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Denial, Disinformation, and Doublespeak:
Big Oil's Evolving Efforts to Avoid Accountability for Climate Change

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Big oil is the new big tobacco. Investigative journalism, white paper reports, and peer-reviewed research, including my own, clearly demonstrate that the fossil fuel regime has deliberately denied Americans and Congress their right to be accurately informed about the climate crisis, just as tobacco companies misled Americans about the harms of smoking¹ (Appendix A). From strategy to networks to personnel to rhetoric, the fossil fuel industry's efforts to deny and delay come straight out of Big Tobacco's playbook, always following the same four key steps:

1. Learn about the dangers of their products.
2. Scheme.
3. Deny the science and scaremonger about the economy.
4. Delay action with other forms of propaganda.

My testimony summarizes each of these four steps. It is based on thousands of pages of documented evidence uncovered and analyzed by scholars, investigative journalists, and advocacy researchers.

Step 1: Oil companies learn about the dangers of their products.

The fossil fuel industry has known that its products could cause dangerous climate change for more than half a century (see also, for example, Appendix B)².

In 1959 – 65 years ago – physicist Edward Teller warned the American oil industry's largest trade association, the American Petroleum Institute (API), that burning fossil fuels could lead to global warming "sufficient to melt the ice cap and submerge New York"³. The industry's knowledge continued to grow in the 1960s and 1970s, with API commissioning multiple reports, one warning of almost certain warming by 2000⁴. Between 1979 and 1983, API and some of America's largest oil companies ran a task force to monitor and share climate science research. As *Inside Climate News* reported, "The group's members included senior scientists and engineers from nearly every major U.S. and multinational oil and gas company, including Exxon, Mobil, Amoco, Phillips, Texaco, Shell, Sunoco, Sohio as well as Standard Oil of California and Gulf Oil, the predecessors to Chevron..."⁵.

At one of API's member companies, Exxon, scientists began studying the problem, conducting cutting-edge climate research throughout the 1970s and 80s, as originally reported by investigative journalists at *Inside Climate News* and the *Los Angeles Times* in 2015^{6,7}. As a 1980 'CO2 Greenhouse Communications Plan' explained, "The research is...significant to Exxon since future public decisions aimed at controlling the buildup of atmospheric CO₂ could impose limits on fossil fuel combustion"⁸. By the late 1970s, Exxon scientists explicitly recognized the likelihood of "dramatic environmental effects before 2050"⁹. "By the late 1970s," an Exxon scientist from the period recently recalled, "global warming was no longer speculative"¹⁰. In 1982, Exxon scientists warned their executives of "potentially catastrophic" climate impacts¹¹.

My peer-reviewed research, coauthored with climate scientist Dr. Stefan Rahmstorf (University of Potsdam) and science historian Dr. Naomi Oreskes (Harvard University), has statistically proven that between 1977 and 2003, Exxon's scientists modeled and predicted global warming with shocking skill and accuracy (Appendix C)¹². First, based on every available global warming projection reported by Exxon and ExxonMobil scientists between those years, we found that Exxon knew that fossil fuel burning

was going to heat the planet by 0.20 ± 0.04 °C every decade. We then statistically tested the performance of all of Exxon's climate predictions using established statistical techniques reported by the United Nations (UN)'s Intergovernmental Panel on Climate Change (IPCC) to compare projections against historical observations. We found that most of Exxon's projections (63-83%, depending on the metric used) accurately forecast warming consistent with subsequent observations. Indeed, their projections were also consistent with, and at least as skillful as, those of independent academic and government models. We also used various other empirical analyses to show that Exxon and ExxonMobil: (1) correctly rejected the prospect of a coming ice age, (2) accurately predicted when human-caused global warming would first be detectable, and (3) reasonably estimated the 'carbon budget' for holding warming below 2°C. It is noteworthy that even in its effort to formally critique our peer-reviewed research, ExxonMobil has not disputed the way in which we have classified any of its private and public statements¹³.

Scholars and investigative journalists have revealed that numerous other fossil fuel interests have also variously known about the basics of climate science and its implications for decades, including: Ford motor company since at least 1961¹⁴; coal companies since at least 1966¹⁵; utilities companies since at least 1968¹⁶; the Italian oil company Eni since at least 1970¹⁷; the French oil company TotalEnergies since at least 1971¹⁸; and Shell oil company and General Motors auto company since at least 1975^{14,19}.

And yet, instead of alerting the public about the coming climate crisis or taking action, the fossil fuel industry stayed silent for as long as they could, until what Exxon privately called a "critical event" in 1988, when NASA climate scientist Dr. James Hansen testified to the United States (U.S.) Congress that he was now 99% confident human-caused global warming was underway²⁰. Climate change became frontpage news and politicians began to take note. "We're starting to hear the inevitable call for action," the Exxon memo warned²⁰.

Step 2: Oil companies scheme.

At that point in 1988, the fossil fuel industry schemed, devising a PR strategy straight out of Big Tobacco's playbook: to weaponize science against itself.

Starting in 1988-89, Exxon set out to "Extend the science" and "emphasize the uncertainty in scientific conclusions regarding the potential enhanced Greenhouse effect"^{20,21}. Or as a leaked memo put it in 1998, "Victory will be achieved when average citizens" and the "media recognize uncertainties in climate science"²². The plan's architects were Exxon, Chevron, API, utilities companies, and numerous front groups funded by fossil fuel companies, tobacco companies, and libertarian billionaires. The 1991 strategy of coal and utilities industries was even blunter: "Reposition global warming as theory (not fact)"²³.

