



# What Exxon knew about the Earth's melting Arctic

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ack in 1990, as the debate over climate change was heating up, a dissident shareholder petitioned the board of Exxon,

one of the world's largest oil companies, imploring it to develop a plan to reduce carbon dioxide emissions from its

production plants and facilities.

The board's response: Exxon had studied the science of global warming and concluded it was too murky to warrant action. The company's "examination of the issue supports the conclusions that the facts today and the projection of future effects are very unclear."

Yet in the far northern regions of Canada's Arctic frontier, researchers and engineers at Exxon and Imperial Oil were quietly incorporating climate change projections into the company's planning and closely studying how to adapt the company's Arctic operations to a warming planet.

Ken Croasdale, senior ice researcher for Exxon's Canadian subsidiary, was leading a Calgary-based team of researchers and engineers that was trying to determine how global warming could affect Exxon's Arctic operations and its bottom line.



Top, the loss of sea ice due to climate change has taken a toll on wildlife. (Mike Lockhart / U.S. Geological Survey, Associated Press) Bottom, rapidly thawing permafrost is changing the landscape in Canada's Northwest Territories. (Scott Zolkos / The Canadian Press)

"Certainly any major development with a life span of say 30-40 years will need to assess the impacts of potential global warming," Croasdale told an engineering conference in 1991. "This is particularly true of Arctic and offshore projects in Canada, where warming will clearly affect sea ice, icebergs, permafrost and sea levels."

Between 1986 and 1992, Croasdale's team looked at both the positive and negative effects that a warming Arctic would have on oil operations, reporting its findings to Exxon headquarters in Houston and New Jersey.

The good news for Exxon, he told an audience of academics and government researchers in 1992, was that "potential

global warming can only help lower exploration and development costs” in the Beaufort Sea.

But, he added, it also posed hazards, including higher sea levels and bigger waves, which could damage the company’s existing and future coastal and offshore infrastructure, including drilling platforms, artificial islands, processing plants and pump stations. And a thawing earth could be troublesome for those facilities as well as pipelines.

As Croasdale’s team was closely studying the impact of climate change on the company’s operations, Exxon and its worldwide affiliates were crafting a public policy position that sought to downplay the certainty of global warming.

The gulf between Exxon’s internal and external approach to climate change from the 1980s through the early 2000s was evident in a review of hundreds of internal documents, decades of peer-reviewed published material and dozens of interviews conducted by Columbia University’s Energy & Environmental Reporting Project and the Los Angeles Times.

Documents were obtained from the Imperial Oil collection at Calgary’s Glenbow Museum and the Exxon Mobil Historical Collection at the University of Texas at Austin’s Briscoe Center for American History.

“We considered climate change in a number of operational and planning issues,” said Brian Flannery, who was Exxon’s in-house climate science advisor from 1980 to 2011. In a recent interview, he described the company’s internal effort to study the effects of global warming as a competitive necessity: “If you don’t do it, and your competitors do, you’re at a loss.”

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Imperial Oil’s Dartmouth refinery in Halifax, Canada. Exxon Mobil owns about 70% of the company. (Andrew Vaughan / The Canadian Press, Associated Press)

The Arctic holds about one-third of the world’s untapped natural gas and roughly 13% of the planet’s undiscovered oil, according to the U.S. Geological Survey. More than three-quarters of Arctic deposits are offshore.

Imperial Oil, about 70% of which is owned by Exxon Mobil, began drilling in the frigid Arctic waters of the Canadian Beaufort Sea in the early 1970s. By the early 1990s, it had drilled two dozen exploratory wells.

The exploration was expensive, due to bitter temperatures, wicked winds and thick sea ice. And when a worldwide oil slump drove petroleum prices down in the late 1980s, the company began scaling back those efforts.

