The Right Choice? Historical Perspectives on Women in Science,” invited speaker,
Women in Science Project Kick-Off meeting, Dartmouth College, September 1991.

“Unity, Gender, and the Authority of Science: Case studies from American Geology, 1922-1933,”
Science, Technology and Society Lecture Series, Franklin and Marshall College, Feb. 1992.

“Gravity Surveys in the ‘Permanent’ Ocean Basins: An Instrumental Chink in a Theoretical Suit of
Armor,” invited speaker, Plenary Session, *Continents vs. Oceans in the Earth Sciences Revolution*, Fifth Intl.
Congress on the History of Oceanography, La Jolla, CA, July 1993.

“Objectivity or Heroism? On the Invisibility of Women in Science,”

- Department of Science and Technology Studies, RPI, Troy, NY, Sept. 1993.
- Feminist Inquiry Seminar, Dartmouth College, March 1994;
- University of California, San Diego, Science Studies Program, March 1994.

“Why Believe a Computer? Verification, Validation, and Confirmation of Numerical Models in the
Earth Sciences”

- Scripps Institution of Oceanography, March 1994.
- Dept. of Computer Science and Electrical Eng., George Washington University, Nov. 1994.
- Georgia Institute of Technology, Dept. of Earth and Atmospheric Sciences, April 1995.
- Carleton College, Luce Lecture Series on Human Dimensions of Global Change, Feb. 1996.

“Did Science Kill Nature? Sex, Gender, and the Scientific Revolution,” Dartmouth Alumni College,
August 1994.

“Work or Glory? The Image and Reality of Women in Science” Chancellor’s Advisory Committee on
the Status of Women, University of California, San Diego, Feb. 1995.

“Looking for a Few Good Women: Military Patronage and Scientific Labor at the Scripps Institution of
Oceanography.” U.S. Naval Research Laboratory, Washington, DC, April 1997

“Evaluation (Not Validation) of Quantitative Models.” U.S. Environmental Protection Agency, Lead Model Validation Workshop, Research Triangle Park, NC, Oct. 1996.

“Truth or Consequence? Trade-offs in Building Computer Models of Complex Natural Systems.” U.S. Geological Survey, Menlo Park, CA, March 1997.

“When Good Models Turn Out to be False: Sobering Examples from the History of Science,” Santa Fe Institute, Santa Fe, NM, January, 1998.

“Model Assessment: Where Do We Go from Here?” Keynote speaker, U.S. Environmental Protection Agency, National Research Center for Statistics and the Environment, Workshop on Quality Assurance of Environmental Models, University of Washington, Sept. 1999.

“Conceptual Issues in Model Assessment: What can we learn from past mistakes?” “

- Los Alamos National Laboratory, Los Alamos, NM, January 2000.
- U.S. Army Conference on Applied Statistics, Houston, TX, October 2000.

“Science and Security Before the Atomic Bomb: The Loyalty Case of Harald Ulrik Sverdrup”

- University of California, Los Angeles, History Department, March 2000
- Oregon State University, Horning Lecture Series, Corvallis, OR., May 2000
- Santa Fe Institute Public Lecture Series, Santa Fe, NM, March 2001
- Physics Department, New Mexico State University, Las Cruces, NM, March 2001
- Caltech Science and Society Lecture Series, Pasadena, CA, June 2001.
- Cornell University, Department of Science and Technology Studies, October 2001.
- Keynote speaker: SOURCE [Symposium on Undergraduate Research and Creative Expression], Central Washington University, May 2003.
- Penn State University, History Department, January 2005.
- SPAWAR Systems Center, Summer Seminar Series, U.S. Department of Defense, Point Loma, California, July 2005.

“From Scaling to Simulation: Changing Meanings and Ambitions of Models in the Earth Sciences”

- History of Science Society Annual Meeting, Vancouver, Canada, November 2000.
- Princeton University, Workshop on Models & Model Systems, Princeton NJ, February 2001.
- Harvard University, History of Science Department, Cambridge MA, March 2001.
- Max Planck Institut für wissenschaftsgeschichte, “Digital Workbench” workshop, Berlin, Germany, December 2001.

“The Rise of Prediction in the Earth Sciences,” Department of Earth Sciences, University of California, Riverside, January 2001.

“Nuclear Waste Disposal: Bridging the Gap between Science and Policy”

Invited Panelist, Geological Society of America, Reno NV, November 2000

“The Role of Quantitative Models in Science.” Keynote speaker, Cary conference IX: Understanding Ecosystems: The Role of Quantitative Models in Observation, Synthesis, and Prediction, Millbrook NY, May 2001.

“From Hydrogen Bombs to Hydrothermal Vents: The Discovery of Black Smokers on the Sea Floor”

- Cornell University, Peace Studies Workshop on Science and the Military, October 2001
- Harvard University, History of Science, Physical Sciences Research Group, November 2001
- Penn State University, Program in Science, Technology, and Medicine, January 2002
- Max Planck Institut für Chemie, Mainz, Germany, October 2002.
- Princeton University, History Dept. Workshop on *Science across the Seas*, March 2003.
- Columbia University, Earth Institute, Science, Technology, and Global Development Seminar, March 2003.
- University of Pittsburgh, History and Philosophy of Science Department Colloquium Series, April 2003.
- University of Minnesota, Program in History of Science and Technology, September 2005.
- University of California, Berkeley, May 2006

“Cold War Secrecy and the Development of Plate Tectonics”

GEO2002, Würzburg, Germany, October 2002.

“Proof is over-rated,” Symposium on “The Politicization of Science: Learning from the Lomborg Affair,” American Association for the Advancement of Science, Denver, CO, February 2003.

“Proof, Persuasion, and Public Policy: Three Examples from the History of the Earth and Environmental Sciences;” *London School of Economics Workshop on the Practices of Objectivity in the Natural and Social Sciences*, London, England, October 2003.

“Decision-making under Uncertainty: Is there any other kind?” Keynote speaker, *European Commission Workshop on Science-Society Interfaces*, Milan, Italy, November 2003.

“Consensus in Science: How Do We Know We’re Not Wrong?” *2004 George Sarton Award Lecture*, American Association for the Advancement of Science, Seattle, WA, February 2004.

Also presented at

- UCSD Humanities Center, February 2004
- Department of Petroleum & Geosystems Engineering, University of Texas, Austin, March 2004
- Department of Earth Sciences, University of California, Riverside, California, April 2004
- Department of Geology, University of California, Davis, California, May 2004.
- Rock Ethics Institute, Penn State University, April 2005.
- Department of Geological Sciences, University of Minnesota, September 2005.
- NOAA (National Oceanic and Atmospheric Agency), Silver Spring, Maryland, July 2006.
- “Capital Science Evening,” Carnegie Institution of Washington, March 2007.

“Why There is Always (Some) Dissent in Science (and How to Think About It): A post-Kuhnian model”, European Commission Group of Policy Advisors, Workshop on *Risk, Uncertainty and Dissent: Dealing With “Chancy” Science and “Chancy” Society*, Seville, Spain, June 2004

“From Weather Modification to Climate Change: The Work of Gordon J.F. MacDonald” International Commission on History of Meteorology, *From Beaufort to Bjerknes and Beyond: Critical Perspectives on Observing, Analyzing, and Predicting Weather and Climate*, July 2004, Weilheim, Germany.

“Writing *Plate Tectonics*”

- Presentations to ERESE (Enduring Resources for Earth Science Education) Summer workshop for high school earth science teachers, Scripps Institution of Oceanography, July 2004 and July 2005.
- Palomar College, San Marcos, California, September 26, 2007.

“Strategies of Dissent over Climate Change”

- London School of Economics, Workshop, *Improving Policy Decisions in Areas of Risk and Scientific Uncertainty*, December 12-13, 2004,
- University of California, San Diego, Patrick Ledden Memorial Lecture Series, February 2005.
- University of California, San Diego, Climate Research Division, June 2005.

“The Misrepresentation of Climate Science.” John F. Kennedy School of Government, Harvard University, Workshop: *Machineries of Representation*, April 8, 2005.

“Deny, Deny, Deny: How to Sow Confusion over Climate Change,” Stanford University, Agnotology: A Workshop on The Cultural Production of Ignorance, October 2005.

“Dissent or Denial: Sorting out the Epistemic and the Political in Climate Change,” Workshop on Contingency and Dissent in Science, London School of Economics, December 2005.

“Reconciling Representations with Reality: Unitization as an Example for Science and Public Policy,” Workshop on Quality Control and Assurance in Scientific Policy Advice, Berlin-Brandenburg Academy of Sciences and Humanities, January 2006

“Science and Public Policy: What's proof got to do with it?” Scripps Institution of Oceanography, Center for Marine Conservation and Biodiversity, August 2006.

“Who’s Confused about Climate Change?”

- 3rd Annual Jack F. Ealy Workshop on Science Journalism, Institute of the Americas, University of San Diego, California, July 2006.
- “Doubt” Seminar, Organized by Professors Martha Minow and Peter Galison, Harvard University, December 6, 2006.

“Media Coverage of Climate Science: Panel Discussion,” Woodrow Wilson Center for Scholars, Washington, D.C., July 2006.

“Opportunities and Opportunism: How Cold War military oceanographers tried (and failed) to become environmental scientists who would resolve the question of global warming.”

- Harvard University, Department of History of Science Colloquium Series, December 5, 2006.
- University of Wisconsin, Madison, Department of History of Science Colloquium Series, February 8, 2007.

“Deflecting Disinformation about Climate Change”

- American Geophysical Union, Union Session, “Communicating Science Broadly,” December 14, 2006.
- U.S. Geological Survey, Menlo Park, California, February 20, 2007.