Other memos also put climate economics in the fossil fuel industry's crosshairs. A 1989 Exxon internal strategy memo, for example, advised that the company's public communications should "Increase emphasis on costs/political realities" of addressing climate change²⁰. A 1995 "communications plan" of the industry's Global Climate Coalition identified their key public "messages" as not just "Science - continued uncertainty of the science" but also "Economics - loss of jobs, higher energy costs, diminished competitiveness" and "Sovereignty - America concedes energy/environmental policy to international bureaucracy"²⁴.

From the late 1980s, oil companies and their trade associations - variously abetted by front groups as well as PR²⁵, consulting²⁶ and even law firms²⁷ - have waged a multi-decade, multi-billion dollar campaign of disinformation, lobbying, propaganda, and the colonization of academia to sabotage science, scare and confuse the public and politicians, and undermine climate and clean energy policies. Big Oil became the new Big Tobacco.

Step 3: Oil companies deny climate science and scaremonger about the economy.

The fossil fuel industry has perpetuated disinformation about climate science and economics in at least four ways: (A) by doing it themselves, and also by funding (B) contrarian scientists, (C) organizations, and (D) politicians to do it for them (for further discussion see Appendix D)²⁸.

(3A) Direct Disinformation

No company has itself denied climate science and scaremongered about the economy more than ExxonMobil. In 2000, for example, ExxonMobil ran an advertisement in *The New York Times* entitled “Unsettled Science”²⁹. Against a “backdrop of large, poorly understood natural variability,” they wrote, “it is impossible for scientists to attribute the recent small surface temperature increase to human causes.” That was untrue. Five years earlier, the UN’s IPCC had concluded a “discernible human influence on global climate”³⁰. ExxonMobil went so far as to claim that the IPCC’s conclusion was “not peer-reviewed”³¹. It was. In fact, the company’s chief climate scientist was a contributing author to the report³².

ExxonMobil’s misrepresentations of mainstream science continued for more than a decade³³. In 2001, the company issued a press release that claimed “there is no consensus about long-term climate trends and what causes them” and presented global cooling as a legitimate alternative to warming, even though scientists had debunked that idea 23 years earlier^{34,35}. In 2015, the company’s then-CEO Rex Tillerson stated: “We do not really know what the climate effects of 600 ppm [parts per million of greenhouse gases] versus 450 ppm will be because the models simply are not that good”³⁶. The company’s own models, developed decades earlier by the company’s own scientists, contradict such statements. A 1982 global warming projection developed by Exxon scientists, for example, indicated that 600 ppm of atmospheric CO₂ would lead to 1.3°C more global warming than 450 ppm³⁷.

In 2017 and 2020, I and Dr. Naomi Oreskes published the first peer-reviewed analyses of ExxonMobil’s 40-year history of climate change communications (Appendices E and F)^{12,13}. We found that between 1996 and 2017, Mobil and ExxonMobil issued at least 45 advertisements and other public statements that contradicted mainstream science.

Despite this, in a 2021 hearing convened by the House Oversight Committee, ExxonMobil CEO Darren Woods repeatedly affirmed that the company’s public statements about climate change have always “been consistent with the general consensus in the scientific community” (for a more detailed discussion of the hearing, see Appendix G)^{38,39}. This is clearly untrue. In fact, our research has shown that ExxonMobil’s public statements about climate change have mostly *not* been consistent even with the company’s *own* internal and scientific positions^{12,13}. On the one hand, we found, Exxon’s internal documents, as well as peer-reviewed studies authored or coauthored by Exxon and ExxonMobil Corp scientists,

overwhelmingly acknowledged that global warming is real and human-caused. By contrast, we found that the majority of Mobil and ExxonMobil Corp’s public communications promoted doubt on the matter.

When asked at the hearing if ExxonMobil now accepts that climate change is real and human-caused, current CEO Woods beat around the bush, saying, “Increased greenhouse gases *can contribute* to the effects of climate change”⁴⁰. “Can” suggests uncertainty; “contribute” implies additional significant causes. This echoed Congressional testimony by Woods’ predecessor, former ExxonMobil CEO Rex Tillerson, who in 2017 wrote to Senator Ben Cardin (D-MD): “I agree with the consensus view that combustion of fossil fuels is a leading cause for increased concentrations of greenhouse gases in the atmosphere. I understand these gases to be a *factor* in rising temperature, but *I do not believe the scientific consensus supports their characterization as the ‘key’ factor*” (emphases added)⁴¹.

In contrast, the IPCC says that “human influence on the climate system is now an established fact” and that increased greenhouse gases have caused 98 percent of global warming⁴². Woods’s peers from Chevron, API, and the U.S. Chamber of Commerce all stuck to the same script at the 2021 hearing.

As a scholar of disinformation, I do not use the word “lie” lightly. But no other word adequately describes the oil industry’s brazen efforts to mislead the public about its history of misleading the public (see sections C and D below for further examples of this deceptive behaviour). This deceit is consistent with the oil companies’ wider obstruction of the Committee’s investigation.

(3B) Contrarian scientists and economists

The fossil fuel industry has also denied climate science by funding contrarian scientists and economists.

For example, as uncovered by Greenpeace and the Climate Investigations Center, astrophysicist Dr. Willie Soon published academic articles - or “deliverables” - in exchange for \$1.25 million from fossil fuel companies - including \$335,000 from fossil fuel interests including ExxonMobil, Southern Company, Texaco (now part of Chevron), API, the Koch Foundation, and others⁴³. In his articles, which often failed to disclose these conflicts of interest, Soon repeatedly emphasized the “flawed notion” of CO₂-driven climate change, wrongly blamed sunspots for warming, and claimed “too much ice is really bad for polar bears”⁴⁴.

