

Inside Climate News

Exxon Confirmed Global Warming Consensus in 1982 with In-House Climate Models

The company chairman would later mock climate models as unreliable while he campaigned to stop global action to reduce fossil fuel emissions.

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Steve Knisely was an intern at Exxon Research and Engineering in the summer of 1979 when a vice president asked him to analyze how global warming might affect fuel use.

“I think this guy was looking for validation that the greenhouse effect should spur some investment in alternative energy that’s not bad for the environment,” Knisely, now 58 and a partner in a management consulting company, recalled in a recent interview.

[Knisely projected](#) that unless fossil fuel use was constrained, there would be “noticeable temperature changes” and 400 parts per million of carbon dioxide (CO₂) in the air by 2010, up from about 280 ppm before the Industrial Revolution. The summer intern’s predictions turned out to be very close to the mark.

Knisely even concluded that the fossil fuel industry might need to leave 80 percent of its recoverable reserves in the ground to avoid doubling CO₂ concentrations, a notion [now known as the carbon budget](#). In 2013, the United Nations’ Intergovernmental Panel on Climate Change formally endorsed the idea.

“The potential problem is great and urgent,” Knisely wrote. “Too little is known at this time to recommend a major U.S. or worldwide change in energy type usage but it is very clear that immediate research is necessary.”

The report, which circulated within the company through the early 1980s, reflected Exxon’s growing need to understand when the climate implications of increased CO₂ emissions would begin to spur policy changes.

So Exxon (now ExxonMobil) shelved an ambitious but costly program that sampled carbon dioxide in the oceans—the centerpiece of its climate research in the 1970s—as it created its own computerized climate models. The models aimed to simulate how the planet’s climate system would react to rising CO₂ levels, relying on a combination of mathematics, physics, and atmospheric science.

Through much of the 1980s, Exxon researchers worked alongside university and government scientists to generate objective climate models that yielded papers published in peer-reviewed journals. Their work confirmed the emerging scientific consensus on global warming’s risks.

Yet starting in 1989, Exxon leaders went down a different road. They repeatedly argued that the uncertainty inherent in computer models makes them useless for important policy decisions. Even as the models grew more powerful and reliable, Exxon publicly derided the type of work its own scientists had done. The company continued its involvement with climate research, but its reputation for objectivity began to erode as it campaigned internationally to cast doubt on the science.

This [eight-month InsideClimate News investigation](#) details Exxon's early research into global warming, based on hundreds of pages of internal documents and interviews with former employees and scientists. The company declined to provide comment or answer questions for this article.

One scientist who crossed over from academia to Exxon Research was [Brian Flannery](#), an associate professor of astronomy from Harvard and an expert in mathematical modeling. Flannery joined the company in 1980. At about the same time, Exxon hired [Andrew Callegari](#), a mathematics professor at New York University. When the company shifted its focus to modeling in 1981, Callegari became head of the company's CO₂ research, replacing [Henry Shaw](#), who had steered the ocean sampling project.

Callegari approached [Martin Hoffert](#), an old colleague at NYU, to work with the Exxon team as a consultant on modeling. Hoffert jumped at the chance. He was already deeply concerned about the consequences of atmospheric carbon and saw the opportunity as an "all hands on deck" approach to heading off an environmental disaster.

"We were all interested as geek scientists at the time," Hoffert, who is now retired, recalled in a recent interview. "There were no divisions, no agendas."

Flannery and Callegari were "very legitimate research guys," Hoffert said. "We talked about the politics of this stuff a lot, but we always separated the politics from the science."

Climate 'Catastrophe' Foreseen

By 1981, Exxon scientists were no longer questioning whether the buildup of CO₂ would cause the world to heat up. Through their own studies and their participation in government-sponsored conferences, company researchers had concluded that rising CO₂ levels could create catastrophic impacts within the first half of the 21st century if the burning of oil, gas and coal wasn't contained.

"When I arrived there, I was quite surprised to discover that people in the research lab were very aware of the increase in the growth rate of carbon dioxide measurements in Hawaii [at the Mauna Loa observatory]," Morrel H. Cohen, a senior scientist at Exxon Research from 1981 to 1996, said in a recent interview. "They were very aware of the greenhouse effect."

As the researchers alerted Exxon's upper management about the CO₂ problem, the scientists worked to provide better estimates of when the warming trend would create noticeable damage, and how large the impacts might be.