“The Scientific Consensus on Climate Change: How Do We Know We’re Not Wrong?” Cal Poly Pomona Campus Forum Distinguished Lecture Series, January 24, 2007

“Cold War Scientists and the Denial of Global Warming,”

- University of Wisconsin, Madison, Department of Geosciences, February 9, 2007.
- Stanford University, Woods Institute for the Environment, Stanford, California, February 20, 2007.
- Department for History, Philosophy and Theory of Science, Roskilde University, Roskilde, Denmark, September 7, 2007.

“Telling the Truth about Global Warming,” Madison Civics Club, Madison, Wisconsin, February 10, 2007.

“The tobacco road to global warming,” American Association for the Advancement of Science Symposium on The Socio-Political Construction of Ignorance: Agnotology, San Francisco, California, February 18, 2007.

“The Crucial Experiment that Wasn’t: Acoustic Tomography of Ocean Climate,”

- Keynote lecture, Knowing Global Environments: A Conference in Honor of Robert Kohler, University of Pennsylvania, May 10, 2007.
- Neils Bohr Institute, Copenhagen, Denmark, September 6, 2007.
- Schools of Life Sciences, Arizona State University, Tempe, Arizona, April 4, 2008.
- Science Studies Program, UC Davis, February 20, 2009.
- Keynote Lecture, Oregon State University, American Oceanography at Mid-Century, Corvallis, Oregon, May 14, 2009.
- University of Southern California, History Department Program in Science and Technology Studies, October 13, 2011.
- Harvard University, Department of History of Science, December 12, 2011.
- Yale University, Program in History of Science, January 30, 2012.
- Roskilde University, Department of Philosophy, September 15, 2016.

“Against disciplining Inter-disciplinarity,” Keynote Speaker, Critical Conversations: Methods and Practices in Interdisciplinary Science Studies, Patrick Suppes Center for the Interdisciplinary Study of Science and Technology, Stanford University, May 18, 2007.

“The Rejection of Continental Drift: Historical Reflections on Scientific Method,” Geological Society of London Bicentenary Celebration (Invitation only conference), September 11, 2007.

“Moving Beyond Crisis: Toward Sustainable Knowledge,” Keynote Speaker, Lewis and Clark 10th Annual Environmental Affairs Symposium, Lewis and Clark College, Portland, Oregon, October 3, 2007.

“The American Denial of Global Warming,”

- Scripps Institution of Oceanography/ Birch Aquarium, Jeffrey B. Graham Lecture Series: Perspectives on Ocean Science,” La Jolla, California, October 8 2007.
http://www.youtube.com/watch?v=2T4UF_Rmlio

“Science and Politics in the USA: Historical and Personal Perspectives,” Ambiente e Salute, Primo convegno internazionale, *Autonomia della scienza dal potere politico: Rischi e Danni di una dipendenza*. Istituto Italiano per gli Studi Filosofici, Naples, Italy, 24 October 2007.

“You can argue with the facts: A political history of climate change”

- British Academy, “Enquiry, Evidence and Facts: An Interdisciplinary Conference,” December 13, 2007, London, England.
- “Dissent in science,” Workshop, March 3, 2008, University of California, San Diego.
- Department of Land, Air, and Water, University of California, Davis, March 7, 2008.
- STS Distinguished Lecture, Dean’s Lecture Series, School of Natural Resources and the Environment, and Ford School of Public Policy, University of Michigan, Ann Arbor, April 7, 2008.
- Department of Geology, Stanford University, Stanford, California, April 17, 2008.
- “History that Matters: A Conference in Honor of Spencer Weart,” American Institute of Physics, May 9, 2008.
- Colby College, 20th Anniversary Celebration, Science and Technology Studies Program, Family Weekend, October 17, 2008

“The Denial of Global Warming”

- Dublin Institute of Advanced Studies, Annual Statutory Public Lecture, September 3, 2008, Dublin, Ireland.
- Bates College, College Lecture Series, Lewiston, Maine, October 20, 2008.
- Franklin and Marshall College, Bonchek Lecture, Lancaster, Pennsylvania, November 10, 2008.

“Disagreement, Dissent, and Denial: The Social Destruction of Scientific Knowledge,” ScienceFutures conference, ETH, Zurich, Switzerland, February 6-8, 2008.

Moving Beyond Carbon? The U.S. Situation.” Keynote Lecture: *Towards Post-Carbon Societies*, Centre for energy and society, Department of interdisciplinary studies of culture, Norwegian University of Science and Technology (NTNU), September 5, 2008.

Politics in Science: Who Decides What Gets Done and What it Means? Presentation and Panel Discussion, Reuben H. Fleet Science Center, San Diego, CA October 1, 2008.

Chancellor’s Pre-Election Briefing, San Diego Civic Center, October 14, 2008.

“My facts are better than your facts”

- Symposium on “Traveling Facts,” History of Science Society Annual Meeting, Pittsburgh, Pennsylvania, November 2008.
- Intellectual History Seminar, The Royal Library, Copenhagen Denmark, March 13, 2009

“Adaptation to global warming: Do climate models tell us what we need to know?”

- Philosophy of Science Association Annual Meeting, Symposium on Climate Models, Pittsburgh, Pennsylvania, November 2008.
- National Science Foundation, Distinguished Lecture Series on Global Systems Science, Washington, DC June 1, 2009.

“The Social Deconstruction of Scientific Knowledge,” Workshop on Knowledge of Doing, Max Planck Institut für wissenschaftsgeschichte, Berlin, Germany, March 7, 2009

“The trouble with supply-side science.”

- Steno Institut, Aarhus University, Aarhus Denmark, March 9, 2009
- Climate Change: Global Risks, Challenges, and Decisions, Copenhagen, Denmark, March 12, 2009.
- Labos 1point5 Conference [Virtual], Environmental footprint and sustainability of research activities, Paris, Sorbonne Université campus Pierre et Marie Curie and online, 6 November 2024.
- Keynote talk, CFP: GWP.2025 - Fifth International Conference of the German Society for Philosophy of Science, Friedrich Alexander University, Erlangen-Nürnberg

“Science, Technology, and Free Enterprise.” Special Session: Meet the Author of American Hegemony and the Postwar Reconstruction of Science in Europe, History of Science Society Annual Meeting, Phoenix, Arizona, November 21, 2009.

“Is Consensus the Goal of Science (and Should it Be)?”

- 10th Swiss Global Change Day, 31 March 2009, Berne, Switzerland, Swiss Academy of Sciences.
- Penn State University, Climate Policy Seminar and Symposium: Addressing Cross-disciplinary Challenges and Solutions, April 7, 2009.

Creativity in the Face of Climate Change: The Role of Humanities in Awakening Societal Change Panel Discussion In conjunction with the exhibition: Human/Nature: Artists Respond to a Changing Planet, Berkeley Art Museum and Pacific Film Archive, Friday, April 24, 2009

“Climate Conservations”, Moderator, [A series of evening lectures on Climate Change, 2009-2010.] Reuben H. Fleet Science Center, San Diego, California.

“Of Heroes, Villians, and Ordinary Men: Right-sizing Roger Revelle,” Reflections on the History of the Biological and Oceanographic Sciences, A Symposium in Honor of Professor Ronald Rainger, Lubbock, Texas, January 11, 2010.

“A New View of Science: Title Search Realism”

- Zucker Fellowship Lecture, Yale University, New Haven Connecticut, October 21, 2009,
- C. P. Snow Lecture Series, University of Maryland, Baltimore Country, Baltimore Maryland, November 2, 2009.
- Birch Aquarium, Scripps Institution of Oceanography, January 13, 2010
- AAAS Climate Literacy Forum, February 17, 2010.

“Merchants of Doubt: How a Handful of Scientists Obscured the Truth about Climate Change”

- University of Rhode Island Vetlesen Lecture Series, People and Planet 2010: Global Environmental Change, March 2, 2010. <http://www.youtube.com/watch?v=XXyTpY0NCp0>
- Geography Department, University of California, Berkeley, March 11, 2010.

“History (of Climate Science) as a Resource for Decision-Making,

University of California, Berkeley, *Conference on History as a Resource for Decision-Making*, March 12-14, 2010.

“Communicating Climate Science: Why is This So Hard?”

NCAR/UCAR 50th Anniversary Lecture sponsored by TIAA-CREF, Conference on World Affairs, Boulder, CO, April 5, 2010.

“What have we learned about limiting knowledge in a democracy?” A panel discussion, *Conference on Limiting Knowledge in a Democracy*, The 21st *Social Research* conference at The New School Thursday, May 27, 2010

“Objectivity in a World of Truthiness,” *Conference on Objectivity in Science*, University of British Columbia, Vancouver, BC, Canada, June 18, 2010.

“Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming” [Book Tour, formal talks, lectures, and/or readings]

- New York Academy of Sciences, May 26, 2010
- Santa Monica Library, Santa Monica, CA, June 1, 2010
- Warwick’s Books, La Jolla, CA June 7 2010
- Reuben H. Fleet Science Center, San Diego California, June 8, 2010
- Climate and Sustainability: Moving By Degrees, a Media Forum sponsored by National Public Radio, Pasadena, California, June 9, 2010.
- Deutsche Welle Media Forum, Panel on dealing with climate “skepticism” Bonn, Germany, June 21, 2010.
- Science Chairs Seminar, University of Southern Denmark, Odense, Denmark, June 24, 2010
- Public Lecture, Copenhagen University, Copenhagen, Denmark, June 24, 2010
- National Press Club, Washington, DC, June 28, 2010
- Pew Center on Climate Change, Business Executives Leadership Council Washington, DC, July 15, 2010
- Netroots Nation, Panel, “Supporting Science, Benefitting Society”
<http://www.sumofchange.com/video.php?vid=5b5114ad8>
- Hubert H. Humphrey Institute for Public Affairs, Minneapolis, Minnesota, August 11, 2010
- Will Steger Foundation Summer Institute for Climate Change Education and on-line Webinar, Minneapolis, Minnesota, August 12, 2010
- Long Beach Aquarium, August 26, 2010.
- Greater Yellowstone Coalition 27th Annual Meeting, Jackson Hole, Wyoming, September 24, 2010.
- Institute for History and Philosophy of Science and Technology, University of Toronto, Toronto, Canada, September 29, 2010.
- Inaugural Lecture, Program in Science and Technology Studies, York University, Toronto, Canada, September 30, 2010.
- Kansas State University, Manhattan, Kansas, October 18, 2010
- University of Kansas, Lawrence, Kansas, October 19, 2010.
- Fort Hays State University, Hays, Kansas, October 20, 2010.
- Brussels, Belgium: Controverses Climatiques : sciences et politique, October 27, 2010
- Brussels, Belgium, American Embassy Speaker Series, October 28, 2010
- Paris, France, Controverses climatiques : sciences et politique, October 29 2010
- Briefing with California State Senators, California State House, Sacramento, California, January 27, 2011
- UCSD Near You, Sacramento, California, January 27, 2011

- Keynote Speaker, Carbonundrums: From Science to Headlines, Oslo, Norway, 8 February 2011.
- McGill University School of Environment Annual Lecture Series, Montreal, Canada, 10 February 2011.
- Smith College, Five College-University Geology Lecture Series and Howard Hughes Medical Institute Lecture Series on Health, Water and Climate, Northampton, Massachusetts, February 17, 2011.
- Wallace Stegner Center, University of Utah, February 28, 2011.
- Gaylord Nelson Lecture Series, University of Wisconsin, Madison, March 8, 2011
- Green Energy Summit, Plenary Session, “The Carbon Imperative,” Milwaukee, Wisconsin, March 10, 2011.
- City of Aspen Canary Initiative and Aspen Ski Company, Limelight Lodge, Aspen Colorado, March 18, 2011.
- Michael Polanyi Memorial Lecture, University of North Carolina, Chapel Hill, March 30, 2011.
- University of California, San Diego, Department of Medicine, Grand Rounds, May 4, 2011.
- Keynote Speaker, National Hydrologic Warning Council, San Diego, California, May 11, 2011.
- Sir Michael King Memorial Lecture, Auckland Readers’ and Writers’ Festival, New Zealand, 14 May 2011, <http://events.nzherald.co.nz/2011/may/auckland-cbd/naomi-oreskes-and-the-merchants-of-doubt>
- University of California, Los Angeles, Law School, May 25, 2011
- University of California, San Diego, Emeritus Association, San Diego, CA, June 8, 2011.
- Woodrow Wilson Center, Washington, DC, Climate Change communicator of the Year Award Ceremony (via web cast), June 8, 2011.
- Google, Science Communication Innovation Workshop, Google, Mountain View, California, June 14, 2011.
- Pacific Institute for Climate Solutions, University of Victoria, British Columbia, Canada June 27, 2011.
- Pacific Institute for Climate Solutions, Simon Fraser University, Vancouver, British Columbia, Canada June 28, 2011.
- Powell’s Bookstore, Portland, Oregon, June 29, 2011.
- Microsoft Research, Visiting Speaker Series, Seattle, Washington, June 30, 2011.
- International Energy Program Evaluation Conference, Annual Meeting, Boston, Massachusetts, August 16, 2011.
- AREDAY (Annual Renewable Energy Day), Aspen, Colorado, August 21, 2011
- Brigham Young University, David M. Kennedy for International Studies, Environmental Ethics Initiative Lecture Series, March 9, 2012.
- Keynote Lecture, Facts, Artifacts, and the Politics of Consensus: A Midwest Conference for Science and Technology Studies, Northwestern University, Evanston, Illinois, May 4, 2012.
- Keynote Lecture, Sustainability Day, California State University, Northridge, October 25, 2012.
- Keynote Lecture, Earth Week, Salem State University, April 15, 2015
- Keynote Lecture, History weekend, North Carolina State University, April 18, 2015.
- Keynote Speaker, West Valley Community College, Third Annual Earth Stewardship Symposium, April 23, 2015.
- Screening and discussion, University of Texas Houston Medical Center, Medical Humanities Program, October 27, 2015
- Distinguished Scientist Lecture Series, Trinity University, San Antonio, Texas, October 28, 2015.

“Why we resist the results of climate science,”

- Philosophy of Science Association, Montreal, Canada November 4, 2010.
- Steve Schneider Memorial Celebration, December 12, 2010, Stanford University, Stanford, California.

“Neo-liberalism, resistance to climate science, and the legacy of the Cold War,”

- History of Science Society, Montreal Canada, November 6, 2010.

“Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming” [Australian Book Tour]

- University of New South Wales, Sydney, Australia, sponsored by Climate Change Research Center and Faculty of Arts and Social Science, November 15, 2010
- University of Queensland, Brisbane, Australia, sponsored by the Global Change Institute, November 16, 2010.
- Experimedia, The State Library of Victoria, Melbourne, Australia sponsored by the Monash Sustainability Institute and the Melbourne Sustainable Society Institute, November 17, 2010.
- The Royal Institution of Australia, Adelaide, Australia, sponsored by the Royal Institution of Australia, November 18, 2010.
- The University of Western Australia, Perth, Australia, sponsored by the Institute of Advanced Studies, University of Western Australia, November 22, 2010.
- Environment Institute of Australia and New Zealand, Climate Change Leadership Forum, Perth, Australia, November 23, 2010.

“If the predictions of climate models have come true, then why don't people believe them?” American Geophysical Union Annual Meeting, San Francisco, California, December 15, 2010.

“Are debatable scientific questions debatable? “Special Session on “Best-selling AGU Authors,” American Geophysical Union Annual Meeting, San Francisco, California, December 15, 2010.

“Facts and Trust, Uncertainty and Doubt: Lessons from the History of Science.” Oslo University Science Studies Seminar, February 7, 2011.

“On Mavericks and Mules: Diversity and Dissent in Science.” American Association for the Advancement of Science, Washington, D.C., February 19, 2011.

“Truth, Trust, and Peer Review: The Case of the 1983 Acid Rain Peer Review Panel,” Center for Culture, History and the Environment, University of Wisconsin, Madison, March 9, 2011.

Inconvenient Truths (A Panel Discussion), Los Angeles Times Book Festival, April 30, 2011.

Saving the World (A Panel Discussion), Auckland Readers' and Writers' Festival, Auckland, New Zealand, May 15, 2011.

Women Warriors for the Environment (A Panel Discussion) Sydney Writers' Festival, May 19,

2011 *The Merchants of Doubt*: Conversation with Robyn Williams, Sydney Writers' Festival, May 20,

2011 “You've Been Warned” (A Panel Discussion) Sydney Writers' Festival, May 20, 2011

“Blinded by the Right: Ideology, Ignorance, and Agnotology,” Conference on Agnotology: Ways of Producing, Preserving, and Dealing with Ignorance, Center for Interdisciplinary Research, Bielefeld University, May 30-1, Bielefeld, Germany, 2011.

Panel discussion of the future of radioactive waste management, Standards and Regulations for Deep Geological Disposal of Radioactive Waste, Center for International Security and Cooperation (CISAC), Stanford University, June 6th, 2011

“*Erring on the Side of Least Drama*: A Source of Confusion in Communicating Climate Science,” 2011 Stephen Henry Schneider Symposium, National Center for Atmospheric Research, Boulder Colorado, August 26, 2011.

“Moving Beyond Doubt: History, Truth, and Anthropogenic Climate Change”

- Rice University, Humanities Research Center, Houston, Texas, September 30, 2011.
- Bard College, Annandale-on-Hudson, New York, Hannah Arendt Center Conference: *Truthtelling: Democracy in an Age Without Facts*. October 28, 2011.
- Washington and Lee University, WS² : Women Scientists and Women in Science Lecture Series, Lexington, Virginia, November 14, 2011
- College, Alfred E. Golz Memorial Lecture, November 15, 2011
- Edwin Hay Teale Lecture Series, University of Connecticut, Storrs, Connecticut, November 17, 2011.
- Grace Tanner Lecture in Human Values, Snow College, Ephraim, Utah, March 17, 2014.

“What is the meaning of policy failure on climate change?” Climate Change 2011: When Policymakers Fail, Knight Science Journalism Fellowship Program, Massachusetts Institute of Technology, October 4, 2011.

“How does the slow motion nature of climate change affect our ability to address it?”

Catastrophe and the Development of Environmental Law, Yosemite Environmental Law Conference, Tenaya Lodge, California, Saturday, October 22, 2011

“ELSD (Erring on the Side of Least Drama): A Source of Under-Estimation in the Communication of Societal Risk.” Can We Trust Science? A Conference Sponsored by the Norwegian Ministry of Education, November 9-10, 2011, Oslo, Norway.

“Information, Disinformation, and Technological Responses to Climate Change”

- Plenary Session, Partners in Environmental Technology Technical Symposium and Workshop, The Strategic Environmental Research and Development Program and the Environmental Security Technology Certification Program, U.S. Department of Defense, November 29, 2011. <http://symposium2011.serdp-estcp.org/Plenary-Session>
- White House Office of Science and Technology Policy, Washington, DC, December 1, 2011.