API has likewise repeatedly hired a small group of economic consultants - specifically Paul Bernstein and David Montgomery, originally of Charles River Associates - to publish reports that exaggerate the costs and ignore the benefits of climate action⁴⁵. The oil industry commissioned and touted these reports to oppose climate policies on the basis of incorrectly high cost estimates throughout the 1990s, including, as Dr. Benjamin Franta (Oxford University) has chronicled, in 1991 against carbon dioxide control, in 1993 against the Clinton Administration’s proposed BTU tax, in 1996 against the goals of the U.N. Conference of Parties in Geneva, in 1997 against the goals of the U.N. Conference of Parties in Kyoto, and in 1998 against the Kyoto Protocol’s implementation⁴⁶. Two decades later, in 2017, when President Trump announced that he was withdrawing the U.S. from the Paris Agreement, he did so citing the same flawed economic arguments by the same oil industry-funded consultants⁴⁶.

(3C) Third-party allies

Big oil has also used third-party allies to do its dirty work.

ExxonMobil alone gave \$39 million to 73 climate-denying organizations between 1992 and 2017⁴⁷. Yet ExxonMobil is just one cog in a well-funded, well-oiled climate denial and delay machine. A labyrinth of people and money connecting fossil fuel companies, foundations, think tanks, PR firms, consultancies, law firms, and front groups; all feeding an echo chamber of AstroTurfs, media, blogs, and politicians^{48,49}. Sociologist Dr. Justin Farrell (Yale University) has identified at least 164 organizations and 4,556 individuals in this climate denial and delay machine, which has worked for decades to create an “ecosystem of influence” on our public and politicians^{50,51}.

To give just one example, BP, Chevron, Exxon, Shell, and API were all members of the Global Climate Coalition, which spent \$13 million campaigning against the 1997 UN Kyoto climate protocol and was so successful that the State Department told them: President Bush “rejected Kyoto in part based on input from you”^{52,53}.

As part of that campaign, the Global Climate Coalition ran an advertisement in 1997 featuring the faces of smiling children, imploring Bush: “Americans work hard for what we have, Mr. President. Don’t risk our economic future”⁵⁴. The coalition also circulated a briefing in 1996 entitled “The IPCC: Institutionalized ‘Scientific Cleansing’?” wrongly alleging that Dr. Ben Santer, an atmospheric scientist at Lawrence Livermore National Laboratory, had manipulated the IPCC’s peer-review process to make unsubstantiated claims⁵⁵. At a time of ethnic cleansing in Bosnia, Santer found this false allegation “deeply disturbing. My family had been ‘cleansed’ by the Nazis in the Second World War; the GCC’s words reopened old wounds”⁵⁶. The Global Climate Coalition’s rhetoric gained mainstream coverage and served, in Santer’s words, to “put the IPCC – and my own scientific integrity – on trial”^{57,58}.

This hostile approach to critics is echoed by the firsthand experiences of me and my colleagues. ExxonMobil has attacked me, Dr. Naomi Oreskes, and our work with straw man arguments, falsehoods, cherry picking, conspiracy theories, intellectual hit jobs, and *ad hominem* attacks^{59–61}. When I was invited to testify to European parliament as an expert witness about ExxonMobil’s history of climate denial in 2019, the company sent a now-leaked memo to Members of European Parliament in an attempt to discredit me⁶⁰. And for roughly three years (2017-20), ExxonMobil ran a social media campaign accusing me and Dr. Oreskes of publishing “manufactured” science at the behest of “a political campaign”⁶². It was viewed millions of times. It has become a familiar pattern. We publish science, ExxonMobil offers spin. Aggressive attitudes are also reflected in the documents made public in 2022 by the House Oversight Committee’s ‘Investigation of Fossil Fuel Industry Disinformation on Climate Crisis’, which, for example, revealed a Shell employee hoping climate activists get “bedbugs”⁶³.

As discussed in Section A above, fossil fuel interests have repeatedly misled the public about their history of misleading the public. This is the case not just at the level of direct disinformation by companies themselves, but also at the level of third-party allies. In 2017, almost a decade after ExxonMobil pledged in 2008 to “discontinue contributions to several public policy research groups whose position on climate change could divert attention from the important discussion on how the world will secure the energy required for economic growth in an environmentally responsible manner,” the company gave \$1.5 million

to 11 climate denying organizations^{64,65}. This directly contradicts 2015 claims by the company's spokesman Richard Keil that "ExxonMobil does not fund climate denial" and that "We do not fund or support those who deny the reality of climate change"^{66,67}.

(3D) Climate-denying politicians.

The fossil fuel industry has also recruited and funded climate-denying politicians.

For instance, Senator Jim Inhofe (R-OK), who retired last year, has repeatedly described global warming as "the greatest hoax ever perpetrated on the American people," compared environmentalists to Nazis, and insisted that climate change is impossible because "God's still up there"²⁸. Inhofe has taken \$1.85 million in campaign contributions from oil and gas companies, including in 2015; the year that he tried to refute record temperatures by producing a snowball on the Senate floor^{28,68}.

More broadly, climate-denying members of the 113th Congress received, on average, four times as much money from fossil fuel companies as those who accept climate science⁶⁹. Indeed, Dr. Matthew Goldberg (Yale University) and his colleagues have shown statistically that the more Congresspeople vote against the environment, the more money they receive from fossil fuel companies⁷⁰.

As in Section C above, fossil fuel interests have repeatedly misled the public about their history of misleading the public, including at the level of climate-denying politicians. In fact, ExxonMobil's support of climate-denying members of Congress rose dramatically since its 2008 pledge, quoted in Section C, to end support of climate denial: between 2007-08 and 2013-14, both Exxon's total monetary contributions to climate-denying Congresspersons and the number of funded climate-denying Congresspersons more than doubled²⁸.

