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A History of Unsustainability: The u.s. Government, the Fossil Fuel Industry, and Climate Change (1957 -1992)

Loetscher Audrey

UNIL | Université de Lausanne
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par

Audrey Lara Loetscher

Directrice de thèse

Prof. Janick Marina Schaufelbuehl

Jury

Prof. Naomi Oreskes, Harvard University
Prof. Ludovic Tournès, Université de Genève
Dr. Raphaëlle Ruppen Coutaz, Université de Lausanne

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Abstract

This dissertation investigates the reception of climate change science by the executive branch of the U.S. government between 1957 and 1992. Looking at the role played by the Office of Science and Technology Policy (OSTP), a committee headed by the president's science advisor and tasked with advising the administration on scientific matters, this work examines the different administrations' responses to climate change and climate science, from the late 1950s, when the issue of rising concentrations of carbon dioxide in the atmosphere was first mentioned at a Congressional hearing and deemed worthy of scientific monitoring at the Mauna Loa Observatory in Hawaii, until the dawn of the twenty-first century and the early empirical detections of climate change. In studying the reception of successive scientific reports, many of which were commissioned by the OSTP to the U.S. National Academy of Sciences, this PhD thesis argues that the executive branch of the federal government refused to act on climate change and contributed to delaying climate policy. Drawing on a large collection of archival material, including OSTP records, the presidential science advisors' personal papers, records of prominent scientists featured in this narrative, as well as fossil fuel industry documents, this narrative outlines the reasons behind the political and legislative gridlock that has prevailed throughout these four decades despite growing evidence of the danger posed by fossil fuel combustion and rising levels of atmospheric carbon dioxide. By tracing interactions between scientists, representatives of the oil industry, and presidential science advisors, this dissertation establishes that the U.S. government repeatedly decided to ignore the facts highlighting the existential threats of a socioeconomic system oblivious to biophysical limits, especially those relating to the climate system. In particular, this work examines why the U.S. government favored unsustainable paths and practices over (more) sustainable ones—most notably, by refusing to support climate policy measures and by blocking the adoption of a robust international treaty to curb CO_2 emissions. In doing so, this research documents a long record of political decisions and actions that further committed the United States to its unsustainable course, thereby jeopardizing the planet's habitability for future generations and populations residing in the most economically vulnerable parts of the world.

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Abbreviations

AAAS	American Association for the Advancement of Science
ACWC	Advisory Committee on Weather Control
AEC	Atomic Energy Commission
API	American Petroleum Institute
CEA	Council of Economic Advisors
CEQ	Council on Environmental Quality
CF	Climate Files (digital archival database)
CFCs	Chlorofluorocarbons
CO_2	Carbon Dioxide
COP	Conference of the Parties
DOE	Department of Energy
DOI	Department of Interior
DPC	Domestic Policy Council
ENIAC	Electronic Numerical Integrator and Calculator
EPA	Environmental Protection Agency
GCC	Global Climate Coalition
GCM	Global Circulation Model
GHGs	Greenhouse Gases
ICBM	Intercontinental Ballistic Missiles
ICSU	International Council of Scientific Unions
IGY	International Geophysical Year
INC	Intergovernmental Negotiating Committee
IPY	International Polar Year
IPCC	International Panel on Climate Change
OECD	Organization for Economic Co-operation and Development
OMB	Office of Management and Budget
ONR	Office of Naval Research
OSTP	Office of Science and technology Policy
NAS	U.S. National Academy of Sciences
NASA	National Aeronautics and Space Administration
NCAR	National Center for Atmospheric Administration
NOAA	National Oceanic and Atmospheric Administration
NRC	National Research Council
NSF	National Science Foundation
PCAST	President's Council of Advisors on Science and Technology
PSAC	President's Science Advisory Committee
UCAR	University Corporation of Atmospheric Research
UNCED	U.N. Conference on Environment and Development
UNEP	U.N. Environment Programme
USGS	United States Geological Survey
UNFCCC	U.N. Framework Convention on Climate Change
WCED	World Commission on Environment and Development
WMO	World Meteorological Organization

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The product of an intense intellectual effort—carried out, for the most part, in the depths of one's mind—this dissertation also came to fruition thanks to a formidable and supportive network. For her guidance, advice and optimism, I would like to warmly thank Janick Schaufelbuehl, whose trust and confidence helped me to take that leap of faith and actually produce a manuscript. I am also very grateful to all of my jury members: Naomi Oreskes, Ludovic Tournès and Raphaëlle Ruppen Coutaz offered generous feedback, and their vision and encouraging words inspired me to make this the best work I could. Heartfelt thanks to Dominique Arlettaz, whose generosity and support helped me weather the turbulent first years. At the University of Washington in Seattle, which I was fortunate to attend for a year thanks to a Fulbright grant, Joshua Reid offered great mentorship and steered the dissertation into a fruitful direction that allowed me complete it. Exactly a decade ago, at San Francisco State University, Nicole Watts shared her passion for historical analysis and comparative politics, and encouraged me to pursue a doctoral degree.

I do not know whether there would have been a dissertation at all if it had not been for the professionalism and support I received from archivists and library staff at the National Archives and elsewhere, as research rooms across the country remained closed for eighteen months due to the pandemic. For their help in selecting material to scan, and for reviewing it on my behalf to give me an idea of what was in these folders before placing orders, I would like to extend my appreciation to Jennifer Donovan and Heather Smedberg at UC San Diego Library's Special Collections and Archives; Liza Talbot at the Lyndon B. Johnson Presidential Library; Myles Crowley at the MIT Distinctive Collections; Jennifer Newby at the Ronald Reagan Presidential Library & Museum ; and Loma Karklins at the California Institute of Technology Library.

When I look back on these years and on this period of my life, I am reminded of many moments of joy and happiness. I also see upheaval and challenges, some of them quite painful. Six months into the PhD, I was diagnosed with a severe and proliferating form of endometriosis. While I finally had a diagnostic for a pain I had experienced for more than half of my life, I had to learn to manage the demands of my job and those of a taxing chronic disease, both mentally and physically. The completion of this dissertation is a testament to the resilience, grit and courage of the millions of women who suffer from this condition but show up every day to improve the lives of their loved ones and that of their communities.

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"Sustainability" is a terribly inadequate word for what I mean. Any word of six syllables is way too long to organize a popular movement around and at the same time way too short to encompass a whole vision. And too many people hear it as "sustaining" the world we have now, whereas I really mean fomenting a revolution.

Donella H. Meadows, February 24, 1995, "Dear Folks" Letter

Then I say the earth belongs to each of these generations during it's course, fully, and in their own right. The 2d. generation receives it clear of the debts and incumbrances of the 1st., the 3d. of the 2d. and so on. For if the 1st. could charge it with a debt, then the earth would belong to the dead and not the living generation. Then no generation can contract debts greater than may be paid during the course of it's own existence.

Thomas Jefferson to James Madison, September 6, 1789

Introduction
Tracing U.S. Unsustainability and the Climate System Breakdown

The political history of climate change is one of paradoxes: while atmospheric science and climate modeling have refined our understanding of the existential threat it poses with a frighteningly accurate degree of precision, public policy has been altogether incapable of rising to the colossal challenge of addressing the problem. In fact, it appears that, as climate change science has become more robust, the paths of science and that of public policy have grown further apart. How can we explain and make sense of that discrepancy? This question lies at the heart of this dissertation, which offers a chronicle of political decisions and actions by the federal government that have contributed to the political and legislative gridlock characterizing these nearly four decades of U.S. climate change politics. Historians have been slow at embracing the subject and the historiography of the U.S. political history of climate change is still surprisingly skeletal. Much of the scholarship on the question has come from other disciplines, most notably environmental sociology, environmental politics, political economy and the humanities. This reflects the complexity of the subject, and the response to my initial question is indeed multifactorial. In the next section I will offer a brief review of the literature which, in the field of history, has been mostly produced by historians of science.

Naomi Oreskes and Erik Conway convincingly outlined the role played by the U.S. fossil fuel industry in sowing doubt and preventing meaningful action on climate.[1] They showed how a coterie of scientists, mostly physicists who had come of age professionally during the height of

[1] Naomi Oreskes and Erik Conway, *Merchants of Doubt: How a Handful of Scientist Obscured the Truth on Issues from Tobacco Smoke to Global Warming* (New York : Bloomsbury Press, 2010); –––, “Challenging Knowledge: How Climate Change Became a Victim of the Cold War,” in *Agnotology: The Making and Unmaking of Ignorance,* ed. Robert N. Proctor and Londa Schiebinger (Stanford University Press, 2008); –––, and Matthew Shindell, “From Chicken Little to Dr. Pangloss: William Nierenberg, Global Warming, and the Social Deconstruction of Scientific Knowledge,” *Historical Studies in the Natural Sciences* 38, no. 1 (2008): 109–152.

the Cold War, joined forces with oil industry executives to mount a powerful counter-movement that disclaimed the findings of science. From expressing skepticism regarding certain aspects of climate change, or the need to politically address it, to full-blown denial that anthropogenic global warming was occurring, these "contrarian" scientists forced the issue into the realm of debate and argumentation, opposing the work of thousands of scientists with spurious claims that escaped the scrutiny and rigor of science. Aided by the media, who felt compelled (or thought it would sell more) to present both sides of the story on equal terms, climate change skeptics an deniers' claims found their way into the public discourse, posing as the legitimate other side of the "debate."

Oreskes and Conway's work inspired new scholarship on the deconstruction of knowledge and on climate change denial in particular. Benjamin Franta studied the oil and gas industry's main trade association, the American Petroleum Institute (API), establishing that oil executives have known about climate change since the early 1950s, and that they have engaged in climate denial since at least the early 1980s, much earlier than previously thought.[2] Franta also examined the role played by economists and consultants hired by the oil industry in the 1990s and 2000s to discredit policy initiatives as costly and inefficient tools to mitigate global warming, and to deny that the issue required any governmental intervention at all.[3] Together with French researchers Christophe Bonneuil and Pierre-Louis Choquet, Franta also showed how Total, the French oil conglomerate, wavered in its position towards climate change, denying the reality of the phenomenon for a period and later embracing the issue and positing itself as an industry leader in the "fight" against global warming.[4] Focusing on the advocacy role assumed by climatologists and other climate experts, oftentimes reluctantly, Joshua Howe demonstrated how their specific science-based form of

[2] Benjamin Franta, "Early Oil Industry Disinformation on Global Warming," *Environmental Politics* 30, no. 4 (2021): 663–668 ; ——, "Early Oil Industry Knowledge of CO_2 and Global Warming," *Nature Climate Change* 8 (2018): 1024–1025.
[3] 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) : 1–10.
[4] Benjamin Franta, "Weaponizing Economics: Big Oil, Economic onsultants, and Climate Policy Delay," *Environmental Politics* (2022): 1–21, published online and available at: https://doi.org/10.1080/09644016.2021.1947636.

advocacy had proven a liability, and hindered progress in climate policy, despite these scientists' best efforts.[5] Earlier works by Spencer Weart and James Rodger Fleming focused on the history and main stages of climate change science, from its beginnings in the field of physics in the late 19th century, to its revival in the late 1950s and then rapid expansion starting in the mid-1970s.[6] For the most part, however, these works did not provide a critical reading of the context in which climatology developed. Their authors were primarily interested in outlining how the various lines of research contributed to mapping the issue (a colossal effort in itself).

The second strand of scholarship to which this dissertation contributes, and which provides the general framework in which it inscribes itself, relates to the role of science in public policy and in the policy-making process. Some four decades after he contributed to establishing the National Science Foundation during the Truman administration, William Golden, an investment banker turned science advisor, gathered a collection of essays, several of which were authored by former science advisors and members of the science advisory committee to the president.[7] Written from the standpoint of past stakeholders in the science advisory apparatus, these essays made the case for improved advisory mechanisms in all three branches of the federal government. Their target audience was not academics, however, and none were scholarly works. Sheila Jasanoff, a professor of science and technology studies, examined the role of what she called the "fifth branch" of government, namely that of technical experts and scientists serving on advisory committees to federal regulatory agencies. Centering her research on two primary users of external scientific advice, the Environmental Protection Agency (EPA) and the Food and Drug Administration (FDA), Jasanoff discussed how, because of science's socially constructed nature, conclusions put forward by these advisory panels hinged on political and

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[5] Joshua P. Howe, *Behind the Curve: Science and the Politics of Global Warming* (Seattle: University of Washington Press, 2014).
[6] Spencer R. Weart, *The Discovery of Global Warming* (Cambridge, MA: Harvard University Press, 2003); James R. Fleming, *Historical Perspectives on Climate Change* (Oxford: Oxford University Press, 1998).
[7] William T. Golden, ed., *Science and Technology Advice To President, Congress, and Judiciary* (Piscataway, NJ: Transaction Publishers, 1988).

administrative imperatives as much as they did on scientific considerations.[8] Gregg Herken, a professor emeritus in the history of the Cold War, studied fifty years of presidential science advising on "cardinal choices," or crucial decisions that he equated mostly with the development, use and control of nuclear weapons, depicting a history of mutual disillusionment between presidents and their scientific advisors. Herken located the origin of that frustration and the decline in influence of presidential science advisors in the Johnson administration, when dissent over the Vietnam War put many on the President's Science Advisory Committee (PSAC) at odds with the president's expectations and policies.[9]

More recently, Zuoyue Wang, a professor of history and a specialist in U.S. Cold War science policy, wrote a history of the PSAC from its founding in 1957 until its dissolution by Nixon in 1973, in which he argued that one of the defining traits of the committee was its skepticism towards technology, and its recognition of the limits of technological responses to social and political issues.[10] Taking such case studies as the debates around the space race, the Vietnam War, the Anti-Ballistic Missile Treaty or the Supersonic Transport, among others, Wang shows that PSAC members sought to point out the social, economic, and political implications of the technical issues they were asked to evaluate, and the committee acted as a voice of moderation in the policy recommendations it made in the tensed context of the Cold War.

This dissertation's contribution to the literature on the U.S. political history of climate change is twofold. On the function of science and scientific advice within the executive branch of the federal government, this is the first historical study to examine the role of presidential science advisors in climate change politics, reviewing how each of them contributed to informing the policy agenda on climate and climate-related issues of the administration they served. Secondly, regarding factors underlying the political gridlock on

[8] Sheila Jasanoff, *The Fifth Branch: Science Advisers as Policymakers* (Harvard University Press, 1990.

[9] Gregg Herken, *Cardinal Choices: Presidential Science Advising from the Atomic Bomb to SDI. Revised and Expanded Edition* (Stanford University Press, 1992.

[10] Zuoyue Wang, *In Sputnik's Shadow: The President's Science Advisory Committee and Cold War America* (New Brunswick, NJ: Rutgers University Press, 2008.

climate change, I concur with historians' findings that climate denial campaigns by the oil industry and free-market conservative organizations has indubitably contributed to stalling climate policy, as has the blind faith in the impersonal, science-driven narrative developed by scientists turned climate advocates in their quest to respond to what was and remains primarily a moral issue. However, I argue that these explanations leave out one of foremost actors in the climate policy failure, namely the U.S. federal government. The successive administrations which I examine in this study did not merely display apathy towards climate change, or disregarded it as unimportant politically. Despite being alerted by numerous scientific reports to the social and environmental disruptions associated with global warming, these administrations refused to act on climate change and actively contributed to delaying climate policy, both domestically and internationally. By tracing interactions between scientists, representatives of the oil industry, and presidential science advisors, this work establishes that the U.S. government repeatedly decided to ignore the facts highlighting the existential threats of a socioeconomic system oblivious to biophysical limits, especially those relating to the climate system. In detailing the U.S. government's approach and responses to climate change and climate science, this dissertation offers the first study of the role of a major, but overlooked, actor in the climate policy delay.

Our story begins in 1957, when the issue of rising concentrations of carbon dioxide in the atmosphere was mentioned at a Congressional hearing and deemed worthy of scientific monitoring at the Mauna Loa Observatory in Hawaii, two significant events in the political history of climate change that were direct consequences of the International Geophysical Year (IGY), a worldwide scientific endeavor that allowed tens of thousands of scientists from more than sixty nations to collaborate on a series of research projects. The year of 1957 is also significant to our narrative as it witnessed the first successful launch of a satellite into orbit by Soviet scientists, a feat that prompted Eisenhower to establish the first presidential science advisory committee whose records, together with the papers of the committee's successive chairmen who doubled as the science advisor to the incumbent president, form the archival foundation of this work.

The scientific discovery of climate change dated all the way back to the nineteenth-century, but the late 1950s witnessed a renewed interest in the issue as contemporary science took off and the federal government, responding to Cold War imperatives, began funding massive research projects in geophysics. The carbon dioxide issue, as it was often referred to, had emerged from a small, specialized field, and had been studied in relation to questions on the origins of ice ages, which had led scientists to examine past climatic changes rather than predict future ones. As such, carbon dioxide had not been considered a matter of public policy, or a political object by legislators and political leaders in the 1950s, although some scientists were already referring to it as a type of industrial air pollutant. Throughout the 1960s and the 1970s, the issue began appearing more frequently in scientific papers and governmental reports, and it was discussed in conjunction with broader concerns over air pollution at government-sponsored public health conferences. Congressional hearings, especially those held in relation to the Clean Air Act of 1970, made explicit mentions of CO_2's adverse impact on the climate system.[11]

The climate issue continued to make strides in the political sphere, as a confluence of geopolitical and economic issues in the early and mid-1970s contributed to propelling the issue to the foreground. A series of droughts and weather events placed climate on the (geo)political map; climatologists became more assertive as to the direction of the change—we were headed for a global warming, not another ice age—and climate models gave a clearer picture of the range of temperature rise the lower atmosphere would experience if human activity injected twice as much carbon dioxide into the atmosphere (compared to pre-industrial levels); and the first oil shock highlighted the unsustainable character of the U.S. economy's heavy dependence on cheap, imported fossil fuels. Some scientists, such as Roger

[11] I am grateful to Naomi Oreskes and her colleagues for sharing with me a copy of their paper on the subject, on which this section draws: Naomi Oreskes, Colleen Lanier-Christensen, Hannah Conway, and Ashton Macfarlane, "Congressional Intent in the the 1970 Clean Air Act," submitted to the Harvard Environmental Law Review.

Revelle, an oceanographer by training and an early advocate for research into anthropogenic global warming, volunteered a bold proposal: perhaps now was the time to start the long and costly project of transitioning to a new energy system including a more diverse national energy portfolio.

At that crucial moment in time, however, the federal government failed to respond to the rapid change of paradigm. If the energy crises highlighted the need for advanced economies to wean themselves off fossil fuels, a need spurred by shortages and an oil peak predicted to materialize in the next decades, they also induced fears of seeing an end to the prosperity and economic growth that had characterized the post-war period. Western societies had just left an era of relative material scarcity and entered one of abundance, when an uncomfortable truth began to ripple across the capitalist system: for all its success at creating wealth and raising the standards of living of millions of people, it also generated so-called negative externalities, in this case vast amounts of greenhouse gases that were impacting society at large.[12]

That change of paradigm, from an era of abundance to one of environmental challenges that, if left unchecked, would come to erase all economic progress, occurred over a short period of time. The implications of what a change in the climate system meant were so severe that many scientists found it hard to match the devastating effects their models were projecting with adequate policy recommendations. In other words, scientists and policymakers were hard-pressed to give legislative weight to what science predicted. In that respect, both groups experienced status quo bias, or a preference for maintaining the system as it was rather than engaging in the

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[12] On capitalism and the cultural and socio-political roots of the climate crisis, see Jason Moore, ed., *Anthropocene or Capitalocene? Nature, History, and the Crisis of Capitalism* (Oakland: PM Press, 2016); —, *Capitalism in the Web of Life: Ecology and the Accumulation of Capital* (London: Verso, 2015); Christopher Wright, and Daniel Nyberg, *Climate Change, Capitalism, and Corporations: Processes of Creative Destruction* (Cambridge: Cambridge University Press, 2015); Naomi Klein, *This Changes Everything: Capitalism vs the Climate* (New York: Simon & Schuster, 2014); Timothy Mitchell, *Carbon Democracy* (London: Verso, 2013); Adrian Parr, *The Wrath of Capital: Neoliberalism and Climate Change Politics* (New York: Columbia University Press, 2012); Rob Nixon, *Slow Violence and the Environmentalism of the Poor* (Cambridge: Harvard University Press, 2011); John Bellamy Foster, Brett Clark, and Richard York, *The Ecological Rift: Capitalism's War on the Earth* (New York: Monthly Review Press, 2010); Kenneth A. Gould, David N. Pellow, and Allan Schnaiberg, *The Treadmill of Production: Injustice and Unsustainability in the Global Economy* (Boulder: Paradigm Publishers, 2008).

massive efforts required to reform it. Such reluctance partly stemmed from the fact that climate change and climatology have never been only about the climate or a set of environmental issues, but they have raised questions of energy and economic policies, wealth distribution and income inequalities, as well as western societies' culture of disposability and consumerism. But in a twist of fate, climate change collided with growing fears about resource scarcity, and the end of an era of seemingly boundless abundance. The Carter administration chose not to promote and invest massively in other types of energies, especially renewable energy, but to increase and secure the supply of fossil fuels. Throughout the 1980s and early 1990s, science depicted the far-reaching consequences of a global climate breakdown in more ominous terms, and it became clear that governmental inaction gravely endangered civilization as we knew it. Yet both the government, led by two Republican administrations, and the fossil fuel industry, had awoken to the threat by then—not that of global warming, but that of a scenario in which citizens and their elected representatives had decided that fossil fuels should be left in the ground, and they gradually began organizing themselves as a countermovement.

Climate change was also exclusively studied by climatologists and other researchers in the natural sciences, and very little input was sought or seriously considered by experts from other scientific disciplines, especially in the social sciences and the humanities. Because of that configuration, all the scientific reports outlining the threat of climate change reported on what their authors knew and could speak authoritatively about, namely the scientific underpinnings of climate change. While the reports underlined its dramatic societal consequences on all populations across the globe, they had risible sections on the political implications of the issue, and they almost never ventured to offer possible policy responses, because none of the scientists on these various panels and committees considered this his (they were all-male panels until very late) domain of expertise. And indeed, it was not. But instead of opening the doors to an array of researchers in other disciplines, who would have had something to say about policy initiatives and political moves that ought to be considered, the panels included a minuscule number of economists (the only social scientists consulted), who all hailed from the same ideological trend, and whose views were never challenged or opposed because they were the lone social science members on those panels. Their views and recommendations, whatever the substance of the arguments they presented, invariably revolved around the idea of *laissez-faire*. In other words, while climatologists were pointing out the troubling scientific facts associated with rising temperatures, a small cadre of economists were busy shushing them, offering a paternalist reassurance that inaction was indeed the best course of action in the face of what they considered insurmountable uncertainty. As this dissertation demonstrates, in the Reagan and first Bush administrations, officials within the U.S. government were not merely influenced by climate deniers: they actively sought them out, and gave credence to their claims, which supported their own posture towards climate change. In light of the facts outlined above, I argue that the U.S. government was a major actor in the legislative and political gridlock on climate change.

Howe writes that climate change has the allure of a tragedy. When looking at the role of the federal government, however, the fact remains that there was no predetermined course of action, and that climate policy could have emerged at any point. The real tragedy is that, while federal funding supported climate change science—the only policy that the various administrations agreed to—and science began to depict the threat in more conclusive terms, becoming a real-time witness to the climate system breakdown, the chances of a breakthrough in climate legislation grew increasingly slimmer.

This narrative is divided into four chapters, covering the successive administrations from 1957 to 1992. The first chapter presents the birth of atmospheric science at a time of heightened interest in geophysics and massive increases in government-sponsored research, as tensions escalated between the United States and the Soviet Union. The chapter opens with the launch of the Soviet satellite Sputnik in 1957, a move that convinced the U.S. government to allocate more funding to basic research, and to give science a more prominent place in the decision-making process. Alongside these changes, the International Geophysical Year (IGY), inaugurated a massive research effort on a global scale. The IGY promoted dialogue and exchange between various disciples such as meteorology, oceanography, glaciology and geophysics, an interdisciplinary effort from which atmospheric science emerged, and the monitoring of atmospheric CO_2 concentrations began. Two indirect but crucial elements also promoted the rise of atmospheric science. One was the development of thermonuclear bombs and the nuclear fallout monitoring network, a global monitoring effort of the atmosphere that strengthened efforts to study the general circulation of air masses and oceanic currents. The other important development was the government's investment in weather modification research, which accompanied the advent of modern computerized meteorology and the first climate models.

Concurrently to these developments and the attempts by some scientists at defining CO_2 as a type of atmospheric pollutant, the oil industry began to take a closer look at air pollution, especially that emanating from its refineries. Contrary to global warming, localized and visible air pollution had indeed begun to attract lawmakers' attention at the municipal, state and federal level of government, which translated to an increase in bills requesting pollution abatement measures. The early 1960s also signaled a shift in the conception of science and a growing awareness of the impact of technology on the geophysical processes of the earth. Scientists and political leaders' confidence in the power of scientific advances and progress to generate economic growth yielded to a more nuanced view of science and technology, whose impact on ecosystems had grown more visible and problematic.

The second chapter centers on the realization by scientists and members of the political class that scientific breakthroughs and modern technology had unwittingly produced various environmental problems, which led to the adoption of a spate of environmental laws and regulations in the early 1970s. This period also signaled a recognition of the relative fragility of the planet's various ecosystems, as well as a shift in the understanding of pollution, from a local issue, which the oil industry had been forced to address in the late 1950s and early 1960s at some of its local refineries, to a global phenomenon, as exemplified by atmospheric pollution. The end of the 1970s witnessed the formation of a scientific consensus on the direction of climate change, as the first general circulation models indicated a warming trend, and refuted the global cooling hypothesis and the advent of a new ice age. The

Carter administration, rattled by the energy crises, saw the publications of two influential reports by the National Academy of Sciences, *Energy and Climate* in 1977, and *Carbon Dioxide and Climate: A Scientific Assessment* in 1979, which both outlined the threat of global warming and spelt out a range of temperature increases that would follow a doubling of carbon dioxide concentrations in the atmosphere. Prompted by these developments and their potential for disrupting its main industry, Exxon quickly set up its own research program on the effects of rising concentrations of atmospheric CO_2. Climate change also became much more controversial as a political and cultural issue beginning in the second half of the 1970s, when atmospheric science and climate modeling became more assertive in their characterizations of the problem. Suddenly a political issue, as opposed to a purely scientific one, with far-reaching social and economic implications in terms of energy production and usage, climate change had just seen a barely-formed consensus emerge that the first rip in the public fabric appeared, when it became clear that the role of fossil fuels in the U.S. (and the global) economy would need to be reassessed in significant ways. Rather than formulating policies in that direction, the Carter administration further entrenched the United States in its dependance on fossil fuels by expanding and investing in its oil and gas infrastructure, using the power and leverage of the federal government to do so.

The third chapter examines how the Reagan administration worked to actively suppress any legislative efforts at regulating CO_2 emissions, while the oil industry began to move away from climate modeling, in which it had invested, choosing instead to devote its resources to drawing attention to the uncertainties surrounding the science of climate change. If the Reagan administration did not deliver the counterrevolution expected by its supporters, it laid the groundwork for its successors in important ways. By polarizing environmental issues, framing them as a choice between nature and the economy (i.e. people’s livelihoods), it made it very difficult for conservative elected representatives to support regulatory measures in environmental policy, contributing to the radicalization of the Republican party. Although an important report by the National Academy of Sciences (NAS), published in 1983, did not contradict the facts concerning climate change, an intentionally misleading summary written by the panel's chair—a future climate denier—opened a type of climate's Pandora's box. By presenting social and economic consequences as open to interpretation, it transformed public discourse on climate change. Meanwhile, officials at the Department of Energy, one of the leading agencies in climate change research, succeeded in eviscerating a report, the fruit of a five-year effort, emptying it of its political power by dwelling on uncertainties, as opposed to examining potential responses to man-made disruptions of the climate system. At the end of Reagan's second term, ozone depletion, another issue of atmospheric pollution, had gained traction in the political world, eventually leading to the adoption of the Montreal Protocol in 1987. Political leaders and scientists expected that a similar international agreement would soon address climate change. However, the oil industry had been put on notice, and it began to organize itself as a countermovement in order to thwart international efforts at regulating fossil fuel emissions. Exxon executives decided to leverage the science they had funded and use the uncertainties they knew existed in atmospheric models to sow doubt and create confusion on climate change.

The fourth and final chapter focuses on the George H. W. Bush administration's obstructionism, the intense political battle over climate change science as laid out in the Intergovernmental Panel on Climate Change (IPCC)'s first assessment report, published in 1990, and the launch of an aggressive campaign of climate change denial by the oil industry. The Bush administration started with a circumspect look at the climate change issue, the president having campaigned on being more receptive to environmental matters. However, when it became clear that any meaningful international treaty would include transitioning to an energy system much less reliant on fossil fuels as well as drastic carbon dioxide emission reductions and new land-use policies, the administration started actively searching for ways to emphasize and publicize the areas of uncertainties underlying the science of climate change. Bush's chief of staff, aided by a compliant science advisor, opened the White House doors to representatives of the denial counter-movement, who were given ample access to the State department and participated in its review of the IPCC's first assessment report and the draft text of the 1992 U.N. Framework Convention on Climate Change (UNFCCC).

The great victory of the Bush administration was its success in killing the UNFCCC before it was even drafted, by greatly watering down the conclusions of the IPCC's first assessment report. By claiming that the observed temperature change over the past century could not be conclusively linked to an increase in the atmospheric concentrations of GHGs, the scientific baseline for a treaty with binding commitments to emission reductions became void. The Bush administration also succeeded in reframing the climate change policy debate by inserting ideas of cost-effective responses and reliance on market mechanisms to achieve emissions reductions rather than commitments by national governments to reduce their emissions. The administration subscribed to a particular economic vision that gave little economic value to the future, and did not realistically include the costs and many detrimental effects of climate change. While it did not refute the science altogether, it prioritized short-term economic growth over the long-term impacts of a warmer planet. The administration's strategy was clear: exaggerate the levels of uncertainty and the short-term costs of action, and sit out on climate change, while giving itself the veneer of environmental conscientiousness by signing a weakened convention.

The section that follows presents the methodology and archival sources I used in this work. But first, let me clarify the scope and limits of this project. It is important to note that I chose to focus on the executive branch of the federal government, with occasional excursus in Congressional affairs. The dissertation does not, however, offer an exhaustive analysis of climate change policy across all of the federal government. Just as environmental policy does not belong to a specific department or a designated agency's portfolio, climate policy is enforced by multiple federal agencies and departments across the U.S. government, among which are the Environmental Protection Agency (EPA), the Department of Agriculture, the Department of Energy, and the Department of Defense, to name but a few. Furthermore, environmental policy, and climate policy in particular, are decided both at the federal and state levels, and the judiciary plays an important role as well, two additional layers that are not examined here.

Three reasons motivated my choice to prioritize the executive branch of government. First, climate change has been defined from the start as a global issue, not a regional or even national one. In their reports, scientists made it clear that measures taken at the local level would not do much to alleviate the problem, while the consequences of a disrupted climate system would impact populations on a worldwide basis, irrespective of their contribution to global warming. The international scope of the issue thus made it a foreign policy issue as well as one relevant to domestic public policy. While Congress has the final authority for ratifying international treaties and agreements, the conduct of (environmental) diplomacy and negotiations with foreign governments rests with the executive. Second, some of the early and politically significant scientific reports exposing the disruptions that climate change would cause were commissioned by the presidential science advisory committee within the White House. Alongside these developments, the Department of Energy acted as another crucial actor in the production of climate change knowledge, funding and publishing numerous assessments of climate science. Finally, the relationships between appointed officials and oil industry executives, documented in governmental and industry records, provided another reason for investigating the executive branch in order to understand the U.S. government's approach to climate change.

Another limit of this work concerns my decision to focus specifically on the U.S. government, without comparing its choices and policies with those of other national governments. Such comparison would have undoubtedly given insight into both global climate policy-making and helped put the U.S. position in perspective. However, it would not have allowed the immersion in and detailed account of the U.S. government's response to climate change that this single lens permitted. In my opinion, two facts justify the attention and priority I hence conferred to the U.S. government: the first one is that United States is the largest historical emitter of carbon dioxide over the past three centuries (a point I will return to in the second part of this introduction), and the second is that its role in blocking international climate policy has been especially damaging due to its broad influence on global governance and its leverage in international negotiations. To understand today's climate predicament requires that we delve into the recesses of one of its foremost architects.

In order to study the role of the federal government in the U.S. political history of climate change, I primarily relied on the papers of presidential science advisors and members of the PSAC, as well as the records of one office within the Executive Office of the President, namely the Office of Science and Technology Policy (OSTP), which is also directed by the president's science advisor. The OSTP has never been a powerful office, the way the Office of Management and Budget (OMB) has. Except for one of the science advisors (Frank Press, in the Carter administration), these officials did not, by themselves, wield much power on the president they served. The value of this office's archival records does not reside in its status within the policy-making apparatus of the White House, but in the fact that it acted as the locus for climate affairs and climate policy in each administration, owing to its mandate to advise the president on matters of technology and science. The OSTP and presidential advisors oversaw the day-to-day management of climate-related issues, coordinating the administration's response to requests for testimonies by legislative committees at Congressional hearings, advising the president on how to respond to scientific reports on the subject, and managing all federal stakeholders involved in climate research.

I did not consult the records of federal departments involved in climate policy such as the Department of Energy, the Department of the Interior or the Department of State, but because of the OSTP's frequent communications with appointed officials in these departments, I was able to incorporate relevant material from these sources into my account. As such, OSTP records provided detailed documentary evidence of each administration's decisions and actions (or lack thereof) on climate change. Although he never served as a presidential science advisor, I also made extensive use of Roger Revelle's papers because of his role as a consummate "statesman of science" who chaired various panels of the National Academy of Sciences that produced reports on the carbon dioxide issue, and served the

U.S. government in an advisory capacity on multiple occasions over more than three decades.[13]

Regarding the status of OSTP and the science advisors' records, I should mention that I did not ask for the declassification of governmental material, nor researched fonds that I was the first one to consult. All archival collections I drew upon were transferred and processed many years ago, and have been open to researchers ever since. OSTP records of the George H. W. Bush administration were released following a FOIA (Freedom of Information Act) request filed in November 2004, but they were released in January 2011 and have been accessible since then. That being said, this is the first work presenting a historical analysis of the source material found in these collections that documents the role of the U.S. government in delaying climate policy, bringing to light previously unpublished archival material. When sources regarding specific episodes of that narrative had already been studied and published in the scientific literature, I relied on and cited this existing literature, and incorporated these findings into my work after assessing them based on the conclusions I had drawn from my own research.

The type of sources I have gathered include all sorts of internal governmental documents, such as memoranda, meeting agendas and minutes, internal reports and policy proposals, and professional correspondence between science advisors, OSTP officials and White House staff; panels and committees' members of the National Academy of Sciences; members of Congress; and appointed officials in various federal departments. I also examined congressional bills as they were reviewed by White House and OSTP officials, testimonies to Congress by the science advisors and OSTP members of staff, as well as administrative documents relating to research budgets, the establishment of the OSTP, and nominations to the presidential advisory committee. Other documents included printed materials, press releases, and speeches delivered by some of the science advisors.

[13] The title is taken from a videotaped interview of Revelle: "Roger Revelle: Statesman of Science," produced by KPBS-TV, San Diego, taped August 17, 1992, Box 92, File 39, Roger Revelle Papers, Special Collections & Archives, UC San Diego (UCSD), La Jolla, CA, cited by Howe, *Behind the Curve*, 218.

This dissertation is also a history of the science, business and public policy nexus, looking at the relationships between the private energy sector and government on issues of technology and science, and on climate change in particular. Each chapter contains a section on the fossil fuel industry's handling of climate change, and its ties to the federal government, most notably through the Department of Energy and the OSTP. While some of the documentary evidence I used to write these sections comes from the governmental archives discussed above, I also relied on internal industry documents taken from a public digital repository called the Climate Files.[14] In the summer of 2019, all of the Climate Files documents were uploaded onto the Fossil Fuel Industry Documents Archive, hosted by the University of California's Industry Documents Library, a digital archive that contains internal documents from U.S. corporations active in the tobacco, opioids, chemical, pharmaceutical and food industries.[15]

Although other oil companies took an interest in climate change, such as Shell and Total, Exxon (as it was known before it merged with Mobil in 1999 and was renamed ExxonMobil) did it on a greater scale, establishing its own in-house research program into the carbon dioxide issue. In light of this work's focus on the U.S. history of climate change, it made sense to choose a U.S. corporation, as opposed to one of the foreign oil majors. During the period examined here, Exxon also was (and has remained) the largest investor-owned oil company in the world, underscoring the significance of its contribution to delaying climate policy. Finally, the governmental sources I had collected mentioned Exxon executives, and they documented partnerships between the company and the Department of Energy on climate research, further highlighting the importance of including Exxon's own internal files. Because of my choice to concentrate on Exxon, I exclusively relied on the Climate Files database, leaving out the other industry documents available on the UC SF Industry Library.

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[14] Primary source documents from the Climate Files database can be downloaded at : http://www.climatefiles.com/collection-index/.

[15] The Fossil Fuel Industry Documents Archive can be accessed at: https://www.industrydocuments.ucsf.edu/fossilfuel/.

Working with digital repositories imposed several limitations. The first one was that, unlike traditional physical archives that are curated by professional archivists, these repositories offer a somewhat haphazard collection of internal industry files, without these constituting a proper fonds. Another problem, although it is probably related to the sensitive nature of these documents, is that these repositories lack transparency as to the origins of the documents, both in terms of their original place in the company that produced them, and on the question of who obtained these documents and submitted them for publication on the platforms. While some of the documents were handed over by companies when they got sued, and others were merely unearthed from public physical archives (a point I will return to), part of the documents' provenance remains unclear. On the Climate Files website, the "about" section simply states that "documents compiled here are from various sources and are derived from more than 20 years of research and data collection."[16] As for the UC SF Library, it mentions that "these documents come from diverse sources, including the Climate Investigations Center [the parent organization behind the Climate Files database], discovery processes in litigation, and documents published on Climate Files, largely derived from Freedom of Information Requests and lawsuits."[17] A final difficulty was that, because the documents published on these platforms are "stand-alone" files, and their position in relation to other documents is unknown, it is impossible to assess how little or how much they represent of the original material produced by Exxon and others.

A physical repository of Exxon's files, known as the ExxonMobil Historical Collection, exists at the Briscoe Center for American History at the University of Texas at Austin. With an estimated 4 million documents, the bulk of which covers over a century of its activities from the 1880s to the 1990s, it is the largest of the Center's collection on the U.S. energy industry, documenting the history of the corporation and its sprawling web of

[16] Climate Files, "About," accessed October 26, 2022, https://www.climatefiles.com/about-2/.
[17] Yogi H. Hendlin, and Naomi Oreskes, "Archiving the Anthropocene: Introducing UCSF's Fossil Fuel Industry Documents," June 27, 2019, accessed October 26, 2022, https://www.industrydocuments.ucsf.edu/fossilfuel/blog/.

subsidiaries and affiliate companies.[18] In 2006, the Center received $1.2 million from ExxonMobil to research and write the fifth volume documenting Exxon's corporate history. Published in 2013, *Exxon: Transforming Energy: 1973-2005*, was written by Joseph Pratt, a professor of history and management at the University of Houston, together with a former senior advisor in the company's public affairs department, William Hale.[19] Their 500-page historical account, however, only dedicates a dozen of pages to the question of Exxon's position on climate change, framing it as a problem of public relations in the 1990s and early 2000s, and saying nothing of Exxon's in-house research program on carbon dioxide in the late 1970s and 1980s.[20] Unfortunately, before I could review the collection myself, the pandemic hit, derailing my plans for collecting primary source material, as the Briscoe Center was closed indefinitely, and I could not place remote scanning orders. It appears that none of the Exxon documents on the Climate Files and the UC SF digital archives stem from the Center's ExxonMobil Collection, which would therefore be worth consulting to complete this research.[21]

The MIT Libraries' Distinctive Collection also hosts a wealth of Exxon files as part of the papers of Edward David, Nixon's science advisor and the president of Exxon Research and Engineering from 1977 to 1986. The library remained closed to non-MIT researchers until the summer of 2021, when it began offering remote consultation services. I took advantage of these but was limited in the number of folders I could review in these one-hour sessions, and I prioritized other documents because there were simply too many Exxon files for a short online review and no indication on the finding aid as to what they contained. The third known physical archives for oil industry documents is at the University of Calgary in Canada. It houses some 300 documents from the Glenbow Museum's Imperial Oil Archive that were dug up by investigative journalists at the Climate Investigations Center and at DeSmog, a news organization that specializes in climate and other

[18] Briscoe Center for American History, "American Energy Industry," accessed October 27, 2022, https://briscoecenter.org/collections/american-energy-industry/.
[19] Joseph A. Pratt, with William E. Hale, *Exxon: Transforming Energy: 1973-2005* (University of Texas Press, 2013).
[20] Pratt and Hale, *Exxon*, 461–471.
[21] As stated by the Briscoe Center in private electronic communications with the author (November 2022).

industry-related disinformation campaigns by corporations. These archives document the activities of Imperial Oil, an Exxon subsidiary in Canada, which I relied on for my first chapter's discussion of air pollution at refineries located in a town on the U.S.-Canadian border.

Some of these internal industry documents have been published in journalistic accounts and are therefore not, stricto sensu, the type of "original" primary source material typically found in dissertations. Yet they have not been the subject of historical analysis—that is to say, analysis by historians, hence my decision to include them in this study.[22] I discuss these newspaper articles in the third chapter, in the section on Exxon's in-house research program, where I explain how my analysis departs from their reporting on these developments. Only one research article has studied some of these records using a historical framework: "Advocating Inaction: A Historical Analysis of the Global Climate Coalition," written by Robert Brulle and published in 2022.[23] Brulle has published extensively on climate change polarization in U.S. politics and on U.S. climate change counter-movement organizations, but he is an environmental sociologist, not a historian.

Finally, I find it important to stress how disruptive the pandemic has been for gathering primary source material. I had two research trips planned for 2020, a two-month stay in February-March, and a longer one in the summer. I spent a month in the United States, during which I worked at the Library of Congress in Washington D.C., the National Archives in College Park, Maryland, and the Special Collections & Archives at the University of California at San Diego, before having to leave the country. This was the only in-person research I was able to conduct in the archives. Presidential libraries, which are part of the federal archives system, and other university libraries I

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[22] See Neela Banerjee, David Hasemyer, Lisa Song, and John H. Cushman, *Exxon: The Road Not Taken* (Inside Climate News, 2015). See also four articles by the *Los Angeles Times*: Ivan Penn, "California to Investigate Whether Exxon Mobil Lied about Climate Change Risks," *Los Angeles Times*, Jan 20, 2016; Amy Lieberman, and Susanne Rust, "Big Oil Braced for Global Warming While It Fought Regulations," *Los Angeles* Times, Dec 31, 2015; Katie Jennings, Dino Grandoni, and Susanne Rust, "How Exxon Went from Leader to Skeptic on Climate Change Research," *Los Angeles Times*, Oct 23, 2015; Sara Jerving, Katie Jennings, Masako Melissa Hirsch, and Susanne Rust, "What Exxon Knew about the Earth's Melting Arctic," *Los Angeles Times*, Oct 9, 2015.

[23] Robert J. Brulle, "Advocating Inaction: A Historical Analysis of the Global Climate Coalition," *Environmental Politics*, published online (11 April 2022): https://doi.org/10.1080/09644016.2022.2058815.

had planned to visit, remained closed to researchers for a total of eighteen months. In addition to the material I was able to review and collect during my stay in February 2020, the majority of the sources I used for this work come from a series of remote scanning orders, which some libraries, but not all, began offering in the fall of 2020.

This had important implications in terms of the documents I could access. I encountered two issues: one was the fact that I had to rely on the archives' inventories, which greatly differed in how detailed or sparse they were in describing fonds, and I could not ask questions to library staff because most of them were working remotely (except in some cases, most notably at the UC SD library, where archivists offered to review some material on my behalf). The second issue was another practical one: while I could place some orders in the early fall of 2020, all libraries sent their staff back home when the pandemic began raging again, and most only resumed taking scanning orders in the late spring and summer of 2021. As a consequence, I had to scale back my project and write four chapters instead of the six I had envisioned. The original second chapter was to cover the years from 1964 to 1976, and thus three different administrations, but I accessed the material for this period late in the writing process, and would have needed more time to go through the thousands of pages I had ordered (inventories for these archives were especially vague, so I could not target specific and relevant primary source material). Pressed for time, I decided to merge these two chapters into one, and made the choice to place the emphasis on the Carter administration, which I considered to be a turning point in the history of climate change. I also had to renounce to the chapter on the Clinton administration, for which I had collected sources during my February 2020 research stay, because of the months I had lost to the pandemic and could not make up for.

This is a work on the U.S. political history of climate change, but I find it important to include an *aparté* to explain what climate change is in lay terms, as it informs this story in extensive ways. The implications of climate change science are complex and subject to uncertainties, and so it is all the more crucial to get a solid understanding of the phenomenon it seeks to describe. To explain it in simple terms, it is useful to resort to the metaphor of the "greenhouse" effect, as it illustrates what is going on. As carbon dioxide is released into the atmosphere (through the burning of fossil fuels, changes in land uses, or the clearing of forests, which store vast amount of CO_2), it traps the heat of the sun radiated back by the earth, elevating the global mean temperature at the surface of the earth. The likely effects of global warming include rising sea levels, altered rainfall patterns, the melting of the Artic sea ice, increases in the number and severity of extreme weather events, the death of large portions of forests, and vast changes in the main agricultural regions of the world. Scientists have warned that levels of atmospheric CO_2 should be kept at 350 part per million (ppm), up from their 280 ppm pre-industrial levels.[24] We are currently experiencing levels of 400 ppm, and are well on our way to reaching 450 ppm by 2040, which is seen by climate experts as the upper limit before irreversible changes occur.[25] But what is considered a safe threshold keeps changing, and scientists have recognized that their predictions have often been too conservative. The Paris Agreement found that a 2°C increase was safe, but scientists believe the safe limit to be 1.5°C. We are currently experiencing a 1.2°C increase, and various scenarios predict that current policies commit us to at least 2.9°C of warming—and up.[26] As climatologists have noted, each centigrade of warming makes a world of differences, in a negative way.

A second point that needs to be clarified pertains to the vocabulary around climate change. I mostly use that term in this work, but I am aware of its associations. While it is true that the phenomenon mentioned here refers to a series of changes in the earth's climate system, this denomination has been criticized as playing into the hands of the so-called "skeptic" and climate change denial movements, by minimizing both the threat and normalizing it ("the climate system has been in constant evolution, changes are part of the

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[24] The Climate Reality Project, "Key Terms You Need to Know to Understand Climate Change," October 27, 2015, accessed August 27, 2020, https://www.climaterealityproject.org/blog/key-terms-you-need-understand-climate-change.

[25] NASA Global Climate Change, "Graphic: Carbon Dioxide Hits New High," accessed August 3, 2020, https://climate.nasa.gov/climate_resources/7/graphic-carbon-dioxide-hits-new-high/.

[26] Climate Action Tracker, "Warming Projections Global Update," May 2021, available for downloading at: https://climateactiontracker.org/documents/853/CAT_2021-05-04_Briefing_Global-Update_Climate-Summit-Momentum.pdf.

natural world.") The term global warming sought to clarify the direction of the change, by emphasizing the elevated temperatures that would impact populations across the globe, and it is considered more politically-charged. As Howe puts it, global warming is "human-caused climate change, plus politics."[27] Journalists at the British newspaper *The Guardian*, a left-leaning, independent media outlet which has offered a strong coverage of the issue in the past decade, have announced that they would employ the terms "climate crisis" and "global heating," finding them more accurate to capture the essence and breadth of the problem. Other denominations include "climate weirding," which refers to the greater frequency of extreme weather events such as the "weird" (i.e. extraordinary) heat dome that engulfed the Pacific Northwest in the summer of 2019; "climate breakdown" and "climate collapse," which allude to the rapid disintegration of important features of the climatic regime in which we have lived for the past ten thousand years, and that has allowed the first agrarian societies to emerge, and civilization as we know it to flourish.

Another important aspect of climate change that tends to get lost in the sea of its numerous and far-reaching repercussions is that the climate system is not changing gradually, slowly evolving over decades. The transition to a new climatic regime, in which humankind has never lived, will be anything but smooth: ancient ice cores show abrupt transitions between very different climatic regimes, occurring over decades, not centuries or millennia. This transition will not be gradual, and it will not be reversible either because of what climatologists call "tipping points" or thresholds that, once they are passed, trigger a series of irreversible changes in the climate system.[28] The concept of tipping points was popularized by James Hansen, a climatologist and leading figure in the climate advocacy movement, who used that term in a 2005 presentation and warned that "we are on the precipice of climate system tipping points beyond which there is no redemption."[29] The

[27] Howe, *Behind the Curve*, 14.
[28] Timothy M. Lenton, "Early Warning of Climate Tipping Points," *Nature Climate Change* 1 (July 2011): 201–209.
[29] James E. Hansen, "Is There Still Time to Avoid 'Dangerous Anthropogenic Interference' with Global Climate? A Tribute to Charles David Keeling," December 6, 2005, Presentation at the American Geophysical Union, San Francisco, California, available at: http://www.columbia.edu/~jeh1/presentations.shtml, cited by Chris Russill, and Zoe Nyssa,

climate system, like any other complex system, maintains itself in a state of equilibrium. Under repeated stress factors, namely the annual injection of billions of tons of greenhouse gases, the system can flip, passing a threshold (a tipping point) and reaching a new state of equilibrium: a climatic regime in which we, as a civilization, have never lived.

Finally, it is worth noting that climate change is not a linear physical phenomenon, and neither are fossil fuel emissions. The World Resource Institute, an environmental think tank based in Washington D.C., writes that "emissions have been climbing since the Industrial Revolution, but the rate of annual emissions increase during the first ten years of this century was almost double the rate between 1970 and 2000."[30] Perhaps more telling, researchers concluded that "half of all global fossil fuel and cement CO_2 emissions since 1751 have been emitted since 1990."[31] Another way of looking at the vast inequality of fossil fuel emissions is to know that the wealthiest (the so-called "one percent") have been responsible for more than twice the amount of carbon dioxide emissions produced by fifty percent of the global population between 1990 and 2015.[32] Research in the field of attribution studies has also shown that a small number of fossil fuel companies—90 corporations, to be precise—have played a significant role in global carbon emissions, accounting for two-thirds of the greenhouse gases released into the atmosphere between 1751 and 2010.[33] A more recent study by the same team of researchers in climate accountability found out that 35% of worldwide carbon emissions can be attributed to only 20 state- and

"The Tipping Point Trend in Climate Change Communication," *Global Environmental Change* 19, no. 3 (August 2009): 336–344.
[30] Kelly Levin, "Climate Science, Explained in 10 Graphics," April 26, 2017, World Resources Institute, accessed October 15, 2019, www.wri.org/blog/2017/04/climate-science-explained-10-graphics.
[31] Climate Accountability Institute, "Press Release on Carbon Majors Update, 1965-2017," October 9, 2019, accessed November 10, 2019, http://climateaccountability.org/publications.html.
[32] Fiona Harvey, "World's Richest 1% Cause Double CO_2 Emissions of Poorest 50%, Says Oxfam," *The Guardian,* September 20, 2020.
[33] Richard Heede, "Tracing Anthropogenic Carbon Dioxide and Methane Emissions to Fossil Fuel and Cement Producers, 1854–2010," *Climatic Change* 122 (2014): 234.

investor-owned oil companies, four of which are American: Chevron, ExxonMobil, ConocoPhillips, and Peabody Energy.[34]

A crisis is, by definition, a discrete event in time, a rupture between a "before" and an "after." In that sense, the climate crisis is *not*, in fact, a crisis, because of its protracted nature. Many authors have noted that we have entered a permanent state of emergency that has become the new normal. Ross Gelbspan, a journalist and environmentalist who has written on climate change deception and denial, argues that "democracies will die before we go under the stress of ecological disasters."[35] And indeed, the stakes are high in terms of what world we will live in—politically and environmentally speaking.

Climate change, like other environmental ills, is a symptom of a broader issue, which I call unsustainability, to refer to our diseased mode of inhabiting the earth. This concept covers a plurality of meanings, and it has been employed to different ends by political economists and political sociologists, but mostly to analyze the causes and factors behind societies' inability to transition towards sustainability. This scholarship has focused in particular on the failure of green parties in Western democracies to shift the dominant narrative underlying advanced consumer capitalist societies.[36] In a short but crisp description, political economist John Barry defines unsustainability as "the exploitation of people and planet," a thread that informs my reading of the climate crisis.[37] Climate change is indeed a warning, and it is by no means a small one, but I would argue that it helps to think of the climate breakdown

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[34] Climate Accountability Institute, "Press Release on Carbon Majors Update, 1965-2017, October 9, 2019, accessed November 2, 2019, http://climateaccountability.org/publications.html.
[35] Ross Gelbspan, *The Heat Is on : The Climate Crisis, the Cover-up, the Prescription* (Reading, PA: Perseus Books, 1998), 153.
[36] Helen Kopnina, "The Victims of Unsustainability: a Challenge to Sustainable Development Goals," *International Journal of Sustainable Development & World Ecology* 23, no. 2 (2016): 113–121; John Barry, *The Politics of Actually Existing Unsustainability: Human Flourishing in a Climate-Changed, Carbon Constrained World* (Oxford University Press, 2012); Ingolfur Blühdorn, "The Governance of Unsustainability: Ecology and Democracy after the Post-Democratic Turn," *Environmental Politics* 22, no. 1 (2013): 16–36; –––, "The Politics of Unsustainability: COP15, Post-Ecologism, and the Ecological Paradox," *Organization & Environment* 24, no. 1 (2011): 34–53 ; –––, and Ian Welsh, ed., *The Politics of Unsustainability: Eco-Politics in the Post-Ecologist Era* (London: Routledge, 2008).
[37] Barry, *The Politics of Actually Existing Unsustainability*, 7.

more broadly by speaking of unsustainability, to highlight both the question of social and environmental justice at the crux of the issue, and the fact that piecemeal, haphazard interventions are not going to help us overcome the crisis of how we inhabit this planet. The human print has simply gotten too big and ecological systems supporting human life on earth are buckling under the weight. In addition to rising temperatures due to CO_2 emissions, large-scale deforestation, chemical pollution of the oceans, soil and atmosphere, as well as biodiversity loss, are all markers of a profoundly diseased tangle of human activity. While this section is not strictly related to the subject of my dissertation, I find it necessary to underline how consequential past inaction on climate change has been (and continues to be). Conversely, I also see it as a useful approach to measure the scope of the problem, and its high moral, political and economic stakes.

Both a system and a phenomenon—the manifestation of that system—unsustainability characterizes a mode of social, political, economic and cultural organization involving the consumption of natural resources, and its corollary, a production of waste, the volumes of which exceed the capacity of ecosystems to produce these same resources and to absorb the waste thus generated. In other words, this consumption and waste production operate on a scale and at a rate that are not sustainable, for they exceed the planet's carrying capacity, requiring the equivalent of one and a half times the resources available to us. On the environmental front, unsustainability manifests itself through a growing range of ecological dysfunctions, all interrelated and mutually influencing one another, of which climate change is the high point, including ocean acidification (the ocean absorbs approximately a quarter of anthropogenic CO_2 from the atmosphere), biodiversity loss, the decline of primary and old-growth forests, melting ice caps, glaciers and permafrost, soil erosion, desertification, sea level rise, and extreme weather events, to name but a few. Unsustainability therefore strongly resembles a disease whose physical manifestations reflect an imbalance within a socio-economic and political system won over to the twin ideas of infinite growth and disposability. In this sense, ecological dysfunctions are not peripheral to the system, mere excrescences or innocuous side effects, but on the contrary prove to be central, intrinsic elements of the dominant mode of social organization. Consequently, it appears that only a series of systematic changes would allow societies, if not to eradicate, at least to mitigate the symptoms of this contemporary ill that is unsustainability.

At its core, unsustainability refers to a mode of living which rests on ecological debt, or the overconsumption of resources and overproduction of waste, most notably greenhouse gases, the "payment" of that debt taking the form of environmental havoc. Not all debts are created equal: the richest half of the world population (high and upper-middle income countries) accounts for 86% of the total output of fossil fuel emissions, while the bottom half (low and lower-middle income countries) emits about 14% of global emissions. Meanwhile, the lowest tier, home to 9% of the population, is responsible for a meager 0.5 %.[38] Another study found that the richest income earners (with incomes higher than USD 23 daily), who compose 10% of the world population, are responsible for about 36% of such emissions, further highlighting the vast inequality in the carbon emission budget.

As a system, unsustainability represents the dominant mode of living, as well as the endpoint for developing or emerging economies. More specifically, it refers to a capitalist system characterized by high consumerism, infinite economic growth and disposability. This organizing system has been and remains heavily dependent on the availability of cheap hydrocarbons. As such, unsustainability directly results from the harmful triad of fossil fuels, namely coal, oil and natural gas, a high-energy society, and economic growth. As novelist and environmental essayist Nathaniel Rich explains, "historically, energy use had correlated to economic growth" and Americans had grown accustomed to the idea that "the more fossil fuels [they] burned, the better [their] lives became."[39] Another way of characterizing unsustainability, as historian David Stradling points out, is to portray it as "a false prosperity," an idea developed by Barry Commoner, a biologist and a leading figure of the U.S. environmental movement, in a

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[38] Hannah Ritchie, "Global Inequalities in CO_2 Emissions," October 16, 2018, accessed August 2, 2019, https://ourworldindata.org/co2-by-income-region.
[39] Nathaniel Rich, "Losing Earth: The Decade We Almost Stopped Climate Change," *New York Times Magazine,* August 1, 2018. Published as —, *Losing Earth: The Decade We Could Have Stopped Climate Change* (London: Picador, 2019).

speech he gave at Harvard University on the eve of the first Earth Day.[40] Indeed, while countries may feel wealthier, they are in fact poorer due to the harm inflicted upon their natural resources and, ultimately, the source of their wealth.

I now turn to figures about unsustainability from a global perspective, before assessing that of the United States. To quantify unsustainability, I resort to the notions of ecological footprint and biocapacity developed in the 1990s by two researchers at the University of British Columbia, Mathis Wackernagel and William Rees, who were then looking for a method to measure sustainability. Ecological footprint and biocapacity can be thought of as another form of supply and demand: ecological footprint is the human demand on nature, while biocapacity represents the amount of resources provided by nature that can meet that demand. A country's biocapacity is the biologically productive area available for that country given its territory, while the ecological footprint measures the area this country actually requires for its resource consumption and waste production, especially its carbon emissions. In concrete terms, biocapacity is calculated in global hectares of biologically productive land and sea area available to provide the resources a population consumes and to absorb its wastes, and each unit is converted in world average productivity to allow comparisons between different lands.[41] As for biocapacity, it is enabled by "sufficient water, a stable and conducive climate, the availability of nutrients in the soil and in the air, the absence of excessive pollution, and an intact web of life."[42]

The carbon footprint is one aspect of the ecological footprint, and it includes emissions of carbon dioxide and methane (the second most common greenhouse gases). In 2016, the world's carbon footprint amounted for two-thirds of our total ecological footprint.[43] On a worldwide scale, the total

[40] David Stradling, ed., *The Environmental Moment: 1968-1972* (University of Washington Press, 2013), 67.
[41] Mathis Wackernagel, David Lin, Mikel Evans, Laurel Hanscom, and Peter Raven, "Defying the Footprint Oracle: Implications of Country Resource Trends," *Sustainability* 11, no. 7 (2019), 6.
[42] Wackernagel et al., "Defying the Footprint Oracle," 4.
[43] Global Footprint Network, "Climate Change," accessed November 2, 2019, https://www.footprintnetwork.org/our-work/climate-change/.

ecological footprint refers to the aggregated demand for raw materials, while biocapacity represent the totality of resources available on the planet. To date, and bearing in mind that many countries have not reached a level of development in any way comparable to that of the richest nations, our global footprint exceeds by one and half times (1.7 times exactly) the biocapacity of the earth.[44] In other words, our consumption of resources and production of waste, especially of carbon dioxide, would in effect require close to two planets. Humanity's total ecological footprint has been increasing steadily at an average of 2.1 percent per year since 1961, nearly tripling from 7.0 billion global hectare (gha) in 1961 to 20.6 billion gha in 2014, while "ecological overshoot has continued to grow since the 1970s at an average rate of 2 percent per year."[45] The answer as to how we are able to sustain that demand while still living on a single planet lies in the concept of ecological debt, also known as ecological overshoot. The first Earth Overshoot Day, marking the moment when all the resources available for a given year have been consumed (i.e. when human use of natural resources exceeds the biosphere's regenerative capacity), occurred in 1970, and experts predict that the threshold of two planets will be reached before 2050.[46]

Similarly to what happens in accounting, the positive or negative balance between a country's ecological footprint and its biocapacity translates to ecological deficit or, conversely, ecological reserve (in Wackerknagel's terminology). As Wackerknagel and his colleagues explain, three mechanisms together enable that national deficit to occur: the first corresponds to increasing one's biocapacity by importing it from another country or region; the second is drawing on the global commons (for instance, by freely releasing greenhouse gases into the atmosphere); and the third one consists in simply depleting resources found on one's territory.[47] I suspect that Wackernagel chose to speak of ecological deficit, and not of ecological debt, a concept devised in South America around the same period, to avoid

[44] David Lin, et al, "Ecological Footprint Accounting for Countries: Updates and Results of the National Footprint Accounts, 2012–2018," *Resources* 7, no. 3 (2018): 15.
[45] Lin, "Ecological Footprint," 9 and 15.
[46] Global Footprint Network, "Country Trends," accessed November 2, 2019, http://data.footprintnetwork.org/#/countryTrends?cn=5001&type=earth.
[47] Wackernagel, "Defying the Footprint Oracle," 7–8.

the politically-loaded claims attached to the latter. As Tim Hayward explains, the term occurred in the context of the developing countries' debt crisis and their campaign for debt relief. These countries argued that they were not financial debtors but ecological creditors, and that the North owed "a much greater accumulated debt toward poorer countries on account of resource plundering, environmental damage, and uncompensated occupation of environmental space to deposit wastes, including the emissions responsible for climate change," underlining the debt's "historical origins in colonial expropriation of natural resources."[48] While Wackernagel's framework perhaps purposefully avoids the reference to this "environmental heist," his concepts of ecological deficit and overshoot implicitly hint at the debt incurred on the back of poor and unborn people. The United States, one of the prime ecological debtors, borrows ecological credit from under-consuming states in what we may call a horizontal (or geographical) form of credit, but it also draws on another type of credit, a vertical (or temporal) one, by draining future generations' ecological reserve to meet its needs. This environmental credit system is what allows advanced economies to consume more than their fair share in a system privileging an equitable allocation of resources, both horizontally and vertically. The fact that the Western mode of socio-economic organization be based on a growing ecological debt (natural resource consumption rises, but the overall natural stock does not) is obviously problematic, but so is the fact that this debt should remain unaccounted for. Or rather, and because any action within a closed system is counterbalanced by an opposite reaction, climate change, and more generally the environmental breakdown, represents the "unpaid bill."

In terms of the United States' own unsustainability, the country is home to 4% of the world population, yet it ranked second as world carbon polluter in 2019 (having been overtaken by China in 2005), having released some 5771 million metric tons of greenhouse gases that year.[49] In comparison, China emitted about 12055 million metric tons of CO_2 in 2019,

[48] Tim Hayward, "Ecological Debt," in *Encyclopedia of Political Theory*, ed. Mark Bevir (Thousand Oaks, CA: Sage, 2010), 409.
[49] Climate Watch, "Historical GHG Emissions," accessed November 7, 2019, https://www.climatewatchdata.org/ghg-emissions.

for a population exceeding that of the United States by over a billion people.[50] Two additional elements are also worth mentioning: the first one is that China's emissions have risen substantially over the past years, nearly doubling between 2005 and 2019. But much of that increase is the result of industries spurred by foreign investments to manufacture goods which are destined for the international market. Secondly, historical emissions amount to a significant fraction of a country's consumption of the global CO_2 budget. In this regard, the United States is the largest national contributor to global greenhouse gas emissions since the First Industrial Revolution: its cumulative emissions, or the sum of its annual emissions over time, account for a quarter of the world's historical emissions.[51] The United States is thus one of the most important emitters of carbon emissions, both in terms of its yearly per-capita and cumulative outputs.

The United States also uses nearly a quarter of the world's resources—burning up 23% of the coal, 25% of the oil, and 27% of the world's natural gas.[52] In terms of ecological footprint, the country exceeds its biocapacity by 122%, using more resources than its land is able to generate and producing more waste than the land can absorb. [53] While it uses more resources than its national territory would permit, the fact that its land is rich in natural resources—its high biocapacity places it third after Brazil and China—downplays its true ecological record. It is therefore more accurate to look at a country's ecological footprint and compare it not to this country's biocapacity, but to the earth's overall biocapacity, or the total amount of productive land each of us would be allowed to use if we were to stay within the biosphere's limits. When considered this way, it appears that the U.S. model of socio-economic development, if replicated on a global scale, would require five planets to meet the demand for raw materials and absorb the costs

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[50] Union of Concerned Scientists, "Each Country's Share of CO_2 Emissions," July 16, 2008 (updated January 14, 2022), accessed August 15, 2022, https://www.ucsusa.org/resources/each-countrys-share-co2-emissions.

[51] Hannah Richie, "Who Has Contributed Most to Global CO_2 Emissions?" October 1, 2019, accessed October 14, 2022, https://ourworldindata.org/contributed-most-global-co2.

[52] Scientific American, "Use It and Lose It: The Outsize Effect of U.S. Consumption on the Environment," September 14, 2012, accessed August 2, 2019, https://www.scientificamerican.com/article/american-consumption-habits/.

[53] Global Footprint Network, accessed August 15, 2022, http://www.footprintnetwork.org/ecological_footprint_nations/.

of externalities, or the pollution generated by the extraction and consumption of these resources. The United States is outranked by six countries in the "number of planets" image: Qatar (8.8), Luxembourg (7.9), the United Arab Emirates (5.47), Bahrein (5.3), Kuwait (5.2), and Trinidad and Tobago (5.1). However, if ranked according to its ecological footprint, which more directly assesses its impact on the planet (all the other countries have a reduced influence because of their modest population), the United States places second after China, making it one of the most unsustainable nations. Taken together, these facts underscore the leading role of the United States in fostering a culture of unsustainability.

A socio-economic model of social organization is unsustainable to the extent that it exhausts the ecosystems on which it relies to support its mode of living. Conversely, and provided it subscribes to the tenets of environmental justice, a sustainable model should demonstrate a use of resources falling within the limits of the biosphere. If efforts to quantify the phenomenon of unsustainability are commendable, allowing the problem to be posed in concrete terms and making it legible across various countries and cultures, the use of a methodology strongly inspired by the economic thought, itself the source of many ecological ills, is problematic. Indeed, one runs the risk of minimizing the problem by reducing it to a series of abstract numbers that can be easily shifted to one side or the other of the equation. This stands in contradiction with the holistic character of nature which, in an ecological perspective, is deemed more than the sum of its parts. Describing it as "the natural capital agenda," the *Guardian* columnist and ardent critic of neoliberalism George Monbiot sees the latter as "the definitive expression of our disengagement from the living world." Projecting this in Orwellian terms, he goes on to lament the loss of nature and the words used to describe it: "First we lose our wildlife and natural wonders. Then we lose our connections with what remains of life on Earth. Then we lose the words that described what we once knew. Then we call it capital and give it a price. This approach is morally wrong, intellectually vacuous, emotionally alienating and self-defeating."[54]

[54] George Monbiot, "The UK government wants to put a price on nature – but that will destroy it," *The Guardian*, May 15, 2018.

Resorting to accounting metaphors comes at the cost of losing sight of the intrinsic and invaluable worth of nature.

The ecological footprint also remains a rough estimate that does not take into account all aspects of sustainability nor all environmental issues. As Lin and his colleagues note, "reducing the human footprint to one planet remains insufficient, since other species must also compete for the planet's biocapacity. […] Half of the planet should be left for wild species 'to stave off the mass extinction of species, including our own.'"[55] The concept of the ecological footprint also looks at sustainability from an economic point of view, implying that the overexploitation of natural resources will, in the short to medium term, curtail growth, without explicitly denouncing the latter as a significant component of the problem. Finally, the concepts of national carbon and per capita footprints can also be questioned, for they erase the vastly unequal participation of individuals in the consumption of resources and generation of waste observed at the national level. The assertion that the American lifestyle presupposes the availability of natural resources found on five planets erases the critical differences between the lifestyle of the ultra-high-net-worth individuals, the middle-class, and the lower quartile. Ultimately, unsustainability characterizes a situation, or rather, a state of crisis, more severe than its name may suggest, for unsustainability is not merely the absence of sustainability, as if the latter only had to be added to an otherwise functional system, but a founding feature of Western societies—and chief among these—of U.S. culture. While physical manifestations of unsustainability allow a first apprehension of the phenomenon, making palpable a rather insidious disease, unsustainability itself remains difficult to identify, and ultimately to undo, being all the more concealed by its profound incorporation into the system.

Addressing unsustainability is, fundamentally, a moral issue. As environmental historian and sociologist Jason Moore notes, "the question of justice and sustainability are deeper than interlinked, they are intimate, they

[55] Lin, "Ecological Footprint," 16.

are different moments of the same question."[56] The question of environmental injustice is not confined to the ecological debt and credit system, or who consumes the most, but it also surfaces in the distribution of the burden, or the question of who should shoulder the costs associated with the environmental crisis. Indeed, the symptoms of the disease of unsustainability do not manifest themselves everywhere in the same way or with the same intensity. Although accurately assessing the extent of the various environmental disruptions in both space and time proves an arduous task, it remains undeniably true that these disruptions do not impact populations equally. If environmental inequalities manifest themselves in the fact that, by consuming far more than their fair share, advanced economies contribute to numerous environmental dysfunctions, compromising access to resources and a healthy environment for future generations, and placing a heavy toll on populations in the Global South, the deleterious consequences of industrialized countries' mode of living impact poorest states the most, because of their reduced capacity of resilience.

A study found that, in order to remain within a 1.5°C warming, each individual's carbon budget should amount to 2.5 tons/year by 2030.[57] To put this into perspective, researchers explained that a transatlantic roundtrip flight would consume two-thirds of that annual budget. In its 2018 report, the IPCC wrote that the world needs to achieve net-zero emissions by 2050 to avoid the worst consequences of global warming, and to prevent environmental breakdown and systemic collapse.[58] In order to move towards a sustainable mode of living, we must transition from an extractive and exploitive system to a regenerative, cyclic one, mirroring that of the earth. This transition calls for the decarbonizing of the economy and the implementation of a "one-

[56] Stepha Velednitsky, "The Case for Ecological Reparations: A Conversation with Jason W. Moore," *Edge Effects*, October 31, 2017, accessed November 10, 2019, https://edgeeffects.net/jason-w-moore/.
[57] Lewis Akenji, et al., "1.5-Degree Lifestyles: Targets and Options for Reducing Lifestyle Carbon Footprints," Institute for Global Environmental Strategies, February 2019, accessed November 6, 2019, https://iges.or.jp/en/pub/15-degrees-lifestyles-2019/en.
[58] Intergovernmental Panel on Climate Change (IPCC), "Summary for Policymakers of IPCC Special Report on Global Warming of 1.5°C Approved by Governments," October 8, 2018, accessed August 2, 2019, https://www.ipcc.ch/2018/10/08/summary-for-policymakers-of-ipcc-special-report-on-global-warming-of-1-5c-approved-by-governments/.

planet" mode of living. Unsustainability is a cultural and socio-economic system of unlimited growth and disposability, as well as an ecological phenomenon characterized by imbalance, impoverishment and extinction in the vast web of life. But unsustainability is also a set of structural problems and a long history of inequity. What is at stake in tackling environmental issues is not the rescuing of nature, but our ability and our willingness to address existing economic and social inequalities.