“Rachel Was Not Wrong: Why the Science Surrounding DDT Matters Now More than Ever”

- UNAVCO Science Workshop, February 29, 2012.
- Wallace Stegner Center, University of Utah, S.J. Quinney School of Law, March 10, 2012.
- University of Nevada, Reno, Discover Science Public Lecture Series, April 17, 2012.
- Connecticut College, Five Decades after Silent Spring (Keynote Panelist), October 19, 2012.

- University of Connecticut, Keynote Speaker, Day in the Humanities, April 5, 2013, Storrs, Connecticut.

From Nuclear Winter to Climate Change: The Political Uses of Scientific Dissent,” Berlin Brandenburg Academy of Sciences, Berlin, Germany March 20, 2012.

“Changing the Mission: American Oceanography at the End of the Cold War,” *Politics and Contexts of Science Studies in the Cold War and Beyond*, Alfred Krupp Wissenschaftskolleg, Greifswald, Germany, March 22, 2012.

“Les Marchands de Doute: Bataille de l’information et controverses sur les changements climatiques,” Catholic University of Louvain, Louvain-la-Neuve, Belgium, March 26, 2012.

“The Scientific Consensus on Climate Change: Where Do We Go From here?” Max von Laue Lecture, Deutsche Physik Gesellschaft, March 26, 2012, Berlin, Germany.

“Neo-liberalism and the Denial of Global Warming”

- Science Writing in An Age of Denial Conference, University of Wisconsin, Madison, Wisconsin, April 23, 2012.
- University of Chicago Franke institute for the Humanities, May 4, 2012
- Joseph Gentili Memorial Lecture, University of Western Australia, Perth, Australia, August 8, 2012.
- Lecture Discussion, Curtin University Sustainability Policy Institute, Fremantle, Australia, August 9, 2012.
- Lecture Discussion, Centre for Learning Technology, University of Western Australia, August 10, 2012.
- PLAN-Boulder Annual Dinner, Keynote Speaker, May 4, 2013, Boulder, Colorado.

“Science and Environmental Policy: How Do Scientists Assess Scientific Knowledge for Action” Karbank Symposium in Environmental Philosophy, Boston University, May 3, 2012.

“When Knowledge Isn’t Power: Science, Technology and the Environment in the 21st Century.”

- Cal Western Law School, June 7, 2012, San Diego, California.
- Invited paper in session GC33F “Countering Denial and Manufactured Doubt of 21st century Science,” American Geophysical Union Annual Meeting, December 3, 2012.
- Keynote Lecture, “Beyond Climate: Knowledge Production about Planet Earth and the Global Environment as Indicators of Social Change,” University of Berne, Berne, Switzerland, 23 January 2013.
- Monfort Professor-in-Residence Lecture, Colorado State University, Fort Collins, Colorado, 2-3 May, 2013.

“Understanding the Climate Change Debate for Pacific People,” Regional Conference on Local Governments for Climate Change, July 18, 2012, University of the South Pacific, Suva, Fiji.

“The Scientific Consensus on Climate Change: Where Do We Go From Here?”

Keynote Speaker, North Dakota EPSCoR (Experimental Program to Stimulate Competitive Research) 2012 State Conference, University of North Dakota, September 18, 2012.

“Building Scientific Knowledge: The Story of Plate Tectonics” and “Climate Change: How Do We Know We’re Not Wrong?” Howard Hughes Medical Institute, 2012 Holiday Lectures on Science, November 15-16, 2012, Bethesda, Maryland.

“Rethinking Uncertainty: What Does the Public Need to Know?” Invited paper in session GC22B “Communicating Climate Science, Seeking the Best of Old and New Paradigms,” American Geophysical Union Annual Meeting, December 4, 2012.

“The Role of Uncertainty in Climate Science,” invited paper in PA13B “Construing Uncertainty in Climate Science,” American Geophysical Union Annual Meeting, December 5, 2012.

“Historians as Expert Witnesses where Scientific Controversy is Alleged,” American Historical Association Annual Meeting, January 4, 2013, New Orleans.

“How Earth Science Became a Social Science,” invited contribution, “Beyond Climate: Knowledge Production about Planet Earth and the Global Environment as Indicators of Social Change,” University of Berne, Berne, Switzerland, 23-25 January 2013.

“Fix or Fail on Climate? An Open Conversation with Naomi Oreskes,” Limelight Dialogues, February 4 2013, Aspen, Colorado.

“Who’s Responsible for Climate Change?”

- University System of Taiwan International Workshop on “Crises and Opportunities in Environmental Study,” February 20-21, 2013, Taipei, Taiwan.
- Arizona State University, Wrigley Lecture Series, Global Institute of Sustainability, Earth Day (April 22) 2013.

“Rachel Was Not Wrong: Why the Science Surrounding DDT Still Matters,” Keynote speaker, University of Connecticut Day of Humanities, April 5, 2013.

“The Boundary between Science and Policy,” Comment on Session III “Climate Change,” U.S. National Academy of Sciences Arthur Sackler Symposium, The NAS at 150: Celebrating Service to the Nation, October 17, 2013.

Science Teller Conference, Dunedin, New Zealand, October 25-27, 2013

“Telling the Truth through Fiction,” October 24. ([Keynote]

“The Fallacy of Rationality,” October 25.

Reading from “The Collapse of Western Civilization,” Closing talk at Literature and Lager, [Final conference event] October 27.

“The Limits of Symmetry,” American Anthropological Association, November 21, 2013. Chicago, Illinois.

“What voice for science?” Invited paper, *An Open World: Science, Technology and Society in the Light of Neils Bohr’s Thought* [Illness prevented my attendance, paper read on my behalf by Finn Asserud.]

“Uncertainty Assessment: A Form of Seepage?” invited paper in Session GC0039 “Assessing and Conveying Uncertainty,” American Geophysical Union Annual Meeting, December 11, 2013.

“Scientists as Sentinels” Invited paper in Union Session U001 *400 ppm CO₂: Communicating Climate Science*, American Geophysical Union Annual Meeting, December 13, 2013.

“The University and the Public Good: What Should We Be Doing on Climate Change?”
UC Davis Provost’s Forum on the Public University and the Social Good, February 21, 2014,
Davis, California.

“Drama and Disbelief in Climate Science,” Shelby Cullom Davis Center,
Princeton University, April 25, 2014.
<https://history.princeton.edu/news-events/events/naomi-oreskes-drama-and-disbelief-climate-science>

“The Collapse of Western Civilization.” A Panel Discussion on Navigating Climate Futures, Pacific
Northwest College of Art, Portland, Oregon, March 14, 2014.

“The Role of Scientists: What Is our Responsibility?” Pontifical Academy of Sciences and Pontifical
Academy of Social Sciences Joint Workshop on Sustainable Humanity, Sustainable Nature, Our
Responsibility, Vatican City, May 2-6, 2014.

“Merchants of Doubt: The Movie,” Panel discussion on Climate Change Denial, WGBH, Jackson Hole
Wildlife Film Festival Bring Science Media Awards & Symposium to Boston September 18, 2014.

“How to stop disastrous climate change,” Week of environmental awareness" sponsored by
Departments of Earth and Oceanographic science, Environmental Studies, and History, Bowdoin
College, Brunswick, Maine, October 3, 2014

“Historical and Normative Perspectives on the,” Keynote lecture, The Anthropocene Project, Haus der
Kulturen der Welt, Berlin, Germany, October 16, 2014; ·*The Anthropocene: a confrontation of scientific and
political realities*”, *idem*. October 17, 2014, and “Petrogeology and Denial,” a conversation with Colin
Summerhayes, *idem*, October 17, 2014.

“Personal and Political Perspectives on Climate Change,” The Wellfleet Seminar, Wellfleet, MA,
October 25, 2014.

“Why I am a Presentist,” History of Science Society, Forum for American Science Distinguished
Lecture, November 2014, Chicago, Illinois, USA.

“Science, Religion, and Climate Change,” invited speaker, American Academy of Religion Annual
Meeting, San Diego California, November 24, 2014.

“Confronting Climate Change,” A conversation with Robert Jay Lifton and Naomi Oreskes, moderated
by Tom Englehardt, TomDispatch.com, The Center for Public Scholarship at The New School,
December 4, 2014.

<http://www.newschool.edu/pressroom/pressreleases/2014/ConfrontingClimateChange.htm>

World Economic Forum, Davos, Switzerland: January 20-24, 2015. Various sessions on science,
technology, and the environment. <http://www.weforum.org/contributors/naomi-esther-oreskes>

“Technofideism and Climate Change,” Keynote Speaker, PACITA (Parliaments and Civil Society in Technology Assessment), Berlin, Germany, February 25, 2015.

William T. Patten Lectures, Indiana University, Bloomington, Indiana:

- “From Crying Wolf to Fiddling while Rome Burns: Historical Perspectives on Scientists’ Social Responsibility,” March 9, 2015.
- “Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming,” March 11, 2015.

“From Crying Wolf to Fiddling while Rome Burns: Historical Perspectives on Scientists’ Social Responsibility,” March 9, 2015, Keynote Lecture, Columbia History of Science Group, Friday Harbor, WA, March 13, 2015.

“Why Should We Trust Climate Science?”

- Orcas Currents Lecture Series, Orcas Island, WA, March 15, 2015.

“What kind of world will musicians inherit in the year 2050? A view from the future with Naomi Oreskes,” New England Conservatory, March 31, 2015.