In total, between 2007 and 2016, ExxonMobil gave at least \$1.88 million to climate-denying members of Congress²⁸. I conservatively estimate that between 1999 and 2016, ExxonMobil gave at least \$3.45 million to at least 208 individual climate-denying members of Congress²⁸. That is, a large portion - on the order of one half - of ExxonMobil's donations to climate-denying Congresspersons has occurred after it publicly pledged to end support for climate denial.

In addition to campaign donations, between 2000 and 2016, fossil fuel interests spent \$2 billion lobbying Congress, including against climate change legislation⁷¹. They outspent environmental groups by 10-to-1⁷¹.

Step 4: Oil companies delay climate action with propaganda.

As the public and policymakers have woken up to the climate crisis, and as my computational analysis of ExxonMobil's climate rhetoric has quantitatively shown (Appendix H), in the mid-2000s the fossil fuel industry began to shift its public affairs strategy from outright denial of science to more subtle, insidious forms of propaganda⁷².

As an ExxonMobil manager explained in the mid-2000s, there was "an effort by [then CEO Rex] Tillerson to carefully reset the corporation's profile on climate positions so that it would be more sustainable and less exposed"⁷³. Because as a Shell employee put it in 1999, the company "didn't want to

fall into the same trap as the tobacco companies who have become trapped in all their lies”⁷⁴. Perhaps Shell saw the writing on the wall; a year earlier, the company’s scenario planners predicted legal backlash prompted by catastrophic weather events and public awareness of the fossil fuel industry’s early knowledge about climate science: “In 2010,” the scenario planners envisioned, “a series of violent storms causes extensive damage to the eastern coast of the US...Following the storms, a coalition of environmental NGOs brings a class-action suit against the US government and fossil-fuel companies on the grounds of *neglecting what scientists (including their own) have been saying for years: that something must be done*. A social reaction to the use of fossil fuels grows” among the public, the scenario imagined, just as “a generation earlier, they had become fiercely anti-tobacco” (emphasis added)⁷⁵.

The fossil fuel industry gradually transitioned their public affairs strategy from denial to delay, and yet their end goal remained the same: To stop action on climate change. In so doing, advertising has been a primary vehicle for their propaganda campaigns. Examining the political spending of nearly 90 U.S. trade associations from 2008 to 2018, scholars Dr. Robert Brulle (Brown University) and Dr. Christian Downie (The Australian National University) found that of the \$3.4 billion that these organizations spent on climate-related political activities, the majority (\$2.2 billion) went towards advertising and public relations⁷⁶. From 1986 to 2015, just five oil majors - BP, Chevron, ExxonMobil, Shell and ConocoPhillips - together spent \$3.6 billion on advertising. This public affairs approach to the climate crisis continues to this day (see also ref. 77)⁷⁸. For example, in the run-up to the 2020 U.S. Presidential election, ExxonMobil spent more on political advertisements on Facebook and Instagram than any other company except Facebook itself⁷⁹.

Historical and social science research have shown qualitatively and quantitatively that the best predictors of fossil fuel industry spending on advertising are media scrutiny and political activity⁷⁸. In this sense, the fossil fuel industry’s environmental advertising is one half of a one-two punch: ‘outside lobbying’ designed to complement traditional ‘inside lobbying’¹². The goal of this outside lobbying is to shape and steer the public climate narrative using myriad rhetorical and framing techniques. They are not selling products, they are selling ideas.

According to our research, the overall narrative communicated by fossil fuel companies’ twenty-first century propaganda is what we term a ‘Fossil Fuel Saviour’ (FFS) framing of the climate crisis⁷². We have identified seven so-called “discourses of delay” that together constitute this FFS frame⁸⁰. According to the FFS frame, consumers are primarily to blame for the risk of climate change and fossil fuel companies are innocent suppliers, simply meeting consumer demand. In the FFS frame, energy is conflated with fossil fuels, such that there is no alternative to our status quo, fossil-fueled society, and we are told we must rely on the trustworthy innovation of the oil industry to solve this problem. This has all the hallmarks of what tobacco companies did, using rhetoric of “risk” and “demand” to justify business-as-usual⁷². In the following, I discuss four of the key discourses of delay that construct the FFS framing: (A) Greenwashing, (B) Individualized Responsibility, and (C) Fossil Fuel Solutionism plus Technological Shell-Games.

(4A) Greenwashing

One of the fossil fuel industry’s most pernicious and ongoing discourses of climate delay is greenwashing, which Nemes *et al.* (2021) define as “an umbrella term for a variety of misleading communications and

practices that “intentionally, or not, induce false positive perceptions of an organization’s environmental performance”⁸¹.

For example, across 3,421 public communications from BP, Shell, Chevron, ExxonMobil, and TotalEnergies in 2021 analyzed by InfluenceMap, 60% contained at least one green claim⁸². In contrast, only 12% of the five companies’ 2022 capital expenditure was forecast to be invested in ‘low carbon’ activities. This is greenwashing-101: talk green, act dirty.

Another recent investigation by *DeSmog* looked at 3,000 YouTube, Twitter, and Facebook posts by six European oil and gas companies between 2019-21, and found that 63% of them presented the companies as ‘green’, despite the fact that 80% of their business is in fossil fuels⁸³.

My own research has similarly found that during the summer of 2022, 72% of social media posts from five of the largest European Union-headquartered oil, gas, and coal producers communicated a narrative of ‘Green Innovation’: messaging that presents companies as environmentally-conscious, engaged in or committed to low-carbon technologies and/or technological innovation⁸⁴. This analysis also demonstrated that fossil fuel interests are strategically appropriating the beauty of nature to strengthen their green messaging; a soft form of greenwashing that we colloquially termed ‘nature rinsing’, although its technical term of art is ‘executional greenwashing’.