One scientist, Werner Glass, wrote an analysis in 1981 for a senior vice president that said the rise in global temperatures would begin to be noticed in a few decades. But Glass hedged his bet, saying the magnitude of the change would be “well short of catastrophic” in the early years.

Exxon manager [Roger Cohen](#) saw things differently.

“I think that this statement may be too reassuring,” Cohen, director of the Theoretical and Mathematical Sciences Laboratory at Exxon Research, [wrote in an August 18, 1981 memo to Glass](#).

He called it “distinctly possible” that the projected warming trend after 2030 “will indeed be catastrophic (at least for a substantial fraction of the earth’s population).”

Cohen continued: “This is because the global ecosystem in 2030 might still be in a transient, headed for much significant effects after time lags perhaps of the order of decades.”

Cohen demonstrated a sophisticated understanding of the climate system. He recognized that even if the impacts were modest in 2030, the world would have locked in enough CO₂ emissions to ensure more severe consequences in subsequent decades. By 2030, he warned, the damage could be irreversible.

Unanimous Agreement

“Over the past several years a clear scientific consensus has emerged regarding the expected climatic effects of increased atmospheric CO₂,” [Cohen wrote to A.M. Natkin](#) of Exxon Corporation’s Science and Technology Office in 1982. “The consensus is that a doubling of atmospheric CO₂ from its pre-industrial revolution value would result in an average global temperature rise of $(3.0 \pm 1.5)^{\circ}\text{C}$.” (Equal to $5.4 \pm 2.7^{\circ}\text{F}$).

“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 in the biosphere.”

Exxon’s own modeling research confirmed this and the company’s results were later published in at least three peer-reviewed science articles. Two of them were [co-authored by Hoffert](#), and a third was [written entirely by Flannery](#).

Exxon’s modeling experts also explained away the less-dire predictions of a 1979 study led by Reginald Newell, a prominent atmospheric scientist at the Massachusetts Institute of Technology. [Newell’s model projected](#) that the effects of [climate change](#) would not be as severe as most scientists were predicting.

Specifically, Newell and a co-author from the Air Force named Thomas Dopplack challenged the prevailing view that a doubling of the earth’s CO₂ blanket would raise temperatures about

3°C (5°F)— a measure known as climate sensitivity. Instead, they said the earth’s true climate sensitivity was roughly less than 1°C (2°F).

They based their results on a mechanism called “evaporative buffering,” in which excess warming at the equator causes increased evaporation, cooling the planet in the same way that perspiration cools a marathon runner.

[Exxon’s research team disagreed](#). Even if the mechanism cooled the equator, the worldwide warming would still be higher, they found, according to the researchers’ peer-reviewed studies.

“In summary, the results of our research are in accord with the scientific consensus on the effect of increased atmospheric CO₂ on climate,” Cohen wrote in the 1982 letter he sent to Natkin.

Exxon’s science turned out to be spot on, and the company’s early modeling projections still hold up more than 30 years later, Hoffert said in an email to InsideClimate News. The Arctic’s rapid warming and the extreme vulnerability of Antarctica’s ice sheets are “consistent with the results of our theory which predicted them before they happened,” Hoffert wrote.

Exxon “should be taking credit for their role in developing useful model predictions of the pattern of global warming by their research guys, as opposed to their [denialist](#) lobbyists saying global warming from fossil fuel burning doesn’t exist or is at best ‘unproven,’” he wrote.

Spreading the Word, Internally

The conclusions of Exxon’s climate modeling were being circulated broadly within the company in the 1980s.

Marvin B. Glaser, an Environmental Affairs Manager at Exxon, [distributed a 43-page primer](#) on climate change on Nov. 12, 1982.

In a cover letter to 15 Exxon executives and managers, Glaser said the document provided guidance “on the CO₂ ‘Greenhouse’ Effect which is receiving increased attention in both the scientific and popular press as an emerging environmental issue.” He continued: “The material has been given wide circulation to Exxon management and is intended to familiarize Exxon personnel with the subject.”

“However, it should be restricted to Exxon personnel and not distributed externally,” he wrote.

Glaser’s primer drew from the best research of the time, including Exxon’s, to explain how global temperatures would rise considerably by the end of the 21st century. Because of the warming, “there are some potentially catastrophic events that must be considered,” including sea level rise from melting polar ice sheets, according to the document. It noted that some scientific groups were concerned “that once the effects are measurable, they might not be reversible.”

Reining in “the greenhouse effect,” the primer said, “would require major reductions in fossil fuel combustion.”