“Why We Should Trust Science: Perspectives from the History and Philosophy of Science”

- Department Seminar, Earth and Planetary Sciences, Harvard University, May 5, 2015
- Arthur Miller Lecture in Science and Ethics, Massachusetts Institute of Technology, Cambridge, MA May 6, 2015.
- Marine Biological Laboratory Friday Evening Lecture Series, Inaugural E. B. Wilson History and Philosophy of Science Lecture, July 31, 2015.
- Virginia Tech University Global Change Center Distinguished Lecture Series, Blacksburg, VA, September 2, 2015. <http://www.vtnews.vt.edu/articles/2015/08/082515-fralin-oreskes.html>
- Penn State University, Sustainability Institute, 2015 Colloquium on the Environment, October 26, 2015
- Southern Methodist University, October 29, 2015.
- Volkswagen Foundation, October 26, 2017, Conference “Science Needs Society - What Next After the March for Science?” <https://www.volkswagenstiftung.de/nc/en/events/event-archive/eventdetail/news/detail/artikel/wissenschaft-braucht-gesellschaft-wie-geht-es-weiter-nach-dem-march-for-science.html>
- ETH Zürich Department of Humanities Seminar, November 16, 2018.
- Keynote Speaker, California Science Teachers Association Annual Meeting, November 30, 2018, Pasadena, CA.
- Keynote Speaker, Founder’s Day Convocation, Illinois Wesleyan University, Bloomington, Illinois, January 16, 2019. <https://www.iwu.edu/news/2019/oreskes-addresses-science-in-a-changing-climate.html>

“Fighting Back Against Attacks on Climate Scientists” Climate Science Legal Defense Fund Litigation Strategies Continuing Legal Education Workshop, Columbia University Law School, May 8, 2015.

- “Will We Survive the Future?” CARTA (Center for Academic Research and Training in Anthropogeny), Salk Institute, La Jolla CA, May 15, 2015.
- “The Collapse of Western Civilization”
- Reading and discussion, Concord Free Public Library, Thursday Night Author Series, Concord, MA, May 21, 2015.
 - Smith College, Freshman Class Common Core Reading Discussion, September 3, 2015
- “The World in Crisis: The Role of the Scientist,” Bar-Hillel Colloquium, Hebrew University, Jerusalem, Israel, June 3, 2015.
- “The Cultural Resonance of Doubt,” Royal Society Conference: Science at a Crossroads, Bletchley Hall, UK, June 15, 2015.
- “Are the Merchants of Doubt Still Selling?” Bristol University, Cabot Institute Public Lecture Series/ Bristol Festival of Ideas, Bristol UK, <http://www.ideasfestival.co.uk/events/naomi-oreskes/> and <http://www.bris.ac.uk/cabot/events/2015/merchants-of-doubt.html>
- “Time-Lapse Earth: The Climate Crisis” [with Randy Sargent] and “Discovering Disruptive Change with Big Data” [with Matthew C. Hansen and Illah Nourbakhsh]
World Economic Forum, Dalian, China September 9-11, 2015.
World Economic Forum, Davos, Switzerland, January 20-23, 2016.
<http://www.weforum.org/contributors/naomi-esther-oreskes>
- “The Dynamics of Disbelief” Cary Lecture Series, Lexington, MA, October 24, 2015.
- “Should We Trust Science? Perspectives from the History and Philosophy of Science.”
- Florida Climate Institute, University of Florida, Gainesville, November 2, 2015.
- “Reticence, Accuracy and Efficacy,” Invited Speaker, American Geophysical Union Annual Meeting, Union Session U13A: *Reticent Researchers! Are We Failing Humanity?*, December 14, 2015, San Francisco, CA.
- “What's the big deal with the Anthropocene?” (Panel discussion), American Geophysical Union Annual Meeting, AGU Great Debate (Union Session) December 14, 2015, San Francisco, CA.
- “Science and Policy after the Merchants of Doubt.” Scripps Institution of Oceanography, Climate Science and Policy Program, January 7, 2016, La Jolla, CA.
- “Truth, Lies and Politics: Ideology and Rationality in an Election Year”, moderated panel discussion, Wake Forest University, Office of Sustainability, February 16, 2016, Winston-Salem, North Carolina.
<http://sustainability.wfu.edu/truth-lies-and-politics-ideology-rationality-and-choice-in-an-election-year/>
- “Dynamics of Disbelief: Science, Society and Social Welfare,” Jesse and John Danz Lecture, University of Washington, Seattle, WA, March 1, 2016.
<http://www.uwpcc.washington.edu/event.jsp?id=1519&action=ViewObject&object=event&forward=no>

“For Thought: Hope for the Planet,” An evening with David Suzuki, Naomi Oreskes, and Tim Flannery, Melbourne Town Hall, Melbourne Australia, March 7, 2016
<http://www.wheelercentre.com/events/for-thought-hope-for-the-planet>

“Ideas at the House,” An evening with David Suzuki, Naomi Oreskes, and Tim Flannery, Sydney Opera House, Sydney, Australia, March 8, 2016
<https://www.youtube.com/watch?v=VwEET1mV2eo>

“Should We Trust Scientists?” A Panel Discussion with “Dr. Karl” [Kruselnicki] and Tanya Munro, The Planet Talks, WOMADelaide, Adelaide, Australia March 14, 2016.
<https://www.womadelaide.com.au/program/the-planet-talks>

“Climate Change Denial: Where Do We Go from Here?”

- University of Missouri, Columbia, MO Life sciences and Society Symposium: Confronting Climate Change, March 19, 2016.
<http://lssp.missouri.edu/climatechange/speakers>, see also
<https://www.youtube.com/watch?v=SbHdI9KJhyM>
- The Wall Exchange: Peter Wall Institute for Advanced Studies, Vancouver, BC, Canada. April 4, 2016 <http://pwias.ubc.ca/events/the-wall-exchange/>
- Kent State University: Guest of Honor University Artist/ Lecture Series, Kent, Ohio. April 7, 2016 <https://www.kent.edu/einside/event/guest-honor-university-artistlecture-series-brings-science-historian-kent-state>
- Ohio University, Athens, Ohio. Institute for Applied and Professional Ethics, co-sponsored by E.W. Scripps School of Journalism, Friday April 8, 2016
<https://calendar.ohio.edu/event/climate-change--public-discourse/>

“The Persistence of Climate Change Denial” Copenhagen University, Sustainability Science Program and Faculty of Humanities April 28, 2016
<http://humanities.ku.dk/calendar/2016/4/the-persistence-of-climate-change-denial/>

“Scholarship and Political Activism: A Personal Report, Roskilde University, Critical Edge Alliance April 29, 2016 <http://www.ruc.dk/en/about-the-university/calendar/view/article/critical-edge-alliance-invites-to-a-talk-by-naomi-oreskes-harvard-university-29-april-2016-1/back/roskilde-universitet/>

“The American Denial of Climate Warming,” [Revised and updated]

- First Unitarian Church of Omaha, Holland Lecture Series, Omaha, Nebraska, May 11, 2016. <http://www.firstuomaha.org/#!/holland-lecture-series/c1jv2>
- [University of Texas at Arlington, Maverick Lecture Series, November 20, 2018. https://www.uta.edu/maverickspeakers/2018-19/naomi-oreskes.php](https://www.uta.edu/maverickspeakers/2018-19/naomi-oreskes.php)

H. Burr Steinbach Scholar Lectures, Woods Hole Oceanographic Institution, Woods Hole, MA, August 1-3 2016.

- “The Crucial Experiment that Wasn’t: ATOC and the Attempt to Prove the Reality of Anthropogenic Climate Change”
- “The Scientist as Sentinel: Science, Policy, and Politics.”

“The Great Derangement” A conversation between Amitav Ghosh and Naomi Oreskes
Rubin Museum of Art, New York City, October 5, 2016.
<http://rubinmuseum.org/events/event/amitav-ghosh-naomi-oreskes>

“Why We Should Trust Science” (Day 1) and “When Not to Trust Science” (Day 2).
Tanner Lectures on Human Values, November 30-December 1, 2016
<https://scholar.princeton.edu/cfi/event/tanner-lectures-human-values-trust-and-distrust-science>
<https://sustain.princeton.edu/events/naomi-oreskes-when-not-trust-science-or-when-science-goes-awry>

“The Global Situation Room: The Climate Crisis” [with Randy Sargent and Michael Oppenheimer]
World Economic Forum, Davos, Switzerland, January 16-20, 2017.
<http://www.weforum.org/contributors/naomi-esther-oreskes>

Climate Wrongs and Human Rights, Panel on Climate Philosophy, University of Miami Law Review
Symposium, February 10, 2017

“Climate Change: Now What?”

- Protect our Winters Annual Breakfast, SIA Snow Show (Snow Show Trade Show), Denver Colorado, 17 January 2017
- Keynote speaker, Climate Leadership Conference, Chicago, Illinois, 3 March 2017
- Dempsey Lecture on Environmental Policy, Willamette University, 10 March 2017.
- Harding Distinguished Lecture, South Dakota State University, Brookings, South Dakota 4 April 2017.
- Xavier University, Cincinnati, Ohio, 6 April 2017.
- Vassar College, Pauline Newman '47 Distinguished Lecture, 27 April 2017
- Keynote Speaker, Intermontane Sustainability Summit, Weber State University, Ogden, Utah, 1 March 2018
- Keynote Speaker, Western State Colorado University Masters of Environmental Management, Spring Symposium, Gunnison Country Rodeo Grounds, Gunnison, Colorado, 4 April 2018.
- Climate Change: Philosophical Perspectives, A Symposium, Hobart and William Smith College, Geneva, NY, September 5, 2018. <https://www2.hws.edu/climate-change-philosophical-perspectives/>

“The Scientist as Sentinel”

- AAAS Plenary Speaker, 17 February, 2017-03-04
- Harvard University Arnold Arboretum, Director’s Lecture Series, 6 March 2017
<https://www.arboretum.harvard.edu/news-events/directors-lecture-series/>
- Scripps Institution of Oceanography, 14 March 2017
- Science Research Public Lecture Series, Harvard University, 29 March 2017.