The fossil fuel industry’s greenwashing is not limited to social media. From June 2020 to September 2021, for example, Chevron aired 29,591 television advertisements - or 65 a day - 80% of which focused on green messages about sustainability⁸⁵. By comparison, between 2010 and 2018, the company spent roughly 99.8% of its budget on the exploration and extraction of fossil fuels⁸⁶.

One of the most common ways in which oil companies publicly ‘green’ their image is to pledge to reach net-zero emissions, typically by 2050. However, studies repeatedly show that no major fossil fuel company anywhere in the world has committed to a business plan consistent with meeting the Paris Agreement⁸⁷⁻⁸⁹.

A 2020 investigation by the Transition Pathway Initiative, for example, found that no major oil, gas, or coal company was on track to align their business with the Paris Agreement’s goal of limiting global warming to well below 2°C by 2050⁸⁹. Trencher *et al.* (2023) similarly concluded that none of the net-zero strategies of BP, Shell, Chevron or ExxonMobil “encompas[s] a business-model transformation away from fossil fuels”⁹⁰. InfluenceMap also concluded that “None of the supermajors’ [BP, Shell, Chevron, ExxonMobil, and TotalEnergies] forecasted oil production appears in line with the International Energy Agency’s Net Zero Emissions by 2050 (as of Q4 2021), with several companies planning to increase oil and gas production between 2021 and 2026.” InfluenceMap also found that “none of the companies have aligned their climate policy engagement activities with the goals of the Paris Agreement, and retain a dense and global network of industry associations globally, which are highly active in their opposition to Paris Aligned climate policies.”

All of these findings are consistent with the fact that the oil and gas industry spent just 2.5% of its budget on clean energy in 2022, according to the International Energy Agency⁹¹. The International Energy

Agency has also reported that major oil companies have never spent more than 1% of their collective annual budgets on low-carbon projects, from 2008 to 2022⁹². The data show that just as the fossil fuel industry misled the public about climate science, it is now misleading us about its commitment to be part of the solution.

(4B) Individualized Responsibility

More subtle but equally insidious is the discourse of Individualized Responsibility, which shifts the blame for climate change from companies to their consumers⁷². Our research has shown, for example, that ExxonMobil's public climate communications use language that is systematically biased towards an individualist framing of the climate problem and its solutions, fixating on consumer energy "demand" rather than on the fossil fuels that the company supplies⁷².

Indeed, the very notion of a personal "carbon footprint" was first popularized in 2004-06 by none other than BP, as part of its \$100-plus million per year "Beyond Petroleum" marketing campaign⁵⁴. BP strategized with corporate image consultants Landor & Associates and ran the campaign through advertising agency Ogilvy & Mather (part of one of the 'Big Four' advertising giants, WPP)⁵⁴.

As part of that campaign, BP published advertisements asking, "What on earth is a carbon footprint?" and "What size is your carbon footprint?", and suggesting that "It's time to go on a low-carbon diet." They created the first carbon footprint calculator, put it on their website, and directed the public to it in their advertisements. In 2004 alone, 278,000 people calculated their footprints⁹³. In the UK, BP's marketing firm filmed regular people on the streets of London for a television advertisement⁹⁴. As communication scientist Dr. Julie Doyle (University of Brighton) has observed, marketers asked questions like "Do you worry about global climate change?", such that people would naturally reply with "I" or "We"⁹⁵. This allowed BP "linguistically to remove itself as a contributor to the problem of climate change."

The fossil fuel industry's efforts to individualize responsibility have continued to this day. In 2019, for example, BP launched a new "Know your carbon footprint" publicity campaign with a "new calculator"⁹⁶. In 2020, the CEO of TotalEnergies said that "Change will not come from changing the source of supply. You have to reduce demand"⁹⁷. At the COP28 UN climate talks last year, Exxon CEO Darren Woods said that UN climate negotiations have "put way too much emphasis on getting rid of fossil fuels, oil and gas, and not...on dealing with the emissions associated with them"⁹⁸. Until 2020, all major oil and gas companies disregarded or disavowed accountability for all Scope 3 greenhouse gas emissions resulting from the use of their products⁹⁹.

Oil companies are part of a lineage of industrial producers of harmful commodities that have used personal responsibility framings to disavow themselves. As early as 1940, for example, the National Association of Manufacturers produced propaganda that "appealed to Americans' individualistic values by portraying industry as a beneficent fellow traveler..."¹⁰⁰. Tobacco, packaging, junk food, lead, car, and alcohol companies and the gun lobby have all emphasized consumer responsibility and downplayed corporate responsibility in public affairs and often litigation⁷².

From the 1950s onwards, for instance, plastics producers (including Exxon, Mobil, and ExxonMobil), packaging and beverage manufacturers, tobacco companies, and waste companies have variously used

advertising to popularize the term “litterbug”, to advance recycling over reuse; to normalize single-use products; and to co-opt the recycling symbol to trick the public into thinking their products are sustainable, in order to justify endlessly producing more plastics⁷². It has likewise been overwhelmingly demonstrated that the tobacco industry used, and continues to use, narratives of personal responsibility—often marketed as “freedom of choice”—both in public relations and in defense against litigation and regulation¹⁰¹.

The fossil fuel industry’s propaganda has clearly not been solely responsible for individualist mindsets on climate change. The spread of neoliberalism and globalization, and the uniquely individualist culture of self-reliance in the U.S. have all contributed to the atomization of society⁷². What fossil fuel companies did was to tap into this trend and into the enduring principles of “rugged individualism” and self-reliance that pervade U.S. culture and ideology, and to bring them to bear on climate change.