Chapter 1

Government-Sponsored Cold War Research and the Birth of Atmospheric Science (1957-63)

1957 is viewed by many historians of science as the starting point of the contemporary history of climate change. That year saw the publication of what would later be regarded as one of the early alerts regarding the danger in releasing ever-growing amounts of carbon dioxide into the atmosphere.[59] One of the article's co-authors was Roger Revelle, the director of the Scripps Institution of Oceanography at the University of California at San Diego, who was poised to become a central figure in the history of climate change science and politics. But while his contribution opened the way to more research into the consequences of rising carbon emissions, eventually leading to the "discovery" of climate change as it was unfolding, a much more consequential event took place that year, whose political, scientific and military impact bore the stamp of the Cold War, namely the successful launch of the first satellite by Soviet scientists. It created quite a sensation, three months into the International Geophysical Year (IGY), an international cooperative effort in geophysics gathering tens of thousands of scientists from more than sixty nations across the globe.

This chapter traces the origins of the contemporary science of climate change in the context of the Cold War and government-sponsored research in geophysics and other earth-related sciences with potential military applications. It discusses how climate science emerged from scientists' and their governmental sponsors' interest in better understanding the atmosphere to achieve military superiority, in applications ranging from the detection of thermonuclear bomb detonations and tests conducted by the Soviets, to the possibilities offered by environmental warfare and man-made weather modification. This period also saw the classification of carbon dioxide as a type of air pollutant. While it had been alerted to the role of fossil fuel

[59] Roger Revelle, Hans E. Suess, "Carbon Dioxide Exchange Between Atmosphere and Ocean and the Question of an Increase of Atmospheric CO_2 during the Past Decades," *Tellus* 9, n°1 (1957): 18–27.

combustion in altering the composition of greenhouse gases in the lower atmosphere, the fossil fuel industry dedicated most of its resources to the twin issues of air and water pollution at its refineries. On the foreign policy front, the period was marked by the Cuban Missile Crisis in the fall of 1962. A juncture in the relations between the two superpowers, the risk of seeing hostilities escalate to a full-scale nuclear war became more tangible during this fraught episode.

1.1 The Launch of Sputnik, Perceived Threats to U.S. National Security, and the Creation of the Presidential Science Advisory Committee

In the evening of 4 October 1957, U.S. intelligentsia received unnerving news: the Soviet Union had succeeded in launching the first artificial satellite. Having been briefed by the *New York Times* science reporter Walter Sullivan, Lloyd Berkner, a physicist and a member of the U.S. delegation to the IGY, brought the news to the assembly of fifty scientists who had convened for a reception at the Soviet embassy in Washington, D.C.[60] Hailing from thirteen nations, these were members of an international workshop aimed at coordinating satellite launches. The news hit the world at large through a rather laconic announcement by Tass, the Soviet press agency, causing a wave of shock among the non-scientific population.[61] A week earlier, the Soviet scientists had partaken in an event hosted by the U.S. National Academy of Sciences (NAS) and organized by the IGY satellite program

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[60] Zuoyue Wang, *In Sputnik's Shadow: The President's Science Advisory Committee and Cold War America* (New Brunswick, NJ: Rutgers University Press, 2008), 71 and "Soviet Embassy Guests Hear of Satellite From an American As Russians Beam," *New York Times*, October 5, 1957, 3. See also Rip Bulkeley, "The Sputniks and the IGY", in *Reconsidering Sputnik: Forty Years Since the Soviet Satellite*, Roger D. Lanius, John M. Logsdon, Robert W. Smith, eds. (London: Routledge, 2000), 125–160. On the impact of Sputnik on U.S. politics, see especially Alan J. Levine, *After Sputnik: America, the World, and Cold War Conflicts* (Taylor & Francis, 2018); Yanek Mieczkowski, *Eisenhower's Sputnik Moment: The Race for Space and World Prestige* (Ithaca: Cornell University Press, 2013); Paul Dickson, *Sputnik: The Shock of the Century* (New York: Walker Publishing, 2001); Roger L. Geiger, "What Happened after Sputnik? Shaping University Research in the United States," *Minerva* 35, no. 4 (Winter 1997): 349-367; Robert A. Divine, *The Sputnik Challenge: Eisenhower's Response to the Soviet Satellite* (Oxford: Oxford University Press, 1993); Barbara Barksdale Clowse, *Brainpower for the Cold War: The Sputnik Crisis and National Defense Education Act of 1958* (Westport, CT: Greenwood Press, 1981).
[61] "The Big Step; Word From Tass," *New York Times*, October 6, 1957, 193.

panel, but they had refused to disclose any information regarding their own launching plans, stating that the world would learn of the launch in due course. Satellites were indeed an integral part of the IGY, and the United States had also been working on its own scientific program, Project Vanguard, but it had not sent one orbiting the earth yet.[62]

The days that followed the launch witnessed some frantic moves by amateur radio receivers to catch echoes of the satellite, which completed a full round around the globe every 96.2 minutes.[63] At times a mere 140 miles from the earth, Sputnik was known to cross the United States seven times a day, with sightings by "Moonwatch groups" reported across the nation, as well as in Australia, Canada, and Russia. National radio and TV broadcasted "the eerie 'ping-ping'" produced by Sputnik.[64] In addition to its pulsating beat, radio Moscow announced Sputnik's spatial voyage as if they were train stations: "Vancouver, 9:50 A.M […] Frederickshaap, 10:00; Casablanca, 10:11; Adelaide, 12:39 P.M.; Kurile Islands, 2:34; Detroit, 2:55; Caracas, 3:05; Singapore, 4:00; Baghdad, 8:57."[65] These announcements certainly aimed to cause distress among citizens of the so-called free world, as they found themselves in sudden proximity to a technology evocative of a highly lethal weapon, the Intercontinental Ballistic Missile (ICBM).[66] If the Soviets could place a satellite into orbit, they could also send an ICBM into space, potentially placing U.S. cities within the reach of nuclear warheads.

Publicly, the U.S. government met the news with cold composure, playing down the Soviet feat's significance and denying any threat to U.S. national security. At a news conference five days later, Eisenhower noted the scientific prowess that the launch of Sputnik represented, remarking that "the Soviets have proved the first part of it, that this thing will successfully orbit," but he insisted that in itself, the launch did not jeopardize national security. "[S]o far as the satellite itself is concerned," Eisenhower declared, "that does

[62] "Soviet Embassy Guests Hear of Satellite From an American As Russians Beam," *New York Times*, October 5, 1957, 3.
[63] "The Big Step," 193.
[64] Ibid.
[65] "Sputnik in Flight," *New York Times*, October 13, 1957, 181–2.
[66] Ibid; "The Big Step," 193.

not raise my apprehensions, not one iota."[67] Yet Sputnik had been brought into orbit by the first Soviet ICBM, the V-7, which had already been successfully tested a few months earlier, and this raised the prospect of national security threats coming from space.[68] The *New York Times* spoke of a "race for survival," underscoring the new reality brought by nuclear warheads and the possibility of total annihilation.[69] The Senate majority leader Lyndon B. Johnson claimed that the Soviet threat was serious and that the control of space should become a prime objective of national security. In a statement at a meeting of Democratic senators in January 1958, he explained that "control of space means control of the world, far more certainly, far more totally than any control that has ever or ever be achieved by weapons, or by troops of occupation […] If, out in space, there is the ultimate position—from which total control of the earth may be exercised—then our national goal and the goal of all free men must be to win and hold that position."[70] Sputnik had effectively launched the space race, and exactly a year later, in October 1958, Congress established a civilian agency for the nonmilitary use of space, the National Aeronautics and Space Administration (NASA).

The successful launch was of course a fitting propaganda vehicle for the Soviets to display their scientific and technological dominance, with all the military implications that this entailed. For all its public efforts at downplaying the incident, however, many officials in the Eisenhower administration felt that the country was trailing behind the Soviet Union. Recalling the role the Soviet accomplishment had played in a lecture he gave at the MIT in 1962, Isidor Rabi, a physicist, chairman of the SAC and then a member of the PSAC for many years, remembered that "it was a serious matter that we could be beaten so badly, that we could so misunderstand the

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[67] Dwight D. Eisenhower, "The President's News Conference," 9 October 1957, Gerhard Peters and John T. Woolley, *The American Presidency Project*, accessed December 18, 2020, https://www.presidency.ucsb.edu/node/233712.

[68] Robert J. McMahon, "US National Security Policy from Eisenhower to Kennedy," in *The Cambridge History of the Cold War, vol. 1*, ed. Melvyn P. Leffler, and Odd Arne Westad (Cambridge: Cambridge University Press, 2010), 288–311.

[69] "Reply to the Sputnik," *New York Times*, October 11, 1957, 26.

[70] "Text of Johnson's Statement on Status of Nation's Defenses and Race for Space," *New York Times*, January 8, 1958, 10, cited by James R. Fleming, *Fixing the Sky: The Checkered History of Weather and Climate Control* (New York: Columbia University Press, 2010), 209.

circumstances of the great development, that we should have lost out so completely."[71] The launch of the satellite was a blow to the U.S. scientific and military establishment, and it acted as a wake-up call to the fact that science needed to be supported and funded accordingly. Walter Orr Roberts, an astronomer and atmospheric physicist who would play a significant role in climate change science, recalled in an interview nearly three decades later that Sputnik "saved" research, and meteorology in particular, whose funding had been scaled back by the Air Force, one of its main sponsors.[72] More than ever, as a *New York Times* article formulated it at the time, the government started acting as a "patron of science."[73]

The push for greater federal funding and support for science resulted in several concrete and immediate measures.[74] The National Science Foundation (NSF), which had been established in 1950, and subsisted on a modest budget after it suffered a cut a year into its existence, saw its purse greatly expand, from $69 million in 1958 to $138 million in 1959.[75] Congress also passed the National Defense Education Act, which aimed at encouraging more students to enter scientific fields, to ensure the long-term supply of competent scientists and the advancement of basic science on which U.S. military supremacy depended.[76] Furthermore, the post of science advisor to the president, formally the president's special assistant for science and technology, was created.[77] On 3 November 1957, a month after the launch,

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[71] Isidor I. Rabi, "Science and Public Policy: Compton Lecture n° 2, MIT," 8 March 1962, I. I. Rabi Papers, LOC, Box 11, "American Association for the Advancement of Science, 1941-1965," 12.
[72] Walter Orr Roberts, interview by David DeVorkin, July 28, 1983, Niels Bohr Library & Archives, American Institute of Physics, College Park, MD, accessed November 15, 2020, www.aip.org/history-programs/niels-bohr-library/oral-histories/28418-3.
[73] John W. Finney, "Sputnik Acts As a Spur to U.S. Science and Research," *New York Times*, November 3, 1957, 186.
[74] James R. Fleming, *Inventing Atmospheric Science: Bjerknes, Rossby, Wexler, and the Foundations of Modern Meteorology* (Cambridge, MA: MIT Press, 2016), *194.*
[75] Jacob D. Hamblin, *Oceanographers and the Cold War: Disciples of Marine Science* (Seattle: University of Washington Press, 2005), 94.
[76] See Wayne J. Urban, *More Than Science and Sputnik. The National Defense Education Act of 1958* (Tuscaloosa, AL: The University of Alabama Press, 2010); on the effects of the Cold War on science, government patronage and the direction of scientific research, see Naomi Oreskes and John Krige, ed., *Science and Technology in the Global Cold War* (Cambridge, MA: The MIT Press, 2014).
[77] Roger Pielke, Roberta A. Klein, "The Rise and Fall of the President's Science Advisor," *in* Roger Pielke, and Roberta Klein, ed., *Presidential Science Advisors: Perspectives and Reflections on Science, Policy and Politics* (Boulder: Springer, 2010) 149.

Eisenhower established the Office of the Special Assistant to the President for Science and Technology and appointed James R. Killian Jr., who was not an active researcher but a science administrator, and the president of the Massachusetts Institute of Technology (MIT) for nine years prior to his appointment at the White House. Another measure taken simultaneously was the re-organization of the science advisory committee (SAC), which had been instituted by Truman in 1951 and was housed in the Office of Defense Mobilization, an agency within the Executive Office established in 1950 to coordinate wartime mobilization activities. On 22 November 1957, Eisenhower enlarged the committee and renamed it the President's Science Advisory Committee (PSAC, pronounced PEA-sack), transferring it to the White House office.[78] Killian was elected chairman of the PSAC, and all science advisors continued to hold these two positions thereafter.[79]

Because the present study follows presidential science advisors and the PSAC's role in informing climate change policy within the executive branch of government, let me briefly expose the administrative history of the committee, whose name changed at various points throughout its existence. The first change came at the recommendation of the PSAC itself. On 13 March 1959, Eisenhower established the Federal Council of Science and Technology (FCST) by executive order, which became responsible for coordinating science policy among federal agencies with large research programs. In 1962, Kennedy created yet another new unit within the executive office, the Office of Science and Technology (OST). All three units, namely the PSAC, the FCST and the OST were headed by the science advisor. The PSAC continued its work until Nixon disbanded the committee in 1973, after his advisor had resigned, and abolished the OST. All of its duties, including that of the science advisor, were transferred to the National

[78] Wang, *In Sputnik's Shadow,* 82. For an insider's perspective on the PSAC by three of its early chairmen, see *James R. Killian* Jr., *Sputnik, Scientists and Eisenhower: A Memoir of the First Special Assistant to the President for Science and Technology* (*Cambridge*, MA: *MIT Press, 1977*); George B. Kistiakowsky, *A Scientist at the White House: The Private Diary of President Eisenhower's Special Assistant for Science and technology* (Cambridge, MA: Harvard University Press, 1976); and Jerome B. Wiesner, *Where Science and Politics Meet* (New York: McGraw-Hill, 1965).

[79] PSAC, "Memorandum for members," 4 Sept 1959, I. I. Rabi Papers, Library of Congress (LOC), Manuscript Division, Washington, D.C., Box 46, "PSAC reports: general (1959-72), 3.

Science Foundation (NSF). As a result, the NSF director became the science advisor during that "interim" period, between 1973 and 1976. Congress resurrected the OST by establishing the Office of Science and Technology Policy (OSTP) in 1976, thereby re-instituting presidential science advisors before Carter came to power. Things changed again with Reagan's election, as his science advisor, George A. Keyworth II, re-established a smaller "White House Science Council" in lieu of the PSAC, which was to report to him instead of directly to the president. The final changes came in the 1990s, when George H. W. Bush renamed that council the President's Council of Advisors on Science and Technology (PCAST), and asked it to report directly to him. PCAST was and remains administered by the Office of Science and Technology Policy (OSTP) to this day. Finally, Clinton renamed the Federal Coordinating Council for Science, Engineering and Technology (FCCSET), which had replaced the FCST in 1976, the National Science and Technology Council (NSTC) in 1993.[80]

In its first years following the re-organization of the PSAC by Eisenhower, the committee was composed of eighteen members and a fluctuating but important number of external consultants, over a hundred, who joined the more than dozen panels that were set up on an ad-hoc basis.[81] Many of the initial members of the committee in the late 1950s and early 1960s were physicists, and a few had worked on the Manhattan Project at Los Alamos, where the secret development of the atomic bomb had taken place during the course of World War II. In his 1962 lecture at the MIT, Isidor Rabi, a physicist and PSAC member for many years, mentioned that the committee's stated purpose was to give "real objective advice from disinterested parties" to the president on matters related to national policy affected by or pertaining to science and technology, as well as national security and defense issues.[82] The committee was established as an advisory

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[80] For more on the administrative history of PSAC and its related governmental bodies, see "Appendix A: A Concise History of the Presidential Science Advisory Structure," *in* Gerhard Sonnert, and Gerald Holton, *Ivory Bridges: Connecting Science and Society* (Cambridge, MA: The MIT Press, 2002).

[81] PSAC, "Memorandum for members," 4 Sept 1959, I. I. Rabi Papers, LOC, Box 46, "PSAC reports: general (1959-72), 3.

[82] Isidor I. Rabi, "Science and Public Policy: Compton Lecture n° 2, MIT" 8 March 1962, I. I. Rabi Papers, LOC, Box 11, "American Association for the Advancement of Science, 1941-1965," 13.

organ within the policy-making bodies of the executive office, and had thus no operating responsibilities.[83] In arguing for a post of science advisor to the president, the SAC had compared the function to that of the economic advisor, and PSAC as an equivalent to the Council of Economic Advisors (CEA). But science did not enjoy the status and prestige in which economics was held, and the scientific community expressed frustration at the government's handling of science and its mistrust of scientists. The integration of "scientist-statesmen" was therefore not a given, and science was only reluctantly granted a seat at the policy-making table.[84] The fact that scientists were invited to join the executive branch owed a lot to the anxiety raised by Sputnik and the perceived "technological imperialism" of the Soviet Union, but their presence as an advisory group was met with a hint of distrust from the beginning.[85] This early configuration of the PSAC and the understanding of the scientific role and place within the government would have a profound influence on the reception by the government of climate change science when it emerged a few years later.

If the idea was to tap into scientific resources to serve the nation's welfare, an important aspect of the committee's job involved providing advice and direction pertaining to national security. The original advisory science committee had reported to the director of the Office of Defense Mobilization and worked closely with the Special Assistant to the President for National Security Affairs and the National Security Council. It was thus heavily rooted in issues of national defense, from the pre- to the immediate postwar era. However, both the committee and the science advisor assumed a wide array of functions and roles from the start. The government lacked a department of science, although this remained an item on the PSAC's wish list, and as such the committee almost immediately also became, quite naturally, a lobbying group for basic science and academic research within the incumbent administration. In that regard, an early and important output of

[83] PSAC, "Memorandum for members," 4 Sept 1959, I. I. Rabi Papers, LOC, Box 46, "PSAC reports: general (1959-72), 1.
[84] SAC, Office of Defense Mobilization, "A Program for the Federal Government to Help In Releasing the Full Scientific Capacities of the U.S. and Her Allies," 23 Oct 1957, I. I. Rabi Papers, LOC, Box 45, "PSAC Correspondence, 1957-73 (1)," 2.
[85] Ibid., 5.

the PSAC was its role in space science, and the establishment of NASA in 1958, which the PSAC recommended after consulting representatives of major military and civilian groups.[86]

1.2 The International Geophysical Year (1957-8)

The Soviet launch of its satellite came as an unexpected blow to the American public, but satellites were an integral part of the IGY, and both the Soviet Union and the United States had publicly announced that they would proceed with launches during the IGY.[87] In doing so, both nations were responding to an invitation by the Special Committee for the IGY, the steering committee coordinating the preparation of the eighteen-month "year," to place spacecraft in orbit.[88] Eisenhower publicly accepted the challenge in July 1955, and the Soviet Union followed suit in September 1956, when it announced its own plans for launching a satellite at the meeting preceding the opening of the IGY.[89] In response to a question on whether there had been an "agreement" between the two nations regarding specific dates of launching, Lee DuBridge, chairman of the SAC between 1952-56 and the president of the California Institute of Technology, stressed that "Neither country made any official commitment as to the dates of launching."[90]

The idea for the IGY is said to have taken off at a dinner hosted by the American geophysicist James Van Allen and his wife, Abigail Halsey Van Allen, on 5 April 1950.[91] Among the guests, all of whom were geophysicists

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[86] PSAC, "Memorandum for members," 4 Sept 1959, I. I. Rabi Papers, LOC, Box 46, "PSAC reports: general (1959-72), 4-5.
[87] This section is based on the work by Fleming, *Inventing Atmospheric Science, 165–92;* Good, "Sydney Chapman," 177-198; Paul N. Edwards, *A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming (Cambridge, MA: MIT Press, 2010), 202–7;* Erik M. Conway, *Atmospheric Sciences at NASA: A History* (Baltimore: Johns Hopkins University Press, 2008), 16–27; Hamblin, *Oceanographers and the Cold* War, 59–98; and Spencer R. Weart, *The Discovery of Global Warming* (Cambridge, MA: Harvard University Press, 2003), 34–8.
[88] Gregory A. Good, "Sydney Chapman: Dynamo behind the International Geophysical Year," *in* Roger D. Launius, James R. Fleming, and David H. Devorkin, ed., *Globalizing Polar Science: Reconsidering the International Polar and Geophysical Years,* (New York: Palgrave Macmillan, 2010), 191.
[89] Good, "Sydney Chapman," 193.
[90] Lee A. DuBridge to Jay Ittleson, 4 Nov 1957, Lee A. DuBridge Papers, Archives, California Institute of Technology (CALTECH), Pasadena, CA, Box 156, Folder 1.
[91] On the origins of the IGY, see Susan Barr, and Cornelia Lüdecke, ed., *The History of the International Polar Years (IPYs)* (Berlin, Heidelberg: Springer, 2010); see also Fae L.

and upper atmospheric researchers, was Lloyd Berkner, who explained that it was time to organize a new International Polar Year (IPY), modelled on the previous IPYs which had taken place in 1882-3 and 1932-3.[92] He suggested organizing the third IPY in 1957-8, which corresponded to a period of maximal solar activity. Even if only twenty-five years had elapsed since the last IPY, Berkner contented that progress in radio, rocketry and ionospheric research warranted an earlier undertaking. If there were compelling scientific reasons for organizing a new IPY, Berkner was acutely aware of the practical political gains of such an endeavor. He had in fact just completed a report as a special consultant to the Secretary of State on the potential of science to advance western interests and values in a divided world.[93] He had realized, long before government pundits, that international science stood as a powerful propaganda tool in promoting U.S. interests in the postwar world. Because he was involved in national security agencies, and because the project had obvious implications for national security, Berkner needed a scientist to bestow an aura of scientific credibility and political neutrality onto the project. He identified that scientist in the person of Sydney Chapman, a British geophysicist who had recently taken an appointment as a visiting professor at the California Institute of Technology (Caltech), and whose scientific credentials were excellent. It was not lost on Chapman that both the United States and the Soviet Union had an interest in understanding radio echoes, radiation belts, and satellites for their military applications, but he was seen by all stakeholders as a more politically neutral actor than Berkner.

In 1952, the International Council of Scientific Union (ICSU), a non-governmental organization founded in 1931 and composed of both national

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Korsmo, "The genesis of the International Geophysical Year," *Physics Today* (July 2007): 38–43; and Robert G. Fleagle, "From the International Geophysical Year to Global Change," *Reviews of Geophysics* 30, no. 4 (1992): 305–13; for a popular and contemporaneous account, see Walter Sullivan, *The International Geophysical Year* (New York: Carnegie Endowment for International Peace, 1959).

[92] On Berkner's career in science and work for the government, see Allan A. Needell, *Science, Cold War and the American State* (Hardwood Academic Publishers & Smithsonian Institution, 2000).

[93] Allan A. Needell, "Lloyd Berkner and the International Geophysical Proposal in Context: With Some Comments on the Implications for the Comité Spéciale de l'Année Géophysique Internationale, CSAGI, Request for Launching Earth Orbiting Satellites," *in* Roger D. Launius, James R. Fleming, and David H. Devorkin, ed., *Globalizing Polar Science: Reconsidering the International Polar and Geophysical Years*, (New York: Palgrave Macmillan, 2010), 217.

academies and international scientific associations, accepted the American proposal to organize an IPY, cementing the project's international stature. The American National Committee for the IGY, the USNC-IGY, formed later that year, under the auspices of the National Academy of Science. It appointed Joseph Kaplan, a physicist at the University of California, Los Angeles, as its chairman, and Hugh Odishaw, a science administrator, as its executive director. Soon after that, the World Meteorological Organization (WMO), which was primarily involved in collecting data for operational purposes, while the ICSU was a research-oriented organization, expressed interest in participating, and the project became a focal point for many interests beyond the exploration of the Arctic circle. Chapman suggested dropping the "polar" in the title and replacing it by "geophysical" to reflect the broader appeal of the project, which was thus renamed the IGY. According to a 1959 article written by Odishaw and published in *Science*, the main purpose of the IGY was "the acquisition of data taken simultaneously at various points on the earth in order to give a planetary view of phenomena and events in most of the major fields of geophysics," a massive synoptic effort at capturing "a snapshot" of the globe.[94] As Chapman said, the goal was to launch a "mass attack" on the problems of geophysics, by studying global systems such as the atmosphere, the oceans, the ionosphere, and the planet's magnetic field and geological structure.[95] In 1953, Chapman was elected president and Berkner vice-president of the Special committee for the IGY.

National committees of the ICSU were invited to join the domains that responded the best to their own objectives, and each committee sent members to the thirteen working groups responsible for developing research programs and coordinating preparations for the IGY. The Soviet Union only officially joined the IGY in October 1954, after its delegate on the WMO's executive committee persuaded its government to do so.[96] Berkner and Revelle played an important role in getting the U.S. Congress to allocate funding to the NSF and allow American participation in the IGY. They presented the collection

[94] Hugh Odishaw, "International Geophysical Year," *Science* 129, no. 3340 (Jan. 2, 1959): 22.
[95] Quoted in Good, "Sydney Chapman," 177.
[96] Edwards, *A Vast Machine*, 203.

of global data as a means to yield useful results for civilian and military ends, allowing the nation to gain a practical advantage over its Soviet adversary.

The IGY was celebrated for its international ambitions and character, and it was promoted as an effort of global cooperation in the pursuit of scientific purposes. But as stated earlier, Berkner belonged to both the scientific world and the national security apparatus and, as historian Allan Needell notes, "[he] worked hard to serve both."[97] As such, the IGY was imbued with Cold War geopolitics, streaks of nationalism, as well as military and security concerns. The United States maintained a heavy military presence in Antarctica, something the Soviets resented. Similarly, the U.S. military was concerned that the Soviets would use the IGY to establish bases in Antarctica. In the end, sixty-six nations and some thirty thousand scientists took part in the IGY.[98] They obtained precious land-based data, by setting up stations across the globe, from the Arctic Circle to the South Pole and the Pacific islands. Scientists also gathered information from space, thanks to the remote eyes of satellites (the United States had successfully managed to place its satellite Explorer 1 on orbit in January 1958). Antarctica was a primary focus of the IGY, for the previous IPYs had concentrated on the Arctic, and measurements had been incomplete as a result of focusing on half of the globe. The white continent also constituted a prime site of research in atmospheric physics, and the complex polar atmosphere in particular.

When he was asked to become the lead scientist of the US/IGY Antarctic expedition, Harry Wexler, then the director of meteorological research at the U.S. Weather Bureau, had to be convinced that studying Antarctica's weather and climate would lead to a better understanding of global meteorology, and was therefore of immediate practical use. Antarctica was only one of the places where the IGY's meteorological research groups focused their attention: the measurement network they set up included 2,100 surface stations and 650 upper-air stations, as well as balloons and radiosondes, distributed on three pole-to-pole chains of stations dividing the globe into thirds.[99] Because the atmosphere and the oceans are treated as a

[97] Needell, "Lloyd Berkner," 206.
[98] Edwards, *A Vast Machine*, 202.
[99] Ibid., 204.

single entity by geophysical hydrodynamics, differing only in density and velocity above and below the limit constituted by the water surface, oceanography played a major role in meteorological research, especially in mapping out the circulation of air and water. The understanding of the global general circulation, as well the study of the earth's heat balance, also known as its heat budget, or the difference between incoming solar radiation and the outgoing energy radiating back from to the earth into space, were key aspects of the IGY meteorology research group and they would prove crucial in the study and understanding of climate, and of climate change more particularly.

A mammoth of a project, estimated to have cost a billion and a half U.S. dollars, the IGY ushered in a new era and its impacts on science were manifold: in the United States, it resulted in a major increase in funding for the NSF. It also signaled a shift in the sources of funding for basic science which, before the establishment of the NSF, had come from a mix of public and private sources, including governmental agencies such as the U.S. Geological Survey (USGS) and the U.S. Coast and Geodetic Survey, military agencies, among which was the Navy through its Office of Naval Research (ONR), as well as private philanthropy and scientific societies.[100] In Antarctica, military concerns were alleviated in 1961, as the Antarctic Treaty consecrated the continent as a permanent international site dedicated to research. On a global level, the IGY institutionalized and formalized international scientific cooperation and collaborative networks.[101] It introduced the idea of collecting and sharing global data, through the establishment of three data repositories, one in Washington D.C., another in Moscow, and the third one in Geneva at the WMO headquarters, all designed to preserve and ensure future public access.[102] The IGY certainly catalyzed Cold War tensions, hampering cooperation efforts, and the renewed competition with Soviet science launched the arms and space race. Yet

[100] See Naomi Oreskes, *Science on a Mission: How Military Funding Shaped What We Do and Don't Know about the Ocean* (University of Chicago Press, 2021): 17–57. See also Howard S. *Miller, Dollars for Research*: *Science and Its Patrons in Nineteenth-Century America* (Seattle: University of Washington Press, 1970).
[101] Frank Press, interview by Ronald Doel, July 30,1997, Niels Bohr Library & Archives, American Institute of Physics, College Park, MD, accessed November 30, 2020, www.aip.org/history-programs/niels-bohr-library/oral-histories/6929-2.
[102] Conway, *Atmospheric Sciences at NASA*, 26.

despite the tensed context and politics, as Frank Press, Carter's science advisor, would remember years later, "one of the great contributions of the IGY was to open the Soviet Union to scientific interchange […] [and] legitimiz[e] cooperation between Russians and Westerners."[103] It also signaled the birth of contemporary science as we know it. As historian Paul Edwards points out, "the IGY took place on the cusp of serval major, related transitions: from manual to computer methods, from surface-based to space-based observing systems, and from internationalism to globalism."[104] A very important outcome of the IGY for atmospheric science in particular was the collaboration between such varied scientific fields as meteorology, oceanography, geophysics and glaciology. The study of climate, then in its infancy, would greatly benefit from the coming together of disciplines that spoke different languages, and had no common definitions or established methods.

1.3 The First Systematic Measurements of Carbon Dioxide Concentrations in the Atmosphere: Drawing the Keeling Curve at the Mauna Loa Observatory

While the IGY played an important role in the rise of atmospheric science, its impact on the study of anthropogenic global warming would turn out to be extremely consequential: and yet, it was almost accidental. Well, that is not quite true, because the story involved Roger Revelle, who had entertained an interest in carbon dioxide for a number of years before the IGY took place. Revelle had studied the chemical composition of the oceans during a stint on the Bikini atoll in 1946, when he was hired by the Office of Naval Research to conduct research on the effects of atomic explosions on oceanic waters and living organisms within the atoll.[105] He discovered that carbon emissions made their way to the ocean, which acted as a "buffer mechanism," by

[103] Frank Press, interview by Ronald Doel, July 30, 1997.
[104] Edwards, *A Vast Machine,* 202.
[105] According to his testimony to the House Committee on Appropriations. Roger Revelle, "Testimony before the House Committee on Appropriations, February 8, 1956," *in* Joshua P. Howe, *Making Climate Change History: Primary Sources from Global Warming's Past* (Seattle: University of Washington Press, 2017), 60–63. See also Ronald Rainger, "Science at the Crossroads: The Navy, Bikini Atoll, and American Oceanography in the 1940s," *Historical Studies in the Physical and Biological Sciences* 30, no. 2 (2000) : 349–37.

capturing atmospheric carbon emissions. Eager to understand the issue more thoroughly and an astute science entrepreneur, he saw the IGY as a unique funding opportunity.

Before returning to the relationship between the IGY and the discovery of climate change, however, we need to take a leap in time. Climate change as a result of increasing industrial emissions of carbon dioxide was by no means breaking news in the late 1950s.[106] Indeed, the science behind the phenomenon dated back to the nineteenth century, or what historian Joshua Howe has termed somewhat affectionately "the scientific prehistory of global warming."[107] French mathematician Jean-Baptiste Joseph Fourier first established a correlation between carbon dioxide buildup and a warmer climate in 1824. Thirty-five years later, Irish physicist John Tyndall discovered that changes in the concentration of gases blocking solar radiation could alter the climate system. At the close of the century, in 1896, Svante Arrhenius, a Swedish physical chemist, introduced the term "greenhouse effect" and offered the first calculation of anthropogenic global warming. His use of the metaphor sought to illustrate the effect of carbon dioxide on the atmosphere. A so-called greenhouse gas (among many others, including

[106] On the history of U.S. climate change science and politics, see Matto Mildenberger, *Carbon Captured: How Business and Labor Control Climate Politics* (Cambridge, MA: The MIT Press, 2020); Joshua P. Howe, *Behind the Curve: Science and the Politics of Global Warming* (Seattle: University of Washington Press, 2014); Naomi Oreskes, and Erik Conway, *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming* (New York: Bloomsbury, 2010); Paul N. Edwards, *A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming (Cambridge, MA: The MIT Press, 2010);* Erik Conway, *Atmospheric Science at NASA: A History* (Baltimore, MD: Johns Hopkins Press, 2008); Spencer R. Weart, *The Discovery of Global Warming* (Cambridge, MA: Harvard University Press, 2003), and Weart's accompanying website: "The Discovery of Global Warming: A Hypertext History of How Scientists Came to (Partly) Understand What People are Doing to Cause Climate Change," https://history.aip.org/climate/index.htm; James R. Fleming, *Historical Perspectives on Climate Change* (Oxford: Oxford University Press, 1998); see also Zeke Baker, "Climate State: Science-State Struggles and the Formation of Climate Science in the US from the 1930s to 1960s," *Social Studies of Science* 47 (2017): 861–87; and David M. Hart, and David G. Victor. "Scientific Elites and the Making of US Policy for Climate Change Research, 1957-74," *Social studies of Science* 23, no. 4 (1993): 643–80. For a recent journalistic account of U.S. climate change politics, see Nathaniel Rich, *Losing Earth: The Decade We Could Have Stopped Climate Change* (London: Picador, 2019). Popular histories include Tim Flannery, *The Weather Makers: How Man is Changing the Climate and What it Means for Life on Earth* (New York: Atlantic Monthly Press, 2005); William K. Stevens, *The Change in the Weather: People, Weather, and the Science of Climate* (New York: Dell Publishing, 1999); and Gale E. Christianson, *Greenhouse: the 200-year Story of Global Warming* (New York: Penguin Books, 1999).

[107] Joshua P. Howe, *Making Climate Change History: Primary Sources from Global Warming's Past* (Seattle: University of Washington Press, 2017).

methane and ozone-destructive chlorofluorocarbons, or CFCs), CO_2 absorbs the heat radiating back from the earth (the technical term for that being "infrared radiation"), reinforcing the insulation effect provided by the atmosphere that prevents the earth from getting scorched during the day and glacial at night.

The question was later taken up by a British steam engineer and amateur meteorologist, Guy Stewart Callendar, who argued in a 1938 paper he gave at the Meteorology Society Conference that global warming had in fact begun.[108] Taking advantage of the post-war increase in funding for basic and applied research, Gilbert Plass, a Harvard-trained Canadian physicist, expanded Callendar's work starting in the mid-1950s. In 1956, Plass told the *New York Times* that "in a few centuries, the amount of carbon dioxide released into the atmosphere will be so large that it will have a profound effect on our climate."[109] In an article published that year, Plass had expressed confidence in the carbon dioxide theory, but he had said that it might take another century of observation and measurement of temperature to confirm it. In the late 1950s, climate change emerged as something more than an interesting theory, but it remained a distant scenario in terms of its timescale, namely it was viewed as a man-made phenomenon that would not occur before a century had elapsed.

Building on his predecessors' work and his own interest in the carbon dioxide uptake by the oceans, which he had developed after the Bikini atoll nuclear experiment, Revelle published an article in 1957 which arguably ushered in the modern era of climate change science.[110] The scientific paper was co-authored with physical chemist Hans Suess, whom Revelle had hired

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[108] For more on the pioneering work of the British meteorologist, see James R. Fleming, *The Callendar Effect: The Life and Work of Guy Stewart Callendar (1898-1964)* (Boston: The American Meteorological Society, 2007). This discussion is based on the first chapter of Spencer R. Weart, *The Discovery of Global Warming* (Cambridge, MA: Harvard University Press, 2003), 1–19, and a forthcoming paper submitted to the Harvard Environmental Law Review by Naomi Oreskes, Colleen Lanier-Christensen, Hannah Conway, and Ashton Macfarlane, "Climate Change and the Clean Air Act of 1970," of which I received an advance copy.

[109] Waldemar Kaempfert, "Science in Review: Warmer Climate on the Earth May Be Due to More Carbon Dioxide in the Air," *New York Times,* October 28, 1956, 191.

[110] Roger Revelle, and Hans E. Suess, "Carbon Dioxide Exchange Between Atmosphere and Ocean and the Question of an Increase of Atmospheric CO_2 during the Past Decades," *Tellus* 9, no. 1 (1957): 18–27.

two years earlier. Suess had worked on radiocarbon, and more particularly on Carbon-14, a radioactive isotope whose concentrations in fossils is used to determine their age. By studying the carbon concentration in recently-harvested trees, and comparing the concentration in older trees, he demonstrated that humans had "withdrawn" carbon from the soil by burning fossil fuels.[111] Published in the international environmental journal *Tellus*, Revelle and Suess' article claimed that, contrary to what had been previously assumed, oceans were not acting as the carbon sink they were thought to be. While oceans *did* absorb emissions, thereby slowing down global warming, the major part of industrial emissions stayed in the atmosphere.[112] As the historian of climate science Spencer Weart explains, this was not the original conclusion of the paper, but Revelle changed it just before submitting the manuscript, owing to a late epiphany.[113] The oft-quoted and rather ominous observation that mankind was "now carrying out a large scale geophysical experiment," would come to be read as an early warning on the danger of releasing unchecked quantities of carbon dioxide.[114] As Weart notes, Revelle was not alarmed, but he viewed global warming as an issue requiring research and monitoring as it could potentially become serious in the future.[115]

In a congressional testimony at a hearing on the IGY in February 1956, before the publication of the *Tellus* article, Revelle had outlined the problem of rising concentrations of atmospheric CO_2. He explained that humanity was burning up "fuels which were accumulated in the earth over hundreds of millions of years [...] [over the course of] a few generations, [...] producing tremendous quantities of carbon dioxide in the air."[116] Revelle was well versed in the theories underlying global warming, and he understood the long-term consequences of society's dependence on fossil fuels. His tone, however, remained dispassionate as he remarked that, since the second

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[111] Edwards, *A Vast Machine*, 210.
[112] Revelle, and Suess, "Carbon Dioxide." See also Roger Revelle, interview by Earl Droessler, February 3,1989, Niels Bohr Library & Archives, American Institute of Physics, College Park, MD, accessed December 5, 2020, www.aip.org/history-programs/niels-bohr-library/oral-histories/5051.
[113] Weart, *The Discovery of Global Warming*, 29.
[114] Revelle and Suess, "Carbon Dioxide Exchange Between Atmosphere and Ocean," 19.
[115] Weart, *The Discovery of Global Warming*, 30.
[116] Roger Revelle, "Testimony on February, 8, 1956", *in* Howe, *Making Climate Change History*, 62.

industrial revolution, “we are conducting, in effect, this vast experiment, and we ought to adequately document it.” First and foremost, Revelle was leveraging the IGY as a funding opportunity for oceanography, and he knew that the best way of achieving his goal was to point out possible consequences affecting national security. He thus offered more immediate and recognizable threats, and explained that, if temperatures were to rise, the Arctic sea would become navigable, and so would 2000 miles of the Russian coastline, turning the Soviet Union into “a great maritime nation.”[117] Revelle aptly perceived that invoking future and distant problems such as climate change would not get him the funding he sought.

In a second congressional testimony in May 1957, Revelle offered a somewhat more candid account of the potential effects of climate change and of the need to study long-range weather forecast, namely the climate system, as opposed to directing financial efforts and human resources solely towards improving weather forecasting. To make his point, Revelle spoke of the radiation study that was to be undertaken in the meteorological, the oceanographic, and the glaciological programs of the IGY, in order to investigate the amount of energy radiated back into space.[118] As Revelle noted, the earth’s heat budget had not always been in equilibrium: for long period of geological times, there was a difference between the incoming energy from the sun and the outgoing energy radiated by the earth, resulting in either ice ages or, on the contrary, in a much warmer earth. While the coming of a “new dark age of ice” was perhaps not a very practical question for people living in this generation, he pointed out that “shorter time climatic changes […] are of great importance.”[119] He also explained that studying carbon dioxide’s emissions and their effects on the atmosphere was “a way of studying climatic changes” in general.[120]

Revelle’s longstanding interest in and advocacy for additional research into the subject of atmospheric CO_2 materialized in 1958, when he helped his latest hire at the Scripps Institution for Oceanography, Charles Keeling, then

[117] Revelle, “Testimony on February, 8, 1956”, 63.
[118] Revelle, “Testimony before the House Committee on Appropriations, May 1, 1957,” *in* Howe, *Making Climate Change History*, 65.
[119] Ibid., 66.
[120] Ibid., 67.

a post-doctoral researcher at Caltech, to set up monitoring stations in two areas far removed from atmospheric pollution. One was at the South Pole, and the other at the top of the Mauna Loa volcano in Hawaii, where the lead scientist of the US/IGY Antarctic expedition Harry Wexler had established the U.S. Weather Bureau's observatory.[121] In an interview shortly before his passing, Revelle recalled that Keeling was "a peculiar guy. He wants to measure CO_2 in his belly," referring to the high degree of precision and accuracy that Keeling sought in his measurement of atmospheric CO_2.[122] In addition to an expected seasonal variation in CO_2 concentrations in the Northern hemisphere, caused by plants' absorption of carbon through photosynthesis in the spring and their release of the chemical element following natural decay in the fall, it did not take long for Keeling's instruments to record a rise in the levels of atmospheric CO_2.[123] In the above mentioned summary report on the IGY published in *Science* in January 1959, the program's executive director Odishaw wrote that "United States Weather Bureau scientists at Little America [one of the U.S. bases in Antarctica] report a five-degree rise in annual mean temperature there over about fifty years about—one-half that noted at Spitzbergen in the Arctic [a Norwegian archipelago located halfway between continental Norway and the North Pole] confirming a belief in the warming trend of the last few decades."[124]

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[121] Fleming, *Inventing Atmospheric Science,* 11. On a collaborative project, in the late 1960s, between New Zealand and the United States to set up a CO2 monitoring station on the nation island's sea cliffs, and the porous disciplinary boundaries between climate change, carbon dioxide monitoring and air pollution research in the late 1960s and early 1970s, see R. Ashton Macfarlane, "The Many Pollutant Identities of Carbon Dioxide: Global Climate Monitoring and Air Pollution Research in New Zealand, 1968–1975," *Environment and History*, published online August 2, 2022, https://doi.org/10.3197/096734022X16552219786627.

[122] Roger Revelle, interview by Earl Droessler, February 3,1989, Niels Bohr Library & Archives, American Institute of Physics, College Park, MD, accessed November 20, 2020, www.aip.org/history-programs/niels-bohr-library/oral-histories/5051.

[123] Dasan M. Thamattoor, "Stratospheric Ozone Depletion and Greenhouse Gasses since the International Geophysical Year: F. Sherwood Rowland and the Evolution of Earth Science," *in* Roger D. Launius, James R. Fleming, David H. Devorkin, ed., *Globalizing Polar Science: Reconsidering the International Polar and Geophysical Years* (New York: Palgrave Macmillan, 2010), 367; At the time Keeling started his measurements, the CO_2 levels stood at 315 parts per million (ppm). In 2019, the global average concentration was 409 ppm, while the "safe" threshold is considered to be at 350 ppm. In addition to Keeling's two original monitoring sites, more than a hundred sites have since sprung up. Thamattoor, "Stratospheric Ozone Depletion," 367.

[124] Odishaw, "International Geophysical Year," 14.

In his statement at a hearing in February 1959, two months after the IGY had formally ended, Laurence Gould, the chairman of the USNC-IGY Antarctic committee, noted that congressmen had already been warned about the consequences of a temperature rise, but he insisted that he could not "refrain from noting again the significance of the melting of only a few feet of ice to our coastal climates and civilization."[125] After the close of the IGY, probably realizing the scientific importance of Keeling's monitoring work, Revelle succeeded in diverting some money from a research grant he had obtained from the Atomic Energy Agency. Save for a small hiatus in the spring of 1964, when funds had dried up, Keeling's measurements continued to record the steady rise of atmospheric carbon dioxide concentrations.[126] Because CO_2 was a notorious greenhouse gas, the detection of a rise on the graph, which eventually came to be known as the Keeling Curve, indicated a burgeoning issue. What had started as a special project of the IGY set the stage for what would become the fuel to a brewing political fire. However, it would take half a decade before that fire gained some strength and the subject landed on the radar of government officials.

1.4 Thermonuclear Bombs, Operation Argus and the Nuclear Fallout Monitoring Network

The news of the Soviet launch of Sputnik had caused great alarm among the public, for it revived fears of a nuclear attack through the control of intercontinental ballistic missiles, fears that were further amplified by the apparent unpreparedness of the U.S. military. Yet matching the Soviets' striking capabilities, therefore creating a strong deterrent, was as imperative as being able to counter any missile attack by destroying warheads before they reached their targets on U.S. territory. While the 1950s had witnessed multiple nuclear tests by the United States, the Soviet Union, and Great Britain, the last years of the decade saw a renewed fervor. The IGY, in

[125] U.S. Congress, House Subcommittee on Independent Offices of the Committee on Appropriations, Hearing, *National Science Foundation, National Academy of Sciences: Report on the International Geophysical Year*, 86th Congress, 1st session, February 1959 (Washington, D.C.: U.S. Government Printing Office, 1959), 98.
[126] Weart, *The Discovery of Global Warming*, 38.

particular, was the theater of a number of covert military operations involving thermonuclear bomb detonations and tests, one of whose purposes was for the United States to determine if it could destroy incoming Soviet ICBMs through targeted nuclear explosions.[127]

These tests were detected by IGY scientists working in the auroral studies program who, in addition to observing naturally-occurring auroras, noticed artificial lightings in the sky. In a statement prepared for a report on the IGY presented at a congressional hearing, the program's executive director Hugh Odishaw mentioned that "a new twilight phenomenon" had been detected on 5 August 1958 by U.S. stations in Antarctica and by a New Zealand station on the southernmost tip of the island nation, and that "a plain inference is that these new manifestations could be related to nuclear tests carried out during the same period as the IGY program."[128] Odishaw went on to explain that a large nuclear explosion could result in a temporary perturbation of the earth's magnetic field, disturbing the trapping conditions for the Van Allen particles that, upon being released, would go on to produce an aurora. The Van Allen radiation belt, which derived its name from James Van Allen, who was on the USNC-IGY earth satellite panel and the head of the department of physics at the State University of Iowa, was discovered by accident in the course of the first successful experiment of the U.S. satellite program. Launched on 1 February 1958, the U.S. satellite Explorer 1, which had been designed to measure the intensity of cosmic rays entering upper layers of the atmosphere, contributed, together with Explorer 2, to

[127] On the history of the atomic and hydrogen bombs during the Cold War, see Martin Gitlin, ed., *The Arms Race and Nuclear Proliferation* (Greenhaven Publishing, 2018); Bruce C. Reed, *Atomic Bomb: The Story of the Manhattan Project: How Nuclear Physics Became a Global Geopolitical Game-Changer* (Morgan & Claypool Publishers, 2015); Harold L. Brode, *Nuclear Weapons in the Cold War* (CreateSpace Independent Publishing Platform, 2014); Tamra B. Orr, *The Hydrogen Bomb: Unleashing the Nuclear Age and Arms Race* (New York: the Rosen Publishing Group, 2004); *Richard Rhodes, Dark Sun: The Making of the Hydrogen Bomb (New York: Simon & Schuster, 1995);* Peter R. Beckman, and Larry Campbell, *The Nuclear Predicament: Nuclear Weapons in the Cold War and Beyond* (Prentice Hall, 1992); *Richard Rhodes, The Making of the Atomic Bomb (New York: Simon & Schuster, 1986). On Operation Argus specifically, see* Lisa Mundey, "The Civilianization of a Nuclear Weapons Effects Test: Operation ARGUS," *Historical Studies in the Natural Sciences* 42, no. 4 (2012): 283–321.

[128] House Subcommittee on Independent Offices, *Report on the International Geophysical Year*, 26.

demonstrating the existence of the radiation belt.[129] In another prepared statement for the congressional hearing, Alan Shapley, a geophysicist and the vice-chairman of the USNC-IGY, alluded to a further sighting of a man-made aurora. Reported at Apia, the capital city of the Samoan Islands, on 1 August 1958, the seven-minute light phenomenon was indeed the result of a nuclear explosion above Johnston Island, an atoll in the North Pacific located some 2'200 miles away.[130] In what was known as Operation Hardtack, the military tested its antiballistic missile and communication disruption capabilities by detonating two 3.8-megaton hydrogen bombs.[131] Because of a malfunction in the missile guiding system, one of these blew up over Johnston island instead of at the original location above ocean waters.

These high-altitude nuclear tests were followed by Operation Argus, during which three shots were fired from U.S. Navy ships in the South Atlantic in late August and early September 1958.[132] Prompted by the Veterans Administration, the predecessor of the current Department of Veterans Affairs, which had received claims for medical benefits from former military personnel because of possible exposures to radioactivity, the Nuclear Defense Agency at the Department of Defense began an investigation in 1977. One of the various reports it produced, which focused specifically on Operation Argus, outlined that one of the objectives had been to demonstrate the validity of the so-called Christofilos theory, which posited that nuclear detonations would create an artificial radiation belt in the atmosphere. Military implications of such an event included "degradation of radio and radar transmissions, damage or destruction of the arming and fuzing mechanisms of ICBM war-heads," in addition to "endangering the crews of orbiting space vehicles that might enter the belt."[133] But, the report was also

[129] Richard Porter, Chairman, Technical Panel on the Earth Satellite Program, US-NC IGY, "Introductory Remarks for Argus Symposium," Argus Symposium and the American Physical Society Meeting, 29 Apr 1959, Lee A. DuBridge Papers, CALTECH, Box 156, Folder 1, 1.
[130] House Subcommittee on Independent Offices, *Report on the International Geophysical Year*, 145.
[131] Fleming, *Fixing the Sky*, 209.
[132] Air Force Special Weapons Center, Air Research and Development Command, "Project Jason Measurement of Trapped Electrons from a Nuclear Device by Sounding Rockets," undated, Lee A. DuBridge Papers, CALTECH, Box 156, Folder 1.
[133] C. B. Jones, M. K. Doyle, L. H. Berkhouse, F. S. Calhoun, E. J. Martin, *Operation Argus 1958* (Washington: Defense Nuclear Agency, 1982), 1.

quick to point out, the Argus experiment "produced a great mass of geophysical data, pure scientific material of great value."[134] At a 1959 symposium on the Argus experiment, Richard Porter, the chairman of the USNC-IGY earth satellite panel, explained that after the discovery of the natural radiation belt theorized by Van Allen, the panel was anxious to further study the phenomenon.[135] Negotiations between the United States, the Soviet Union and Great Britain toward a test suspension treaty were underway, pushing members of the IGY earth satellite panel and the advanced research project agency of the Department of Defense to join forces and equip the satellite Explorer 4 with instrumentation designed to observe both the Van Allen (natural) radiation belt, and the artificial belt, a thin layer of electrons trapped in the magnetic field, created by the Argus nuclear bursts.[136] While the Argus experiment had primarily a military purpose, as opposed to a purely scientific one, it contributed to reinforcing interest in the atmosphere.

If the study of the atmosphere gained traction within scientific and military circles, nuclear tests also led to a renewed interest in the general circulation of air and water masses, and the thermal exchanges between the ocean and the atmosphere which form the basis of climatology. What interested meteorologists were not the blasts themselves, but the radiation emanating from them. Nuclear tests offered real-life experiments that could not be reproduced in laboratories, and provided critical data as initial conditions were known and effects could be measured in controlled conditions. Meteorology stations were therefore equipped with instruments measuring nuclear radiation and offering insight into the spread of radioactive debris from tests conducted during the IGY. Military stakes, once again, played an important role in the meteorological scientific community's interest in nuclear fallout, or the clouds of radioactive dust produced by nuclear explosions. While it offered a way of studying the circulation of air masses,

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[134] Ibid., 2.
[135] The tests were announced in 1959, but the full results and other documentation remained classified for the next 25 years. Fleming, *Fixing the Sky,* 210.
[136] PSAC, "Memorandum for Members," 4 Sept 1959, I. I. Rabi Papers, LOC, Box 46, "PSAC reports: general 1959-72 (1)," 5. See also Richard Porter, Chairman, Technical Panel on the Earth Satellite Program, US-NC IGY, "Introductory Remarks for Argus Symposium,", 2–4, and N. C. Christofilos, "The Argus Experiment," 2, Argus Symposium and the American Physical Society Meeting, 29 Apr 1959, Lee A. DuBridge Papers, CALTECH, Box 156, Folder 1.

leading to a better understanding of the climate system, the monitoring of radioactive particles provided meteorologists with a way of determining where and when an atomic bomb had been launched on Soviet territory.[137] Atmospheric research was thus born out of Cold War anxieties, as nuclear fallout monitoring stations paved the way for a more systematic study of the atmosphere's composition. Meteorologist Harry Wexler, who was in charge of the Mauna Loa observatory, had first-hand knowledge of the nuclear contamination of air, water and soil and he perceived how critical it was to establish the infrastructure to support a global monitoring effort of the atmosphere, which had been treated as a limitless dumping ground since the advent of the first industrial revolution. Nuclear fallout research thus proved critical to the emerging study of anthropogenic climate change.

While the Argus experiment was carried out in secrecy, without preliminary announcement to or public discussion with the scientific community, the PSAC was consulted on the subject because of the experiment's scientific, political and military implications.[138] The committee constituted an ad-hoc panel, comprising both scientific and military members, to produce a report, which served as a basis for a White House press release published in the *New York Times* on 26 March 1959.[139] A series of articles had already appeared in the newspaper, among which was a front-page article by the *New York Times* science reporter, Walter Sullivan.[140] The news caused quite an uproar among scientists, who had not been informed of the injection of electrons into the earth's magnetic field that could interfere with their own research on atmospheric phenomena. It is not surprising that the PSAC was involved in these discussions. It had its origins in the Office of Defense Mobilization, and its portfolio included a large array of national security matters. In its activities related to national defense, the PSAC was often consulted in the field of military technology and research, of which nuclear

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[137] Fleming, *Inventing Atmospheric Science,* 142.
[138] U.S. Congress, House Committee on Government Operations, Subcommittee on Military Operations, *The Office of Science and Technology,* 90th Cong., 1st sess., March 1967 (Washington D.C.: U.S. Government Printing Office, 1967), 71.
[139] "Text of White House Report on Argus Experiments," March 26, 1959, *New York Times*, 16.
[140] Sullivan also offered a popular account of the experiment in his book *Assault on the Unknown* (New York: McGraw-Hill, 1961).

armament was a predominant aspect. Half of the committee's panel studies had been directed toward the advancement of weapons technology, and the defense against ballistic missiles in particular.[141] In the context of nuclear tests, the PSAC reviewed studies on the detection and identification of such covert operations. Fallout monitoring became a critical tool in allowing a nuclear test ban treaty to come into effect. Without a global infrastructure enabling the detection of nuclear testing, there was no way of enforcing the treaty, effectively rendering it moot.[142] The treaty went through several rounds of negotiations, a process which had begun in April 1958 when Eisenhower proposed that a conference of experts from both blocs meet to explore the feasibility of detecting nuclear explosions. The PSAC directly assisted the State department in preparations for a series of meetings, which led to the ratification by the United States, the Soviet Union, and Great Britain of the Limited Test Ban Treaty in 1963. The Advisory Committee was thus at the forefront of the association established at that time between nuclear weapons tests, geophysical research and Cold War policies, which would lay the foundations for the study of climate change.[143] The Limited Test Ban Treaty had indeed two major goals: one was to slow down the arms race, and the other was to prevent nuclear contamination of the atmosphere. As such, the treaty can be considered as the first global agreement on the environment, one that instituted the atmosphere as a global commons and recognized the threat posed by industrial activity.

The early 1960s witnessed a significant change of paradigm, as scientists and political leaders gradually came to recognize that the earth and the various geophysical processes that had been deemed stable were in fact extremely sensitive to chemical alteration and could change over short periods of (geophysical) time. Large-scale experimentations were revisited in light of their bearing on the environment. In a 1962 report by its international science panel, the PSAC recognized that "alteration of our environment has reached the point of requiring intensive study and understanding on an urgent

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[141] PSAC, "Memorandum for Members," 4 Sept 1959, I. I. Rabi Papers, LOC, Box 46, "PSAC reports: general 1959-72 (1)," 7.
[142] Edwards, *A Vast Machine, 214.*
[143] Ibid.

basis."[144] Penned in unusual gravitas, the report stated that "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."[145] The panel distinguished between two types of problematic large-scale experiments. The first related to actions that were individually small but whose compounded effects could be serious, and the continuous release of CO_2 was cited as an example. The second category comprised nuclear tests, which were comparatively fewer, but had much larger consequences (or so it was thought at the time). The committee thus recommended that ecological factors be considered along the technological, military and scientific objectives. That same year Rachel Carson, a U.S. marine biologist, published her best-selling book, *Silent Spring*, which offered similar warnings regarding the indiscriminate use of pesticides and of DDT in particular, and the negative effects these chemical substances could have on entire ecosystems.[146] Interestingly, the PSAC called for a U.N. conference on "environmental contamination" exactly a decade before the first global environmental meeting took place in Stockholm in June 1972, under the auspices of the U.N. As a matter of fact, the PSAC report concluded: "We urge active consideration of this proposal for a UN conference, especially in the light of what we believe to be an important need for the United States to be a leader on this issue instead of sometimes appearing to be one of the chief offenders."[147]

The explosion of the first atomic bomb in the desert at Alamogordo, New Mexico, in July 1945, had ushered in the Atomic Age, demonstrating humanity's capacity to alter the environment on a worldwide scale. Between 1945 and 1962, the U.S. Atomic Energy Commission conducted 235 atmospheric nuclear weapons tests.[148] The notion that large-scale scientific

[144] E. B. Skolnikoff, PSAC, "International Science Panel: The Problem with Large-Scale Experimentation with Possible Environmental Effects," 20 Sept 1962, I. I. Rabi Papers, LOC, Box 46, "PSAC reports: general 1959-1972 (2)," 1.
[145] Ibid., 3.
[146] Rachel Carson, *Silent Spring* (Boston: Houghton Mifflin Co., 1962).
[147] PSAC, "International Science Panel", 11.
[148] C. B. Jones, M. K. Doyle, L. H. Berkhouse, F. S. Calhoun, E. J. Martin, *Operation Argus 1958* (Washington: Defense Nuclear Agency, 1982), 3.

experiments and human activity in general could have serious environmental repercussions took two decades to sink in. But the Cold War prospect of a thermonuclear war between the two superpowers, and the fears raised by nuclear testing, would profoundly influence the perception of and discourse on climate change in the ensuing decades.[149]

1.5 Environmental Warfare: Weather Modification, Intentional Climate Change, and the First General Circulation Models

While concerns about thermonuclear bombs and nuclear fallout propelled the federal government's interest in atmospheric research, another type of warfare had an influential role in putting atmospheric science on the governmental agenda: weather modification. Beginning in 1953, when outdoor nuclear testing was proceeding full steam in the desert across Nevada, the public started blaming weather events on atomic bombs and radioactive clouds, sending letters of complaints to the Weather Bureau and the Atomic Energy Commission.[150] Their grievances were not without merit, for scientists had envisaged ways of controlling weather patterns through nuclear explosions.[151] From the late 1940s through the 1960s, weather modification, also known as weather control, was indeed an important focus of research both in the civilian industry, where corporations sought to commercialize cloud "seeders," or rainmaking services, and in the military, which quickly perceived how weather could be manipulated to its strategic advantage in a war.[152] During the IGY, efforts towards collecting weather and

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[149] For an account of the development of environmental warfare in the postwar period and its connections with the rise of "catastrophic" environmentalism during the Cold War, see Jacob D. Hamblin, *Arming Mother Nature: The Birth of Catastrophic Environmentalism* (Oxford; New York: Oxford University Press, 2013).

[150] Fleming, *Inventing Atmospheric Science,* 140.

[151] Weart, *The Discovery of Global Warming,* 41.

[152] Meteorologist Howard T. Orville offered a definition of weather control in his statement to Congress in March 1958. He explained that "Weather control means that our knowledge of atmospheric processes has reached the level where we are able to apply manmade techniques to large scale weather patterns to start a chain reaction that will produce known results over a specific portion of the globe for a known period of time." U.S. Congress, House Committee on Interstate and Foreign Commerce, *Weather Modification Research*, 85th Congress, 2nd Session, March 18-19, 1958 (Washington, D.C.: U.S. Government Printing Office, 1958), 51. For two very complete histories of U.S. weather modification and climate control efforts, see Kristine C. Harper, *Make It Rain: State Control of the Atmosphere in Twentieth-Century America* (Chicago: University of Chicago Press, 2017); and James R. Fleming, *Fixing the Sky: The Checkered History of Weather and Climate*

climate data stemmed from a desire to markedly improve weather forecasting capabilities, but also from the need to better understand climate in order to proceed with temporary and localized alterations of the weather. More than inadvertent weather modification, or what we know as climate change, scientists and politicians' prime interest resided in purposeful weather modification. Environmental warfare through weather control remained an important component of U.S. and Soviet military strategies until June 1975, when delegations from both blocs met at a disarmament conference in Geneva and negotiated a ban on environmental warfare and the military uses of weather modification.[153] This led to The Environmental Modification Convention (ENMOD), which was ratified by the two superpowers and more than thirty nations in 1977. However, as historian Jacob Hamblin argues, the main effect of the treaty "was not to ban anything real," but "to reinforce the impression that global catastrophic environmental change was quite possible, and that the Cold War superpowers already possessed knowledge of how to accomplish it."[154]

The history of weather modification is an important aspect of the climate change narrative for three reasons: first, weather modification developed conjointly with computerized meteorology; second, and as a consequence of progresses in modern meteorology, numerical forecasting allowed the development of climate models, which would go on to become the prevailing tools for predicting climate change and studying its effects on eco-systems; thirdly, the notion that weather patterns could be altered purposefully led to a more general realization that technology could also foster *inadvertent,* as opposed to controlled climate change. But before examining the inception of modern meteorology and climate models, it is necessary to take a step back and study the role of the government's growing interest in weather modification throughout the 1950s. Government-sponsored experiments in weather modification had a long history dating all

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Control (New York: Columbia University Press, 2010). See also Kristine C. Harper, "Cold War Atmospheric Sciences in the United States. From Modeling to Control," *in* Jeroen van Dongen, ed., *Cold War Science and the Transatlantic Circulation of Knowledge,* (Leiden: Brill, 2015), 217–242.

[153] Bernard Gwertzman, "A U.S.-Soviet Ban on Weather Use for War is Near," *New York Times,* June 24, 1975, 68.

[154] Hamblin, *Arming Mother Nature,* 216.

the way back to 1891, when explosives were fired in the Texan sky in an attempt to provoke rain. In the 1920s, the U.S. Army similarly attempted to generate rain by sprinkling electrified sand onto clouds.[155] The process of "mutual orientation," which gave scientists and their military sponsors common general directions, accelerated the transition from analog to numerical forecasting.[156] Computerized meteorology provided the military with more accurate weather forecasts, but it also fostered the possibility of mastering weather control, a potential breakthrough in warfare, something that scientists and engineers were quick to point out.

Things accelerated throughout the 1950s and reached a culmination with the presentation before Congress of a report by the Advisory Committee on Weather Control (ACWC) in December 1957. Established in 1953 after previous attempts to set up a regulatory body had failed, the committee was chaired by a meteorologist and retired Navy captain, Howard Orville, who was assisted by representatives of various cabinet departments.[157] Upon reviewing weather control techniques and research, the committee concluded that federal regulation was unnecessary and altogether best avoided. The committee recommended that weather control efforts be pursued, but emphasized that the best course of action was to channel funding for experimentation and research through the NSF. At a March 1958 hearing on weather modification, in an unsubtle reference to Sputnik, Orville attributed the need to pursue research in that field to the intractability of "a nation and its satellites whose leaders are stark realists and who will stop at nothing to achieve their objective—the absolute domination of communism throughout the world."[158] While he mentioned the warming caused by carbon dioxide emissions, a form of unintentional alteration of the climate, Orville was far more concerned about malignant weather control techniques that the Soviets might deploy, such as the melting of the polar ice caps by spraying black dust over them (thus changing the ice's albedo, of its reflective power, as the blackened surface would absorb the heat coming from the sun), or the

[155] Harper, "Cold War Atmospheric Sciences in the United States," 227.
[156] Edwards, *A Vast Machine,* 112.
[157] Harper, "Cold War Atmospheric Sciences in the United States," 235.
[158] House Committee on Interstate and Foreign Commerce*, Weather Modification Research,* 51.

formation of a new ice age through the detonation of two thousands hydrogen bombs over a period of twenty years. These "frightening and disastrous consequences" warranted "gaining a breakthrough," and Orville urged Congressmembers to "not become complacent" by turning away from weather control.[159]

In a 1958 paper published in *Science*, the meteorologist in charge of the US/IGY Antarctic expedition Harry Wexler also mused on the potential consequences of altering the earth's heat budget through the detonation of hydrogen bombs. While this constituted a particularly hypothetical scenario, Wexler was keenly aware of the serious issues raised by industrial activity and large-scale scientific experiments, noting in the concluding paragraph: "When serious proposals for large-scale weather modification are advanced, as they inevitably will be, the full resources of general-circulation knowledge and computational meteorology must be brought to bear in predicting results so as to avoid the unhappy situation of the cure being worse than the ailment."[160] In another example of the shift that occurred between the end of the 1950s and the beginning of the 1960s, Wexler delivered a series of lectures, "On the Possibilities of Climate Control," throughout 1962, in which he more forcefully emphasized the dangers in altering the earth's heat balance and the adverse consequences of both intentional and inadvertent climate change, and of the unmitigated burning of fossil fuels especially, reiterating the need to use numerical models to assess the physical, chemical and meteorological effects of the human alterations of the atmosphere.[161]

Meteorology had undergone profound changes in the postwar decade, having been significantly impacted by the arrival of the first electronic digital computers, the products of the prodigious accomplishments made in information technology during the war.[162] Numerical weather forecasting had

[159] Ibid., 53.
[160] Harry Wexler, "Modifying Weather on a Large Scale," *Science* 31 (October 1958): 1063, quoted in Fleming, *Fixing the Sky,* 216.
[161] Ibid., 216–217.
[162] Of the numerous historical studies on meteorology and the atmospheric sciences, see especially James R. Fleming, *Inventing Atmospheric Science: Bjerknes, Rossby, Wexler, and the Foundations of Modern Meteorology* (Cambridge, MA: The MIT Press, 2016); Kristine C. Harper, *Weather by the Numbers: The Genesis of Modern Meteorology* (Cambridge, MA: MIT Press, 2008); Robert G. Fleagle, *Eyewitness: Evolution of the Atmospheric Sciences* (Boston: American Meteorological Society, 2001); Clark A. Miller,

been first envisioned by an English mathematician, Lewis Fry Richardson, who had designed a numerical system for predicting the weather by subdividing a given territory into a grid. Each point, or cell, on the grid contained a set of numbers representing variables such as air pressure and temperature, which could be filled in to reflect real weather conditions at a given time. Basic physical equations were applied to these cells, which in turn would produce results related to air flows.[163] What had constituted a vision turned into reality when John von Neumann, a brilliant and world-renowned mathematician, was invited in January 1946 by Francis Reichelderfer, the director of the U.S. Weather Bureau, at its headquarters in Washington D.C.[164] Von Neumann, a consultant to the Manhattan Project, had worked on the Electronic Numerical Integrator and Calculator (ENIAC), the main wartime American computer project, located at the U.S. Army's Aberdeen Proving Grounds in Maryland.[165] While the computer had been designed to solve ballistic problems, von Neumann suggested using the ENIAC to simulate a hydrogen bomb explosion.[166] Through his knowledge in fluid dynamics, he saw another application for ENIAC in the form of weather prediction.[167] While meteorology offered the mathematician an avenue for developing computers, numerical weather prediction appeared as a promising tool to Reichelderfer and Wexler, his successor at the Weather Bureau. In June 1946, the Office of Naval Research agreed to fund von Neumann's computer and the Meteorology Project at Princeton's Institute of Advanced Studies: computerized meteorology was born.[168]

The Meteorology Project only properly took off in 1948, under the new leadership of Jule Charney, a mathematician who had learnt the rudiments of meteorology during a year he spent in Norway, whose "Bergen

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"Scientific Internationalism in American Foreign Policy: The Case of Meteorology, 1947-1958," *in* Clark A. Miller, and Paul N. Edwards, ed., *Changing the Atmosphere. Expert Knowledge and Environmental Governance* (Cambridge, MA: The MIT Press, 2001); and James R. Fleming, *Meteorology in America, 1800-1870* (Baltimore, MD: Johns Hopkins University Press, 1990).

163 Weart, *The Discovery of Global Warming,* 56.
164 Harper, "Cold War Atmospheric Sciences," 221.
165 Ibid., 222.
166 Edwards, *A Vast Machine,* 113.
167 Ibid.
168 Harper, "Cold War Atmospheric Sciences," 222.

School" had largely contributed to the development of the discipline.[169] In 1950, a 24-hour forecast required the model to run for 24 hours on ENIAC to produce the prediction, which was of course not ideal, but Charney and his team knew that it was only a matter of time before 24-hour forecast computations could be done in an hour.[170] In addition to being rudimentary, these models were regional in scale, as opposed to global.[171] By the mid-1950s, however, weather services had started to integrate numerical weather models in their forecasting. The recognition of the high potential of numerical models for short-term prediction had also stimulated the scientific appetite for general circulation models, which could produce long-term scenarios of the global climate.[172] The first true General Circulation Model (GCM) was completed in 1955 by an American meteorologist, Norman Phillips. While this represented a foundational step for atmospheric science, Philips' model soon imploded: after twenty or so days of weather simulation, the model started producing climatic scenarios that had never been observed on earth.[173] The initial reaction was to blame this on the inaccuracy of weather data, but that explanation soon fell apart, for weather professionals often relied on maps drawn from primitive data to make predictions. A crucial piece of the puzzle and of weather forecasting in general was delivered in 1961 by another mathematician interested in meteorology, Edward Lorenz. Laying out the foundations of chaos theory, Lorenz discovered that a slight change in initial conditions produced vastly different outcomes. Minor differences in the approximation of decimals generated diametrically-opposed scenarios, ranging from clear to stormy weather.

Weather control was an important factor in the quest for greater basic scientific knowledge of the atmosphere and of atmospheric processes. Mathematical models run on computers were primarily developed for their application in weather control techniques and nuclear fallout detection, which were both thought to offer strategic military advantages. The models' initial raison d'être, however, soon morphed as they became crucial tools of

[169] Ibid.
[170] Edwards, *A Vast Machine,* 123.
[171] Weart, *The Discovery of Global Warming,* 59.
[172] Edwards, *A Vast Machine,* 111.
[173] Weart, *The Discovery of Global Warming,* 59.

climatology and the growing understanding of climate change. Atmospheric science and climate change science in particular, were thus unmistakably born out of Cold War calculations and interests.

1.6 The Institutionalization of Atmospheric Science and the Classification of CO_2 as a Pollutant

Atmospheric research took off in the early 1960s following the shift initiated in 1957, which saw the rapid transition from meteorology to the broader and interdisciplinary atmospheric science.[174] As their field developed and rising complexity in weather forecasting research called for forays into adjacent disciplines, meteorologists found themselves studying politically fraught issues such as air pollution, weather control and nuclear fallout. Fearing that their field was becoming politicized, they turned to the U.S. National Academy, which established a Weather Bureau Advisory Committee on Meteorology.[175] The committee started its work in April 1956, and recommended the creation of a national institute of atmospheric research in November 1957 and again in January 1958.[176] Governmental research in the atmospheric sciences was indeed scattered over a dozen federal agencies, and suffered from a lack of coordination, long-term national goals and overall focus.[177] A month later, the committee presented its first report to the Academy, providing copies to the executive branch of government, including the PSAC, the NSF and the Departments of Defense and Commerce.[178] In addition to funding, the committee argued for the professionalization of meteorology. Very few universities offered doctoral degrees in that field at the time and most professional weather forecasters did not hold a degree in the discipline. A sign of the field's metamorphosis, the committee changed its name to become the Committee on Atmospheric Sciences in the summer of that year. Following its recommendations, atmospheric scientists from

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[174] Fleming, *Inventing Atmospheric Science*, 193.
[175] Ibid., 194.
[176] Ibid., 195; Ibid., 201.
[177] U.S. Congress, House Committee on Government Operations, Subcommittee on Military Operations, *The Office of Science and Technology*, 90th Cong., 1st sess., March 1967 (Washington D.C.: U.S. Government Printing Office, 1967), 72.
[178] Fleming, *Inventing Atmospheric Science*, 201.

fourteen universities established a parent organization for the center, the University Corporation of Atmospheric Research (UCAR), whose status was formalized in March 1959. Soon after, UCAR's directorate initiated the first steps for the construction of the actual research center, the National Center of Atmospheric Research (NCAR).