“The History and Politics of American Climate Change Denial,” Keynote Speaker, Israeli Society for Ecology and Environmental Studies (ISEES) annual meeting, 10 July 2017, Centre for Interdisciplinary Studies, Herzliya, Israel.

“Can Science Be Viewed as *Ex Ante* Authoritative in a Post-Factual World?” Plenary Lecture, International Society for the History, Philosophy and Social Studies of Science, Sao Paolo, 17 July, 2017.

“Truth, Trust, and Methodological Fetishism: Perspectives from the History and Philosophy of Science.”

- Plenary Lecture, International Congress for the History and Philosophy of Science and Technology, Rio de Janeiro, Brazil 15 July 2017.
- WZB: Wissenschaftszentrum Berlin für Sozialforschung, Achtung: Demokratie Series, 23 October 2017.

“Narratives of Climate Change.”

- The Gallatin Climate Change Initiative: A Conference. Gallatin School of Individualized Study, New York University, 14 September 2017.
- BEEC: Behavior, Energy and Climate Change Conference, Sacramento, CA (via web), 16 October 2017.

“Giant Power: Technology, Energy and Post-Truth America,”

- Harvard University Humanities Center, Cambridge, MA, 18 October 2017.
- “Phunday,” Harvard-Princeton workshop in History of Science, Princeton University, 21 October 2017.

“Confronting the Unthinkable,” Panel Discussion with Amitav Ghosh, Elke Weber, and Andrew Revkin, Museum of the City of New York, 22 October 2017.

“Conservatives in Academia,” Princeton University Workshop, The University Left to Right, 9 February 2018.

“Historical Foundations of Free Market Fundamentalism,” Humanities Department Seminar, Caltech, 29 November 2018.

“Defeating the Merchants of Doubt: Where Do We Go from Here?” Seminole State College Lecture Series, January 30, 2019. <https://www.seminolestate.edu/speaker-series>

“Why Trust Science?”

- Illinois Wesleyan University, Founders’ Day Convocation, January 16, 2019. <https://www.iwu.edu/news/2019/events/expert-on-climate-change-to-speak-at-founders-day-convocation.html>
- London School of Economics, Grantham research Institute on Climate Change, 19 September, 2019. <http://www.lse.ac.uk/GranthamInstitute/event/why-trust-science-a-talk-by-professor-naomi-oreskes/>
- Book Launch, NYU, Institute for Public Knowledge, 15 October 2019.
- Western University, London Ontario, Canada, 14 November 2019. <http://www.events.westernu.ca/events/arts-humanities/2019-11/naomi-oreskes.html>
- Phi Beta Kappa Visiting Lecture. University of South Florida, Tampa, Florida, 6 February 2020.
- Phi Beta Kappa Visiting Lecture, Carnegie Mellon University, Pittsburgh, PA, 20 February 2010.

- Discussion, Department of History and Philosophy of Science, University of Pittsburgh, Pittsburgh, PA 21 February 2020.
- The Rockefeller University, Science & Humanity Lecture Series, 14 February 2020. <https://www.rockefeller.edu/events-and-lectures/science-humanity-lecture-series/>
- Harvard University Center for the Environment, on-line happy hour and book talk, 14 April 2020.
- Panel Discussion, “Why people don’t trust the evidence of science,” Council of Scientific Society Presidents, 2020 Spring Leadership Workshop, 2 May 2020. [Virtual]
- Conservation Law Foundation, Webinar, 12 May 2020. [Virtual]
- Culinary institute of America, “Menus of Change” Webinar, 26 August 2020. [Virtual] <https://www.menusofchange.org/advisory-councils/biographies/naomi-oreskes>
- 7th Annual Trottier Symposium on Sustainable Engineering, Energy and Design (SED), 16 September 2020 | Online – YouTubeLive. <https://www.trottierysymposium.org/>
- Trento Festival of Economics [virtual] <https://2020.festivaleconomia.eu/en/26-September-2020>
- Van Leer Institute, Jerusalem, Israel. 18 October 2020.
- **Ohio State Bownecker Memorial Lecture**, <https://earthsciences.osu.edu/events/77th-bownecker-lecture-featuring-prof.-naomi-oreskes-why-trust-science>, 5 November 2020 [virtual]
- Kick-off Lecture, PERITIA series on Policy, Expertise, and Trust, 6 April 2021. <https://allea.org/peritia-lecture-naomi-oreskes-on-trust-in-science/>
- The Royal Institution, London, England, 13 April 2021. https://www.rigb.org/whats-on/events-2021/april/public-why-trust-science?gclid=Cj0KCQjwvYSEBhDjARIsAJMn0lg2x4THtQ0KF7YBNrtNPzAQXVoIQn06tEBV5zjMSfZldt4bKiuD1pQaAp2-EALw_wcB
- Politics and Prose Bookstore, a Conversation with Frank Cesno, 26 April 2021.
- Chatauqua Lecture Series, [Virtual] 15 July 2021. <https://chq.org/event/naomi-oreskes/>
- Crested Butte Public Policy Forum, 17 August 2021, Crested butte, CO. <https://www.crestedbutteforum.org>
- Festiva Internacional de Ciencia, Oeiras, Portugal, 14 October 2021.
- Cambridge Conservation Initiative, Cambridge University, Cambridge, England, 21 October 2021.
- It Festival della Scienza, Genoa, Italy, 24 October 2021.
- Harvard University, Division of Social Science, Symposium on “Truth Decay,” 18 November 2021
- Columbia University Symposium on Promoting Credibility, Reproducibility, and Integrity in Research, 11 March 2022 <http://www.pcri-symposium.net/>
- University of Kansas, Lawrence Kansas, 5 April 2022. <https://today.ku.edu/2022/03/21/acclaimed-author-researcher-naomi-oreskes-present-commons>
- Kansas State University, Manhattan, Kansas 6 April 2022. <https://www.k-state.edu/today/announcement/?id=81720>
- Fort Hays State University, Hays, Kansas. <https://www.fhsu.edu/news/2022/03/harvard-professor-to-speak-at-fort-hays-state>
- Oeschger Centre for Climate Research, University of Berne, Berne Switzerland, 30 June 2022.
- Lectio Magistralis at Biennale Tecnologia 2022, 13 November 2022.
- Federal Circuit Historical Society, 16 December 2022.

- Temple Adas Israel, Sag Harbor, NY 14 August 2023.
- “What in the World is Going On?” Lecture series, Valley City State University, Valley City, North Dakota, 4 October 2023.

“Scientific Consensus, Climate Change, and the Role of Uncertainty in Science,” University of Utah Philosophy Colloquium Series, February 11, 2019, Salt Lake City, Utah.

“Is Climate Change the End? If so, the End of What?” Cleveland Humanities Festival, Case Western Reserve University, Baker-Nord Center for the Humanities, March 22, 2019.

“Discerning Experts: The Practices of Scientific Assessment for Environmental Policy,” Book Launch, NYU Law School, Institute for Policy Integrity, and the Department of Environmental Studies, March 28, 2019.

“What Exxon-Mobil Did and Why It Matters,” Keynote Speaker, Midwest Renewable Energy Fair, Custer, Wisconsin, 22 June 2019. <https://www.theenergyfair.org/keynote-speakers/>

“Why American Conservatives Turned Against Science.” Bavarian Academy of Sciences Workshop, Criticism of Science: Past and Present. 24 June 2019.

“Escaping the Balance Trap: Rethinking Science Journalism in an Era of Fabricated Controversies,” Keynote Speaker, World Conference of Science Journalists, Lausanne, Switzerland, 4 July 2019.

“What Should Individuals, Communities, Schools and Universities Do to Stop Climate Change? A panel discussion. London School of Economics, 20 September 2019.
<http://www.lse.ac.uk/GranthamInstitute/event/what-should-individuals-communities-schools-and-universities-in-the-uk-do-to-stop-climate-change/>

“What Gets Left Out: How History Has Shaped What We Don’t Know about the Ocean,” Keynote Speaker, Encounters and Exchanges Conference, Hosted by the University of Otago, Blenheim, New Zealand, 2 December 2019.

“Closing Comment,” New Earth Histories Conference, 4-6 December 2019, University of New South Wales, Sydney, Australia. <https://www.arts.unsw.edu.au/research/new-earth-histories-research-program/conference/>

“Facts are Not Enough: From Science to Disinformation in 20th Century America,” USC Wrigley Center for the Environment, University of Southern California, Los Angeles, California, 12 March 2020.

“How to Talk to Coronavirus Skeptics.” American Academy of Arts and Sciences, an on-line discussion, 9 April 2020. <https://www.amacad.org/events/oreskes-coronavirus-skeptics>

“Reclaiming Cooperation in a World of Competition”: A Lecture on the International Day of Peace 39th Peace BAR Festival. 21 September 2020 Kyong Hee University, Korea.
<https://koreajoongangdaily.joins.com/2020/09/22/national/diplomacy/Kyung-Hee-University-System-Peace-BAR-Festival-2020/20200922171200408.html>

“Who wants to hide the truth about climate change?” A panel discussion with Daniela Ovadia and Serena Giacomini) [BergamoScienza.it](https://www.bergamoscienza.it) <https://www.bergamoscienza.it/> 10 October 2020

“How Military Funding Delayed the Development of Plate Tectonics,”

- Ohio State University Bownecker Lecture Technical Seminar, https://osu.zoom.us/webinar/register/WN_LW3mnIjkReaa89wTTqSzHA 6 November 2020
- [Kalb Memorial Lecture, Rice University. 23 February 2021.](#)

“Why Earth Systems Science Needs Social Science,” NASEM-NRC committee on *Advancing a Systems Approach to Studying the Earth: A Strategy for the National Science Foundation*, Keynote Speaker, 12 January 2021.

