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NEW ENERGIES

A HISTORY OF ENERGY TRANSITIONS IN EUROPE AND NORTH AMERICA

EDITED BY STEPHEN G. GROSS & ANDREW NEEDHAM



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TWELVE

A FUTURE FORESEEN AND TRANSITION DELAYED

BIG OIL AND GLOBAL WARMING, 1959–1986

BENJAMIN FRANTA

THE PLANET HAS WARMED, ON AVERAGE, BY ABOUT ONE DEGREE CELSIUS since the nineteenth century[1] and is potentially headed toward three more degrees by the end of this century.[2] With each fraction of a degree comes new sea levels, diseases, droughts, heat waves, and storms. In 2003 Europe experienced a heat wave that killed an estimated seventy thousand people.[3] At four degrees Celsius of warming, this heat could occur, on average, every year.[4] The last time the planet was that warm, seas were hundreds of feet higher.[5] Four of the five known mass extinctions in Earth's history (beyond the one occurring today) were associated with changes in greenhouse gases; the end-Permian mass extinction 252 million years ago, for example, began with carbon warming the globe by five degrees Celsius and ended with 97 percent of life gone.[6]

Summarizing global warming in degrees obscures reality, since a degree of global warming bears little relationship to our conceptions of temperature. Analogizing to a fever ("a fever of three degrees Celsius is dangerous") is not quite apt, since fevers are part of staying healthy and eventually go away. The stages of cancer might offer a better analogy: today we are at stage 1 and are barreling to stage 4.

The consequences of global warming we experience today and foresee for the future were often predicted by fossil fuel companies in the 1980s and earlier. They had good reason to pay

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attention, understanding global warming as a side effect of their lucrative products. Yet that knowledge did not prevent the industry from promoting ever-greater use of fossil fuels or denying in public what it privately acknowledged as true. As a result, more fossil carbon has been emitted into the atmosphere since 1988—after fossil fuel companies understood the impacts of their products and began forming worldwide campaigns of denial and delay—than in the entire previous history of humankind.[7]

This chapter focuses on the period before 1988—before climate change denial was created on a mass scale and most of history's fossil carbon was burned. Global warming grew as a scientific concern in the 1950s and after and presented fossil fuel companies with a dilemma: promote an energy transition or impede it?

The petroleum industry was informed early on of the connection between its products and global warming and responded first by carrying out research on the problem while, for the most part, remaining silent about it in public. As public concern over industrial pollution grew throughout the 1960s, Big Oil developed a public relations strategy of weaponizing science, selectively advertising corporate research to gain credibility with scientists and policymakers and to reassure the public that pollution problems were being solved.

As the scientific consensus around the expected timing and magnitude of global warming solidified near the end of the 1970s, and Exxon and the American Petroleum Institute established research programs on carbon dioxide, with internal memos revealing that the main purpose of these efforts was to cultivate the public credibility needed to influence future regulation in ways favorable to the industry. The companies placed special attention on predicting when global warming from fossil fuels would be detected and fossil fuel controls proposed. Exxon and Shell compiled detailed projections of global warming and its consequences, including sea level rise, ocean acidification, flooding, intense heat, human migration, and habitat destruction. Yet the companies refused to take responsibility for preventing the damage from their products and instead chose to promote further fossil fuel production for as long as possible, even at the cost of deceiving the public about one of the most consequential industrial impacts in human history.

In the early 1980s, Exxon predicted that major legislative proposals for reducing fossil fuel emissions wouldn't emerge until the end of the decade, and the company was right. When such policies were eventually proposed, fossil fuel companies in the United States and around the world responded with coordinated campaigns of obstruction through industry groups like the Global Climate Coalition and the International Petroleum Industry Environmental Conservation

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Association.[8] Today, the replacement of fossil fuels has been intentionally delayed for over three decades, with permanent consequences for life on the only planet known to sustain it.

AN UNEXPECTED WARNING

In November 1959, the American Petroleum Institute (API) held a centennial celebration of the US oil industry at Columbia University in New York City. The event was attended by approximately three hundred people, including leaders from the oil and gas industry, and one of the keynote speakers for the event was the renowned nuclear physicist Edward Teller.[9]

Teller's speech, titled "Energy Patterns of the Future," was mostly a promotion of nuclear power. Yet among his reasons for moving beyond fossil fuels was the prospect of anthropogenic global warming and sea level rise. He explained:

> Ladies and gentlemen, I am to talk to you about energy in the future. I will start by telling you why I believe that the energy resources of the past must be supplemented. First of all, these energy resources will run short as we use more and more of the fossil fuels. . . . . But I would . . . like to mention another reason why we probably have to look for additional fuel supplies. And this, strangely, is the question of contaminating the atmosphere. . . . . Whenever you burn conventional fuel, you create carbon dioxide. . . . . The carbon dioxide is invisible, it is transparent, you can't smell it, it is not dangerous to health, so why should one worry about it?
>
> Carbon dioxide has a strange property. It transmits visible light but it absorbs the infrared radiation which is emitted from the earth. Its presence in the atmosphere causes a greenhouse effect . . . . It has been calculated 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. All the coastal cities would be covered, and since a considerable percentage of the human race lives in coastal regions, I think that this chemical contamination is more serious than most people tend to believe.[10]

During the question and answer session that followed, Teller was asked to "summarize briefly the danger from increased carbon dioxide content in the atmosphere in this century," to which he responded: "At present the carbon dioxide in the atmosphere has risen by 2 percent over normal. By 1970, it will be perhaps 4 percent, by 1980, 8 percent, by 1990, 16 percent, if we keep on with our exponential rise in the use of purely conventional fuels. By that time, there will be a serious additional impediment for the radiation leaving the earth. Our planet will get a little warmer. It is hard to say whether it will be two degrees Fahrenheit or only one or five."