Located in Boulder, Colorado, and led by Walter Orr Roberts, "a genial, well-liked, hands-off director" in Howe's words, the NCAR represented the successful outcome of a multi-pronged effort by the NAS committee on atmospheric science, but also the NSF, the American Meteorological Society, and leading figures such as Wexler, Berkner and Revelle, who had channeled government interest in geophysics into funding opportunities for research in atmospheric science and sought to make their efforts more durable by institutionalizing this type of research.[179] The NAS committee had pressed the center to hire scientists from meteorology departments rather than government bureaucrats, but the large budget required for this type of research had to come from federal funds, and the center thus became a governmental institution, albeit one with an atypical form of hierarchy. A reflection of its hybrid nature, the NCAR is divided between several facilities, in which scientists working at North American and affiliated foreign research institutions come to conduct research, a mix of permanent and visiting staff. Its hybrid character was itself testament to the unusual "big science" that atmospheric science represented.[180] Contrary to other large-scale government-sponsored research, which had a clear object of study or a single focus, atmospheric science is "an umbrella term" for a vast array of interrelated specialties and sister domains of research.[181] As historian James Fleming remarks, "the unity […] is nominal, and the umbrella is huge."[182] Among the various strands of climate research conducted at the NCAR labs in Boulder, the study of CO_2 did not signal growing concerns over global warming, but merely the need for more research into a scientific

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[179] Howe, *Behind the Curve,* 32; Ibid., 28.
[180] As Howe reports, the term was invented in 1961 by Alvin Weinberg of the Oak Ridge National Laboratory, who defined *big science* as "describ[ing] expensive, large-scale, government-sponsored research carried out either by private corporations or large scientific institutions." Howe, *Behind the Curve,* 31.
[181] Fleming, *Inventing Atmospheric Science,* 194.
[182] Ibid.

problem.[183] Scientists feared that CO_2 might alter the earth's heat budget, provoking unintentional climate modification, but such consequences seemed too distant to prove a cause for alarm. These possibilities therefore fostered "seeds of concern," but no greater anxieties.[184]

In January 1961, testifying to the growing interest in atmospheric science within the White House, Kennedy's science advisor, Jerome Wiesner, asked the National Academy's Committee on Atmospheric Sciences to conduct a study outlining research opportunities in this upcoming field.[185] The PSAC also sent two steering committees to assist the NAS committee, one from the Office of Science and Technology, and the other from the Federal Council of Science and Technology.[186] In *The Atmospheric Sciences, 1961-71*, the report prepared for the PSAC that outlined the goals and plans for the discipline for the decade to come, the NAS committee recommended a global effort to establish an international weather data collection network in support of meteorological services and atmospheric science, as well as the launch of meteorological satellites, radiosondes and rocketsondes to access both sparsely populated regions and the upper atmosphere.[187] Under the aegis of the Kennedy administration, these ideas made their way to the U.N. General Assembly and led to a resolution on international cooperation in meteorology and the peaceful uses of outer space, established the World Weather Watch, and consecrated the WMO as the leading U.N. body in weather research and service.[188] On the CO_2 question, the NAS report proposed to study water vapor and CO_2 together with other trace gases that had interested the oil industry, such as ozone, methane, oxides of nitrogen and sulfur. In doing so, the report drew a strong connection between CO_2 accumulation, inadvertent weather modification, atmospheric radiation and air pollution.[189] While air pollution and carbon dioxide were connected, as

[183] Howe, *Behind the Curve*, 34.
[184] Ibid., 33.
[185] Fleming, *Inventing Atmospheric Science*, 207.
[186] Ibid., 209.
[187] National Academy of Sciences, Committee on Atmospheric Sciences, *The Atmospheric Sciences, 1961-71* (Washington D.C.: National Academy Press, 1962); Fleming, *Inventing Atmospheric Science*, 210.
[188] Ibid.
[189] Howe, *Behind the Curve*, 36.

some scientists and policy-makers had started recognizing, conflating CO_2 and other industrial pollutants came with its own set of challenges. Unlike gases emanating from local refineries or manufacturing plants, whose harmful effects on nearby populations could be regulated by targeted laws, CO_2 was harmless at the local level, and only became a major issue when taken in its entirety, the result of fossil fuel combustion at the global level.

As he was working on the monitoring of atmospheric carbon dioxide at the Mauna Loa Observatory in Hawaii, geochemist Charles Keeling started to see a connection between the renewed interest of the scientific community for the CO_2 accumulation, and the growing discontent of the U.S. population toward air pollution. Keeling couched this understanding of CO_2 as a type of air pollutant in the *Implications of Rising Carbon Dioxide Content of the Atmosphere*, a report based on a conference organized on 12 March 1963 by the Conservation Foundation, a non-profit organization based in New York.[190] Established in 1948, the foundation eventually merged with the World Wide Fund for Nature (WWF) in 1990, after joining the U.S. branch of the WWF in 1985.[191] The conference was a small gathering compared to typical scientific congresses, with half a dozen experts from various disciplines in attendance, and a similar number of observers, all of them associated with the foundation. While the report presented the consensus that had been reached at the conference, it was largely based on the work of Keeling and Canadian physicist Gilbert Plass.[192] The report warned of a 4°C increase in the average surface temperature if CO_2 concentration in the atmosphere were to double. While it did not give a timeframe for when this would occur, the report spoke of an incremental yet constant increase of atmospheric carbon dioxide due to the combustion of fossil fuels. The report also anticipated much more clearly that "the carbon dioxide situation" would become a controversial subject, and that "pollution is now a political and social problem far more than it is a scientific one."[193] In a first threatening

[190] Noel Eichhorn, *Implications of Rising Carbon Dioxide Content of the Atmosphere* (New York: Conservation Foundation, 1963); *The Conservation Foundation: A Description of its Purposes* (New York: The Conservation Foundation, 1962), 3.
[191] "History," WWF, accessed December 14, 2020, https://www.worldwildlife.org/about/history.
[192] Fleming, *Fixing the Sky*, 237.
[193] Eichhorn, *Implications*, 14.

line to the oil industry, experts also pointed out the need to find alternative sources of power, for the combustion of fossil fuels would translate into a "changed" earth, "more than likely for the worse."[194]

A mere six years had elapsed between the conference organized by the Conservation Foundation in 1963 and Revelle's 1956 congressional testimony, but the tone of the foundation report was noticeably more urgent. The context in which these two texts were produced was of course different, as the first half of the 1960s marked a departure from the postwar optimistic and technocentric view of scientists and political leaders, who had conceived of science as a powerful tool in the quest to put an end to mankind's ailments, to a recognition that science could be both the source of new problems and an aid in detecting issues related to modernization. At a meeting of the Federal Council on Science and Technology in 1963, Revelle, then the science advisor to Interior Secretary Stewart Udall and the chairman of the PSAC's Committee on Natural Resources, observed "a shift from earlier 'Malthus' attitudes of apprehension over scarcity […] to an optimism that science could help meet resources needs, but with a new concern on man's contribution to pollution of his own environment."[195] The interest in the rising concentration of atmospheric carbon dioxide thus responded to a growing concern within the scientific community about environmental issues more generally. In a report on its yearly activities, the committee indeed stated that "the three areas within which [The Federal Council on Science and Technology] activity was most intense during 1963 concerned oceanography, atmospheric sciences and natural resources."[196] The PSAC's records clearly attest to that transition, from an entrenched belief in the power of science in generating technology and therefore economic prosperity in the late 1950s, to an awareness of the interconnectedness of the earth's ecological systems, and their relative fragility in the face of human interventions and disruptions.

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194 Ibid.

195 Revelle's words are quoted in: Edward Wenk, Executive Secretary, Federal Council for Science and Technology, "Minutes and Record of Action," 31 Jan 1963, I. I. Rabi Papers, LOC, Box 45, "Meetings, agenda and minutes, 1957-1972 (1)," 4.

196 Federal Council for Science and Technology, "Interim Report on Activities During Calendar Year 1963," Feb 1965, I. I. Rabi Papers, LOC, Box 46, "PSAC reports: general 1959-72 (4)," 3.

1.7 The Fossil Fuel Industry Responds to Air Pollution Legislation: Corporate-Sponsored Scientific Research and Reports

In the late 1950s and early 1960s, as data started depicting an increase in atmospheric carbon dioxide resulting from the burning of fossil fuels, the oil industry was dealing with a very different kind of atmospheric pollution. The industry had received warnings as early as 1957, at a meeting of the American Chemical Association, during which physicist Edward Teller, who had worked on the development of the hydrogen bomb on the Manhattan Project, gave a talk. A second warning came in 1959, at a symposium hosted by the Columbia Graduate School of Business and the American Petroleum Institute (API), a lobbying group founded by oil executives in 1921.[197] Organized for the centennial of the American oil industry, the event was attended by over 300 government officials, economists, historians, scientists, and industry executives.[198] In his talk addressing "energy patterns of the future," Teller bluntly remarked that "the energy resources of the past must be supplemented," not because he thought oil resources would soon be depleted, though he mentioned that as well, but because of what he called the "chemical contamination" of the atmosphere. Teller explained that carbon dioxide was known to have a "strange property," whereby "It transmits visible light but it absorbs the infrared radiation which is emitted from the earth […] caus[ing] a greenhouse effect […]." He went on to warn the audience that "a temperature rise corresponding to a 10 per cent increase in carbon dioxide will be sufficient to melt the icecap and submerge New York," although he added that "It is hard to say whether it will be 2 degrees Fahrenheit or only one or 5."[199]

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[197] Vance N. Jenkins, "The Petroleum Industry Sponsors Air Pollution Research," *Air Repair* 3, no. 3 (February 1954): 144-49, 145, The Climate Files (CF). All the source material quoted in this section is accessible on the Climate Files database at: http://www.climatefiles.com/collection-index/. On the API's functioning, see Jie Jenny Zou, and Chris Young, "Wave of climate lawsuits threatens the future of Big Oil," *Center for Public Integrity*, December 12, 2017, https://apps.publicintegrity.org/united-states-of-petroleum/venue-of-last-resort/.
[198] Benjamin Franta, "On its 100th birthday in 1959, Edward Teller warned the oil industry about global warming," *The Guardian*, January 1, 2018.
[199] Quoted in Franta, "Edward Teller."

We do not know how oil representatives and the other attendees reacted to his presentation. What we do know is that Teller's words had not gone unnoticed after his first talk in 1957, but that his "solemn warning" was dismissed. In an article published in the journal *The New Scientist* on 8 October 1959, a director of research and development of the Shell company wrote that "There have been suggestions that the burning of fossil fuels may so increase the carbon dioxide content of the atmosphere as to cause a drastic climatic change," but that because of carbon cycles, which are massive geochemical processes, the belief that "Man will upset the balance" seemed preposterous.[200] The petroleum executive offered a number of reasons why this would not happen. One of these was that the atmosphere already contained vast amounts of carbon dioxide, and that a residual addition from "chimneys and exhaust pipes" would not alter its composition.[201] Other reasons advanced by the businessman was that "the sea acts as a buffer," namely a carbon sink, while plants themselves removed carbon dioxide from the atmosphere through the photosynthetic process. Invoking "the magnitude of Nature's carbon cycles," he concluded that the burning of fossil fuels would not "have any large effect on the carbon dioxide balance."[202]

We also ignore whether the leading executives of the petrochemical industry privately believed carbon dioxide to be a credible threat, but documents indicate that they did not take any serious measures at this point to protect their image or business.[203] While an API air pollution research committee did commission a research institute to conduct a study on the ratio of "natural" vs. "industrial" carbon dioxide in the atmosphere as early as 1958, this does not allow us to conclude, as certain authors have, that the oil

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200 M. A. Matthews, "The Earth's Carbon Cycle," *The New Scientist* 6, no. 151 (8 October 1959): 644, CF.

201 Ibid.

202 Ibid., 646.

203 As authors from the Center for International Environmental Law (CIEL) note, an API air pollution research committee had commissioned a research institute to conduct a study on the ratio of "natural" vs. "industrial" carbon dioxide in the atmosphere as early as 1958. I do not agree with the CIEL authors, however, that this element allows us to conclude that the oil industry "was investigating the climate question." As this subsection will show, oil executives were first and foremost concerned about visible and irritant air pollution emanating from refineries, and carbon dioxide was neither of these. See the CIEL's "Smoke and Fumes" database at: https://www.smokeandfumes.org/documents/9.

industry "was investigating the climate question."[204] As we will see, oil executives were first and foremost concerned about visible and irritant air pollution emanating from refineries, and carbon dioxide was neither of these. This more visible, localized and recognizable type of air pollution, on the other hand, had taken center stage.

Exactly a week after the symposium, on 11 November 1959, the API elected Monroe Jackson Rathbone as its new chairman during its annual meeting.[205] The president of the Standard Oil Company of New Jersey (also known as Esso, and the future Exxon), Rathbone was given a mandate to steer the trade association, whose eleven thousand members included industry representatives from large and small oil companies, into calmer waters.[206] At the time, the industry was indeed confronting an economic downturn. Prices had hit a low point because of worldwide overproduction, and supply exceeded demand by 20%.[207] At a press conference following the closing session of the annual meeting, Rathbone announced two things. First, he explained that air pollution was a growing public concern, which would soon land on the desk of various municipal, state and federal legislative bodies, and that as such, it ought to be treated as a pressing matter by the industry itself. Second, the oil executive made clear that the oil consortium needed a much more robust public relations arm. As a *New York Times* article reported, he declared that the "the oil industry must adopt a 'hard-hitting' program to improve its relations with the public" and that he saw as his "most important job" the aim of "winning better public understanding of the problems and achievements of the oil industry." Insisting on the latter's "self-reliant" character, Rathbone also described in plain terms the danger in allowing

[204] See the Center for International Environmental Law (CIEL) authors' introduction to the article by Charles A. Jones, "A Review of the Air Pollution Research Program of the Smoke and Fumes Committee of the American Petroleum Institute," at https://www.smokeandfumes.org/documents/9.
[205] John J. Abele, "Informed Public Aim of Oil Group," *New York Times,* November 12, 1959, 51.
[206] The Standard Oil Company of New Jersey was one of the spin-off companies created in the wake of the dismantlement of the original Standard Oil Company in 1911. The U.S. Supreme Court ruled that the Sherman Antitrust Act required Standard Oil to be dissolved as it constituted a blatant monopoly, and the company was split into 34 entities. Standard Oil of New York was renamed Mobil (it would later merge with Exxon to become ExxonMobil), while Standard Oil of California became Chevron. "Spokesman of a Giant," *New York Times,* November 10, 1959, 49.
[207] Abele, "Informed Public," 51.

public misinformation to lead legislation and regulation, a first step viewed by the industry as dangerous as "Government controls tend to breed more controls." The idea was to nip legislation in the bud, combatting "Government encroachment into a basic area of the economy."[208]

As the points discussed during the API annual meeting attest, the relationship between public opinion, which stemmed in large part from government-sponsored research on air pollution, whose results were picked up by the media, and new regulations, worried oil industry leaders. This issue, however, was not new to them, as it dated back to the early 1950s. Air pollution had indeed become a problem for the oil industry after the Second World War, more particularly through the widely publicized issue of the Los Angeles smog. The API had set up a Committee on Disposal of Refinery Wastes as early as 1930, but it mostly dealt with water pollution.[209] The post-war period was characterized by a rapid growth of population and industrial activity on the West Coast and in the Los Angeles area in particular, and the oil industry was criticized as one of the chief culprits for air pollution and ground-level ozone.[210] After a particularly devasting episode for its image on 11 December 1946, in which a national newspaper featured a photograph on its front page of one of the local refineries and accused it of being the source of the smog, the industry leaders became aware that they needed to control the research agenda and the public discourse on atmospheric pollution if they were to avoid onerous or disruptive regulation to their business.[211] On the afternoon of that fateful day, oil executives voted to establish the Petroleum Industry Committee on Smog, which later became the Committee on Smokes and Fumes of the Western Oil and Gas Association in November 1951.[212] Six months later, at its mid-year meeting in May 1952, wary of seeing the Los Angeles legislative movement spread to the rest of the country, the API formed its own air pollution research committee, the Smokes and Fumes

[208] Quoted in Abele, "Informed Public," 51.
[209] Charles A. Jones, "A Review of the Air Pollution Research Program of the Smoke and Fumes Committee of the American Petroleum Institute," *Journal of the Air Pollution Control Association* 8, no. 3 (November 1958), CF, 268.
[210] Ibid.
[211] Vance N. Jenkins, "The Petroleum Industry Sponsors Air Pollution Research," *Air Repair* 3, no. 3 (February 1954), CF, 146.
[212] Jones, "A Review of the Air Pollution Research Program," 268.

Committee.[213] After the API decided to set aside $250'000 for the committee's research activities in 1953, the committee commissioned the Stanford Research Institute to conduct two studies, one of which pertained to the formation of ground-level ozone (i.e. smog) in the atmosphere of polluted industrial centers.[214]

The Stanford Research Institute studies showed that the smog was the product of "unique topographical and meteorological conditions" of the Los Angeles area.[215] The results were reported by the API Smoke and Fumes Committee's executive secretary, Vance Jenkins, in an article published in *Air Repair*, a journal providing technical information to inform, and influence, policy regarding issues of air pollution control and waste management.[216] While this statement was technically correct, it was also misleading if interpreted the way Jenkins did, which was to affirm that air pollution was "not a national problem," but a series of local problems with each area "unique with respect to the factors influencing its air pollution problems."[217] The aim of localizing air pollution issues was of course a means to prevent the adoption of state or federal laws. The fact that topography and local climatological conditions influenced the way pollutants reacted with the local atmosphere, failing for instance to materialize as smog, did not make the toxic discharge benign. But as these industry documents attest, oil executives were primarily concerned with what people could see and feel.

Before the Stanford Research Institute published the results of its investigations, the Los Angeles Country Air Pollution Control District had commissioned its own research, and found out that hydrocarbon emissions did play a role in the formation of smog. The industrial leaders, through the Stanford Research Institute, disputed these findings, claiming that "there are

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[213] Jenkins, "The Petroleum Industry Sponsors Air Pollution Research," 148.
[214] R. M. Shepardson, Director, Esso Laboratories, Standard Oil Development Company to William Naden, Manufacturing Department, 5 August 1953, CF.
[215] Jenkins, "The Petroleum Industry Sponsors Air Pollution Research," 147.
[216] According to its home page, "The Journal of the Air & Waste Management Association is one of the oldest continuously published, peer-reviewed, technical environmental journals in the world. First published in 1951 under the name Air Repair, the Journal is intended to serve those occupationally involved in air pollution control and waste management through the publication of timely and reliable information." Also known as the Journal of the Air Pollution Control Association (1955-1986). "Journal," The Journal of the Air & Waste Management Association, accessed December 14, 2020, https://www.awma.org/journal.
[217] Jenkins, "The Petroleum Industry Sponsors Air Pollution Research," 144.

a number of apparent errors in both this theory and its interpretation to account for the various phenomena associated with smog."[218] The fact that this theory on the origin of smog was adopted by other air pollution enforcement agencies throughout the country led the industry executives to operate a shift. As Jenkins explained in his article, the oil industry would no longer simply investigate air pollution, but rather it would direct its efforts at "determin[ing] the degree, if any, to which this theory coincides with facts," essentially attempting to undermine the science resulting in "unnecessary control […] and unnecessary expenditures."[219] This marked the beginning of the oil industry's attempt at undermining the science of atmospheric pollution and later, that of climate change, by developing alternative theories or exposing and overstating existing weaknesses. The seeds of the industry's strategy of manufacturing and spreading doubt on climate change science, to borrow historians of science Naomi Oreskes and Erik Conway's terms, had just been planted.[220]

Esso chose to establish its own Subcommittee on Fundamental Research on Air and Water Pollution Control in the spring of 1953, most probably as a result of the political agitation around smog reported in Los Angeles.[221] That subcommittee was part of the Central Refinery Loss Committee, and it included representatives from Esso's subsidiaries, including Humble Oil and Imperial Oil.[222] The Central Refinery Loss Committee, established in 1930, owed its name to efforts by Esso for preventing costly oil losses at its refineries. At its first meeting on 28 July 1953, the subcommittee cited a number of similar initiatives from other corners of the petrochemical industry, among which was the air pollution research program sponsored by the API, a symposium by the American Chemical Society on "waste disposal problems of the Petroleum industry,"

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[218] Ibid., 147.
[219] Ibid.
[220] Naomi Oreskes, and Erik M. Conway, *Merchants of Doubt: How a Handful of Scientist Obscured the Truth on Issues from Tobacco Smoke to Global Warming* (New York: Bloomsbury Press, 2010).
[221] H. Prescott, Secretary of the Central Refinery Loss Committee, "Minutes of 23rd General Meeting of the Central Refinery Loss Committee, New York, April 8-10, 1953," CF, 13.
[222] J. E. Miller, Chairman of the Central Refinery Loss Committee, "Minutes of the first meeting of the subcommittee on air and water pollution research of the Central Refinery Loss Committee," 7 October 1953, CF, 1.

and the preparation of a manual and a bibliography on the subject of air pollution by the Manufacturing Chemists Association.[223] The API Smoke and Fumes Committee and the Central Refinery Loss Committee's Subcommittee on Air and Water Pollution Research also decided to keep one another apprised of their respective findings and of the progress of their research projects.[224]

The air pollution problems faced by Esso at its refineries were numerous and increasing in complexity, following the development of new types of products, in particular those stemming from the petrochemical branch. Air pollutants resulting from the refineries' activities included sulphur dioxide, nitrogen oxides (also known as NO_x, these gases contribute to the formation of smog and acid rain), and catalyst dust, among many other by-products, while water pollution consisted in the contamination of watercourses through the discharge stemming from refinery effluents: all these pollution problems were brought to the attention of Esso's upper levels of management a year later, in 1954.[225] In a letter dated 7 January 1955, William C. Child, the chairman of the subcommittee, reported that four items out of the list had been selected for further research. These issues testified to the industry's chief preoccupations with waste disposal, and all shared the characteristics of being localized and visible forms of air and water pollution. Child observed that "black water effluent is most undesirable as it visually advertises the presence of pollution," while he noted the importance in preventing the conversion of sulphur dioxide to sulphur trioxide (but not the discharge of sulphur dioxide itself) because "the latter contributes to blue haze and eye smarting."[226] 1955 was also the year that saw the first federal law on the issue, the Air Pollution Control Act, the result of a long battle following a deadly industrial smog episode in Donora, Pennsylvania.[227]

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223 Ibid.
224 H. Prescott, to J. E. Miller, "Fundamental Research on Air Pollution," 27 August 1953, CF, 1.
225 J. E. Miller et al., "Report of the Subcommittee on Fundamental Research to be Presented to the Central Refinery Loss Committee on April 12, 1954," 8 April 1954, CF, 1.
226 William C. Child, Chairman, Central Refinery Loss Committee to E.D. Reeves, Executive Vice-President, Standard Oil Development Company, 7 January 1955, CF, 2.
227 Fleming, *Inventing Atmospheric Science*, 145. See also Devra L. Davis, *When Smoke Ran Like Water: Tales of Environmental Deception and the Battle against Pollution* (New York: Basic Books, 2002).

Throughout the 1950s and in the early 1960s, visible and local air pollution hence prevailed as the key issue in both the political and the industrial circles.

In parallel to the activities undertaken by the Central Refinery Loss subcommittee, a similar project regarding industrial air and water pollution was developed in the city of Sarnia, in Canada. Located near Lake Huron, the city sits along the St. Clair river, which separate the U.S. state of Michigan from the Canadian Ontario province. Known as "Chemical Valley," the Sarnia area was the focus of a report by the St. Clair River Research Committee published in 1960.[228] Offering an insight into in-house research efforts regarding industrial pollution, the report presented the activities and project supervised by the St. Clair River Research Committee between 1956 and 1960, most of them surveys of air and water pollution in the Sarnia area.[229] Established in 1952, the committee comprised representatives from eleven industries active in the region. A mix of oil and chemical manufacturing companies, these included Imperial Oil, Dow Chemical, DuPont and Sun Oil (which later became Sunoco), among others.[230] The committee's findings were not meant to provide the foundation work for tighter governmental regulation of industrial operations. On the contrary, they were supposed to inform oil executives of any potential issue that needed to be remedied, thereby preventing any regulating attempts by local or state authorities from arising. One member of the St. Clair River Research Committee was also sitting on the city's technical advisory committee on air pollution.[231] Through that channel, the oil executives made sure to stay informed of any complaints brought by citizens before the city council, so as to avoid falling behind potential legislative moves.

A two-year survey on air pollution in Sarnia conducted between 1958 and 1960, and included in the 1960 report by the St. Clair River Research Committee, pointed out some of the reasons behind the "atmospheric

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[228] The St. Clair River Research Committee, "Control of Industrial Pollution in the Sarnia Area: Industrial Progress Report," November 1960, CF.
[229] Ibid., 2.
[230] After the dissolution of Standard Oil, which had acquired Imperial Oil, then a Canadian oil company, ownership of Imperial Oil was transferred to Standard Oil New Jersey (Esso); The St. Clair River Research Committee, "Control of Industrial Pollution in the Sarnia Area: Industrial Progress Report," 6.
[231] Ibid., 9.

contamination" by local industries at the Chemical Valley industrial complex.[232] The report singled out a number of contaminants responsible for air pollution. While some of the chemical reactions generated irritants and phytotoxic substances, the most immediately visible effect was that produced by smog-forming aerosols.[233] The formation of smog depends on local meteorological conditions, geophysical characteristics and the types of chemical substances released by industries. While the report recommended that "appropriate steps be taken to control, at the source wherever practicable, some of the losses of [these chemical substances]," it also underlined that the type of smog found in the Sarnia region was similar to the one found in Los Angeles, which was deemed less problematic than the type of smog that had resulted in more than four thousand deaths after a particularly severe episode in December 1952, known as the Great Smog of London.[234]

Because the St. Clair River report was probably written with a large distribution in mind, radiating beyond the purview of upper management at the various companies involved in the report, it did not dwell on complaints brought by citizens in Sarnia. But while that aspect did not appear in the report, the investigation at Sarnia had been prompted by mounting pressure from citizens and local authorities.[235] At a general meeting of the Central Refinery Loss Committee that took place at the Esso headquarters in New York City on 13 May 1960, a few months prior to the Sarnia report's publication, executives noted the increased legislative activity regarding air and water pollution abatement, as numerous bills at all three levels of government, federal, state and local, were introduced to establish more restrictive pollution controls. As stated in the meeting's minutes, executives noted that the "Los Angeles philosophy is gradually spreading and we can expect it to continue to do so."[236] The executives also underlined the problems

[232] Ibid., 22.
[233] The report defined phytotoxic as "causing damage to plants and vegetation." Ibid., 25. Aerosols were defined as "dusts and solids of very small particle size which remain suspended in the atmosphere for long periods of time." Ibid., 22.
[234] Ibid., 27.
[235] William C. Child, chairman, Central Refinery Loss Committee, to E.D. Reeves, Executive Vice-President, Standard Oil Development Company, 7 Jan 1955, CF, 2.
[236] Construction Engineering Division, Esso Research and Engineering Company, "Refinery Loss Committee: Minutes of the 30th General Meeting," 13 May 1960, CF, 1.

the industry was facing in terms of increasing opposition and complaints, and they recognized that the approach adopted by the industry in the early 1950s, when air pollution concerns first arose, would fail to stem the flow of legislation that threatened to come its way. "Be[ing] a good neighbor" did nothing to alleviate local communities' grievances and thus avert the prospect of costly regulation. As the meeting's minutes aptly summarized, executives recognized that "to delay such effort [at reducing air and water pollution] until compelled by authorities breeds bad public relations and invariably results in much greater expenditure."[237] New permits were also more difficult to obtain as a result of the negative public image of the industry, whose refineries were regarded as severe air and water pollution sources. It was thus very much in its interest to take conclusive action so as to preempt legislative offensives. Importantly, and as this section has demonstrated, the industry's main concern at the time did not pertain to carbon dioxide. Oil executives worried about the consequences of local and visible air pollution, for which the industry could be blamed, and whose tangible effects on the health of neighboring communities constituted a direct threat to their business. In the early 1960s, the burning of fossil fuels and the rise in carbon dioxide emissions did not appear as preoccupying matters to oil executives, because their consequences were deemed too distant. The CO_2 issue was not perceived as a potential disruptor to the industry, as it did not respond to the criteria of visibility and immediacy, contrary to conventional air pollution. As a result, industry-sponsored atmospheric research remained quite narrow, in line with the issues that concerned it the most.

Recognizing the threat posed by the prospect of tighter regulation at the state and federal levels affecting its business, the industry began to perceive the importance of swaying the public discourse on air pollution by investing more robustly in PR campaigns, an objective formulated by Monroe Jackson Rathbone, the president of Esso and the API's chairman, at the trade association's general meeting held in New York in November 1959. The API Smokes and Fumes Committee hence found itself a new mission: to

[237] Ibid.; The St. Clair River Research Committee, "Control of Industrial Pollution in the Sarnia Area: Industrial Progress Report," 1.

disseminate the results of its research projects, which had only been reported through the journals of professional societies such as *Air Repair*. In the spring of 1959, the API reorganized its Technical Publications Committee, which became the more ubiquitous Information Committee, and included public relation professionals with oil industry backgrounds.[238] In an article published in 1961, the coordinator of public affairs at Esso Standard and the chairman of that committee stated that its duty was to "get the general public to appreciate the meaning of those facts" that the industry's research arm had unearthed. An informed public would, in turn, "help to prevent unsound legislation, duplication of effort, waste and 'wheel spinning' at all levels."[239]

Beside its focus on combatting pollution at refineries' sites and its domestic efforts in preventing costly legislation from being implemented, the oil industry also entertained geopolitical concerns, centered around the perceived threat posed by growing Soviet oil exports. This concern is particularly interesting because of the close ties it reveals between the government and the oil industry, which have a long history.[240] One of the industry's avenues into the federal government was (and remains) the Department of the Interior, which oversees conservation and oil and gas drilling on public lands and off the nation's coastlines. Part of the resistance by the federal government to regulate fossil fuel emissions years later stemmed from that close relationship and oil executives' privileged access to government officials. Stewart Udall was Kennedy's and then Johnson's Secretary of the Interior from 1961 to 1969. Udall was recognized during his lifetime as one of the foremost figures of the conservation movement, and he left behind an impressive environmental legacy at the time of his death in 2010, among which are the Great Swamp National Wildlife Refuge in New Jersey, the Clean Air Act of 1963, the Wilderness Act of 1964, and the Endangered Species Act of 1966.[241] He told oil executives that "the Department of the Interior might well

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[238] G. A. Lloyd, "The Petroleum Industries' Air Pollution Control Program," *Journal of the Air Pollution Control Association*, 11, no.1 (1961), CF, 8.
[239] Ibid.
[240] See for instance David Painter, "Oil and the American Century", *The Journal of American History* 99, no. 1 (2012): 24–39.
[241] For a history of Udall's environmental legacy, see Thomas Gary Smith, *Stewart L. Udall: Steward of the Land* (Albuquerque: University of New Mexico Press, 2017).

be called the Department of the future" because of the impact of resource management and policies on future generations.[242] Describing himself as "a conservationist across the board with it comes to natural resources," in which he included oil, Udall was an advocate of oil conservation throughout his tenure.[243] But in the tensed Cold War context, oil conservation was not on the mind of industry executives and government officials as much as the threat posed by Soviet competition for market shares. Udall recognized that one of the challenges facing the industry was the fact that world consumption was outpaced by exploration and newfound oil fields. As a result, oil companies were forced to secure entry into new markets, and sponsor the development of "enlarged uses of petroleum," epitomized by the rise of the petrochemical branch of the oil industry.[244]

Two subjects dominated the opening sessions of the API annual meeting on 13 November 1961: internal remonstrances and the growing exports of Soviet oil.[245] Frank Porter, the president of the API, criticized oil representatives for failing to adapt domestic production output to the decreasing growth rates and thus contributing to overproduction. Monroe J. Rathbone returned to the public image concern he had voiced as he accepted the chairmanship of the API two years earlier, and expressed unease towards the "disorderly picture" presented by the industry, which he feared might result in more governmental regulation.[246] The second object was brought up by Mike Monroney, a Democratic Senator from Oklahoma. Monroney outlined an effort by Soviet leadership to compete with Western oil exporters in under-developed countries and thereby advance the Union's industrial development. According to the senator, the answer to this economic war resided in a "partnership between the government and the oil industry," which would deliver "a steady flow of intelligence on Soviet maneuvers" and tax

[242] Stewart L. Udall, "Remarks at the American Petroleum Institute Meeting," White Sulphur Springs, WV, 27 Jul 1961, Stewart L. Udall Papers, Special Collections, University of Arizona Libraries (UAL), Tucson, AZ, Box 93, Folder 4, 18.
[243] Ibid., 15.
[244] Ibid., 20.
[245] John J. Abele, "Monroney Calls Oil Exports Key Soviet Weapon," *New York Times,* November 14, 1961, 53.
[246] Ibid.

policies to "give every possible assistance to American companies in meeting Soviet prices."[247]

Government's partnership with the oil industry was not an idiosyncrasy of the Kennedy era. During World War II, the government had returned to the oil industry for support, the same way it had under the Woodrow Wilson administration. That wartime committee became the National Petroleum Council in 1946, an advisory committee to the Interior department and, from 1977 onwards, to the Secretary of Energy.[248] As Udall remarked in his address to a 1961 API meeting, "the Department [of the Interior] and the domestic petroleum industry have a long history of close and fruitful cooperation in the development of nation interest solutions to resource related problems," in part because one of the department's duties included its "mission as a principal petroleum agency of the Federal Government."[249] As the governmental institution overseeing the use of federal lands, the Interior department was (and remains to this day) a prime actor in selling leases and opening "major new oil provinces." A year later, Udall told the National Petroleum Council that government officials within the department needed to cultivate a "close" and "effective" relationship with industry leaders for the "good [of] our Nation."[250] Even as a dedicated environmentalist, Udall saw oil and gas as intrinsic components of the American way of life, and he did not contemplate the idea that this relationship might need to be revised. His invitation remained valid over the next decades, and the relationship of the oil industry with the government partly explains the latter's resistance to calls for implementing a national climate plan and transitioning to a low-carbon energy system.

1.8 Conclusion

[247] Ibid.

[248] Jie Jenny Zou, Chris Young, and Rachel Leven, "The unlikely partnership between Big Oil and the White House," *Center for Public Integrity*, December 12, 2017, https://apps.publicintegrity.org/united-states-of-petroleum/century-of-influence/.

[249] Stewart L. Udall, "Remarks at the American Petroleum Institute Meeting," 27 Jul 1961, Stewart L. Udall Papers, UAL, Box 93, Folder 4, 18.

[250] Stewart L. Udall, "Remarks Before the National Petroleum Council," 4 Oct 1962, Stewart L. Udall Papers, UAL, Box 104, Folder 1.

The era spanning the launch of Sputnik in 1957 until the final year of the Kennedy presidency witnessed the birth of atmospheric science. The Soviet move convinced the government to allocate more funding to basic research, and it also resulted in science being given a more prominent place in the decision-making process. In addition to these changes, the IGY launched a massive research effort on a global scale, and established international cooperation through the creation of world data centers. It also promoted dialogue and exchange between various disciples such as meteorology, oceanography, glaciology and geophysics, an interdisciplinary effort from which atmospheric science emerged. The IGY also allowed Charles Keeling to begin tracking atmospheric CO_2 concentrations at the Mauna Loa Observatory on Hawaii's Big Island. Besides the IGY itself, there were two indirect but crucial elements behind the rise of atmospheric science. One was the development of thermonuclear bombs and the nuclear fallout monitoring network, a global monitoring effort of the atmosphere that strengthened efforts the study the general circulation of air masses and oceanic currents. The other important development was the government's investment in weather modification research, which accompanied the advent of modern computerized meteorology and the first GCMs. Meanwhile, the NCAR, inaugurated in 1960, marked an important step in the institutionalization of atmospheric research.

Concurrently to these developments and the attempts by Keeling and others at defining CO_2 as a type of atmospheric pollutant, the oil industry began to take a closer look at air pollution, especially that emanating from its refineries. Contrary to global warming, localized and visible air pollution had indeed begun the attract lawmakers' attention at all three levels of government, which translated to an increase in bills requesting pollution abatement measures. Much as the signature of the Limited Test Ban Treaty in 1963 spoke to the growing realization of the impact of technology, not just nuclear power, on the geophysical processes of the earth, scientists and political leaders' confidence in the power of scientific advances and progress to generate economic growth yielded to a more nuanced view of science and technology, whose impact on ecosystems had grown more visible and problematic.

Chapter 2

The Global Commons Endangered: Awaking to the Environmental Crises (1964-80)

This chapter chiefly concerns itself with the Carter administration, as this period coincides with a surge of activity in climate science, legislation and politics, but it begins with an overview of significant developments that took place during the three preceding administrations, namely that of Johnson, Nixon and Ford. The realization by scientists and members of the political class that scientific breakthroughs and modern technology could have unforeseen impacts on the environment translated into the adoption of a spate of environmental laws and regulations in the early 1970s, as environmentalism appealed to a growing segment of the citizenry. On the scientific front, the first general circulation models indicated a warming trend and refuted the advent of a new ice age. The question of energy was especially acute after the first oil shock of 1973, and Congress established a new Department of Energy in 1977, whose Office of Carbon Dioxide Research would play an important role in climate research from this point onwards. The Carter administration also saw the publication of numerous reports on the subject, and the first scientific consensus that global warming would occur materialized in 1979.

Prompted by these developments and their potential for disrupting its main industry, Exxon quickly set up its own research program on the effects of rising concentrations of atmospheric CO_2. Embattled by the energy crises, the administration responded to the emerging threat by encouraging more research on climate change, but it refused to initiate a phase-out of fossil fuels. On the contrary, it deepened U.S. dependance on them by supporting the expansion of domestic oil production.

2.1 The Rise of Environmentalism and the Lead-Up to the Politicization of Climate Change

This section will briefly review developments in national and international environmental policy between 1964 and 1976, as well as advances in climate science and modeling, which contributed to turning the scientific subject of climate change into a political issue. As noted in the previous chapter, environmental pollution became more prominently discussed both in scientific and lay circles starting in the early 1960s. Lyndon Johnson's science advisor, Donald Hornig, recognized the need to assess threats to ecological systems and he worked to include environmental considerations in Johnson's Great Society program in 1964, organizing a workshop on environmental pollution that led to the publication of a report in 1965.[251] Authored by the President's Science Advisory Committee (PSAC), *Restoring the Quality of Our Environment* considered environmental pollution broadly, examining the sources and consequences of air, water and soil pollution. Discussing the effects of carbon dioxide in particular, the panel noted that the continuous burning of coal, oil and gas would add "about 25% more CO_2" in the atmosphere compared to 1965 levels by the turn of the century, causing "marked changes in climate."[252] In an appendix written by a special sub-panel chaired by Revelle, the authors labeled carbon dioxide "the invisible pollutant," and they listed in no uncertain terms some of its effects, melting the Antarctic sea ice, rising sea level and warming ocean water.[253] The authors also warned that a 25 percent increase in atmospheric CO_2 would cause the average temperature at the earth's surface to grow warmer by 0.6°C to 4°C.[254] These warnings were serious enough to be included in one of Johnson's Special Messages to Congress.[255] For different but obvious reasons given the

[251] Zuoyue Wang, "Donald F. Hornig," *American National Biography* (New York: Oxford University Press, 2018), 2. U.S. President's Science Advisory Committee (PSAC), *Restoring the Quality of Our Environment: Report of the Environmental Pollution Panel* (Washington D.C.: U.S. Government Printing Office, 1965).
[252] PSAC, Restoring the Quality, 9.
[253] Roger Revelle, Wallace Broecker, Harmon Craig, Charles D. Keeling, Joseph Smagorinsky, "Appendix Y4: Atmospheric Carbon Dioxide," in *Restoring the Quality*, 111-133.
[254] Revelle et al., "Appendix Y4: Atmospheric Carbon Dioxide," 121.
[255] Lyndon B. Johnson, "Special Message to Congress on Conservation and Reforestation of Natural Beauty, February 8, 1965, American Presidency Project, https://www.presidency.ucsb.edu/documents/special-message-the-congress-conservation-and-restoration-natural-beauty, cited by Naomi Oreskes and Erik Conway, *Merchants of Doubt: How a Handful of Scientist Obscured the Truth on Issues from Tobacco Smoke to Global Warming* (New York : Bloomsbury Press, 2010), 171.

report's emphasis on the role played by fossil fuels in global warming, the PSAC report's findings also landed in a speech by the president of the American Petroleum Institute (API) at the trade association's annual meeting.[256] The president of the API warned his peers that "this report unquestionably will fan emotions, raise fears, and bring demands for action," something the industry needed to be ready to quash.[257] He did not contest, however, one of the report's prediction that the burning of fossil fuels would "modify" the heat balance by the turn of the century, "possibly caus[ing] marked changes in climate beyond local or even national efforts."[258]

A testament to the growing awareness regarding the impact of human activity on ecosystems, and in response to the view that science and technology were potentially harmful to the environment, the Academy established the Environmental Studies Board in 1967—which Revelle was invited to join—on the eve of what historian David Stradling has called "the environmental moment" to characterize the period of increased environmental activism and heightened public concern for the environment that occurred between 1968 and 1972. As Stradling explains, this movement came from various segments of society: it was bipartisan; spanned generations; involved both the working class and the upper management of big companies; and its claims were heterogeneous, from improving urban environments to preserving wilderness.[259] The movement coalesced into the first Earth Day on April 3, 1970, and the passage of a number of landmark environmental laws that same year, such as the Clean Air Act, and the National Environmental Policy Act (NEPA), a law mandating that federal agencies conduct environmental impact assessments of their actions and proposed projects. NEPA created the President's Council on Environmental Quality (CEQ), an agency within the executive office of the President

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[256] Benjamin Franta, "Early Oil Industry Knowledge of CO_2 and Global Warming," *Nature Climate Change* 8 (2018): 1025.
[257] Frank N. Ikard, "Meeting the Challenges of 1966," American Petroleum Institute, Proceedings: 1965, CF, cited by Franta, "Early Oil Industry Knowledge," 1025.
[258] Ibid.
[259] David Stradling, ed., *The Environmental Moment: 1968-1972* (University of Washington Press, 2013), 4. On the bi-partisanship characterizing this period of increased environmental concerns, see Gregg Coodley, and David Sarasohn, *The Green Years, 1964-1976: When Democrats and Republicans United to Repair the Earth* (University Press of Kansas, 2021).

responsible for implementing NEPA and overseeing completion of impact assessment reports by federal agencies, and preparing the president's annual report to Congress on the "quality" of the nation's environment, governmental policies and their results.

Through a series of executive orders, Nixon established the Environmental Protection Agency (EPA), an independent agency within the federal government tasked with enforcing numerous environmental laws protecting air, water and land quality. Another executive order by Nixon created The National Oceanic and Atmospheric Administration (NOAA) within the department of Commerce, a scientific agency responsible for monitoring oceanic and atmospheric conditions, observing and predicting changes in Earth systems. Finally, new environmental advocacy groups, such as the Environmental Defense Fund (1967), Friends of the Earth (1969), the Natural Resources Defense Council (1970) and Greenpeace (1971) joined the National Audubon Society and the Sierra Club to exert pressure on states and the federal government to compel them to address environmental matters.[260]

Revelle had left the Scripps Institution of Oceanography in 1964 to lead the Center for Population Studies at Harvard, a research institute he had co-founded to study issues of population growth. Fears of "explosive" population growth, especially in the developing world, coupled with a rarefaction of natural resources due to overconsumption and widespread pollution, had become prominent political topics in the second half of the 1960s, and more so after the publication in 1968 of the best-seller *The Population Bomb* by Paul Ehrlich, a professor of biology at Stanford. In an outlet published by Planned Parenthood, a nonprofit health-care organization, Revelle wrote a scathing review of *Population/Resources/Environment: Issues in Human Ecology*, another book by Ehrlich, co-authored with his wife Anne and released in 1970.[261] Depicting Ehrlich as the "new high priest of ecocatastrophe," Revelle criticized the biologists' "fervent evangelism" that had gripped "many of the diviners of imminent ecological catastrophe caused

[260] Stradling, ed., The Environmental Moment, 8.
[261] Roger Revelle, "Paul Ehrlich : New High Priest of Ecocatastrophe," *Family Planning Perspectives* 3, no. 2 (April 1971): 66-70.

by overpopulation."[262] Revelle contended that population growth was an important element in the debate around sustainable uses of natural resources, but so were questions of equity, both in accessing resources and in sharing the burden of the pollution caused by human activity. A couple of years later, he spoke of the United States as "an island of affluence in a sea of scarcity" at a symposium on the "Politics of Scarcity" organized by the University of California at San Francisco in April 1976. At the UC SF symposium, Revelle observed that developed economies consumed 85 per cent of the world's industrial output and services, while two-thirds of humanity subsisted on the remaining 15 per cent.[263] Revelle concluded his talk with a warning, stating that "all people of our planet must march forward together to help each other solve our problems, now held in common by all, or we will indeed observe the disintegration of the West."[264]

Amid these debates around resource scarcity, scientists began to talk about the biosphere's physical limits in providing resources and absorbing waste (of which pollution is a form). So-called systems sciences grew interested in the reactions occurring within closed systems, especially ones submitted to stress factors, similar to what the earth experienced under growing human activity and societies' industrial imprint. Four reports were prepared between 1969 and 1972 that warned about humanity's growing impact on the global environment.[265] Written for the Club of Rome, an international forum debating global problems, *The Limits to Growth* became an international best-seller. Except for this one, all the reports had been prepared ahead of the U.N. Conference on the Human Environment that took

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[262] Ibid., 66.
[263] Paul Sorensen, "A Symposium : the Politics of Scarcity," *Synapse (The UCSF Student Newspaper)* 20, no. 22, April 8, 1976, 1.
[264] Ibid.
[265] Study of Critical Environmental Problems (SCEP), *Man's Impact on the Global Environment. Assessment and Recommendation for Action: Report on the Study of Critical Environmental Problems* (The MIT Press, 1970); International Council of Scientific Unions (ICSU), Scientific Committee on Critical Problems of the Environment (SCOPE*), Global Environmental Monitoring: A Report Submitted to the United Nations Conference on the Human Environment, Stockholm 1972* (Stockholm: ICSU-SCOPE, 1971); Study of Man's Impact on Climate (SMIC), *Inadvertent Climate Modification: Report of the Study of Man's Impact on Climate* (The MIT Press, 1971); Donella H. Meadows, Dennis L. Meadows, Jørgen Randers, and William W. Behrens III, *The Limits to Growth : A Report for the Club of Rome's Project on the Predicament of Mankind* (New York: Universe Books, 1972).

place in Stockholm in June 1972. While there had been other U.N conferences on the environment between 1968 and 1971, such as the 1968 UNESCO conference on the protection of the biosphere, Stockholm is the one that stuck in the public consciousness, perhaps because it had led to the creation of the United Nations Environment Programme (UNEP). The Conference did not focus specifically on problems pertaining to the atmosphere, but two of the 109 recommendations of its Action Plan called for additional research on and monitoring of climate change.[266]

The Nixon years proved pivotal for the science-public policy nexus. The PSAC clashed with the administration on technical issues that were of utmost importance to the administration, most notably the Supersonic Transport (a civilian aircraft designed to fly at speeds exceeding the speed of sound) and the Anti-Ballistic Missile (ABM) Treaty, an arms control treaty between the United States and the Soviet Union aimed at reducing the number of ABM systems used by both nations to shield their and allied territories from nuclear weapons.[267] But the Vietnam War, which many scientists and members of PSAC opposed, contributed the most to the hostile climate between the committee and the president, as scientists began to call into question the role of scientific progress and technological development in the war.[268] The largest U.S. scientific organization, the American Association for the Advancement of Science (AAAS) issued numerous resolutions between 1965 and 1972 supporting a peaceful resolution of the Vietnam War, and in the end denounced the U.S. military's resort to chemical warfare and the war itself.[269] PSAC members' disapproval of the administration's policy in Vietnam only intensified after the Cambodian invasion and the bombing of Laos. When Edward David, his science advisor, resigned in January 1973 to become the vice-president of an electronics firm, Nixon seized the

[266] 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 (November 2021): 3.
[267] For a detailed account of the PSAC's demise under Nixon, see Zuoyue Wang, *In Sputnik's Shadow: The President's Science Advisory Committee and Cold War America* (New Brunswick, NJ: Rutgers University Press, 2008), 287–310.
[268] Joshua P. Howe, *Behind the Curve: Science and the Politics of Global Warming* (Seattle: University of Washington Press, 2014), 59.
[269] Howe, *Behind the Curve*, 60.

opportunity and he dismantled the PSAC.[270] He also abolished the Office of Science and Technology (OST) that Kennedy had created in 1962. All of the Office's duties, as well as those of the science advisor, got transferred to the National Science Foundation (NSF), and the NSF director acted as the president's science advisor for three years. In 1976, Congress revived the OST by creating the Office of Science and Technology Policy (OSTP), whose chairman would serve as the president's science advisor, as it had been the case previously.

At the Academy's annual meeting in April 1974, the NAS president's report offered a good overview of the context in which the scientific body was operating. The oil crisis was still very present, and with it the prospect of a looming exhaustion of world oil reserves; also evoked were issues related to the physical limits of the planet, the difficulty of building models such as that used in the *Limits to Growth* report, uncontrolled population growth and the perceived threat of overpopulation. Philip Handler, the Academy's president, also spoke of the abrupt transition from "the exuberant economics of abundance" in the western world to "the economics of scarcity" brought by the first oil crisis, in which science would come to play an even more important role in "avoid[ing] sharp discontinuities, minimiz[ing] political threats," and perhaps even "defer indefinitely an otherwise inexorable reduction in living standards as formerly abundant low cost resources dwindle."[271] Although not at the forefront of environmental threats and political issues, Handler mentioned that "some worry about the adverse effects of […] climatic trends already in progress."[272]

[270] Wang, *In Sputnik's Shadow,* 306. Many years later, D. Allan Bromley, George H. W. Bush's science advisor, ventured that betrayal and a lack of loyalty towards the president had precipitated the death of the science advisor post and that of PSAC. Bromley declared in the interview: "As you remember, PSAC died in 1972, I think. It died for a very obvious reason, and that was that the members of the then PSAC committed suicide, in a very real sense. They were given access to classified information, and tentative thought schemes of various possible courses of action the administration might take, and asked for their advice, they went public, and went screaming around talking to newspaper men and beating the administration over its head. Not surprisingly, President Nixon said, 'Do I need these bastards?'" D. Allan Bromley, interview by Finn Aaserud on October 30, 1986, Niels Bohr Library & Archives, American Institute of Physics, College Park, MD.

[271] National Academy of Sciences, "Annual Report of the President," April 23, 1974, H. Guyford Stever Papers, Gerald R. Ford Presidential Library, Ann Arbor, MI, Box 100, Folder "National Academy of Sciences - Annual Meeting, 1975," 4.

[272] Ibid.," 5.

The Central Intelligence Agency (CIA) had also picked up on the issue, producing a report in August 1974, in which climate change was discussed in relation to the "small chance" that the world might experience "chronic food scarcity."[273] Atmospheric sciences, and climate modeling in particular, made some breakthroughs in the mid-1970s. Computerized models of the climate had been continuously refined since the development of the first general circulation model in 1956. In 1975, Japanese-American climatologist Syukuro Manabe and U.S. meteorologist Richard Wetherald, who both worked at Princeton University's Geophysical Fluid Dynamics Laboratory, built a three-dimensional general circulation model that predicted a warming of about 3.5°C for a doubling of carbon dioxide levels in the atmosphere from their pre-industrial levels.[274] Although the CIA report had stated that "climatologists hold widely varying opinions on the direction, pace, and permanence of climate change," and the media had published sensational accounts of a coming ice age, the majority of scientific publications predicted a global warming as a result of increasing concentrations of atmospheric CO_2, and the so-called cooling hypothesis, which predicted a global cooling, had begun to recede from the scientific conversation starting in 1973.[275]

2.2 The Carbon Dioxide Issue Takes on a New Urgency: The 1977 NAS *Energy and Climate* Report

The end of the 1970s and the Carter administration's single-term constitute a crucial period in the history of climate change science and that of climate

[273] U.S. Central Intelligence Agency (CIA), "A Study of Climatological Research as it Pertains to Intelligence Problems," Working Paper of the Office of Research and Development, August 1974, 652. Available at: https://history.state.gov/historicaldocuments/frus1977-80v02/d209; CIA, "Potential Implications of Trends in World Population, Food Production, and Climate," Central Intelligence Agency, Directorate of Intelligence, Office of Political Research, August 1974. These confidential reports were made public by the Library of Congress in May 1976. See Howe, *Behind the* Curve, 103-104.
[274] Spencer R. Weart, *The Discovery of Global Warming* (Harvard University Press, 2003), 97.
[275] Thomas C. Peterson, William M. Connolley, and John Fleck, "The Myth of the 1970s Global Cooling Scientific Consensus," *Bulletin of the American Meteorological Society* 89 (2008): 1325–1337, cited by Bonneuil, Choquet, and Franta, "Early Warnings and Emerging Accountability," 3. CIA, "A Study of Climatological Research as it Pertains to Intelligence Problems," 655.

change as a political object. In particular, the year 1977 marks a turning point, as it saw the publication by the Academy of one its first reports documenting the effects of rising temperatures across the globe as a direct consequence of fossil fuel combustion. Global warming had made its way into previous reports, but always in conjunction with other environmental issues, as it had in the 1965 President's Science Advisory Committee Report, *Restoring the Quality of Our Environment*. This section will examine the significance of a report authored by a Geophysics panel of the National Academy of Sciences under the chairmanship of Roger Revelle who, as we saw in the previous chapter, had demonstrated a sustained interest in the growing accumulation of CO_2 in the atmosphere since the early 1950s. The published report, *Energy and Climate : Studies in Geophysics* played a pivotal role in alerting lawmakers and executives from the fossil fuel industry to the threat posed by the carbon dioxide build-up in the atmosphere.[276]

In 1974, the NAS Geophysics Research Board established a Geophysics Study Committee to conduct a series of "Studies in Geophysics," the first of which was *Energy and Climate*, to provide science-based advice to policymakers on matters involving geophysics.[277] At the time of its publication, four other studies were in an advanced stage or near completion. *Energy and Climate* was therefore not a stand-alone study, but it would be the most consequential one.[278] The Geophysics Research Board thought that the survey of the field that the studies would conduct was timely: geophysics was evolving rapidly, and it could respond to new societal concerns about the environment.[279] Work on *Energy and Climate* began shortly after the Geophysics Research Board's plan for the series of studies was approved by

[276] National Research Council, Geophysics Research Board, Geophysics Study Committee, *Energy and Climate: Studies in Geophysics* (Washington, D.C.: The National Academies Press, 1977).
[277] Geophysics Study Committee, "Studies in Geophysics," February 10, 1977, Roger Revelle Papers, UCSD, Box 37, Folder 2 "Geophysics Research Board, 1959-1977, part 2 of 2," 1; Geophysics Research Board, "Brief Overview," May 18, 1977, Roger Revelle Papers, UCSD, Box 37, Folder 2 "Geophysics Research Board, 1959-1977, part 2 of 2," 1.
[278] Geophysics Study Committee, "Studies in Geophysics," February 10, 1977, Roger Revelle Papers, UCSD, Box 37, Folder 2 "Geophysics Research Board, 1959-1977, part 2 of 2," 2.
[279] National Academy of Sciences, Geophysics Research Board, "Studies in Geophysics," Draft, May 15, 1974, Roger Revelle Papers, UCSD, Box 37, Folder 11 "NAS, Panel on Energy and Climate, 1970 –1975, part 2 of 2," 1-2.

the NAS Governing Board in March 1974.[280] In a letter to Revelle dated July 26, 1974, Hugh Odishaw, the dean of the College of Earth Sciences at the University of Arizona and a member of the Geophysics Study Committee, offered a draft outline for the study. The panel had been asked to produce a study on future energy consumption levels and their impacts on the climate, but their work was undertaken in the aftermath of the first oil crisis, which had erupted in October 1973. In Odishaw's letter, the report was titled *Energy and Climate: Outer Limits to Growth?*, an explicit reference to the (in)famous *Limits to Growth* report by the Club of Rome, published just two years earlier.[281] This title, which prevailed until late in the process because it remained unchanged in December 1976, mirrored a shared sentiment among the authors of the report, who insisted on the role of fossil fuels in the coming climate crisis and the need to pivot towards other energy sources, not because of depleted oil reserves, but because of the warming induced by the release of unlimited amounts of carbon dioxide into the atmosphere.[282] The reference to extrinsic limits to growth highlighted the fact that the era of fast oil-fueled economic growth might be coming to an end because of external (i.e. environmental) factors, namely concerns that had nothing to do with the laws of economics. While the reference to the existence of biological limits was eventually erased in the published version of the report, the preface still spoke of the "possible constraints placed on energy use by the danger of climatic change," hence holding onto the idea of external obstacles that were not related to world oil and gas supplies or market forces.[283] By talking of an outside barrier to growth, the title also expressed an uneasy thought for many:

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[280] Hugh Odishaw to Roger Revelle, July 26, 1974, Roger Revelle Papers, Special Collections & Archives, UC San Diego (UCSD), La Jolla, CA, Box 37, Folder 11 "NAS, Panel on Energy and Climate, 1970 –1975, part 2 of 2 ;" National Academy of Sciences, Geophysics Research Board, "Studies in Geophysics," Draft, May 15, 1974, Roger Revelle Papers, UCSD, Box 37, Folder 11 "NAS, Panel on Energy and Climate, 1970 –1975, part 2 of 2," 6.

[281] Hugh Odishaw to Roger Revelle, July 26, 1974, Roger Revelle Papers, UCSD, Box 37, Folder 11 "NAS, Panel on Energy and Climate, 1970 –1975, part 2 of 2;" National Academy of Sciences, Geophysics Research Board, "Energy and Climate: Outer Limits to Growth?," Draft, June 29, 1974, Roger Revelle Papers, UCSD, Box 37, Folder 11 "NAS, Panel on Energy and Climate, 1970–1975, part 2 of 2."

[282] Geophysics Research Board, Geophysics Study Committee, "Energy and Climate: Outer Limits to Growth?", Draft, December 21, 1976, Roger Revelle Papers, UCSD, Box 37, Folder 10 "NAS, Panel on Energy and Climate, 1970 –1975, part 1 of 2."

[283] National Research Council, *Energy and Climate,* xii.

that governmental intervention might be required to avert climate change, because the market did not factor in distant, environmental threats.

The task of the panel was, in Revelle's words, "to try to estimate possible climatic effects of future human energy consumption, including the effects of hot spots [i.e. sites which generate a lot of GHG emissions] and carbon dioxide and particulate emission."[284] In other words, the report was an attempt at addressing all of the problems associated with fossil fuel combustion, not just the production of CO_2. However, and as Revelle noted in his introductory chapter, carbon dioxide emissions had "the greatest apparent potential for disturbing global climate over the next few centuries," even if he had recognized in 1975 letter that "prudence requires that we prepare for a possible worsening of climate, but nobody can tell whether or how such a worsening will occur."[285] One interesting detail regarding the composition of the report relates to the changes made to the outline. A draft outline dated June 1974 showed that the report was originally divided into four parts presenting the general context; the impact of energy production; an assessment of the carbon dioxide problem through monitoring and modeling; and an action plan.[286] The first three parts made it into the printed publication, but the last part on the action plan and policy recommendations disappeared. Yet the Geophysics Research Board was sensitive to the supposed thread tying science to policymaking when it established its serial studies project. An early internal document explicitly mentioned the fact that "the Studies will provide a series of reports directed toward policy makers, with a view toward […] postulating criteria for rational judgments and for developing priority directions."[287]

[284] Roger Revelle to Wallace Broecker, July 9, 1975, Roger Revelle Papers, UCSD, Box 37, Folder 10 "NAS, Panel on Energy and Climate, 1970 –1975, part 1 of 2."
[285] National Research Council, *Energy and Climate,* 2; Roger Revelle to Wallace Broecker, July 9, 1975, Roger Revelle Papers, UCSD, Box 37, Folder 10 "NAS, Panel on Energy and Climate, 1970 –1975, part 1 of 2."
[286] National Academy of Sciences, Geophysics Research Board, "Energy and Climate: Outer Limits to Growth?," Draft, June 29, 1974, Roger Revelle Papers, UCSD, Box 37, Folder 11 "NAS, Panel on Energy and Climate, 1970 –1975, part 2 of 2."
[287] National Academy of Sciences, Geophysics Research Board, "Studies in Geophysics," May 15, 1974, Roger Revelle Papers, UCSD, Box 37, Folder 11 "NAS, Panel on Energy and Climate, 1970 –1975, part 2 of 2," 6.

A year later, in the summer of 1975, as contributions were coming in, the outline was modified again but the action plan chapter was still mentioned, although this time it was called "social aspects and policy," and the paper's author would be Revelle, and not the panel as a whole.[288] Revelle's records do not indicate why the Geophysics Research Board decided to forego that particular chapter. What we do know is that there were concrete plans for that chapter. John Perry, the executive secretary to the NAS Climate Research Board and himself the holder of a PhD in meteorology, wrote what he called "a springboard" to the actual chapter.[289] Did Revelle disagree too much with Perry's draft or was he too busy to work on the chapter himself? Or was Revelle not convinced that it would be good enough for publication and that policy recommendations were premature at that point? In any case, Perry's draft did not lead to a chapter in the final version of the report. Yet excerpts from his work are worth citing in order to understand what those policy recommendations might have been, and to capture the views of the panel, on which Perry must have at least partly relied when preparing the document. While *Energy and Climate* was moderate in its conclusions, the views of some of the panel's members were not. In a list of points to be included in Revelle's introductory chapter, a document for the Geophysics Study Committee noted gravely: "key point—world is at edge of survival."[290]

Perry's draft chapter reflected that same urgency in its tone. While acknowledging that fundamental research in atmospheric chemistry and climate modeling should be "vigorously pursued" in the short term, and recognizing that "the impacts of climate variations, if any, produced by future

[288] Geophysics Study Committee, Panel on Energy and Climate, "Records of Actions," June 20, 1975, Roger Revelle Papers, UCSD, Box 37, Folder 10 "NAS, Panel on Energy and Climate, 1970 –1975, part 1 of 2," 1 and 3; Geophysics Study Committee, "Study on Energy and Climate (New Outline – 20 June 1975," Roger Revelle Papers, UCSD, Box 37, Folder 10 "NAS, Panel on Energy and Climate, 1970 –1975, part 1 of 2," 1.
[289] John Perry to Roger Revelle, Tom Malone, Hugh Odishaw, and Pembroke Hart, "Energy and Climate Study," Memorandum, May 23, 1975, Roger Revelle Papers, UCSD, Box 37, Folder 10 "NAS, Panel on Energy and Climate, 1970 –1975, part 1 of 2."
[290] Geophysics Study Committee, Panel on Energy and Climate, "Records of Actions," June 20, 1975, Roger Revelle Papers, UCSD, Box 37, Folder 10 "NAS, Panel on Energy and Climate, 1970 –1975, part 1 of 2," 1 and 3; Geophysics Study Committee, "Study on Energy and Climate (New Outline – 20 June 1975," Roger Revelle Papers, UCSD, Box 37, Folder 10 "NAS, Panel on Energy and Climate, 1970 –1975, part 1 of 2," 2.

energy use will be felt by our children, not by us," Perry also warned that "the distant time horizon and the quantitative uncertainty of our concerns cannot be allowed to permit indefinite postponement of concrete efforts."[291] Perry remarked that a report by the U.S. Committee for the Global Atmospheric Research Program (GARP) had just released a study on natural climatic variations, but the *Energy and Climate* report sought to prompt more research into the man-made climate effects of energy production and the burning of fossil fuels.[292] One of Perry's ideas that survived the omission of the draft chapter was that the Energy Research and Development Administration (ERDA) be given the leadership in directing federal agencies such as NASA, NSF and NOAA in studying uncertainties regarding future energy uses and energy production's byproducts.[293] ERDA was eventually incorporated into what became the Department of Energy in August 1977, but the idea remained and the new department inherited the mandate to coordinate research into the climatic impacts of carbon dioxide emissions.

Energy and Climate was prepared and published in the context of oil shortages and price surge, and a simmering political crisis. In the foreword to the report, Philip Abelson and Thomas Malone, the Geophysics Study Committee's co-chairmen, praised the panel's efforts to study the long-term effects of energy use, arguing that "with the end of the oil age in sight, we must make long-term decisions as to future energy policies."[294] Their perspective was a rational, scientific one: if the burning of fossil fuels proved to be so harmful to the climate system, then the world needed to transition to a new, carbon-free energy system. The Geophysics Study Committee's co-chairmen thought that good science would lead to good policymaking, and that knowledge of the danger posed by climate change would influence future energy policies. Adopting the dispassionate tone of science, they explained

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[291] John Perry, "Chapter IV: An Action Plan," May 23, 1975, Roger Revelle Papers, UCSD, Box 37, Folder 10 "NAS, Panel on Energy and Climate, 1970 –1975, part 1 of 2," 2-3.
[292] United States Committee for the Global Atmospheric Research Program (GARP), *Understanding Climatic Change: A Program for Action* (Washington, D. C.: National Academy of Sciences, 1975); John Perry, "Chapter IV: An Action Plan," May 23, 1975, Roger Revelle Papers, UCSD, Box 37, Folder 10 "NAS, Panel on Energy and Climate, 1970 –1975, part 1 of 2," 4-5.
[293] John Perry, "Chapter IV: An Action Plan," May 23, 1975, Roger Revelle Papers, UCSD, Box 37, Folder 10 "NAS, Panel on Energy and Climate, 1970 –1975, part 1 of 2," 9.
[294] National Research Council, *Energy and Climate*, vii.

that "the results of the present study should lead neither to panic nor to complacency" and that the "lively sense of urgency" applied only to "resolving the scientific uncertainties that remain."[295] They also anticipated that "the primary limiting factor" on oil-derived energy use would not be the market, but the impacts on the climate of carbon dioxide emissions.[296] While acknowledging the differences between the outcomes predicted by the various climate models of the study, they nevertheless pointed out that a four- to eightfold increase of carbon dioxide in the atmosphere would lead to an increase in the global mean temperature of more than 6°C in the latter part of the twenty-second century, far surpassing any natural temperature fluctuations the climate system had experienced over the past millennia.[297] For all their cautiousness, they concluded that, should these "preliminary estimates of climate change" be validated by further research, "a reassessment of global energy policy must be started promptly because, long before that destined date, there will have been major climatic impacts all over the world."[298]

Historian of science Gabriel Henderson argues that high-level science advisors and administrators within scientific organizations, as well as science officials in the White House, adopted a politics of restraint and moderation in managing climate risks, so as to assuage the fears prompted by alarming scenarios of a climate breakdown of an anxiety-prone citizenry.[299] This "heuristics of moderation," in Henderson's view, was deemed by these officials as way to buy time and let experts devise solutions to the climate issue without the pressure of having to act fast and under the constraints of a public whipped up by irrational fears of impending climatic doom. Following his argument, Henderson places Revelle squarely within that movement of restraint, an interpretation I disagree with. In the "Overview and Recommendations" introductory chapter he prepared on behalf of the Geophysics Research Board, Revelle adopted a more urgent tone than that of

[295] Ibid., viii.
[296] Ibid.
[297] Ibid.
[298] Ibid., ix.
[299] Gabriel Henderson, "Adhering to the 'Flashing Yellow Light': Heuristics of Moderation and Carbon Dioxide Politics During the 1970s," *Historical Studies in the Natural Sciences* 49, no. 4 (2019): 384–419.

Malone and Abelson, when he observed that "if the decision is postponed until the impact of man-made climate changes has been felt, then, for all practical purposes, the die will already have been cast."[300] Revelle also cited the work of Syukuro Manabe and Richard Wetherald, whose climate model of the general circulation of the atmosphere, "the most complete one yet devised," predicted a 2-3°C increase in average temperatures for a doubling of atmospheric CO_2.[301] Revelle reiterated the point that "the prospect of damaging climatic changes may thus be the stimulus for […] a more rapid transition to alternate energy sources than is justified by economic considerations alone."[302] After exposing a long list of the potential effects of climate change, Revelle concluded his discussion of the problem by declaring that no practical countervailing measures existed, such as increasing the earth's albedo (reflectivity) or storing carbon in the biosphere, while mitigation efforts, such as increasing the resilience of the world's food-supply systems "would require planning, research, and investment of international scope on an unprecedented scale."[303] As such, a turn towards renewable energy sources and a decrease in carbon dioxide emissions appeared as "a more practical alternative to these countervailing measures."[304] Revelle understood the importance of curbing fossil fuel emissions, and nothing in his words suggests that he advocated a "wait-and-see" approach or restraint in climate policy.

Frank Press, Carter's science advisor and the director of the White House Office of Science and Technology Policy (OSTP), apparently was not convinced by what he read. On July 7, 1977, shortly before the publication of the report, he sent a memo to the president in which he sought to strike a delicate balance between acknowledging the seriousness of the threat and downplaying the need for preventive action. According to Press, who chose to quote Abelson and Malone rather than Revelle, the NAS report highlighted

[300] National Research Council, *Energy and Climate*, 3.
[301] Revelle, "Overview and Recommendations," *in* NAS Geophysics Study Committee, *Energy and Climate*, 4; Syukuro Manabe, and Richard T. Wetherald, "The Effect of Doubling the CO_2 Concentration on the Climate of a General Circulation Model," *Journal of Atmospheric Sciences* 32 (1975): 3.
[302] National Research Council, *Energy and Climate*, 5.
[303] Ibid., 14.
[304] Ibid.

"the growing weight of scientific support which raises the CO_2-climate impact from speculation to a serious hypothesis worthy of a response that is neither complacent nor panicky."[305] Press relayed the report's findings that within sixty years, global temperatures could rise from 0.5°C to 5°C, and that such "a climatic fluctuation may result in large scale crop failures […]."[306] Press also recognized that "the situation could grow out of control before alternate energy sources and other remedial actions become effective," yet he declared that "the present state of knowledge does not justify emergency action to limit the consumption of fossil fuels in the near term."[307] Beyond conservation efforts, Press recommended that global warming be incorporated into the administration's long-term energy strategy, and to look more closely at the options provided by nuclear power and alternative renewable sources. The Academy organized an event with government representatives to present the report's findings. The *New York Times* dedicated two articles to it, one of which appeared on the issue's front page. Walter Sullivan, the newspaper's science reporter, emphasized that the central recommendation of the report was that an interdisciplinary effort at the national and international level was required to narrow down the existing uncertainties regarding climate change. He also quoted Thomas Malone, one of the chairmen of the Geophysics Study Committee, who spoke of the report as a "'flashing yellow light'" saying 'Watch out.'"[308] Despite Malone's emphasis on the report's cautious concern, one of Exxon's corporate scientists spoke of the "sensational publicity" the report had received.[309]

The sudden leap in scientific research on climate change was prompted by a combination of factors. One of these was the predictions of Manabe and Wetherald's climate model, which signaled a 2-3°C increased temperature for a doubling of atmospheric CO_2 levels in a not-so-distant

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305 Frank Press to the President, Memorandum, "Release of Fossil CO_2 and the Possibility of a Catastrophic Climate Change," July 7, 1977, Records of the Office of Science and Technology Policy, Frank Press' Subject Files, Jimmy Carter Presidential Library (JCPL), Atlanta, GA, Box 6, Folder "Environment, 7/12/77-9/25/79."
306 Ibid.
307 Ibid.
308 Walter Sullivan, "Scientists Fear Heavy Use of Coal May Bring Adverse Shift in Climate," *New York Times*, July 25 1977, 1.
309 James F. Black, "'The Greenhouse Effect', Transcript of a Talk Delivered Before the PERCC Meeting, May 18, 1978," CF, 3.

future. Another reason for the growing interest in carbon dioxide were the energy crises that jolted the decade, but also offered an opportunity to rethink the United States (and the world)'s overreliance on fossil fuels, whose environmental liabilities, especially with regard to the climate, offered even more reasons to initiate a transition to other energy sources. These were on the minds of the scientists who authored *Energy and Climate*, but the report's findings collided with fears of diminishing petroleum supplies in the short-term (U.S. oil imports had accounted for some forty percent of the total national consumption since the first oil crisis, making it very vulnerable to the whims of the OPEC).[310] The report's concerns regarding the burning of fossil fuels and their impact on the climate system also failed to sway Press, who took issue with the report's singling out of the oil and gas industry in causing global warming. Carter's science advisor would go on to play a major role in downplaying the report's findings and pushing for more oil at all costs, as the subsequent sections of this analysis will make clear.