Indeed, BP’s “Know your carbon footprint” campaign was highly successful. “Carbon footprint” went from an almost never-used expression prior to BP’s campaign to the Oxford Word of the Year immediately afterwards in 2007¹⁰². Individualized climate responsibility framings in general, and the carbon footprint specifically, have become pervasive across society, working to shape the way many scholars, policymakers, and members of the public see the problem and their role in it. This fixation on demand and emissions rather than on supply and fossil fuels is evident in the fact that it took 28 years of UN climate talks - until just last year at COP28 - for fossil fuels to be mentioned, for the first time ever, in a UN climate agreement (the Paris Agreement, for example, does not mention fossil fuels)¹⁰³. A focus on demand has also been evident more broadly. For instance, the Republican Party’s 2020 climate agenda was premised on the idea that “fossil fuels aren’t the enemy. It’s emissions”¹⁰⁴. Overall, it appears that fossil fuel industry discourse has encouraged a dangerous acceleration in the individualization of responsibility, which continues to groom us to see ourselves as consumers first and citizens second¹⁰⁵. There is experimental evidence to support this: a study in 2020 indicated that messages framed in terms of individual behavior decrease peoples’ willingness to take both personal and collective climate actions¹⁰⁶.

(4C) Fossil Fuel Solutionism and Technological Shell-Games

A third pair of discourses of climate delay, which are often deployed together by fossil fuel interests, are Fossil Fuel Solutionism and Technological Shell-Games⁷².

The discourse of Fossil Fuel Solutionism presents fossil fuels and their industry as an essential and inevitable part of the solution to the climate crisis, in contradiction to the science of stopping global warming (the International Energy Agency’s 2021 Roadmap to net-zero emissions by 2050 stipulates that “from today,” there must be “no investment in new fossil fuel supply projects, and no further final investment decisions for new unabated coal plants”)^{107,108}. Technological Shell-Games, meanwhile, are defined by Schneider *et al.* (2016) as “misdirection that relies on strategic ambiguity about the feasibility, costs, and successful implementation of technologies”¹⁰⁹. Together, these two discourses frame fossil fuel technologies as essential and their alternatives as unreliable and unviable. This typically involves either downplaying the climate impacts of a fossil fuel technology (such as methane gas), over-relying on unproven or uneconomical technologies (such as carbon capture and storage and offset schemes), or both^{110,111}.

An example of the former is the fossil fuel industry's long-standing effort to establish methane gas as a solution to climate change by calling it "clean" and conflating it with renewable energy technologies. In 2006-08, BP "developed an 'all of the above' strategy" for marketing energy "before any presidential candidates spoke of the same," according to BP's PR lead at the advertising agency Ogilvy & Mather⁵⁴. This involved running advertisements that visually grouped oil and methane gas alongside solar, wind, and biofuels, with a green tick indicating that "all of the above" was the right choice. This was highly influential. In the words of one of the PR agents on the project, it was "co-opted by politicians in 2008"⁵⁴.

Other BP ads proclaimed that "natural gas is the clean bridge to renewable energy"⁵⁴. This built on the American Gas Association's marketing of methane as "clean" since at least the 1980s⁵⁴. Calling methane "clean" or "cleaner" was highly deceptive. Like "clean coal", calling methane "clean", "cleanest" or "low-carbon" has since been deemed false advertising by regulators¹¹². And yet oil companies have continued to promote this narrative of Fossil fuel Solutionism and Technological Shell-Games, including the "all of the above" language, on social media, in Congress and in paid-for, pretend editorials in *The Washington Post*⁵⁴. "Natural gas is already clean," said API Facebook advertisements and billboards in 2020⁵⁴.

Building on its own marketing, in 2011 BP funded an influential Massachusetts Institute of Technology (MIT) report that nine times asserted that "natural gas is a bridge to a low-carbon future"¹¹³. MIT Professor Ernest Moniz chaired the study group that authored the report and, following its publication, testified to Congress on the report's findings, which served to counter academic and popular criticisms at the time of the climate and health harms of methane gas and fracking. At a press conference, Moniz described the report as an "independent study," even though, as the report itself disclosed, it was funded by numerous methane gas interests, including a foundation founded by the CEO of a gas company, by a gas producer, by a gas utility, by a gas industry research organization, and by Columbia's national oil and gas agency. Moreover, a Public Accountability Initiative investigation revealed that the report did not disclose that many of the study's authors, including its chair and co-chair, had past or present ties to the oil and gas industry¹¹³. It also reportedly failed to disclose that 10 out of 18 of the study's advisory committee members were simultaneously employed by or held financial stakes in petroleum companies.

In 2013, Dr. Ernest Moniz was nominated by President Obama to be U.S. Secretary of Energy. The mantra of methane gas as a "bridge" fuel and part of an "all of the above" solution to climate change became a centerpiece of the Obama administration's energy and climate policies for the next decade¹¹⁴.

The MIT case study has all the hallmarks of what Dr. Benjamin Franta and I in 2017 termed the fossil fuel industry's "invisible colonization of academia," whereby "Fossil fuel interests - oil, gas, and coal companies, fossil-fueled utilities, and fossil fuel investors - have colonized nearly every nook and cranny of energy and climate policy research in American universities, and much of energy science too. And they have done so quietly, without the general public's knowledge". Ongoing research by me and my colleagues indicates the widespread infiltration of fossil fuel interests into higher education¹¹⁵. Oil companies and their foundations fund climate and energy research, host student-recruitment events at campuses, sit on university governance boards, and more, creating real or apparent conflicts of interest that threaten the mission and reputation of academia and its ability to address the climate crisis. Fossil fuel interests can - and have - weaponized their patronage of academia to protect their business interests in

myriad ways. It has been statistically shown, for example, that fossil fuel industry funding of research centers at Harvard University, Stanford University, and MIT (specifically the MIT Energy Initiative, which Ernest Moniz directed) has measurably biased their published reports in favor of methane gas¹¹⁶.