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"But when the temperature does rise by a few degrees over the whole globe, there is a possibility that the icecaps will start melting and the level of the oceans will begin to rise. Well, I don't know whether they will cover the Empire State Building or not, but anyone can calculate it by looking at the map and noting that the icecaps over Greenland and over Antarctica are perhaps five thousand feet thick."[11] Teller's estimate was prescient: by his accounting, the global atmospheric CO_2 concentration in 1990 would be around 360 parts per million, close to the actual concentration that year of 354 parts per million.[12]

In his speech, Teller referenced measurements of atmospheric carbon dioxide at the Scripps Institution of Oceanography in La Jolla, California, presumably referring to ongoing research by scientist Charles Keeling. Keeling's key measurements would not be published until the following year, 1960, but Teller appears to have been aware of the work in progress.[13] Given rising greenhouse gas concentrations, the question was not whether global warming would occur, but how much—and how soon.

CONFIRMING THE THREAT

By the mid-1960s, global warming had made its way onto the US federal government's radar. In 1965 President Lyndon B. Johnson's Science Advisory Committee produced an extensive report warning that a 25 percent increase in carbon dioxide concentrations could occur by the year 2000, that such an increase could raise globally averaged temperatures by 1.1–4 degrees Celsius, that melting of the Antarctic ice cap and rapid sea level rise could result, and that fossil fuels were the clearest source of the pollution.[14] Three days after the report was published, API president Frank Ikard addressed the industry at its annual meeting in Chicago, stating, "The substance of the report is that there is still time to save the world's peoples from the catastrophic consequence of pollution, but time is running out."[15] He went on to describe the report's findings:

> One of the most important predictions of the report is that carbon dioxide is being added to the earth's atmosphere by the burning of coal, oil, and natural gas at such a rate that by the year 2000 the heat balance will be so modified as possibly to cause marked changes in climate beyond local or even national efforts. The report further states, and I quote: " . . . the pollution from internal combustion engines is so serious, and is growing so fast, that an alternative nonpolluting means of powering automobiles, buses, and trucks is likely to become a national necessity."[16]

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Perhaps prompted by the report's stark warnings, the API hired the Stanford Research Institute, a private research consultancy affiliated with Stanford University, to assess the state of science surrounding various air pollutants, including carbon dioxide.[17] The assessment endorsed the findings of the White House's report, summarizing that "significant temperature changes are almost certain to occur by the year 2000, and these could bring about climatic changes . . . there seems to be no doubt that the potential damage to our environment could be severe."[18] The links between fossil fuels, carbon dioxide, and the eventuality of global warming were not in doubt, the scientists reported, as "past and present studies of CO_2 are detailed and seem to explain adequately the present state of CO_2 in the atmosphere."[19] Rather, what was missing was work on "air pollution technology and . . . systems in which CO_2 emissions would be brought under control."[20] Thus, by the end of the 1960s, the petroleum industry was not merely aware of the connection between fossil fuels and global warming—it had been warned by its own scientific consultants.

GROWING AWARENESS, SELECTIVE SILENCE, AND A NEW STRATEGY

By the late 1960s, at least some within government and the industry began discussing the need to replace fossil fuels with other sources of energy in order to prevent global warming.[21] In 1969, at the 90th Congress of the American Institute of Mining, Metallurgical, and Petroleum Engineers, Victor Erickson, from the US Department of Commerce, discussed "potential effects of air pollution regulation on manufacturing," telling the industry audience the time was ripe to consider the effects of carbon dioxide:

> The immediate future of pollution control is clear. There will be more of it. We are in a catch up phase, which may last five or ten years or more . . . In the meantime new pollutants or new effects may be discovered . . . The fears of the environmental scientists are pertinent here. If, for example, we are faced with the problem of a warming of the earth from the 'hot house' effect of carbon dioxide in the upper atmosphere or with the cooling of the earth from particulates cutting out the radiation of the sun, entirely new approaches may be needed . . . These are matters to be watched and researched. They will raise major economic issues and it is not too early to be thinking about them.[22]

At the same conference, David Evans, from the Colorado School of Mines, reviewed the conclusions of the White House's report from 1965, including potential warming by the end of the century and subsequent "disastrous" sea level rise. He also noted that particulates from

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industrial pollution had a cooling effect, which at the moment appeared to be greater than the warming effect of carbon dioxide. Evans observed, however, that the short-term effect of particulates did not negate the long-term, cumulative warming effects of carbon dioxide and called for the energy industry to practice "enlightened self-interest" and "take the lead" to "prevent the pollution of the atmosphere and oceans."[23]

At the next year's conference, in 1970, the program included contingency planning for a low-carbon energy system by the year 2000,[24] and the year after that, a member of the Federal Power Commission warned the industry audience in a keynote address, "We have an environmental crisis that poses hazards for our air, water and food supply."[25] Another speaker from the US Department of the Treasury noted that to address atmospheric pollution, "Future demands may be met by systems which are not dependent on fossil fuels."[26] Even a dialogue between oil producers from the United States and the Organization of Petroleum Exporting Countries (OPEC) hosted by the American Enterprise Institute in 1974 included a warning from Canadian politician Donald S. MacDonald of the "awakening concern about our environment, especially the threat of damage to the biosphere from the development and consumption of extractive resources and, particularly, fossil fuels."[27]