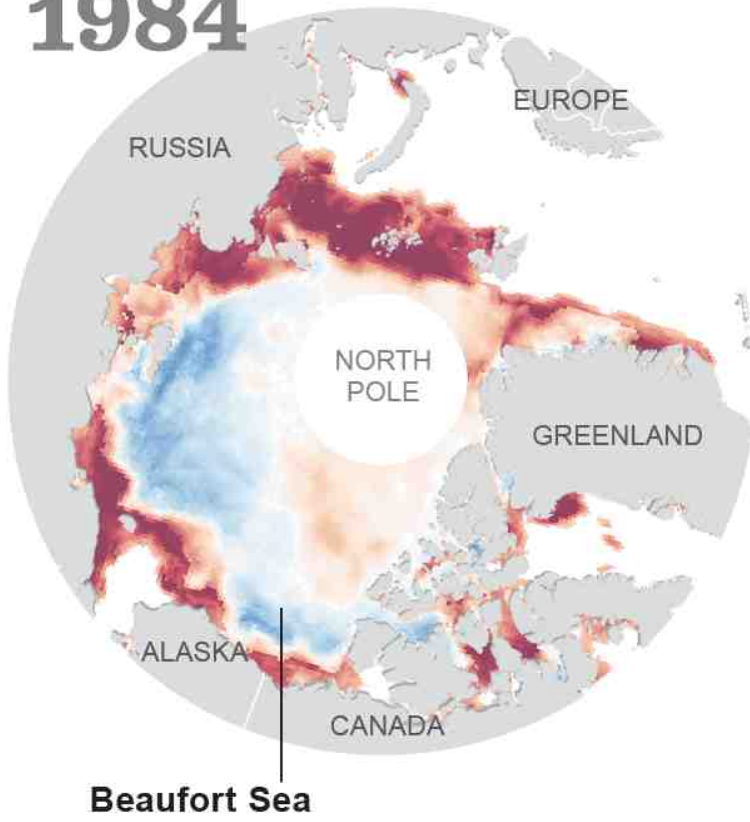
### Changes in Arctic sea ice from 1984 to 2013

Less ice

More ice



# 1984

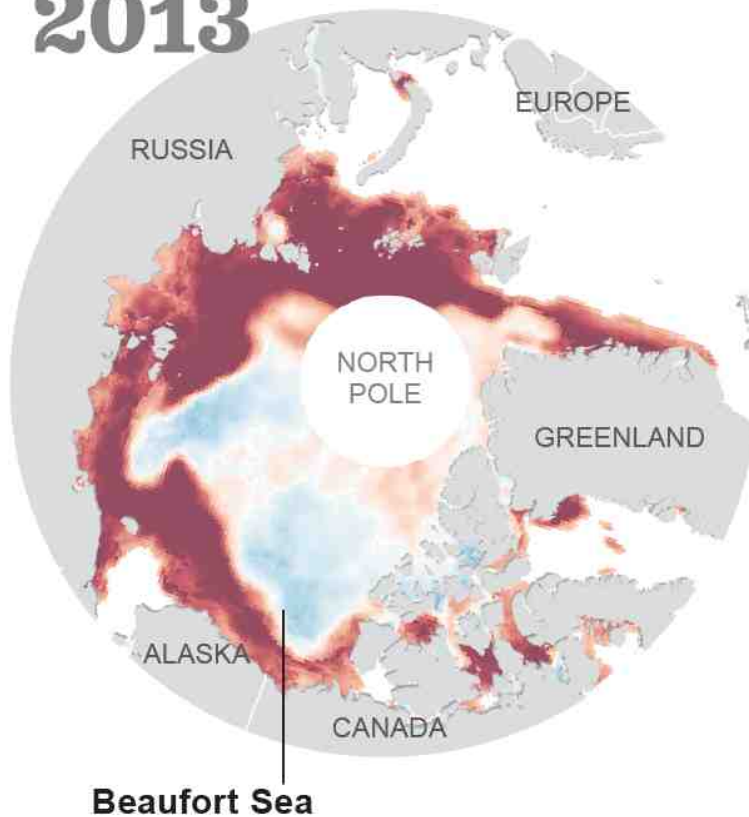


Less ice

More ice



2013



Before: Arctic ice coverage in 1984. After: Receding coverage in 2013.