Conclusion

There is overwhelming evidence that fossil fuel interests have deliberately deployed disinformation, lobbying, propaganda, and academic influence to stop action on climate change for decades. As the UN's IPCC has concluded, this "has sowed uncertainty and impeded recognition of risk" and "has created polarisation in public and policy domains in North America, particularly in the USA, limiting climate action"¹¹⁷.

For all the skeletons we have already found in Big Oil's closet, however, we are still only looking through the keyhole. Tracking down a few hundred documents has allowed scholars, journalists, and advocacy researchers to uncover some key cogs in the climate denial machine. Yet it is a sprawling, well-funded, well-oiled network that spans hundreds of organizations and thousands of individuals. I believe that the American public deserve to know the truth – and see the receipts – of these dealings that have already led to deaths, destruction and the injustices of a collapsing climate. This is particularly crucial because all available evidence suggests fossil fuel companies have failed to change their stripes since the Paris Agreement, continuing to delay climate action by putting spin before science.

This is where Congressional authority to request documents and, if necessary, issue subpoenas, comes in¹¹⁸. Key breakthroughs in tobacco control came as Congressional investigations – as well as legal discovery and industry whistleblowers – exposed thousands, and ultimately millions, of damning documents. The tobacco industry was found guilty of racketeering in part because of the ways that individual companies had coordinated with each other and with third-party allies to present false information to consumers. That history is a precedent for Congress to investigate an industry network that has misled the public and policymakers in an effort to deny the dangers of its products and derail regulation. As the Congressional scholar Morton Rosenberg testified in the Senate in 2019: "Congress and its committees have virtually plenary power to compel production of information needed to discharge their legislative functions"¹¹⁹.

I am not a lawyer, politician, or political strategist, so I do not presume to dictate how Congress exercises its investigatory powers. But as an expert in the history of climate denial and global warming politics, it is my opinion that holding the fossil fuel industry accountable would be one of the most impactful ways for Congress – and governments around the world – to combat the climate crisis.

Thank you for bringing your attention and leadership to bear on the fossil fuel industry's obstruction of climate action, which lies at the heart of America's failure to meaningfully address the climate crisis¹²⁰.

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Appendix A

AMERICA MISLED

How the fossil fuel industry
deliberately misled Americans
about climate change

John Cook, Geoffrey Supran,
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For more information, visit <https://www.climatechangecommunication.org/america-misled/>

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How the fossil fuel industry polluted the information landscape

Key points

1. Internal corporate documents show that the fossil fuel industry has known about the reality of human-caused climate change for decades. Its response was to actively orchestrate and fund denial and disinformation so as to stifle action and protect its status quo business operations.
2. As the scientific consensus on climate change emerged and strengthened, the industry and its political allies attacked the consensus and exaggerated the uncertainties.
3. The fossil fuel industry offered no consistent alternative explanation for why the climate was changing—the goal was merely to undermine support for action.
4. The strategy, tactics, infrastructure, and rhetorical arguments and techniques used by fossil fuel interests to challenge the scientific evidence of climate change—including cherry picking, fake experts, and conspiracy theories—come straight out of the tobacco industry's playbook for delaying tobacco control.

These key points reflect the position of experts studying climate denial and the history of fossil fuel interests, based on thousands of pages of documented evidence.

The Essential Truth About Climate Change in Ten Words

The basic facts of climate change, established over decades of research, can be summarized in five key points:

IT'S REAL

Global warming is happening.

IT'S US

Human activity is the main cause.

EXPERTS AGREE

There's scientific consensus on human-caused global warming.

IT'S BAD

The impacts are serious and affect people.

THERE'S HOPE

We have the technology needed to avoid the worst climate impacts.

Denying our right to be accurately informed

Over the past few decades, the fossil fuel industry has subjected the American public to a well-funded, well-orchestrated disinformation campaign about the reality and severity of human-caused climate change. The purpose of this web of denial has been to confuse the public and decision-makers in order to delay climate action and thereby protect fossil fuel business interests and defend libertarian, free-market conservative ideologies¹. The fossil fuel industry's denial and delay tactics come straight out of Big Tobacco's playbook. As a result, the American public have been denied the right to be accurately informed about climate change, just as they were denied the right to be informed about the risks of smoking by the tobacco industry. While fossil fuel companies attacked the science and called on politicians to "reset the alarm," climate-catalyzed damages worsened, including increased storm intensities, droughts, forest damage and wildfires, all at substantial loss of life and cost to the American people².

“
The fossil fuel industry's denial and delay tactics come straight out of Big Tobacco's playbook.”

Climate disinformation has had many negative effects. It reduces public understanding of climate change³, lowers support for climate action⁴, cancels out accurate information^{5,6}, polarizes the public along political lines⁷, and reinforces climate silence—the lack of public dialogue and private conversation about climate change⁸. Climate deniers directly impact the scientific community—and, in turn, its ability to serve the public good—by forcing climate scientists to respond to bad-faith demands⁹ and arguably causing a chilling effect pressuring scientists to underplay scientific results^{10,11,12}.

Strategies proposed to counter climate disinformation include political mechanisms, financial transparency, legal strategies, and inoculation of the public¹³. Inoculation involves explaining how and why climate deniers mislead, in order to neutralize the influence of their disinformation.

This report explores the techniques used to mislead the American public about climate change, and outlines three ways of inoculating against disinformation:

1. Communicating facts (this is a necessary but insufficient condition in the face of disinformation).
2. Revealing misleading sources (explaining why, how and from whom the disinformation arose).
3. Explaining denialist techniques (explaining fallacies and tactics used to mislead).