Despite awareness within the industry of the threat posed by global warming, the API exhibited public silence. In 1967 the trade association's chairman, Robert Dunlop, testified to Congress on why the development of electric vehicles was unnecessary, saying, "We in the petroleum industry are convinced that by the time a practical electric car can be mass-produced and marketed, it will not enjoy any meaningful advantage from an air pollution standpoint. Emissions from internal-combustion engines will have long since been controlled." He went on to describe efforts to control pollutants, including carbon monoxide, nitrous oxides, and hydrocarbons, but omitted mention of carbon dioxide.[28]

The following year, in 1968, the API published *Facts about Oil*, a booklet that was part of its "petroleum school program" for junior and high school students.[29] By then, API materials were being used in 80 percent of American schools,[30] and *Facts about Oil*, like Dunlop's testimony, was silent on the issue of carbon dioxide, promoting an energy future of unfettered petroleum growth. The API told students that by the year 2000, oil and gas consumption in the United States would more than double, water energy would hardly grow at all, and solar and wind energy would be negligible. Under a section titled "New Energy Sources," the API focused solely on shale oil and tar sands, and the booklet heaped praise on the industry for its

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efforts to tackle air pollution. Despite the climatic warning the API received that year from its own consultants at the Stanford Research Institute, the API's public education materials were written as if the greenhouse effect didn't exist.

The closing years of the 1960s had not been kind to the petroleum industry in terms of public relations. Oil companies, the API ruefully assessed, were seen as "big and powerful, unresponsive to public demands, and insensitive to environmental considerations."[31] Public awareness of industrial pollution and its effects on human and environmental health had burgeoned, and various environmental and health problems had become associated with fossil fuels, from smog to carbon monoxide to acid rain. Global warming was but the latest entry in the growing list of negative fossil fuel side effects.

In response, the API developed a public relations plan. The industry would portray itself as working toward solving environmental problems (which were largely caused by its own products) and turn the nation's growing environmental awareness to Big Oil's advantage. "Individual companies should consider the environmental story as part of their institutional advertising programs," the API's Committee on Public Affairs encouraged, urging that any environmental solutions found by the industry "should be widely publicized."[32] In the absence of solutions, "an API-sponsored advertising campaign highlighting the industry's effort in air and water pollution control, and the magnitude of the research effort being employed" was recommended. It was a win-win strategy: if the industry managed to clean up its mess, it could take credit, and if not, it could still take credit by telling the public how hard it was working on research. Pollution and science could be used for advertising.

The API also formulated a strategy of promoting fossil fuel inevitability, recommending that its members emphasize that "modern man is dependent on oil" and "huge amounts of energy will be required" for the continued growth of the US economy.[33] The implication was that vague concepts like modernity and the economy, not oil companies, were to blame for pollution.

Thus, by 1970, the API had conceived two mainstay strategies for deflecting concerns about pollution: advertising research to portray the oil industry as a partner in the fight for a clean environment, and shifting the blame by equating fossil fuels with energy more broadly and civilization itself. Without a solution to global warming that favored fossil fuels, however, the API would largely ignore its existence in public. Thus the API's vice president for environmental affairs, Peter Gammelgard, in a hearing on the Clean Air Act in 1970, told Congress, "When burned completely, hydrocarbons produce just two byproducts, water vapor and carbon dioxide—neither of which has any significance from an air quality standpoint."[34]

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EXXON BUYS CREDIBILITY

In the late 1970s, as scientists solidified their findings on the potential magnitude of global warming and the need for action, the petroleum industry increased its focus on climate. Exxon began a research program around 1977, when company scientist James Black told Exxon's management committee, "There is general scientific agreement that the most likely manner in which mankind is influencing the global climate is through carbon dioxide release from the burning of fossil fuels."[35] Black also informed the company's leaders that doubling the atmosphere's CO_2 concentration would lead to global warming of two to three degrees Celsius, with two to three times more warming near the poles, and that as a result "some countries would benefit, but others would have their agricultural output reduced or destroyed."[36] The scientist warned that it could only be five to ten years before "changes in energy strategies might become critical."[37]

In 1979 Exxon produced an internal report (marked PROPRIETARY INFORMATION) by summer employee Steve Knisely titled *Controlling the CO_2 Concentration in the Atmosphere*. The report noted that uncurtailed fossil fuel use would lead to "dramatic climate changes" in the next seventy-five years, and that preventing significant climate changes would require "dramatic changes in patterns of energy use," including leaving fossil fuel reserves unexploited. "Only about 20% of the recoverable fossil fuel could be used before doubling the atmospheric CO_2 content," Knisely calculated.[38] The report emphasized uncertainty surrounding the precise impacts of global warming but nonetheless concluded, "The *potential* problem is great and urgent."[39]

Unless limits were placed on fossil fuel production, Knisely noted, "Noticeable temperature changes would occur around 2010 as the concentration reaches 400 ppm. Significant climatic changes occur around 2035 when the concentration approaches 500 ppm." By 2050, the preindustrial concentration of CO_2 would double, causing "dramatic climatic changes in the world's environment." Knisely's predictions have so far been accurate: atmospheric CO_2 concentrations passed 400 ppm in 2013.[40]

The report considered three scenarios and their implications for Exxon: one in which fossil fuels were used without limit, another in which the CO_2 increase would be limited to 75 percent above preindustrial levels (510 ppm), and another in which the CO_2 increase would be limited to

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440 ppm, “assumed to be a relatively safe level for the environment,” Knisely wrote. The report found that to achieve the relatively safe concentration, nonfossil energy sources would need to be substituted for coal beginning in the 1990s and supply 50 percent of world energy by 2010. Neither shale oil nor coal could become major energy sources. Carbon dioxide emissions would need to peak in the mid-1990s and decline thereafter. Knisely’s report made clear that the CO_2 emitted by Exxon’s products posed serious negative side effects for humanity, and that if those effects were to be limited, the company’s business plans would soon need to change.