But with mounting evidence the planet was warming, company scientists, including Croasdale, wondered whether climate change might alter the economic equation. Could it make Arctic oil exploration and production easier and cheaper?

“The issue of CO<sub>2</sub> emissions was certainly well-known at that time in the late 1980s,” Croasdale said in an interview.

Since the late 1970s and into the 1980s, Exxon had been at the forefront of climate change research, funding its own internal science as well as research from outside experts at Columbia University and MIT.

With company support, Croasdale spearheaded the company’s efforts to understand climate change’s effects on its Arctic operations. A company such as Exxon, he said, “should be a little bit ahead of the game trying to figure out what it was all about.”

Exxon Mobil describes its efforts in those years as standard operating procedure. “Our researchers considered a wide range of potential scenarios, of which potential climate change impacts such as rising sea levels was just one,” said Alan Jeffers, a spokesman for Exxon Mobil.

The Arctic seemed an obvious region to study, Croasdale and other experts said, because it was likely to be most affected by global warming.

That reasoning was backed by models built by Exxon scientists, including Flannery, as well as Marty Hoffert, a New York University physicist. Their work, published in 1984, showed that global warming would be most pronounced near the poles.

Between 1986, when Croasdale took the reins of Imperial’s frontier research team, until 1992, when he left the company, his team of engineers and scientists used the global circulation models developed by the Canadian Climate Centre and NASA’s Goddard Institute for Space Studies to anticipate how climate change could affect a variety of



operations in the Arctic.

These were the same models that — for the next two decades — Exxon’s executives publicly dismissed as unreliable and based on uncertain science. As Chief Executive Lee Raymond explained at an annual meeting in 1999, future climate “projections are based on completely unproven climate models, or, more often, on sheer speculation.”

One of the first areas the company looked at was how the Beaufort Sea could respond to a doubling of carbon dioxide in the atmosphere, which the models predicted would happen by 2050.

Greenhouse gases are rising “due to the burning of fossil fuels,” Croasdale told an audience of engineers at a conference in 1991. “Nobody disputes this fact,” he said, nor did anyone doubt those levels would double by the middle of the 21st century.

Using the models and data from a climate change report issued by Environment Canada, Canada’s environmental agency, the team concluded that the Beaufort Sea’s open water season — when drilling and exploration occurred — would lengthen from two months to three and possibly five months.

They were spot on.



Seismic lines are used to detect natural gas and other underground deposits on the frozen Beaufort Sea. (Tom Cohen / Associated Press)

In the years following Croasdale’s conclusions, the Beaufort Sea has experienced some of the largest losses in sea ice in the Arctic and its open water season has increased significantly, according to Mark Serreze, a senior researcher at the National Snow and Ice Data Center in Boulder, Colo.

For instance, in Alaska’s Chukchi Sea, west of the Beaufort, the season has been extended by 79 days since 1979, Serreze said.

An extended open water season, Croasdale said in 1992, could potentially reduce exploratory drilling and construction costs by 30% to 50%.



Members of the environmental group Greenpeace work to hang a banner protesting oil drilling at the Alyeska Pipeline Service Co.’s Valdez, Alaska terminal, on August 5, 1991. (Carey Anderson / Associated Press)

He did not recommend making investment decisions based on those scenarios, because he believed the science was still uncertain. However, he advised the company to consider and incorporate potential “negative outcomes,” including a rise in the sea level, which could threaten onshore infrastructure; bigger waves, which could damage offshore drilling structures; and thawing permafrost, which could make the earth buckle and slide under buildings and pipelines.

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The most pressing concerns for the company centered on a 540-mile pipeline that crossed the Northwest Territories into Alberta, its riverside processing facilities in the remote town of Norman Wells, and a proposed natural gas facility and pipeline in the Mackenzie River Delta, on the shores of the Beaufort Sea.

The company hired Stephen Lonergan, a Canadian geographer from McMaster University, to study the effect of climate change there.

Lonergan used several climate models in his analysis, including the NASA model. They all concluded that things would get warmer and wetter and that those effects “cannot be ignored,” he said in his report.