2.3 Creation of the Department of Energy (DoE), the National Climate Program Act of 1978, and DoE-Sponsored Carbon Dioxide Research

Because of the major role it went on to assume in climate research, I want to briefly explain how the Department of Energy came to be. Among the many issues the 1973 oil crisis had highlighted was the need to centralize national energy policy. In 1974, Ford abolished the Atomic Energy Commission and replaced it with two entities: the Nuclear Regulatory Commission, responsible for regulating commercial nuclear power, and the Energy Research and Development Administration (ERDA), which was required to manage all non-commercial uses of nuclear energy, including the development of nuclear weapons, as well as energy research and development programs.[311] Three months after his arrival at the White House, Carter

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[310] "Oil and petroleum products explained: oil imports and exports," U.S. Energy Information Administration, accessed *July 11, 2022,* https://www.eia.gov/energyexplained/oil-and-petroleum-products/imports-and-exports.php.
[311] Alice L. Buck, *A History of the Energy Research and Development Administration* (Washington, D.C.: U.S. Department of Energy, 1982); —, *A History of the Atomic Energy Commission* (Washington, D.C.: U.S. Department of Energy, 1983).

announced his intention to establish a Department of Energy as part of his National Energy Plan, proposing to merge ERDA and a dozen of agencies dealing with federal energy programs into a single entity.[312] Before Carter signed The Department of Energy Organization Act of 1977, in August of that year, his administration wrestled with Congress over what, exactly, the new department would look like. In an early memo commenting on the draft bill, an OSTP official complained that "administrative leadership might be lost" as a result of the vague character of the bill, and that "there is so little consensus about energy and a Department of Energy" to begin with.[313] Aside from the danger of seeing "a lot of congressional 'fixing' of the legislation" due to a lack of specificity in the bill's titles, especially regarding the department's objectives, another contentious point between the administration and Congress related to the research component of the proposed department.[314] The bill called for the creation of an Office of Energy Research to lead the DoE's basic research portfolio but, as another OSTP official remarked, while half of the department's budget were to go to its R&D program, the latter only received a "four-line statement" in the bill.[315]

Alerted by both congressional staff and representatives of the scientific community about perceived attempts by the administration at downgrading the role of science within the new department, Press relayed these concerns to James Schlesinger, Carter's special advisor on energy, a former Republican Secretary of Defense whom the president had nominated to head the future department.[316] As the bill was making its way into both chambers, Press asked Schlesinger to show his support for the DoE's R&D program, "one of the largest and strongest […] in the world," and to respond

312 Ibid.
313 Philip Smith to Russell Drew, OSTP, and Joe Kearney, OMB, "Comments on the Department of Energy Organization Act," Memorandum, February 24, 1977, Frank Press Papers, Massachusetts Institute of Technology (MIT), Department of Distinctive Collections, Cambridge, MA, Box 41, Folder "Energy Policy--DoE, 1977–1980," 1.
314 Ibid., 1–2.
315 Russell Drew, OSTP, to Ronald Peterson, OMB, "Energy Organization," Memorandum, February 25, 1977, Frank Press Papers, MIT, Box 41, Folder "Energy Policy-- DoE, 1977 – 1980," 1.
316 Frank Press to James Schlesinger, Stu Eizenstat, Bert Lance, Memorandum, March 11, 1977, Frank Press Papers, MIT, Box 41, Folder "Energy Policy-- DoE, 1977 – 1980." W. K. H. Panofsky to Frank Press, April 15, 1977, Frank Press Papers, MIT, Box 41, Folder "Energy Policy-- DoE, 1977 – 1980."

to the concerns of scientists with whom the DoE would collaborate who "feel demeaned and are worried and uncertain about the future because they received no signal from you on the role of research in the new Department."[317] As it stood to take over the management of national laboratories from ERDA, the DoE was poised to become one of the largest nexus of Big Science in the U.S., funding basic and applied research, from high energy physics to advanced technologies in renewable and non-renewable energy sources.

The administration's push for federally-sponsored research manifested itself in the first domestic piece of climate legislation: the National Climate Program Act, signed into law by Carter in September 1978.[318] The bill had been introduced on a bi-partisan basis by members of Congress who felt concerned that climatic changes were already impacting their constituents, from farmers and ranchers to business owners operating in industrial production or logistics. The climate program was developed to respond to the forecasting needs of a broad swath of society, but the question of the practical consequences of climate change on human systems, in particular on world food production, predated the introduction of the bill. In the early 1970s, crop failures in the Sahel and in the Soviet Union caused by prolonged droughts had spurred fears about similar scenarios affecting U.S. agricultural production, and a special committee of the White House Domestic Council had suggested the creation of a national climate program to improve climate prediction capability already in 1974.[319]

Three years later, these members of Congress were not questioning whether climate change was happening: they accepted that it was, and they

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[317] Frank Press to James Schlesinger, Memorandum, May 12, 1977, Frank Press Papers, MIT, Box 41, Folder "Energy Policy-- DoE, 1977 – 1980."

[318] For an in-depth analysis of the various legislative stages of the National Climate Program Act, and the Carter administration's opposition (especially that of Press) to the Congressional version of the bill with its bottom-up, user-oriented approach to climate governance, see Gabriel Henderson, "Governing the Hazards of Climate : The Development of the National Climate Program Act, 1977-1981," *Historical Studies in the Natural Sciences* 46, no. 2 (April 2016): 207–242.

[319] William Bartley to Frank Press, "Issue paper on climate research 12/01/76," April 29, 1977, Frank Press Papers, MIT, Folder "Climate, 1977–1979." U.S. Domestic Council Subcommittee on Climate Change, *A United States Climate Program* (Dec 1974). This was followed by another climate program report: National Academy of Sciences, *Understanding Climate Change – A program for Action* (Washington D.C.: Printing and Publishing Office, 1975), both cited by Henderson, "Governing the Hazards of Climate," 208.

were concerned about what the practical aspects of a warming world would mean for agricultural, industrial and energy planners, what George Brown, a Democratic House representative from California and a co-sponsor of the bill, broadly referred to as "users of climate knowledge."[320] But more than passive users of meteorological forecasts produced by the federal government, Brown and his colleagues had in mind a service-oriented program that would generate climate knowledge from the bottom-up through federal research grants attributed to anyone working with climate data, from farmers to state climatologists, to local industries and policymakers.[321] Following hearings held in April 1977, and in an attempt to convey to the president the most salient points of the congressional testimonies supporting his policy project, Brown explained that he envisioned not just a climate program with a research capability, but one with "an operational means of getting predictive and monitoring data to those for whom it is important."[322] Although he and supporters of the bill in the Senate intended for the law to fund a service-oriented climate program, providing their constituents with climate forecasting tools designed to help them withstand the fluctuations of a changed climate and to decrease their vulnerability to its impacts, the administration had a very different goal in mind, as historian of science Gabriel Henderson has shown.[323]

Moving away from the practical applications that Congress sought, Press and the OSTP worked hard to reframe the bill towards a federal research program. At a Senate hearing convened in June 1977, Press framed his statement around the need to design a climate program suited for "policy planning and analysis on a broad scale."[324] In a memo to the president a month later, Press explained that he was working with other federal agencies on a national climate research program to get "a better assessment of the CO_2

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[320] George E. Brown Jr., "Opening Statement: Review of the Preliminary Plan for the National Climate Program," July 10, 1979, Roger Revelle Papers, UCSD, Box 120, Folder 2 "National Climate Program, 1979, part 1 of 2," 2.
[321] Henderson, "Governing the Hazards of Climate," 209.
[322] George E. Brown Jr. to President Jimmy Carter, April 7, 1977, Roger Revelle Papers, UCSD, Box 53, Folder 4 "Energy and climate, 1975 – 1979, part 4 of 6," 1.
[323] See Henderson, "Governing the Hazards of Climate," 223–232.
[324] U.S. Congress, Senate Subcommittee on Science, Technology and Space, Hearing, *The National Climate Program Act: Hearings*, 95th Congress, 1st session, June 1977 (Washington, D.C.: U.S. Government Printing Office, 1977), 96.

hazard," demonstrating his resolution to establish a program dedicated primarily to basic research in atmospheric science.[325] At the June hearing, Press argued that the program's research findings could not be used in any practical ways because of the "probabilistic" nature of climate predictions, and he warned about "unduly raising expectations in the matter of such vast importance to millions of people which we may not be able to satisfy."[326] The concerns he raised may have come from a genuine political calculus, as he warned senators that underdelivering might come at a price and compromise their re-election. But as Henderson explains, Press also had private motives that led him to defend a research-only climate program.[327] One of these was that he was wary of jeopardizing the science advisory function to the executive branch that had been restored just a year earlier, and more generally of hurting the standing of the scientific community and its access to the federal government. Another reason for Press's reluctance to follow Congress was his willingness to bring the OSTP closer to power and to the center of policy decisions within the White House, by aligning the science office's views with that of the Office of Management and Budget (OMB), whose director objected to Brown's legislative agenda. Finally, Press had serious misgivings about the predictive capability of climate science to meet the practical needs of individual users. On the other hand, he argued that a robust federal research program would ultimately benefit the government in making informed policy choices, and positively impact these climate data users.

The National Climate Program Act led to the creation of the National Climate Program Office, the national focus for all climate-related programs, and an entity to be administered by the National Oceanic and Atmospheric Administration (NOAA) within the Department of Commerce. The bulk of climate and CO_2 research, however, landed in the newly established Department of Energy which, over the years, would produce numerous reports on the effects of carbon dioxide. The department's predecessor, the

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[325] Frank Press to the President, Memorandum, "Release of Fossil CO_2 and the Possibility of a Catastrophic Climate Change," July 7, 1977, Records of the Office of Science and Technology Policy, Frank Press' Subject Files, JCPL, Box 6, Folder "Environment, 7/12/77-9/25/79."

[326] Senate Subcommittee on Science, Technology and Space, *The National Climate Program Act*, 98.

[327] Henderson, "Governing the Hazards of Climate," 226–231.

Energy Research and Development Administration (ERDA), had seized the carbon dioxide issue in 1976, and organized what turned out to be an influential conference for climate research in March 1977. Held in Miami Beach, Florida, the workshop included seventy-five leading scientists in climatology and climate modeling.[328] In the preface to the conference report, the editors stated that "implicit in all the panel reports is the acceptance of increasing atmospheric CO_2 content, well documented since 1958 and most probably the case since the industrial era began."[329] The editors also stressed that one could not conclude that the burning of fossil fuels would "bring on catastrophic climate changes," yet they warned that "the best current estimates do indicate potential problems."[330] In a measured but resolute tone, they concluded that "it behooves all to heed the warnings inherent in these calculations and support efforts to reduce the uncertainties of the predictions."[331]

Under the federal reorganization of climate change research brought by the National Climate Program Act, the DoE was not supposed to conduct research itself, unlike NASA or NOAA, but it was responsible for overseeing the production of an assessment report documenting priority research needs in the science of climate change through its Office of Health and Environmental Research. Drawing on the findings of the Miami Beach workshop, the DoE published a two-volume "Comprehensive Plan for CO_2 Effects Research and Assessment" in 1980, which identified areas where further research was required to understand the climatic response to elevated concentrations of atmospheric CO_2 under various scenarios of CO_2 releases.[332] The second volume, dedicated to the societal consequences of

[328] William Elliott and Lester Machta, ed., Workshop on the Global Effects of Carbon Dioxide from Fossil Fuels, Miami Beach, Florida, March 7-11, 1977. Carbon Dioxide Effects Research and Assessment Program (Washington D.C.: U.S. Department of Energy, May 1979).
[329] Ibid., v.
[330] Ibid., vi.
[331] Ibid.
[332] U.S. Department of Energy, A Comprehensive Plan for Carbon Dioxide Effects Research and Assessment. Part I: The Global Carbon Cycle and Climatic Effects of Increasing Carbon Dioxide (Washington D.C.: Carbon Dioxide and Climate Division, August 1980); U.S. Department of Energy, Environmental and Societal Consequences of a Possible CO_2-Induced Climate Change: A Research Agenda (Washington D.C.: Carbon Dioxide and Climate Division, December 1980).

climate change, was the result of a two-year process that had begun with a conference held in Annapolis in April 1979, the first of a series of workshops jointly organized by the DoE and the American Association for the Advancement of Science (AAAS), an international non-profit science organization based in the United States, whose climate panel's chairman was none other than Revelle. Attended by eighty-five scientists, the workshop's five panels produced reports on the physical, biological, agricultural, social and economic impacts of climate change.

In a second phase following the workshop, Revelle and a steering committee composed of the five panels' chairmen identified research issues that remained understudied but were critical to the understanding of a CO_2-induced climate change. Thirty papers were commissioned that recommended potential research projects, from which the steering committee drew up a more condensed research agenda. That condensed agenda formed the second volume of the DoE's comprehensive plan. In his introduction to the published volume, Revelle exhibited a more concerned disposition than the editors of the Miami Beach workshop report had shown, declaring that atmospheric levels of carbon dioxide would be higher and average temperatures would be warmer "than at any time during the last 100,000 years."[333] He also found it "less likely, though not impossible" that the continuous increase in carbon dioxide emissions could trigger an abrupt transition into a new climatic regime, as opposed to a slow rise in the mean global temperature.[334] In either scenarios, he noted, the accumulation of CO_2 and the associated changes "may be irreversible on a human time-scale, requiring several hundred to a thousand years before the added carbon dioxide is sequestered in deep ocean water."[335] In assuming that solid, scientific documenting of the consequences of climate change could be used to pave the way for "a rational groundwork for policies and actions […]," Revelle perfectly embodied the "forcing function of knowledge," or the notion that policymaking necessarily ensued

[333] Ibid.; Roger Revelle, "Introduction," in U.S. Department of Energy, *Environmental and Societal Consequences*, 1.
[334] Ibid.
[335] Ibid.

from the scientific demonstration of a problem.[336] In the short-term, however, the massive, two-part research plan developed by the DoE and the AAAS was intended to guide the U.S. funding strategy for CO_2 research coordinated by the National Climate Program Office.[337] David Slade, the director of the DoE's Office of Carbon Dioxide, told Revelle that this "comprehensive and interdisciplinary research program" was directly inspired by what he and his peers had called for in *Energy and Climate*.[338]

Slade was in frequent contact with Revelle and he knew how to pay him a compliment, especially when he sought his input. At the time, Slade was indeed hard at work building an ambitious program for the DoE's carbon dioxide research unit. As he explained to Revelle, he envisioned a ten-year plan, which would culminate in the publication of two reports on the fifth and tenth year of the program, in 1984 and 1989 respectively. Slade envisaged the 1984 report to be no less than "the most authoritative statement of CO_2 costs or benefits that can be made at that time."[339] His overarching plan was to channel the work of climatologists to policymakers, using the resources and funding capabilities of the DoE. In the foreword to the second volume of the comprehensive plan, Slade explained that this publication "marks the beginning of the end of the major part of the Department of Energy's planning activity," and that important work, especially on the societal impact of climate change, could now begin in what he hoped would become "a network of cooperative international research efforts."[340] But by the time his words were published, Reagan had won the election, and the arrival of the Republican administration would substantially upend Slade's vast project for the DoE's Office of Carbon Dioxide's research program.

[336] Ibid., 4. On the concept of the forcing function of knowledge and the problematic "science-first" type of climate change advocacy, see Howe, *Behind the Curve*, 107–12.
[337] David Slade to Roger Revelle, May 14, 1979, Roger Revelle Papers, UCSD, Box 138, Folder 9 "'Environmental and Societal Consequences of a Possible CO_2 Induced Climate Change,' Annapolis, 1979 April 2-6, General information and correspondence, 1979, part 1 of 3," 1.
[338] Ibid., 3.
[339] Ibid.
[340] David Slade, "foreword," U.S. Department of Energy, *Environmental and Societal Consequences*.

2.4 The OSTP Organizes itself to Thwart Calls for Action as Scientific Alerts to the Potentially Deleterious Consequences of Global Warming Multiply

As many scholars have noted, 1979 marks a turning point in the political history of climate change. That year, the Academy published an authoritative report entirely dedicated to the carbon dioxide issue, and an international meeting was convened in Geneva to discuss the emerging threat of climate change. Howe writes that, at the end of the 1970s, climate scientists entertained high hopes that legislation regulating CO_2 emissions appeared within reach and that the next decade would witness the adoption of science-based climate legislation.[341] Nathaniel Rich's investigative essay also opens on the premise of the imminence of a policy breakthrough that ought to have followed the scientific consensus which had emerged by 1979.[342] The issue of climate change had undeniably gathered momentum under the Carter administration, starting in 1977 with the publication of *Energy and Climate*. But as this section will show, scientists' optimism and belief that scientific evidence would translate into public policy betrayed a lack of understanding of the politics behind the legislative process, and they failed to take into account the context in which climate change emerged in the political and legislative arenas. That context was the major economic and political disruption brought by the second oil shock.

Climate change's début on the global environmental governance the stage occurred at the first World Climate Conference that took place in Geneva in February 1979. Convened under the auspices of the World Meteorological Organization, it gathered scientists from a wide range of disciplines, but no heads of state were present. Among the attendees was Stephen Schneider, who had founded the climate project at the National Center for Atmospheric Research, in Boulder, Colorado, a few years earlier. Schneider recalled in his memoir that he expected "a controversial meeting,"

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[341] Howe, *Behind the Curve*, 116–117.

[342] Nathaniel Rich, *Losing Earth: The Decade We Could Have Stopped Climate Change* (London: Picador, 2019), 1–10.

and he was not disappointed.[343] In one of the plenary sessions, John Mason, the head of the British Meteorological Office, denied that human activities would modify the climate systems because of its resilience.[344] According to Schneider, Mason and others also berated an economist whose paper focused on estimating the costs of climate change.[345] Despite the controversial exchanges in the meetings, the scientists agreed that it was "now urgently necessary […] to foresee and to prevent potential man-made changes in climate that might be adverse to the well-being of humanity."[346] The conference's declaration adopted a conservative outlook on the subject, stating that "uncertainty exists about many of [the causes of climate variations and their relative importance]," and finding it "plausible" that increased levels of atmospheric CO_2 could lead to "a gradual warming of the lower atmosphere."[347] That being said, the declaration also asserted that if the effects of climate change became significant by the middle of the next century, this period of time was "similar to that required to redirect, if necessary, the operation of many aspects of the world economy, including agriculture and the production of energy," a bold statement given the cautiousness regarding the science documenting the issue itself.[348] Heeding the calls for more research outlined in the declaration, U.N. delegates subsequently acquiesced to the WMO's proposal to establish the World Climate Programme, which concerned itself mainly with applied climate research but also comprised a global research aisle through its World Climate Research Programme.[349]

Two months after the World Climate Conference, the JASON, a secret elite group of scientists advising the government on matters of national security, contributed a report on *The Long Term Impact of Atmospheric Carbon Dioxide on Climate,* in which they stated that CO_2 levels in the

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[343] Stephen Schneider, *Science as a Contact Sport: Inside the Battle to Save Earth's Climate* (Washington, D.C.: National Geographic, 2009), 80–81.

[345] Schneider, *Science as a Contact Sport*, 83.
[346] World Meteorological Organization (WMO), *Declaration of the World Climate Conference (*Geneva: World Meteorological Organization, 1979), 1.
[347] Ibid., 2.
[348] Ibid.
[349] Paul N. Edwards, *A Vast Machine : Computer Models, Climate Data, and the Politics of Global Warming* (Cambridge: MIT Press, 2010), 376–77.

atmosphere were expected to double by 2035.[350] The group of physicists had constructed two models of the ocean-atmosphere system, one of which predicted an increase of the average surface temperature of 2.4°C for a doubling of CO_2, which was consistent with the findings of the most complete model of the general circulation of the atmosphere at the time, that of Manabe and Wetherald, which predicted a 2-3°C rise.[351] In the conclusions to the first section of the report, dedicated to a study of the impacts of increased levels of carbon dioxide, U.S. geophysicist Gordon MacDonald, an early climate advocate, wrote that "despite the many uncertainties […], it seems highly probably that continued increased [sic] in the world-wide use of carbon based fuels […] will lead to climatic changes in the second half of the 21st century."[352] He prescribed more research as he deemed the dangers associated with a warming world "sufficiently serious" to warrant such effort, but only recommended that policymakers paid "continued attention" to the carbon issue.[353] The report chiefly concerned itself with the DoE's comprehensive research plan, of which it offered some critiques, but it did not venture into policy matters. We know from an internal memo that, at a meeting where MacDonald was presenting the JASON's work on climate change, John Deutch, a senior DoE executive, had tried to discourage the group from drawing up any policy proposals, perhaps explaining the final report's silence in that regard.[354] We also know from that same memo that Press, Carter's science advisor and the director of the OSTP, was briefed on the report's principal scientific conclusions, none of which were particularly heart-warming, but that did nothing to alter his views on climate change.[355]

A few months later, yet another report reached the administration. Written by Revelle, Keeling, MacDonald and U.S. biologist George

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[350] Ann K. Finkbeiner, *The Jasons: The Secret History of Science's Postwar Elite* (New York: Penguin, 2006), cited by Oreskes and Conway, *Merchants of Doubt*, 171. Gordon MacDonald et al., *The Long Term Impact of Atmospheric Carbon Dioxide on Climate* (Arlington, VA: SRI International, 1979), i.
[351] Gordon MacDonald et al., The Long Term Impact of Atmospheric Carbon Dioxide on Climate, iii.
[352] Ibid., 28.
[353] Ibid., 29.
[354] Richard "Dick" Meserve, "CO_2 File," Memorandum, October 10, 1979, Frank Press Papers, MIT, Box 41, Folder "Carbon Dioxide (CO_2) , 1978–1980."
[355] Ibid.

Woodwell (the lead author), the report was prepared after James Speth, the chairman of the President's Council on Environmental Quality, promised MacDonald, who was seeking to alert top governmental officials in various departments and agencies, that he would bring the issue to the president, if MacDonald delivered "a reliable, scientifically credible memorandum."[356] The four scientists did not mince their words: the report laid bare the threat in unequivocal terms, stating that "man is setting in motion a series of events that seem certain to cause a significant warming of world climates over the next decades unless mitigating steps are taken immediately."[357] The authors warned that waiting longer before acting would make the effects of global warming "more difficult to control" and that changes to the climate system would have "unpredictable consequences," and they recommended that the CO_2 issue be considered in all future developments of energy policy.[358]

In a foreword to a 2008 reprint of the report, Speth explains that the DoE responded negatively to the report's findings. Indeed, the department was working on developing "synfuels" (synthetic fuels produced through chemical processes from coal, oil shale and tar sands), whose emissions dwarfed those of conventional fossil fuels. Additionally, Press was personally informed by the director of the U.S. Geological Survey (USGS), a scientific agency within the Department of the Interior, of an article USGS scientists had recently submitted to *Science*, which described the high CO_2 emissions of the oil shale component of the synthetic fuel program.[359] The USGS director warned Press about "the controversy" that these findings might "reignite," underlining how contentious the CO_2 issue had become.[360] Records do not tell us whether Press received a copy of the Woodwell report, but he was most probably apprised of its main conclusions. Presumably

[356] James G. Speth, "foreword", in George M. Woodwell, Gordon J. MacDonald, Roger Revelle, and Charles D. Keeling, *The Carbon Dioxide Problem: Implications for Policy in the Management of Energy and Other Resources. A Report to the Council on Environmental Quality* (July 1979), 2.
[357] Woodwell et al., The Carbon Dioxide Problem, 7.
[358] Ibid., 11.
[359] Eric Sundquist and G.A. Miller, "Oil Shales and Carbon Dioxide," *Science* 208, no. 4445 (16 May 1980): 740-741. H. William Menard (USGS) to Frank Press, November 15, 1979, Frank Press Papers, MIT, Box 41, Frank Press Papers, MIT, Folder, "Carbon Dioxide (CO_2) , 1978–1980."
[360] Ibid.

because he needed to hear from a purportedly neutral scientific authority, something Press must have decided the Woodwell-led tetrad was not, and because, as historians of science Naomi Oreskes and Erik Conway note, none of the JASONs were climatologists themselves, Press asked the Academy to weigh in on the issue by preparing another report on the subject.[361]

Led by U.S. meteorologist Jule Charney, an ad-hoc panel met at the Academy's summer studies center at Woods Hole, Massachusetts, to assess the conclusions drawn from various models of the global atmospheric circulation. Finding them consistent with one another, the panel asserted that a doubling of atmospheric CO_2 would result in a global warming of 3°C (one most likely comprised between 1.5-4°C), potentially disrupting a host of social and environmental systems.[362] Another important finding was that, for all their imperfections and approximations, "none of the model calculations predicts negligible warming," and the panel stood by its conclusion that "there will be appreciable warming."[363] It also alerted its audience to the role played by the ocean in delaying the effects of a global warming by several decades: "We may not be given a warning until the CO_2 loading is such that an appreciable climate change is inevitable."[364] Recognizing that "the conclusions of this brief but intense investigation may be […] disturbing to policymakers," Verner Suomi, the chairman of the NAS Climate Research Board, warned that "[a] wait-and-see policy may mean waiting until it is too late."[365] The Charney report, as it became referred to, was the first report to the U.S. government presenting the consensus among climatologists on a CO_2-induced global warming.[366] Emanating from a respected scientific body,

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[361] Oreskes and Conway, *Merchants of Doubt,* 172.
[362] National Academy of Sciences, Climate Research Board, *Carbon Dioxide and Climate: A Scientific Assessment* (Washington D.C.: The National Academies Press, 1979), 1. On the question of the institutionalization of scientific assessments and consensus-building in the policy-making process, see "The Need for Expert Judgement," *in* Michael Oppenheimer, Naomi Oreskes, Dale Jamieson, Keynyn Brysse, Jessica O'Reilly, Matthew Shindell, and Milena Wazeck, *Discerning Experts: The Practices of Scientific Assessment for Environmental Policy* (Chicago: The University of Chicago Press, 2019), 1–18.
[363] National Academy of Sciences, *Carbon Dioxide and Climate*, 1–2.
[364] Ibid., 2.
[365] Verner Suomi, "Foreword," National Academy of Sciences, *Carbon Dioxide and Climate*, viii.
[366] Naomi Oreskes, Erik M. Conway, and Matthew Shindell, "From Chicken Little to Dr. Pangloss: William Nierenberg, Global Warming, and the Social Deconstruction of Scientific Knowledge," *Historical Studies in the Natural Sciences* 38, no. 1 (2008): 116.

it was also a major milestone in the scientific acknowledgment of global warming.

Press and the OSTP did not waste time mounting a counter-effort. In a letter dated October 5, 1979, weeks before the Charney report was released publicly, an OSTP policy analyst in charge of the carbon dioxide question asked Suomi, to whom the Charney committee were to report, whether "a possible follow-on effort" might be considered by the board at its next meeting.[367] The policy analyst conceded that "we obviously have not yet had an opportunity to examine the [Charney] report," yet his claim sounds dubious and the OSTP probably had first-hand knowledge of the report's outline.[368] After all, this was not some highly-classified information, nor was the panel's work conducted in secret. This alleged white lie matters because it underlines the fact that the OSTP sought to appear neutral in its efforts to seek a follow-up study, and to not disclose that it had an agenda for the future report. At any rate, the OSTP official knew precisely about the report's Achilles heel, namely the fact that the panel had not examined the question of when the consequences of climatic changes would be felt.[369] As Oreskes and her peers have shown, the omission of a timescale for climate change's effects would have direct consequences in creating a breach that climate change skeptics used to quell policy measures before these were even formulated.[370]

The OSTP request for a follow-up assessment was granted, and the NAS Climate Research Board asked U.S. physicist William Nierenberg to get in touch with the OSTP and to start forming an ad-hoc panel.[371] Nierenberg, the director of the Scripps Institution of Oceanography in La Jolla, California, was well aware of the developments around the carbon dioxide issue, as one of the authors of the 1979 JASON report, a member of the NAS Climate Research Board, and a former chair of the National Advisory Committee on Oceans and Atmosphere (NACOA), an advisory body created by Congress in

[367] Richard Meserve, OSTP, to Verner Suomi, NAS Climate Research Board, October 5, 1979, Frank Press Papers, MIT, Box 41, Folder, "Carbon Dioxide (CO_2) , 1978–1980."
[368] Ibid.
[369] Ibid.
[370] Oreskes, Conway, and Shindell, "From Chicken Little to Dr. Pangloss," 120–1.
[371] John Perry to Richard Meserve, OSTP, October 30, 1979, Frank Press Papers, MIT, Box 41, Folder, "Carbon Dioxide (CO_2), 1978–1980."

1971 to assess oceanic and atmospheric issues. Oreskes and her colleagues speak of the lobbying Nierenberg engaged in a few months later to secure the chairmanship of the Academy's third assessment report, published in 1983.[372] This was probably not the first time he sought to position himself strategically, and he must have done it for the Academy's second assessment too, on whose panel he sat as well. Undoubtedly, his lobbying efforts succeeded because he had the ear of Press. Nierenberg's skepticism on the issue, although, at that point, he had not advertised as publicly as he would starting in the mid-1980s, must have been known to Press and the OSTP.

At any rate, by the end of January 1980, the panel for the report on the economic and social impacts of climate change was established. Its chairman, Thomas Schelling, was a well-regarded professor of economics at Harvard.[373] Among the other panelists were at least two climate change skeptics. The first one was an agronomist at Michigan State University, Sylvan Wittwer, who had chaired the panel on climate change's effects on agriculture at the DoE-AAAS 1979 Annapolis workshop. The workshop's report would only be published in October 1980, but Wittwer's views on the subject were known to Revelle (who was also on the panel) and to all who had attended the workshop. Wittwer supported the idea, later rehashed by oil companies in their own climate change denial campaigns, that a "CO_2-enriched" atmosphere would benefit crops and plants through the role played by carbon in photosynthesis and increase agricultural production. In a series of comments written ahead of the workshop, presumably sent to the members on his panel, Wittwer argued that climate change could "be viewed as an opportunity," as opposed to "a threat, problem, risk or catastrophe [having] dislocating effects," following the characterization of most climatologists, meteorologists and ecologists.[374] The second climate change skeptic on the

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[372] Oreskes, Conway, and Shindell, "From Chicken Little to Dr. Pangloss," 123.
[373] Ibid., 124.
[374] A month later, Wittwer wrote his last memo to members on the agricultural effects panel at the DoE-AAAS Annapolis workshop. This time, he did not label climate change an opportunity but merely "an issue or a phenomenon," although he reiterated the need to refrain from considering it "necessarily a problem, a risk, a threat, or a catastrophe." Perhaps Revelle had asked him to adopt a more neutral tone. Whatever happened in that last memo, Wittwer ultimately did not renounce his views, as the workshop's published report later showed. Sylvan Wittwer to Panel III "Environmental Effects on the Managed Biosphere," February 16, 1979, Roger Revelle Papers, UCSD, Box 138, Folder 9

panel was William Nordhaus, a professor of economics at Yale. Nordhaus' skepticism stemmed less from a belief that climate change could be beneficial (*à la* Wittwer), or benign, but that the price to transition away from fossil fuels was prohibitive compared with the costs of a warmer climate.

Although the panel also included Revelle and Joseph Smagorinsky, an eminent meteorologist and the director of the Geophysical Fluid Dynamics Laboratory at Princeton University, the inclusion of climate change skeptics was no accident. On the contrary, an important factor in the composition of the panel was the fact that its members had been handpicked by the OSTP. In a memo to Press, an OSTP official referred to the panel thus formed as "our proposed group," and he supported a suggestion by another member of the panel that someone from OSTP attend the first meeting "to set the stage for the panel."[375] Another revealing point was the fact that OSTP was warned that NOAA's climate office and the DoE's Carbon Dioxide Office might regard the completion of that assessment as "intrusion on their turf," perhaps suggesting that the OSTP was conducting its operation without consulting the two agencies.[376]

Due to time and budget constraints, the panel produced an eleven-page letter report which was completed by April 1980.[377] In its proposal, the Climate Research Board had stated that the objective of the study was to develop recommendations about new lines of research on the socio-economic

"'Environmental and Societal Consequences of a Possible CO_2 Induced Climate Change,' Annapolis, 1979 April 2-6, General information and correspondence, 1979, part 1 of 3," 1-2; Sylvan Wittwer to Members, Panel III, Environmental Effects on the Managed Biosphere of the AAAS Workshop on Environmental and Societal Consequences with a Possible CO_2 Induced Climate Change, Annapolis, MD, April 2-6, 1979, March 13, 1979, Roger Revelle Papers, UCSD, Box 53, Folder 1 "Energy and climate, 1975 – 1979, part 1 of 6," 2.

[375] Richard Meserve (OSTP), "Conversation with John Perry on 1/31/80," Memorandum to CO_2 File, February 1, 1980, Frank Press Papers, MIT, Box 41, Folder, "Carbon Dioxide (CO_2), 1978–1980;" Richard Meserve (OSTP), "Conversation with Bob White," Memorandum to CO_2 File, January 25, 1980, Frank Press Papers, MIT, Box 41, Folder, "Carbon Dioxide (CO_2), 1978–1980."

[376] Richard Meserve (OSTP), "Conversation with John Perry on 1/31/80," Memorandum to CO_2 File, February 1, 1980, Frank Press Papers, MIT, Box 41, Folder, "Carbon Dioxide (CO_2), 1978–1980.

[377] Oreskes and Conway, *Merchants of Doubt*, 174. See also Oreskes, Conway, and Shindell, "From Chicken Little to Dr. Pangloss," 124–6.

implications of climate change.[378] But as Oreskes and Conway note, the panel used the study as an opportunity to negate the need for public policy, by emphasizing uncertainties in the social sciences examining climate change as well as shortcomings in the physical sciences, a fact they argued called for more research and prohibited political measures.[379] In fact, they abhorred the term "political," recommending that research be conducted "*with as low a political profile as possible*," as if they themselves were speaking from a platform devoid of ideology.[380] Joining the chorus of fellow skeptics on the panel, Schelling also argued, although he had no training in climatology whatsoever, that climate change effects might not all be "necessarily unfavorable."[381] The report adopted the views of the economists, declaring that what truly mattered was the timing of climate change, not the change itself. It concluded that the issue would unfold gradually, leaving ample time for adaptation.[382] Henderson argues that Shelling's argument for political restraint with respect to climate policy, which in effect amounted to advocating for governmental inaction in reducing carbon dioxide emissions, at least in the near and medium term, did not deviate from the "already-existing consensus position of political restraint as defined by scientific and political communities" at the time.[383] "If anything," Henderson writes, "Schelling merely reaffirmed the tapestry of logic that had been at play since the release of Revelle's NAS report in 1977."[384] But as we saw earlier in the discussion, Revelle and Suomi did not favor nor did they urge political inaction on climate change, as they understood that waiting to know more about the issue might cause irreparable harm.

It is not altogether clear why Revelle agreed to associate himself with the letter report at all, as the economists' findings and recommendations were at odds with his policy proposals in previous reports. Perhaps he viewed that publication as inherently less valuable than the Charney report or *Energy and*

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378 NAS/NRC Climate Research Board, "Carbon Dioxide: Initiatives for Economic and Social Research," undated, Frank Press Papers, MIT, Box 41, Folder, "Carbon Dioxide (CO_2), 1978–1980," 2.
379 Oreskes and Conway, *Merchants of Doubt,* 174.
380 Ibid., 176 (emphasis in the original source document).
381 Ibid., 175.
382 Oreskes, Conway, and Shindell, "From Chicken Little to Dr. Pangloss," 124.
383 Henderson, "Adhering to the 'Flashing Yellow Light,'" 415.
384 Ibid., 416.

Climate, being a much less extensive work, and thought that it would not matter much. Or maybe he felt that economics and the social science issues at the heart of the CO_2 conundrum had been relatively unaddressed in other reports, and he thought that scientists from other disciplines ought to have a say in the matter, and he respected their views even if he did not share them. Another reason might be that he may have not suspected the ideological motives of the climate skeptics on the panel, because their professional affiliation did not make them "obvious" fossil fuel proponents at the time. As far as we know, in the early 1980s, no one among the skeptics had any connections to or had received any financial incentives from the oil industry to express these views.[385]

On April 3, 1980, the same month the Academy issued its letter report, the Senate committee on energy and natural resources held a hearing on the issue of the carbon dioxide build-up.[386] In his opening remarks, Paul Tsongas, a Democratic senator from Massachusetts, cited the Charney report and explained that even if the precise timeline of climate change was not yet established, "[its] ultimate effects may be no less destructive when they do occur," and as such the issue required a prompt response that the administration was not working on.[387] On the contrary, and this was another reason for convening the hearing, the executive branch was actively promoting its synthetic fuels and coal program.[388] One of the four scientists called to testify, MacDonald reminded senators that although all models were trying to predict when a doubling of atmospheric CO_2 could be expected, climatic changes would occur before reaching that threshold, and a

[385] Many years earlier, in 1972, as part of his work on the NAS Environmental Studies Board, Revelle had voiced his concerns regarding the composition of a panel assembled to review surface mining, because he thought the panel included a majority of representative of that very industry, who had a "vested interest" in minimizing its environmental impact. There were no discernible vested interests (at the time) in the case of Nierenberg, Wittwer, Schelling or Nordhaus. See Roger Revelle to Ruben Brown (National Academy of Sciences), December 18, 1972, Roger Revelle Papers, UCSD, Box 36, Folder 8 "Environmental Studies Board, 1967 – 1975;" Roger Revelle to George Kistiakowsky, December 18, 1972, Roger Revelle Papers, UCSD, Box 36, Folder 8 "Environmental Studies Board, 1967 – 1975."

[386] U.S. Congress, Senate, Committee on Energy and Natural Resources, Hearing, *Effects of Carbon Dioxide Buildup in the Atmosphere*, 96th Congress, 2nd Session, April 3, 1980 (Washington D.C.: U.S. Government Printing Office, 1980).

[387] Committee on Energy and Natural Resources, Effects of Carbon Dioxide Buildup in the Atmosphere, 3.

[388] Ibid.

temperature raise of 1C° would already impact human infrastructures.[389] In an article published a year later in the scientific journal *Climatic Change*, John Perry, the executive secretary to the NAS Climate Research Board, reiterated that point:

> Physically a doubling of CO_2 is no magic threshold. If we have good reason to believe that a 100 per cent 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.[390]

In his recommendations, MacDonald advocated that the U.S. government demonstrate leadership in international arenas, not only in pursuing international research efforts, but also to make the carbon dioxide issue a central element in the U.S. and other national governments' energy policies. He also recommended that the administration considered the alternatives offered by renewable energy sources and the potential of conservation initiatives.[391] Woodwell, who was also present at the hearing, argued that reforestation and measures to prevent the loss of forests to agriculture would help mitigate the problem, but he insisted that "there isn't much question but that we need a policy of limitation in the use of fossil fuel energy," and that the United States' own political agenda in that regard would greatly influence other nations' behavior.[392]

Two other reports were also specifically prepared for the administration that year, both by the President's Council on Environmental Quality (CEQ).[393] In *Global Energy Futures and the Carbon Dioxide Problem*, the CEQ recommended prioritizing the carbon dioxide issue in domestic energy policy and capping the concentration of CO_2 in the atmosphere to 50% above pre-industrial levels, keeping those at or below 420 parts per million (ppm), which would correspond to a peak in fossil fuel use

[389] Ibid., 60.

[390] John S. Perry, "Energy and Climate: Today's Problem, not Tomorrow's," *Climatic Change* 3 (1981): 223–224, cited by Oreskes and Conway, *Merchants of Doubt,* 176.

[391] Ibid., 61.

[392] Ibid., 39–40.

[393] Council on Environmental Quality (CEQ), *Global Energy Futures and the Carbon Dioxide Problem* (Washington D.C.: U.S. Government Printing Office, 1981). Gerald O. Barney, ed., *The Global 2000 Report to the President of the U.S.: Entering the 21st Century* (New York: Pergamon Press, 1980).

in the first decade of the new century, followed by a steady decline.[394] The report made it clear that waiting for climate change to be detected would commit the world to potentially irreversible climate changes, and make the energy transition much more difficult due to greater dependence on fossil fuels.[395]

The *Global 2000 Report to the President*, a collaborative work between the CEQ and the Department of State, looked at future environmental conditions at the turn of the century based on projections regarding population growth and resource use. The report did not focus on carbon dioxide specifically but examined an array of environmental issues and their impact on human activities. That said, it found that increased levels of carbon dioxide and ozone-depleting chemicals "could alter the world's climate and upper atmosphere significantly by 2050."[396] Although their assessment was bleak, the authors warned that their projections "may actually understate the impending problems" due to an "optimistic bias."[397] Their main conclusion was clear: now was the time to act. As the authors explained, "if decisions are delayed until the problems become worse, options for effective action will be severely reduced."[398]

While all these scientific reports and expert testimonies pointed in the same direction, namely the need to take preventive steps to avoid increased reliance on fossil fuels and a more costly transition to non-carbon energy sources in the decades to come, the Carter administration, confronted with a severe energy crisis, chose to double down on fossil fuels. As the next section will show, the administration plowed on with its synthetic fuels program devised to increase the domestic supply of oil and achieve energy independence, instead of initiating a gradual phasing-out of these types of energy sources. In that sense, the breach in which the Reagan and Bush administrations would engulf themselves to kill climate legislation had materialized on Carter's watch: Press and Nierenberg's activism, and the economists and agronomists they recruited to paint a vastly different picture

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[394] CEQ, *Global Energy Futures and the Carbon Dioxide Problem*, 60.
[395] Ibid., 61.
[396] Barney, ed., The Global 2000 Report, 3.
[397] Ibid.
[398] Ibid., 5.

than that outlined by climatologists, all paved the way for the backlash and delays climate change policy would experience in the 1980s and beyond.

2.5 Deepening U.S. Dependance on Fossil Fuels: Synthetic Fuels and the Administration's Plan for Bolstering Domestic Oil Production

In his introduction to the 1977 *Energy and Climate* NAS report, Revelle had explicitly referred to the "major decision" that political leaders in industrial societies worldwide would face over the next few decades: "whether to continue reliance on fossil fuels as principal sources of energy or to invest the research and engineering effort, and the capital […]" to initiate the fifty-year energy transition to non-carbon energy sources.[399] In their foreword, the co-chairmen of the Geophysics Study Committee had also spoken of the coming "end of the oil age" which signaled an opportunity for carefully weighing options in designing future energy policies.[400] Instead of taking this opportunity to stir the nation in another direction, however, the administration chose to further invest in oil by increasing domestic production, especially of so-called unconventional oil (extracted from tar sand or oil shale, among others), while reducing its dependence on foreign imports. This section centers on the administration's energy policy in the context of the 1979 oil crisis.

A modest decline in oil production following the Iranian Revolution and an agreement among OPEC members led to a steep increase of the prices of crude oil, which reverberated throughout the western world and in the United States in the form of fuel shortages, long waiting lines at gas stations, and high fuel expenses.[401] The early years of the decade had been marked by

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[399] Roger Revelle, "Overview and Recommendations," *in* NAS Geophysics Study Committee, *Energy and Climate*, 1.
[400] Philip H. Abelson, and Thomas F. Malone, "Foreword," *in* NAS Geophysics Study Committee, *Energy and Climate*, vii.
[401] On U.S. energy politics in the 1970s and the energy crises, see Meg Jacobs, *Panic at the Pump: The Energy Crisis and the Transformation of American Politics in the 1970s* (New York: Hill and Wang, 2016); Peter Shulman, *Coal and Empire: The Birth of Energy Security in Industrial America* (Johns Hopkins University Press, 2015); Michael Foley, *Front Porch Politics: The Forgotten Heyday of American Activism in the 1970s and 1980s* (New York: Hill and Wang, 2013); Matthew T. Huber, *Lifeblood: Oil, Freedom, and the Forces of Capital* (University of Minnesota Press, 2013); Timothy Mitchell, *Carbon Democracy: Political Power in the Age of Oil* (New York: Verso, 2011); Daniel Horowitz,

energy anxiety and growing fears about the coming end of fossil fuels, but these fears persisted throughout Carter's presidency, eventually engulfing his first and only term. In July 1979, Carter addressed the nation on television in what came to be known as his "malaise speech" (although he did not use that word, but spoke of a "crisis of confidence"), in which he set forth a six-point strategy to confront the multilayered energy issues facing the country.[402] Among these was the proposal to fund the development of alternative sources of fuel from coal, shale and unconventional gas (though Carter also listed solar energy). Press, in particular, played an important role in pushing for continued reliance on oil and gas as the nation's principal energy sources. A geophysicist by training, he was on familiar terrain to make recommendations that had to do with oil exploration and drilling, and he did not shy away from submitting bold initiatives directly to Carter.

In a memo from November 1979, responding to the president's call for "innovative ideas" to solve the energy conundrum, Press offered three ways to bolster domestic and worldwide oil and gas supplies.[403] The first was to open the mostly untouched continental margin (i.e. the area of transition between the land and the deep seafloor) beyond the Outer Continental Shelf to federal offshore leasing, exploration and drilling; secondly, Press recommended convincing other industrialized countries to increase their investments in the development of synthetic fuel production; and thirdly, relaying a proposal by the Venezuelan minister of Energy with whom he had just met, Press exhorted that the United States invest in an Inter-American government fund to accelerate the exploration and testing of oil fields in Latin America and the Caribbean, whose reserves remained largely under-exploited, an initiative on which he suggested that the DoE take the lead.

A few months later, and as historian of science Benjamin Franta has shown, an API policy booklet cited a publication by an MIT-based

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Jimmy Carter and the Energy Crisis of the 1970's. The "Crisis of Confidence" Speech of July 1979 : A Brief History with Documents (Boston: Bedford Books, 2005).

402 Jimmy Carter, "Energy and National Goals," July 15, 1979, *Public Papers of the Presidents of the United States: Jimmy Carter, 1977-1981* (Washington D.C.: U.S. Government Printing Office, 1979), 2: 1235–41, quoted in Horowitz, *Jimmy Carter and the Energy Crisis of the 1970's*, 108–119.

403 Frank Press to the President, "Your call for innovative ideas," Memorandum, November 5, 1979, Records of the Office of Science and Technology Policy, Frank Press' Subject Files, JCPL, Box 6, Folder "Energy Policies, 4/24/77-11/5/79."

organization called the World Coal Study, funded in part by fossil fuel companies. Under the leadership of Carroll Wilson, a professor at the MIT Sloan School of Management, it had gathered the input of industrial and governmental leaders from sixteen countries, and pushed for a three-fold increase in coal production and use by 2000, arguing that oil reserves were almost used up.[404] Wilson used the report to lobby Carter on expanding worldwide coal production, a recommendation approved by the G7 states in an amended yet more radical form, as they called for a tripling of coal production by 1990.[405] It does not appear that the administration needed to be further convinced about the benefits of fossil fuels, but it is highly probable that someone, if not Press himself, who had chaired the MIT Department of Geology and Geophysics prior to his governmental appointment, was briefed on that coal report, in which he would have found support for the administration's energy policy from one of the nation's foremost centers of knowledge production.

As the study of OSTP records demonstrate, Press advocated renewed investments in the national petroleum infrastructure as well as policies promoting the development of domestic oil production at all costs. Joining the chorus of pro-oil presidential advisors, he championed a combination of approaches to reduce oil imports in order to free the national energy system from unreliable supplies and economic threats by the "OPEC cartel," in the words of an internal report to the president.[406] In response to various congressional initiatives on synthetic fuels, and at the request of Carter's chief

[404] Carroll L. Wilson, *Coal: Bridge to the Future. Report of the World Coal Study, WOCOL* (Cambridge, MA: Ballinger Publishing Co, 1980), cited by Benjamin Franta, "Early Oil Industry Disinformation on Global Warming," *Environmental Politics* 30, no. 4 (2021): 665. Wilson, a member of the Club of Rome from 1972 to 1981, initiated other studies on global environmental and energy issues. He organized and led the Summer Study of Critical Environmental Problems (SCEP) in July 1970, and the Summer Study of Man's Impact on Climate (SMIC) a year later in Stockholm. Another international project organized by Wilson and sponsored by the MIT was the Workshop on Alternative Energy Strategies (WAES), which argued for the need to develop alternative fuels, as it found that conventional oil would fail to meet the world's energy needs by as early as the mid-1980s, and most probably before the year 2000. The World Coal Study was a follow-up to the WAES report. Carroll L. Wilson, *Energy: global prospects, 1985-2000. Report of Workshop on Alternative Energy Strategies* (New York: McGraw Hill, 1977).

[405] Franta, "Early Oil Industry Disinformation," 665.

[406] OSTP, "Options for Reducing 1985-1990 Petroleum Imports," options paper for the president on energy, undated and unsigned, Records of the Office of Science and Technology Policy, Frank Press' Subject Files, JCPL, Box 6, Folder "Energy Policies, 4/24/77-11/5/79," 36.

domestic policy adviser, the DoE set up an interagency effort to prepare a memo for the president listing possible measures to respond to the energy issues and oil shortages. Although some of these measures revolved around conservation, increased automotive efficiency and the phase-out of oil- and gas-fired power plants (though the idea was for them to shift to coal, whose combustion makes it an important source of CO_2 emissions), the development of fossil fuels by any means and the resulting increased domestic supplies of oil and gas sat at the top of that list.[407] An OSTP analyst informed Press that "in spite of the attempt to balance synthetic fuels with other options, it is clear that major interest is in the synthetic fuels area."[408] The presidential decision memo produced by the interagency group eventually found its way into the Energy Security Act, which Carter signed into law in June 1980. While it included incentives for geothermal, solar, and biomass energy to help electric companies move away from oil-generated power plants, the act also established the Synthetic Fuels Corporation, a federally-chartered corporation whose central mission was to promote the development of synfuels.

One amendment to the Energy Security Act of 1980 called for the production of another report by the Academy to assess the socio-economic impacts of atmospheric carbon dioxide accumulation, especially in light of the government's promotion of synfuels. But the fate of that report, released in 1983, was sealed before its committee had written anything. As Oreskes and her colleagues have shown, Nierenberg, who had revealed his true colors in the preparations of the 1980 NAS letter report, had already secured the panel's chairmanship by October 1980.[409] More probably than not, he had read *Energy and Climate*, and concluded that such publications constituted a real threat to the use and trade of fossil fuels. Though we may never know his or Press' personal motives for discarding climate change and promoting oil and gas, their actions had serious consequences in hindering and delaying climate policy. What is striking is that such delay was not organized outside the federal government, but it came from within, most notably under Press'

[407] Larry Linden to Frank Press and Phil Smith, Memorandum, June 28, 1979, Frank Press Papers, MIT, Box 41, Folder "Energy Policy-- DoE, 1977–1980," 2.
[408] Ibid.
[409] Oreskes, Conway, and Shindell, "From Chicken Little to Dr. Pangloss," 122.

leadership, who was in a position to understand the science and push for action, but chose not to.

2.6 Reacting to the Federal Government's Impetus in Sponsoring Research on the Effects of Climate Change : Exxon's Carbon Dioxide Research Program

From the mid-1960s until the advent of the Carter administration, environmental concerns at Exxon mostly concerned air and water pollution at refineries, as the company continued to monitor federal legislation, choosing to intervene only when it was required to do so by law.[410] In the fall of 1966, the API commissioned a survey of U.S. public opinion on air and water pollution and pollution control.[411] Based on a sample of some two thousand national residents, the survey sought to determine to what extent the public felt concerned by these issues, and whether people ascribed any responsibility for the pollution to different segments of heavy industry, as well as their thoughts regarding cars (i.e. exhaust pipes) as a source of pollution. The survey, whose results the API insisted on keeping closely guarded within the oil industry, showed that the level of public awareness on air and water pollution was substantial: 75 percent of the respondents declared having heard or read about it within the past year. In a letter to an executive within Exxon's public relations department, a senior research associate at Exxon insisted that "the petroleum and automotive industries have a

[410] As Benjamin Franta demonstrates, the oil industry had been informed by its main trade association, the API, of the dangers posed by the carbon build-up in the atmosphere, in the 1950s and again in 1965 after the public release of the PSAC's report *Restoring the Quality of Our Environment*. At the API's annual meeting, Frank Ikard, its president, alerted the industry to the impending measures that he thought would follow the publication of the report. Oil industry leaders thus knew about climate change before it became a more publicized issue at the start of Carter's term, but I argue that until then, Exxon had directed most of its attention and resources to the more tangible and practical issues of air and water pollution. And indeed, Ikard dedicated most of his speech to these very issues. See Benjamin Franta, "Early Oil Industry Knowledge of CO_2 and Global Warming," *Nature Climate Change* 8 (2018): 1024–1025. For a perspective on French oil major Total and its own knowledge and handling of the CO_2 problem, see Bonneuil, Choquet, and Franta, "Early Warnings and Emerging Accountability," 1–10.

[411] J. F. Kunn, to B. L. Bragg, Standard Oil Company of New Jersey (Esso), "API Public Opinion Survey on Pollution and Pollution Control, April 26, 1967, Climate Files. All the source material quoted in this section is accessible on the Climate Files (CF) database, a digital repository documenting more than 20 years of research by the Climate Investigations Center, and reporters at *Inside Climate News* and at the *Los Angeles Times*: http://www.climatefiles.com/collection-index/.

tremendous public information job on their hands" regarding these issues.[412] The PR work to be undertaken, however, had to do with these local, often visible sources of pollution. The survey showed that the forty percent people who mentioned oil companies in relation to air pollution spoke of the odors of the fumes and gases emitted by refineries, and the smog caused by exhaust pipes. In other words, people mentioned nuisance they could see or smell, and carbon dioxide was no such pollutant.[413]

Another internal Exxon document from 1971 details the legislative and regulatory actions for air pollution control adopted by the federal government "at a head-long pace," according to one Exxon executive.[414] These measures derived from the Clean Air Act, signed into law by Nixon in December 1970, shortly after establishing the Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA). Both federal agencies were tasked with monitoring national pollution levels and, in the case of the EPA, of enforcing the new law's mandates. In regulating the concentrations of certain air pollutants and setting emission standards for specific toxic substances released by industrial facilities, the Clean Air Act constituted a cause for concern for the oil industry. But carbon dioxide, which was not included in the list of pollutants targeted by the law, was not one of them.[415]

Things took a sharp turn in 1977, after the Miami Beach workshop organized in March by the ERDA (the agency that was later merged into the DoE) that had gathered some seventy-five leading scientists in climatology and other fields relevant to climate change. A few months later, on October 15, Henry Shaw, a science manager at Exxon, attended a meeting of a DoE committee dedicated to the study of carbon dioxide's global environmental effects. Chaired by Alvin Weinberg, who had administered the Oak Ridge National Laboratory during the Manhattan Project, the study group consisted of directors of national laboratories and universities. Also present were

[412] J. F. Kunn, to B. L. Bragg, Standard Oil Company of New Jersey (Esso), "API Public Opinion Survey on Pollution and Pollution Control, April 26, 1967, CF, 2.
[413] Ibid.
[414] F. W. Church to W. E. Lifson, "Ambient and Emission Air Pollution Regulations," June 18, 1971, CF, 1.
[415] Ibid.

Thomas Malone, chairman of the Geophysics Study Committee that had sponsored the NAS *Energy and Climate* report, and two DoE officials, one of whom was David Slade, the director of the DoE's Office of Carbon Dioxide.[416] Shaw did not give a reason for his presence at the meeting. Perhaps a representative from Exxon had been invited to what was seen as a routine meeting to keep the company apprised of the DoE's work, since new regulations or findings might impact its business, but the memo did not mention the presence of other oil industry executives. At any rate, Shaw's attendance underlines the close connection between Exxon and the federal government on energy policy matters. Internal company records tell us that the CO_2 issue was on Exxon's radar by July 1977, when its Management Committee (the company's highest executives) had received a comprehensive review of climate change science.[417] The issue had gained political traction after the Miami Beach workshop and presentations by Revelle and two other members of the Geophysics Study Committee to government and industry representatives on the *Energy and Climate* report. Exxon was thus well aware of the newfound interest of the federal government in climate change, and it launched its own carbon dioxide research program after Shaw attended the DoE study group meeting.[418]

Three items stand out in Shaw's memo regarding that meeting, which point out that he worried about possible repercussions on Exxon's activities from federal legislation. First, the fact that Slade's Office of Carbon Dioxide forecast a tenfold increase in its budget within two years, a result of the recommendations made by the experts at the Miami Beach workshop.[419] Second, a 40-page summary of the NAS *Energy and Climate* report was distributed by Malone, who also reported its main conclusions to the committee, one of which was that the effects on the climate of carbon dioxide release may be the "primary limiting factor on energy production from fossil

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[416] Henry Shaw to John Harrison, "Environmental Effects of Carbon Dioxide, October 31, 1977, CF, 1.
[417] James F. Black to F. G. Turpin, Vice-President of ER&E, "The Greenhouse Effect," June 6, 1978, CF, 1.
[418] Walter Sullivan, "Scientists Fear Heavy Use of Coal May Bring Adverse Shift in Climate," *New York Times*, July 25 1977, 1.
[419] Henry Shaw to John Harrison, "Environmental Effects of Carbon Dioxide," October 31, 1977, CF, 1.

fuels over the next few centuries."[420] Finally, and most importantly from Exxon's perspective, Weinberg discussed "the best political moves" to alert the administration to the problems caused by fossil fuel combustion.[421] The committee agreed to brief James Schlesinger, the Secretary of Energy, and Frank Press, Carter's science advisor, so they could relay the issue directly to the president. Exxon therefore knew that it had very little time to assess the problem that carbon dioxide build-up might pose to its activities, should legislation follow.

The Miami Beach workshop and the publication of the NAS *Energy and Climate* both contributed to bringing the issue of a fossil fuel-driven climate change to a nation reeling from the first oil shock and wary of future oil shortages. Talks of initiating a move away from fossil fuels had resurfaced in both instances, but what worried Exxon was the outlining of a new type of air pollution that might bring swift action from the federal government, a scenario reminiscent of the start of the decade. Anticipating governmental measures and concerned that it might fail to assess the threat to its business correctly, Exxon launched its own climate change research shortly after that DoE October meeting. ER&E, its research division (formally, Exxon Research & Engineering Company), designed an ambitious, three-pronged program. The first project involved a sampling operation in the Indian and Atlantic oceans from an Exxon tanker known as the Esso Atlantic. The tanker had been specially outfitted to include a CO_2-measurement system controlled by a computer. The idea was to collect data from surface water and the air to understand the dynamics of mixing in the ocean, namely the process of how carbon dioxide dissolves in the surface ocean water. A second ocean sampling project was also planned, this time aboard drilling ships off the coast of Australia.

In improving the science on the air-ocean carbon exchange model, both of these experiments also sought to better assess the ocean's carbon storage capacity, a key point for Exxon in advocating for the continued use of fossil fuels. Finally, the third project sought to determine the relative

[420] Ibid., 2–3.
[421] Ibid., 4.

contribution of fossil fuel combustion and deforestation to the CO_2 build-up, by measuring the ratios of two carbon isotopes in wines of different vintages, in order to estimate the composition of the atmosphere at specific times since the mid-19th century, and determine to what extent the CO_2 increase could be attributed to forest clearing as opposed to fossil fuel combustion.[422] Ultimately though, only the tanker project was implemented. It ran for one year out of the five it was planned to, and never made it to the next phase.

Exxon's involvement with climate change research began on a high note, though. In a letter dated March 7, 1978, Harold Weinberg, the director of ER&E's Technology Feasibility Center, expounded his vision for a massive research undertaking on the CO_2 issue to Edward Gornowski, the vice-president of ER&E. Weinberg spoke of his ideas as "some grandiose thoughts," as he proposed that the company "be the initiator of a worldwide 'CO_2 in the Atmosphere' R&D program along the lines of the International Geophysical Year concept."[423] He mentioned that such program would be "aimed at benefitting mankind" but it would also, crucially, help the company determine "whether a long-term CO_2 problem really exists and, if so, what counter measures would be appropriate."[424] In other words, Exxon would protect its business by defining the problem and laying out solutions it deemed appropriate. Weinberg suggested establishing "a worldwide network of land, sea, and air sampling systems," even satellites, and he understood that "a massive effort would be required over a long period of time."[425] He left "the major role" to governments, but his idea was that Exxon could work as an "initiator" and a "consultant" on this worldwide effort.[426] Weinberg concluded his letter by proposing to discuss the project with Edward David, the president of ER&E, highlighting the importance of the issue to those on the company's highest echelons.[427]

A few months later, in June 1978, James Black, a senior corporate scientist at Exxon, shared the text of a presentation he had given twice: to

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[422] Henry Shaw to Edwards David, December 7, 1978, CF, 1.
[423] H. N. Weinberg to E. J. Gornowski, "CO_2," March 7, 1978, CF, 1.
[424] Ibid.
[425] Ibid., 1–2.
[426] Ibid., 1.
[427] Edward David had been Nixon's science advisor from 1970 to 1973. Upon retiring, he became an overt climate change denier.

Exxon's Management Committee a year earlier, and to another internal committee in May 1978.[428] In his accompanying letter, addressed to the vice-president of ER&E, Black explained that his presentation had been transcribed "to satisfy requests for a written version of the talk from people who had not heard the presentation last July," attesting to the wide interest inside the company regarding that particular issue. That document also evidences that Exxon managers had received extensive briefing on climate change and that its scientists were closely monitoring and reporting on the science as it was developing. In the summary of his talk, Black explained that levels of atmospheric CO_2 had increased by 10-15 % above their normal (i.e. pre-industrial) levels and that a doubling of the CO_2 concentration in the atmosphere was expected by the year 2075.[429] Black reported that, although models were not capable of integrating all the feedback interactions between the various components of the climate system, they predicted that such a doubling would lead to a mean temperature increase of 2°C to 3°C, with the poles experiencing up to a 10°C increase.[430]

Black tempered the role of the oil industry in the CO_2 increase, citing the "primitive stage of development" of climatic models and the fact "meteorologists have no direct evidence that the incremental CO_2 in the atmosphere comes from fossil carbon" and not from natural changes in the earth's thermal balance or man-made causes such as deforestation.[431] That said, he recognized that "there is no guarantee that better knowledge will lessen rather than augment the severity of the predictions" and, perhaps most importantly, he cited "a time window of five to ten years before the need for hard decisions regarding changes in energy strategies might become critical," citing the DoE's ambitious research plan to produce the necessary science within the next decade.[432] Although Black offered an honest and accurate presentation of scientific knowledge of climate change at the time, he also insisted on the areas of uncertainty in the science, such as cloud feedback in

[428] James F. Black to F. G. Turpin, Vice-President of ER&E, "The Greenhouse Effect," June 6, 1978, CF, 1.
[429] James F. Black, "The Greenhouse Effect: Summary," undated, CF, 1.
[430] Ibid.
[431] Ibid., 2.
[432] Ibid.

dampening or enhancing global warming and the role of the ocean as a carbon sink, and mentioned the consequences of climate change only summarily. He also went to great lengths to dispute the scientific agreement on the primary source of the observed increase in atmospheric CO_2, namely fossil fuel combustion, citing deforestation, agriculture and the biosphere as significant contributing factors in the production of carbon dioxide.[433] Black also mentioned the 1977 NAS *Energy and Climate* report, which cited fossil fuels as the main drivers of climate change, and had "received a considerable amount of sensational publicity."[434] Throughout his presentation, and perhaps as a way to countervail negative publicity, Black's strategy consisted in providing Exxon executives with cherry-picked facts they could use and cite so as to continue doing business as usual.

By the end of 1978, Exxon had its research program ready. In a letter to David, Shaw explained that the goal was to implement all three projects by the summer of 1979, starting with the drilling ship and the wine projects in May of that year. The projects were supposed to run for five years, from 1979 until 1984, in two phases. Once again, the rationale for conducting these experiments was a very pragmatic one, namely to "assess the possible impact of the greenhouse effect on Exxon business."[435] In order to gain in scientific credibility and receive DoE funding, which was supposed to cover phase II of the projects, Exxon enlisted two geochemists at the University of Columbia's Lamont-Doherty Earth Observatory, Wallace Broecker and Taro Takahashi. In a March 1979 presentation to Lester Machta, the director of NOAA's Air Resources Laboratory, Henry Shaw and another scientist on the tanker project, Edward Garvey, presented the rationale for Exxon involvement in climate studies rather candidly, citing the PR value of such an undertaking in terms of generating scientific knowledge, and reducing "the business risk of inadequate government policy" by providing "high quality information."[436] Another important element of that document is the fact that,

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[433] James F. Black, "'The Greenhouse Effect' Transcript of a Talk Delivered Before the PERCC Meeting," May 18, 1978, CF, 3.
[434] Ibid.
[435] Henry Shaw to Edwards David, December 7, 1978, CF, 2.
[436] Edward Garvey, Henry Shaw, Wallace Broecker, and Taro Takahashi, "Proposed Exxon Research Program to Help Assess the Greenhouse Effect. Presented to Dr. Lester Machta, Air Resources Laboratory, NOAA," March 26, 1979, CF, 3.

at this point in time, Exxon was prepared to launch three applied research projects, stating that it had no capability in terms of climate modeling.[437] We know, however, that two years later, Exxon would shift its focus to mathematical modeling exclusively, completely revising its approach to climate research.

Less than a year later, however, in October 1979, some within ER&E expressed unease with the emerging realization that energy use patterns would need to change drastically if the goal was to reduce CO_2 emissions from fossil fuels. At the time, an extremely well-researched report was circulated among ER&E managers, though we do not know whether it was shared with senior executives on Exxon's Management Committee.[438] The report was the work of a summer intern, Steve Knisely. The study focused on the relation between fossil fuel combustion and global warming, and it reviewed various world energy consumption scenarios to limit CO_2 build-up in the atmosphere. In one of the three scenarios it reviewed, in which CO_2 would be limited to a 50% increase over the pre-industrial concentration of 290 ppm, Knisely wrote that such control over CO_2 release would imply a switch from coal to non-fossil fuels (i.e. nuclear, geothermal, biomass, hydroelectric and solar power) starting in the 1990s, and that they would have to account for 50% of the energy supplied worldwide, an "extremely difficult and costly effort if possible" according to Knisely.[439]

A letter accompanying the report stated that climate models predicted that expected levels of fossil fuel consumption would produce "dramatic climatic changes" by 2050. The letter also reported the main conclusion of Knisely's study, which was that equally dramatic changes in energy systems were required to avert such changes in the climate. The study also assumed that no technological fix would make the recovering and disposing of CO_2 emissions possible, as none had been developed yet.[440] Although the study spoke of a "great and urgent" potential problem, the issues it raised were brushed aside by the author of the accompanying letter, who underlined the

[437] Ibid., 7.
[438] W. L. Ferrall to L. E. Hill, "Controlling Atmospheric CO_2," October 16, 1979, CF, 1.
[439] Steve Knisely, "Controlling the CO_2 Concentration in the Atmosphere," October 16, 1979, CF, 6.
[440] W. L. Ferrall to L. E. Hill, "Controlling Atmospheric CO_2," October 16, 1979, CF, 1

"great uncertainty" of climate models and noted that "much more study and research in this area before major changes in energy type usage could be recommended."[441] The records we have do not document whether Knisely's findings were shared with Exxon's Management Committee. The fact that the report was the work of an intern made it easier to dismiss it as either too speculative, or informative but not important enough to reach the highest levels of the company's management. What is clear is that the author of the accompanying letter took pain to tone down the explosive nature of Knisely's findings, perhaps sensing or knowing that Exxon management would not be receptive to them. In any case, the report did not steer the company in a different direction.

Whether or not he had heard rumors that Exxon's upper management was about to shrink its CO_2 research program, Henry Shaw made an appeal to the director of ER&E, Harold Weinberg, in November 1979, a month after the Knisely report had been shared with ER&E managers. Although he would align his views with that of Exxon a couple of years later, at that time Shaw was still trying to convince the company's executives to launch a serious scientific investigation into climate change. In his memo, Shaw spoke more broadly about how "atmospheric science will be of critical importance to Exxon in the next decade," not just regarding "the potential greenhouse effect," but to respond to other "critical ecological questions" including ozone depletion, acid rain, fine particulates, and the atmospheric transport of sulfates and nitrates.[442] Perhaps he sought to impress on Weinberg the fact that all of these issues might generate legislation, giving more weight to his claim that it was crucial for the company to determine how it could "influence possible legislation on environmental controls" that might target other pollutants outside carbon dioxide.[443] Shaw warned of a "strong intervention of environmental groups" and stated that part of Exxon's response relied on the production and access to "reliable and credible data."[444] To emphasize his point on the need for Exxon to anticipate problems and "start a very

[441] Ibid.
[442] Henry Shaw to Harold Weinberg, "Research in Atmospheric Science," November 19, 1979, CF, 1.
[443] Ibid.
[444] Ibid.

aggressive defensive program" before governmental intervention, he evoked the supersonic plane controversy that had rocked the aircraft industry in the early 1970s, and how the discovery of the ozone hole had led to a ban on freons that caught the chemical industry unprepared, two cases in which legislation adversely affected business. He also reminded his boss of the environmental lobbying pressure that was responsible for killing the synthetic fuels industry, in his opinion.[445] Shaw was serious in his proposal that Exxon build a credible research program and he recommended hiring "a scientist with a national reputation to provide leadership […] and attract talent" to head the CO_2 study.[446] The fact that Shaw suggested Stephen Schneider, a prominent figure in climatology, for the post, even though the latter was known to be on the left-wing side of the political spectrum, speaks to his commitment and willingness to build a leading research program. The records that have been retrieved do not tell us if or why Schneider declined working for Exxon, or whether Exxon never offered him the job after all, but the insistence of Shaw that the climate issue be taken seriously shows that the initial enthusiasm for in-house climate studies had quickly subsided among his colleagues and superiors.

The new company's stance on CO_2 research soon made its way up the corporate echelons. In January 1980, Maurice "Morey" O'Loughlin, a senior vice-president on Exxon's Management Committee, received a response to his inquiry about the company's position on climate change. His correspondent, Walter Eckelmann, a deputy manager within the Science & Technology department at Exxon's headquarters in New York, assured him that the latter considered the rising concentrations of atmospheric carbon dioxide "a potentially serious problem," but that "a huge worldwide research effort" was required to assess global changes in the climate.[447] In other words, Eckelmann was acknowledging the existence of a problem, but he was also insisting on the need for additional research to assess its scope and severity, research efforts that he deemed to lay "beyond the resources and

[445] Ibid., 1–2.
[446] Ibid., 2.
[447] Walter Eckelmann to Maurice O'Loughlin, "Exxon's view and position on 'Greenhouse Effect'," January 29, 1980, CF, 1.

responsibility of any single company or industry […].”[448] Eckelmann then explained that the DoE’s office on carbon dioxide research was the lead agency coordinating national and international research projects, and that its main objective was to provide the government with data for policy-making.[449] Eckelmann also explained that, contrary to what had been initially decided in early 1978, Exxon had later found the idea of setting up an independent research program “impractical” and had instead decided to channel its resources in three ways: first, to research “critical components,” or parts of the CO_2 issue that were the most relevant for the company: these consisted in the tanker data collection, the vintage wine and the drilling ship projects; second, to monitor the climate science conducted by the DoE and others; and third, to hire Wallace Broecker, the renowned geochemist at Columbia University’s Lamont-Doherty Earth Observatory. A specialist on thermohaline circulation (vertical currents that are part of ocean circulation) and the ocean’s role in the climate system, Broecker worked on the data collected by the “Esso Atlantic” tanker. Exxon’s role vis-à-vis the DoE was not to develop its own extensive program anymore using DoE funding, but to monitor the federal agency’s results and “to critically evaluate predictions of CO_2 effects as they are developed.”[450] In the conclusion to his letter, Eckelmann explained what he meant by conducting a critical appraisal of the scientific predictions on climate change, which was that Exxon would draw its own conclusions from the DoE research program’s results “which might be biased for political or other reasons.”[451] This shows that, early in its research program, Exxon was aware of the political implications and high stakes of climate science for its industry.