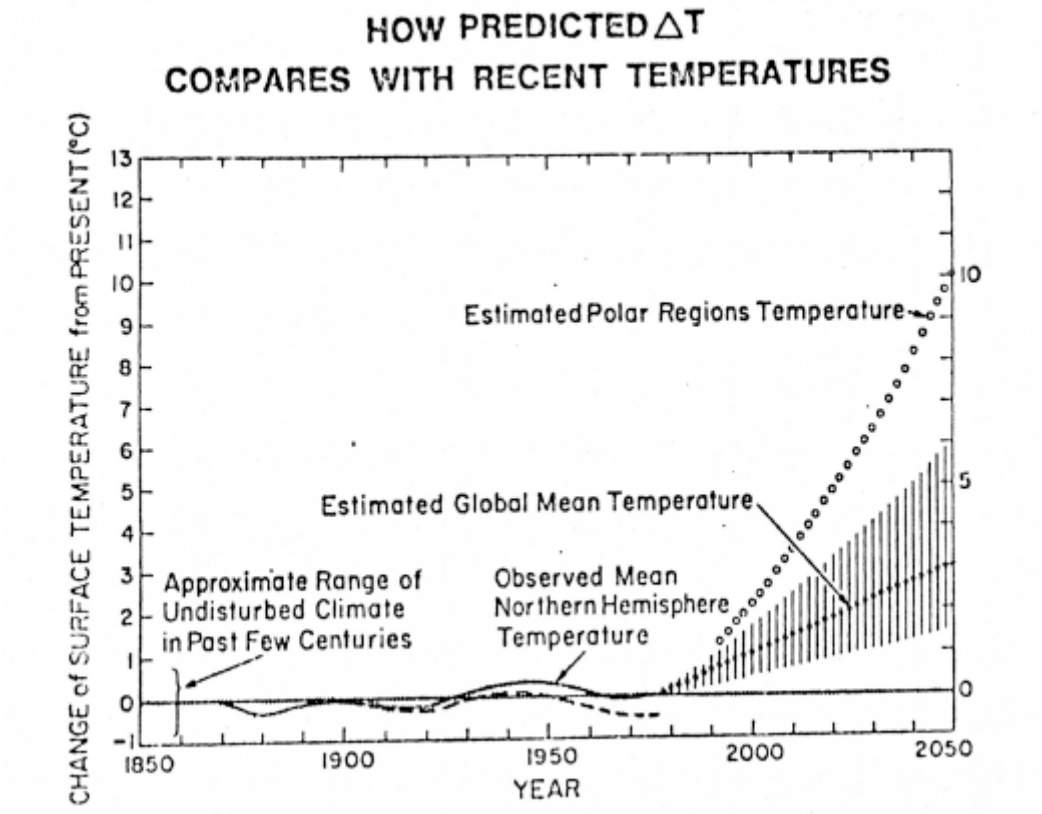


FIGURE 12.1: Global warming predicted to arise from unrestrained fossil fuel use, from an internal Exxon report in 1979. The difference between the dashed and solid lines indicates Exxon’s estimate of global warming already occurring at the time of publication. *Source*: Steve Knisely, *Controlling the CO_2 Concentration in the Atmosphere* , Exxon Research and Engineering Company, October 16, 1979, fig. 4.

The following month, one of Exxon’s scientists, Henry Shaw, wrote an internal memo stressing the company “should determine how Exxon can best . . . influence possible legislation on environmental controls.” Shaw pointed out that environmental groups had already attempted to curb the production of fuels from coal and tar sands due to their high CO_2 emissions and suggested that a scientific research program would arm Exxon with “reliable and credible data” to counteract similar efforts in the future.[41]

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Shaw made clear the importance of controlling the public narrative. “It behooves us to start a very aggressive defensive program in . . . atmospheric science and climate because there is a good probability that legislation affecting our business will be passed. . . . We should be prepared for, and [be] ahead of the government in making the public aware of pollution problems.” Shaw recommended a “small task force” be formed to analyze the climate problem and that outside consultants be invited to inform Exxon of the ecological consequences of its products, suggesting atmospheric scientist Stephen Schneider, then at the National Center for Atmospheric Research and later at Stanford University, as the best candidate to lead the initiative. Schneider ultimately did not hold the post, but Shaw’s choice illustrates the intermingling between Exxon’s research efforts, described internally as a public relations campaign, and influential climate scientists in government and academia.[42]

The main purpose of Exxon’s climate research program—to cultivate the credibility with policymakers, scientists, and the broader public needed to influence fossil fuel policy—was alluded to in numerous internal documents. In 1980, for instance, Exxon public relations executive Ed K. Wiley distributed an internal memo on the company’s climate research, saying the work was “significant to Exxon since the build-up of atmospheric CO2 could impose limits on fossil-fuel combustion,” and that research was “an excellent vehicle to help achieve the corporate objective of improved recognition of Exxon as a center of scientific and technological excellence.”[43] In October of that year, Exxon scientist Henry Shaw, who advocated internally for the establishment of the research program, participated in a workshop of the National Commission on Air Quality, editing the text of the workshop’s findings to emphasize uncertainty and undermine calls for action by replacing phrases like “predicted,” “will probably result,” and “almost surely will occur” with lower-certainty terms such as “possibly,” “rudimentary,” and “may occur.”[44] Exxon’s research program essentially followed the public relations advice given by the API a decade earlier: By showcasing apparent efforts to counteract the pollution caused by its own products, the company could purchase public credibility, gain access to the drafting of government assessments, and move public policy in the company’s preferred direction.