As a result, the company should expect “maintenance and repair costs to roads, pipelines and other engineering structures” to be sizable in the future, he wrote.

A warmer Arctic would threaten the stability of permafrost, he noted, potentially damaging the buildings, processing plants and pipelines that were built on the solid, frozen ground.

In addition, the company should expect more flooding along its riverside facilities, an earlier spring breakup of the ice pack, and more-severe summer storms.

But it was the increased variability and unpredictability of the weather that was going to be the company’s biggest challenge, he said.

Record-breaking droughts, floods and extreme heat — the worst-case scenarios — were now events that not only were likely to happen, but could occur at any time, making planning for such scenarios difficult, Lonergan warned the company in his report. Extreme temperatures and precipitation “should be of greatest concern,” he wrote, “both in terms of future design and ... expected impacts.”

The fact that temperatures could rise above freezing on almost any day of the year got his superiors’ attention. That “was probably one of the biggest results of the study and that shocked a lot of people,” he said in a recent interview.

Lonergan recalled that his report came as somewhat of a disappointment to Imperial’s management, which wanted specific advice on what action it should take to protect its operations. After presenting his findings, he remembered, one engineer said: “Look, all I want to know is: Tell me what impact this is going to have on permafrost in Norman Wells and our pipelines.”

As it happened, J.F. “Derick” Nixon, a geotechnical engineer on Croasdale’s team, was studying that question.

He looked at historical temperature data and concluded Norman Wells could grow about 0.2 degrees warmer every year. How would that, he wondered, affect the frozen ground underneath buildings and pipelines?

“Although future structures may incorporate some consideration of climatic warming in their design,” he wrote in a technical paper delivered at a conference in Canada in 1991, “northern structures completed in the recent past do not have any allowance for climatic warming.” The result, he said, could be significant settling.

Nixon said the work was done in his spare time and not commissioned by the company. However, Imperial “was certainly aware of my work and the potential effects on their buildings.”

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Exxon Mobil declined to respond to requests for comment on what steps it took as a result of its scientists’ warnings. According to Flannery, the company’s in-house climate expert, much of the work of shoring up support for the infrastructure was done as routine maintenance.

“You build it into your ongoing system and it becomes a part of what you do,” he said.

Today, as Exxon’s scientists predicted 25 years ago, Canada’s Northwest Territories has experienced some of the most dramatic effects of global warming. While the rest of the planet has seen an average increase of roughly 1.5 degrees in the last 100 years, the northern reaches of the province have warmed by 5.4 degrees and temperatures in central regions

have increased by 3.6 degrees.

Since 2012, Exxon Mobil and Imperial have held the rights to more than 1 million acres in the Beaufort Sea, for which they bid \$1.7 billion in a joint venture with BP. Although the companies have not begun drilling, they requested a lease extension until 2028 from the Canadian government a few months ago. Exxon Mobil declined to comment on its plans there.

Croasdale said the company could be “taking a gamble” the ice will break up soon, finally bringing about the day he predicted so long ago — when the costs would become low enough to make Arctic exploration economical.

*Amy Lieberman and Elah Feder contributed to this report.*



Coast Guard crew members at work on a mission with NASA to study changing Arctic conditions. Exxon has used such studies to help plan future operations. (NASA / Kathryn Hansen / Rex Features)

### **Contact the reporters**

**About this story:** Over the last year, the Energy and Environmental Reporting Project at Columbia University’s Graduate School of Journalism, with the Los Angeles Times, has been researching the gap between Exxon Mobil’s public position and its internal planning on the issue of climate change. As part of that effort, reporters reviewed hundreds of documents housed in archives in Calgary’s Glenbow Museum and at the University of Texas. They also reviewed scientific journals and interviewed dozens of experts, including former Exxon Mobil employees. This is the first in a series of occasional articles.

**Additional credits:** Digital producer: [Evan Wagstaff](#). Lead photo caption: Ice in the Chukchi Sea breaks up in open water season, making oil exploration cheaper and easier.