If Exxon had revised its research ambitions downward, there were nevertheless plans to publicize its three-pronged research program. In a July 1980 memo to Weinberg, Richard Werthamer, a manager at ER&E explained that he and others had worked on a public relations “plan for achieving

[448] Ibid.
[449] Ibid.
[450] Ibid.
[451] Ibid., 2.

national recognition" on the ongoing research projects.[452] Controversy around climate change science and Exxon's role towards both the issue and the science within the company had not crystallized yet, and Werthamer thought that the CO_2 communications plan did not require approval beyond that of general managers from the relevant departments.[453] The draft of the plan presented by Werthamer was a rather general outline of the communication tools Exxon could deploy to disseminate the results of its research and gain credibility in the public discourse on climate change, especially as it sought to confront the burgeoning "doomsaying theories."[454] It appears that the plan failed to materialize. Another memo simply stated that no implementation of the plan was scheduled for the remaining half of the year.[455] Six months later, however, Exxon's strategy towards climate change science had further evolved, and it shut down the tanker data collection project, the only one of the three projects to have launched.

The two remaining internal documents we have regarding Exxon are two memos sent in December 1980 by Henry Shaw to managers within the ER&E, of which Weinberg received a copy. The first document contained Shaw's comments on a report produced by the National Commission on Air Quality (NCAQ).[456] Created by the 1977 Clean Air Act Amendments and comprising thirteen members, the commission was asked to report to Congress on the efficiency of measures provisioned by the law to mitigate air pollution, as well as identify alternative means for air pollution abatement.[457] The commission had held a two-day workshop in October 1980, among whose participants were Henry Shaw and the Exxon consultant John Laurmann; John Perry, the executive secretary of the NAS Climate Research Board; George Woodwell, who had authored a report for the CEQ together with Revelle, Keeling and MacDonald in 1979; David Burns, the director of the climate project at the AAAS, and David Slade, the director of the carbon

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[452] Richard Werthamer to Harold Weinberg, "CO_2 Greenhouse Communications Plan," July 8, 1980, CF, 1.
[453] Ibid.
[454] Ibid.
[455] E. K. Wiley to R. E. Barnum, M. P. Margolis, and Richard Werthamer, "CO_2 / Greenhouse Communications Plan," CF, 1.
[456] Henry Shaw to Alexis Hoskins and Joe Ducket, December 5, 1980, CF.
[457] "Proceedings of the National Commission on Air Quality Carbon Dioxide Workshop: Volume I," St. Petersburg, Florida, October 29-31, 1980, CF, 7.

dioxide research program at the DoE. The purpose of the workshop was to help the commission assess the carbon dioxide issue to make appropriate policy recommendations to Congress, as it had been directed by Congress to study unregulated pollutants that could adversely impact public health.[458] But the controversy that was going to emerge publicly a decade later was already visible. Jeanne Malchon, a member of the commission who got elected as a Democrat to the Florida state Senate two years later, in 1982, remarked in her opening speech that the workshop organizers believed in the fact that "by planning now in 1980 we may forestall environmental problems […] from increased carbon dioxide emissions."[459] However, Malchon deemed the issue to be "characterized by both political controversy and scientific uncertainty."[460] She also cited the conclusion of the 1980 NAS letter report, which found that adaptation would trump any harmful consequences of CO_2 build-up, and added that if one agreed with that claim, then "we need do nothing about putting the policy wheels in motion now."[461]

In the letter accompanying his comments on the draft statement of the workshop report, Shaw mentioned that he felt "comfortable with the spirit of the recommendations" although he thought the policy recommendations could be "made more specific."[462] While we do not have the final version of the workshop report, it appears from Shaw's copy, that some of his amendments and suggestions sought to introduce a hint of skepticism, replacing for instance "potential direct" with "postulated possible results [of climate change]," and "changes in world climate almost surely will occur" with "may occur."[463] That said, he appeared in agreement with the report's findings and recommendations, which recognized that delaying action until climate change became discernible was bad policy, and as a result encouraged taking action "with imperfect knowledge."[464] The commission offered the usual prescription for additional research, but it insisted on involving social

[458] Ibid., 12.
[459] Ibid., 5.
[460] Ibid., 5–6.
[461] Ibid., 7.
[462] Henry Shaw to Alexis Hoskins and Joe Ducket, December 5, 1980, CF.
[463] Henry Shaw, "National Commission on Air Quality CO_2 Workshop. Draft Statement of Findings and Recommendations," CF, 1–2.
[464] Ibid., 4.

and political scientists to identify policy alternatives. Besides the unimpeachable recommendations towards energy conservation and efficiency, reforestation and anti-deforestation initiatives, and providing greater resources to the development of alternative energy sources, the report also advised the control of long-term growth of CO_2 emissions (Shaw struck the word "control," writing instead that the United States should "develop discussions on national and international policies designed to affect energy supply and consumption.") Finally, and quite importantly, the report marked as "a high priority" the fact the U.S. government take "international measures" to control CO_2 emissions, which was a rather bold call for an international agreement on climate change.[465] The records we have do not tell us how Harold Weinberg, the director of ER&E's Technology Feasibility Center, reacted to the report, but he did receive a copy of it.

The second memo from Shaw concerned a report he and another corporate scientist, Patrick McCall, had written about Exxon's predictions regarding global warming.[466] Their study reflected the change that had taken place within the company, just two years after it had inaugurated its CO_2 research program. In their report, Shaw and McCall offered a candid assessment of climate change science, noting that "there is little doubt that (Keeling and others') observations indicate a growth of atmospheric carbon dioxide."[467] They also further noted that "a number of scientists have postulated that a doubling of the amount of carbon dioxide in the atmosphere could occur as early as 2035," although Exxon scientists expected a doubling by 2060.[468] Such doubling of atmospheric carbon dioxide, Shaw and McCall explained, would trigger a 1.5-4.5°C increase in the global average temperature, a range cited in the Charney report published a year earlier. The report also warned of "serious global problems," such as the sea level rise caused by the disintegration of the West Antarctica ice sheet which would "cause flooding in much of the U.S. East Coast including the state of Florida

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[465] Ibid., 7–9.
[466] Henry Shaw and Patrick McCall, "Exxon Research and Engineering Company's Technological Forecast: CO_2 Greenhouse Effect," December 18, 1980, CF.
[467] Ibid., 1.
[468] Ibid., 2.

and Washington D.C."[469] Having acknowledged the undisputed facts around climate change and some of its dramatic impacts, the authors ended their report with the most benign and illogical conclusions, given what they had just acknowledged. They quoted the report of the AAAS-CO_2 research program workshop held in Annapolis in the spring of 1979, which had found that higher concentrations of atmospheric CO_2 would improve agricultural yields, and that human societies could adapt gradually to the change. These were not the only results of the Annapolis workshop report, which detailed worrisome impacts on a range of life-supporting ecological systems. But out of the five panels, two of them, on the agricultural and economic impacts of climate change, had indeed depicted a much rosier picture.

Chaired by Sylvan Wittwer, who worked at Michigan State University's Agricultural Experiment Station and had led a panel at the DoE-AAAS 1979 Annapolis workshop, the panel examining impacts on the managed biosphere (i.e. agricultural lands and forests) wrote in the opening lines of its report that "the prospects of climatic change from increasing atmospheric levels of carbon dioxide do not terrify U.S. agriculturalists and foresters," due to the benefits on crops of a CO_2-enriched atmosphere and the adaptability of U.S. agriculture that Shaw and McCall, the two Exxon scientists, mentioned in their own report.[470] Lester Lave, a Harvard-trained economist, chaired the panel on the economic consequences of climate change, which also included Shaw himself, and John Laurmann, a consultant hired by Exxon. Of the eighteen panelists, only three were economists (including Lave himself). In its report, the panel stressed that economic forecasts for the next fifty years were necessarily hazardous, and it considered itself "woefully ignorant" due to the many uncertainties of climate change

[469] Henry Shaw and Patrick McCall, "Exxon Research and Engineering Company's Technological Forecast: CO_2 Greenhouse Effect," December 18, 1980, CF, 3.

[470] In 1998, Wittwer appeared in "The Greening of Planet Earth Continues," a short documentary by the Greening Earth Society, a group funded by the Western Fuels Association, an association of coal-burning utility companies, in which he repeated his claims that higher levels of atmospheric carbon dioxide would increase agricultural production. At least another member of the panel, Paul Waggoner, was also a staunch enthusiast of the theory of enhanced crop production in a high-CO_2 world. See chapter 4, page 250, footnote 856, for more information on Waggoner's role as a climate change "cheerleader."

science.[471] It devoted exactly one paragraph to prevention and spent the entire report discussing another type of response to the continued build-up of atmospheric CO_2, namely adaptation. It also labeled climate change as a type of “pervasive, slowly developing long-range potential environmental threats.”[472] Going against the views of climatologists, it considered it “far from proven that CO_2 increases would prove a danger to the human race with the time span considered here [i.e the next fifty years],” and argued in favor of adaptation over prevention, because the impacts of climate change “could be positive […] or at most slightly negative,” and as such did not warrant any costly preventive measures.[473] It appears that at least one of the panel members, Alvin Weinberg, a nuclear physicist and the director of the Institute for Energy Analysis at Oak Ridge Associated Universities, complained to Lave about the panel’s written report. Four years later, Weinberg would excoriate the economic chapters of a NAS assessment report that downplayed the threat of climate change, and he probably held similar views at the time of the DoE-AAAS workshop.[474] Lave’s response was that “with the exception of some dramatic increase in the level of the oceans,” which he deemed outside the time horizon considered in the report, the panel did not see what would make carbon dioxide “a dominant issue in the next 50 years” among all the other impending catastrophes facing humanity. Lave also repeated the agronomists’ claim that a CO_2-fertilized world would extend growing areas.[475] Given the final report’s content, it appears that Weinberg’s misgivings were not taken into account at all.

To go back to Shaw and McCall’s report, aligning their conclusions with that of the two DoE-AAAS panels which had found no real issue with a CO_2-induced climate change offered Exxon management a clever way out of

[471] U.S. Department of Energy, Carbon Dioxide Effects Research and Assessment Program, Workshop on Environmental and Societal Consequences of a Possible CO_2-Induced Climate Change, Annapolis, Maryland April 2-6, 1979 (Springfield: National Technical Information Service / Department of Commerce, October 1980), 107.
[472] Ibid.
[473] Ibid.
[474] Oreskes, Conway, and Shindell, “From Chicken Little to Dr. Pangloss,” 145–148.
[475] Lester Lave to Alvin Weinberg, June 7, 1979, Roger Revelle Papers, UCSD, Box 138, Folder 9 "’Environmental and Societal Consequences of a Possible CO_2 Induced Climate Change,’ Annapolis, 1979 April 2-6, General information and correspondence, 1979, part 1 of 3.”

the fossil fuels predicament. In doing so, Exxon scientists provided executives with credible intelligence, which absolved Exxon of any wrongdoing and supported the view that the company had decades before being compelled to revise its business model. First in the company scientists' list of arguments supporting the status-quo was the fact that the lead federal agency for climate change research, the DoE, had decided to conduct a decade-long research project (which were to produce two reports, one in 1984 and the other in 1989) before making any policy recommendation; second was that the scientific community believed that "a general consensus" would not be reached before a temperature increase could be detected above the range of natural variations, which would only take place early into the next century; finally, Shaw and McCall reported that a number of potential energy scenarios had been studied, but that any new energy source would require fifty years to secure half of the total energy market.[476] The report did not explicitly spell it, but its recommendations were implicit: Exxon needed not worry about climate change, and it could proceed with its business as usual.

While Exxon was the oil company most directly involved in climate research in the early 1980s, the API, the largest oil and gas trade group, was also busy determining the best course of action for the industry. As *Inside Climate News* (ICN) reporter Neela Banerjee and historian of science Benjamin Franta have shown, the API had set up a CO_2 and climate task force in 1979 to monitor and respond to new developments on the issue, both scientific and political, and to determine whether to engage in research projects.[477] In a letter from July 1979, Raymond Campion, a scientist at ER&E and a member of the API task force, advised the latter not to conduct a study on the subject, because if "indicat[ing] no serious CO_2 problems, the results would be greeted with skepticism."[478] This was Campion's first reason for advocating silence—at least temporarily—on climate change, as opposed to skepticism or denial. The second reason for not speaking on the subject

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[476] Henry Shaw and Patrick McCall, "Exxon Research and Engineering Company's Technological Forecast: CO_2 Greenhouse Effect," December 18, 1980, CF, 4–5.
[477] Franta, "Early Oil Industry Disinformation on Global Warming." See also Neela Banerjee, "Exxon's Oil Industry Peers Knew About Climate Dangers in the 1970s, Too," *Inside Climate News*, December 22, 2015.
[478] R. J. Campion to W. W. Madden, July 9, 1979, CF.

was that the workshop organized by the DoE and the AAAS in April 1979 had found no cause for alarm, and that given the credibility of the source, these results would not be contested by other scientists, allowing Exxon to benefit from a respite it had not created itself (which would have looked suspicious). Campion was perhaps waiting for Exxon's Greenhouse Project to yield results that could be used in a future API publication, reasoning that opposing the scientific consensus on the potentially devastating climatic responses to increased levels of CO_2 expressed in reports such as NAS's *Energy and Climate* required scientific evidence. Only two months later, however, another letter by Campion shows that the API had apparently decided to override his advice, and that it had started working on a policy paper requested by one of its lobbyists in Congress.[479] We do not have a copy of that paper, but Campion offered some corrections, one of which was to insist on the fact that effects from a rise in the global mean temperature would not become visible before another twenty years had elapsed.[480] The API published a report, perhaps based on that policy paper, in August 1980. *Two Energy Futures: A National Choice for the 80s*, as Franta has shown, recognized that rising concentrations of atmospheric carbon dioxide were problematic, but it also claimed that a cooling effect from desertification and deforestation would offset global warming.[481]

Six months before the publication of the API report, the chairman of its CO_2 task force announced at a meeting that the latter "should be the focal point" for all API comments on CO_2-related issues.[482] The need to speak in an unified voice was growing stronger, and it laid the foundations for the creation, almost a decade later, of a front organization that would defend the industry's interests against the barrage of inconvenient findings published in scientific reports and reported in the press. Although the API was already engaged in a disinformation campaign on climate change, it received a detailed exposé on the issue. Indeed, at that same meeting, and as Franta notes, the members of the task force were given a presentation by a senior

479 R. J. Campion to J. T. Burgess, September 6, 1979, CF.
480 Ibid.
481 Franta, "Early Oil Industry Disinformation on Global Warming," 663–4.
482 Jimmie Nelson for the API CO_2, and Climate Task Force (AQ-9), "Minutes of Meeting, LaGuardia Airport, New York City, NY, February 29, 1980," CF, 1.

research associate at Stanford University, John Laurmann.[483] In the outline of his presentation, Laurmann stated that there was "strong empirical evidence" linking the build-up of atmospheric CO_2 and the burning of fossil fuels and that climate models predicted a rise in the global mean temperature of 2.5°C by 2038, whose impacts included "major economic consequences."[484] While insisting on the "high uncertainty" of these predictions, Laurmann also emphasized that "large effects" were a mere fifty years away and that "there is no leeway," as the economic theory of market penetration held that this was the time needed for a new, non-fossil energy source to end the dominance of fossil fuels in the national energy mix (by achieving fifty percent share of the total market).[485]

In two *Science* articles in which he had discussed the "market penetration time" theory, Laurmann had concluded that climate change predictions called for immediate action.[486] "If planning decisions for avoidance of possible CO_2 climatic impacts are to be effective," he wrote in 1976, "the time to make them appears to be now."[487] Perhaps because of the nature of his audience, however, Laurmann concluded that day that immediate action depended on the validity of the market penetration theory, and on the weight given to the "discounting factor" ascribed to the future by economists, whereby present or immediate gains overcome future benefits based on costs in the present.[488] Exxon itself had cited the 50-year figure for a new form of energy production to achieve market dominance. The only explanation behind the discrepancy between what the API knew on climate change and what it decided to publicize, is that it ascribed little economic value to the future.

Exxon probably did not receive the DoE funding on which they had counted to finance the second phase of their research projects, yet this element

[483] Franta, "Early Oil Industry Disinformation on Global Warming," 667.
[484] API CO_2, and Climate Task Force (AQ-9), "Attachment A: The CO_2, Problem: Addressing Research Agenda Development," CF, 5 and 8.
[485] Ibid., 3 and 10.
[486] John. A. Laurmann, "Market Penetration Characteristics for Energy Production and Atmospheric Carbon Dioxide Growth," *Science* 205, no. 4409 (Aug. 31, 1979): 896–898; —, "Climate Research," *Science* 191, no. 4231 (Mar. 12, 1976) :1002 and 1004–1005.
[487] Laurmann, "Climate Research," 1005.
[488] API CO_2, and Climate Task Force (AQ-9), "Attachment A: The CO_2, Problem: Addressing Research Agenda Development," CF, 11.

alone cannot explain why the company suddenly changed course vis-à-vis climate research. Exxon's limited research goals, as well as the changing context of the early 1980s, explain why it chose to discontinue these projects just two years after launching them, concentrating its resources on climate modeling. More than the research it conducted on CO_2, an important factor of Exxon's involvement with the issue is the close relationship it cultivated with the U.S. government through its privileged access to the DoE. Exxon would not have invested in a research program if the DoE had not taken up the issue with a certain urgency starting in 1977. Another important element is the fact that there was no unified view of climate change within the company, but that competing interests were at play from the beginning. As Franta has shown, the API engaged in climate denial in the early 1980s already, a decade before what the historiography considered the starting date of their campaign.[489] The same can be said about Exxon, complicating the prevalent media narrative about the company's knowledge of climate change, which holds that Exxon first conducted "legitimate" research into the CO_2 issue before reversing course entirely in 1989 and disavowing its own findings. As this research demonstrates, even a dedicated scientist as Shaw quickly realigned his views with that favoring its industry and its employer, once it became clear that no legislative threat would emerge in the near future, and that uncertainties in the science could be accentuated so as to dismiss, or at least greatly minimize, the dangers associated with a warming planet.

Throughout the 1980s, Exxon would exploit these areas of uncertainty, before resorting to disinformation when it could no longer simply promote scientific uncertainty. While I do not suggest that this absolves Exxon's management in any way (quite the opposite), I think that it offers some nuance that has been missing in the reporting by news organization such as *Inside Climate News* (ICN). Contrary to what ICN reporters imply, Exxon never embarked on scientific ventures devoid of any industrial bias, but it mounted a highly targeted (if ambitious, at least initially) research project. One of the company's objectives appears to have been to find a way to absolve itself and to find other culprits (such as deforestation) or ways that

489 Franta, "Early Oil Industry Disinformation on Global Warming."

would mitigate the effects of fossil fuel combustion (most notably, the ocean acting as a huge carbon reservoir.) I do not know whether the sudden "moral lapse" served journalistic purposes, producing a more dramatic narrative, but records show that Exxon always sought to serve its own interests in conducting CO_2 research. When it proved too costly and difficult, and very early on, the company switched to climate modeling, but its primary objective remained the same: to see where the flaws lied and to exploit them. As such, I would not even say that Exxon engaged in "willful blindness:" it knew exactly what it is doing and funding, and it used the data to serve its own interests.[490] In line with that self-serving posture, and as the next chapter will show, Exxon veered course again in the mid-1980s, and embarked on the offensive, using the weaknesses of climate science it knew all about.

2.7 Conclusion

The late 1970s and the Carter administration represent a pivotal moment in the political history of climate change, at which point climate legislation appeared on the cusp of making a breakthrough. This period saw the emergence of a more robust science of climate change, which clearly pointed out the far-reaching consequences of a warming planet and its impact on all life-supporting ecological systems, from the ocean, to the biosphere and the atmosphere. These scientific claims emerged amidst fears of a return to scarcity, a scourge that had plagued human societies for millennia. After the economic abundance and largesse of the post-war period, the prospect of placing constraints on the economy and returning to a frugal lifestyle was simply not conceivable for political leaders. In a dramatic twist of fate, the science of climate change collided with a period of economic uncertainty and "stagflation," characterized by high inflation, slow economic growth and higher unemployment levels.

In that context, Press and other White House officials strongly opposed initiating a phase-out of fossil fuels, advocating instead for a

[490] Judith Bovensiepen, and Mathijs Pelkmans, "Dynamics of Willful Blindness: An Introduction," *Critique of Anthropology* 40, no. 4 (December 2020): 387–402, cited by Bonneuil, Choquet, and Franta, "Early Warnings and Emerging Accountability," 2.

renewed commitment to coal and oil from synthetic fuels in the hopes of reviving a solid, carbon-based economic growth. As Henderson argues, we tend to think of the Republican party as a major obstructionist to climate legislation, but this only became true in the Reagan years and beyond.[491] The Carter presidency was a defining moment, a unique historical junction in which a Democratic executive stifled bi-partisan congressional climate and energy initiatives. Press's role has not been depicted by the historiography as a roadblock to climate legislation, but he clearly wielded power within the administration, and his pro-oil stance and extreme reluctance towards regulating fossil fuel emissions had a considerable impact in putting off crucial political decisions concerning climate change. Two years into its single term, the administration knew enough to consider taking action. As the president's science advisor, Press did not merely communicate climate science's emerging findings. Rather, he chose to downplay them, so as to justify his stance against governmental action on climate, and his support for expanding the national oil and gas infrastructure, using the power and leverage of the federal government to do so, thereby increasing the United States' dependance on fossil fuels. As the next chapters will show, the Carter administration's reaction to climate change science set the stage for the governmental inaction that persisted throughout the subsequent administrations, which all committed themselves to doing nothing politically except funding more research on climate change.

Another important take-away from this chapter is how controversial climate change became in the second half of the 1970s, when atmospheric science and climate modeling became more assertive in their characterizations of the problem. Suddenly a political issue, with far-reaching social and economic implications in terms of energy production and usage, climate change had just seen a barely-formed consensus emerge in 1979 that the first rip appeared, when it became clear that the role of fossil fuels in the U.S. (and the global) economy might need to be reassessed in significant ways in order to address the issue. While scientists mostly agreed that *something* ought to be done, they left it entirely to their colleagues in the

491 Henderson, "Governing the Hazards of Climate," 212.

social science (mostly economists) to determine *what* ought to be done politically. These social scientists, however, shared similar socio-economic backgrounds and they lacked a diversity of point of views. Nevertheless, their recommendations prevailed in the Carter era and have continued to do so ever since. For the most part, these consisted in *not* doing anything, and let societies adapt to whatever was headed their way in the rapidly-evolving world of climate disruption.

Chapter 3

The Reagan Administration’s “Blitzkrieg” on Environmental Policy and Climate Change Research, and the Intensification of Political Polarization (1981-88)

The election of Ronald Reagan in November 1980 portended the rise of the New Right, and a change in the ideological nature of the Republican party, especially in regard to environmental protection and regulation.[492] As historian Andrew Isenberg and political scientist James Morton Turner explain, over the course of the previous century, the Republican party had undergone what they call a “reversal.” Republicans went from championing conservation at the end of the 19th century and supporting environmental protection in the first half of the 1970s—when Congress enacted a series of major environmental laws sponsored by the Nixon administration—to taking the opposite direction starting in the 1980s, when the party began calling for environmental de-regulation.[493] Reagan’s election marked the beginning of the reversal, a process that lasted for four decades and culminated with the inauguration of the Trump administration in 2016. Isenberg and Morton Turner single out three characteristics of this reversal: first, the party began

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492 For a historical account of Reagan’s presidency, see especially Jefferson Decker, *The Other Rights Revolution: Conservative Lawyers and the Remaking of American Government* (New York: Oxford University Press, 2016); Kim Phillips-Fein, *Invisible Hands: The Businessmen's Crusade Against the New Deal* (New York: W. W. Norton, 2009); James Mann, *The Rebellion of Ronald Reagan: A History of the End of the End of the Cold War* (New York: Viking, 2009); Sean Wilentz, *The Age of Reagan: A History, 1974–2008* (New York: Harper Collins, 2008); James T. Patterson, *Restless Giant: The United States from Watergate to Bush v. Gore* (Oxford: Oxford University Press, 2005). On his administration’s (attack on) environmental policy, see “Ronald Reagan Brings Conservatism to the White House,” *in* Judith A. Layzer, *Open for Business: Conservatives’ Opposition to Environmental Regulation* (Cambridge, MA: The MIT Press, 2012), 83–133; “Business and the Reagan Administration,” *in* David Vogel, *Fluctuating Fortunes: the Political Power of Business in America* (New York: Basic Books, 1992), 240–289; “The Reagan Antienvironmental Revolution,” *in* Samuel P. Hays, *Beauty, Health, and Permanence: Environmental Politics in the United States, 1955-1985* (Cambridge, MA: Cambridge University Press, 1987), 491–526; Jonathan Lash, *A Season of Spoils: The Reagan Administration’s Attack on the Environment* (New York: Pantheon Books, 1984).

493 James Morton Turner, and Andrew C. Isenberg, *The Republican Reversal: Conservatives and the Environment from Nixon to Trump* (Cambridge, MA: Cambridge University Press, 2018).

to treat environmental issues as little more than false alarms, as opposed to legitimate concerns requiring political action; second, the Republican policy platform aligned itself more closely with special interest and industry lobby groups, whose views on environmental protection often contradicted scientific prescriptions; and third, Republican representatives at the state and federal levels increasingly rejected governmental regulation as a form of encroachment on economic growth, individual liberty and free enterprise.[494]

The polarizing lens through which science and scientific expertise were viewed by Republican officials played an important role in their appraisal of climate change.[495] Up until the 1980s, science had received consideration from both parties, and from a large swath of the electorate. The arrival of the Reagan administration, however, set in motion the progressive divorce of the Republican party from science, which led to the disparaging of the scientific community by Republican representatives, the dismissal of scientific expertise and advice in informing public policy, and the characterization of science and scientific results as politicized and skewed in favor of the Democratic political agenda. This resulted in the somewhat awkward association of scientists with environmentalists, as these groups reluctantly joined forces to confront a resolutely anti-science administration and engaged in what historian Joshua Howe calls "a politics of dissent."[496]

3.1 Reagan's Anti-Environmentalist Agenda

The administration's hostility towards environmental policy manifested itself early on, throughout the transition period and the first months of the new presidency. Upon moving to the White House, Reagan ordered that the solar panels installed by his predecessor be removed, demonstrating his contempt

[494] Ibid., 6–7.
[495] On Republicans' relationship to the environment, see Brian Drake, *Loving Nature, Fearing the State: Environmentalism and Antigovernment Politics Before Reagan* (Seattle: Seattle University Press, 2013); Paul Sabin, *The Bet: Paul Ehrlich, Julian Simon, and Our Gamble over Earth's Future* (New Haven, CT: Yale University Press, 2013); Thomas G. Smith, *Green Republican: John Saylor and the Preservation of America's Wilderness* (Pittsburgh: University of Pittsburgh Press, 2006); Chris Mooney, *The Republican War on Science* (New York: Basic Books, 2005); J. Brooks Flippen, *Nixon and the Environment* (Albuquerque: University of New Mexico Press, 2000).
[496] Joshua P. Howe, *Behind the Curve: Science and the Politics of Global Warming* (Seattle: University of Washington Press, 2014), 118–46.

for renewable energy.[497] His anti-environmental crusade began in the transition period, when his advisory team enquired about the dismantlement of the Council on Environmental Quality (CEQ), an agency within the president's executive office responsible for the development of environmental policies and initiatives at the federal level. Because such an action would have required legislative authorization, the administration opted for a simpler solution and decided to drastically reduce the agency's annual budget, from $2.5 million in 1981 to $700,000 in 1984, and to shrink its staff capacity to a quarter of its original size.[498] In doing so, the administration effectively reduced the CEQ to one of the executive's "shadow programs," a term employed in an internal memo by Edwin Harper, a deputy director within the Office of Management and Budget (OMB), to describe another target of the administration: the White House Office of Consumer Affairs.[499] The incoming administration also debated dispensing with the Office of Science and Technology Policy (OSTP) and the post of science advisor altogether, but revised its plans because it was decided that the office's international activities, some of which bore on national security, could not be transferred to the Office of Domestic Policy along with the domestic matters overseen by the OSTP. This point had been made by two of Reagan's closest advisors, James Baker, his chief of staff, and Edwin Meese, whose official title was "Counselor to the President" but who oversaw a large chunk of policy-making, earning him the nickname "Deputy President" in the media. Baker and Meese nevertheless agreed to greatly reduce the size of the OSTP, cutting its staff by 50 percent.[500]

Once they had decided to salvage the post of science advisor, Baker and Meese also weighed in on the choice of whom to appoint to the position.

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[497] Stephen H. Schneider, *Science as a Contact Sport: Inside the Battle to Save the Earth's Climate* (Washington, D.C.: National Geographic, 2009), 90.
[498] Layzer, *Open for Business*, 104.
[499] Edwin Harper to Edwin Meese, Memo, "Science and Technology Advisors / Consumer Advisors et al," March 1981, James A. Baker papers, Digital Library Collections, Ronald Reagan Presidential Library (RRPL), Folder: "OSTP," Box 2.
[500] George A. Keyworth II, "Policy, Politics and Science in the White House (The Reagan Years)," *in* Roger Pielke, and Roberta A. Klein, ed., *Presidential Science Advisors: Perspectives and Reflections on Science* (London, New York: Springer, 2010), 58; Frank Hodsoll to Edwin Meese and James A. Baker, Memo, "OSTP," 16 March 1981, James A. Baker papers, Digital Library Collections, RRPL, Folder: "OSTP," Box 2, 2.

They recommended Arthur Bueche, then a senior vice president at General Electric. Bueche held a doctorate in physical chemistry, but he had spent most of his career in the industry. In a memo to Reagan dated March 1981, Baker and Meese detailed Bueche's qualities, namely the fact that he was "a respected technologist, compatible in outlook [i.e. a conservative], and who would do his job in a low key."[501] In other words, they expected Bueche to fully adhere to the administration's anti-regulatory standpoint, and its understanding of science as a lever of economic growth. Bueche had worked on Reagan's transition team in the Office of Policy Coordination and co-chaired the task force on science and technology prior to the election, but he eventually declined the offer to become Reagan's science advisor.[502]

After other candidates who had been vetted also declined the job, the candidature of George Keyworth, a nuclear weapon physicist at the Los Alamos National Laboratory stood out, probably aided by the recommendation of Edward Teller, the so-called father of the hydrogen bomb.[503] In a letter supporting his candidacy, Keyworth stated that "the President and the administration would benefit more from the presence of a scientific advisor rather than an advocate for science."[504] In asserting his disapproval of the use of the post as a lobbying seat for the scientific community, Keyworth strived to alleviate one of the new administration's fears of hiring an activist scientist. In his view, Reagan would be best served by "a loyal, nonaligned representative," as opposed to "a 'hero' to science." Keyworth also spoke of the importance of hiring an advisor "whose responsibility is directed inward rather than outward," accompanied by "a

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501 James A. Baker and Edwin Meese, Memorandum for the President, "Selection of a Science Advisor," 17 March 1981, James A. Baker papers, RRPL, Folder: "OSTP," Box 2, 1.

502 Bueche cited private reasons for turning down the offer. He died a few months later "after a brief illness," at the age of sixty. Joan Cook, "Arthur M. Bueche, 60, served G.E. as Top Technical Officer," *New York Times*, October 23, 1981, 18.

503 Edwin Gray to James Baker, Memo, "George A. Keyworth," 21 April 1981, James A. Baker papers, RRPL, Folder: "OSTP," Box 2.

504 G. A. Keyworth to Edwin Gray, 15 April 1981, James A. Baker papers, RRPL, Folder: "OSTP," Box 2. For a perspective on his tenure as Reagan's science advisor from 1981 to 1985 (although it mostly centers on defense issues and Keyworth's role in Reagan's Strategic Defense Initiative), see George A. Keyworth II, "Policy, Politics and Science in the White House (The Reagan Years), *in* Roger Pielke, and Roberta A. Klein, ed., *Presidential Science Advisors: Perspectives and Reflections on Science* (London, New York: Springer, 2010), 57–64.

small but carefully selected staff," both points he knew resonated well with the administration's general philosophy. Reagan offered him the job in May 1981, and he was confirmed by the Senate a month later.[505]

Reagan's attempt at subverting environmental policy from within extended to two of the executive agencies most directly responsible for environmental regulations and protection within the federal government: the Environmental Protection Agency (EPA) and the Department of the Interior. Reagan's nominees both drew criticisms and experienced heated confirmation hearings. Anne Gorsuch, who had been chosen to lead the EPA, was a fervent proponent of the administration's anti-regulation agenda, and she brought in an array of former industry executives to lead the offices responsible for the regulatory work overseeing some of their industries.[506] As for the post of secretary of the interior, Reagan nominated James Watt, the president and founder of the Mountain States Legal Foundation, which had vowed to "fight in the courts those bureaucrats and no-growth advocates who create a challenge to individual liberty and economic freedom."[507] An evangelical Christian, Watt summarized his responsibility as that of "follow[ing] the Scriptures which call upon us to occupy the land until Jesus returns," which to him meant to "err on the side of public use vs. preservation."[508] Both eventually resigned before the end of Reagan's first term and were replaced by less divisive figures, but the administration had sent a loud and clear message by nominating them: environmental protection hampered business, and it ought to be reduced to a set of minimal environmental regulations, if any at all.

For all its talks and promises of deregulation, the Reagan administration disappointed conservatives on various matters.[509] Environmental institutions prevailed, and the administration failed to

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505 Philip J. Hilts, "Physicist, Relatively Unknown, Named as Reagan's Science Adviser," *The Washington Post*, June 14, 1981.
506 Howe, *Behind the Curve*, 124.
507 Quoted in Layzer, *Open for Business*, 101, citing Lou Cannon, *President Reagan: The Role of a Lifetime* (New York: Simon & Schuster, 1991), 359.
508 "James Watt and The Puritan Ethic," *Washington Post*, May 24, 1981, quoted in Howe, *Behind the Curve*, 124; Quoted in Layzer, *Open for Business*, 101, citing Pamela Fessler, "A Quarter-Century of Activism Erected a Bulwark of Laws," *CQ Weekly*, January 20, 1990, 156.
509 Layzer, *Open for Business*, 130–33.

eliminate any of the environmental statutes. That said, it successfully prevented legislative moves to update the Clean Air Act, while the Interior Department eased restrictions on natural resource development on federal land, delegating implementation and enforcement of the Endangered Species Act to the states, which were a lot more sympathetic to the coal, gas and logging industries' claims, and generally had fewer resources than the federal government to enforce environmental protection. Even though its efforts at deregulation were countered, the Reagan administration also greatly weakened federal environmental programs by imposing drastic budget cuts, thereby complicating agencies' regulatory work. Yet one of the unintended consequences of the administration's antagonistic approach to environmental policy was the formidable countermovement it helped spawn.[510] Environmental organizations such as the Sierra Club, the National Audubon Society, and the Wilderness Society all saw their memberships rise, and their budgets more than doubled between 1980 and 1985.[511] At the onset of the Reagan administration, the battle for the control of the narrative over climate change had just begun.

3.2 The Administration Weaponizes Seemingly Divergent Assessments of Climate Change to Justify Delaying Action

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[510] On the history of the U.S. environmental movement, see Thomas Jundt, *Greening the Red, White, and Blue: The Bomb, Big Business, and Consumer Resistance in Postwar America* (New York: Oxford University Press, 2014); Adam Rome, *The Genius of Earth Day: How a 1970 Teach-In Unexpectedly Made the First Green Generation* (New York: Hill & Wang, 2013); David Stradling, *The Environmental Moment: 1968-1972* (Seattle: University of Washington Press, 2013); Christopher Sellers, *Crabgrass Crucible: Suburban Nature and the Rise of Environmentalism in Twentieth-Century America* (Chapel Hill: University of North Carolina Press, 2012); Thomas Robertson, *The Malthusian Moment: Global Population Growth and the Birth of American Environmentalism* (New Brunswick, NJ: Rutgers University Press, 2012); Nancy C. Unger, *Beyond Nature's Housekeepers: American Women in Environmental History* (Oxford; New York: Oxford University Press, 2012); Robert Gottlieb, *Forcing the Spring: The Transformation of the American Environmental Movement* (Washington D.C.: Island Press, 2005 [1993]); Philip Shabecoff, *A Fierce Green Fire: The American Environmental Movement* (Washington, D.C.: Island Press, 2003 [1994]); Hal K. Rothman, *The Greening of a Nation?: Environmentalism in the US since 1945* (Fort Worth: Harcourt Brace College Publishers, 1998); Kirkpatrick Sale, *The Green Revolution: The American Environmental Movement, 1962-1992* (New York: Hill and Wang, 1993).
[511] Layzer, *Open for Business*, 132.

As we saw in the previous chapter, the late 1970s and early 1980s had witnessed a flurry of reports and conferences on the effects of rising concentrations of carbon dioxide in the atmosphere. Roger Revelle had headed the panel of the National Academy of Sciences (NAS) Geophysics Study Committee, which had released its report, *Energy and Climate*, in 1977, finding that "the primary limiting factor" on fossil fuels may come from the impacts of climate change.[512] Two years later the Charney report had offered the first scientific consensus on a CO_2-induced climate change, stating that a doubling of atmospheric CO_2 would result in a global warming comprised between 1.5–4°C, potentially disrupting a host of social and environmental systems. Other reports, produced by very different groups of experts, namely the JASONs and the Council on Environmental Quality (CEQ), had arrived at similar conclusions.[513] The Academy had been tasked with updating the 1979 Charney report, and it published a second assessment in 1982, which supported the 1979 report's conclusions.[514] Chaired by Joseph Smagorinsky, the director of Princeton's Geophysical Fluid Dynamics Laboratory, a panel of leading meteorologists and climatologists wrote that it agreed with the 3°C estimate for a doubling of atmospheric carbon dioxide and that "no substantial revision of this conclusion is warranted at this time."[515]

At the outset of the decade, it had therefore seemed probable that the accumulation of reports on climate change might lead to the adoption of relevant policy measures in the years ahead, whether on the domestic level or through an international treaty. But the Reagan administration had other plans in mind, and it held a tight grip on the scientific discourse on climate change. This was particularly visible in the way it handled the publication of two

[512] National Research Council, *Energy and Climate: Studies in Geophysics* (Washington D.C.: The National Academies Press, 1977), viii.
[513] Naomi Oreskes, Erik M. Conway, and Matthew Shindell, "From Chicken Little to Dr. Pangloss: William Nierenberg, Global Warming, and the Social Deconstruction of Scientific Knowledge," *Historical Studies in the Natural Sciences* 38, no. 1 (Winter 2008): 134–135.
[514] National Research Council, CO_2/Climate Review Panel, *Carbon Dioxide and Climate: A Second Assessment* (Washington D.C.: National Academies Press, 1982). On the content and bearing of the 1982 NAS report, see Oreskes, Conway, and Shindell, "From Chicken Little to Dr. Pangloss," 127–133.
[515] National Research Council, *Carbon Dioxide and Climate*, 7.

further reports released in the fall of 1983, the Academy's *Changing Climate*, and the EPA's *Can we Delay a Greenhouse Warming?*[516]

The Academy's report, mandated by the Energy Security Act of 1980, would come in the form of another comprehensive assessment of the science. One of the questions driving the report pertained to the consequences of using synthetic fuels with regard to carbon dioxide build-up.[517] As explained in the previous chapter, "synfuels," as they are also known, are derived from sources such as coal, shale oil and tar sands, and used as substitutes for oil or natural gas, and they had been heavily promoted by the previous administration as a way to bolster the domestic supply of fossil fuels and address the energy crises that had roiled Carter's presidency.

A month after Carter had signed the Energy Security Act, which earmarked funding for a third assessment report on carbon dioxide and the climate by the Academy, and before a panel had been formed to conduct the study, Revelle pondered on the type of work the Academy could realistically deliver to Congress.[518] In a July 1980 letter to Robert White, the president of the University Corporation for Atmospheric Research (UCAR) in Boulder, Colorado, Revelle explained that he did not think the Academy could provide lawmakers with "a definitive statement about the seriousness of the 'CO_2 problem'" before "broadly conceived, well-funded, long-term research programs involving many talented natural and social scientists" could help alleviate the many uncertainties surrounding the issue.[519] Instead of professing a final word on the issue, Revelle argued, the Academy could "undertake inquiries, apply scientific judgments, and make recommendations which will help to ameliorate the problem, both by lowering the rate of CO_2 addition to the atmosphere and by mitigating the socio-economic

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[516] National Academy of Sciences, Carbon Dioxide Assessment Committee, *Changing Climate* (Washington D.C.: The National Academies Press, 1983); Stephen Seidel and Dale Keyes, *Can We Delay a Greenhouse Warming? The Effectiveness and Feasibility of Options to Slow a Build-Up of Carbon Dioxide in the Atmosphere* (Washington D.C.: U.S. Government Printing Office, 1983).
[517] Naomi Oreskes, and Erik Conway, *Merchants of Doubt: How a Handful of Scientist Obscured the Truth on Issues from Tobacco Smoke to Global Warming* (New York : Bloomsbury Press, 2010), 176.
[518] Roger Revelle to Robert M. White, President, University Corporation for Atmospheric Research (UCAR), 25 July 1980, Roger Revelle papers, Special Collections & Archives, UCSD, Box 178, Folder 14 "Carbon Dioxide – Correspondence 1979-1986, part 1 of 2," 1.
[519] Ibid.

consequences."[520] In proposing that the Academy assume an active role in its advising capacity to Congress, Revelle appeared to have been weary of wasting resources on scientific assessments that he knew would yield very little knowledge that scientists did not already possess, and provide no direction to elected representatives in formulating policies to address the problem. Such a proposal is all the more striking as Revelle was, by training and vocation, a physical scientist. He had, however, acquired a lot of experience in working with the government by the time the obstructionist Reagan administration came to power, and a deep understanding of the intricacies specific to climate change, most notably the social, economic and political stakes of the issue on which science could not pronounce itself. In order to avoid stumbling into a political impasse, Revelle recommended a three-part effort by the Academy, centered on an appraisal of the various federal carbon dioxide research efforts, the construction of a range of scenarios mirroring future world energy and land use (so as to determine a global carbon budget), and the consideration of various U.S and international policies which could help lower global CO_2 emissions.[521]

As we have seen in the previous chapter, Revelle was not selected to lead the NAS Carbon Dioxide Assessment Committee, probably because his views contradicted those of the Reagan administration. His successor at the Scripps Institution of Oceanography in San Diego, California, U.S. physicist William Nierenberg, who had been on the NAS panel of the 1980 letter report that had greatly downplayed the consequences of climate change, was appointed chairman of the new committee, most probably after lobbying for the post.[522] The committee included the same climate skeptics that had been on the 1980 NAS panel with Nierenberg, namely the two economists, William Nordhaus and Thomas Schelling (who had chaired the letter report). Among the seven physical scientists was Paul Waggoner, an agronomist at the Connecticut Agricultural Experiment Station in New Haven, who had been on the panel on agriculture and climate change chaired by Sylvan Wittwer at the DoE-AAAS 1979 Annapolis workshop, and whom, like Wittwer,

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[520] Ibid.
[521] Ibid.
[522] Oreskes and Conway, *Merchants of Doubt*, 176–7.

subscribed to the theory of enhanced crop production in a high-CO_2 world (and thus viewed climate change as beneficial).

While the natural science chapters presented results that aligned closely with those of other scientific publications on climate change, the chapters drafted by the economists arrived at vastly different conclusions than their colleagues in the physical science chapters.[523] Schelling and Nordhaus argued that, given the time scale of the problem, which they said would unfold over a century, world populations would have time to adapt to a warmer climate, and people could migrate to more favorable regions if theirs became uninhabitable. The fact that a multi-authored, nearly 500-page report offered different assessments of the carbon dioxide issue was not in itself problematic, nor suspicious. However, as historians of science Naomi Oreskes and Erik Conway demonstrate, what constituted a contentious point was the fact that Nierenberg wrote a synthesis that misrepresented the content of the report by siding with the economists' conclusions.[524] Nierenberg knew that the synthesis would capture the media's attention, and by extension the public's perception of climate change. In an interview for the *New York Times*, Nierenberg declared that "we have 20 years to examine options before we make drastic plans. In that 20 years we can close critical gaps in our knowledge."[525] The recommendation to adopt a "wait-and-see" approach, while doing more research, would become a staple of the conservative aisle in Congress and of the climate change denial movement throughout Reagan's presidency and that of his immediate successors.

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[523] For an extensive discussion of the content of the 1983 NAS report and analysis of the role of Nierenberg in misrepresenting the report's conclusions in the synthesis, see Naomi Oreskes, Erik M. Conway and Matthew Shindell, "From Chicken Little to Dr. Pangloss: William Nierenberg, Global Warming, and the Social Deconstruction of Scientific Knowledge," *Historical Studies in the Natural Sciences* 38, no. 1 (Winter 2008): 137–152. See also Oreskes and Conway, *Merchants of Doubt,* 174–83. Historian of science Gabriel Henderson offers an opposite interpretation of Nierenberg's intentions (with which I disagree), arguing that the accompanying press release by the Academy did not seek to summarize the report's findings, but to modulate its impact on the public's perception of the risks posed by climate change. Henderson further argues that Nierenberg's position of "restraint" on the subject was not an attempt at undermining the emerging scientific consensus on the question, but rather aligned itself with the mainstream governmental approach to environmental risk management. See Gabriel Henderson, "Adhering to the 'Flashing Yellow Light': Heuristics of Moderation and Carbon Dioxide Politics During the 1970s," *Historical Studies in the Natural Sciences* 49, no. 4 (2019): 384–419.

[524] Oreskes, Conway, and Shindell, 142–143.

[525] Howe, *Behind the Curve,* 133, citing Philip Shabecoff, "Haste on Global Warming Trend is Opposed," *New York Times,* October 21, 1983.

By contrast, the other report published in October 1983, this one by the EPA, offered a much sterner verdict, stating that the accumulation of CO_2 emissions required a revision of national energy policy, and it called for the adoption of precautionary measures.[526] Seizing the opportunity offered to him to cast doubt on climate science as a whole, George Keyworth, Reagan's science advisor, opposed the reports' divergent conclusions so as to deride the EPA's publication as yet another example of doomsday thinking. In a memo to Meese, one of Reagan closest advisors, Keyworth commented disdainfully that "an in-house EPA report which professes to be a compendium of other scientific reports was rushed out on [October 20, 1983] probably to steal the limelight from the Nierenberg report," and he accused the EPA publication of being "highly speculative and irresponsible" for suggesting a temperature increase of 9°F (5°C) by the end of the next century, coupled with climate changes and sea level rise.[527] Worst offense of all, in Keyworth's opinion, the EPA report "even lists a cut-off of all coal consumption by the end of this century as one remedy which may be needed."[528] In contrast to the EPA's heretic publication, Keyworth explained that "unlike Bill [Nierenberg]'s acid rain report [i.e. by a panel chaired by Nierenberg to assess the acid-rain issue], this one does not call for any action other than continued study. In fact, it specifically advises against any action because of the lack of scientific knowledge regarding any potential effects of atmospheric CO_2 build-up."[529] Expecting "considerable press attention,"

[526] Howe, *Behind the Curve*, 134.
[527] George A. "Jay" Keyworth, Memorandum for Ed Meese, "National Academy of Sciences (NAS) Report on Carbon Dioxide (CO_2) Build-Up," 21 October 1983, George A. Keyworth papers, Ronald Reagan Presidential Library (RRPL), Simi Valley, CA, Box 4, Folder "EPA – Environmental Protection Agency," 1.
[528] Ibid.
[529] Ibid. Naomi Oreskes and Erik Conway have shown how Nierenberg sabotaged another report, this time on acid rain: William A. Nierenberg, Chairman, "Report of the Acid Rain Peer Review Panel for George Keyworth, Science Advisor to the President and Director of the Office of Science and Technology Policy," July 1984. Oreskes and Conway demonstrate that Nierenberg worked with the OSTP to weaken the final report, after an interim report, which reflected the consensus among members of the panel, had found that acid rain constituted a grave threat to ecological and human systems. See Oreskes and Conway, *Merchants of Doubt*, 66–106. Interestingly, in a letter to the editors at the *New York Times*, Nierenberg disclosed that Frank Press, Carter's science advisor and the president of the National Academy of Sciences at the time, had publicly decried a previous NAS report on acid rain as "unsatisfactory." William Nierenberg, "Laissez-Faire Landscape," *New York Times*, December 5, 1982, 174. This claim concurs with what we

Keyworth noted that the Nierenberg report "has the potential for being misinterpreted" by biased members of the press, by which he meant that journalists might call Nierenberg's sincerity and objectivity into question. Nevertheless, Keyworth deemed it "a sound report which should help defuse worst-case fears of the impacts of the greenhouse effect."[530] Devising a strategic use of the report's amenable conclusions, Keyworth advised Meese to showcase the president and William Ruckelshaus, the administrator of the EPA after the departure of Anne Gorsuch, at a briefing by Nierenberg "as part of our effort to show that the President is sensitive to and on top of environmental issues."[531] Not only was this good PR material, but it would ensure that the Nierenberg report's conclusions took precedence over those of the EPA in the public discourse on climate change.

3.3 Appointed Officials Neutralize the DoE's Research Program on Carbon Dioxide

Throughout the first half of Reagan's presidency, the Department of Energy (DoE), established in 1977 under the Carter administration, acted as a focal point for research on CO_2-induced climate change. After a scientific congress held in Miami Beach in March 1977, where scientists all but noted that more research was needed to evaluate the societal impacts of climate change, the DoE began sponsoring specific projects and dozens of workshops on the effects of an increase in atmospheric carbon dioxide, which were convened under the aegis of the American Association for the Advancement of Science (AAAS), an international non-profit science organization based in the United States.[532] As noted in the previous chapter, the National Climate Program Act of 1978, for all its flaws and shortcomings, had increased funding for research on climate change, if only for a brief period of time, and commissioned several governmental agencies, such as the Departments of Agriculture,

know about Press's own brand of climate change skepticism, discussed in the second chapter.

530 Ibid., 1–2.

531 Ibid., 2.

532 Howe, *Behind the Curve*, 107–14; U.S. Department of Energy, Office of Basic Energy Sciences, *The Carbon Dioxide Research Plan: A Summary* (Washington D.C.: U.S. Government Printing Office, 1983), 33.

Commerce, Defense, Interior and Transportation, to develop research programs.[533] The DoE quickly became the lead agency and the main coordinating platform for federal research on the question through a special program, administered by its Office of Carbon Dioxide. The division's new director, Frederick Koomanoff, played a key role in organizing this research, as he took over the DoE-AAAS collaboration on carbon dioxide research initiated by David Slade, his predecessor. Among the major projects Koomanoff took over was the coordination of the major publication Slade had envisaged back in 1979.

That publication, a 4-volume state of the art (SOA) on the effects of a CO_2-induced climate change, was published five years into the Reagan presidency, in December 1985.[534] Each volume dealt with a specific aspect of the problem. The first focused on the magnitude and rate of climate changes resulting from increasing concentration in atmospheric CO_2, while the second assessed the scientific detections of these changes. The third volume centered on the global carbon cycle, and more particularly the sources, sinks and exchanges of carbon between the various components of the carbon cycle (the atmosphere, the biosphere, the hydrosphere, the pedosphere—the outermost layer of the earth—and the cryosphere). Finally, and perhaps more importantly for policy-makers, the fourth volume assessed what it called the "direct effects" of climate change on vegetation in the managed and unmanaged biosphere, namely agriculture and the various ecosystems. In his preface, Roger Revelle, who at the time chaired the AAAS Climate Committee, wrote that together "these volumes may prove to be the most comprehensive assembly to date of scientific results about [the effects of increased atmospheric carbon dioxide]."[535] Koomanoff agreed and pointed out that the DoE publication sought to "document what is known, unknown,

[533] Howe, *Behind the Curve*, 110.
[534] Technically, the SOA 4-volume series' date of publication is December 1985, but the reports were released one after the other between October 1985 and July 1986. Michael P. Farrell, "Preface," *in* U.S. Department of Energy, Office of Basic Energy Sciences, *Master Index for the Carbon Dioxide Research State-of-the-Art Report Series* (Washington D.C.: U.S. Government Printing Office, 1987), v.
[535] Roger Revelle "AAAS Review," *in* Michael C. MacCracken, and Frederick M. Luther, ed., *Projecting the Climatic Effects of Increasing Carbon Dioxide* (Washington D.C.: U.S. Government Printing Office, 1985), xiii.

and uncertain about CO_2 data, analyses, and modeling capabilities," so as to "outline potential avenues of research for reducing critical unknowns and uncertainties."[536] Each volume, thought of as a SOA on a specific domain of research, featured between seven and ten articles, followed by a summary of all the chapters' main findings and recommendations for future areas of research. In order to bestow credibility on the report, the DoE had commissioned the AAAS to conduct a thorough peer review, a task which fell to the ubiquitous Revelle, and took a year and half to complete. As state of the arts of their respective field of research, each of the four volumes comprised scientific articles presenting highly technical material. In other words, the entire SOA report was unintelligible to the lay people who constituted the vast majority of Congress members to whom it had originally been addressed. As the following section will show, this was hardly accidental, but the result of a deliberate maneuver by Reagan's appointees at the DoE, who reframed a project that had begun before their arrival in the department so as to deprive it of its substance and render it inoperative. While disagreement and competing views most probably existed between scientists and political appointees within the department, this section demonstrates how high-level science administrators at the Office of Carbon Dioxide worked to align DoE reports and publications with the administration's views on the issue.

The SOA report also represents another instance of what historian of science Joshua Howe calls the "top-down, science-first" approach to climate change, an "overweening faith in the power of science to inspire political action," adopted by environmentalists and scientists-turned-climate-change advocates.[537] Instead of offering a scientific basis for policymaking, the report's results and recommendations remained safely circumscribed within the boundaries of science, prescribing nothing in terms of possible avenues for energy policy, sticking instead to the most innocuous message it could deliver: more research was needed. As Oreskes and Conway have observed,

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[536] Frederick A. Koomanoff, "Foreword," *in* Michael C. MacCracken, and Frederick M. Luther, ed., *Detecting the Climatic Effects of Increasing Carbon Dioxide* (Washington D.C.: U.S. Government Printing Office, 1985), vii.
[537] Howe, *Behind the Curve,* 9.

scientists (and later, climate change deniers) have tended to firmly believe in the idea that solid science necessarily leads to good public policy.[538] It appears that Reagan's appointees at the DoE took advantage of scientists' candor, knowing how sorely mistaken they were.

We know from an article Koomanoff wrote for the Bulletin of the American Meteorological Society that his office had decided to launch "a program of directed research" focusing on five research areas, which would lead to the publication of five "interim research assessments," namely the SOA reports.[539] Together with a "statement of findings," the SOAs would "present an integrated, systems view of the entire research program needed to reduce uncertainties."[540] But as stated earlier, the final product released by the DoE in 1985 consisted in a 4-volume series. What had happened to the fifth research area, which should have documented the "indirect effects" of climate change, or some of the consequences it would have on life-sustaining resources such as forests or fisheries? The fate of that last volume offers an apt synecdoche for the Carbon Dioxide Research Program as a whole.

What should have been the fifth SOA was released as one of two "companion reports," published alongside but separately from the four SOA reports. The volume's demotion illustrates the unwillingness of the DoE's Carbon Dioxide Office to offer a comprehensive state of the knowledge on the impact of climate change and its potentially adverse effects on the global environment and societal systems throughout the world. While the four SOAs delineated lines of research, and thus proved valuable to researchers interested in the carbon dioxide question and to funding bodies in their reviewing of research proposals, the fifth SOA was the only truly useful document for policymaking. By outlining some of the costs associated with increased levels of atmospheric carbon dioxide, this SOA could have offered a basis for assessing policy options and providing justifications to adopt a

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[538] Naomi Oreskes and Erik Conway, "Challenging Knowledge: How Climate Science Became a Victim of the Cold War," in *Agnotology: The Making and Unmaking of Ignorance*, ed. Robert Proctor, and Londa Schiebinger (Stanford University Press, 2008), 79.
[539] Michael R. Riches and Frederick A. Koomanoff , "Overview of the Department of Energy Carbon Dioxide Research Program," *Bulletin of the American Meteorological Society* 66, no. 2 (February 1985): 152–8. Ibid., 153.
[540] Ibid.

precautionary approach. But it turned out to be the weakest of the five assessments, and it elicited a highly negative feedback from AAAS members who had been invited to give an appraisal of the volume. One of these specialists, Stephen Schneider, a climate expert at the National Center for Atmospheric Research (NCAR) in Boulder, Colorado, said he was "entirely unwilling to be associated with the Indirect Effects chapters until substantial modifications have been made […]."[541] Revelle's records do not tell us who made the decision, but it appears that a compromise was found in the publication of the original fifth SOA as a separate companion report. What the compromise also achieved was to bury the opportunity for that volume to serve as a guideline for policy.

It must have been particularly painful for Revelle to see the sabotage of the SOA report, and of the fifth volume especially. In *Science as a Contact Sport*, Schneider spoke of the DoE's Carbon Dioxide Research Program as "the Revelle effort that had been under way for several years."[542] Through his work at the National Academy of Sciences and the American Association for the Advancement of Science, Revelle was deeply engaged with all aspects of climate change, and he often insisted on the necessity of interdisciplinary work to tackle the problem from a scientific standpoint.[543] Despite his training in the natural sciences, Revelle had turned to social sciences when he had helped to found the Center for Population Studies at Harvard in 1963, and had taught public policy after returning to the University of California at San Diego in 1976. His command of a range of disciplines shaped his understanding of the social, political and economic consequences of climate change. With the arrival of the Reagan administration, however, the DoE reversed course on climate change, and especially on social science research

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541 Stephen H. Schneider to Roger Revelle, 16 August 1985, Roger Revelle papers, Special Collections & Archives, UCSD, Box 136, Folder 14 "AAAS Committee on Climate 1979-1990," 2.

542 Schneider, *Science as a Contact Sport,* 89.

543 In the minutes of an AAAS meeting on January 12, 1983, Revelle is quoted as saying that "the great strength of the Association is that its Board, its magazine, its raison d'etre, are all inter-disciplinary. It brings together ALL the sciences, social and natural. […] It encourages symbiosis and interchange. […] For a cross-cutting issue like climate change, you need biology, and policy, and the social sciences." David Burns to the members of the AAAS Committee on Climate, minutes, "Meeting of January 12, 1983," Roger Revelle papers, Special Collections & Archives, UCSD, Box 137, Folder 9 "AAAS Climate Project, 1978-1988, part 3 of 5," 2.

and input on all the other aspects of the CO_2-induced disruption outside of the climatic system itself. The fifth SOA focused on areas of human welfare that would be impacted by climate change (human health, agriculture, forestry, water resources, and fisheries), but the methodology and approach to these consequences was much more limited than what Revelle, Slade and the steering committee had outlined in their original research plan in 1980.

Although its content drew pointed criticisms, reviewers already took issue with the outline and the general tone of the fifth volume before it was written, for it already appeared at that stage that the volume was only going to be a report on the state of knowledge, and no basis for political reflection or legislative action. Perhaps this was more visible in that volume, but the nature of the entire SOA report was fraught from the start: as a state of the art and a *research* plan, it aimed at pointing out gaps in knowledge. Its target audience, therefore, was the scientific community, and less so Congress or other branches of government. The document prepared under Slade in 1980 also was a research plan, and yet its authors had recognized its role in informing policy. In his preface to a DoE research planning document published in May 1978, Slade had written that the Department's aim was "to develop the ability to predict the environmental, economic, social and political costs of increasing atmospheric concentrations of carbon dioxide with sufficient confidence to permit policy decision to be made on the future global use of fossil fuels."[544] The research plan's purpose was to serve the government, not just the community of researchers.

A similar point was made by David Burns, the AAAS coordinator of the DoE 1980 research plan, who explained in his statement at a congressional hearing that "any change in a fundamental resource, such as climate, could cause serious and costly disruptions. But general, hypothetical studies are unlikely to provide compelling justification for an international effort to switch away from a fossil-based fuel economy—nor are they a justification

[544] David Slade, "Preface," *A Comprehensive Plan for Carbon Dioxide Effects Research and Assessment, Part I: The Global Carbon Cycle and Climatic Effects of Increasing Carbon Dioxide* (Washington D.C.: U.S. Government Printing Office, 1978), i.

for inaction."[545] In the article published in the Bulletin of the American Meteorological Society in January 1985, Koomanoff presented the rationale behind the SOA publication, and he too claimed that, under David Slade's leadership, the DoE's Office of Carbon Dioxide had aimed "to identify possible policy options for government action in response to effects of increased CO_2."[546] Koomanoff was well aware that none of the SOAs would prove helpful to lawmakers, but he was reiterating what had been the primary intention behind the SOA publication when it was first conceived of by Slade's Office of Carbon Dioxide, namely that the five SOAs would serve as tools for policy-making and legislative road mapping, not mere assessments of the science on climate change.

The missed opportunity for providing guidance to lawmakers, the unwillingness to lend any sense of urgency to the matter by drawing attention to the scientific uncertainties, and the overall lenient treatment of climate change's consequences, some of which were even deemed beneficial (some agronomists argued that an increase in CO_2 would bolster plant growth, something Schneider said made them "loo[k] like they're stressing the benefits and ignoring the potential risks"), informed the bulk of the responses penned by members of the AAAS Climate Committee and the SOA Subcommittee regarding the SOA's general outline, as they reviewed it before invitations for contributions were sent out.[547] In a letter to David Burns, the AAAS coordinator of the SOA's peer review process, dated September 16, 1983, Schneider proclaimed that the fifth section was "the worst of all—not because of what it does but because of what it doesn't do," and drew up a list of potential impacts of climate change he said "the DoE appears to be choosing to minimize."[548] Invited to chair the subcommittee of the fifth volume, Robert Kates, a professor of Geography at Clark University,

[545] U.S. Congress, Senate Committee on Energy and Natural Resources, Hearing, *Effects of Carbon Dioxide Buildup in the Atmosphere,* 96th Congress, 2nd Session, April 3, 1980 (Washington D.C.: U.S. Government Printing Office, 1980), 164.
[546] Riches and Koomanoff, "Overview of the Department of Energy Carbon Dioxide Research Program," 152.
[547] Stephen H. Schneider to David Burns, 16 September 1983, Roger Revelle papers, Special Collections & Archives, UCSD, Box 136, Folder 14 "AAAS Committee on Climate 1979-1990, part 2 of 3," 3.
[548] Ibid.

justified his decision for refusing to take on the assignment by referring to that section's inadequacy: "I am not in sympathy with the motivations and direction of the Department of Energy. In particular, I have even less sympathy with the lumping of all effects of climate change beyond vegetation in the so-called indirect effects," Kates wrote, aptly pointing out the downplaying by the DoE of far-reaching consequences on human welfare.[549] Norman Rosenberg, a professor of Agricultural Meteorology at the University of Nebraska-Lincoln, similarly reckoned that "the major weakness in the overall SOA effort […] is the absence of a serious study of 'second order' effects on agriculture and other natural ecosystems."[550] That criticism was echoed by J. Murray Mitchell, a climatologist at NOAA, who said his "main concern is that the effects of CO_2 change on agriculture are to be considered only in terms of direct effects, ignoring CO_2-related climatic changes."[551] Rosenberg also feared that the outline would fail to generate "useful analyses […] in the sense of providing the kind of information that legislators and other decision makers will need."[552]

An undated and unsigned document in Revelle's records provides a snapshot of the committee's sentiment towards the general SOA outline. The document uses a collective "we," most probably referring to the members of the AAAS Climate Committee, as some of its criticisms reappear verbatim in individual letters by committee members to David Burns. The document also bears annotations in the margins, probably by Revelle, in which his opinion appears to have been at odds with that of the committee regarding certain points. The apparent rift, I believe, owed to Revelle's position as chair of the committee (thus responding more directly to the DoE than the other members) and his long involvement as an advisor to the government, which perhaps

[549] Robert Kates to David Burns, 30 August 1983, Roger Revelle papers, Special Collections & Archives, UCSD, Box 136, Folder 13 "AAAS Committee on Climate 1979-1990, part 1 of 3," 1.
[550] Norman Rosenberg to David Burns, 27 October 1983, Roger Revelle papers, Special Collections & Archives, UCSD, Box 136, Folder 13 "AAAS Committee on Climate 1979-1990, part 1 of 3," 1.
[551] J. Murray Mitchell, Jr. to David Burns, 31 October 1983, Roger Revelle papers, Special Collections & Archives, UCSD, Box 136, Folder 13 "AAAS Committee on Climate 1979-1990, part 1 of 3," 1.
[552] Norman Rosenberg to David Burns, 27 October 1983, Roger Revelle papers, Special Collections & Archives, UCSD, Box 136, Folder 13 "AAAS Committee on Climate 1979-1990, part 1 of 3," 1.

made it difficult for him to criticize the DoE so openly. Nevertheless, the document clearly lays out the tensions between the AAAS Climate Committee and the DoE. Committee members indeed wrote that "the expectation is that the US Department of Energy, the lead agency for research on [climate change], will do more than summarize the scientific consensus (and the bewildering array of new questions raised in the process)."[553] Fearing or sensing that "the aim of the CO_2 research program […] to provide policy options for governmental action […] [might] […] become bogged down in minutiae," the authors expressed their disappointment in seeing what they considered a crucial piece towards legislation rendered meaningless by DoE's attempt at encasing it in obscure scientific accounts.[554] The absence of a discussion of policy choices and actions could not be justified by the uncertainties surrounding the issue.

In a forceful rebuke of the DoE, the authors explained that "ducking these questions does not avoid controversy. Rather, it will create it, since the intended audience […] may charge that the DoE CO_2 program had abdicated its responsibility."[555] Fully aware of what the agency was doing in proposing a benign and inoperable—from a legislative perspective—scientific review of the literature, the authors further charged that "not to offer the best advice to the Congress is a form of advice itself: it says that it is not necessary to do anything now or even very soon—otherwise the report would surely have said more."[556] In a bold indictment of the DoE's carbon dioxide office, the AAAS Climate Committee members also asserted that to speak of "'indirect effects', 'second-order effects' etc. conveys the view that the issue is comfortably small and remote, and that policy-makers need not concern themselves with it, but can safely leave it in the hands of […] scientists for a decade or two."[557] The DoE was acting irresponsibly, in the eyes of these concerned scientists, but it was also doing so in plain sight.

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[553] Untitled, undated and unsigned document, Roger Revelle papers, Special Collections & Archives, UCSD, Box 136, Folder 13 "AAAS Committee on Climate 1979-1990, part 1 of 3," 1.
[554] Ibid.
[555] Ibid., 2.
[556] Ibid.
[557] Ibid.

David Rose, a professor of Nuclear Engineering at MIT and a member of the Subcommittee preparing the SOA volume, reiterated some of these charges in a letter to David Burns, remarking with a note of sarcasm the fact "that all these five big volumes will be dumped on the Congressional desks with details on uptake in soybeans and kohlrabi, with carrots and rhubarb to come in a little while, is to mis-assess both what the Congress (and the public) need, and what they can handle."[558] Rose cited some of the reasons offered by Koomanoff to justify the DoE's editorial choices, such as the need to point out uncertainties and the duty of the DoE to "not give irresponsible advice," but he also claimed that "there is more. The Congress—and the White House, for that matter—have to make decisions about energy policy."[559] The DoE's justifications for not including the social and political impact of climate change appeared as convenient strategies deployed by the agency to kill the SOA report in the bud. Either naively or sarcastically, Rose asked Burns: "If the Department of Energy can't seem to get its head together on this matter, better than to quote unimpeachable literature, how do they expect the Congress to do better?"[560] As the AAAS Climate Committee's scathing reviews attest, the DoE could not have come up with a better plan—both a research plan and a strategy—to paralyze Congress and prevent meaningful legislation, and these impassioned responses demonstrate that these scientists knew that and were outraged by the agency's schemes.

The reviewers' and the AAAS Climate Committee's misgivings about the SOA report's general outline did not derail the DoE's plan, which proceeded unaltered. After the five volumes were completed, the AAAS Climate Committee was commissioned to coordinate the peer-review process, which lasted for over a year. In a letter to Revelle dated August 16, 1985, Schneider recognized that "one can quibble endlessly about omitted issues, degrees of emphasis and shades of meaning," but he judged the work

558 David Rose to David Burns, 27 October 1983, Roger Revelle papers, Special Collections & Archives, UCSD, Box 136, Folder 13 "AAAS Committee on Climate 1979-1990, part 1 of 3," 2.
559 Ibid.
560 Ibid.

presented in the first four volumes to be “in reasonably good shape.”[561] The last volume, however, failed to meet basic scientific standards. In that same letter, Schneider qualified the fifth section as belonging to “a sub-minor league” compared to the four other sections, noting that “this volume […] is so bad relative to the others that it may take a year or more to bring it even part way to the level of quality of the natural scientific volumes.”[562] The fifth SOA was indeed the last volume to be published, in July 1986, attesting to the major revisions that must have been prescribed by reviewers. However, the harm was done well before the chapters were even written, when the DoE chose not to include any social scientists, thereby greatly restraining the volume’s scope. The point was made by Schneider in his letter’s concluding paragraphs, in which he remarked that “the DoE, through its own policy choices made five years ago, has relatively underfunded and underemphasized the all-important question: ‘So what if CO_2 increases and the climate changes?’”[563] Reagan’s DoE’s choice not to push forward a narrative countering its views on a fossil fuel-based economy and unfettered economic growth was deliberate.