A WATCHFUL EYE AT THE AMERICAN PETROLEUM INSTITUTE

By 1979, the API had formed its own climate change task force, which included Shaw as well as representatives from other major oil companies such as Texaco (now Chevron) and Standard Oil

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of Ohio (now part of BP).[45] Initially named the CO_2 and Climate Task Force and renamed the Climate and Energy Task Force in 1980, the group's internal memos again show how it viewed climate research as a strategic tool to influence regulation rather than a program to advance science per se. One memo from Raymond Campion, an Exxon scientist, recommended the group not conduct original climate research, because "the industry's credibility on such issues is not high at the present time, and should an API study indicate no serious CO2 problems, the results would be greeted with skepticism."[46] Moreover, Campion wrote, the US Department of Energy and the American Association for the Advancement of Science (bodies the public did trust, he noted) had held a workshop in April of that year (which Shaw had participated in) and would soon issue a report concluding that CO_2 would pose no catastrophic hazards for the next one hundred years. (Campion's confidence turned out to be misplaced: the report concluded that global warming posed severe risks and called for corrective action.) Without the need to fight regulation nor the credibility required to reassure the public, Campion saw no reason for research, although he did recommend the task force monitor climate work by outside groups.

Campion reiterated his recommendations in another memo later that year, recommending that the API monitor government and academic research, but stating there was no need for the industry body to engage in research of its own since there were no pending regulations to ward off. Although the greenhouse effect was in fact being discussed in Congress, he noted, most of the negative attention for the time being was on coal rather than petroleum.[47]

The API prepared a background paper on the effects of CO_2 for distribution within the industry, and Campion offered revisions that reveal the industry's outlook on climate science at the time. "We are now in a cooling phase," he stated, "and will not revert to a warming trend until 1990. It is not likely that any 'warming' effects of CO_2 will be apparent until at least the year 2000, and probably beyond this time. At that point, these 'warming effects' would be superimposed on a cyclic warming trend (non-CO_2 related) which would be additive, worsening the effect. Therefore," he concluded, "it is unlikely this [warming] effect will be 'noticeable within the next twenty years,'" as the API background paper had warned. Campion did not question the links between fossil fuels, carbon dioxide, and global warming. Rather, he was concerned with when the rest of the world would notice.

In 1980 the industry task force invited John Laurmann from Stanford University to give a presentation on CO_2 and climate.[48] The meeting, which lasted for seven hours, included

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representatives from the API, Exxon, Texaco (now Chevron), and Standard Oil of Ohio (now part of BP). Laurmann discussed the various facets of the climate problem, including climate modeling, socioeconomic impacts of global warming, and how energy sources and policies would affect CO_2 emissions. Despite the lack of complete certainty on all fronts, his warning to the industry was straightforward. Current fossil fuel production trends, Laurmann said, would produce global warming of 1 degree Celsius by 2005, 2.5 degrees Celsius by 2038, and 5 degrees Celsius by 2067. Global warming of 2.5 degrees would have "major economic consequences" and bring "world economic growth to a halt," while 5 degrees Celsius would cause "globally catastrophic effects." Laurmann concluded with the question, "Time for action? Market penetration time theory says there is *no* leeway." Thus, in 1980, the API's invited expert warned of catastrophe—and indicated that the need for action was urgent.

EXXON AND SHELL FORESEE OUR PRESENT AND FUTURE

As the 1980s continued, so did private industry research of global warming. In 1981 Exxon's Corporate Planning Department asked ER&E to assess whether global warming could influence the company's market projections out to 2030. Exxon scientist Werner Glass drafted a reply, speculating that climatic changes would occur by 2030, but that they would be "well short of catastrophic" and would not change the fossil fuel market fundamentally.[49] Glass's boss, Roger Cohen, director of ER&E's Theoretical and Mathematical Sciences Laboratory, was less optimistic. After reviewing Glass's reply, he told Glass his assessment was "too reassuring," saying, "It is distinctly possible that the CPD [Corporate Planning Department] scenario will later produce effects which will indeed be catastrophic (at least for a substantial fraction of the earth's population)."[50] As Shaw had pointed out in his reports, Cohen explained that "the global ecosystem in 2030 might still be in a transient, headed for much more significant effects after time lags perhaps of the order of decades."[51] (Shaw and Cohen were right about the time delay. As discussed by climate scientist James Hansen in 1985 and by others since then, due to the thermal inertia of the earth, around thirty to fifty years are required for increased CO_2 levels to produce most of their warming effects.)[52] Cohen's memo was surreal: a senior Exxon manager observing over forty years ago that the business plans of his own company would spell catastrophe for much of the world's population.