“Action Beyond Persuasion,” World Economic Forum Youth & Climate Panel, 28 January 2021.

“*Why Trust Science?*” A book conversation with Katharine Hayhoe, “Texas Tech University Climate Center, 9 February 9, 2021.

“The Magic of the Marketplace: The True History of a False Idea: How Fredrich von Hayek Was Brought to America by American Businessmen,” Seminar, Ecole des Haute Etudes, Paris, France, 2 March 2021.

“The National Climate Assessment: What Next?” US Global Climate Research Program, Sustained Assessment Working Group (SAWG) Lecture Series, 11 March 2021.

“Can Science Be Saved?”/ “Why People Distrust Science”

- Oregon Humanities Center, University of Oregon, 2020-21 Cressman Lecture, 12 March 2021 https://ohc.uoregon.edu/calendar_event/can-science-be-saved/
- Institute for Advanced Study 2021 IAS Lecture on Public Policy, Princeton, NJ 7 April 2021 <https://www.ias.edu/publicpolicy-Oreskes>
- Penn State, Rock Ethics Institute, 22 April 2021 <https://rockethics.psu.edu/events/science-and-values-in-climate-risk-management-speaker-series-naomi-oreskes/>
- UQAM ISC Climate Change Summer School Keynote, 24 May 2021
- Nebraska Wesleyan University, Visions and Ventures Symposium, 21 September 2021 <https://www.nebrwesleyan.edu/about-nwu/news-center/visions-and-ventures-address-breaking-down-boundaries-race-class-and>
- Inaugural lecture, XI Festiwal Przemiany, 8 October 2021. <https://www.youtube.com/watch?v=NfoTr3AOPsY>
- Center for Inquiry, 28 October 2021. <https://centerforinquiry.org/news/can-science-be-saved-naomi-oreskes-on-skeptical-inquirer-presents-oct-28/>
- [CSI.com](#), 21 October 2022, Las Vegas, Nevada.

“Science on a Mission: How Military Funding Shaped What We Do and Don’t Know about the Ocean,”

- Institute for Advanced Study Seminar, Princeton, NJ, 8 April 2021
- Bielefeld University, Bielefeld, Germany, 1 June 2021.

“Diversity Isn’t Just the Right Thing to Do; Diversity Helps Us Get the Right Answers”

- Amherst College, Annual Hugh Hawkins Lecture. 14 April 2021
- Harvard University, Department of Earth and Planetary Sciences, 16 April 2021
- Harvard Alumni Association, 29 April 2021

- Moore Foundation, 21 September 2021
- MIT Earth, Atmosphere, and Planetary Sciences Department Colloquium, 19 November 2021
- Cardiff University, Seminar on Knowledge, Expertise and Science (KES), 25 March 2022.
- Keynote Speaker, Midwest Student Conference on Atmospheric Research, University of Illinois, Urbana-Champaign 1 October 2023.

“Climate in Context: Towards a History of the Future,” Closing Keynote Address, Climate in Context Conference, University of Texas, Austin 23 April 2021.

“Trust and Distrust in Science,” Mellon-Sawyer Seminar, Columbia University, 17 May 2021.

“Giving the Tripod of Freedom Intellectual Legs: How American Businessmen Promoted Hayek in America.”

- Ecole des Hauts Etudes des Sciences Sociale (EHESS), 2 March 2021 [virtual]
- Utrecht University History of Knowledge Seminar, 20 May 2021 [virtual]

“Why Does Truth Break Down?” Presentation to the United Nations Senior Management Group. Secretary António Guterres, Chair, 7 July 2021 [virtual]

“Historical perspectives on climate litigation” Final Keynote Speaker, Out Future in the Balance: The Role of Courts and Tribunals in Meeting the Climate Crisis, sponsored by the Global law firm Hausfeld and the British Institute for International and Comparative Law (BIICL), 8 July 2021 [virtual].

“Funding Matters”

- Keynote Presentation: Public Research and Private Knowledge, Center for Applied Philosophy and Key Qualifications, Friedrich -Alexander Universität Erlangen-Nürnberg, Germany, 23 July 2021.
- Institute for Practical Ethics 2022 Keynote Lecture, University of California, San Diego, 19 October 2022.
- Climate Misinformation and Academia: A Workshop, Brown University, 15 September 2023.

“*The Big Myth: How American Business Taught us to Loathe Government and Love the Free Market* [Book talks and readings]

- The President’s Lecture Series, Brennan Guth Memorial Lecture in Environmental Philosophy, University of Montana, 17 February 2022
- Sippola Family Lecture, Miami University Ohio, 20 April 2022
- Annual Johannes Sløk Lecture, Aarhus University, Denmark 27 June 2022
- Hans Oeschger Lecture, Swiss Congress on Historical Sciences, Geneva, Switzerland, 1 July 2022
- Center for the History of Science and Philosophy (CIUHCT), Lisbon University, Lisbon, Portugal, 15 July 2022.
- Tanner Center for the Humanities, University of Utah, Salt Lake City, Utah, 13 February 2023 (co-sponsored by the King’s English bookstore.)
- Brooklyn Public Library, Brooklyn, NY, 21 February 2023.
- Harvard Bookstore, Cambridge, MA, 22 February 2023.
- Politics and Prose Bookstore, Washington, DC, 23 February 2023.

- Stephens Institute of Technology, Hoboken, NJ, 1 March 2023 [Virtual]
- John Carroll University, Annual Don Shula Lecture, Cleveland, Ohio, 29 March 2023.
- Cuyahoga County Library, Spring Lecture Series, “[BeyondBookJackets.com](https://www.beyondbookjackets.com/),” Beachwood Branch, 29 March 2023.
- Center for Inquiry, Los Angeles, 16 April, 2023 <https://cfiwest.org/event/the-big-myth-how-american-business-taught-us-to-loathe-government-and-love-the-free-market/>
- Graduate School of Business, Stanford University, 4 May 2023.
- Climate Crisis 101, University of California, Santa Barbara, 11 May 2023 [virtual]..
- Conference on the Sociology of Paradigm Change, MIT Open learning, 16 May 2023 [virtual].
- Gonzaga University Center for Climate, Society, and the Environment, 1 June 2023 [virtual].
- Virtual keynote, Workshop on the Influence of the Fossil Fuel Sector, University of Cambridge, UK, 9 June 2023 [virtual].
- Keynote speaker, Funders Forum on Oil and Gas, Tenaya Lodge, Yosemite, CA, 11 June 2023.
- Crested Butte Policy Forum, Crested Butte, CO, 5 July 2023.
- Book signing and discussion, Zandbroz bookstore, Fargo, ND 3 October 2023.
- Brandeis-Osher Lifelong Learning Institute [on-line], 13 October 2023.
- Columbia University, Center for Political Economy, New York, NY, 23 October 2023.
- Bard College, Alt-Liberal Arts College [on line] 25 October 2023.
<https://www.bard.edu/inside/calendar/altliberalarts-earth-scientist-naomi-oreskes-on-science-and-politics>
- [CSI.com](https://www.csi.com/), Las Vegas, NV, 28 October 2023.
- London School of Economics, 11 December 2024.
- Borhaave Rijksmuseum, Leiden, Netherlands, 8 February 2024.
- Aspen U, Limelight Hotel Lecture Series, Aspen, CO, 20 March 2024.
- Paris School of Economics, Workshop on “Corporate Capture and the Environmental Emergency,” 28 March 2024.
- The Jacob Marschak Interdisciplinary Colloquium on Mathematics in the Behavioral Sciences, UCLA, Los Angeles, California, 30 April 2024
- Santa Fe Institute Public Lecture Series, 17 December 2024.

“Why the Supply-Side Model of Science Hasn’t Worked,” Indian National Science Academy Panel Discussion on the Awarding of the Jawaharlal Nehru Birth Centenary Medal to Dr. Marcia McNutt, 3 March 2022.

“Worth a Little Tsuris: How a Historian Came to Stand Up Against Disinformation,” Max Planck Institute for Human Development, Summer Institute on Bounded Rationality, Berlin, Germany, 21 June 2022.

“The Magic of the Marketplace: The True History of a False Idea,”

- Historical Seminar on Ökonomisierung, Ludwig Maximilians University, Munich, Germany, 23 June 2022.

“Climate Change and the Promise of Progress,” Duke University, inaugural speaker, *Let’s Talk about Climate Change* series, Duke University, Raleigh, NC, 22 September 2022.

“There’s no scientific method (but that’s ok),” CAT Conversations: Sixth College Celebrating Twenty Years, University of California, San Diego, 19 October 2022.

“Is the Enlightenment Relevant?” University of Southern California, CESR Conference on *The End of Enlightenment?*, Los Angeles, CA, 15 March 2023.

“From DDT to Climate Change: How warnings about environmental hazards have been ignored, dismissed, and disparaged,” Canadian Farmers’ University, sponsored by the Canadian Farmers’ Union, 16 March, 2023 [virtual].

“Can Truth Survive Platform Capitalism?” Keynote Speaker, Science and Platform Capitalism: The New Organization of Knowledge Production, A Conference in Honor of Phil Mirowski, University of Notre Dame, South Bend, Indiana, 13 April 2023.

“The Race, Class and Gender of Climate Change Denial,” Harvey Mudd College, Dr. Bruce J. Nelson ’74 Distinguished Speaker Series, Claremont, CA, 17 April 2023.

“Beyond Doubt: A Climate Conversation,” Earth Day Symposium, Fullerton College, Fullerton, CA, 20 April 2023.