Yet the report also argued against a rapid shift to non-fossil fuel energy sources, noting that “making significant changes in energy consumption...amid all the scientific uncertainties would be premature in view of the severe impact such moves could have on the world’s economies and societies.”

Exxon’s reputation for conducting serious carbon dioxide research was growing outside the company. Its scientists were frequent participants on industry and government panels.

Flannery, for example, contributed to a multi-volume series of Energy Department reports published in 1985 on the state of climate change science. It concluded that atmospheric carbon dioxide concentrations had already increased by about 25 percent in the past century, and continued use of fossil fuels would lead to substantial temperature increases in the future.

Flannery was the only industry representative among 15 scientists [who wrote the volume titled](#) “Projecting the Climatic Effects of Increasing Carbon Dioxide.”

Hoffert and Flannery co-authored a chapter that concluded that since the Industrial Revolution the Earth would warm 1°C (or 2°F) by 2000 and rise another 2 to 5°C (4 to 9°F) over the next hundred years.

As it turned out, the world’s temperature has risen about 0.8°C (1.4°F) and mainstream scientists continue to predict, with increasing urgency, that if emissions are not curtailed, carbon pollution would lock in warming of as much as 3 to 6°C (or 5 to 11°F) over the next several decades.

Quantifying the Uncertainty

Throughout its climate modeling phase, Exxon researchers, like outside scientists, grappled with the uncertainties inherent in climate model projections.

“Models are being used to explore physical effects (scenarios) and as a predictive tool,” [Andrew Callegari said in a Feb. 2, 1984 presentation](#) for colleagues. The “validity of models [are] not established,” Callegari wrote. “Complexity of carbon cycle and climate system require many approximations.”

Scientists, regulators and Exxon all had to ask themselves: what should be done, given that uncertainty? Should governments and corporations wait for the ambiguities to be resolved before acting to cut fossil fuel emissions? Or should the researchers recommend immediate action because of a preponderance of evidence?

Since then, modeling has become an increasingly useful and reliable tool. The IPCC, the United Nations institution that compiles the scientific consensus on global warming, has issued a series of reports since 1990 based on those models. Each report has grown more certain. By the fifth report in 2013, the IPCC said it was “*extremely likely* that human influence has been the dominant cause of the observed warming since the mid-20th century.”

As the consensus grew within the scientific world, Exxon doubled down on the uncertainty. Its campaign to muddy research results placed the company outside the scientific mainstream. Some of the researchers who once led the company's modeling became vocal climate contrarians, among them Brian Flannery and Roger Cohen.

Flannery survived the lay-offs of the mid-1980s that decimated the Exxon Research staff and rose in the corporate ranks to become the company's chief scientist. He attended IPCC meetings from the outset and by the early 1990s, he emerged as a prominent skeptic of the science he had once conducted.

For example, in a 1999 paper based on a speech to Exxon's European affiliates, Flannery derided the second IPCC assessment that concluded in 1995 that the scientific evidence suggested "a discernible human influence on climate."

"You'll note that this is a very carefully worded statement, recognizing that the jury is still out, especially on any quantifiable connection to human actions," Flannery wrote. "The conclusion does not refer to global warming from increases in greenhouse gases. Indeed, many scientists say that a great deal of uncertainty still needs to be resolved."

The change in Cohen's thinking was also stark, as he acknowledged in 2008. While still at Exxon he was "well convinced, as were most technically trained people, that the IPCC's case for Anthropogenic Global Warming (AGW) is very tight." But he wrote in a 2008 essay for the Science and Public Policy Institute, a climate denial website, that upon closer inspection of the research he found it to be "flimsy."

In 2007, the American Physical Society, the country's largest organization of physicists, adopted a strong statement on climate change that said "The evidence is incontrovertible: Global warming is occurring."

Cohen, an APS fellow, helped lead a campaign to weaken the APS's official position and earlier this year succeeded in stripping out the word 'incontrovertible' from a draft text. APS members will vote on the final language in November.

Flannery and Cohen declined to comment, despite multiple requests.

Exxon's former chairman and CEO, [Lee Raymond](#), took an even tougher line against climate science. Speaking before the World Petroleum Congress in Beijing in 1997, Raymond mocked climate models in an effort to stop the imminent adoption of the Kyoto Protocol, an international accord to reduce emissions.

"They are notoriously inaccurate," Raymond said. "1990's models were predicting temperature increases of two to five degrees Celsius by the year 2100," he said, without explaining the source of those numbers. "Last year's models say one to three degrees. Where to next year?"