In 1982 Cohen sent a summary of the company's climate research to Alvin Natkin of Exxon's Office of Science and Technology. Cohen explained that although it was certain that CO_2

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levels were increasing, it wasn't yet possible to measure their effects, and assessing the threat of climate change required models of varying complexity. Despite the uncertainties, "over the past several years a clear scientific consensus has emerged regarding the expected climatic effects of increased atmospheric CO_2," Cohen explained. "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. . . . There is unanimous 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 of the biosphere. The time required for doubling of atmospheric CO_2 depends on future world consumption of fossil fuels. . . . It is generally believed that the first unambiguous CO_2-induced temperature increase will not be observable until around the year 2000."[53]

The fact that Exxon's research might draw unwanted attention to the company wasn't lost on Cohen, but he argued that the benefits were worth the risks. "As we discussed," Cohen wrote, "there is the potential for our research to attract the attention of the popular news media because of the connection between Exxon's major business and the role of fossil fuel consumption in contributing to the increase of atmospheric CO_2," but nonetheless, the company scientist argued, research was necessary for business forecasting and "to provide Exxon with the credentials required to speak with authority in this area."[54]

Later in 1982, Exxon's manager of Environmental Affairs Programs, Marvin Glaser, sent a comprehensive summary of the company's research on global warming to fifteen company executives and managers. Glaser's cover letter stated the report was intended to "familiarize Exxon personnel with the subject" of global warming and "be used as a basis for discussing the issue with outsiders as may be appropriate. However," Glaser continued, "it should be restricted to Exxon personnel and not distributed externally."[55]

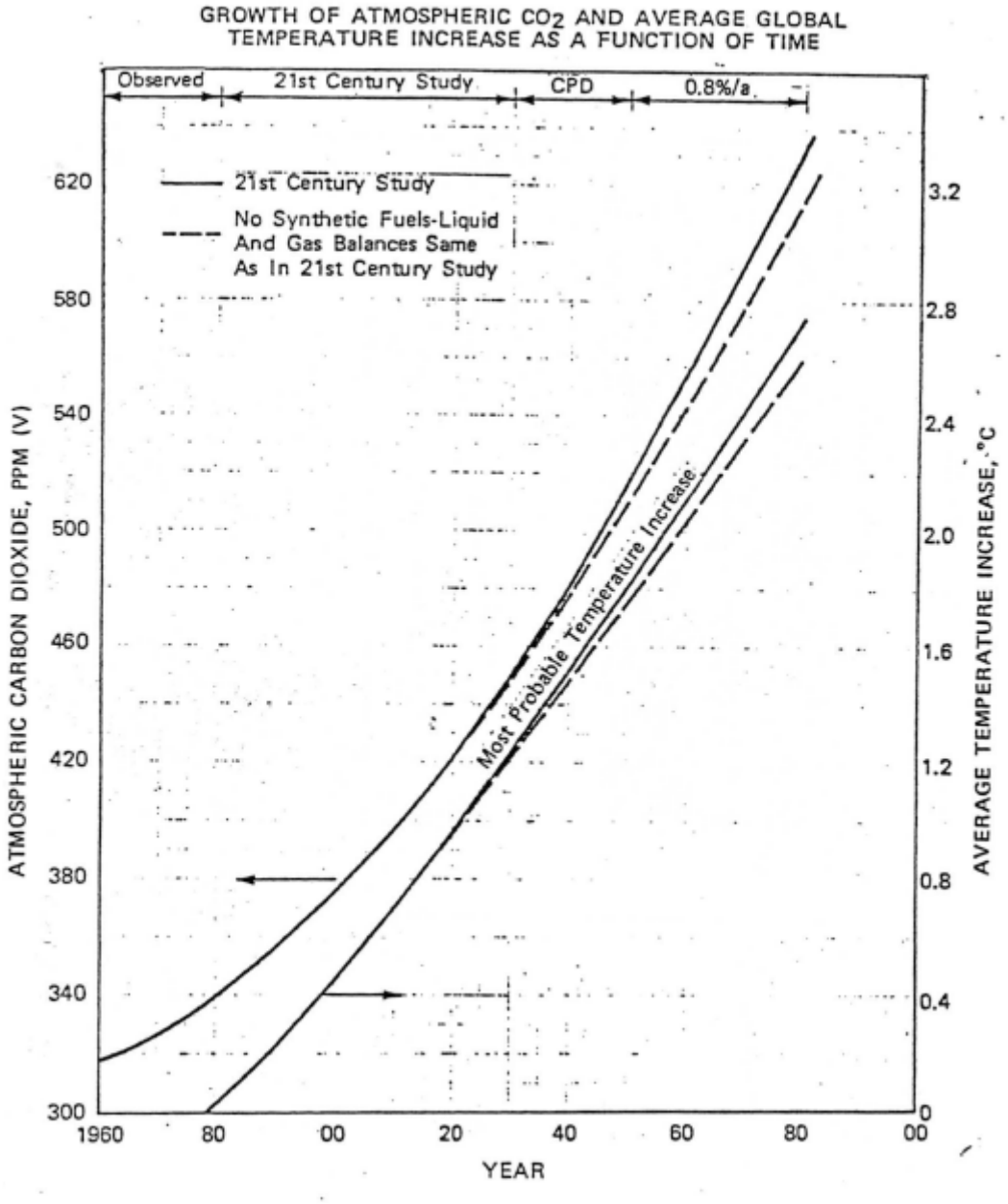
The report went into substantial detail on the effects of global warming, including the aridification of the American Midwest and impacts on food production. "In addition to the effects of climate on global agriculture," the report warned, "there are some potentially catastrophic events that must be considered," such as rapid disintegration of the Antarctic ice sheet and subsequent flooding of the East Coast, including Florida and Washington, DC. Despite these warnings, a course of climatological adaptations, such as low-water irrigation techniques, was emphasized, rather than cutbacks on fossil fuels. Citing a workshop held by the American Academy for the Advancement of Science and the Department of Energy in 1979, the

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report bizarrely assured that climate change would not be "as significant to mankind as a nuclear holocaust or world famine."