“Current Issues: Money, Tech and Capitalism [A panel discussion],” *Los Angeles Times* Book Festival, University of Southern California Campus, Los Angeles, CA, 23 April 2023.

“Backlash against Science [A panel discussion],” Behavioral Science and Policy Association Annual Meeting [Virtual], 4 May 2023.

“How the Chicago School Reconstructed Adam Smith,” Conference on Agnotology: The New Science of Creating and Preventing Ignorance, Stanford University, 5 May 2023.

“How the Myth of the Free Market has Blocked Climate Action,”

- MillerComm Lecture, University of Illinois, Urbana-Champaign, 2 October 2023.
- Stanford University Environmental Ethics Seminar [virtual] 14 November 2023.
- Conservation Law Foundation, President’s Lecture Series, Boston, MA 15 November 2023.
- Keynote Speaker [Virtual], Conference: *Capitalism and the Environment from Stockholm to COP28: New Historical Research on the Role of Business and Labor*, Lausanne University, 10 November 2023.
- Franklin and Marshall College, Program in Science, Technology and Society, 23rd annual Darwin Day, 23 February 2024

“Teaching in the Storm: Academic Freedom, Scientific Integrity, and Best Pedagogic Practices” [A panel discussion], Harvard School of Public Health, Boston, MA, 11 October 2023.

“The Climate Crisis: A Discussion Panel” Maestoso at Anteo City Life, National Geographic Fest 2023, Italy, [online], 17 November 2023.

“Think the Future, Imagine the Present,” A Panel Discussion, Belgian Climate Center, Brussels, Belgium, 13 December 2023.

“Science, Scientists and the Great Acceleration.” <https://sciences.ulb.be/la-recherche/conference-naomi-oreskes> Public Lecture on occasion of Doctor Honoris Causa, Université Libre de Brussels, Brussels, Belgium. 13 December 2023.

“Neoliberalism vs the social-ecological state: decrypting the myths”, A Research Seminar, with Eloi Laurent, Sciences Po and Stanford. Université Libre de Brussels, Brussels, Belgium. 14 December 2023. <https://iitse.ulb.be/fr/agenda/neoliberalism-vs-the-social-ecological-state-decrypting-the-myths>

“Doubt and Scientific Consensus,” Conference on *Fact, Fakes and Fiction*, Lorentz Center, Leiden University, Leiden, Netherlands, 5-9 February 2024.

“Climate Change and Business History: New Directions in a Time of Environmental Challenges” Plenary Session panel discussion with Bathsheba Demuth and Bart Elmore, Business History Conference, Providence, Rhode Island, 14 March 2024.

“How Market Fundamentalism Has Blocked Climate Action,”

- Colorado State University, Interdisciplinary Science Communication Workshop, Fort Collins, Colorado, 2 April 2024 <https://philosophy.colostate.edu/events/naomi-oreskes-how-market-fundamentalism-has-blocked-climate-action/>
- University of Colorado, Boulder, 2024 Patricia Sheffels Visiting Scholar, Department of Environmental Studies, Boulder, Colorado, 4 April 2024.
- University of Oregon, SOJC Hearst Visiting Professionals Lecture series, Eugene, Oregon, 8 November 2024.

Epistemic Privilege and the Gender of Climate Change Denial

- Marian Fox Martel Distinguished Lecture in Gender and Science at the Center for the Study of Women, Gender and Sexuality at Rice University, 11 April 2024.
- Sir Run Run Shaw Lecture, Stonybrook University Humanities Institute, 17 October 2024.

“A conversation on climate change and activism with Jane Fonda and Dr. Naomi Oreskes,” sponsored by Academy Museum of Motion Pictures and Studio B. at Berggruen Institute, David Geffen Theatre, Academy Museum of Motion Pictures, 19 April 2024.

“Ethical Pessimism: Climate Change and the Limits of Narrative, A book workshop with Faculty Fellow Roy Scranton”, Kellogg Institute for International Studies, University of Notre Dame, South Bend, Indiana, 2-3 May 2024.

“Why is it so hard to talk about population? A personal story,” *Conference paper for How Do We Think about Population in the Anthropocene?* Jesus College, Cambridge, UK, 2-4 July 2024.

“Why science and politics can’t be (entirely) separated,” 22nd Swiss Climate Summer School: Climate Change: From the Dawn of the Anthropocene to Options for the Future, Grindelwald, Switzerland 1 September 2024 [virtual]

“How incumbents work to block positive tipping points,” Workshop on Positive Tipping Points, Bezos EarthFund Foundation, 20 September 2024, Washington, DC [virtual].

“Rebuilding Trust in Science” A Morton L. Mandel Conversation, panel discussion with Sean Decatur and moderated by Holden Thorp, American Academy of Arts and Sciences, 16 October 2024, Cambridge, MA.

“Why Disinformation Matters,” University of Rhode Island, Honors Colloquium Series, *Democracy in Peril*, 29 October 2024, Kingstown, Rhode Island.

“Merchants of Doubt”: A Discussion
Climate Science Honors Seminar [Professor Diana Bernstein], University of Southern Mississippi,
19 November 2024, Hattiesburg, Mississippi.

“The End of the Supply-Side Model of Science, 2024 Tyndall History of Global Environmental Change Lecture American Geophysical Union Annual Meeting, 13 December 2024, Washington, DC.

“Ending Fossil Fuels,” WOMADelaide Planet Talks, 10 March 2025, Adelaide, Australia.

“In Conversation with former South Australian Premier Mike Rann,” The Bob Hawke Prime Ministerial Centre, 11 March 2025, Adelaide, Australia.

“From Anti-Government to Anti-Science and Back Again,”

- The 2025 Science, Technology, and Society Pauline Newman '47 Distinguished Lecture by Naomi Oreskes, Vassar College, 4 April 2025. <https://www.vassar.edu/news/events/2025/anti-government-anti-science-and-back-again>
- USA: USA: Misinformation, “lobbyism” and deregulation, A public talk sponsored by the KR Foundation and Politiken, 8 April 2025. <https://laederstraede20.dk/events/usa-misinformation-lobbyisme-and-deregulation-meet-harvard-professor-naomi-oreskes>
- Roskilde University, Research Group for Science Studies, Department of Communication and Art, 9 April 2025, Roskilde, Denmark.

Appendix 2. Summary of IPCC Analysis of Terms Related to Sea Level Rise

Report Name	Year	Assessment	Filename	sea level rise	slr	coastal flooding	sea-level rise
FAR Working Group I Full Report	1990	FAR	1990_ipcc_	84	0	0	6
FAR Working Group I SPM	1990	FAR	1990_ipcc_	15	0	0	0
FAR Working Group II Full Report	1990	FAR	1990_ipcc_	47	0	4	144
FAR Working Group III Full Report	1990	FAR	1990_ipcc_	104	0	1	1
IPCC First Assessment Report Overview	1992	FAR	1992_ipcc_	33	0	2	61
Climate Change 1992: The Supplement	1992	FAR	1992_ipcc_	1	1	0	54
Climate Change 1992: The Supplement	1992	FAR	1992_ipcc_	10	0	0	0
SAR Working Group I Full Report	1995	SAR	1995_ipcc_	117	3	1	2
SAR Working Group II Full Report	1995	SAR	1995_ipcc_	46	0	9	266
SAR Working Group III Full Report	1995	SAR	1995_ipcc_	0	0	0	0
SAR Synthesis Report	1995	SAR	1995_2nd-	0	0	1	11
Regional Impacts Full Report	1997	Special_Reports	1997_The-F	37	0	6	273
SRES Full Report	2000	Special_Reports	2000_emis	5	0	0	1
LULUCF Full Report	2000	Special_Reports	2000_GPG_	0	0	0	0
TAR Working Group I Full Report	2001	TAR	2001_WGI_	211	0	1	15
TAR Working Group II Full Report	2001	TAR	2001_WGII	78	1	11	656
TAR Working Group III Full Report	2001	TAR	2001_WGIII	4	0	0	1
TAR Synthesis Report	2001	TAR	2001_SYR_	27	0	6	144
SRCCS Full Report	2005	Special_Reports	2005_srccs_	0	0	0	0
SROC Full Report	2005	Special_Reports	1997_The-F	37	0	6	273
AR4 Working Group I Full Report	2007	AR4	2007_ar4_v	304	0	0	9
AR4 Working Group II Full Report	2007	AR4	2007_ar4_v	0	0	0	0
AR4 Working Group III Full Report	2007	AR4	2007_ar4_v	7	0	0	4
AR4 Synthesis Report	2007	AR4	2007_ar4_s	80	0	8	2
SRREN Full Report	2011	Special_Reports	2011_SRRE	2	0	0	0
SREX Full Report	2012	Special_Reports	2012_SREX	122	2	16	34
AR5 Working Group I Full Report	2013	AR5	2013_WG1.	0	0	0	0
AR5 Working Group II Full Report Part A	2014	AR5	2014_WGII.	0	0	0	0
AR5 Working Group II Full Report Part B	2014	AR5	2014_WGII.	160	138	21	34

Table 1. IPCC Analysis of Terms Related to Sea Level Rise

Appendix 3. Additional Reliance Materials

In addition to the materials referenced in footnotes, I disclose the following materials as well:

SOPUS_NHVN02463950

SOPUS_NHVN02464005

SOPUS_NHVN00025923

SOPUS_NHVN02484918

SOPUS_NHVN01067702

SOPUS_NHVN01704390

SOPUS_NHVN02407015

SOPUS_NHVN02407227

SOPUS_NHVN02407297

SOPUS_NHVN02409148

SOPUS_NHVN02409214

SOPUS_NHVN02448774