We do not know from Revelle’s records what Koomanoff and the DoE leadership’s view of CO_2 was, but they gave a number of testimonies at Congressional hearings that at least partly reveal their approach towards the problem and the importance to give (or not) to scientific research on the matter. Hearings are part of Congress’ regular oversight duties of the executive branch of government but as Howe notes, they were used by the Democrat minority in the Senate as a way to bring back the issue of climate change to the front, while the Reagan administration was working hard to shelve it.[564] In 1981, James Hansen, a prominent scientist who had developed climate modeling at NASA, sent Walter Sullivan, the *New York Times* science reporter, a copy of a forthcoming article he and his colleagues had submitted to *Science*, in which they claimed that the warming signal would rise above

[561] Stephen Schneider to Roger Revelle, 16 August 1985, Roger Revelle papers, Special Collections & Archives, UCSD, Box 136, Folder 13 “AAAS Committee on Climate 1979-1990, part 1 of 3,” 1.
[562] Ibid.
[563] Ibid., 2.
[564] Howe, *Behind the Curve*, 125.

the "noise" of weather fluctuations around the turn of the century.[565] The authors also offered a bold policy recommendation: in the coming decades, society should divest from fossil fuels and develop alternative sources of energy. Their results, which predicted a global warming "of almost unprecedented magnitude" and seal-level rise of up to six meters, made it on the front page of the newspaper, provoking the ire of the administration.[566] Koomanoff rescinded the research grant Hansen had obtained from the DoE under the Carter administration, forcing him to lay off five researchers.[567]

The first public test for the administration concerning its policy on climate change research came in July 1981, when the House Committee on Science and Technology convened a hearing to throw light on the White House's rumored cuts to the DoE's budget, and especially its carbon dioxide research program on the impacts of climate change. On that committee sat Albert "Al" Gore, who had been taught by Revelle at Harvard and who would dedicate a significant part of his political life to climate change, and George Brown, the Democratic Representative from California who had pushed for the 1978 National Climate Program Act. The sessions proceeded smoothly and cordially until, in the words of Schneider who was also testifying that day, "the proceedings took an ugly turn" when senators began to question the last panel of witnesses, composed of Koomanoff and his bosses, Nelson Douglas Pewitt, the acting director of the Office of Energy Research, and James Kane, the associate director of the Office of Basic Energy Science, on the proposed budget cuts.[568]

Gore pressed Pewitt about these cuts to the DoE Carbon Dioxide Research Program, which Pewitt had preemptively dismissed as "hallway gossip" in his opening remarks.[569] As the questioning continued, he later conceded that the carbon dioxide program was getting assessed and that "no commitment has been made to a specific level of funding," although as Gore

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[565] Ibid., 130–1; Nathaniel Rich, *Losing Earth: The Decade We Could Have Stopped Climate Change* (London: Picador, 2019), 68–9.
[566] Howe, *Behind the Curve,* 130, citing James Hansen, et al., "Climate Impact of Increasing Carbon Dioxide," *Science* 213 (Aug. 28, 1981): 966.
[567] Howe, *Behind the Curve,* 131.
[568] Quoted in Schneider, *Science as a Contact Sport,* 88.
[569] U.S. Congress, House Committee on Science and Technology, Hearing, *Carbon Dioxide and Climate: The Greenhouse Effect*, 97th Congress, 1st Session, July 31, 1981 (Washington, D.C.: U.S. Government Printing Office, 1981), 83.

pointed out, a budgeted amount for the program had already been set and approved by Congress.[570] According to Pewitt, the program was "being reviewed; not reduced."[571] Gore moved to a sensitive part of the research program, related to the "social, political and economic costs and/or benefits of the global environment change," which he argued "was in some jeopardy."[572] Pewitt responded that he was "less than happy […] to spend the taxpayers' money on that sort of social research," which he deemed "aimed at things like how Congress makes decisions."[573] James Scheuer, a Democratic Representative from New York, fired back and explained that "we don't want that kind of research either" but that some members of Congress were concerned about the "major dislocations that not only national but regional and international implications […] for which a research program should be designed."[574] Pewitt spoke of "management changes that are necessary to have a responsible, reasonable, cost-effective assessment of the carbon dioxide issue," but the fate of the fifth SOA indicates that some within the DoE sought to muffle that important area of climate change research relating to societal impacts.[575]

The rest of Pewitt's testimony revealed his thinly veiled disdain towards scientists such as Revelle or Schneider, who had testified in earlier panels that day, when he said that "you can't have scientists using alarmism in order to justify bigger research budgets" and that he "absolutely refuse as an official in a responsible position to engage in that type of alarmism."[576] Koomanoff adopted a more measured tone, telling Gore that "the carbon dioxide concern is a very important one," an issue requiring "good scientific answers."[577] But he also insisted on the "many questions and much uncertainty that must be resolved," and he warned against "mak[ing] a conclusion at this point with our lack of knowledge and the great uncertainties

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[570] House Committee on Science and Technology, *Carbon Dioxide and Climate: The Greenhouse Effect,* 84.
[571] Ibid.
[572] Ibid., 84–5.
[573] Ibid., 85.
[574] Ibid.
[575] Ibid., 86.
[576] Ibid., 87–8.
[577] Ibid., 89.

that exist and jump[ing] in the future [as] a very dangerous thing to do."[578] In another hearing on climate change held in 1984, Koomanoff's boss, James Kane, alluding to the 1983 NAS report, told committee members that the DoE "side[ed] with their viewpoint to a large extent" and that he deemed the report's conclusion, which stated that "we have time to conduct the needed research," to be "reasonable."[579]

In their 1985 article, Koomanoff and his colleague, mirroring the confidence expressed by many scientists in the supposedly direct relationship between science and policy, wrote that "improved data, models, and more definitive analysis for policy decision making are expected to be available in the early 1990s."[580] While this is what had indeed been announced originally, the second assessment report, which was scheduled for 1989, never materialized.[581] Nor did the Statement of Findings, the summary that was meant to introduce the 1985 SOA report. In a letter dated November 27, 1985, Koomanoff informed Revelle that "due to the delays we have encountered, it is no longer practical to have your Committee review the Executive Summary of the Statement of Findings," but that the DoE would make sure to send Revelle a copy "as soon as it is drafted, which should be in a few months."[582] As expected, the SOA publication did little to stir Congress into action. But, together with mounting evidence pointing to a change in the climate, it sent an alarm to a perhaps unintended audience, namely the oil industry. By the

[578] Ibid.
[579] U.S. Congress, House Committee on Science and Technology, Hearing, *Carbon Dioxide and the Greenhouse Effect*, 98th Congress, 2nd Session, February 28, 1984 (Washington, D.C.: U.S. Government Printing Office, 1984), 168.
[580] Riches and Koomanoff, "Overview of the Department of Energy Carbon Dioxide Research Program," 153.
[581] In a 1980 document prepared by the DoE, David Slade, the director of the Carbon Dioxide and Climate Division, had written that "in the fifth and tenth year of the program, 1984 and 1989, a comprehensive, authoritative analysis report will be issued." U.S. Department of Energy, Carbon Dioxide Effects and Assessment Program, *Summary of the Carbon Dioxide Effects Research and Assessment Program* (Washington D.C.: U.S. Government Printing Office, 1980), 36. Exxon, in one of its 1981 internal reports, also referred to "an interim assessment of the problem" scheduled for publication in 1984, and "a full report […] to be made by the DoE to the 'policy community' (executive, Congress, and public)" to be ready by 1989. R. E. Barnum, "Scoping Study on CO_2, CF, 6. As late as 1985, Koomanoff continued to speak of five "interim research assessments" in his article for the Bulletin of the American Meteorological Society. Riches and Koomanoff, "Overview of the Department of Energy Carbon Dioxide Research Program," 153.
[582] F. A. Koomanoff to Roger Revelle, 27 November 1985, Roger Revelle papers, Special Collections & Archives, UCSD, Box 104, Folder 2 "Department of Energy 1979-1987, part 1 of 7," 1.

end of the decade, major oil conglomerates had joined forces and embarked on a vehement denial campaign of the reality of climate disruption.

3.4 Scientific Advances, International Conferences and the Emergence of a Global Consensus on the Need for Governmental Responses to Climate Change

If the DoE SOA reports had emphasized scientific uncertainties in the various threads surrounding the issue of climate change, an international conference held in 1985 in Villach, Austria, arrived at a consensus on the question. Organized by the International Council of Scientific Unions (ICSU) and the World Meteorological Organization (WMO) as a series of meetings held at Villach throughout the 1980s, the 1985 conference marked a turning point in the history of climate change politics.[583] Unlike previous meetings, whose recommendations had centered on calls for more research into the problem, the last of these Villach conferences produced a report in which scientists from twenty-nine countries declared that "in the first half of the next century a rise of global mean temperature could occur which is greater than any in man's history."[584] For the first time, beside calling for more research, scientists were also careful to point out that "while some warming of climate now appears inevitable due to past actions, the rate and degree of future warming could be profoundly affected by government policies."[585]

The existence of an international scientific consensus on anthropogenic climate change, albeit a prudently-worded one, represented a significant achievement in itself. At the time of the 1985 Villach conference, the U.S. scientific community was indeed still reeling from a seismic controversy over a thought experiment including nuclear weapons. In their assessment of a hypothetical event known as "nuclear winter," a euphemism referring to the aftermath of a nuclear war, a group of scientists at NASA's Ames Research Center in Mountain View, California, attempted to determine

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[583] Howe, *Behind the Curve*, 155.
[584] Bert Bolin, et al, ed., *The Greenhouse Effect, Climatic Change, and Ecosystems* (Chichester: John Wiley, 1986), quoted in Weart, *The Discovery of Global Warming,* 151.
[585] Ibid.

the global impact of a nuclear exchange using computer models.[586] Known by an acronym made up of the first letter of their family name, the so-called TTAPS group claimed that the firing of nuclear weapons would cause a global cooling in the form of a month-long winter freeze, because of the sun-blocking action of soot and dust particles released into the atmosphere by burning cities.[587] Led by Carl Sagan, an astrophysicist and a well-known popular science figure, the team of researchers convened a conference in Washington D.C. on Halloween night 1983 to publicize their results. Sagan was pursuing an overtly political goal, as he sought to expose the threat posed by the Reagan administration's aggressive promotion of nuclear weapons and its willingness to expand the U.S. nuclear arsenal. In an effort to corroborate the TTAPS results, another group of researchers headed by Schneider at the National Center for Atmospheric Research, had run simulations on a three-dimensional atmospheric model. Contrary to what TTAPS's one-dimensional model predicted, Schneider and his colleagues had found no episode of nuclear winter, no "perpetual deep freeze" but rather a series of "fluctuating freezes."[588] They called it a nuclear fall, and a disaster in its own right, but rejected Sagan's framing of the issue as foreshadowing the next mass extinction. More importantly for national security considerations, Schneider's model disproved the existence of a threshold above which a nuclear exchange would trigger an atmospheric cataclysm, one of Sagan's main policy recommendations. Before the 1983 October conference in Washington D.C., Schneider attempted to convince Sagan to retract his idea of the threshold, but Sagan declined, and a public exchange between the two scientists enfolded in scientific journals and popular media from the fall of

[586] On the origins and unfolding of the controversy, see Howe, *Behind the Curve*, 134–44, and Schneider, *Science as a Contact Sport*, 95–108. For a detailed historic account of the nuclear winter episode, see Lawrence Badash, *A Nuclear Winter's Tale: Science and Politics in the 1980s* (Cambridge, MA: The MIT Press, 2009). See also Paul N. Edwards, *A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming* (The MIT Press, 2010), 380–384; Erik M. Conway, *Atmospheric Sciences at NASA: A History* (Baltimore: Johns Hopkins University Press, 2008), 206–212; Matthias Dörries, "The Politics of Atmospheric Sciences: 'Nuclear Winter' and Global Climate Change," *Osiris* 26, no. 1 (2011): 198–223; and Brian Martin, "Nuclear Winter: Science and Politics," *Science & Public Policy* 15, no. 5 (1988): 321–334.
[587] Howe, *Behind the Curve*, 136.
[588] Schneider, *Science as a Contact Sport*, 101.

1983 until the summer of 1986.[589] In *Science as a Contact Sport,* Schneider remembers the episode as "one of the most unpleasant chapters in my life," as he felt torn between his concurring with Sagan's idea that "a winnable nuclear war is insanity" and the need to push back against the administration's hawkish impulses, and his integrity as a scientist which he thought compelled him to publish his results, even if they invalidated the TTAPS findings.[590]

Although the nuclear winter controversy had little to do with the issue of a CO_2-driven climate change, the heated exchanges between Sagan and Schneider provided fodder to conservative scientists and critics who denounced Sagan's scientific activism as an example of prejudiced, liberal manipulation of science for political purposes. Reviving the specter of the warming vs. cooling "debate" of the 1970s, the episode also called into question the reliability of climate modeling in offering a basis for political decisions and legislative measures, making climate change science one of the nuclear winter controversy's unintended collateral damages. Finally, Sagan and Schneider's public fallout further exacerbated the political divide over the science and politics of climate change.

A strand of research that was picking up steam at the time pertained to another source of atmospheric pollution, namely ozone-depleting gases. Chlorofluorocarbons (CFCs), which were commonly found in aerosol sprays, and used as solvents and refrigerants, had been known since the mid-1970s to disrupt the ozone layer in the stratosphere, allowing increased ultraviolet radiation to reach the earth.[591] In 1974, chemists Sherwood Rowland and Mario Molina demonstrated how various gases had an adverse impact on stratospheric ozone in a paper that would earn them the Nobel Prize in chemistry in 1995.[592] A decade later, the problem remained a theoretical issue

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[589] Howe, *Behind the Curve,* 141–142.
[590] Schneider, *Science as a Contact Sport,* 103.
[591] On the scientific assessment of ozone depletion, see "Assessing Ozone Depletion," in *Discerning Experts: The Practices of Scientific Assessment for Environmental Policy,* ed. Michael Oppenheimer, Naomi Oreskes, Dale Jamieson, Keynyn Brysse, Jessica O'Reilly, Matthew Shindell, and Milena Wazeck (Chicago: The University of Chicago Press, 2019), 81–126; on the spread of doubt and misinformation on this issue, see "Constructing a Counternarrative: The Fight over the Ozone Hole," in *Merchants of Doubt: How a Handful of Scientist Obscured the Truth on Issues from Tobacco Smoke to Global Warming,* Naomi Oreskes, and Erik M. Conway (New York: Bloomsbury Press, 2010), 107–135.
[592] Howe, *Behind the Curve,* 150.

and no serious policy move was expected from the Vienna Convention for the Protection of the Ozone Layer signed by twenty nations in 1985, "a toothless expression of hopes" in historian Spencer Weart's words, until a British research team reported the discovery of an ozone "hole" over Antarctica that same year.[593] Further research confirmed the role of chemicals in destroying the ozone layer, and the associated risks that this phenomenon posed to human health, bolstering a momentum that led to the adoption of the groundbreaking Montreal Protocol of the Vienna Convention in 1987. Formally known as the Montreal Protocol on Substances that Deplete the Ozone Layer, the international agreement called for a drastic reduction of CFC emissions. Despite his administration's antagonist stance on environmental policy, Reagan signed the international treaty on April 5, 1988, probably aided by the fact that leading companies in the domestic chemical industry such as DuPont had calculated that they stood to benefit from selling substitute chemicals.[594] The chemical industry also favored an international treaty as it would regulate its foreign competitors, as opposed to a national one that would place the burden solely on domestic companies.

The adoption of the protocol was hailed as a success, and it was soon viewed as a model for international policymaking on other global environmental issues, such as climate change.[595] In the late 1980s, a binding framework on greenhouse gases seemed within reach. As issues related to the state of the atmosphere, the differences between ozone depletion and climate change were nevertheless significant. Unlike fossil fuel emissions, the literal engine of economic growth, ozone-depleting gases formed a group of distinct and specific pollutants, which could be relatively easily replaced by other products at acceptable costs. Transitioning to a whole new energy system on a global scale represented a vastly different type of political and economic endeavor. Finally, and as Howe notes, the element of surprise and the short time period between the discovery of the ozone hole and the legal concoction of a binding treaty prevented the industry from mounting an efficient

[593] Weart, *The Discovery of Global Warming*, 152.
[594] Morton Turner, and Isenberg, *The Republican Reversal*, 145–47.
[595] James Gustave Speth, *Red Sky at Morning: America and the Crisis of the Global Environment* (New Haven: Yale University Press, 2004), 91–2, quoted in Howe, *Behind the Curve*, 151.

campaign to derail negotiations regarding the phasing out of CFCs. But it also taught them a lesson, which informed their reaction to emerging talks on regulating fossil fuel emissions.[596]

Another step in the accelerating pace of global environmental governance was the release, in 1987, of the report *Our Common Future* by the World Commission on Environment and Development (WCED). Also known as the Brundtland report after the name of the commission's chairwoman, Gro Harlem Brundtland, the Norwegian prime minister, the report offered a set of possible institutional responses to environmental challenges which could potentially disrupt human societies. The commission framed its response around the concept of "sustainable development," which the authors defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own need."[597] In calling for the necessity to strike a balance between three distinct but interdependent realms, namely the economy, the global environment and society, the WCED re-affirmed capitalism while underlining the necessity to reconcile economic development with social and environmental objectives. As such, the Brundtland report was anything but a radical call to arms against one of the two predominant forms of socio-economic organization. Attesting to an emerging reckoning within international institutions that environmental crises were real and required some form of collective response, the report sought to integrate demands by the Global South regarding economic development, as well as concerns they shared with Western nations over environmental degradation.[598] As Howe observes, the sustainable development paradigm became the prevailing lens through which solutions to climate change would come be to be developed and assessed, a phenomenon further amplified by the fall of the Soviet Union two years later.[599]

596 Howe, *Behind the Curve*, 153–54.
597 World Commission on Environment and Development, *Our Common Future* (Oxford: Oxford University Press, 1988), 54.
598 Howe, *Behind the Curve*, 174.
599 Ibid.

3.5 Climate Change Bursts into the Open: Expectations for an International Treaty to Curb CO_2 Emissions Rise

Throughout Reagan's presidency, Democratic members of Congress, alarmed by the prospect of social and economic disruptions wrought by climate change, had held hearings as a means to oppose resistance to the administration and its attempts at silencing and withdrawing funds for climate science, and draw public attention to climate change. This strategy failed to attract important media coverage for the 1981, 1982 and 1984 hearings, but things changed after John Chafee, a Republican Senator from Rhode Island and the chair of the Senate subcommittee on environmental pollution, agreed to tie climate change to another concern pertaining to atmospheric degradation, namely ozone depletion, which had become a hot topic by then.[600]

One June 10, 1986, presentations by some of the administration's lead negotiators on the international CFC agreement, which featured vivid imagery of the "hole," struck a chord with journalists and made headlines in the national newspapers, and so did climate change. In his opening statement, Chafee proposed a six-point plan to address both climate change and ozone depletion, which he said were "no longer just science issues" but "policy issues."[601] In particular, he called for the U.N. Environment Programme (UNEP) to convene a meeting to initiate international negotiations of a convention on climate change.[602] The ozone scare had given impetus to global environmental issues and problems of atmospheric pollution in particular, and Senators appeared willing to move past the usual "wait-an-see" policy of further documenting these issues before drafting new legislation. The old

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[600] U.S. Congress, House Committee on Science and Technology, Hearing, *Carbon Dioxide and Climate: the Greenhouse Effect,* 97th Congress, 1st Session, July 31, 1981 (Washington, D.C.: U.S. Government Printing Office, 1981); U.S. Congress, House Committee on Science and Technology, Hearing, *Carbon Dioxide and Climate: the Greenhouse Effect,* 97th Congress, 2nd Session, March 25, 1982 (Washington, D.C.: U.S. Government Printing Office, 1982); U.S. Congress, House Committee on Science and Technology, Hearing, *Carbon Dioxide and the Greenhouse Effect*, 98th Congress, 2nd Session, February 28, 1984 (Washington, D.C.: U.S. Government Printing Office, 1984); Rich, *Losing Earth*, 109.
[601] U.S. Congress, Senate Committee on Environment and Public Works, Hearing, *Ozone Depletion, the Greenhouse Effect, and Climate Change*, 99th Congress, June 10-11, 1986 (Washington D.C.: U.S. Government Printing Office, 1986), 3.
[602] Ibid., 4.

question of how much research and certainty was needed before committing to action resurfaced the next day during the testimonies of government representatives.

In a Q&A following the statement of the deputy administrator of NASA, William Graham, who would be confirmed as Reagan's science advisor four months later, replied that he agreed there were "potential adverse environmental effects of both of those phenomena [ozone depletion and climate change]" but "that it would be premature to make a statement concerning the state today of those."[603] Pressed by George Mitchell, a Democratic Senator from Maine, as to whether he thought projections were "inaccurate or unjustified," Graham kept to the administration's script, and he stated that "projections into the future have a large uncertainty associated with them, and that uncertainty needs to be reduced as we go forward to look to specific actions in the future." Any "preventive steps," in Mitchell's words, was deemed premature because issues had different "time scales" according to Graham, who deflected all of Mitchell's questions and suggestions by hiding behind the uncertainty paradigm.

In a later panel, Michael Oppenheimer, an atmospheric physicist at Harvard and senior scientist for the Environmental Defense Fund, took issue with government representatives' attitude towards climate change, and he did not mince his words. Oppenheimer declared that "it was perhaps surprising to sit and watch five Government witnesses speak for less than 40 minutes on [climate change]. What we got was massive underreaction. These people […] exhibit what I would call a spectacular lack of ideas on how to proceed, and a perplexing sense of lethargy on what is apparently the most important long-range problem that we have to face."[604] In stark contrast to Graham's passivity, Oppenheimer insisted that "we cannot afford to just let it happen. The costs of a nonpolicy will be enormous" and that waiting any longer amounted to being "overtaken by the dire consequences of inaction."[605] He

[603] Senate Committee on Environment and Public Works, *Ozone Depletion, the Greenhouse Effect, and Climate Change*, 172.
[604] Ibid., 188.
[605] Ibid., 189.

further warned the audience that "unacceptable levels of climate change may be in the bank before we have even understood what we have wrought."[606]

For all the forceful language used in these hearings, climate change made its true media breakthrough two years later, during the sweltering summer of 1988. NASA climatologist James Hansen had gained political acumen through his successive testimonies and the setbacks he had experienced at the hands of the DoE when forced to re-apply for research grants by the Reagan administration. Alerting public opinion to an abstract problem which only existed in computer models' simulations was a challenge in itself, but doing so in the winter time certainly did not help. Working out a plan with Timothy Wirth, a Democratic Senator from Colorado, Hansen suggested convening the hearings during the warm months, when Washington D.C. turned into a literal swamp. That year's summer had witnessed a series of severe heat waves and droughts that had crippled many regions of the country, raising the profile of global warming as a potential culprit in the national media.[607] Scientists knew that no single environmental catastrophe could be directly attributed to climate change, but press coverage drew a connection between the environmental devastation brought by forest fires and droughts and "the greenhouse effect."

Hansen's intuition proved right: on June 23, the day of the hearing, the room was packed with reporters.[608] Appearing before the Senate Committee on Energy and Natural Resources, Hansen announced point blank that "the earth is warmer in 1988 than at any time in the history of instrumental measurements" and that "barring a remarkable and improbable cooling, 1988 will be the warmest year on record."[609] He then told Senators that global warming was happening and that it was the product of increasing carbon dioxide concentrations in the atmosphere. Refuting suggestions that the recorded warming trend may result from "a chance fluctuation," Hansen

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[606] Ibid.
[607] Weart, *The Discovery of Global Warming,* 155.
[608] Rich, *Losing Earth,* 131.
[609] James Hansen, "testimony," U.S. Congress, Senate Committee on Energy and Natural Resources, Hearing, *Greenhouse Effect and Global Climate Change*, 100th Congress, June 23, 1988 (Washington D.C.: U.S Government Printing Office, 1988), 39.

declared with "99 percent confidence:" "the greenhouse effect has been detected, and it is changing our climate now."[610]

A few days later, another important event in the realm of climate change politics took place in Toronto, Canada: the World Conference on the Changing Atmosphere, an assembly of governmental representatives and scientists. Organized in the wake of the 1985 Villach conference, where climate change had been first recognized as a problem requiring governmental action, the Toronto Conference report called for clear targets for reducing carbon dioxide emissions to be set in an international framework, from which governments could then derive national plans to meet the agreed-upon objectives.[611] A group of energy experts had even volunteered a number: by 2005, emissions ought to be reduced by 20 percent below their 1988 levels.[612] The introduction of an international agreement on greenhouse gases seemed imminent.

The events at the end of the decade had underlined the role of climate scientists and of science in general in informing policy and shaping global environmental governance. Suddenly, the production of science and of scientific recommendations took a different meaning. As Weart notes, scientists from all over the world "wielded increasing power by claiming dominion over views about the actual state of the world—shaping perceptions of reality itself."[613] This fact did not escape conservative minds, who warned that prescriptions by scientists, to whom they lent left-leaning ideological and political affiliations, might lead to radical policy measures. Talks about creating an international, consensus-driven body to assess both the science of climate change and the policy responses to it were already underway before the summer hearings of 1988 and the Toronto Conference. At the 1985 conference in Villach, a group of scientists, led by Swedish meteorologist and long-time climate science advocate Bert Bolin, had begun to call for a new assessment process.[614] Scientists such as Bolin and NGOs viewed the Villach

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[610] James Hansen, "testimony," Senate Committee on Energy and Natural Resources, *Greenhouse Effect and Global Climate Change*, 39–40.
[611] Weart, *The Discovery of Global Warming*, 154.
[612] Howe, *Behind the Curve*, 157.
[613] Weart, *The Discovery of Global Warming*, 159.
[614] Howe, *Behind the Curve*, 156–160. For a personal account by the chairman of the IPCC, Swedish meteorologist Bert Bolin, on the history of the IPCC, see Bert Bolin, *A History of*

conference consensus as an authoritative basis from which an international treaty on greenhouse gases could be hatched, but their conviction was not shared by most national governments, and certainly not the United States under the Reagan administration.

Responding to conservative fears of seeing an assessment of climate change drafted by independent scientists dictate the terms of an international agreement, the National Climate Program (NCP), administered by NOAA, provided a solution in the form of a new intergovernmental body, led by government representatives, which would be responsible for producing another comprehensive assessment of the state of climate change science.[615] A memo by an official at the Department of State to the U.S. permanent representative to the WMO explained that "we believe calls for negotiation of an international legal instrument to address the [climate change] issue are premature. What we need is an intergovernmental forum to provide an interface between science and policy."[616] The stakes were clear: scientific knowledge (and unknowns) would form the foundation from which policy-makers would evaluate possible response strategies, and therefore the question of who would produce that scientific baseline had become all the more significant. Underscoring the fact that this task should not be the scientists' exclusive prerogative, the official further noted that "government representatives [on the panel] should reflect the full range of their government's policy interests, including, for instance, energy and agricultural policies as well as science and environmental policies."[617] The product of intense negotiations, any report from the IPCC would also probably favor conservative scientific estimates, especially if it took into consideration a wide array of national governments' interests, while the process of producing the report would further delay the implementation of a binding international treaty.

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the Science and Politics of Climate Change (Cambridge: Cambridge University Press, 2007).

[615] Howe, *Behind the Curve*, 158.

[616] Richard J. Smith to Richard Hallgren, U.S. Permanent Representative to the World Meteorological Organization, "Intergovernmental Panel on Climate Change," January 27, 1988, Cobb, Tyrus W. Files, Ronald Reagan Presidential Library (RRPL), box 2, Folder "Global Climate Change (1)," 1.

[617] Ibid.

The executive branch of government was mandated, through the Global Climate Protection Act of 1987, to produce a strategy for addressing climate change, and the creation of a scientific-cum-politics intergovernmental body appeared as a convenient first step. Following the American proposal, the WMO and UNEP created the Intergovernmental Panel on Climate Change (IPCC), a hybrid body composed of scientists from governmental science agencies and career diplomats, and tasked it with a clear but difficult mission: to forge a scientific consensus which could be used to support an international treaty, namely the U.N. Framework Convention on Climate Change (UNFCCC).

3.6 Exxon and Climate Change: Navigating Internal Dissent on How to Respond to Academic and Corporate Science's Findings

In 2015, the non-profit news organization *Inside Climate News* (ICN) published its 8-months investigation into Exxon, titled *Exxon: The Road Not Taken*.[618] Based on archival material, including Exxon's own archives at the University of Texas at Austin's Briscoe Center for American History, interviews with former employees, scientists and officials, the investigation centers on Exxon's carbon dioxide research activity between 1977 and 1986.

[618] Neela Banerjee, David Hasemyer, Lisa Song, and John H. Cushman, *Exxon: The Road Not Taken* (Inside Climate News, 2015). The nine articles that form the e-book are also available on ICN's website: https://insideclimatenews.org/news/16092015/exxons-own-research-confirmed-fossil-fuels-role-in-global-warming/. The e-book gives access to the primary sources cited in the articles as well as additional material. The source material retrieved by both investigations is hosted on The Climate Files (CF), an archival database documenting more than 20 years of research by the Climate Investigations Center, *Inside Climate News* and *Los Angeles Times* investigative journalists. Primary source documents can be downloaded at http://www.climatefiles.com/collection-index/. Geoffrey Supran and Naomi Oreskes, in a 2017 study and a follow-up article published in 2020, examined ExxonMobil's public and private communications on climate change, finding a significant discrepancy between the two. Using textual content analysis, the authors analyzed over a thousand documents, such as advertorials in the *New York Times*, internal company reports, peer-reviewed articles, and other types of publications, and concluded that the corporation had misled the public about the issue before and after the 1999 merger. See Geoffrey Supran, and Naomi Oreskes, "Assessing ExxonMobil's climate change communications (1977–2014)," *Environmental Research Letters* 12 (2017): 1–18; —, "Addendum to 'Assessing ExxonMobil's climate change communications (1977–2014),'" *Environmental Research Letters* 15 (2020): 1–18. Finally, using a similar line of inquiry, the Energy and Policy Institute documented electric utility companies' early knowledge of climate change. *See* David Anderson, Matt Kasper, David Pomerantz, "Utilities Knew: Documenting Electric Utilities' Early Knowledge and Ongoing Deception on Climate Change From 1968-2017" (The Energy and Policy Institute, July 2017).

That same year, the *Los Angeles Times*, together with the Columbia University School of Journalism, conducted a distinct but similar investigation, further highlighting Exxon's leadership in CO_2 research and climate modeling in particular.[619] Both investigations prompted a social media campaign under the hashtag #Exxonknew, which snowballed into the legal world when attorney generals of various cities and counties across the country began filing lawsuits against ExxonMobil (Exxon and Mobil had merged in 1998), and other oil conglomerates such as Chevron, Shell, and BP.[620]

The Sabin Center for Climate Change Law at Columbia University's Law School keeps a record of past and ongoing lawsuits in two databases dedicated to climate change litigation, one for international cases and the other for U.S. cases, among which are the lawsuits brought by U.S. municipalities against oil corporations.[621] The main question driving these legal challenges centers around the notion of responsibility, which requires litigants to demonstrate that Exxon and the other major oil corporations knew of climate change and to construct a timeline of their knowledge and actions.[622] Recalling similar types of investigations in the 1990s into the tobacco industry's early knowledge about the health risks of smoking, and its deliberate attempts at sowing doubt on the science linking tobacco use and cancer, these lawsuits seek damages for the harm caused by the oil industry, which has known about fossil fuels' direct contribution to climate change for at least four decades. At the heart of these litigations hence lies the question

[619] Ivan Penn, "California to Investigate Whether Exxon Mobil Lied about Climate Change Risks," *Los Angeles Times*, Jan 20, 2016; Amy Lieberman, and Susanne Rust, "Big Oil Braced for Global Warming While It Fought Regulations," *Los Angeles* Times, Dec 31, 2015; Katie Jennings, Dino Grandoni, and Susanne Rust, "How Exxon Went from Leader to Skeptic on Climate Change Research," *Los Angeles Times*, Oct 23, 2015; Sara Jerving, Katie Jennings, Masako Melissa Hirsch, and Susanne Rust, "What Exxon Knew about the Earth's Melting Arctic," *Los Angeles Times*, Oct 9, 2015.

[620] Esso, formally the Standard Oil of New Jersey, had changed its name to Exxon in 1972.

[621] "U.S. Climate Change Litigation," The Sabin Center for Climate Change Law, Columbia Law School, accessed March 20, 2021 http://climatecasechart.com/us-climate-change-litigation/.

[622] On the notion of climate liability, see Peter C. Frumhoff, Richard Heede, and Naomi Oreskes, "The Climate Responsibilities of Industrial carbon Producers," *Climatic Change* 132 (2015): 157–171; Richard Heede, "Tracing Anthropogenic Carbon Dioxide and Methane Emissions to Fossil Fuel and Cement Producers, 1854-2010," *Climatic Change* 122 (2014): 229–241.

of what, exactly, corporate scientists had discovered about climate change, and what Exxon's high-ranked executives did with that knowledge.

According to ICN journalists, the company's own scientists had initially produced unbiased and solid research on the greenhouse effect, as climate change was known then, and they had published their results in scientific journals. Exxon's strategy, from the late 1970s to the early 1980s, was to position itself as a leader and expert on climate change. But, starting in 1989, company executives adopted a completely different approach. Contradicting their own in-house results and the predictions of the models their scientists had developed, executives decided to blatantly deny the reality of climate change, orchestrating a decade-long denial campaign. This is the argument presented in the ICN articles, and it was echoed by Oreskes in an opinion piece she wrote for the *New York Times*, and by environmental sociologist Ronald Kramer in his book *Carbon Criminals, Climate Crimes*.[623]

To be sure, 1989 marks a turning point in the political history of climate change, not just because of the fall of the Berlin Wall and the start of a new geopolitical era, but because one of the industry's front groups, the Global Climate Coalition (GCC), was founded that year to advance the fossil fuel industry's interests and to promote a "skeptic" approach to the science of climate change. It was joined by another important hothouse of science denial, the George C. Marshall Institute, which had been established in 1984 by a triumvirate of retired Cold War physicists to support Reagan's Strategic Defense Initiative (SDI) and more generally to counter the "leftist" arm of the scientific community they deemed hostile to nuclear weapons.[624] Something important in the history of climate change clearly took place in the later part of the 1980s/early 1990s, but I argue that Exxon executives' change of heart took place earlier in the decade, and not in 1989 when, Oreskes writes, "corporate executives turned about face" after letting Exxon scientists

[623] Banerjee and her colleagues wrote: "After a decade of frank internal discussions on global warming and conducting unbiased studies on it, Exxon changed direction in 1989 and spent more than 20 years discrediting the research its own scientists had once confirmed." See Banerjee et al., *Exxon*, 11; Naomi Oreskes, "Exxon's Climate Concealment," *New York Times*, October, 9, 2015; Ronald C. Kramer, *Carbon Criminals, Climate Crimes* (Rutgers University Press, 2020).
[624] See Oreskes and Conway, *Merchants of Doubt*, 36–65 and 169–215; —, "Challenging Knowledge: How Climate Science Became a Victim of the Cold War," 55–89.

"behave as scientists" up to that point.[625] My reading of Exxon's internal records shows that the paradigm shift initiated by the company's senior executives occurred as early as 1981. While it took a couple of years to arrive at executives' denial *en bloc* of climate change, the downplaying of the science and the emphasis on doubt and uncertainty were well underway at the start of the decade. While this may appear as a detail in the larger narrative seeking to prove that Exxon knew of the harm caused by the use of its product, it is a damning one in terms of Exxon executives' moral culpability. It shows that Exxon's upper management never allowed free research for the sake of it, but only did so temporarily and for a brief period of time when it needed accurate results to assess the threat to its business. The fact that only two years into the research, executives ordered budget cuts into the company's carbon dioxide research program demonstrates that they knew enough to see how serious the threat was to their industry (and obviously, to humanity as a whole). And yet, they chose to stay the course, emphasize uncertainty and highlight climate models' shortcomings, instead of joining the chorus of scientists who had begun to alert the political world to the threat.

The first blow to Exxon's carbon dioxide research program came in January 1981, in the form of an assessment report of what was called the "Atmospheric CO_2 Scoping Study." The research program had launched just two years earlier in one of its subsidiaries, Exxon's Research and Engineering Company (ER&E). The report recommended not implementing the next phase of the "high-impact" research program on atmospheric CO_2, deeming "the ER&E projects underway and (those) planned on atmospheric CO_2 R&D […] adequate to serve Exxon needs."[626] The report mentioned a five-point rationale for Exxon's involvement in CO_2 research: to "make an early assessment of the possible impact of the greenhouse effect on Exxon's Business," management's first and foremost objective; to "develop expertise to evaluate Government programs" and to "provide the Government with high quality information to reduce the business risk of poorly formulated

[625] Oreskes, "Exxon's Climate Concealment."
[626] G. H. Long to P. J. Lucchesi et al., "Atmospheric CO_2 Scoping Study," Feb 5, 1981, The Climate Files (CF), 1.

Government policy," priorities that had preoccupied Exxon in the 1960s when legislation on air pollution seemed imminent; to "generate important scientific information that will enhance the Exxon image and provide public relations value," a goal outlined by Exxon's in-house scientists as a nice collateral benefit; and finally, to "form a responsible team that can credibly carry bad news, if any, to the Corporation," the most delicate objectives of all.[627] The January 1981 report was therefore not a call to disengage from all research into CO_2, and ongoing projects were indeed maintained, at least initially. But as later records show, Exxon soon abandoned large, experimental research projects, such as the ocean sampling project carried out aboard one of its tanker, the Atlantic Esso, to prioritize the mathematical modeling of climate change. Executives understood that "these predictions will influence the perception of the problem by key groups such as Congress, Federal R&D groups, and the public."[628] This type of theoretical research also required fewer financial and human resources. But more importantly, and as an overview of the domestic legislative situation presented in the final section of the January 1981 report attests, the authors noted that "no near term threat of legislation to control CO_2" existed, for "it has not yet been proven that the increases in atmospheric CO_2 constitute a serious problem that requires immediate action."[629] Even if legislation did not appear as a threat in the short term, the authors mentioned two reports they thought were worth monitoring: one was the DoE SOA report, and the other the 1983 NAS publication on carbon dioxide for which, the authors wrote, "the desirability for ER&E to monitor developments on this study and input to the study is obvious."[630] Exxon's management knew that a threat was more likely to emerge from a report by the National Academy of Sciences, than one prepared under Reagan's DoE. But as these documents make clear, in the days before the new administration was inaugurated, Exxon was still interested in conducting targeted research on CO_2, funding projects tailored to its needs.

[627] R. E. Barnum, "Scoping Study on CO_2," January 1981, CF, 9.
[628] Ibid., 3.
[629] Ibid., 13.
[630] Ibid.

In May 1981, Henry Shaw, a science manager at ER&E, volunteered a "position statement" on CO_2 to Edward David, the president of ER&E and Nixon's science advisor from 1970 to 1973, who was scheduled to attend a public event.[631] In his memo, Shaw underlined the timescale which, he believed, or wanted the audience to believe, applied to climate change: namely, that consequences would only manifest themselves a century later and that, as a result, no measures should be taken by the government in the foreseeable future. Shaw wrote: "There is sufficient time to study the problem before corrective action is required."[632] He also predicted that the increase in the average global temperature would not be measurable, i.e. distinguishable from normal climatic variations, before the turn of the century, a claim made by Hansen and his colleagues in their *Science* article, published three months later, in August 1981.

Contrary to Hansen, however, Shaw emphasized that point to support his claim that government had time to fund additional research on climate change, and that the issue could be dealt with —*if* it had to be dealt with—at a later point in time. He added that "effective energy conservation and high price for fossil fuels over the last few years have now delayed the projected doubling time of CO_2 [to] about 100 years."[633] This was of course a fallacious statement. It was indeed disingenuous to invoke technological improvements, which said nothing of growing consumption levels of fossil fuels, and economic conditions, which would necessarily fluctuate in the next decades, to make predictions about the levels of CO_2 emissions a century away. Nevertheless, these projections allowed Shaw to conclude that the problem's extended timeframe would give "time for an orderly transition to non-fossil fuel technologies should restrictions on fossil fuel use be deemed necessary."[634] Yet Shaw also explained that Exxon scientists' calculations projected that, from the 15% increase observed since 1957, CO_2 levels would reach 380 ppm by the year 2000, and that Exxon scientists expected a 3°C temperature rise of the global average temperature and an increase of 10°C at

[631] Rather unsurprisingly, David became a climate change denier after retiring. Banerjee, *Exxon: The Road Not Taken*, 70–2.
[632] Henry Shaw to E. E. David, Jr., "CO_2 Position Statement," 15 May 1981, CF, 2.
[633] Ibid., 2.
[634] Ibid.

the poles following a doubling of CO_2. Consequences included majors shifts in rainfall and agriculture, and polar ice melt.[635]

While these were rather alarming potential future developments, Shaw reiterated his claim that the doubling of atmospheric CO_2 levels would not occur before another full century had elapsed, dismissing any sense of urgency that the issue might have raised. As this internal document attests, in the early 1980s, Exxon's official public position on the matter did not underline uncertainty or called climate change a non-issue, but it insisted on the long timespan between the discovery of the problem and the first detections of its effects, which allowed executives to defend a wait-and-see policy.

Exxon's public message focused on the timeframe of the issue to quell any legislative impulse, but the question proved to be a thorny one within the company, giving rise to internal dissent. In the summer of 1981, Maurice Edwin James "Morey" O'Loughlin, a senior vice-president on Exxon's Management Committee, had asked for ER&E's opinion on the subject, and specifically on the possible consequences of the Corporate Planning Department's projections for fossil fuel combustion levels out to 2030 in relation to climate change and acid rain. O'Loughlin had asked for "a short reply," and was thus not calling for an extensive review of the literature, but his query signals an awareness and interest for the CO_2 issue at the highest levels of the corporation.[636]

One of the department's scientists, Werner Glass, produced a draft response on behalf of David, which greatly downplayed the issue, stating that "much is still unknown about the sources and sinks for atmospheric CO_2, as well as about the climatic effect of increasing CO_2 levels […] so that prognostications remain highly speculative."[637] While a significant amount of additional research on the role of the ocean and the biosphere was required to improve atmospheric models, predictions could not be dismissed as being unsubstantiated, the way Glass did. The latter even acknowledged that "models that appear most credible (to us) do predict measurable changes in

[635] Ibid.
[636] W. Glass to J. F. Black, R. W. Cohen, S. A. Diamond, H. Shaw, 14 Aug 1981, CF, 1.
[637] Ibid., 2.

temperature, rainfall pattern and sea-level by the year 2030 for the postulated fossil fuel combustion rates," but he quickly added that expected changes were "of a magnitude well short of catastrophic and probably below the magnitude that need trigger otherwise noneconomic responses to the problem of energy supply."[638] By noneconomic, Glass certainly meant interventionist, state-sponsored economic measures, as opposed to letting the market operate without governmental intervention. In his review of the proposed draft response to O'Loughlin, Roger Cohen, who assembled the first research laboratory in theory and modeling at Exxon after joining the company in 1978, expressed uneasiness at Glass's suggestion that changes would not be catastrophic, writing that the latter's statement "may be too reassuring."[639] Cohen explained his point by drawing a distinction between observable phenomena in 2030, which might not be catastrophic due to a "time lag," or a delaying of the full effects because of various buffer mechanisms, and the real, baked-in effects that might only start to manifest themselves a few decades later.[640] Cohen argued that projections of oil consumption after the year 2000 were not credible, because by that time, "we will unambiguously recognize the threat […] because of advances in climate modeling and the beginning of real experimental confirmation of the CO_2 effect."[641] As such, Cohen deemed predictions based on oil availability and economics "hazardous," and he invited Glass's revised reply to include a statement about "the strong evidence for a delayed CO_2 effect of a truly substantial magnitude."[642] As Cohen's letter attests, halfway into 1981, internal disagreement between Exxon's in-house scientists and the company's upper echelons over the severity of climate change's repercussions had begun to quietly simmer.

In 1982, the year following the Reagan administration's coming into power, larger cracks within the company began to appear, illustrating the pressure induced by climate science and the necessity for Exxon's upper

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638 Ibid.
639 Martin P. Fricke, Laurence I. Gould, William Happer, "Roger W. Cohen," *Physics Today*, February 21, 2017 , https://physicstoday.scitation.org/do/10.1063/pt.5.6265/full/. R. W. Cohen to W. Glass, 18 Aug 1981, CF, 1.
640 R. W. Cohen to W. Glass, 18 Aug 1981, CF, 1.
641 Ibid.
642 Ibid.

circles of management to position themselves vis-à-vis this growing threat to their industry. One of the first indicators of that change was the decision to curtail research on carbon dioxide. The research momentum of 1978, which had started to falter after two years, further receded, while internal dissent regarding climate models' predictions grew more visible, even though they were alluded to rather than stated explicitly. But although models could and would be greatly refined over the following decades, the theory of greenhouse warming was established and widely accepted within the scientific community by then.

In March 1982, the API received a report it had commissioned to the Lamont-Doherty Geological Observatory at Columbia University, entitled *Climate Models and* CO_2 *Warming: A Selective Review and Summary*. Exxon had partnered with the institute and funded research done by two of its geochemists, Wallace Broecker and Taro Takahashi, so this state of the art was necessarily known to Exxon's executive team. The report reviewed and assessed five types of climate models, from the simplest to the most complex and advanced ones, which were the General Circulation Models (GCMs). Except for one, all the models predicted an increase in the global mean temperature of the earth of 2°C to 3.5°C for a doubling of CO_2 concentrations in the atmosphere.[643] Yet in a brief summary, the authors wrote that "it seems clear from the discussion herein that all models are still sufficiently unrealistic that a definitive evaluation of the problem requires continued effort."[644] More to the point for the API, Broecker and Takashi also stated that "optimum forecasting of climate changes is a necessity for any realistic long term planning by government and industry," and that "there is sufficient uncertainty in the range of predictions to leave the consequences of the CO_2 doubling in considerable doubt."[645] Models, as we saw in previous chapters, are mathematical descriptions of the ocean-atmosphere system run on computers. As such, they necessarily generate imperfect simulations of highly complex systems such as the ocean-atmosphere one, and uncertainty is

[643] Lamont-Doherty Geological Observatory, "Climate Models and CO_2 Warming: a Selective Review and Summary," Prepared for the American Petroleum Institute by Alan Oppenheim and William L. Donn, 16 March 1982, CF, 3.
[644] Ibid.
[645] Ibid., 5–6.

inevitable. Ignoring the exact contours of global warming did not allow one to conclude that the problem did not exist or that no preventive measure ought to be taken. But oil industry executives anticipated that models might influence long-term government planning and policy choices, and they therefore chose to capitalize on climate models' inherent weaknesses. Whether inadvertently or because they responded to cues about what the API wanted to hear, the Lamont-Doherty researchers provided oil corporations with a potent weapon: doubt.

In line with their decision not to advance to phase II of the research plan outlined in the 1981 "Atmospheric Scoping Study," and despite growing evidence of the adverse effects of rising carbon dioxide emissions, Exxon executives decided to slash funding for in-house research on the greenhouse effect. In a letter dated June 1982, immediate cuts were announced and the 1982 budget was slashed from $900'000 for the year to $385,000, while funds for 1983 were brought down to $150'000, an 83 percent cut.[646] The early 1980s witnessed a deep recession, and an oil glut was driving prices down.[647] But Exxon's total research budget at the time amounted to more than $600 million, so 1 million represented a drop in its global research effort bucket.[648] The severe cuts illustrate the company's senior management's change of priorities, from a willingness to contribute to the body of knowledge on climate change, to a decision to merely monitor the science produced elsewhere. As Alvin Natkin, an environmental affairs coordinator in the Science and Technology Office, explained in his letter announcing the cuts, the set budget was "intended to support a resident source of scientific expertise on all phases and aspects of the CO_2 Greenhouse effect," in order for the company "to stay abreast of developments in order to assess the impact of new scientific discoveries and to respond to various inquiries."[649] In other words, from an active engagement in the issue, Exxon executives choose to

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646 A. M. Natkin to H. N. Weinberg, "CRL/CO_2 Greenhouse Program," 18 June 1982, CF, 1.
647 Simon Pirani, *Burning Up: A Global History of Fossil Fuel Consumption* (Pluto Press, 2018), 122–37.
648 John H. Cushman Jr., "Exxon Made Deep Cuts in Climate Research Budget in the 1980s," *Inside Climate News*, November 25, 2015.
649 A. M. Natkin to H. N. Weinberg, "CRL/CO_2 Greenhouse Program," 18 June 1982, CF, 1.

adopt a more passive stance. Natkin also alluded to the Esso tanker CO_2 sampling research program, which had begun in 1979, and explained that this too would be terminated, as a letter from Cohen later confirmed.[650] While Natkin presented seemingly reasonable economic reasons for shutting the initiative, namely that "expenses required to carry out a multi-year program needed to build a meaningful data base" would run high and the fact that "it is virtually impossible to schedule tanker movements" because of market unpredictability, Exxon's willingness to pursue research on CO_2 had unmistakably weakened early in Reagan's first term.[651]

One letter from Cohen to Natkin dated September 2, 1982 particularly attests to the continuing tensions between the company's various departments, especially its research department and the public affairs one. The object of that letter was to provide Natkin with a summary of the findings of in-house research in climate modeling, and the place of these results within the overall scientific body of knowledge. Records do not tell us the reason behind this exchange of information: perhaps it was a way for the public affairs managers to monitor what was done by Exxon's research team, in order to assess what could be published and marketed publicly. The content of the letter appears to indicate that Cohen, as the lead researcher, found himself in a particularly difficult position. He was indeed careful, in his letter to Atkin, to insist on the scientific consensus on climate change, a consensus bolstered by his own department's findings. Departing from the emphasis on uncertainty displayed in the Lamont-Doherty report to the API, Cohen first acknowledged the "considerable variation" in the various climate models' quantitative predictions, but then immediately referred to "a clear scientific consensus […] regarding the expected climatic effects of increased atmospheric CO_2."[652] Most probably alluding to the 1979 Charney report, Cohen wrote that "the consensus is that a doubling of atmospheric CO_2 from its pre-industrial revolution value would result in an average global temperature rise of (3.0 ± 1.5)°C."[653] He further insisted on the "unanimous

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[650] Roger W. Cohen to Peter Kimon, 14 July 1982, CF, 1.
[651] A. M. Natkin to H. N. Weinberg, "CRL/CO_2 Greenhouse Program," 18 June 1982, CF, 1.
[652] Roger W. Cohen to A. M. Natkin, 2 Sept 1982, CF, 1.
[653] Ibid.

agreement in the scientific community that a temperature increase of this magnitude would bring about significant changes in the earth's climate, including rainfall distribution and alterations in the biosphere.”[654] While models did not give a precise timing for the doubling of atmospheric CO_2 concentrations, as the latter depended on future world consumption of fossil fuels, they did predict that the effects of climate would become visible around the turn of the century.

Displaying scientific integrity, Cohen recognized that the consensus was “not unanimous,” and he dedicated a paragraph to scientific outliers who “have taken positions that openly question the validity of the predictions of the models, and [among whom] a few have proposed mechanisms which could mitigate a CO_2 warming.”[655] Regarding the question of possible mitigating effects, Cohen cited the research of Reginald Newell, a professor of meteorology at the MIT. Cohen explained that Newell had postulated the existence of an “evaporative buffering mechanism” in the equatorial waters, which was supposed to counterbalance global warming.[656] Exxon scientists, as Cohen explained, had confirmed the existence of the mechanism, but they had also discovered “a compensatingly [sic] larger temperature increase in the polar regions, giving a global averaged temperature increase that falls well within the range of the scientific consensus.”[657] In other words, “one of the most serious” of the mitigation proposals was refuted by Exxon’s own researchers, a point underlined by Cohen.[658] In a tone that did not leave room for doubt, Cohen concluded that “the results of our research are in accord with the scientific consensus on the effect of increased atmospheric CO_2 on climate,” and he explained that his department intended on presenting these results to the scientific community “through the usual mechanisms of conference presentations and publications in appropriate journals.”[659]

The letter did not stop here, however, and the final paragraph further demonstrates how much Cohen appeared to have been walking on eggshells.

[654] Ibid.
[655] Ibid., 2.
[656] Ibid.
[657] Ibid.
[658] Ibid.
[659] Ibid.

Referring to a previous meeting the week before between ER&E and the public affairs department, he recognized that publishing these findings might attract negative publicity: "Despite the fact that our results are in accord with those of most researchers in the field and are subject to the same uncertainties, it was recognized that it is possible for these results to be distorted or blown out of proportion."[660] But, Cohen insisted, the "consensus position" was that Exxon had an interest in continuing this line of research in order to both understand how future scenarios might impact its business and to provide the company with "the credentials required to speak with authority in this area."[661] In concluding his appeal, Cohen referred to "Exxon's public position and ethical credo on honesty and integrity," both of which he perhaps knew were already in jeopardy.[662]

While records show internal disagreement among Exxon executives over the best course of action regarding in-house research on the CO_2 question, the company presented a united front in the public sphere, which consisted in acknowledging the issue while drawing attention to the uncertainties surrounding climate change science. In October 1982, David, the head of the research department, gave a presentation at a symposium supported by Exxon. His talk, "Inventing the future: energy and the CO_2 'greenhouse' effect," proved a difficult exercise in carefully balancing opposite points of view, while promoting Exxon's position. On one hand, and very importantly, David acknowledged climate change. He did that reluctantly, declaring that "the scientific community is apparently reaching some consensus about the general mechanisms of the greenhouse effect," a fact settled by 19th-century physicists.[663] This was very different from acknowledging that, as Exxon's own scientists had demonstrated, most advanced models were predicting a significant global warming. In a barb to the academic scientists attending the workshop, David pointed out that "man does not have the gift of prophecy," as if mathematical modeling amounted

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[660] Ibid., 3.
[661] Ibid.
[662] Ibid., 2.
[663] E. E. David, Jr., "Remarks at the Fourth Annual Ewing Symposium," 26 Oct 1982, CF, 4.

to no more than an exercise in chiromancy.[664] However guarded his acknowledgment was, it still was not comparable to the position Exxon would take on the subject starting in the early 1990s, which was to flatly deny the existence of a problem. He also conceded that "few people doubt that the world has entered an energy transition away from dependence upon fossil fuels and toward some mix of renewable resources," which was a remarkable comment on the part of one of the major investor-owned oil corporations.[665] That said, the talk was also a lobbying opportunity, and David employed his time to dismiss any calls for immediate action. Recalling his memo to O'Loughlin, David insisted on the long period of time before the first effects of the temperature increase would manifest themselves. He also spoke of the technological breakthroughs in energy conservation and the drop in global fossil fuel consumption driven by price increases as reasons for not expecting a doubling of atmospheric CO_2 before another century had elapsed. Citing these factors as evidence that scientists could not predict "what people will do" was an attempt, however poorly done, to once again emphasize the uncertainty, according to him, surrounding a significant variable in the equation, namely "how fast the buildup will occur."[666]

In a move that is difficult to logically reconcile with his main argument, which claimed that no immediate set of action was warranted, David offered a three-part rationale for why the energy transition would not happen in the near future. In outlining Exxon's scenarios for future fossil fuel consumption, he presented three reasons for their continued and growing use. First, he said, "nearly all societies will continue to give primacy to economic growth," and the doubling of world population would in turn necessitate a major growth in energy use and economic output "just to hold per capita incomes even."[667] Second, David argued that "most societies will prefer least cost energy alternatives" in their pursuit of growth, especially developing economies. Third, David predicted that the transportation sector would continue to "prefer the efficiencies of fossil-based liquid fuels."[668] These

[664] Ibid., 1.
[665] Ibid., 3.
[666] Ibid., 4.
[667] Ibid., 6.
[668] Ibid., 7.

trends, combined with the fact that "a new energy source requires about 50 years to achieve just half the total energy market," all pointed towards a slow energy transition. They certainly did not alleviate concerns about continuously rising levels of carbon dioxide emissions, and therefore contradicted David's argument that inaction was the best course of action.[669]

Regarding the sharp increase in fossil fuel consumption announced by Exxon's own predictions, David stated that "our estimate is that the doubling of atmospheric CO_2 levels might occur sometime late in the 21st century," and that "assuming the greenhouse effect occurs, rising CO_2 concentrations might begin to induce climatic changes around the middle of the 21st century."[670] While climatic changes would increase in severity as CO_2 concentrations built up in the atmosphere (assuming fossil fuel emissions continued unabated), David's latter statement omitted an uncomfortable parameter, namely that the consequences of climate change would be felt sooner than 2050, findings with which Exxon's own scientists concurred. That claim, however, challenged his argument, as his goal was to underscore the supposed extended period of time at society's disposal to further research the issue before taking any measures. In his view, "the real point of these extrapolations is to get an understanding of how soon the problem may become serious enough to require action—and the lesson is that […] we can still afford further research on the problem [before society has] to contend with the problem."[671] In line with what Oreskes and Conway, borrowing hedge-fund billionaire George Soros's expression, call "free market fundamentalism," David impressed on his audience the imperious need to reject any major governmental intervention into the energy market, asserting that "any manager or government planner would err seriously by masterminding a plan based unalterably on some vision of the future."[672] Invoking the 100th anniversary of the company, David explained that the massive transformations in the field of energy and transportation had been

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[669] Ibid., 9.
[670] Ibid., 9–10.
[671] Ibid., 10.
[672] Oreskes and Conway, *Merchants of Doubt*, 248–55; E. E. David, Jr., "Remarks at the Fourth Annual Ewing Symposium," 26 Oct 1982, CF, 1.

driven primarily by “technology and economic markets,” and he intended that to remain the guiding principle for the next energy transition.[673]

Three weeks after David gave his talk at the Ewing Symposium, in November 1982, Exxon circulated an internal report on climate change to its personnel, a “briefing material on the CO_2 ‘Greenhouse’ Effect.” In the accompanying letter, the company recognized that climate change was “receiving increased attention in both the scientific and popular press as an emerging environmental issue.”[674] The 39-page document was an in-depth, if rather biased presentation of the problem and of the science. It was not signed, but most probably represented an aggregate of various contributions from ER&E, resulting in a rather puzzling document. While some figures and paragraphs described the seriousness of the subject and the adverse consequences of global warming, the overall message consisted in emphasizing the remaining uncertainties, at times questioning whether there would be a warming at all, and more generally arguing that the right course of action was to produce more research before considering any policy measure.

Much like the 1983 Nierenberg report, the two-page summary did not represent the report accurately, but the effect was the same: to downplay the severity of the issue and to offer a more restrained view than what the bulk of the report suggested of how climate change should be dealt with. The authors stated that “considerable uncertainty also surrounds the possible impact on society of such a warming trend, should it occur,” adding that some of the impact on agriculture or rainfall patterns “could be beneficial in some regions and detrimental in others,” although they recognized that the least favorable scenarios predicted “the flooding of some coastal land masses as a result of a rise in sea level due to melting of the Antarctic ice sheet.”[675] However, and although that claim was not supported by the authoritative voices in the field, the report hastily added that “such an effect would not take place until centuries after a 3°C global average temperature increase actually

673 Ibid.
674 M. B. Glaser to R. W. Cohen et al, “CO_2 ‘Greenhouse’ Effect,” 12 Nov 1982, CF.
675 ER&E, Coordination and Planning Division, CO_2 “Greenhouse Effect,” 1 April 1982, CF, p.1 of the summary.

occurred."[676] The report also stated that "there is currently no unambiguous scientific evidence that the earth is warming."[677] While this was true, as observed global temperatures still remained within the range of natural climate variability, the Keeling curve, which was featured in the report, showed a clear increase in the concentrations of atmospheric carbon dioxide. All the scientific reports released up to that point had concluded that CO_2-induced global warming would occur—even if that warming had not been detected yet and its effects would not become visible before another twenty years had elapsed, because of an initial lag and inertia in the climate system. Exxon's own scientists had written, in 1981, that "the 'greenhouse effect' has become recognized […] as a descriptor for a global warming effect due to build-up of CO_2 in the atmosphere," and that "an upward trend in CO_2 content is well documented through measurements since 1957 by weather stations of the United States Government."[678]

No such sobering assessment appeared in the document circulated to Exxon's employees. On the contrary, the last paragraph in the report's summary ended on a wishful note, unsupported by science, which claimed that "overall, the current outlook suggests potentially serious climate problems are not likely to occur until the late 21st century or perhaps beyond."[679] But this allowed the report's authors to assert their main argument, namely that "making significant changes in energy consumption patterns now to deal with this potential problem amid all the scientific uncertainties would be premature."[680] What this record illustrates is the discrepancy between the executive spheres of power at Exxon, and the rest of its employees. While executives' understanding of climate change and its repercussions reflected the scientific consensus, which was affirmed by its own researchers, it was not the view they chose to share with the bulk of Exxon employees. At the end of 1982, the tide had turned, and Exxon's position had shifted from one of open contribution to science, to an insistence

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676 Ibid.
677 Ibid.
678 G. H. Long to P. J. Lucchesi et al., "Atmospheric CO_2 Scoping Study," Feb 5, 1981, CF, 5.
679 ER&E, Coordination and Planning Division, CO_2 "Greenhouse Effect," 1 April 1982, CF, p.2 of the summary.
680 Ibid.

on the uncertainties surrounding the issue. The report concluded that "given the long term nature of the potential problem and the uncertainties involved, it would appear that there is time for further study and monitoring before specific actions need be taken."[681] By the end of the decade, uncertainty would make way for full-blown climate change denial.

Fewer internal records among those retrieved by investigative journalists cover the second half of Reagan's first term, but two presentations on the CO_2 research conducted by Exxon scientists offer insight into executives' knowledge of and approach to the issue. In February 1984, Andrew Callegari, who had taken over the CO_2 research program in 1981, gave a conference presentation titled "CO_2 greenhouse and climate issues," in which he offered an overview of the corporate research program that confirmed the turn taken by Exxon, which had decided to favor climate modeling over conducting large-scale experiments.[682] His presentation further evidences Exxon's knowledge of global warming, as it included a figure of the Keeling Curve illustrating the rise of atmospheric CO_2 from 1957 to 1981.[683] Another figure, depicting the growth rate of industrial CO_2 emissions produced by gas, oil, coal and fossil fuels between 1950 and 1980, testifies to Exxon's awareness of the main culprit for the observed increase in atmospheric CO_2 concentrations, namely the rise of fossil fuel emissions, whose growth rates were at their highest between 1950-70, a period of strong economic growth following World War II.[684] While insisting that the validity of models had not yet been established due to the "many approximations and parametrizations," Callegari included a graph taken from Hansen's 1981 *Science* article, which showed that climate change effects would become apparent by the turn of the century, and that the mean surface temperature

[681] ER&E, Coordination and Planning Division, CO_2 "Greenhouse Effect," 1 April 1982, CF, 29.
[682] Banerjee et al., *Exxon*, 70–1; A. J. Callegari, "Corporate Research Program in Climate/CO_2-Greenhouse," 2 Feb 1984, CF, 2.
[683] Ibid., 3.
[684] Ibid., 4. Deforestation and slash-and-burn farming in developing countries had sometimes been cited as sources of carbon emissions, and they were, but they alone could not explain the sharp rise in atmospheric CO_2 levels, and Exxon scientists knew that.

would continue its sharp rise, leaving the range of natural variations starting in the 1990s.[685]

A conference presentation given in March 1984 by Henry Shaw echoed Callegari's claims. Shaw reiterated that "there is adequate time to study the problem, and that "legislation is premature."[686] He also declared that "the general consensus is that society has sufficient time to technologically adapt to a CO_2 greenhouse effect," and that "our conclusion was recently reaffirmed by a number of studies," among which he cited 1983 NAS report, which vindicated Exxon's views on the carbon dioxide issue.[687] Shaw's remarks can also be read as reflecting the crystalizing consensus within Exxon's management that no corrective measure needed to be implemented to abate the greenhouse effect, least of all a comprehensive legislative or political overhaul. At the same time Exxon's management was publicly decrying political action, it was alerting other oil majors to the gravity of the threat at a meeting of the IPEICA (International Petroleum Industry Environmental Conservation Association) held in Houston in 1984.[688] Exxon did not concern itself with the repercussions of a fossil fuel-driven rise in atmospheric CO_2, but it sought to thwart any attempts at regulating CO_2 emissions at the national and international levels.

Reagan's second term marks an acceleration in Exxon's handling of climate change as a threat to its industry that needed to be firmly opposed. In a telling move, and as ICN journalists have reported, Exxon paused publications in peer-reviewed journals for five years, between 1986 and 1990.[689] This voluntary withdrawal from the scientific community clearly illustrates the completion of the shift in the company's policy towards climate change, which would culminate at the end of the decade with its resolution to cover

685 A. J. Callegari, "Corporate Research Program in Climate/CO_2-Greenhouse," 2 Feb 1984, CF, 6 and 8.
686 Henry Shaw, "CO_2 Greenhouse and Climate Issues," EUSA/ER&E Environmental Conference, Florham Park (NJ), 28 March 1984, CF, 7.
687 Ibid., 14.
688 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), 4.
689 John H. Cushman Jr., "Exxon Made Deep Cuts in Climate Research Budget in the 1980s," *Inside Climate News*, November 25, 2015.

up its own results and embark on a campaign of denial, led by the Global Climate Coalition and other front groups. A presentation given in October 1985 by Brian Flannery, one of Exxon's leading climate modelers, on the CO_2 issue and the research conducted by Exxon, gives an overview of the company's research engagement at the time. More importantly, this document sheds light on what Exxon scientists knew about global warming, but also what they thought still remained unknown and how these areas of uncertainty could bolster the company's position on the question. Flannery centered his presentation on two ongoing research projects. One was the collaboration with Columbia University's Lamont-Doherty Earth Observatory, where Broecker and Takahashi, using data from the specially outfitted Exxon tanker, worked on developing a better understanding of the oceanic carbon cycle, and more specifically the sea-air exchange of CO_2 in the North Atlantic waters.[690] While the ocean constitutes a central variable in the climate system, whose role in the carbon cycle needed to be better understood, what appeared to have motivated Exxon in sponsoring research into the ocean/CO_2 relationship was the mechanism known as thermal buffering, or the fact that the ocean acts as a carbon sink, potentially delaying global warming by several decades. This was alarming news for everyone but the oil industry, which clearly stood to benefit if climate change's effects were delayed for another couple of decades. Models offered predictions, but these remained theoretical scenarios, not observable facts.

Exxon's executives had probably inferred that no domestic or international political action would derive from computerized, *potential* consequences of climate change, however serious and far-reaching models predicted them to be. The question, formulated by Flannery in his presentation, "why hasn't warming been observed?", further evidences the manifest interest of Exxon's executive team in the ocean's delaying of global warming, an "emerging dilemma" for climate modelers, according to Flannery.[691] A "proposed solution," he went on to explain, was that "oceanic thermal buffering [was] much greater than found in previous studies."[692] Not

[690] B. P. Flannery, "CO_2 Greenhouse Update 1985," 4 Oct 1985, CF, 2.
[691] Ibid., 16.
[692] Ibid.

only did this theory buy Exxon time before it had to profoundly alter its business model, it also provided the company with a crucial piece for denying, or at least questioning the validity of model predictions. As long as global warming remained a scientific theory, no matter how plausible it was, Exxon could cast doubt on it.

The second research project mentioned by Flannery in the presentation he gave to Exxon's management in October 1985 further evidences the fact that Exxon had pivoted its research operations, from a willingness to understand the greenhouse effect in the late 1970s and early 1980s, to looking for blind spots or weaknesses in climate models that executives could exploit. The project mentioned by Flannery was a chapter in the 1985 DoE SOA report co-authored with Martin Hoffert, a professor of physics at New York University and a consultant to the company from 1981 to 1987.[693] Like the rest of the volume, the paper was a review of the science of climate modeling and as such, highly technical in nature.[694] The contribution focused on transient climate models, or models that do not look to determine a new static climate equilibrium following changing levels of CO_2 concentration in the atmosphere, but are dynamic models which describe how the climate evolves to reach the new equilibrium state, such as the GCMs developed by Hansen and his team at the NASA Goddard Institute for Space Studies.[695]

Recalling the research question underlying the study conducted at Lamont-Doherty on the ocean's role in the carbon cycle, one of the article's main threads was the question of "where and when a climate change is likely to be observed in the future."[696] One of the difficulties pertaining to transient models was that thermodynamics, the set of physical laws underlying climate science, does not allow scientists to draw conclusions regarding any systems'

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693 Marianne Lavelle, "Former Exxon Scientists Tell Congress of Oil Giant's Climate Research Before Exxon Turned to Denial," *Inside Climate News*, October 24, 2019.
694 Martin I. Hoffert, and Brian P. Flannery, "Model Projections of the Time-Dependent Response to Increasing Carbon Dioxide," in *Projecting the Climatic Effects of Increasing Carbon Dioxide*, ed. Michael C. MacCracken, and Frederick M. Luther (Washington D.C.: U.S. Government Printing Office,1985), 151–190. I thank my friend Robin Nigon, who holds a PhD in materials science and engineering, for taking the time to read Hoffert and Flannery's article carefully and explain it to me in accessible terms.
695 Martin I. Hoffert, and Brian P. Flannery, "Model Projections," 151.
696 Ibid.

transient response (in this case, climate's response to rising atmospheric CO_2 concentrations). In other words, Flannery and Hoffert argued that, in spite of important research efforts, prevailing models at the time were unable to provide answers concerning the scope and magnitude of climate change. Climatic variations, caused by a variety of external factors (large-scale deforestation, emissions of trace greenhouse gases, variations in solar luminosity, and volcanic aerosols), had occurred throughout the earth's geological history, and it was not clear, according to Flannery and Hoffert, that a warming trend was underway at all. While underlining legitimate scientific concerns about climate models' shortcomings, and although they never phrased their main claim explicitly, Flannery and Hoffert unmistakably called into question models' predictive capabilities. In the conclusion to their article, they cited the scientific consensus drawn from "transient climate models currently available, [which] indicate a warming of the order of 1°C by the year 2000, relative to the year 1850, and an additional 2-5°C warming over the next century," but they immediately shrouded that consensus in layers of doubt, adding that "the sensitivity of such predictions to known uncertainties of the models—that is, the robustness of CO_2 warming predictions—has not yet been extensively explored."[697] This claim, like the paper as a whole, was a subtle but clear attempt at challenging the validity of climate models.

In his presentation to Exxon's managers, Flannery offered a summary of the DoE SOA chapter's findings, insisting on the fact that there were "major disagreement between models," that global warming was "not yet confirmed by observation" and that "modern climate is forced by factors other than CO_2."[698] These claims were not false, per se, as models differed in their predictions, the recorded global mean temperature increase remained within the range of normal fluctuations at the time, and many elements outside of CO_2, natural and man-made, influence the climate system. Yet the growing concentration of carbon dioxide resulting from the combustion of fossil fuels had been and still was contributing to a steadfast warming of the lower

[697] Ibid., 185.
[698] B. P. Flannery, "CO_2 Greenhouse Update 1985," 4 Oct 1985, CF, 11–12 and 14

atmosphere, and as a physicist and a climate modeler, Flannery understood that better than anyone else.[699]

In a memo dated August 1988, Joseph Carlson, a public affairs manager at Exxon, acknowledged what the company had known for at least a decade by then, namely that the "greenhouse effect may be one of the most significant environmental issues for the 1990s" and that carbon dioxide constituted one the "gases that favor absorption of infrared radiation."[700] Carlson's memo declared that "the greenhouse effect [...] is essential to the support of life on earth," and that what worried scientists was the "'enhanced' greenhouse effect," so as to insist on the idea that global warming was the mere increase of a natural phenomenon, one essential to life on earth itself.[701] Carlson applied the same grain of doubt to climate models, declaring that these "are not very reliable because approximations are used to represent poorly understood interactions," a point that had been emphasized by corporate scientists.[702] In direct contradiction to Hansen's congressional testimony two months earlier, Carlson added that "it is too early to specify the severity of the potential impacts of the enhanced greenhouse effect."[703]

In his concluding remarks, Carlson reaffirmed Exxon's position, which was to "emphasize the uncertainty in scientific conclusions regarding the potential enhanced Greenhouse effect," as well as "urge a balanced scientific approach."[704] But balance has no place in science: competing theories can coexist until one emerges as the most plausible one, invalidating the others. In 1988, and although important aspects of climate models needed to be worked out, all serious scientific endeavors were pointing in one direction. Climate change was not a question of values, ideology or policies: it was a fact, and as such, required no "balancing" of opposite viewpoints.

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[699] Flannery later joined an inter-industry "working group on global climate change," established in 1988 after a IPIECA meeting in Paris. The group's avowed goals were three-fold: to insist on pockets of uncertainties in climate change science; to examine "no-regrets" options that would benefit the industry in its response to climate change; to review possible efficiency measures related to fossil fuels in terms of their respective emission intensity. See Bonneuil, Choquet, Franta, "Early warnings and emerging accountability," 4–5.
[700] Joseph M. Carlson, Memo, "The Greenhouse Effect," 3 Aug 1988, CF, 2.
[701] Ibid., 1.
[702] Ibid., 4.
[703] Ibid., 5.
[704] Ibid., 7.

Carlson's memo also reveals Exxon's role in guiding the oil industry, by "providing leadership through API in developing the petroleum industry position."[705] We know that Exxon succeeded in building a strong coalition. Just two years after its own research had confirmed fossil fuel emissions' direct role in upsetting the climate system and shown that the corrective action implied a drastic curtailment of CO_2 emissions and the transition to low-carbon sources of energy, Exxon and the major actors in the oil industry opted for a wholesale rejection of science, and the spread of falsehood and misleading statements. In successful unison through lobbying groups such as the George C. Marshall Institute, the Global Climate Coalition, and IPIECA, the oil industry not only "resisted the overstatement and sensationalization of potential greenhouse effect which could lead to noneconomic development of non-fossil fuel resources," in Carlson's words, but effectively prevented any meaningful political action on climate change.[706]

3.7 Conclusion

If the Regan administration did not deliver the counterrevolution expected by its supporters, it laid the groundwork for its successors in important ways. By polarizing environmental issues, framing them as a choice between nature and the economy (i.e. people's livelihoods), it made it very difficult for conservative elected representatives to support regulatory measures in environmental policy, contributing to the radicalization of the Republican party. Climate change also crystalized a number of frustrations and fears of Republican voters and their representatives who, after Reagan's departure, embarked on a quasi-crusade against attempts at developing a national climate policy or regulating greenhouse gases through an international treaty. The political battle over climate change left the realm of ideas and policy debate, to enter that of deep-seated values Republicans viewed as imperiled, such as individual freedom and free enterprise, deepening the polarization of the issue. Although the 1983 NAS report did not contradict the facts concerning climate change, Nierenberg's misleading synthesis opened a type

[705] Ibid.
[706] Ibid., 8.

of climate's Pandora's box, by presenting social and economic consequences as open to interpretation, and forever changed the public discourse on climate change. As for the SOA report published by the DoE in 1985, it succeeded in emptying science of its political power by dwelling on uncertainties and the workings of the climate system, as opposed to examining the responses of that system to man-made disruptions. An abstract issue, invisible to the human eye and subject to a strong initial inertia, climate change formed a particular type of environmental problem, one that only existed in computer simulations in the 1980s. For that reason, climatology, and climate models in particular, acquired prime importance in determining the severity of its impact on human life, making them extremely vulnerable to all sorts of attacks. The nuclear winter controversy, for instance, was used by climate change skeptics as a way to illustrate, according to them, the difficulty of relying on models alone to predict the future consequences of increased levels of carbon dioxide in the atmosphere. Ozone depletion gained traction in the political world, leading to the adoption of the Montreal Protocol in 1987, and raising climate change's profile. However, the oil industry had been put on notice by then, and it began to take measures to organize a countermovement and thwart any international efforts at regulating fossil fuel emissions. Exxon executives decided to leverage the science they had funded and use the uncertainties they knew existed in atmospheric models, to sow doubt and confusion on climate change.