All of this raised the issue of when Exxon would need to act. The report noted that nonfossil energy sources, such as nuclear and solar, "would need about 50 years to penetrate and achieve roughly half of the total market."[56] According to the same document, by 2030, fifty years in the future, atmospheric CO_2 concentrations would be about 450 ppm, enough to produce warming of around two degrees Celsius.[57] Thus, the company's own analysis indicated that preventing significant global warming would require immediate action. Yet the report counseled delay and more research. Curtailment of fossil fuel consumption, it concluded, "Would undoubtedly seriously impact the world's economies and societies."[58]

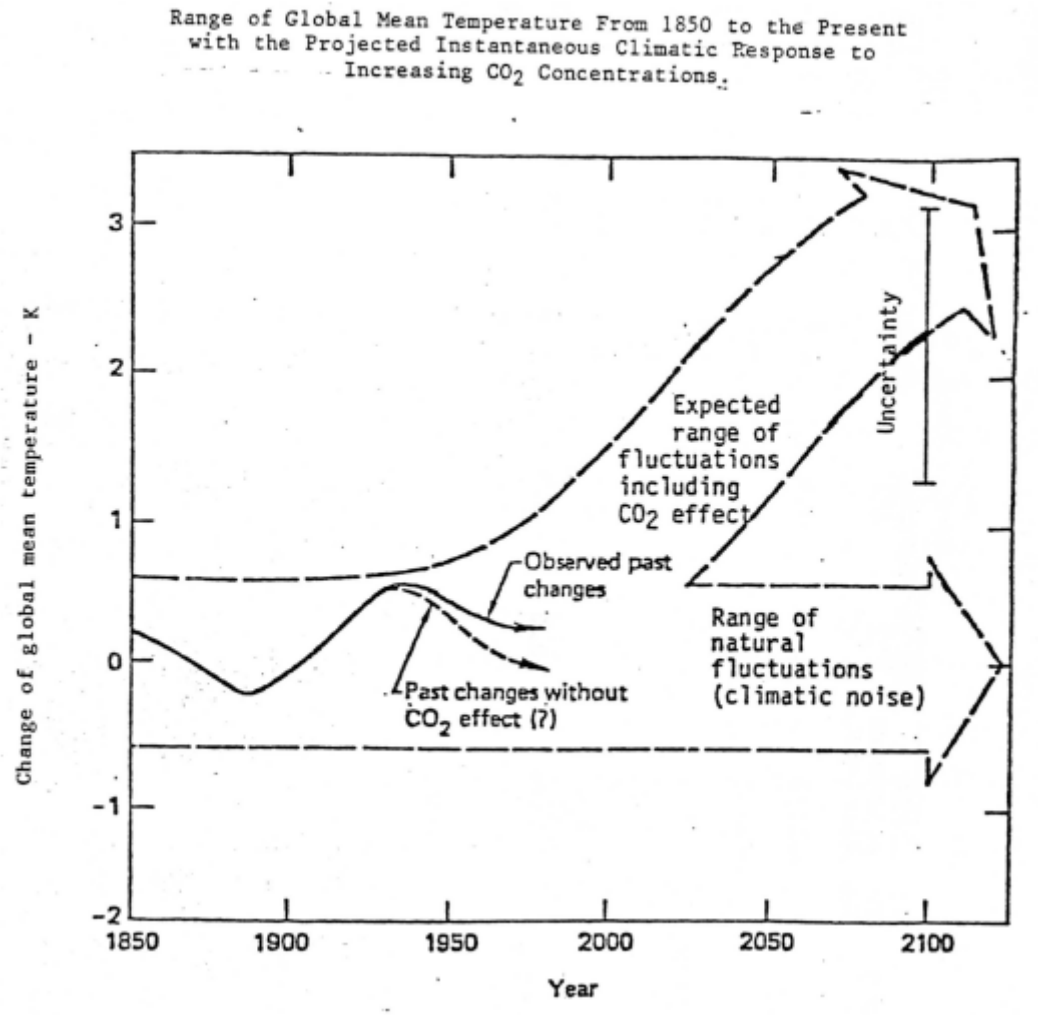


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FIGURE 12.2: Exxon's 1982 projection of atmospheric CO_2 buildup (left axis and curve) and global temperature rise (right axis and curve). Exxon envisioned a 3–4 degree Celsius temperature rise by the end of the twenty-first century and calculated the long-term effect of foregoing synthetic fuel development (dashed lines). As of 2022, Exxon's projections have been remarkably accurate. *Source*: M. B. Glaser, *CO2 "Greenhouse Effect,"* Exxon Research and Engineering Company, November 12, 1982, fig. 3, p. 7.

Exxon's internal report of 1982 recommended inaction despite acknowledging the climatic changes its products would cause, as well as the possibility that global warming was already underway, as shown in figures 12.2 and 12.3. Without fossil fuel controls, the company predicted a doubling of CO_2 from preindustrial concentrations by 2060, planetary warming of two to four degrees Celsius by the end of the twenty-first century, and irreversible impacts worldwide.



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FIGURE 12.3: A schematic projection of global warming by Exxon in 1982. The company envisioned that global warming may already have begun (difference between dashed and solid lines) and that fossil fuels would cause Earth to depart its natural climatic range around the year 2000. *Source*: M. B. Glaser, *CO2 "Greenhouse Effect,"* Exxon Research and Engineering Company, November 12, 1982, fig. 9, p. 28.

Exxon refused to act on its own to reduce or avoid the impacts of its own products, but what if it were forced to by government? Exxon considered this possibility, too, and predicted that the US federal government was unlikely to pursue climate policies until around 1989, when the Department of Energy was expected to finish a ten-year research program on global warming. The industry had time to monitor, plan, and strategize, and between 1984 and 1989, Exxon helped oil companies around the world develop strategies to block climate legislation and treaties through the International Petroleum Industry Environmental Conservation Association.[59]

Exxon wasn't the only oil major assessing the looming climate problem. In 1986 Exxon's Dutch cousin, Shell, completed its own internal assessment, marked CONFIDENTIAL.[60] The report, nearly one hundred pages with appendices, predicted a doubling of atmospheric carbon dioxide by the mid-twenty-first century and a multitude of consequences, including a minimum of around one meter of sea level rise, possible disintegration of the West Antarctic Ice Sheet (which, the company noted, "Would result in a worldwide rise in sea level of 5–6 m[eters]"), and in some parts of the world, a loss of fisheries and increase in "runoff, destructive floods, and inundation of low-lying farmland."[61]

The impacts would be far reaching. "More [than] 30% of the world's population live within a 50-kilometre area adjoining oceans and seas, some even below sea level," Shell's report observed. "Large low-lying areas could be inundated (e.g., Bangladesh) and might have to be abandoned or protected effectively."[62] "Changes in ecosystem stability, disturbance of ecosystem structure and function and even local disappearance of specific ecosystems or habitat destruction could occur."[63] Acidification of seawater could lead to the "disappearance of complete coral islands."[64] "Poorer countries would run the greatest risk" of agricultural impacts, since "their capacity to adapt would be the smallest."[65] Changes in air temperature would require "costly" adaptations, some of which "would drastically change the way people live and work."[66] Carbon dioxide from fossil fuels would have a "substantial impact on global habitability," could require "adaptation, migration, and replacement," and could lead to changes "the greatest in recorded history."[67]

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In such destruction, Shell also saw business opportunities. “Climatic change could alter the relative wealth of certain LDC’s [least developed countries] and lead us to examine the possibilities of expanding or contracting our business accordingly.”[68] And if reforestation efforts were pursued to reduce atmospheric carbon dioxide, the report observed optimistically, “then there would be some call on companies, including Shell, with experience in tropical forestry.”[69]

Like Exxon, Shell refused to take responsibility for the planet-wide impacts of its products. “It will not be appropriate to take the main burden” for solving the problem, the report asserted, asserting that responsibility sat instead with governments and customers.[70] Yet while placing the burden on government, the company also expected government action to be ineffective, stating that even though “it is possible to legislate for a reduction in fossil fuel use, it must be the case that any global reduction is most unlikely.”[71] Thus, the report suggested that global warming would proceed as predicted, while cautioning the company had “very strong interests at stake” and “its own reputation to consider, there being much potential for public anxiety and pressure group activity.”[72] Considering the compendium of disastrous impacts Shell expected, the public had good reason to be anxious, even if it didn’t yet know it.

. . .

As Exxon predicted, legislative attention on global warming emerged in the late 1980s. In 1988 climate scientist James Hansen testified to Congress, telling the nation that anthropogenic global warming was underway, the United Nations established the Intergovernmental Panel on Climate Change, and a government-sponsored conference in Toronto, Canada, called for a tax on fossil fuels and worldwide carbon emissions to be reduced by 20 percent by 2005.[73]

In 1989 the API and other corporate fossil fuel interests created the Global Climate Coalition, an industry alliance that would spread disinformation and block national and international climate policy for over a decade. Even years later, in 1996, API chairman and Exxon CEO Lee Raymond told the public that efforts to reduce fossil fuel use were “based on the unproved theory that they affect the earth’s climate” and that “scientific evidence remains inconclusive as to whether human activities affect global climate.”[74] In 1997 API executive vice president William O’Keefe wrote in the *Washington Post*, “Climate scientists don’t say that burning oil, gas and coal is steadily warming the earth.”[75] And the same year, the Global Climate Coalition said there was “no convincing evidence that future increases in greenhouse

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gas concentrations will produce significant climate effects . . . the scientific community has not yet met the 'burden of proof' that greenhouse gas emissions are likely to cause serious climate impacts."[76]

The industry cultivated climate change denial as a widespread belief, and the public remained unaware that the companies spearheading denial had actually spent decades secretly confirming what they now disavowed. Today, as global warming continues to accelerate, we see the internal predictions of companies like Shell and Exxon coming to pass. The necessary replacement of fossil fuels, which could and should have begun in the 1980s, continues to be delayed, at profound cost to humanity.

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CHAPTER 12: A FUTURE FORESEEN AND TRANSITION DELAYED

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CHAPTER 13: RENEWABLE ENERGIES IN THE UNITED KINGDOM AND THE FEDERAL REPUBLIC OF GERMANY, 1970S–1990S

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