Chapter 4

Negotiated Science and Political Paralysis: Global Environmental Governance, the IPCC, and the George H. W. Bush Administration's Obstructionism (1989-92)

After the media storm caused by the congressional testimony of NASA atmospheric physicist James Hansen over the summer of 1988, the presidential campaign saw environmental issues rise to the fore of public concerns.[707] In his bid to succeed Reagan, George H. W. Bush actively sought to distance himself from his former boss on environmental matters. Polls showed that Republican voters viewed federal environmental laws enacted in the 1970s as well founded and important in preserving natural resources. Bush pledged to be "a Republican president in the Teddy Roosevelt tradition. A conservationist. An environmentalist," and he promised to convene an international conference on global environmental issues in his first year in office.[708]

During the transition, he met with representatives of some thirty environmental organizations who submitted a long list of proposals to be reviewed by the new administration. Bush then made a series of well-received appointments, most notably at the EPA, for which he chose William Reilly, the president of the World Wildlife Fund and the Conservation Foundation, and a respected figure in both environmental and economic circles. Bush's other appointees at the Council on Environmental Quality and at the Office of Management and Budget for Natural Resources, Energy, and Science were also considered strong environmentalists, as was Frederick Bernthal, the deputy director of the National Science Foundation, who was selected to lead the climate change negotiations through the Department of State. These nominations were viewed negatively by antiregulatory organizations in the

[707] Michael E. Kraft and Norman J. Vig, *Environmental Policy in the 1990s toward a New Agenda* (Washington: CQ Press, 1990), 33–54; Joshua P. Howe, *Behind the Curve: Science and the Politics of Global Warming*, (Seattle: University of Washington Press, 2014), 161–162.

[708] Kraft and Vig, *Environmental Policy in the 1990s*, 33.

federal capital, and a pamphlet published by the Competitive Enterprise Institute, a libertarian think tank, lamented that "the Bush team has become cheerleader in the Greenie Cause, and America seems doomed for another round of poorly considered regulations."[709] His nominees for other critical agencies dealing with natural resources and public lands were not perceived as favorably, however. Manuel Lujan, Bush's candidate for the post of secretary of the Department of the Interior, was criticized by environmental groups for supporting oil drilling and timbering in the West, and so were other candidates for the Bureau of Land Management and the National Park Service. This mixed bag of appointments was characterized by a journalist for the *New York Times* as indicative of a "split personality," and from the onset of his presidency, Bush found himself pulled in opposite directions on environmental issues, and on climate change in particular, as various factions within the executive vied for power.[710]

4.1 A Compliant Science Advisor Meets Bush's Chief of Staff: Science and Climate Change under the New Administration

One of the notable changes from the previous administration included the explicit attribution of the climate issue to the president's science advisor for the domestic portion of its policy on climate change. D. Allan Bromley, a Canadian-American nuclear physicist and a professor of physics at Yale for most of his life, also enjoyed a renewed prestige of his post, which was officially promoted to a cabinet-level one, allowing him to sit on various councils within the Executive Office.[711] As the president's science advisor, Bromley held the chairmanship of the OSTP, as had been customary in previous administrations, but he also headed the Domestic Policy Council working group on climate change, which was tasked with developing the

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[709] Competitive Enterprise Institute, "Wandering Into the Swamp: Bush's Environmental Policy," Newsletter, March 1989, The Fossil Fuel Industry Documents Archive, University of California San Francisco Library (UC SF), available at: https://www.industrydocuments.ucsf.edu/fossilfuel/.

[710] Kraft and Vig, *Environmental Policy in the 1990s*, 50 ; Philip Shabecoff, "Washington Talk: Environment," *New York Times*, April 11, 1989, 8.

[711] For his personal perspective on his time at the White House, see D. Allan Bromley, *The President's Scientists: Reminiscences of a White House Science Advisor* (New Haven: Yale University Press, 1994).

administration's domestic policy on climate change.[712] While the latter was officially part of Bromley's portfolio, it was closely monitored by a central figure in the new administration, namely John Sununu, Bush's chief of staff. Bromley was promised and granted direct access to Sununu, the president's top advisor and his "gatekeeper," as part of the revalorization of his function, but the asymmetry of that relationship was evident.[713] Throughout his tenure as science advisor, Bromley kept Sununu informed of the developments in international climate change politics, the work by the IPCC and the several rounds of negotiations leading up to the 1992 U.N. Conference on Environment and Development (UNCED), but Sununu rarely heeded Bromley's advice when giving back instructions and directions regarding the administration's official course of action. Experiencing a fall from grace with the Republican establishment, who feared his political scandals and difficult character would impede Bush's re-election chances, Sununu resigned his post in December 1991.[714] Until the end of the administration's single term, though, the communication channel between Bromley and Sununu worked uninterruptedly, with memos flowing from the science advisor to the chief of staff.

While the post of science advisor gained in stature within the administration, Bromley worked hard to elevate the status of the science advisory committee as a whole. After Nixon had terminated PSAC in 1973, Reagan's science advisor had set up a smaller "White House Science Council" in place of the former committee. Neither the council nor Reagan's two science advisors had been granted access to the president, and the council had therefore mostly remained pro forma throughout Reagan's terms. Determined to breathe new life into his role and that of the committee he was to chair, Bromley worked hard to establish a new committee, closer to what PSAC had been before it was disbanded by Nixon, and he named it the President's Council of Advisors on Science and Technology (PCAST). In a

712 David Q. Bates, Jr., Memorandum for Governor Sununu, Andy Card, Alan Bromley, 31 October 1989, Records of the Office of Science and Technology, The National Archives and Records Administration (NARA), College Park, MD, Office files 1989 – 2000, box 4, folder "Global Warming, General," 2.

713 Andrew Rosenthal, "Sununu Resigns under Fire as Chief Aide to President; Cites Fear of Hurting Bush," *New York Times,* Dec. 4, 1991, 1.

714 Ibid.

memo to Sununu dated May 12, 1989, Bromley explained that he viewed it as "very important, from the outset, for us to avoid a possible pitfall that would result were the Bush Council to be viewed as a reincarnation of the former PSAC."[715] That association was best avoided, according to Bromley, because "the PSAC acronym itself is loaded with negative baggage from the latter PSAC days under President Nixon when to a significant degree it—or at least some of its members—ran amok, publicly opposing Presidential decisions about terminology and the like."[716] In an interview he gave in 1987, two years before his tenure as science advisor, Bromley had also singled out PSAC members' lack of deference towards the administration they were serving as the reason behind Nixon's decision to dismantle the committee: "They were given access to classified information, and tentative thought schemes of various possible courses of action the administration might take, and asked for their advice, they went public, and went screaming around talking to newspaper men and beating the administration over its head. […] PSAC really shot itself well and truly." [717] As one could expect, Bromley cited loyalty as one of three qualities he was looking for when putting together his list of twelve advisors, and he would go on to display a copious amount of loyalty himself, though that loyalty was directed less to the president than it was to his true boss, namely Sununu.[718] This would have important repercussions on the administration's response to climate change.

In an early memo on climate change he addressed to Sununu in July 1989, Bromley wrote with somewhat jarring candor—considering his later stance on the matter—that "total melting of both polar caps would result in a mean sea level rise of 60.5 meters with a rough uncertainty figure of ± 15

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[715] Allan Bromley, Yale University, Memorandum to Governor John Sununu, The White House, May 12, 1989, Bush Presidential Records: Staff and Office Files, Records on the Office of Science and Technology Policy (OSTP), Office of the Chief of Staff to the President, John Sununu Files, George H. W. Bush Presidential Library (GHWB), College Station, TX, folder "Science and Technology (1989) [1]," 2. Both the John Sununu Files and the D. Allan Bromley Files were released following a FOIA request (FOIA 2005-0336-F). They are arranged by folders but no box numbers are mentioned in the finding aid.
[716] Ibid.
[717] D. Allan Bromley, interview by Finn Aaserud, October 30, 1986, Niels Bohr Library & Archives, American Institute of Physics, College Park, MD.
[718] Ibid.

meters."[719] The memo as it appears in Bromley's records is one-page long, but it may have consisted of several pages. While a simple calculation of sea level rise, based on factual data regarding polar ice, does not in itself indicate that Bromley thought climate change was a real issue, it shows that he was at least open to the possibility of continuously rising carbon emissions posing a problem. At any rate, it certainly does contrast with the posture he would later adopt on the subject, which was to insist on the uncertainties of the science *ad nauseam* and reject the calls for CO_2 emission reductions. If anything, it seems that Bromley chose loyalty (in this case, to Sununu's views) over his own scientific understanding of the issue. Sununu was known to be highly skeptical of climate change, having derided it as some kind of Trojan horse for the "no-growth" ideology he said dated back to the 1970s and the Club of Rome's "Limits to Growth" report.[720] An MIT-trained engineer, Sununu rejected mathematical models as "unrealistic," and he was deemed "by all accounts the single individual most responsible for the United States' wait-and-see stance on global warming" by a 1991 *New York Times* article.[721]

Choosing loyalty over whatever personal views he may have entertained on the matter, Bromley sided with the wing opposing domestic and international action on climate change within the Bush administration, which was spearheaded by Sununu. While this position put him at odds with the broader scientific community, he explained in an interview for *The Washington Post*, published in December 1989: "I'm not a lobbyist for the scientific community. If I were perceived as one, I would have zero effectiveness in the White House."[722] Bromley had learnt early in his tenure that he was expected to follow Sununu's lead on science policy matters, not the other way round. And indeed, as this chapter will demonstrate, while there was notable disagreement within the administration on environmental policy,

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[719] D. Allan Bromley, Memorandum for John H. Sununu, "Sea Level Raising," July 31, 1989, Bush Presidential Records: Staff and Office Files, Records on the Office of Science and Technology Policy (OSTP), Office of the Chief of Staff to the President, John Sununu Files, GHWB, folder "Science and Technology (1989) [3]."
[720] "Where Sununu Stands," *New York Times*, September 10, 1991, 9; Nathaniel Rich, *Losing Earth: The Decade We Could Have Stopped Climate Change* (London: Picador, 2019), 151.
[721] "Where Sununu Stands," 9.
[722] William Booth, "Bush's Science Adviser Gains Visibility," *The Washington Post*, December 26, 1989, 21.

especially between the chief of staff and EPA administrator William Reilly, who represented the “old guard” of traditional Republican environmentalism, Sununu succeeded in swaying the president and setting the administration’s agenda on climate change.

Another important change operated by Bromley regarding PCAST that would bear down on the administration’s approach to climate policy was his decision to include a social scientist, namely an economist, Harold Shapiro, in the presidential science committee. In that same May 1989 memo, Bromley wrote: “I feel that the Reagan Administration made an early mistake in alienating a large faction of the social science community.”[723] He also noted that “picking the wrong social scientist could, of course, be a disaster since many of them find it impossible to communicate easily in predominantly physical science and engineering discussions without endless, disruptive questions about terminology and the like.”[724] It appears that to Bromley, a representative of the social sciences could easily turn into an unwelcome nuisance, but he seemed to place economists in a different category, equating the latter to researchers in the natural sciences, probably due to the appearance of objectivity ascribed to the dismal science and economists’ preference for quantitative research. At any rate, the nomination of Shapiro as vice-chairman of PCAST (Bromley being the chairman) prefigured the administration’s intent to read climate change almost exclusively through the lens of the free market ideology.

4.2 Evaluating Options for Mitigating Climate Change: The United States Secures the Chairmanship of the IPCC’s Crucial Working Group 3

U.S. climate change politics under the Bush administration got closely entangled with international environmental governance, as climate policy became as much a question of foreign policy as it was one of domestic policy.

[723] Allan Bromley, Yale University, Memorandum to Governor John Sununu, The White House, May 12, 1989, Bush Presidential Records: Staff and Office Files, Records on the Office of Science and Technology Policy (OSTP), Office of the Chief of Staff to the President, John Sununu Files, GHWB, folder “Science and Technology (1989) [1],” 2.
[724] Ibid.

The 1985 Vienna Convention for the Protection of the Ozone Layer and the 1987 Montreal Protocol aimed at regulating ozone-depleting gases had given impetus to calls for an international agreement on climate change, which had grown louder after the 1985 conference in Villach where scientists had called for national governments to begin taking measures. Phasing out CFCs came with a set of challenges, but reducing carbon dioxide emissions required adopting a sprawling web of policies and regulations, and the economic stakes of such an endeavor were much higher. The Reagan administration had been wary of the scientific basis from which the agreement would spring, and it had pushed for the creation of the Intergovernmental Panel on Climate Change (IPCC), operating under the aegis of the World Meteorological Organization (WMO) and the United Nations Environment Program (UNEP), as a way to control the production of knowledge it believed would shape international climate change policy.[725] The new body would be led by government representatives, mostly scientists from governmental science agencies and national career diplomats, and responsible for producing a comprehensive review of the state of climate change science. The IPCC was mandated to present a scientific consensus in the form of an assessment report. The latter would, in turn, inform an international treaty on climate change, namely the U.N. Framework Convention on Climate Change (UNFCCC) open for signature at the UNCED, also known as the Rio Earth Summit, in June 1992. Before discussing the process behind the completion of the first IPCC report in 1990, I want to briefly come back to 1988, the year the IPCC was established, and examine more closely how the organization came to be, because the circumstances around its creation impacted its output substantially.

An internal memo from the Department of State to the U.S. representative to the WMO, dated January 1988, outlines the Reagan administration's views on the IPCC.[726] This position paper mostly recognized the need for such an intergovernmental organization, to succeed the informal

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[725] Howe, *Behind the Curve*, 158.

[726] Richard J. Smith to Richard Hallgren, U.S. Permanent Representative to the World Meteorological Organization, "Intergovernmental Panel on Climate Change," January 27, 1988, Cobb, Tyrus W. Files, Ronald Reagan Presidential Library (RRPL), box 2, Folder "Global Climate Change (1)," 1.

advisory group of climate scientists that had formed in the wake of the Villach Conference, and give government representatives the lead in the production of the scientific assessment report. The dual nature of the IPCC, "an interface between science and policy," signaled a turn in the climate change politics.[727] From that moment on, science became highly contentious on grounds that were not scientific: politics had entered the realm of science. In seeking the active participation of world governments into the assessment process, Bert Bolin, the Swedish meteorologist who had spearheaded efforts after the Villach Conference, and Maurice Tolba, the executive director of UNEP, opened science to national governments' political priorities. Both men, however, considered this a small price to pay in order to force governments into action.[728] As Howe notes, by mere virtue of being engaged in the IPCC process, even reluctant governments such as the United States, the Soviet Union and Saudi Arabia implicitly recognized that something ought to be done.[729] In exchange for greater control over the production of a scientific agreement under the U.N. umbrella, Bolin hoped to nudge national governmental leaders towards a global framework to address climate change. Bolin viewed "political ownership" of that international scientific consensus as the gateway to climate policy.[730]

In terms of structure, the United States had envisioned for the panel to be divided into four working groups, but at a November 1988 meeting in Geneva, the delegates from the twenty-eight countries in attendance opted for a tripartite division: the first Working Group was given the easiest task, namely that of assessing the physical scientific basis of climate change, an undertaking that had been done many times throughout the 1980s; the second Working Group would review the vulnerability of socio-economic and natural systems to climate change; finally, Working Group 3 was responsible for evaluating options for mitigating climate change.[731] The meeting also

[727] Ibid.
[728] Howe, *Behind the Curve*, 159.
[729] Ibid.
[730] Stephen Schneider, *Science as a Contact Sport : Inside the Battle to Save Earth's Climate* (Washington, D.C.: National Geographic, 2009), 125.
[731] Unsigned draft, "U.S. Strategy For Implementation of WMO-UNEP Intergovernmental Panel on Climate Change (IPCC)," August 15, 1988, Cobb, Tyrus W. Files, (RRPL), box 2, Folder "Global Climate Change (2);" Bert Bolin, *A History of the Science and Politics of*

ascribed a chairman and two vice-chairmen to Group 1 and 2, led by the United Kingdom and the Soviet Union respectively, while the third group would be chaired by a U.S. State Department official, Frederick Bernthal, accompanied by no fewer than five vice-chairmen, a testimony to the political weight of that group. As a State Department memo noted, the Reagan administration had sought a leadership position in the IPCC, "tak[ing] an active role in shaping this panel to meet the U.S. Government objectives."[732] Delegates also agreed to a rather tight schedule proposed by Malta for completing the assessment report, which had to be ready for the U.N. General Assembly in October 1990.[733] On December 6, 1988, the General Assembly adopted a resolution on the "Protection of the Atmosphere for Present and Future Generations of Mankind" and enshrined the creation of the IPCC, an international effort aimed at providing scientific assessments of the environmental and socio-economic impacts of climate change.[734]

4.3 Leveraging Uncertainties in Climate Science and the Costs of Governmental Action: the Administration Sets its Agenda on Climate Change

The United States pressured national governments to acquiesce to its demands, and it got almost everything it sought both in the IPCC's first assessment report and in the Framework Convention. The Bush administration secured these outcomes by positioning itself as an obstructionist force and an outlier in the realm of international environmental governance early in the negotiation process. While the administration's role started drawing more criticisms once international rounds of negotiations for the Framework Convention got underway, its position had been settled in the

Climate Change: the Role of the Intergovernmental Panel on Climate Change (Cambridge: University Press, 2008), 49–50.

[732] Richard J. Smith to Richard Hallgren, U.S. Permanent Representative to the World Meteorological Organization, "Intergovernmental Panel on Climate Change," January 27, 1988, Cobb, Tyrus W. Files, Ronald Reagan Presidential Library (RRPL), box 2, Folder "Global Climate Change (1)," 1.

[733] Bolin, *A History of the Science and Politics of Climate Change*, 50.

[734] U.N. General Assembly, *Protection of global climate for present and future generations of mankind : resolution / adopted by the General Assembly*, 6 December 1988, A/RES/45/43, available at: https://digitallibrary.un.org/record/54234?ln=en#record-files-collapse-header, accessed October 12, 2021.

early days of the new presidency, and the basic tenets of its approach to climate change determined well before the IPCC assessment process began in early 1990, as this section will show.

The administration's stance was clearly reflected in a letter Bromley addressed to Watkins, the Energy Secretary, in September 1989. The letter concerned a bill that had been introduced in the Senate six months earlier by Timothy Wirth, the Democratic Senator who had convened the Hansen hearings in the summer of 1988. The bill called for a strong national policy on global warming and set the goal for the United States to reduce its carbon dioxide emissions from 1988 levels by 20 percent by the end of 2000. Watkins rejected the call for reducing carbon dioxide emissions as "premature" and stated that more science was needed before such measure could be implemented.[735] But he also recognized that "[this] does not mean we must wait before we do anything," and listed a series of actions that "also make sense for other reasons," i.e. that had economic value in themselves, such as energy conservation efforts, reductions in the release of ozone-depleting gases (chlorofluorocarbons, or CFCs, are greenhouse gases, alongside water vapor, methane, ozone and nitrogen oxides, and of course carbon dioxide), and the development of alternative fuels.[736] Watkins's proposals were far from radical but they irked the White House nonetheless. Bromley gently but firmly called Watkins to order, reiterating the administration's agenda on the matter. First, he insisted that "energy conservation techniques must be looked at from an economic perspective," and that "cost/benefit considerations or the return to investors" mattered as much, if not more than ecological concerns.[737] Second, Bromley echoed the administration's position on CFCs, whereby it sought to distance itself from the commitments made by Reagan in Montreal two years before. The Montreal Protocol was viewed by Bush as "unilateral action by the U.S.," and the U.S. government refused to "find [itself] too far

[735] James D. Watkins to Timothy E. Wirth, September 8, 1989, Records of the Office of Science and Technology, NARA, Office files 1989 – 2000, box 9, folder "Congressional – BROMLEY to WIRTH,"1.
[736] Ibid.
[737] D. Allan Bromley to James D. Watkins, September 22, 1989, Records of the Office of Science and Technology, NARA, Office files 1989 – 2000, box 9, folder "Congressional – BROMLEY to WIRTH,"1.

out front on an issue that other countries are less sanguine about."[738] Bromley's third point dismissed the alternative fuel option mentioned by Watkins, stating again that "environmental and economic impacts" needed to be reviewed more thoroughly "before the Administration can come in favor of any particular, alternative fuel source."[739]

Two months later, in November 1989, the U.S. delegation refused to commit to a mandatory timetable and a specific target for stabilizing carbon dioxide emissions at the Noordwijk Conference on Atmospheric Pollution and Climate Change in the Netherlands, attended by environmental ministers from sixty-seven nations.[740] Although Reilly, the EPA administrator, was favorable to begin discussing a policy framework to address climate change, Sununu's views prevailed.[741] At the meeting of the final negotiation, Bromley, who had accompanied Reilly to the conference, succeeded in imposing Sununu's rejection of national commitments to freeze CO_2 emissions at a specific level, having won over the British, Japanese and Soviet delegations.[742] At a press conference on November 7, 1989, Bush defended his position by stating that the United States was "standing off against the extremes."[743] This was not the first time Sununu had won over the president despite Bush's avowed commitment to environmentalism during his campaign. A month before the Noordwijk Conference, a critical provision of a new clean air bill that would have required automakers to produce more alternative fuel vehicles, was voted down by Republican representatives on the House subcommittee deliberating the bill, after it received opposing statements from Reilly, who supported the measure, and Sununu, who opposed it and said that the White House would accept a weaker provision.[744]

The outcome of the Noordwijk Conference was a logic sequel to a series of anti-climate policy maneuvers coming from the White House. Earlier that year, ahead of a Senate hearing, Hansen, a government employee,

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738 Ibid.
739 Ibid.
740 Ronald C. Kramer, *Carbon Criminals, Climate Crimes* (New Brunswick: Rutgers University Press, 2020), 107.
741 "Global Lukewarming," *New York Times,* November 5, 1989, 22.
742 Rich, *Losing Earth,* 171.
743 Margaret Kriz, "Ozone and Evidence," *National Journal,* November 11, 1989.
744 Allan R. Gold, "Bush Proposal For Clean Air Is Dealt a Blow," *New York Times*, October 12, 1989, 1; "Global Lukewarming," *New York Times,* November 5, 1989, 22.

had to submit his testimony to the White House for reviewing. Hansen was directed by the Office of Management and Budget, who was led by Richard Darman, a Reagan hold-over who opposed climate change regulations, to tone down his testimony, and was told that he could not speak as the Director of the NASA Goddard Institute.[745] The censorship caused a public outcry when Gore, alerted by Hansen, revealed the scheme to the press, but nothing emerged from the incident except for a vague mention of a workshop dedicated to the issue to be held at the White House.[746] A couple of months later, however, Bush retracted his campaign promise of convening an international conference on climate change, a decision that was criticized by Wirth in a letter to the president, in which he urged the latter to "seize this opportunity to establish a leadership role in the fight to protect the global environment […]" and deplored that "continued U.S. inaction and ambivalence on the most important environmental issue of the century sends a dangerous signal to the rest of the world […]."[747]

Letters penned by citizens supportive of Bush's stance on climate change and addressed to Bromley in the fall of 1989 make it clear that the administration found itself at odds with the general public on climate change. One supporter expressed his "sympathy […] as you must be now contending with fervid opposition […]," while another remarked that "Gov. Sununu is now under fire from the Greens for opposing an immediate long-term US commitment to incredibly costly reduction of CO_2 emission [in Noordwik]" and praised him for "st[icking] his neck out."[748] There was no formal Green Party in 1989, but an organization called the Committees of Correspondence

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745 Judith A. Layzer, *Open for Business: Conservatives' Opposition to Environmental Regulation* (Cambridge, Mass: MIT Press, 2012), 157.
746 Rich, *Losing Earth*, 55.
747 Timothy Wirth and J. Bennett Johnston to George H. W. Bush, October 30, 1989, Records of the Office of Science and Technology, NARA, Office files 1989 – 2000, box 4, folder "Global Warming, General."
748 Matthew Bashaw to D. Allan Bromley, November 21, 1989, Records of the Office of Science and Technology, NARA, Office files 1989 – 2000, box 4, folder "Global Warming, General,"1; Roger Allan Moore to Andrew Card, Jr. Deputy to the Chief of Staff, November 30, 1989, Records of the Office of Science and Technology, NARA, Office files 1989 – 2000, box 4, folder "Global Warming, General."

had been created in the summer of 1984 and it was working toward establishing a national Green platform.[749]

The fall of 1989 also witnessed two unrelated but analogous events in that both played into the administration's contrarian stance on climate change. The first was the publication of a report by the George C. Marshall Institute, the scientific-policy think tank established in 1984 to support Reagan's Strategic Defense Initiative. As Oreskes and Conway have shown, the Marshall Institute had first specialized itself in attacking the findings of mainstream science on the effects of tobacco on human health. In 1990, with the end of the Cold war, it found itself a new target: climate change science.[750] As Oreskes and Conway note, the Marshall Institute did not initially deny climate change, but it offered an alternative explanation for the increase in the global mean temperature.

In a report published in 1989 entitled "Global Warming: What Does the Science Tell Us?," the authors—among whom was Nierenberg—claimed that fluctuations in solar output were mainly responsible for the observed warming.[751] Briefed on these findings, the administration saw a lifesaver in the report, and a leading climate expert, Stephen Schneider, deplored the fact that "Sununu is holding up the report like a cross to a vampire, fending off greenhouse warming."[752] In a letter to Bromley, the vice-president for research at the Worldwatch Institute, a now defunct environmental think tank, could not hide his contempt for the administration and he did not mince his words, calling the U.S. government's position on the matter "scientifically illiterate and politically cowardly."[753] He enclosed a recent report produced

[749] Jodean Mark, "A Historical Look at Green Structure: 1984 to 1992," accessed October 7, 2022, http://www.greens.org/s-r/14/14-03.html.
[750] Naomi Oreskes, and Erik Conway, *Merchants of Doubt: How a Handful of Scientist Obscured the Truth on Issues from Tobacco Smoke to Global Warming* (New York : Bloomsbury Press, 2010), 169–215.
[751] Robert Jastrow, William Nierenberg, and Frederick Seitz, "Global Warming: What Does the Science Tell Us?" (Washington, D.C.: George C. Marshall Institute, 1989), cited by Oreskes and Conway, *Merchants of Doubt*, 186–190.
[752] Leslie Roberts, "Global Warming: Blaming the Sun," *Science* 246, no. 4933 (November 24, 1989): 992–3, cited by Oreskes and Conway, *Merchants of Doubt*, 186.
[753] Christopher Flavin, Vice-President for Research at the Worldwatch Institute, to Allan Bromley, October 25, 1989, Records of the Office of Science and Technology**,** NARA, Office files 1989 – 2000, box 4, folder "Global Warming, General."

by his think tank "in hopes of clearing up some of the apparent White House confusion about the scientific consensus on global warming," together with a scientific paper by an expert on solar variance and climate, who refuted the claims by Nierenberg and his colleagues at the Marshall Institute.[754]

The second event playing into the hands of the administration was an economic assessment of the costs of addressing climate change compared to the costs of inaction.[755] Prepared for the president's Council of Economic Advisors, an influential cabinet within the White House, the report was authored by William Nordhaus, the Yale economist who had contributed a chapter in the Nierenberg-led NAS report published in 1983.[756] In his "Sixteen theses on the greenhouse effect," Nordhaus displayed manifest cognitive dissonance. The bulk of his report consisted in refuting the possibility of seeing climate change severely impact the global economy, yet he also seemed to accept the plausibility of some of the most destructive environmental consequences such a change would precipitate.[757] In the early 1990s, no one talked of a planet turned uninhabitable by climate change, and at the time Nordhaus could reasonably write that "less than one-fifth of economic activity is directly sensitive to climate."[758] His view of climate change was shortsighted and hinged on a narrow understanding of the climate system's interaction with the biosphere, but it reflected the grasp of people with no training in atmospheric physics. However, Nordhaus was misguided when he repeated a claim, often rehashed by the oil industry, that agricultural production would likely increase thanks to "CO_2 fertilization."[759] Carbon dioxide plays a role in vegetation growth, but whatever positive impact it may

[754] Ibid.
[755] On the less studied but central role of economists in delaying climate policy, and on economic consultants hired by the oil industry from the 1990s to the 2010s in particular, see Benjamin Franta, "Weaponizing Economics: Big Oil, Economic onsultants, and Climate Policy Delay," *Environmental Politics* (2022), published online and available at: https://doi.org/10.1080/09644016.2021.1947636.
[756] See chapter 3, 158–160.
[757] For a highly critical appraisal of Nordhaus's work in climate change economics, and his prejudicial role in framing the debate on the damages to the economy from climate change since his first publication on the subject in 1991, see Steve Keen, "The Appallingly Bad Neoclassical Economics of Climate Change," *Globalizations* 18, no. 7 (2021): 1149-1177.
[758] William Nordhaus, "Sixteen Theses on the Greenhouse Effect," November 8, 1989, Records of the Office of Science and Technology, NARA, Office files 1989 – 2000, box 4, folder "Global Warming, General," 2.
[759] Ibid.

have on plants would be dwarfed by the rest of climate change's devastating impacts, and such a claim was both myopic and rejected by the majority of the scientific community. He also stated that studies had found "the net impact over the next half-century to century [to be] quite small" for the U.S, but he did not elaborate on those studies nor did he include any references.[760]

In a paragraph devoted to "uncertainties and environmental impacts," he shared a surprisingly high number of concerns about climate change, such as the fact that "it is essentially irreversible" and that a source of anxiety was the notion that "the ultimate climate is outside the range of experience during human history."[761] Nordhaus candidly listed devastating consequences, among which were "a rise in sea levels of 20 feet or more in a few centuries; dramatic shifts in ocean currents, such as a displacement of the Gulf Stream that would lead to a major shift in climates of Atlantic coastal communities; or large-scale desertification of the current grain belts of the world."[762] After listing so many potential calamities, Nordhaus conceded almost comically that the ozone hole had also been "completely unforeseen by anyone."[763] Ultimately, though, he argued that an agreement on CO_2 would have "uncertain benefits, large costs, and require nearly everyone to change behavior significantly," and therefore concluded that "in balancing costs and benefits, it is difficult to find economic costs of climate change that justify major economic dislocations."[764] To put this in perspective, Nordhaus found that the costs required to stabilize emissions, and therefore mitigate climate change, amounted to at least "the total costs imposed by both of the oil crises of 1973 and 1973," or "USD 1 to USD 3 trillion in global revenues."[765] That said, he recognized that "the prospects of unprecedented and potentially disastrous climate change would justify prudent steps […]."[766] Such an assessment was music to the ears of the Council of Economic Advisors, and it fell in line with the administration's creed.

[760] Ibid.
[761] Ibid., 4.
[762] Ibid.
[763] Ibid.
[764] Ibid.
[765] Ibid., 5.
[766] Ibid., 6.

A year later, another Yale-educated economist, William Cline, offered his own assessment, which differed substantially from that of Nordhaus.[767] Adopting an opposite posture, Cline argued that "the true stakes of global warming are considerably higher than the bulk of the policy suggestion to date has suggested" and that "preventive action on the greenhouse problem may have a firmer basis in rational economic cost-benefit analysis than previously suggested."[768] In other words, Cline accused Nordhaus and other economists brandishing the cost-benefit cross of failing to assess the true economic damages of climate change in the decades ahead. Cline had in mind a horizon of 250 years, which amounted to nothing in short-term economics due to the "discount" ascribed to the future and thus was not considered seriously by mainstream economists, but his understanding of the scope (if not the timeline) of climate breakdown was more in line with the predictions of climate models than Nordhaus' was. Cline pointed out that "uncertainty works in both directions," and that "if policymakers are risk averse, greater uncertainty (and its corresponding widening of the spread of possible outcomes) […] should mean more action, not less […]."[769] Cline also convincingly remarked that each decade lost to inaction implied a commitment to additional warming. Records I consulted do not tell us how Sununu reacted to these claims, but it is highly probable that he knew about Nordhaus' report, as he had been invited to an inaugural event convened by the chairman of the White House Council of Economic Advisers, Michael Boskin, at Camp David, Maryland.[770] At any rate, the administration plowed merrily with its policy, shunning the red flags raised by Cline and Nordhaus himself.

Perhaps as a result of what he and Sununu had read from Nordhaus, Bromley said in a December 1989 interview for *The Washington Post* that the science on climate change was too uncertain to warrant taking immediate and

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[767] Shortly after, Cline offered a detailed rebuttal of Nordhaus's claims in William Cline, *The Economics of Global Warming* (Washington D.C.: Institute for International Economics, 1992).
[768] William Cline, draft paper on the economics and science of the Greenhouse Effect, November 20, 1989, Records of the Office of Science and Technology, NARA, Office files 1989 – 2000, box 4, folder "Global Warming, General," 40.
[769] Ibid., 41.
[770] "Bush to Gather Economists," *New York Times*, April 21, 1989, 12.

broad measures.[771] Dismissing some of the models' projections as "extreme scenarios," Bromley stressed the administration's prioritization of the economic costs of climate policies (as opposed to taking into account the costs of inaction), rejecting the notion that the administration was "skeptical of the theory [of greenhouse warming]" but insisting on its "aware[ness] that in our present state of knowledge there are large uncertainties."[772] The use of the term theory, of course, undermined that claim, while the insistence on knowledge gaps, which had been greatly reduced by then, underscored the administration's denial of the issue.

4.4 The U.S. Delegation's Role in Weakening the IPCC's First Assessment Report's Conclusions

In a memo to Sununu and Bromley dated October 1989, a White House official offered an overview of the steps taken by the administration regarding climate change, in which he stated that preliminary discussions on the Framework Convention prepared for the Earth Summit in Rio had already begun in Working Group 3, the Response Strategies committee chaired by the United States. The official also explained that "improper or ill-advised actions, ie: those taken before we have an international consensus […] could have enormous unintended environment, economic and social consequences."[773] The administration's chief concern did not pertain to global warming's *unintended* consequences, but to policy measures that could impact U.S. economic competitiveness. Another internal document drafted within the White House also explained that the IPCC was viewed by the administration as "the principal international forum for discussion of global warming issues," noting that the U.S. government had been "aggressive in shaping the IPCC and is chairing a crucial working group […]."[774] As Howe

[771] Booth, "Bush's Science Adviser Gains Visibility," 21.
[772] Ibid.
[773] David Bates, Jr., memorandum for Governor Sununu, Andy Card, Allan Bromley, October 31, 1989, Records of the Office of Science and Technology, NARA, Office files 1989 – 2000, box 4, folder "Global Warming, General."
[774] Stephen Danzansky, memorandum for Allan Bromley, November 17 1989, Bush Presidential Records: Staff and Office Files, Records on the Office of Science and Technology Policy (OSTP), Office of Science and Technology Policy, D. Allan Bromley

explains, the science of climate change stood in as a proxy for climate politics, and the debates surrounding the production of the report formed "the front line of a larger battle over a future international legal regime—the UNFCCC […]."[775]

In February 1990, at the third plenary meeting of the IPCC held in Washington D.C., Bush reiterated his administration's stance on climate change, which centered around its "commitment to finding responsible solutions."[776] The president emphasized the well-known trope of the "convergence between global environmental policy and global economic policy, a bargain where both perspectives benefit—and neither is compromised."[777] This was also the first time Bush described the administration's "no regrets" policy on climate change—a precautionary principle turned on its head—whereby no policy measure ought to have any detrimental effect on the economy, should climate change turn out to be, in fact—and against all evidence—a benign phenomenon. Following this emphasis on the economics of climate change, he also announced that he was convening an international conference at the White House in April of that year on "Science and Economics Research Related to Global Change." A presidential campaign pledge, the conference's theme had only been loosely defined, and administration officials reviewed a number of options, including a conference on natural resources and sustainable development, before settling on one assessing the economic impacts of climate change policy. An internal draft from November 1989 mentioned in one of the conference's preliminary titles both the "cost of response" and the "cost of inaction."[778]

Files, GHWB, folder "Intergovernmental Panel on Climate Change (IPCC): General [2 of 2] [1990]," 1.

[775] Howe, *Behind the Curve*,163

[776] George H. W. Bush, "Presidential Remarks: Intergovernmental Panel on Climate Change, February 5, 1990, Georgetown University, Bush Presidential Records: Staff and Office Files, Records on the Office of Science and Technology Policy (OSTP), Office of Science and Technology Policy, D. Allan Bromley Files, GHWB, folder "Intergovernmental Panel on Climate Change (IPCC): General [2 of 2] [1990]," 1.

[777] Ibid.

[778] Stephen Danzansky, memorandum for Allan Bromley, November, 17 1989, Bush Presidential Records: Staff and Office Files, Records on the Office of Science and Technology Policy (OSTP), Office of Science and Technology Policy, D. Allan Bromley Files, GHWB, folder "Intergovernmental Panel on Climate Change (IPCC): General [2 of 2] [1990]," 2.

At the actual event, however, the focus clearly fell on the first of these concerns, and the United States was heavily criticized by European delegates for using the occasion as a unilateral platform for showcasing its approach to climate change while muzzling competing views.[779] In his opening remarks, Bush emphasized the uncertainties underlying the science of climate change, and argued against any "drastic reordering of our economy that could cause us […] 'to end up the impoverished nation awaiting a warming that never comes.'"[780] Overall, the conference was viewed by representatives from European states as an avenue for delaying and obstructing progress on international climate policy.

Six months elapsed between the third plenary meeting of the IPCC in Washington D.C. and the fourth one in Sundsvall, Sweden, at which the final version of the IPCC's first assessment report was adopted at three o'clock in the morning, after hours of difficult deliberations. While Bromley's records do not give us an overview of the process followed by the U.S.-led Working Group 3, they nevertheless suggest a high degree of involvement by administration officials and U.S. delegates throughout the various phases of the report's production. In May 1990, after each group had submitted its report, Bromley compiled a dense, 6-page long explanatory document for Sununu, appraising IPCC's assumptions regarding climate change, future fossil fuel emissions, and more generally "how the various numbers fit together."[781]

By his own admission, Bromley was no impartial observer, writing that "a fair degree of definitial [sic] confusion […] is being used to the advantage of activists in the field."[782] One thing that bothered him in particular was the fact that the total radiative forcing (the scientific term for

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[779] Loren R. Cass, *Failures of American and European Climate Policy* (Albany: State University of New York Press, 2006), 37.
[780] George Bush, "Remarks at the Opening Session of the White House Conference on Science and Economics Research Related to Global Change," Gerhard Peters and John T. Woolley, *The American Presidency Project*, accessed November 7, 2021, https://www.presidency.ucsb.edu/node/264133.
[781] D. Allan Bromley, memorandum for John H. Sununu, "Carbon Problem," May 2, 1990, Bush Presidential Records: Staff and Office Files, Records on the Office of Science and Technology Policy (OSTP), Office of Science and Technology Policy, D. Allan Bromley Files, GHWB, folder "Intergovernmental Panel on Climate Change (IPCC): General [1 of 2] [1990]," 2.
[782] Ibid.

the “greenhouse effect”) of 50 percent above preindustrial levels was calculated using all greenhouse gases (i.e. methane, nitrous oxide, etc…). Carbon dioxide was thought to be responsible for half of the forcing, while the other gases together accounted for the other half, but Bromley criticized the report for misleading the public by not making it clear that the doubling included all greenhouse gases (GHGs), and not just carbon dioxide. This was no accidental mention: on the contrary, this fact aligned well with the U.S. government’s willingness to take into account all greenhouse gases when speaking of emission reductions, as opposed to focusing exclusively on carbon dioxide because of its association with fossil fuel combustion, a point that bothered the administration. Under its “comprehensive approach” to climate change, however, all sources and sinks of greenhouse gases were treated using as a baseline their warming potential relative to CO_2 (methane’s 100-year global warming potential is about 28 times that of CO_2, but methane has a much shorter lifetime in the atmosphere).

Another point that Bromley sought to underline related to the IPCC’s proposed scenarios for a doubling of atmospheric levels of carbon dioxide. According to him, the three dates corresponding to the low-, medium- and high-emission scenarios, with a doubling occurring in 2025, 2050 and 2090 respectively, were “the result of a rather arbitrary selection,” instead of a “credible, complete attempt to build these effective doubling dates from the bottom up.”[783] Bromley also criticized the fact that the high emission scenario, in which atmospheric concentrations of carbon dioxide were calculated to double by 2025, was selected as the “business as usual” scenario and the one on which analyses were based. Bromley also highlighted the role of deforestation, a favorite culprit and one for which the U.S. government could not be blamed (or less so than developing countries). Bromley wrote that “given all of the above, you have some feeling for some of the uncertainties involved […],” which he deemed serious enough to undermine “the basic thrust of the IPCC calculations” and its predictions regarding the timing for a doubling of atmospheric carbon dioxide.[784]

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783 Ibid., 3.

784 D. Allan Bromley, memorandum for John H. Sununu, “Carbon Problem,” May 2, 1990, Bush Presidential Records: Staff and Office Files, Records on the Office of Science and

After reviewing time scale predictions for a doubling of CO_2, Bromley turned to global circulation models (GCMs) and their estimates for an increase in global temperatures. Here he recognized the existence of a "general agreement in the scientific community" that the mean global temperature had indeed risen by 0.5°C since preindustrial times.[785] He did not explicitly stated whether he himself agreed with the consensus, but added that such a fact "would, therefore, fall at the low end of the model predictions if all of this warming could be attributed to anthropogenic carbon. Obviously it cannot."[786] In other words, according to him, GSMs had offered wrong and alarmist estimates, even when natural variations (such as solar radiation) were left out of the calculations. Finally, Bromley quickly mentioned the fact that IPCC calculations had also assumed that CFC emissions (which contribute to global warming) would not drop by more than 50% in developed countries. Bromley contested these assumptions, musing that "it is entirely possible that a very large fraction of the most potent CFCs will be removed from the atmosphere by about 2000," something that would move the doubling time back by a decade or more.[787] In a somewhat ironic twist, Bromley probably based these claims on the Montreal Protocol, but he made no explicit mention of the treaty, which was anathema to the Bush administration. The science advisor ended his report by stating that he had come to the conclusion that "relatively few people who have been engaged in the global warming discussions really understand what is going on with the numbers […]."[788] And indeed, his report to Sununu clearly emphasized the areas of uncertainty in climate change science, purposefully losing sight of the bigger, problematic picture.

Ahead of the fourth IPCC plenary meeting in Sundsvall, Sweden, whose main objective was to have the text of the first assessment report officially approved by all national delegations, the United States took an especially active role in the drafting of two important documents: the

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Technology Policy (OSTP), Office of Science and Technology Policy, D. Allan Bromley Files, GHWB, folder "Intergovernmental Panel on Climate Change (IPCC): General [1 of 2] [1990]," 5.

785 Ibid.

786 Ibid.

787 Ibid., 6.

788 Ibid.

executive summary and the Overview and Conclusions paper. In a letter to Bolin, the IPCC chairman, Frederick Bernthal, the chairman of Working Group 3 and the head of the U.S. delegation, expressed "concerns about tone or policy implications [which] will require that substantive revisions be made […] to the drafts of these documents."[789] What bothered the U.S. delegation in the executive summary and the Overview and Conclusions paper was the lack of emphasis on the (supposedly) vast scientific uncertainty surrounding climate change that they wanted to see reflected in all the final documents produced by the IPCC. The U.S. government had worked hard to include a high degree of skepticism and restraint in the wording of the three reports. Bernthal did not frame it in these terms, but spoke of "a balance" that the working groups had "labored" to achieve, and he said he found it "essential that the plenary documents clearly distinguish between what is known and what is projected or hypothesized."[790] The U.S. stance was hypocrite because the future impacts of climate change were mediated through computer models, and therefore necessarily hinged on projections. The science documenting the effects of greenhouse gases, however, was not an open or debatable question, and the rise in atmospheric concentrations of carbon dioxide was clearly documented thanks to Keeling's and others' continuous measurements since the late 1950s. The U.S. position missed, voluntarily or unwittingly, the crux of the matter: namely that it would be too late to act once climate change's repercussions became fully visible. In a polite but unequivocal tone, Bernthal told Bolin that he expected "a considered response to these matters […] if were are to have any hope of reaching consensus in Sundsvall," implying that the U.S. government would not endorse a report that did not represent its view for the most part.[791]

A month later, a memo drafted by a White House official one day after the start of the plenary meeting, reported that Bernthal had expressed frustration in another letter addressed to Bolin a week before the conference,

[789] Frederick Bernthal to Bert Bolin, July 5, 1990, Bush Presidential Records: Staff and Office Files, Records on the Office of Science and Technology Policy (OSTP), Office of Science and Technology Policy, D. Allan Bromley Files, GHWB, folder "Intergovernmental Panel on Climate Change (IPCC): General [1 of 2] [1990]," 1.
[790] Ibid.
[791] Ibid., 5.

lamenting the fact that "'the careful balance which was struck in the Working Groups and conveyed in their Reports has not been maintained'" in the summary for policymakers.[792] In a phone call from Sweden reported in the memo, Bernthal noted that U.S. points had a chance of being included but it was too early in the meeting to predict the final outcome. A fax sent to the Undersecretary of Commerce for oceans and atmosphere in the evening of the last day of the plenary meeting described the mayhem prompted by the heated discussions. The response strategies part of the executive summary was "being hotly debated word for word," according to the senders of the fax.[793] Conflicts between national delegations were so intractable that some delegates suggested to hold another meeting in Geneva to finalize the Overview and Conclusions paper, but Western European countries and the United States pushed for an agreement on a final and complete version of the report in Sundsvall. Two members on the U.S. negotiating team criticized the conduct of the meeting but recognized that the high number of U.S. interventions in the days before had earned U.S. delegates the title of "obstructionists" and that any intervention they made was "usually debated strongly by others."[794]

A few days after the plenary meeting in Sundsvall, Bernthal reported that the IPCC's first assessment report had been approved and that an agreement had been reached at 3.00 a.m., "despite efforts by some developing countries seemingly designed to prevent completion of [the] report […]."[795] Developing countries had sought to include provisions for financial resources

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792 Robert Corell, "Background Notes on Science and Policy Issues Related to Global Change (August 1990)," August 28, 1990, Bush Presidential Records: Staff and Office Files, Records on the Office of Science and Technology Policy (OSTP), Office of Science and Technology Policy, D. Allan Bromley Files, GHWB, folder "Intergovernmental Panel on Climate Change (IPCC): General [1 of 2] [1990]," 1.

793 J. R. Spradley and Martin Yerg, Jr., fax message for John Knauss, Undersecretary of Commerce for Oceans and Atmosphere, August 30, 1990, Bush Presidential Records: Staff and Office Files, Records on the Office of Science and Technology Policy (OSTP), Office of Science and Technology Policy, D. Allan Bromley Files, GHWB, folder "Intergovernmental Panel on Climate Change (IPCC): General [1 of 2] [1990]," 1.

794 Ibid., 2.

795 Frederick Bernthal, fax message, "IPCC 4th plenary session," September 5, 1990, Bush Presidential Records: Staff and Office Files, Records on the Office of Science and Technology Policy (OSTP), Office of Science and Technology Policy, D. Allan Bromley Files, GHWB, folder "Intergovernmental Panel on Climate Change (IPCC): General [1 of 2] [1990]," 1.

by richer countries to help them transition away from fossil fuels. Bernthal reported that the U.S. delegation had once more taken umbrage at what it considered a lack of "the careful balance struck in the underlying working group reports" and "an overstatement of what is known about the science of climate change […]."[796] The part of the report that had caused the most controversy, the Overview and Conclusions paper, was ultimately abandoned, a suggestion made by Bolin to steer discussions out of the impasse, and the executive summary was enlarged and renamed "Overview."[797] This was an important victory for the U.S. government, which had invested much effort in the revisions and rewriting of the three summaries for policymakers. The problematic paper was gone, and the executive summary (renamed "Overview") bore a distinctive U.S. imprint. Bernthal himself declared that "the final IPCC text is highly desirable because it is drawn largely verbatim from the underlying documents" over which the U.S. had held sway while they were circulated for revisions, and that "the full range of views" were included in the report.[798] The Working Group 1 report's executive summary, the most scientific report of the three, reflected the intense argument over climate change. Acknowledging both sides of the "debate," and stopping short from declaring that climate change had been detected, it stated:

> The size of this warming is broadly consistent with predictions of climate models, but 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.[799]

Additionally, the report found a similar climate sensitivity range to a doubling of atmospheric CO_2 levels as the Charney report published in 1979 (i.e. an increase in the global average mean temperature comprised between 1.5 and

[796] Ibid., 2.
[797] Ibid., 3.
[798] Ibid.
[799] Intergovernmental Panel on Climate Change, "IPCC First Assessment Report Overview and Policymaker Summaries and 1992 Supplement" (Geneva: World Meteorological Organization), 64.

4.5°C), and it determined that the world had warmed by between 0.3 and 0.6°C over the past century. The observed warming, however, could not be attributed conclusively to anthropogenic factors. As Brysse, Oreskes, O'Reilly and Oppenheimer have demonstrated, far from drawing "alarmist" conclusions, the type of consensus science produced by the IPCC has tended to err on the conservative side, notably because of the norm prescribing that scientists appear as objective, dispassionate and moderate in their conclusions as possible.[800] The report was so cautious and guarded that it bode well for the U.S. government, which had no intention of signing a highly constraining convention. From a U.S. perspective, the IPCC's first assessment report was therefore, in Bernthal's words, "a sound base from which to initiate negotiations [on the Framework Convention]."[801] In fact, the true round of negotiations had just ended. At a November 1989 hearing convened by Senators John Kerry and Al Gore, Bromley had insisted on the importance of the IPCC report, as opposed to all the scientific reports already published, because he knew that the latter represented the foundational *policy* document from which the Framework Convention would spring.[802]

4.5 The Administration Pushes Forward with its Approach to Climate Change: Shifting the Focus Away from Fossil Fuel Emissions and Prioritizing Economic Considerations

The fall of 1990 witnessed the Second World Climate Conference in Geneva. Divided in two parts, the conference opened with a scientific meeting of experts, which issued a statement on the serious risks of climate change, followed by a ministerial meeting from 137 states and the European Community (EC). As climate expert Stephen Schneider recalled in his memoir, unlike the first World Climate Conference of 1979, this one was

[800] Keynyn Brysse, Naomi Oreskes, Jessica O'Reilly, and Michael Oppenheimer, "Climate Change Prediction: Erring on the Side of Least Drama?" *Global Environmental Change* 23, no. 1 (2013): 327–337.
[801] Frederick Bernthal, fax message, "IPCC 4th plenary session," September 5, 1990, Bush Presidential Records: Staff and Office Files, Records on the Office of Science and Technology Policy (OSTP), Office of Science and Technology Policy, D. Allan Bromley Files, GHWB, folder "Intergovernmental Panel on Climate Change (IPCC): General [1 of 2] [1990]," 3.
[802] Marjorie Sun, "Global Warming Becomes Hot Issue for Bromley," *Science* 246, no. 4930 (Nov. 1989): 569.

"dominated by political leaders."[803] As Schneider explained, the conference's ministerial declaration recommended pursuing negotiations for the framework agreement on climate change but, courtesy of the U.S. delegation, made no mention of mandatory emission reduction targets.[804] Similar to what had happened in Noordwijk, the administration had pushed back against the adoption or mention of policy measures, playing the "policy actions are premature" card, and arguing that such statements in the declaration would "prejudge the outcome of the future negotiations on a framework."[805] This strategy helped the administration to buy time to torpedo the future agreement.

After the adoption of the IPCC assessment report by the U.N. General Assembly in October 1990, preparations for the Framework Convention negotiation rounds began in earnest. As the chair of the Domestic Policy Council's Global Change Strategy Group, an interagency group, Bromley was responsible for coordinating the many federal departments and agencies involved in drawing up the administration's climate change policy. Two things dominated the government's plan for the Framework Convention, both of which had found their ways into the first assessment report: the so-called comprehensive approach, which stipulated that all greenhouse gases (and not just carbon dioxide) should be taken into account when drafting global climate change policy, and the weight given to economics and economic considerations in that policy.

The comprehensive approach had one main objective, which was to diminish the importance given to fossil fuel emissions, hence shifting the focus away from the energy sector. The idea was to express emissions of each GHG in terms of a common metric, known as a carbon equivalent. As a briefing booklet explained, this "allow[ed] flexibility among all relevant

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[803] Schneider, *Science as a Contact Sport,* 126.
[804] Christopher J. Bailey, *US Climate Change Policy* (Farnham: Ashgate, 2015), 61
[805] Robert Corell, "Background Notes on Science and Policy Issues Related to Global Change (August 1990)," August 28, 1990, Bush Presidential Records: Staff and Office Files, Records on the Office of Science and Technology Policy (OSTP), Office of Science and Technology Policy, D. Allan Bromley Files, GHWB, folder "Intergovernmental Panel on Climate Change (IPCC): General [1 of 2] [1990]," 5.

gases, sources and sinks [i.e. carbon-absorbing reservoirs]."[806] In other words, the United States could announce GHG reductions simply by using policy initiatives that had become law or that it had agreed to in international settings, such as the 1987 Montreal Protocol, the Clean Air Act amendments of 1990, an initiative to plant a billion trees a year for five years incorporated in the 1991 budget request, and the National Energy Strategy, with the biggest projected reductions coming from the application of the Montreal Protocol. Taken together, these measures formed "America's Climate Change Strategy," which Bromley et al. promoted tirelessly starting in 1991, when negotiations for the Framework Convention began. This flexibility mechanism enabled the administration to adhere to the Framework Convention without having to implement any new domestic measures, especially those that could have impacted the energy sector, in what policy pundits within the administration termed a "least-cost policy."[807]

Alongside this effort, the U.S. also sought to put greater emphasis on greenhouse gases' sinks (mainly forests), as opposed to mostly considering sources when reviewing policy options, in an attempt to further lower the need for drastic cuts in carbon dioxide emissions. A report by the EPA had calculated the United States' GHG budget using the comprehensive approach and concluded that total U.S. GHG emissions would be held at 1987 levels in the year 2000, despite a 15% growth of CO_2 emissions compared to 1987 levels.[808] Stated otherwise, the comprehensive approach was a way to turn the proposed effort at reducing carbon emissions on its head, and use every tool in the policy toolbox that allowed GHG reductions while leaving intact fossil fuel emissions. In fact, the ideological opposition to carbon dioxide emission reductions was so entrenched within the White House that Bromley asked

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[806] Department of Justice, Environment & Natural Resources Division, "A Comprehensive Approach to Climate Change," Briefing to the DPC Global Change Strategy Group, November 28, 1990, Bush Presidential Records: Staff and Office Files, Records on the Office of Science and Technology Policy (OSTP), Office of Science and Technology Policy, D. Allan Bromley Files, GHWB, folder "Framework Convention on Climate Change (2) [2 of 2] [1990]," 4.

[807] Ibid., 8.

[808] Alexander Cristofaro and Joel Scheraga, Office of Policy Analysis, U.S. EPA, "Policy Implications of a Comprehensive Greenhouse Gas Budget," September 1990, Bush Presidential Records: Staff and Office Files, Records on the Office of Science and Technology Policy (OSTP), Office of Science and Technology Policy, D. Allan Bromley Files, GHWB, folder "Framework Convention on Climate Change (2) [2 of 2] [1990]," 18.

Sununu whether highlighting Bush's accomplishments in stabilizing GHG emissions (though not by targeting CO_2) would run counter to and undermine the administration's position that no scientific or economic evidence justified the implementation of CO_2 reduction targets at the global level.[809]

An article written by Bromley and published in the fall of 1990 in "Issues in Science and Technology," a journal exploring issues of public policy related to science and technology, repeated this list of policy accomplishments, which constituted the thrust of the administration's climate change policy. Written in the same cognitive dissonant voice as the report by Nordhaus, the Yale economist advocating for a business-as-usual scenario in addition to continued research on climate change, Bromley expressed frustration at "dwell[ing] so predominantly on a phenomenon—anthropogenic climate change on a global scale—that has yet to conclusively demonstrated."[810] After listing all the scientific uncertainties regarding the "magnitude, timing, rate and regional consequences of potential climate change," Bromley acknowledged that "unknowns cut both ways" and that "climate models could understate as well as over-state the extent of the problem."[811] While conceding, in convoluted language, that "these many uncertainties did not argue for inaction," he called for the adoption of "prudent" measures.[812] These included the ever-renewed calls for more research, including an annual $1 billion budget for the U.S. Global Change Research Program. Although not specific to climate change, the presidential initiative became the world's largest funding effort on that particular issue, as the law established a 10-year research plan.[813]

Outside research initiatives, Bromley promoted the set of policies already enacted or called for by the administration, which he compared to "an

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809 D. Allan Bromley and Ede Holiday, memorandum for Governor Sununu, "Climate Change Framework Convention Meeting at 9:30 Wednesday morning," January 23, 1991, Bush Presidential Records: Staff and Office Files, Records on the Office of Science and Technology Policy (OSTP), Office of Science and Technology Policy, D. Allan Bromley Files, GHWB, folder "Framework Convention on Climate Change (3) [1 of 2] [1991]," 1.
810 D. Allan Bromley, "The Making of a Greenhouse Policy," *Issues in Science and Technology* 7, no. 1 (Fall 1990): 54–55.
811 Ibid., 58.
812 Ibid., 57.
813 Paul N. Edwards, *A Vast Machine : Computer Models, Climate Data, and the Politics of Global Warming* (Cambridge: MIT Press, 2010), 394.

insurance policy" against climate change.[814] The administration was adamant that any action to mitigate the problem be deemed favorable regardless of the severity (or lack thereof) of climate change. All these measures had been or would be implemented without any consideration for climate change, and the fact that the administration chose to pin climate change onto them illustrated its utter disregard for the issue. The end of year also saw the passage of the Clean Air Act amendments of 1990, considered an important piece of legislation in U.S. environmental law. The Bush administration's "signature environmental policy effort," it helped address acid rain by imposing reductions of sulfur dioxide (SO_2) and oxides of nitrogen (NO_x) emissions; it also targeted other airborne toxic pollutants and chemicals responsible for the destruction of the ozone layer, but it left carbon dioxide out of the picture.[815]

4.6 Upending Negotiations on the U.N. Framework Convention on Climate Change: U.S. Opposition to Mandatory Targets and Timetables for CO_2 Emission Reductions

Throughout 1991, climate change policy progressed on two parallel tracks. On the international front, the administration was engaged in several rounds of negotiations for the Framework Convention, while domestically it fought to repel various amendments to the National Energy Security Act, a bill introduced by a Democratic Senator from Louisiana, John Bennett Johnston, that sought to include provisions for tackling the issue. I speak of parallel tracks because in both its international and domestic climate change policy, the administration worked hard to promote measures that addressed everything but CO_2, in order to arrive at a stabilization of CO_2 emissions in carbon equivalents, while allowing economic growth and a continued increase in these emissions. This position, however, was unpopular both at home, where the executive faced a Democratic Congress bent on curbing fossil fuel emissions, and among foreign political leaders, who complained of the obstruction caused by the United States on a convention on climate change. I will first discuss U.S. international climate change policy in the four

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[814] Bromley, "The Making of a Greenhouse Policy," 60.
[815] Matto Mildenberger, *Carbon Captured: How Business and Labor Control Climate Politics* (Cambridge: MIT Press, 2020), 105.

UNFCCC negotiation rounds that took place throughout 1991, and then turn to the domestic part of the administration's policy on climate change.

The Intergovernmental Negotiating Committee (INC), the official negotiating body, met four times throughout the year, without arriving at a consensus on the Framework Convention. The first INC meeting, held in Chantilly, VA, in February 1991, achieved very little besides establishing procedural matters. Before that meeting, in January 1991, a House committee had requested for the Department of Energy, the State Department, the EPA, and OSTP to testify on a range of global change issues. The Subcommittee on Health and Environment had sought testimonies on the official position of the U.S. government at that first INC meeting. In a memo to Sununu, Bromley explained that the State Department had refused to testify "as that could prejudice the U.S. position."[816] A few days earlier, Henry Waxman, the chairman of the subcommittee, had sent a letter to James Baker III, the Secretary of State, calling the refusal to testify "extremely distressing."[817] Waxman had also objected to the reason stated for not acceding to the subcommittee's request, namely the fact that the U.S. position on climate change was "classified," further noting that "the Administration's position is that Congress—and the public—should not be informed of the U.S. position until after the fact," and that U.S. policy on climate change was thus "formulated and executed in secret."[818]

A survey conducted at the end of 1990 had reported that sixty-nine percent of Americans believed that the United States should join other countries in reducing CO_2 emissions.[819] The administration thus probably knew its position was unpopular not just internationally but also domestically, and it did not want a Democratic majority in Congress to highlight that

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816 D. Allan Bromley, memo for Governor Sununu, "Congressional Hearings on Framework Convention," January 14, 1991, Bush Presidential Records: Staff and Office Files, Records on the Office of Science and Technology Policy (OSTP), Office of Science and Technology Policy, D. Allan Bromley Files, GHWB, folder "Environment – Global Climate Change [1991]."
817 Henry Waxman to James A. Baker III, January 10, 1991, Bush Presidential Records: Staff and Office Files, Records on the Office of Science and Technology Policy (OSTP), Office of Science and Technology Policy, D. Allan Bromley Files, GHWB, folder "Environment – Global Climate Change [1991]," 1.
818 Ibid., 2.
819 "America at the Crossroads: A National Energy Strategy Poll," *ECO* (February 19, 1991), cited by Cass, *Failures of American and European Climate Policy*, 75–6.

inconvenient fact in a public forum. In his memo to Sununu, Bromley did not directly address the issue of the administration's position running counter to U.S. public opinion but he contended that "whatever is said, a hearing will probably result in bad publicity for the Administration."[820] In another memo written a week after advising against attending the Waxman hearing, Bromley further argued that the U.S. approach to global climate change policy, namely the comprehensive approach, "has been poorly-understood and our motives have been badly misconstrued."[821] Bromley's remarks to Sununu indicate that he was nonetheless aware of the unpopularity of the administration's stance on the U.N. climate change convention.

The INC met again four months later in Geneva. Tensions arose along the North/South divide, as developing countries argued for funding by developed countries and sought exemptions from timetables for themselves. The U.S. delegation, headed by Robert Reinstein, who had replaced Frederick Bernthal as he had left the State department for the vice-presidency at the NSF, kept a low profile. As Bromley explained to Sununu, "other nations are now advancing our points of view so that we can keep a lower profile while getting what we want and operating behind the scenes."[822] The U.S climate change policy established early in the presidency was still the same: salvaging the production of CO_2 emissions without having to concede anything. Bromley's "insurance policy" had become a "no regrets" environmental policy, whereby the administration refused to take any measure that it might come to regret, should climate change turn out to be benign.[823] At this second INC meeting in Geneva, the British delegation introduced the idea of a "pledge and review" system for cutting GHG emissions, whereby each state

[820] D. Allan Bromley, memorandum for Governor Sununu, "Congressional Hearings on Framework Convention," January 14, 1991, Bush Presidential Records: Staff and Office Files, Records on the Office of Science and Technology Policy (OSTP), Office of Science and Technology Policy, D. Allan Bromley Files, GHWB, folder "Environment – Global Climate Change [1991]."

[821] D. Allan Bromley, memorandum for Governor Sununu, "Response to your request for specific points that the president might include in a welcoming address to the first negotiating session for the Framework Convention on climate change," January 22, 1991, Bush Presidential Records: Staff and Office Files, Records on the Office of Science and Technology Policy (OSTP), Office of Science and Technology Policy, D. Allan Bromley Files, GHWB, folder "Environment – Global Climate Change [1991]," 2.

[822] Ibid.

[823] C. Boyden Gray and David B. Rivkin Jr., "A No Regrets' Environmental Policy," *Foreign Policy* 83 (Summer 1991): 47–65, cited by Howe, *Behind the Curve*, 183.

would draft its own commitment to reduce its emissions and then be evaluated on its progress by an independent commission. This system allowed for a Framework Convention without any specific targets or timetables, a high point of friction between the U.S. government and European states. As for the EC, it argued for a common pledge to stabilize carbon dioxide emissions at 1990 levels by the year 2000.[824] NGOs criticized the pledge-and-review system as too lenient on polluters, while the U.S. delegation saw it as a target-and-timetable in disguise, and the idea was dropped. Negotiations reached a deadlock at the third INC meeting, held in Nairobi in September 1991, where the U.S. government found itself increasingly isolated among developed nations as it continued advocating against binding CO_2 emission reduction targets and timetables.[825]

A memo by an OSTP official to Bromley from October 1991 relayed the complaints of Robert Reinstein, the U.S. chief negotiator, about the passivity of the administration. According to the memo, Reinstein argued that "the US needs to be seen as actively participating in the process (as opposed to simply responding as we have up to this point)" and that a more active approach would benefit the U.S. government in terms of drafting a convention that matched its priorities.[826] What that memo reveals was the active dismissal of climate change within the Bush administration, and the fact that it did not need to be more active: the INC was not making any progress, and this played into its hands. No agreement was reached at what should have been the final negotiating session in December 1991, and a fifth meeting was scheduled in April 1992, a few weeks before the conference in Rio.

4.7 The OSTP's Role in Combating Climate Policy at Home and Elevating Denialism on Climate Change

[824] Cass, *Failures of American and European Climate Policy*, 57–58.
[825] William K. Stevens, "At Meeting on Global Warming, U.S. Stands Alone," *New York Times*, September 10, 1991, 1.
[826] Nancy Maynard, memorandum for D. Allan Bromley, "Reinstein request for INC strategy," October 8, 1991, Bush Presidential Records: Staff and Office Files, Records on the Office of Science and Technology Policy (OSTP), Office of Science and Technology Policy, D. Allan Bromley Files, GHWB, folder "Framework Convention on Climate Change (3) [2 of 2] [1991-92]."

I now turn to the domestic side of U.S. climate change policy throughout 1991, and the administration's legislative battle with Congress concerning energy policy. In a letter to Johnston, the chairman of the Senate Committee on Energy and Natural Resources and the sponsor of the National Energy Security bill, Bromley outlined the administration's opposition to an amendment proposed by Timothy Wirth, the Democratic Senator who had invited Hansen to testify on climate change. Wirth's amendment addressed climate change by reducing GHG emissions, aiming at a 20% reduction in the generation of carbon dioxide by the year 2005 (as recommended by a group of energy experts at the Toronto Conference on the Changing Atmosphere in 1988).[827] The explicit focus on carbon dioxide was, of course, a major point of contention. While noting the administration's support for the international Framework Convention, Bromley once again invoked the "balanced and comprehensive approach" to climate change and its considerations of all GHGs, including their sources and sinks. That approach, Bromley explained, also guided the National Energy Strategy, a mix of initiatives and proposals developed by the department of energy that, together with other federal programs, aimed at keeping *net* GHG emissions (sources minus sinks) at their 1990 levels through 2030.[828]

Bromley also took issue with the fact that the amendment's provisions "could also be interpreted as undercutting our ability to protect U.S. vital national interests in the negotiating process."[829] This was of course a highly convenient and self-serving move for the administration, which strived to neutralize the most potent aspects of climate change policy, namely the reduction of CO_2 emissions, at the national and international political levels. In an attempt to kill two birds with one stone, so to speak, the U.S. government invoked the superiority of the Framework Convention compared to a domestic bill such as the one introduced by Johnston, while working hard

[827] "Amendment NO. WIRTH #1," May 6, 1991, Records of the Office of Science and Technology, NARA, Office files 1989 – 2000, box 4, folder "CONGRESSIONAL – JOHNSTON, B. re National Energy Strategy – Wirth Amendment (5/7/91)," 1; on the Toronto Conference, see chapter 4, 26-29.

[828] D. Allan Bromley to J. Bennett Johnston, May 7, 1991 Records of the Office of Science and Technology, NARA, Office files 1989 – 2000, box 4, folder "CONGRESSIONAL – JOHNSTON, B. re National Energy Strategy – Wirth Amendment (5/7/91)," 1.

[829] Ibid., 2.

to empty the future convention of its substance, namely the provision on specific emission reduction targets and timetables for fossil fuels. Bromley justified the administration's "market-based and flexible" approach as a way to avoid "the painful and costly mistakes of 1970s-type energy policies."[830] A year later, at the Rio Conference, Bush exclaimed that "the American way of life is not up for negotiation," drawing a parallel between CO_2 release and high living standards (for some, but not all U.S. citizens).[831] In the end, the NES allowed fossil fuel exploration in the Arctic National Refuge in Alaska, as well as other deregulation measures in the electric utility industry and in the oil and gas sectors.[832] The NES was aimed at reducing U.S. dependence on oil imports by increasing domestic supply instead of supporting the development of non-carbon energy sources, which would translate into higher CO_2 emissions, thereby losing an opportunity to address climate change through a revised approach to energy production.

Another important aspect of the domestic side of U.S. climate change policy as negotiation rounds succeeded one another throughout the first half of 1991, was the active search by Bromley and Sununu for "alternative" scientists whose views on climate change departed significantly from the IPCC consensus. The search appears to have been at least partly triggered by the publication of yet another NAS report. Released in April 1991, *Policy Implications of Greenhouse Warming* counted many climate change skeptics and climate change "enthusiasts" who saw (or claimed to see) more benefits than harm in global warming.[833] Led by a former Senator from Washington, Daniel Evans, the "synthesis panel" (named as such because it was tasked with producing a synthesis of the four panels' detailed reports) consisted of twelve experts, none of them with formal training in atmospheric physics, except for Stephen Schneider, who worked at the National Center for Atmospheric Research and had been a vocal critic of governmental inaction on climate change under the Reagan administration. Schneider clearly stood

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830 Ibid.
831 Schneider, *Science as a Contact Sport*, 133.
832 Cass, *Failures of American and European Climate Policy*, 77.
833 National Academy of Sciences, Committee on Science, Engineering, and Public Policy, Synthesis Panel, *Policy Implications of Greenhouse Warming* (Washington D.C.: The National Academies Press, 1991).

out among the economists, zoologists and engineers, and he must have been the only one calling climate change a serious threat and urging for a coordinated policy plan. The panel also included William Nordhaus, the economist who advocated against policy measures on economic grounds. Mirroring the composition of its panel, the report offered a much watered-down assessment of the threat, and a rather long list of potential environmental benefits in a warming world. The report concluded that the United States could reduce its GHG emissions by 10 to 40 percent below 1990 levels at very low economic cost, through a combination of policies including: raising energy prices, improving automobile and building efficiency, increasing mass public transport, collecting landfill gas, slowing deforestation and encouraging reforestation efforts at home and abroad.[834]

In spite of this, Bromley told Sununu that the report "advocates a more activist response to a projected greenhouse effect—beyond the 'insurance policy' approach that we have taken thus far."[835] Bromley (and Republicans in general) abhorred the idea of having "some centralized control mechanism" in charge of implementing policy measures.[836] That being said, Bromley also stated that the report "is very parallel to the position of this Administration in a great many of its statements [sic]" and he therefore insisted that the administration be "supportive overall" of the report.[837] In that short memo to Sununu, Bromley did not elaborate on the reason for his plea to concur with the report's findings, but it probably stemmed from his knowing that the administration found itself isolated on the issue, both on the international stage and at home, confronted by a Democratic majority in both chambers of Congress.

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[834] National Academy of Sciences, *Policy Implications of Greenhouse Warming*, 63.
[835] D. Allan Bromley, memorandum to Governor Sununu, "The NRC Evans Report," April 8, 1991, Bush Presidential Records: Staff and Office Files, Records on the Office of Science and Technology Policy (OSTP), Office of Science and Technology Policy, D. Allan Bromley Files, GHWB, folder "Environment – Global Climate Change [1991]."
[836] Quoted in Michael Weisskopf, "Strict Energy-Saving Urged to Combat Global Warming," *The Washington Post*, April 11, 1991, cited by Bailey, *US Climate Change Policy*, 62.
[837] D. Allan Bromley, memorandum to Governor Sununu, "The NRC Evans Report," April 8, 1991, Bush Presidential Records: Staff and Office Files, Records on the Office of Science and Technology Policy (OSTP), Office of Science and Technology Policy, D. Allan Bromley Files, GHWB, folder "Environment – Global Climate Change [1991]."

Sununu probably resented the fact that the administration appeared to subscribe to an ostracized position, and he decided to elevate contrarian voices on the matter. Against Bromley's recommendation, he ordered the science advisor to find a group of scientists who would publicly oppose the NAS report's findings. In a memo to Bromley, an OSTP official listed several scientific "skeptics" who had actively participated in the "debate" on climate, arguing against what she called "the popular view—'the Popular Vision'—(IPCC science and/or potentially very negative effects)."[838] The term popular referred to underlined the fact that the IPCC perspective was held by a majority of scientists, but it also served to discredit it as if it were some folk tale. Twenty-four scientists had attended a conference in October 1990 entitled "The Popular Vision is Wrong," in which they had sought to develop a research agenda "to explore the '[…] emerging view of neutral or possibly beneficial change […]" as the threat of climate change "is becoming more remote[…].'"[839] The OSTP official recommended inviting eight of these scientists to a meeting at the White House. Four of them, Richard Lindzen, Fred Seitz, Robert Jastrow and William Nierenberg worked for the George C. Marshall Institute; Patrick Michaels was an agricultural climatologist by training and a professor at the University of Virginia; Hugh Ellsaesser a meteorologist at the Lawrence Livermore National Laboratory; Andrew Solow, an environmental statistician at the Woods Hole Oceanographic Institution; and Reginald Newell, a professor of meteorology at the MIT, had postulated the existence of an evaporative mechanism in the equatorial waters that would counterbalance global warming, a hypothesis refuted by Exxon's own scientists.[840] Bromley came around Sununu's idea of enlisting contrarian scientists to oppose the NAS report but he recommended discretion: above all, he wanted to avoid any scandals, fearing that the media might portray the

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[838] Nancy Maynard, memorandum for D. Allan Bromley, "Scientific Skeptics on Global Warming," April 17, 1991, Bush Presidential Records: Staff and Office Files, Records on the Office of Science and Technology Policy (OSTP), Office of Science and Technology Policy, D. Allan Bromley Files, GHWB, folder "Environment – Global Climate Change [1991]."
[839] Ibid.
[840] See chapter 3, 197.

meeting as a "'White House draft [of] right-wing elements to combat [the] Evans report."[841]

The meeting took place on June 5, 1991, as the scientists had gathered in the capital for a conference organized by the Cato Institute, a libertarian think-tank co-founded by the billionaire and oil magnate Charles Koch, entitled "Global Environmental Crises : Science or Politics ?" The list of invited scientists had shrunk to five, with Lindzen as the sole representative of the Marshall Institute and Newell being replaced by Robert Balling, a professor of geography at Arizona State University, but only four attended the meeting (Ellsaesser was giving a talk at the same time at the Cato conference).[842] During the hour-and-a-half meeting, which took place in Sununu's own office, the chief of staff asked the scientists several rounds of questions that all related to the idea of strengthening the "alternative" view on climate change. He asked about science that "addresses a more conservative approach to global warming" and sought to understand how to "make a more aggressive hard sell toward this more conservative view."[843]

As the minutes of the meeting make clear, Sununu was not being informed of breakthrough studies that contradicted the bulk of climate change science: he was looking for allegedly scientific credibility to support his and the administration's entrenched view on the issue. He was also looking for ways to elevate these contrarian claims, whatever their intrinsic scientific values, and to give more power to the supposedly discriminated side of the debate. There was, of course, no "debate" on climate change, merely hypotheses awaiting confirmation and areas where more research was

[841] D. Allan Bromley, memorandum to John H. Sununu, "Possible Group from whom to Obtain reaction to the NAS/Evans Report," April 18, 1991, Bush Presidential Records: Staff and Office Files, Records on the Office of Science and Technology Policy (OSTP), Office of Science and Technology Policy, D. Allan Bromley Files, GHWB, folder "Environment – Global Climate Change [1991]."
[842] For a quick overview of the scientific background, publications and role in the denial movement of several high-profile deniers (Michaels, Balling, Singer and Lindzen), and especially of the funds they have received from the fossil fuel industry, see Ross Gelbspan, *The Heat Is on: The Climate Crisis, the Cover-up, the Prescription* (Reading, PA: Perseus Books, 1998), 33–61.
[843] D. Allan Bromley, memorandum for Governor Sununu, "Meeting with Global Change Scientists," June 3, 1991, Bush Presidential Records: Staff and Office Files, Records on the Office of Science and Technology Policy (OSTP), Office of Science and Technology Policy, D. Allan Bromley Files, GHWB, folder "Global Warming: Sununu Meeting with Global Change Scientists, 6/5/91."

needed. That was not what Sununu saw in climate change science, however, as he stated to his audience that "the world should not be making trillion dollar decisions on 25 cents worth of information."[844] Records do not reveal Sununu's intrinsic motivation for seeking out and promoting the views of these so-called contrarian scientists. In trying to discern their motives for advancing climate change denial starting in the late 1980s, Oreskes and Conway argue that recognizing the failures of capitalism in dealing with externalities (i.e. waste or pollution in its various forms) would have been "ideologically-shattering," something too damaging to these scientists' system of beliefs to be integrated without compromising the whole structure.[845] Unable and unwilling to change their *Weltanschauung*, which had been shaped by the Cold War and decades of a relentless fight against communism, they chose to deny the reality of the culprit, namely climate change. Sununu declared in a 2000 oral history interview that "environmental issues [should not] become surrogates for anti-growth."[846] Knowing this, it appears plausible that "market fundamentalism," which views environmental and other types of regulations as unwarranted governmental interference with the market, also animated Sununu's quest for discrediting climate science.[847]

Throughout the meeting, the invited scientists complained of being unjustly discriminated against, whether in their requests for funding or in the peer reviews of their work. Another of their complaints pertained to the prejudice they felt animated federal science funding agencies such as the NSF which, according to Lindzen, approached the issue "with bias that something deleterious is going to happen."[848] Someone noted that one of the most

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[844] "Notes from meeting between Governor Sununu and Global Change Scientists from the CATO Institute Global Warming Conference," Bush Presidential Records: Staff and Office Files, Records on the Office of Science and Technology Policy (OSTP), Office of Science and Technology Policy, D. Allan Bromley Files, GHWB, folder "Global Warming: Sununu Meeting with Global Change Scientists, 6/5/91," 1.
[845] Erik M. Conway, *Atmospheric Science at NASA : A History* (Johns Hopkins University Press, 2008), cited by Naomi Oreskes, and Erik M. Conway, "Challenging Knowledge: How Climate Change Became a Victim of the Cold War," in *Agnotology: The Making and Unmaking of Ignorance*, ed. Robert N. Proctor and Londa Schiebinger (Stanford University Press, 2008), 80.
[846] John H. Sununu Oral History, June 8-9, 2000, Miller Center, University of Virginia, accessed October 18, 2022, https://millercenter.org/the-presidency/presidential-oral-histories/john-h-sununu-oral-history-062000.
[847] Oreskes and Conway, "Challenging Knowledge: How Climate Change Became a Victim of the Cold War," 78.
[848] Ibid., 3.

important battles to come would be "the battle for the public minds."[849] And indeed Sununu repeated a number of times that getting the alternative point of view treated on equal footing as mainstream science in the media was crucial. What mattered was "good showmanship" and the "look of quality" to achieve success in spreading the message.[850] Sununu also noted that "repetition is important in getting our message across—we need to say it over and over."[851]

Sununu was busy spreading the gospel of climate skepticism on other fronts as well, most notably in Congress. A few weeks after the meeting with the Cato Institute's scientists, Sununu received a handwritten note from Don Ritter, a Republican member of the House Subcommittee on the Environment. In a memo shared with Sununu, Ritter appeared quite incensed by the NAS report whose appropriation had come from Wirth and Gore, the Democratic senators most engaged on climate change. Speaking of a weekend retreat at Woods Hole for NAS scientists, Ritter explained that the "'favorably disposed (to global warming) outnumbered skeptics (on the panels) big time," and he suggested convoking a hearing to discuss the "pros and cons of the science."[852] In Ritter's views, the Academy was mostly composed of "nice social scientists who see this as the Big Buck Bonanza for research […]."[853] Sununu replied personally, encouraging him to "keep fighting the good fight!"[854]

Although initially reluctant to publicly support climate change deniers, Bromley decided to side with Sununu. In a speech he gave at John Hopkins University, Bromley described himself as "an honest broker for the scientific information on global change," and he explained that his job

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849 Ibid., 6.
850 Ibid., 5.
851 Ibid., 8.
852 Don Ritter, typed notes to Joel Eisen, "Global Warming: NAS Report; Observations following the July 21, 1991 Woods Hole Conference, July 23, 1991, Bush Presidential Records: Staff and Office Files, Records on the Office of Science and Technology Policy (OSTP), Office of Science and Technology Policy, D. Allan Bromley Files, GHWB, folder "Executive Office of the President: Sununu Tracking."
853 Ibid.
854 John H. Sununu, note to Don Ritter, August 5, 1991, Bush Presidential Records: Staff and Office Files, Records on the Office of Science and Technology Policy (OSTP), Office of Science and Technology Policy, D. Allan Bromley Files, GHWB, folder "Executive Office of the President: Sununu Tracking."

included "provid[ing] some sense of how reliable that information is."[855] His stated impartiality appears to have existed in name only: indeed, the "solid scientific foundation" he invoked to resist efforts to mandate CO_2 emission reductions was none other than an article by Revelle published shortly before his death in July 1991. As Oreskes and Conway have shown, the publication, which appeared in *Cosmos*, a non-peer-reviewed magazine, was in fact the brainchild of S. Fred Singer, who had authored most of the paper himself and taken advantage of Revelle at a time when he was especially vulnerable, having suffered a severe stroke episode.[856] The article, which Bromley quoted in his speech, asserted that "the scientific base for a greenhouse warming is too uncertain to justify drastic action at this time."[857] As Oreskes and Conway argue, nothing in Revelle's records indicate that he had changed his mind on climate change and come to view it as a benign, natural phenomenon. But this

[855] Nancy Maynard, memorandum for Cam Findlay, "Status Report on US Global Change Policy Development," Appendix "speech by Dr. Bromley," January 13, 1992, Records of the Office of Science and Technology, NARA, Office files 1989 – 2000, box 4, folder "Global Climate Change Policy: Development Status Report," 1. The records I consulted do not mention the date of the speech. But a copy of the speech was included in a memo by one of Bromley's assistants dated January 13, 1992, and from the information disclosed in the speech, I can say that it appears to have been delivered between November 1991 and early January 1992.

[856] Oreskes and Conway, *Merchants of Doubt,* 190–197. This was not the first time Revelle was listed as the co-author of a "skeptical" paper on climate change. In 1988, he wrote a summary on climate change and U.S. water resources with Paul Waggoner, a scientist at the Connecticut Agricultural Experiment Station in New Haven (where he still works to this day). At the time of publication, Waggoner was the chairman of the AAAS Panel on Climate Variability, Climate Change and the Planning and Management of U.S. Water Resources, and Revelle the chairman of the AAAS Committee on Climate. We do not know how much Revelle contributed to the summary paper, which certainly did not read like him ("Climate change has not yet secured a lasting position on the agenda. The question is whether its seriousness will win that position despite its uncertainty, un-soon-ness and lack of easy solution and visible villain"), and whether he was cited as a co-author because of his role as chairman of the AAAS climate committee. AAAS Panel on Climatic Variability, Climate Change and the Planning and Management of U.S. Water Resources, Paul Waggoner, Panel Chairman and Roger Revelle, Chairman, AAAS Committee on Climate, "Summary," September 27, 1988, Roger Revelle papers, Special Collections & Archives, UC San Diego (UCSD), La Jolla, CA, box 137, folder "AAAS Climate Project, 1978-1988 pt. 3 of 5," 32. The book in which the summary appeared listed Waggoner as the sole editor: Paul E. *Waggoner*, ed., *Climate Change and U.S. Water Resources* (New York: Wiley, 1990). Waggoner's main argument was that greater levels of atmospheric CO_2 would contribute to increased vegetation and crop yields. He repeated these claims in the NAS 1991 study, for which he chaired the panel on adaptation. As of November 2021, Waggoner does not seem to have changed his views: he is listed as a "policy expert" at the Heartland Institute, a libertarian think-tank engaged in climate change denial.

[857] Nancy Maynard, memorandum for Cam Findlay, "Status Report on US Global Change Policy Development," speech by Dr. Bromley, Appendix, January 13, 1992, Records of the Office of Science and Technology, NARA, Office files 1989 – 2000, box 4, folder "Global Climate Change Policy: Development Status Report," 8.

was too good to be ignored, and Bromley must have been eager to quote one of the most respected scientist on the subject to back up his claims, lauding the *Cosmos* article as “a welcome balance in the ‘sky is falling’ rhetoric all too common elsewhere […].”[858] In the persons of Jastrow, Nierenberg, Seitz and Singer, and many others, the industry had just begun to organize itself into a powerful countermovement, but it was clearly encouraged to proceed by people at the highest echelons of the government.

4.8 The U.S. Delegation Achieves its Objective and Obtains A Weakened Framework Convention

Negotiation rounds throughout 1991 had reached a stalemate, and six months before the Rio Summit, the fate of the Framework Convention on climate change was far from certain. Within the science advisor’s office, things were not rosy either. In an internal report on the status of the U.S. government’s global climate change policy from January 1992, an OSTP official recognized that “this is a very difficult issue,” and one that could harm Bush’s reelection prospects.[859] The official also conceded that “the US is in a very difficult position because the President and the US are viewed by many in this country and internationally as obstructing the success of (UNFCCC negotiations and the UNCED).”[860] The OTSP official explained that policy development in that area “has been difficult at best” because of the “very wide spectrum of opinion within the Administration on this issue” as well as the “significant uncertainties in the science of climate change.”[861] Throughout the report, the author’s comments revealed a serious lack of interest for both the Framework Conventions and the Rio Summit within the White House, something Bromley had already noted in a memo to Sununu in March 1991, in which he had stated that there was “a greater need for White House supervision.”[862]

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858 Ibid., 9.
859 Ibid. 1.
860 Ibid.
861 Ibid., 2.
862 D. Allan Bromley and Ede Holiday, memorandum for Governor Sununu, “Preparation for the 1992 U.N. Conference on Environment and Development,” March 22, 1991, Bush Presidential Records: Staff and Office Files, Records on the Office of Science and Technology Policy (OSTP), Office of Science and Technology Policy, D. Allan Bromley Files, GHWB, folder “Environment – Global Climate Change [1991].”

This was a mistake, according to the OSTP official, as the conference would be "a huge media event," and while the United States was "late in the game," it could still regain a leadership position.[863] The official concluded her report by calling for the crafting of "a winning strategy for US participation" in Rio.[864]

No such strategy was devised, and only a last-minute intervention by the British delegation after the fifth INC meeting managed to rally U.S. negotiators over a common text. A draft text of the convention, making no mention of targets and timetables, was adopted on May 9, 1992, yet Bush waited until three days before the conference to announce his decision to attend.[865] Organized on the twentieth anniversary of the Stockholm conference, which established the United Nations Environment Program (UNEP), the UNCED considered a wide range of environmental issues besides climate change: land resources, toxic wastes, oceans and coastal areas, and biodiversity. The Framework Convention received almost all of the media attention, but there were two other treaties open for signature at the Conference, one convention aimed at combatting desertification, and the other one being the Convention on Biological Diversity (which Bush refused to sign). The Conference also produced Agenda 21 (an action plan based on the concept of sustainable development) and the Rio Declaration on Environment and Development.

The objective of the Framework Convention, a non-binding international treaty, was the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system."[866] The Bush administration had gotten its way, and the convention contained no mandatory greenhouse gas emission reduction targets, but instead established voluntary goals for stabilizing

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863 Nancy Maynard, memorandum for Cam Findlay, "Status Report on US Global Change Policy Development," January 13, 1992, Records of the Office of Science and Technology, NARA, Office files 1989 – 2000, box 4, folder "Global Climate Change Policy: Development Status Report," 4.

864 Ibid.

865 Cass, *Failures of American and European Climate Policy*, 58 ; Byron W. Daynes and Glen Sussman, *White House Politics and the Environment: Franklin D. Roosevelt to George W. Bush*, (College Station: Texas A&M University Press, 2010), 167.

866 Joshua P. Howe, *Making Climate Change History : Primary Sources from Global Warming's Past* (Seattle: University of Washington Press, 2017), 233.

concentrations (but said nothing of emissions). One of the most contentious points during the negotiations had been the question of economic aid to help developing countries move away from fossil fuels, something the United States opposed. For the sake of compromise, the convention differentiated between states, with members of the Organization for Economic Co-operation and Development (OECD) and former Soviet Republics falling under an "Annex I" rubric, which directed them to finance their energy transition themselves. Additionally, the richest among Annex I countries would also help poorer nations to reduce their emissions. Signatories of the treaty agreed to draft national inventories of their GHG emissions, and emission reductions were left for future rounds of negotiations, at annual convenings known as a Conference of the Parties (COP), where a future climate protocol could be established. The convention adopted the comprehensive approach so fervently promoted by the United States, but it referred to all greenhouse gases "not controlled by the Montreal Protocol," and thus avoided the double-counting distortion.[867] The Framework Convention was ultimately signed by 165 states and it entered into force in early 1994.

The U.S. Senate ratified the treaty in October 1992, making the Framework Convention U.S. law. Deprived of any enforcement mechanisms and binding limits on emissions, the convention was so hollow, however, that even the GCC called for it to be ratified. At a Senate hearing before the Foreign Relations Committee, Michael Baroody, the chairman of the coalition, stated that the convention put forward "important principles that we consider essential to a sound approach to the climate change issue […]."[868] That same month, Congress also passed the National Security Act, the pinnacle of a long debate on national energy policy that had spanned Bush's single term. At the heart of the debate were questions of domestic oil production (notably the opening of Alaska's Artic National Wildlife Refuge to oil drilling), fuel efficiency standards for vehicles and national energy

[867] Howe, *Making Climate Change History*, 234.
[868] John Schlaes, press release, September 18, 1992, CF, 1.

security. Climate change had not featured prominently in the debate and, consequently, the act did not tackle CO_2 emissions.[869]

4.9 "No Choice but to Enter the Fray:" The Fossil Fuel Industry's Mounting Offensive[870]

The private records retrieved by reporters at the *Los Angeles Times* and *Inside Climate News* for their respective investigations into Exxon's approach to climate change mostly document the Carter and Reagan eras. We therefore do not have a similarly broad overview of the company's handling of the issue under the Bush administration. However, other private records that have been made available to the public on platforms such as the Climate Files offer a kaleidoscope of the various industry-sponsored front groups and lobbies at work against climate change policy, including the now defunct Center for Environmental Information and the Information Council on the Environment, as well as more established organizations, such as the American Petroleum Institute (API), the Western Fuel Association and the Cato Institute.[871] These records also document the rise of the most prominent U.S. actor in the climate change denial campaign, namely the Global Climate Coalition (GCC).[872]

[869] James Morton Turner and Andrew C. Isenberg, *The Republican Reversal: Conservatives and the Environment from Nixon to Trump* (Harvard University Press, 2018), 154.
[870] Western Fuels Association, 1991 Annual Report, CF.
[871] Judith Layzer also cites the U.S. Chamber of Commerce as another lobbying organization funded by fossil fuel interests to sow doubt on climate change (but so far none of their records have been published on digital platforms), in Judith A. Layzer, "Deep Freeze: How Business Has Shaped the Global Warming Debate in Congress, in *Business and Environmental Policy: Corporate Interests in the American Political System*, ed. Michael E. Kraft and Sheldon Kamieniecki (Cambridge: MIT Press, 2007), 99. The Information Council on the Environment was founded in 1991 by the National Coal Association, the Western Fuel Association and the Edison Electric Institute, the largest utility trade association. See Naomi Oreskes, "My Facts are Better than Your Facts: Spreading Good News about Global Warming," in *How Well Do Facts Travel?*, ed. Mary S. Morgan and Peter Howlett (Cambridge University Press, 2010), 136–166. Other groups have sprung up during the George W. Bush administration, such as Americans for Prosperity, a pseudo-grassroots organizations and one of many entities funded by the Koch network's "dark money." The Koch industries, the second-largest private company in the United States, makes most of its revenue from fossil fuel products and services. See American investigative journalists' books: Jane Meyer, *Dark Money: The Hidden History of the Billionaires Behind the Rise of the Radical Right* (New York: Penguin, 2016) and Christopher Leonard, *Kochland: The Secret History of Koch Industries and Corporate Power in America* (New York: Simon & Schuster, 2019).
[872] All primary source documents are accessible on The Climate Files database (abbreviated as "CF" in subsequent references) at: https://www.climatefiles.com/collection-index/. Robert Brulle, an environmental sociologist who has worked extensively on the climate denial countermovement, has offered a detailed historical account of the GCC from its

Founded in June 1989 under the aegis of the National Association of Manufacturers, the GCC was a consortium of trade organizations and individual corporations active in the fossil fuel industry, such as the automobile-, the petrochemical- and the mining industries.[873] Exxon only formally joined the GCC in 1992, although the API, of which it was part, was mentioned in a 1989 membership list.[874] The GCC remained active until its dissolution in 2001, after several corporations rescinded their membership following mounting public pressure, but not before it succeeded in thwarting international efforts at curbing emissions.

This section is divided in two: the first part focuses on Exxon's approach to climate change in the early years of the Bush administration, while the second part reviews the professionalization of private interest groups, and of the GCC in particular, which allowed it to launch an offensive against domestic and international attempts at regulating fossil fuel emissions.[875]

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founding to its demise, in Robert J. Brulle, "Advocating Inaction: a Historical Analysis of the Global Climate Coalition," *Environmental Politics* (2022): 1–22, available at: https://doi.org/10.1080/09644016.2022.2058815.

[873] Brulle's research shows that the oil and gas sector made up about 14 to 18 percent of the total membership of the GCC, with the utility, coal, steel and rail sectors accounting for about half of all members. Yet all the major oil companies were represented through the API, their trade organization. Brulle, "Advocating inaction," 6–7.

[874] Katie Jennings, Dino Grandoni, and Susanne Rust, "How Exxon Went from Leader to Skeptic on Climate Change Research," *Los Angeles Times*, Oct 23, 2015.

[875] Except for Oreskes and Conway's work, sociologists more than historians have studied the conservative climate change denial countermovement in the U.S. See Justin Farrell, "Network Structure and Influence of the Climate Change Counter-Movement," *Nature Climate Change* 6 (2016): 370–374; Robert J. Brulle, "Institutionalizing Delay: Foundation Funding and the Creation of the U.S. Climate Change Counter-Movement Organizations, *Climatic Change* 122 (2014): 681–694; Leah Ceccarelli, "Manufactured Scientific Controversy; Science, Rhetoric, and Public Debate," *Rhetoric and Public Affairs* 14 (2011): 195–228; Robert Antonio and Robert J. Brulle, "The Unbearable Lightness of Politics: Climate Change Denial and Politics Polarization," *Sociological Quarterly* 52 (2011): 195–202. Popular and journalistic accounts of the phenomenon include Jane Meyer, *Dark Money: The Hidden History of the Billionaires behind the Rise of the Radical Right* (New York: Penguin, 2016); Shawn Otto, *The War on Science: Who's Waging it, Why it Matters, What we Can Do about It* (Minneapolis: Milkweed Editions, 2016); Naomi Klein, *This Changes Everything: Capitalism Vs. The Climate* (New York: Simon Schuster, 2014); Washington Hayden and John Cook, *Climate Change Denial: Heads in the Sand* (New York: Taylor & Francis, 2011); James Hoggan and Richard Littlemore, *Climate Cover-Up* (Vancouver: Greystone Books, 2009); Ross Gelbspan, *Boiling Point; How Politicians, Big Oil and Coal, Journalists and Activist Are Fueling the Climate Crisis – and What We can Do to Avert Disaster* (New York: Basic Books, 2004); ––, "*The Heat is On: The Climate Crisis, the Cover-Up, the Prescription* (Reading, MA: Perseus Books, 1998).

A month after the inauguration of the new administration, Duane Levine, Exxon's manager of science and strategy development, gave the company's board of directors a presentation titled "potential enhanced greenhouse effects: status and outlook," attesting to the continued relevance of the issue at the highest echelons of the company.[876] At this point, however, the focus was on refuting the validity of the global warming claim, as opposed to studying it as Exxon scientists had done starting in 1979. Devine opened his talk by declaring that "the greenhouse effect is real [...] without it current life could not exist," but emphasized that what preoccupied scientists was the "potential enhanced greenhouse (PEG)."[877] Speaking of an "enhancement" of that effect allowed him to insist on the so-called natural character of the phenomenon, downplaying any potentially disastrous consequences of unchecked global warming, and it set the tone for the rest of his exposé. Levine concluded his introduction by insisting that "in spite of the rush by some participants in the greenhouse debate to state that the science has demonstrated the existence of PEG today, I do not believe such is the case. Enhanced greenhouse is still deeply imbedded in scientific uncertainty, and we will require substantial additional investigation to determine the degree to which its effects might be experienced in the future."[878] What interested Exxon directors first and foremost was the policy implications of climate change, which they knew were intimately tied to the status of climate change science. As Levine explained, "policy initiatives are being advanced now and they could well outpace scientific progress."[879] It was therefore important to echo the message that science was mired in uncertainty, preventing lawmakers from drafting legislation.

Despite his implicit aim of highlighting areas of doubt, Levine's presentation offered a solid discussion of the atmospheric systems underlying climate change. He was also unmistakably engaged in deflecting blame from the fossil fuel industry for the role of carbon dioxide in global warming by

[876] Kramer, *Carbon Criminals*, 71.
[877] Duane G. Levine, "Potential Enhanced Greenhouse Effects: Status and Outlook," Presentation to the Board of Directors of Exxon Corporation, February 22, 1989, The Climate Files (CF), 1.
[878] Ibid.
[879] Ibid., 2.

evoking other GHGs such as water vapor and the ozone-destructive CFCs. His main contribution, however, focused on discrediting scientific models used to describe the future consequences of global warming on the climate and, by extension, on the biosphere, a strategy that Exxon had capitalized on as early as 1982, when it had decided that models required less investment and they yielded better results, that is to say, they allowed Exxon scientists to challenge academic physicists' claims. As Levine put it, "the difficulty in predicting climate change [owed to scientists'] capabilities to understand and model the response of climate [to greenhouse gases]," given the climate system's many components and their reaction to multiple changes in the system (increased water vapor, cloud formation, ocean currents among many other factors).[880]

Although Levine asserted that fossil fuels constituted the primary source of CO_2 emissions, he also stated that global temperatures showed "only slight warming not enough to confirm enhanced greenhouse."[881] He also relayed some of the industry's fears by speaking of a "pattern […] rooted in the evolution of the just-completed Montreal Protocol […]."[882] Levine went on to explain that the scientific discovery of the role of CFCs in damaging the ozone layer might not have led to the measures adopted at the Vienna Convention, had it not been for the discovery of the "ozone hole" over Antarctica. That "critical event," in Levine's view, was the drought experienced by the United States in 1988.[883] Levine singled out three flaws or "misconceptions" in drawing a parallel between climate change and ozone depletion. Two of the misconceptions had to do with the feasibility of phasing out fossil fuels and switching to an alternative energy system. But one of the misconception denounced by Levine had to do with research and the idea that enough was known for the government to act, which could "lead to premature limitations on fossil fuels."[884] Levine deplored "arguments that we can't tolerate delay and must act now" which, he said, led to "irreversible and costly

880 Ibid., 10.
881 Ibid., 22.
882 Ibid., 27.
883 Ibid., 29.
884 Ibid.

draconian steps."[885] Levine also criticized the "'crisis mentality'" he detected among scientists and the media, and he called for "more rational responses [that] will require efforts to extend the science and increase emphasis on costs and political realities […]."[886] Other measures he cited included "energy conservation, restriction of CFC emissions, and efforts to increase the global ration of re/deforestation."[887] None called for a phasing out of fossil fuels.

Connections, an in-house publication from Exxon's research and engineering division, published a short article in the fall of 1989 by Brian Flannery, Exxon's chief scientist in climate modeling, who had written a contribution for the Department of Energy's state-of-the-art publication discussed in chapter three.[888] Unlike the DoE publication, this was not a scientific article, but most probably of one the many pieces penned by Exxon researchers on climate change and intended for widespread distribution within the company. The article, soberly titled "Greenhouse science," offers an interesting parallel with Levine's presentation to the board of directors, in that it also swings between two polar opposites, namely acknowledging the science rather fairly on one hand, yet rejecting its logical conclusions on the other. This was also the strategy Flannery employed in his chapter for the DoE publication four years earlier, and one that Exxon would favor, at least in the early years of its campaign of denial. Indeed, a complete repudiation of climate change science would not have looked as an earnest input to the "debate" on climate change and it may well have backfired. Showcasing restrained skepticism, however, proved an efficient method to sow doubt, both on the veracity of climate change as an actual phenomenon and on the appropriate policy measures required to address the problem. In the article, Flannery explained that he had been "asked to study the enhanced Greenhouse Effect" because it was believed in 1980 that "this issue would some day have profound important for the petroleum industry."[889] Symptomatic of the tenuous thread he was following, Flannery stressed that "the idea that man might change the atmosphere enough to alter climate is

[885] Ibid., 31.
[886] Ibid., 32.
[887] Ibid., 33.
[888] See chapter 3, 206-208.
[889] Brian Flannery, "Greenhouse Science," *Connections,* Fall 1989, CF.

neither obvious nor preposterous [but] a fit subject of scientific inquiry," so as to place the issue within the safe confines of scientific research and let it rest there, immune to political, economic or moral probing.[890] The rest of the article was replete with a careful acknowledgement of the problem posed by fossil fuel emissions, while insisting on the ocean of uncertainties surrounding the issue and the severity of climate change. For instance, Flannery recognized that "concentrations of trace atmospheric gases are growing at a rate that could impact human and natural systems through global warming and associated climate change," but in the next sentence hastened to say that "modeled projections are far from certain: potential impacts could be small and manageable or they could be profound and irreversible."[891] In 1989, a year after Hansen's Senate testimony, all serious atmospheric models were pointing towards catastrophic change, even if these were not expected in the immediate future. Flannery explained that in-house models were to "serve as a tool to analyze the effectiveness of proposed policies to limit [climate] change." Indeed, in Flannery's opinion, "impacts on Exxon will come sooner from society's efforts to reduce potential risks from climate change than from change itself," a statement that appears to have been meant to justify Exxon's attempts at campaigning against the adoption of domestic and international measures to curb emissions.[892]

If the "enhanced greenhouse effect" was on Exxon's radar in the early 1990s, it ranked lower than other environmental concerns that could prove potentially disruptive to its business. An internal memo from Exxon's department of Public Affairs including the draft of a 1990 shareholders' environmental report listed a dozen of such issues, including soil contamination, water and air pollution, as well as occupational safety measures related to operational accidents and environmental hazard. What a corporation discloses to its shareholders constitutes a particular genre in the PR exercise, and these issues were therefore not framed as such, but rather discussed under the umbrella of Exxon's "commitment to environment and

[890] Ibid.
[891] Ibid.
[892] Ibid.

safety."[893] In the opening message, Lawrence Rawl, the chairman of the board, emphasized Exxon's "responsibility to manage its operations in an environmentally sound manner."[894] The Exxon Valdez oil spill that had occurred in Alaska in March 1989, when 10 million gallons of crude oil were spilled into Prince William Sound, had been both an environmental and a PR disaster for the corporation, and that report was primarily aimed at defusing the bulk of negative press and reassuring investors. Unlike the very visible harm brought by an oil spill, climate change's imprint was not yet detectable, nor the subject of intense public scrutiny, and as such only received a passing mention in the last pages of the report, in the "global environmental concerns" section, together with ozone depletion and deforestation. The report stated that "our scientists believe much more research still needs to be done to either confirm or deny a cause and effect relationship between emissions from man-made sources and global warming."[895] It also found that "a consensus among scientists has yet to be reached," and it concluded that "until these uncertainties are resolved, Exxon is committed to supporting additional research."[896] At a meeting of oil executives in March 1991, Rawl conveyed his skepticism towards climate change more overtly and, as a *New York Times* article put it, "expressed doubt that theories on global warming would eventually prove accurate."[897]

I now turn to the GCC's role in the climate countermovement. In what environmental sociologist Robert Brulle calls its "initial mobilization" period between 1989 and 1991, the coalition testified four times before Congress, each time grounding its testimony on three core arguments: scientific uncertainties that prevented expansive moves in climate policy; the costs of actions to mitigate climate change and the negative consequences of these measures on the economy ; and the need to include all countries, irrespective of their historical contributions to carbon emissions, in a global treaty on

[893] Exxon Public Affairs Department, "Exxon and the Environment: A Progress Report," Shareholders' Environmental Report, October 31, 1990, CF.
[894] Ibid., 1.
[895] Ibid., 63.
[896] Ibid.
[897] "Speech by Exxon Chairman," *New York Times*, March 6, 1991, 4.

climate change.[898] In November 1991, two years after it was first established as an informal committee inside the National Association of Manufacturers, the GCC entered a new phase of its existence : it became a more structured and better funded organization, by hiring a two-person staff (the so-called executive committee) to manage its daily activities and by raising its membership fees.[899] A board of directors and an operating committee were also set up to represent the various industries forming the coalition and make policy decisions on behalf of its members.[900] Its executive director, John Schlaes, took up his post in January 1992, giving the organization the impulse it needed, six months before the Rio Conference.

Three months later, in March 1992, Michael Baroody, the senior vice president at the National Association of Manufacturers and the chairman of the board of the GCC, testified before the House Committee on Energy and Commerce. The hearing had been convened ahead of the Rio Earth Summit by Representatives on the Subcommittee on Energy and Power who feared that the national industry's competitiveness would be hurt, should the U.S. government sign the United Nations Framework Convention on Climate Change (UNFCCC). Baroody focused his intervention on the notion that environmental issues *demanded* unhampered economic growth, as opposed to reining in the economy and constraining it within the planet's biological limits. In his introduction, Baroody explained that "a strong and growing economy and a robust industrial sector are prerequisites to addressing domestic and international environmental challenges."[901] The GCC's main argument was that technology was the answer to all environmental ailments and as such, only "a strong and growing economy" could help the United States produce the required technologies, both for itself and "through technology cooperation make it possible for developing nations and those with economies in transition to expand their economies in an environmentally

[898] Brulle, "Advocating Inaction," 9.
[899] John Cohen, GCC memorandum to Interested Parties, "Global Climate Coalition Information," November 27, 1991, CF; Brulle, "Advocating Inaction," 5.
[900] Ibid.
[901] Testimony of the Global Climate Coalition to the U.S. Congress, House Committee on Energy and Commerce, Energy and Power Subcommittee, 102nd Congress, 1st Session, March 3, 1992, CF, 1.

sound manner."[902] The one and only lens through which the GCC (and the Bush administration) read international climate change policy was the latter's potential impact on the U.S. economy, which it preemptively declared entirely negative. Baroody explained that "proposed climate change response strategies must be thoroughly analyzed to assess their competitive impacts on our economy," but undermined the idea of even considering solutions to the problem, declaring that "measures to sharply reduce greenhouse gas emissions would impose massive costs on the U.S. economy."[903] Baroody articulated his testimony around five points, all of which served to justify placing economic considerations before environmental concerns. Of these five, I will discuss two: the GCC's view of climate change science, and the approach it proposed in view of the Framework Convention. One way of supporting giving precedence to the economy over other considerations was to downplay the science on climate change. Baroody indicated that "science – not emotional or political reactions – must serve as the foundation for global climate policy decisions," but he also stated that "there is still substantial uncertainty about the importance of human-induced global warming."[904] According the GCC, "substantial uncertainty within the scientific community" remained, as were "the costs and benefits of those changes."[905] By the time this hearing was convened, the hypothesis of a "natural variation" explaining the changes in the global mean temperature was not seriously considered by the scientific community, and Hansen and others had found no benefit to a massive shift in the climate system.

The second point of Baroody's testimony, regarding the role of the United States versus that of other nations, reiterated the Bush administration's "comprehensive approach" towards climate change. More probably, Sununu and others had drawn inspiration from GCC briefings, and the coalition's involvement in the negotiation rounds was no secret. In an interview for the *Energy Daily,* an outlet from the energy sector, Schlaes explained that, as the then director of the Edison Electric Institute, he had participated in the first

[902] Ibid.
[903] Ibid.
[904] Ibid., 2.
[905] Ibid.

meeting of the intergovernmental negotiating committee on climate change held in Washington D.C. in February 1991.[906] Following the U.S. government's submission of its national action plan to the INC in December 1992, a press release by the GCC stated that "several GCC members […] are actively participating in the deliberations of the INC concerning the Framework Convention on Climate Change in Geneva this week."[907] And we know that the GCC was consulted throughout the INC negotiation rounds, as a State department official disclosed to a member of Congress asking if NGOs had been involved that the GCC had been "very active in this process."[908] That approach, Baroody explained, was to be "based on cost-effective, scientifically sound policies that are independently justifiable in their own right." This is almost a verbatim quotation of the administration's "no regrets" policy, in which the only precautionary principle that mattered was one whereby economic concerns prevailed over environmental ones. Similarly, the GCC argued that any international agreement such as the one opened for signature in Rio should respect four principles by being: grounded in "sound science;" "comprehensive," that is, encompassing other greenhouse gases outside of carbon dioxide; addressed to all world nations irrespective of their past or present contribution to global warming; and flexible in how countries were to implement national policies, allowing for market-based solutions.[909]

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[906] Dennis Wamsted, "Global Climate Coalition Prepares for the Long Haul," *The Energy Daily*, November 17, 1992, CF; Brulle found out that the GCC was a participant in the February 1991 negotiation session. Brulle, "Advocation Inaction," 10.

[907] Global Climate Coalition, "The Global Climate Coalition Recognizes U.S. Leadership for Presenting National Plan In Geneva," news release, December 8, 1992, CF, 2. For a personal account of the role of the oil industry in the production of the 1990 IPCC assessment report and the UNFCCC negotiation rounds, see Jeremy K. Leggett, *The Carbon War: Global Warming and the End of the Oil Era* (New York: Routledge, 1999). Leggett, a former lecturer at the Royal School of Mines, Imperial College, went on to work for the international environmental group Greenpeace as a technical advisor. Throughout the years, he witnessed the lobbying by scientists working for the major carbon companies who, like him, had been granted access to meetings as "observers." The oil industry also sought to influence ongoing negotiations on the Framework Convention through their trade organization, the IPIECA, by organizing a symposium two months before the Rio Conference. See 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), 5.

[908] Janet Mullins to John Dingell, Records of the Office of Science and Technology, NARA, Office files 1989 – 2000, box 4, folder "Global Climate Research Program," 5.

[909] Testimony of the Global Climate Coalition to the U.S. Congress, House Committee on Energy and Commerce, Energy and Power Subcommittee, March 3, 1992, CF, 3.

Having secured everything it had pushed for ahead of the Rio Earth Summit, it came as no surprise when, a few months after the conference, the GCC called for the ratification by the Senate of the U.N. Framework Convention: it knew how harmless the treaty was. A memo, possibly a press release, dated September 1992, quoted Michael Baroody, the chairman of coalition, who testified before the Senate Foreign Relations Committee that "the Framework Convention on Climate Change affirms several important principles that we consider essential to a sound approach to the climate change issue […]."[910] These principles included the rejection of targets and timetables, in the form of a cap on fossil fuel emissions, such as the 20% reduction below 1990 levels that had been called for four years earlier at the Toronto Conference; the focus on economic growth and the industrial sector as "prerequisites" to address environmental issues; and the "comprehensive" approach including all greenhouse gases in reducing emissions.[911] Citing Baroody's congressional testimony, the memo noted that developed economies should not bear the brunt of climate change mitigation measures, but that the onus should instead be placed on developing countries, whose fossil fuel emissions were expected to increase substantially in the years to come.

One of the proposed solutions the GCC called for was one that would not impact its own industry, namely equipping those countries' polluting industries with "cost-effective technology," without expounding on what that technology would be.[912] Another of the GCC's talking points, "technology transfer," had been a mainstay on the fossil fuel industry's list of solutions to climate change. In the article for *Energy Daily*, Schlaes repeated the coalition's argument that a capping on fossil fuel emissions "would be the worst possible outcome" because the main new sources of carbon dioxide would come from developing countries, where the combination of increasing energy demand and population growth would render any reduction efforts by developed countries "ineffective."[913] Of course the GCC did not phrase it that

[910] Global Climate Coalition, September 18, 1992, CF.
[911] Ibid.
[912] Ibid.
[913] Dennis Wamsted, "Global Climate Coalition Prepares for the Long Haul," *The Energy Daily*, November 17, 1992, CF.

way, but spoke of the "needs of the developing countries" and economic development.[914] This strategy of deflecting the problem onto others, as Geoffrey Supran and Naomi Oreskes argue, has been deployed repeatedly over decades by the oil industry to shift the blame away from itself.[915] Finally, the September 1992 GCC memo insisted on the supposed uncertainty of climate change science, stating that "increasingly, new scientific evidence gives additional weight to the theory that adverse climate change is not occurring," a statement that was simply false.[916] Downplaying the validity of scientific predictions and climate models was indeed part of the GCC's rhetorical arsenal. In the December 1992 press release cited earlier, Schlaes outlined "a clear danger in the debate on global climate change for policy makers to rush into action before the scientific community agrees that proposed actions will actually impact any climate trend."[917] That whole statement was problematic: it conflated research-in-progress with a "debate" on climate change, and warned against what it deemed as premature measures that could impact the economy.

4.10 Conclusion

The Bush administration started with a circumspect look at climate change, the president having campaigned on being more receptive to environmental matters. However, when it became clear that any meaningful international treaty would include transitioning to an energy system much less reliant on fossil fuels as well as drastic carbon dioxide emission reductions and new land-use policies, the administration started actively searching for ways to emphasize and publicize the areas of uncertainties underlying the science of climate change. Sununu, aided by a compliant science advisor who would not stand up to him, opened the White House doors to representatives of the denial counter-movement, and the GCC had ample access to the State

[914] Ibid.
[915] Geoffrey Supran, and Naomi Oreskes, "Rhetoric and Frame Analysis of ExxonMobil's Climate Change Communications," *One Earth* 4 (May 21, 2021): 696–719.
[916] Global Climate Coalition, September 18, 1992, CF.
[917] Global Climate Coalition, "The Global Climate Coalition Recognizes U.S. Leadership for Presenting National Plan in Geneva," news release, December 8, 1992, CF, 1.

department and participated in its review of the IPCC's first assessment report and the draft text of the Framework Convention. Unknowns and areas of uncertainties did not invalidate the reality of climate change or its severity, nor did they justify inaction. Compared to the consequences of an abrupt transition to a new climatic regime, the "ozone hole" appeared almost as a risible issue. The great victory of the Bush administration, which owed much to Sununu's substantial involvement in climate policy matters, was its success in killing the Framework Convention before it was even drafted, by greatly watering down the conclusions of the IPCC's first assessment report. By claiming that the observed temperature change over the past century could not be conclusively linked to an increase in the atmospheric concentrations of GHGs, the scientific baseline for a treaty with binding commitments to emission reductions became void.

The United States also succeeded in reframing the climate change policy debate by inserting ideas of cost-effective responses and reliance on market mechanisms to achieve emissions reductions rather than commitments by national governments to reduce their emissions. The administration subscribed to a particular economic vision that ascribed little value to the future, and did not realistically include the costs and many detrimental effects of climate change. On this point again, Sununu succeeded in imposing his vision of climate change economics, against that of other figures in the administration, most notably EPA administrator William Reilly.

While the Bush administration did not refute the science altogether, its focus was clearly and almost exclusively on economics and it refused to deal a blow to the nation's own oil-pumped economic growth. In addition to insisting on uncertainties, it also emphasized the question of costs and benefits in any mitigation measure, especially with regard to short-term economic growth, and advocated market mechanisms in potential policy responses, wary of anything that might be deemed "command-and-control approaches."[918] The administration's strategy was clear: exaggerate the levels of uncertainty and the short-term costs of action to mitigate climate change,

[918] D. Allan Bromley, "The Making of a Greenhouse Policy," *Issues in Science and Technology* 7, no. 1 (Fall 1990): 61.

and sit out on that issue, while giving itself the veneer of environmental conscientiousness by signing a weakened convention.

Yes, we are hypocrites. Because we are embedded in the systems we contest, and life is complicated, no one has ever achieved moral purity. The choice we face is not between hypocrisy and purity, but between hypocrisy and cynicism. It is better to strive to do good, and often fail, than not to strive at all.

George Monbiot, "Today, I aim to get arrested. It is the only real power climate protesters have," October 16, 2019

Conclusion

Assessing the U.S. Government's Role in Delaying Climate Policy

Throughout the pages of this dissertation, I have set out to account for the discrepancy between the science of climate change, on one hand, and public policy decisions designed to protect the integrity of the climate system, and therefore the only climate regime humanity has ever lived in, on the other. In other words, I have sought to explain the divide between calls for actions by scientists that have grown louder as climate change has emerged as a credible threat to Earth's life-supporting ecological systems, imperiling millions of people's livelihoods and the lands they inhabit, and the inadequacy of responses to this issue. I argue that the U.S. federal government has been a prominent actor in the political and legislative gridlock that has characterized U.S. climate change politics during the nearly four decades examined in this study. Successive administrations, both Democratic and Republican, have known about climate change for a long time, at least since the mid-1960s, and they have been alerted to the social and environmental disruptions associated with global warming by numerous scientific reports, yet they all refused to act on climate change and actively contributed to delaying climate policy, both at the national and international levels.

While the devastating impacts associated with a warmer climate came into focus at the end of the 1970s, when the first scientific consensus that a CO_2-driven global warming would occur emerged in 1979, and a clearer picture developed throughout the 1980s, culminating in Hansen's 1988 proposal that global warming had in fact begun, none of the administrations put forward policy proposals or supported preventive measures, such as establishing a national climate policy framework or initiating a transition away from fossil fuels. On the contrary, they decided to ignore scientific warnings drawing attention to the consequences of pumping unlimited amounts of carbon dioxide into the atmosphere.

The U.S. government's decisions and actions has resulted in the absence of extensive domestic climate legislation, and a weakened international treaty to address the issue. The 1992 U.N. Framework Convention on Climate Change provided a framework in which subsequent negotiations took place to operationalize the convention through established processes called protocols. The first of these, the Kyoto Protocol, adopted at the third Conference of the Parties (COP 3) in December 1997, set legally-binding emission reduction targets for Annex 1 Parties to the Convention (i.e. high-income countries). Al Gore, Clinton's vice president, was credited for his last-minute rescuing of the Protocol, but the Senate had dealt U.S. ratification a fatal blow six months earlier, by voting unanimously in favor of the Byrd-Hagel Resolution.[919] Introduced by two senators, Chuck Hagel, a Republican, and Robert Byrd, a Democrat, the resolution prevented the United States from becoming a signatory to the Protocol unless the latter also mandated developing countries to reduce their GHG emissions. The resolution also called for a detailed analysis of the costs to the U.S. economy of a potential adhesion to the Protocol, and stipulated that the United States was barred from ratifying the treaty if it was found to potentially harm it. In effect, the Byrd-Hagel resolution prohibited the U.S. government from joining the Kyoto Protocol. The United States was the only industrialized nation which refused to sign the treaty.

Through its decisions and actions, as well as its refusal to act, the U.S. government participated in worsening the climate breakdown and making it more difficult for future generations down the policy road to devise a set of solutions to respond to, or at least attempt to mitigate, climate change. As we take stock of the role of this major actor in the climate crisis, I want to reiterate the ways in which the U.S. government's approach and responses to climate change and climate science have contributed to the climate policy failure, which is the subject of the next section.

The federal government could not have been reasonably expected to respond to climate change in a significant way throughout the 1960s and in the early 1970s. Congressional hearings pursuant to the Clean Air Act of 1970 had mentioned carbon dioxide as a type of air pollutant, and recognized its

[919] Howe, *Behind the Curve*, 193.

adverse impact on the climate, but at this point scientific uncertainties regarding the scope and timescale of ensuing changes remained too important to warrant broad climate legislation. However, as general circulation models improved, and the first, simplified such model predicted, in 1975, a 2-3°C global temperature rise for a doubling of CO_2 in the atmosphere compared to pre-industrial levels, the responsibility of the government in addressing the issue arguably changed. Six months into the Carter administration, Press was apprised of the NAS *Energy and Climate* report that Revelle had chaired. The report's main conclusion was that the primary limiting factor on oil-derived energy use would not be the market, but the impacts of carbon dioxide emissions. Revelle insisted again in his introduction to the report that considerations for transitioning to alternate energy sources should prevail over economic justifications alone. He also warned in no uncertain terms against postponing long-term energy decisions until the effects of climate change had been empirically detected, when it would be too late to prevent them from occurring.

In a memo to the president, Press communicated the potential severity of global warming, and he recognized that deleterious changes might occur before remedial actions become effective, yet he also recommended that no immediate action be taken regarding the burning of fossil fuels. Press and the OSTP's successful efforts in turning a National Climate Program into a federal research program, which led to the 1978 National Climate Program Act, further attested to his willingness to keep the climate issue within the bounds of science, and away from what he considered premature governmental action. More research was needed, indeed, and the force of the status quo bias cannot be dismissed, but that did not prevent the administration from reviewing policy options and possible preventive measures.

In 1979, the administration received three reports, the JASON, the Woodwell- and the Charney-led ones, which all depicted the seriousness of CO_2-induced climate changes. The Charney report presented the first scientific consensus on the fact that global warming would occur, and it stated that it would be "appreciable." Press and the OSTP responded to mounting evidence of the dangers posed by rising temperatures by proposing a follow-up assessment to be produced by a panel they handpicked themselves. This was the first time that economists were brought in to make policy recommendations, and it prefigured what would happen three years later with more lasting, negative impacts for climate policy prospects. Although the mandate it received from the Academy's Climate Research Board was to develop recommendations about new lines of research on the socio-economic implications of climate change, the panel used the study as an opportunity to negate the need for public policy, by emphasizing uncertainties in the social sciences as well as shortcomings in the physical sciences, a fact they argued called for more research and prohibited political measures. The report insisted on the idea that what truly mattered was the timing of climate change, not the change itself and it concluded that the problem would unfold gradually, leaving ample time for adaptation. At the time of the report, the only known climate change skeptic (i.e. skeptic about its negative impact) was Sylvan Wittwer, who had argued in a previous report and in the panel he had chaired at a DoE-AAAS workshop that more carbon dioxide would increase agricultural crop. But other members of the NAS 1980 study would resurface in subsequent reports, to which they brought their climate change skepticism: Thomas Schelling and William Nordhaus, both professors of economics at Harvard and Yale respectively, and William Nierenberg, then the director of the Scripps Institution of Oceanography in La Jolla, California. But in 1980 already, Press had obtained the outcome he had sought, namely a NAS-approved recommendation against governmental intervention.

The year of 1979 was marked by the second oil crisis, which had important repercussions on the administration's energy policy. Although the reports cited previously had seen the end of the oil age as an opportunity for carefully weighing options in designing future energy policies, the administration chose to further invest in oil by increasing domestic production, especially of so-called unconventional oil, in order to reduce its dependence on foreign imports. Press himself submitted ideas in response to a presidential request for innovative solutions to the energy crisis, all of which sought to bolster domestic and worldwide oil and gas supplies. As Carter's first term drew to an end, more scientific reports and testimonies at Congressional hearings called for policy measures to be implemented before irreversible climate changes took place, and the window for effective action had shrunk. These scientists also recommended that carbon dioxide be given weight in domestic energy policy, and they argued in favor of limiting the use of fossil fuels. The Carter administration had not heeded these warnings, but neither would the next administration.

If the Academy's 11-page study on the economic and social impacts of climate change had not reverberated in the public discourse, its third assessment report did so with astounding force. A month after Carter had signed the 1980 Energy Security Act, which allocated funding for the completion of the report, Revelle had shared his reservations with Robert White, the president of the University Corporation for Atmospheric Research (UCAR) in Boulder, Colorado, about the Academy's ability to deliver a definitive statement on the carbon dioxide issue, as more long-term research was required to clear up the many uncertainties surrounding it. Yet Revelle was confident that the Academy could make valuable policy recommendations both to curb the rate of CO_2 emission production and mitigate climate change's socio-economic consequences. Just as he had stated in the 1977 *Energy and Climate* report, he did not deem a "wait-and-see" approach to the problem an adequate response. However, this is precisely the response Nierenberg, the chairman of the NAS Carbon Dioxide Assessment Committee, marketed to the media, through a press conference and a synthesis of the report that misrepresented the content of the natural science chapters by siding with the conclusions of the economists on the panel, who were none others than Nordhaus and Schelling. The seven physical scientists on the panel also included Waggoner and Wittwer.

Another report by the EPA, also published in October 1983, called for the adoption of preventive measures and a revision of national energy policy. Reagan's science advisor, George Keyworth, privately and publicly criticized the EPA report for its supposed alarmism and praised the Academy's study for recommending no other action than continued research. By promoting one report over the other, and especially the views of the economists and agronomists over those of the natural scientists, the administration justified its own inaction. By giving more weight to Nierenberg's claim that nothing ought to be done before another twenty years had elapsed, as he argued that action might be more costly than inaction, the Reagan administration fed on but also directly helped Nierenberg in his stratagem to redirect public perception of climate change away from the idea that precautionary policy measures might be in order.

Another channel the administration used to push back against calls for governmental intervention was the Department of Energy. Under the previous administration, the director of its Office of Carbon Dioxide, David Slade, had worked hard to build an ambitious program for the DoE's carbon dioxide research unit, laying out a ten-year plan and the publication of two reports on the fifth and tenth year of the program, in 1984 and 1989 respectively. Slade's goal was for these state-of-the-art reports to provide a clear assessment of the costs and benefits of increasing levels of atmospheric carbon dioxide, thereby helping policymakers devise a set of responses. But the nomination of Frederick Koomanoff, the division's new director, upended Slade's research project. When they had discussed its contours back in 1979 and 1980, Slade and Revelle, who was the AAAS climate panel's chairman (this was part of a collaborative project between the DoE and the AAAS), had planned for a 5-volume publication. The fifth volume, dealing with the so-called "indirect" effects of climate change, namely its impact on various areas of human welfare such as human health, agriculture, forestry, water resources, and fisheries, would be especially important to policy-makers. Although this volumed would assess the societal impacts of climate change, the DoE chose not to include any social scientists, thereby greatly restraining the volume's scope.

When the final publication came out, in December 1985, it only contained four volumes, all highly technical and scientific, and therefore unintelligible to the lay people who constituted the vast majority of Congress members to whom it had originally been addressed. What should have been the fifth volume was released a year later as one of two "companion reports," published alongside but separately from the other four reports. The fifth volume's demotion, which was a direct consequence of a series of interventions made by Reagan appointees at the DoE, who wanted nothing less than for the Department to offer a comprehensive state of the knowledge on climate change's adverse effects on the global environment and societal systems throughout the world. The only truly useful document for policymaking, it turned out to be the weakest of all the assessments, and its purpose in outlining some of the serious costs associated with climate change and providing justifications to adopt a precautionary approach, was lost.

But even as the administration worked hard to dampen the impact of scientific reports, alerts from the scientific community regarding the necessity to tackle climate change continued to increase in number and volume. In 1985, at a conference in Villach, Austria, scientists from twenty-nine countries warned that unpreceded warming could occur already in the first half of the next century, while noting that the rate and degree of the future warming could be profoundly affected by government policies. In another area of atmospheric pollution, 1987 witnessed the adoption of the Montreal Protocol, an international agreement aimed at reducing CFC emissions, which Reagan signed in April 1988. The protocol was hailed as a success, and it was soon viewed as a model for international policymaking on other global environmental issues, most notably climate change. After James Hansen testified before a Senate committee that global warming had begun, the World Conference on the Changing Atmosphere in Toronto, Canada, issued a report requesting that targets for reducing carbon dioxide emissions be set in an international framework. The plates of global climate governance were shifting, and the WMO and UNEP created the Intergovernmental Panel on Climate Change (IPCC), a hybrid entity tasked with a clear but difficult mission: to forge a scientific consensus which could be used to support an international treaty, namely the U.N. Framework Convention on Climate Change (UNFCCC). The Reagan administration supported the idea of new intergovernmental body, led by government representatives, as the right avenue for producing another comprehensive assessment of the state of climate change science, providing the foundation from which policy-makers would evaluate possible response strategies.

As the adoption of international agreement on CO_2 emissions appeared more imminent than ever, the Bush administration mounted a multi-pronged effort to defeat climate policy, both at home and abroad. Seizing an opportunity to impose his views on the rest of the administration's leadership, John Sununu, Bush's chief of staff, assumed an unusually preponderant role in climate affairs, convincing Allan Bromley, the president's science advisor, to defer to him. The administration, led by Sununu, worked hard to leverage uncertainties in the science of climate change, and it made clear that it prioritized the economic costs of governmental action over the long-term costs of climate change. Sununu was known to be highly skeptical of climate change, which he saw as a kind of Trojan horse for the "no-growth" ideology he said dated back to the 1970s and the Club of Rome's *Limits to Growth* report. An MIT-trained engineer, he also rejected mathematical models as unrealistic. Knowing his stance on climate change was unorthodox, Sununu searched for credible sources in order to bolster his own position, which he found in a 1989 report by the Marshall Institute, whose authors, among which featured Nierenberg, offered an alternative explanation for the increase in the global mean temperature, namely fluctuations in solar output. That year, Nordhaus published "Sixteen theses on the greenhouse effect" in which he refuted the possibility of climate change severely impacting the global economy, and found that the costs of climate change did not justify what he thought would be major economic dislocations to address it. The report was prepared for the president's Council of Economic Advisors, but it appears highly probable that Sununu had been informed of its content.

Sununu and Bromley, together with the chief U.S. negotiator at the Department of State, were closely involved in the preparation of the IPCC's first assessment report. Both in the various phases of the report's production and at the final meeting where the text was officially approved by all national delegations, U.S. stakeholders made sure that the final texts underlined uncertainties and showed restraint in their statements. The report acknowledged that a warming had been observed, but said it could not be attributed conclusively to anthropogenic factors. The administration had obtained the type of report it had pursued, and it entered negotiations for the Framework Convention with no intentions of signing a legally-binding treaty.

The administration positioned itself as an obstructionist force and an outlier among advanced economies early in the negotiation process. Two things dominated the government's plan for the Framework Convention, both of which had found their ways into the first assessment report: the so-called comprehensive approach, which stipulated that all greenhouse gases (and not just carbon dioxide) should be taken into account when drafting global climate change policy, and the weight given to economics and economic considerations in that policy. The preponderance of economics stemmed from the administration's "no regrets" policy on climate change, which held that no policy measure ought to have any detrimental effect on the economy. While it was engaged in international negotiation rounds, the administration fought the adoption of domestic climate legislation. Timothy Wirth, the Democratic Senator who had invited Hansen to testify on climate change, had introduced an amendment to a bill on national energy security which set both a target and a timetable for reducing GHG emissions, something that Sununu and Bromley opposed in the negotiations on the Framework Convention. In an attempt to kill two birds with one stone, so to speak, Bromley invoked the superiority of the Framework Convention compared to a domestic bill in establishing specific emission reduction targets and timetables, especially as the former would apply to other national governments as well, even as he and Sununu were making sure that the convention would not contain such provision. In the end, the U.S. delegation succeeded in imposing its demands, and the convention only established voluntary goals for stabilizing GHG concentrations, saying nothing of emissions.

Another important contribution of Sununu and Bromley to the derailing of climate policy came in the form of an active search for so-called contrarian scientists, whose views on climate change departed significantly from the IPCC consensus. The search appears to have been prompted by the publication of yet another NAS report. Released in April 1991, *Policy Implications of Greenhouse Warming*, one of whose contributors was Nordhaus, had offered a much watered-down assessment of the threat, and a rather long list of potential environmental benefits in a warming world. The report has also concluded that the United States could reduce its GHG emissions by 10 to 40 percent below 1990 levels at very low economic cost. Sununu still found that the report promoted an activist approach to climate change, and he ordered Bromley to assemble a group of scientists who would publicly oppose the NAS report's findings. Sununu met the scientists at a

White House meeting, during which he hammered the idea that getting the alternative point of view treated on equal footing as mainstream science in the media was crucial. While the fossil fuel industry had just begun to organize itself into a powerful countermovement, it was encouraged to proceed by high-level officials in the government.

The oil industry's own knowledge about climate change dated back to the 1950s at least, but at the time, its executives were primarily concerned about visible and irritant air pollution emanating from refineries, to which carbon dioxide did not contribute. This more visible, localized and recognizable type of air pollution had become a growing public concern and Exxon, then known as Esso, had established its own Subcommittee on Fundamental Research on Air and Water Pollution Control in the spring of 1953, most probably as a result of the political agitation around smog in Los Angeles. Oil executives worried about the consequences of local and visible air pollution, for which the industry could be blamed, and whose tangible effects on the health of neighboring communities constituted a direct threat to their business. Throughout the 1950s and 1960s, fossil fuel consumption and the rise in carbon dioxide emissions did not appear as preoccupying matters to oil executives, because their consequences were deemed too distant. CO_2 did not respond to the criteria of visibility and immediacy, contrary to conventional air pollution. From the mid-1960s until the advent of the Carter administration, environmental concerns at Exxon mostly concerned air and water pollution at its refineries, as the company continued to monitor federal legislation, choosing to intervene only when it was required to do so by law.

Exxon's position on climate change evolved rapidly starting in 1977, when the carbon dioxide issue began to attract the interest of the federal government. The company's Management Committee received a comprehensive review of climate change science in the summer of that year. In October, one of its science managers, Henry Shaw, was invited to attend a DoE meeting dedicated to the study of carbon dioxide's global environmental effects, where the committee discussed how to proceed to alert the administration to the problems caused by fossil fuel combustion. Exxon knew that it had very little time to assess the problem that carbon dioxide build-up might pose to its activities, and it launched its own climate change research shortly after that DoE October meeting. ER&E, its research division (formally, Exxon Research & Engineering Company), designed an ambitious, three-pronged program. Two of the projects involved a sampling operation in the Indian and Atlantic oceans, to better assess the ocean's carbon storage capacity, a key point for Exxon in advocating for the continued use of fossil fuels, while the third project sought to determine the relative contribution of fossil fuel combustion and deforestation to the CO_2 build-up. By the end of 1978, Exxon had its research program ready, and the goal was to implement all three projects by the summer of 1979. The three projects were supposed to run for five years, from 1979 until 1984, in two phases. The rationale for conducting these experiments was a very pragmatic one: Exxon sought to contribute to research on climate change to stand up to the government, should the latter decide to implement policies that might hurt Exxon's core business.

The momentum that corporate research on carbon dioxide had experienced did not last long, however. Shaw, who had been very involved in the company's research program, attempted to convince the director of ER&E of the importance of continuing with the projects, but they were all terminated in early 1982. A number of factors contributed to that decision, but one is particularly interesting in view of Exxon's relationship with the DoE. It appears plausible that the company was influenced by some of the conclusions of a workshop organized by the DoE and the AAAS in April 1979, which had found no cause for alarm. Two of the five panels, one on the agricultural impacts of climate change, chaired by Wittwer, and the other on its economic repercussions, had indeed depicted a much rosier picture than their colleagues.

As Republicans took over the presidency, Exxon abandoned its large, experimental research projects, and turned to climate modeling. Not only did this type of theoretical research require fewer financial and human resources, but Exxon was convinced that legislation to control CO_2 would not materialize in the near term. In the early 1980s, Exxon's official public position on the matter did not underline uncertainty or called climate change a non-issue, but it insisted on the long timespan between the discovery of the problem and the first detections of its effects, which allowed executives to defend a wait-and-see policy. While Exxon's message focused on the timescale of the issue to quell any legislative impulse, its public position on climate change elicited internal dissent within the company, or at least it made it more visible. Roger Cohen, in particular, who had assembled the first research laboratory in theory and modeling at Exxon after joining the company in 1978, began pushing back against assertions that climate change would not have consequential effects, and he also insisted on the validity of the scientific consensus on climate change, a consensus bolstered by his own department's findings. But while disagreement over the fate of in-house research on the CO_2 question simmered, the company presented a united front in the public sphere, which consisted in acknowledging the issue while drawing attention to the uncertainties surrounding climate change science, and arguing against governmental action. At any rate, at the end of 1982, the tide had turned, and Exxon's position had shifted from one of open contribution to science, to an insistence on the uncertainties surrounding the issue. Reagan's second term saw an acceleration in Exxon's handling of climate change science as a threat to its industry that needed to be opposed.

Under the Bush administration, the company began to echo the message that science was mired in uncertainty more forcefully, in order to prevent legislation on climate change. The climate countermovement also began to take shape, and the Global Climate Coalition, a consortium of trade organizations and individual corporations active in the fossil fuel industry, such as the automobile-, the petrochemical- and the mining industries, was founded in June 1989. The chairman and other members of the coalition testified before Congress on a number of occasions, and they also participated in the negotiations over the Framework Convention on Climate Change, which they encouraged the Senate to ratify, knowing how harmless the treaty was to the fossil fuel industry.

Taking a step back, I think it is important to underline two claims this dissertation makes. First, I believe that the Carter administration marked a turning point in the political history of climate change. The emergence of a consensus on the fact that global warming would occur took place in a particular context that was not amenable to reforming strategic aspects of the nation's economic foundations or its energy infrastructure. While the energy crises of the 1970s provided an opportunity for rethinking the United States' dependance on fossil fuels, and climate science highlighted the need to initiate a transition to a more diversified energy mix, the Carter administration chose to double down on fossil fuels. The resource scarcity scare in which the country found itself, when fears of seeing an end to the prosperity and economic growth that had characterized the post-war period abounded, put pressure on political leaders to drive the bad omen away, and not lean into it to begin wholesale reforms. Over a few generations, Western societies had indeed achieved relative material security and even abundance when, historically, the majority had only known scarcity, if not destitution. The seemingly abrupt realization that the capitalist system, while raising the standards of living of millions of people, also created environmental impacts that, if left unaddressed, would come to erase all economic progress, occurred over a very short period of time.

This sudden change of paradigm caught political leaders unawares, and the government responded by securing and increasing access to cheap fossil energy source, as policymakers were hard-pressed to give legislative weight to what science predicted. Scientists struggled to match the devastating effects their models were projecting with policy recommendations that would meet the challenges posed by climate change. Both policy-makers and scientists experienced status quo bias to varying degrees, but it is also true that many among the latter group still called for the adoption by the federal government of preventive measures, if not remedial ones. The Carter administration, however, chose not to promote or invest massively in other types of energies, especially renewable energy, but to increase the supply of fossil fuels, while waiting for climate science to refine its predictions. Arguably, that position was not indefensible in the late 1970s and early 1980s, although incremental steps could have been taken already at the time, but it certainly became so in subsequent administrations, which all further committed the country to its unsustainable energy system by supporting the development and use of fossil fuels, while refusing to act on climate change and delaying climate policy.

The second claim I would like to emphasize pertains to the role of economists in helping the government to justify its stance on climate change. Because the issue had emerged on the radar of physical scientists, it remained within the bounds of the natural sciences for a long time. While this was reasonable in the early years of research, prior to the 1979 Charney report, it became less justified thereafter, as it became clear that the ramifications of a changed climate system largely exceeded the types of questions climatology could answer (and ask). When confronted with Reagan's DoE's recalcitrance about including social scientists in its state-of-the-art report, Schneider had nailed the problem when he had provocatively asked : "So what if the climate changes?" The questions of what ought to be done in light of the costs of both action and inaction, of what society deemed an acceptable price to pay for economic prosperity, but also of who got to decide what was acceptable and for whom, were not questions which physical scientists had the expertise or the mandate to respond to.

Another issue was that all of the reports that featured a section on the social and economic impacts of climate change included only economists, leaving out experts from other social science disciplines that would have had something to contribute. These economists formed a small coterie of people, sharing similar socio-economic backgrounds and *Weltanschauung*. To state the obvious, they were all white men who were part of an economic elite. While this may also have been true of the natural scientists, it mattered more in the case of the social scientists because these were the people from whom policy recommendations were expected. And indeed, their recommendations were heeded, not those of the climatologists.

While climate science was the result of thousands of scientists' work, advice to the government on the social and economic impacts of climate change came from a small set of people. The concept of checks and balances did not apply here, because these people knew one another. The personal ties they had developed over the years would have made it difficult for them to push back against anyone in the group, even if they had wanted to, something Nierenberg capitalized on to advance his agenda. This constant rotation of similar people and posts (Press and Keyworth had served on the PSAC before their tenure as presidential science advisors; Press presided the Academy from 1981 until 1993; Nierenberg was Revelle's successor at the Scripps Institution), made it difficult for alternative perspectives and different understandings of what climate change entailed to emerge. The paucity of proposals from the social sciences and the humanities, in particular, left the natural scientists who pressed for governmental action with no backing from colleagues in the social sciences who shared their views, amplifying that of the few economists who had been invited to make recommendations.

I framed this discussion using the concept of unsustainability to point out the ramifications of the unsustainable way of living that has characterized the "American way of life." The unsustainable character of the United States, I believe, outweighs climate change, or rather, it encompasses it, and it is symptomatic of an underlying issue, one specific to the U.S. culture. By way of concluding this work, but also in order to suggest future lines of inquiry into the U.S. history of climate change, I would like to discuss, even if briefly, the cultural roots of unsustainability, which I locate in the nation's self-representation.

National self-representation sustains itself—and survives competing interpretations—through cultural repetition and references to a set of national myths that, taken together, compose a nation's master narrative. Although they are presented as natural, self-evident and eternal truths, myths are products of social construction whose aim is to offer an accommodating view of the nation by leaving out disturbing or discordant aspects and emphasizing glorious—and often imaginary—deeds and features. Myths occupy a central place in the collective national imagination because of their compelling explanatory power. They provide a simpler reading of the nation, as opposed to a complex, nuanced one reflecting its full history and that of its people. Through the narrative power of this mythical national self-representation, myths also allow detrimental policies and social norms to persist.

In order to understand and fully account for the pervasiveness of the idea of infinite resources, which is so central to U.S. identity, and the rejection of the notion of limits, whether self-imposed or external, one has to study the pregnancy, in the national imagination, of certain myths, and the conceptions of the natural world and the environment that they have fostered. The

American Dream, or the idea that upward social and economic mobility is within reach of anyone, including the newly-arrived immigrant, who is willing to work hard for it, irrespective of his or her background, demands that the environment be conceived as a bountiful, or perhaps even as an unlimited well of natural resources, for the dream to ring true. Accepting that there are limits (to the development of industry, the economy or the nation, but also socio-economic limits to what individuals can achieve) would endanger the assumption that anyone can live, through his or her willpower alone, the American Dream. A nation that sees itself as the land of the free and of eternal rebirth cannot allow external factors to curtail individual freedom, another sacrosanct trait of U.S. national identity. The myths of Manifest Destiny, or the God-given right for the nation to expand to the West, and that of the Frontier, whereby an open land of unlimited opportunity will reward determined and ambitious individuals, also continue to wield power over the collective national imagination, fueling the desires of expansion and progress of an empire in search—and need—of perpetual growth. Finally, American Exceptionalism, which claims that the United States holds a special place and role among other nations, one ordained by divine providence, further contributes to enshrining its right to free itself from limits and constraints.

This constellation of myths point to the existence of an ideology of abundance and infinite resources which is essential to the nation's self-understanding, but runs counter to notions of restraint and limits that are central to sustainability. The necessity to keep alive and live by the idea of an abundant land, the source of individual freedom, has worked against ideas of self-imposed restrictions, limitations and other constraining measures without which no true sustainable path can be outlined. What does this mean for the future of climate policy in America? I believe that in order for sustainable approaches and practices to flourish, a reckoning of the nation's conception of itself needs to take place. A re-conceptualization of its identity is required for the United States, and its people, to be able to move towards sustainability. Americans need to redefine the idea of "America," allowing new narratives to thrive.

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