Attacking the scientific consensus on climate change

In the late 1980s and early 1990s, a scientific consensus emerged that human-caused climate change—which had long been predicted—was now underway^{14,15,16}. Since that time, a number of studies have found over 90% agreement among climate scientists on human-caused global warming, with multiple studies converging on 97% consensus¹⁷. The emergence of a shared consensus among thousands of independent scientists all around the globe through independent lines of evidence is a clear and strong signal of robust scientific knowledge¹⁸. Climate scientists are as sure that burning fossil fuels causes global warming as public health scientists are sure that smoking tobacco causes cancer¹⁹.

Climate scientists are as sure that burning fossil fuels causes global warming as public health scientists are sure that smoking tobacco causes cancer.

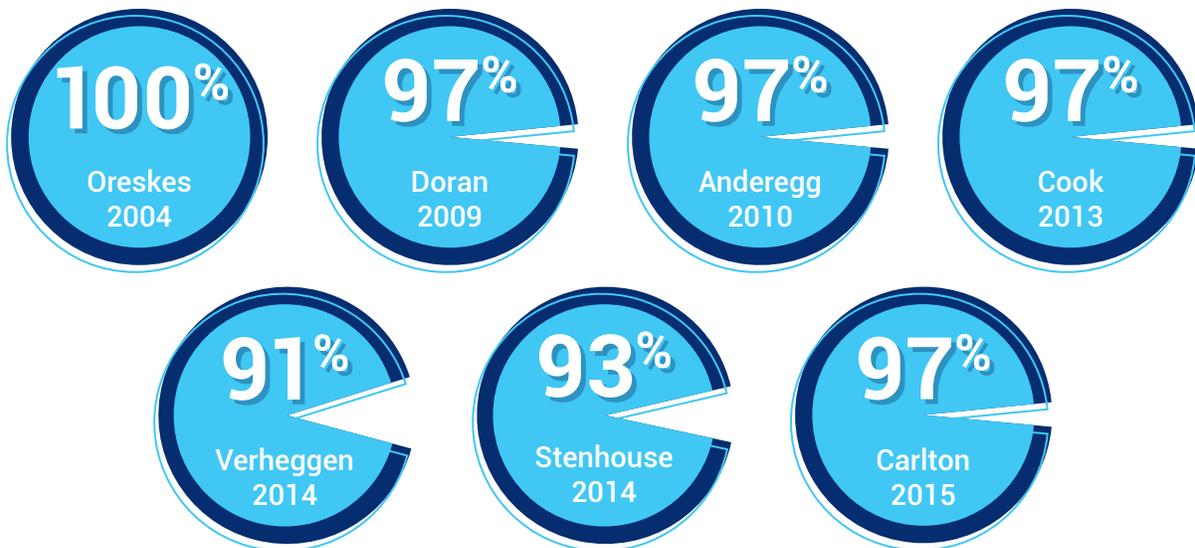


Figure 1: Studies quantifying the consensus on human-caused global warming¹⁷.

Attacking this consensus is one of the chief strategies of climate deniers²⁰. The strategy behind the denialist attack on consensus is informed by market research conducted by industry groups²¹ and political strategists²². This market research found that confusing the public about the scientific consensus on climate change reduced public support for climate policy. Science denial continues unabated—in the last decade, content analysis of online misinformation has found the prevalence of science denial has been on the increase²³.

What fossil fuel knew vs. what fossil fuel did

Scientists working for the fossil fuel industry knew about the potential warming effects of CO₂ emissions as early as the 1950s²⁴. Exxon's internal documents show that their own scientists were explicitly aware of the potential dangers of human-caused climate change caused by their products, but instead of taking action or warning the public, they spent millions of dollars on disinformation campaigns designed to obscure the scientific reality²⁵.



CO₂ is causing climate change.

CO₂ comes from burning fossil fuels.

SUMMARY

- I. CO₂ RELEASE MOST LIKELY SOURCE OF INADVERTENT CLIMATE MODIFICATION.
- II. PREVAILING OPINION ATTRIBUTES CO₂ INCREASE TO FOSSIL FUEL COMBUSTION.
- III. DOUBLING CO₂ COULD INCREASE AVERAGE GLOBAL TEMPERATURE 1°C TO 3°C BY 2050 A.D. (10°C PREDICTED AT POLES).
- IV. MORE RESEARCH IS NEEDED ON MOST ASPECTS OF GREENHOUSE EFFECT.
- V. 5-10 YR. TIME WINDOW TO GET NECESSARY INFORMATION.
- VI. MAJOR RESEARCH EFFORT BEING CONSIDERED BY DOE.

Time is running out!

CO₂ emissions will cause 1-3°C warming.

HOW PREDICTED ΔT COMPARES WITH RECENT TEMPERATURES

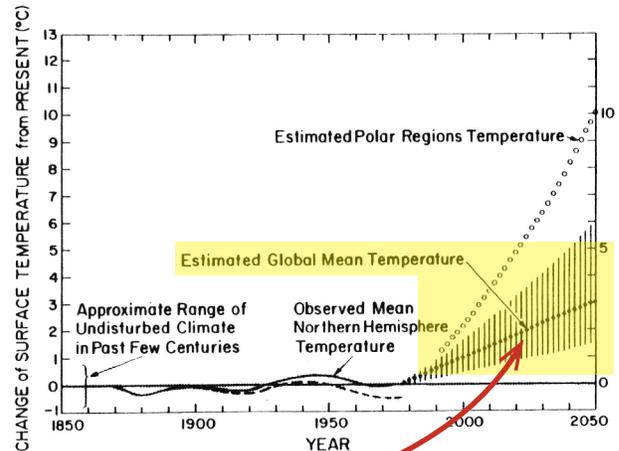


Figure 2: Exxon 1977 internal memo.

Fossil fuel industry documents show that they knew the basics of climate science in the 1950s-80s.

Fossil fuel schemed (1980s-90s)

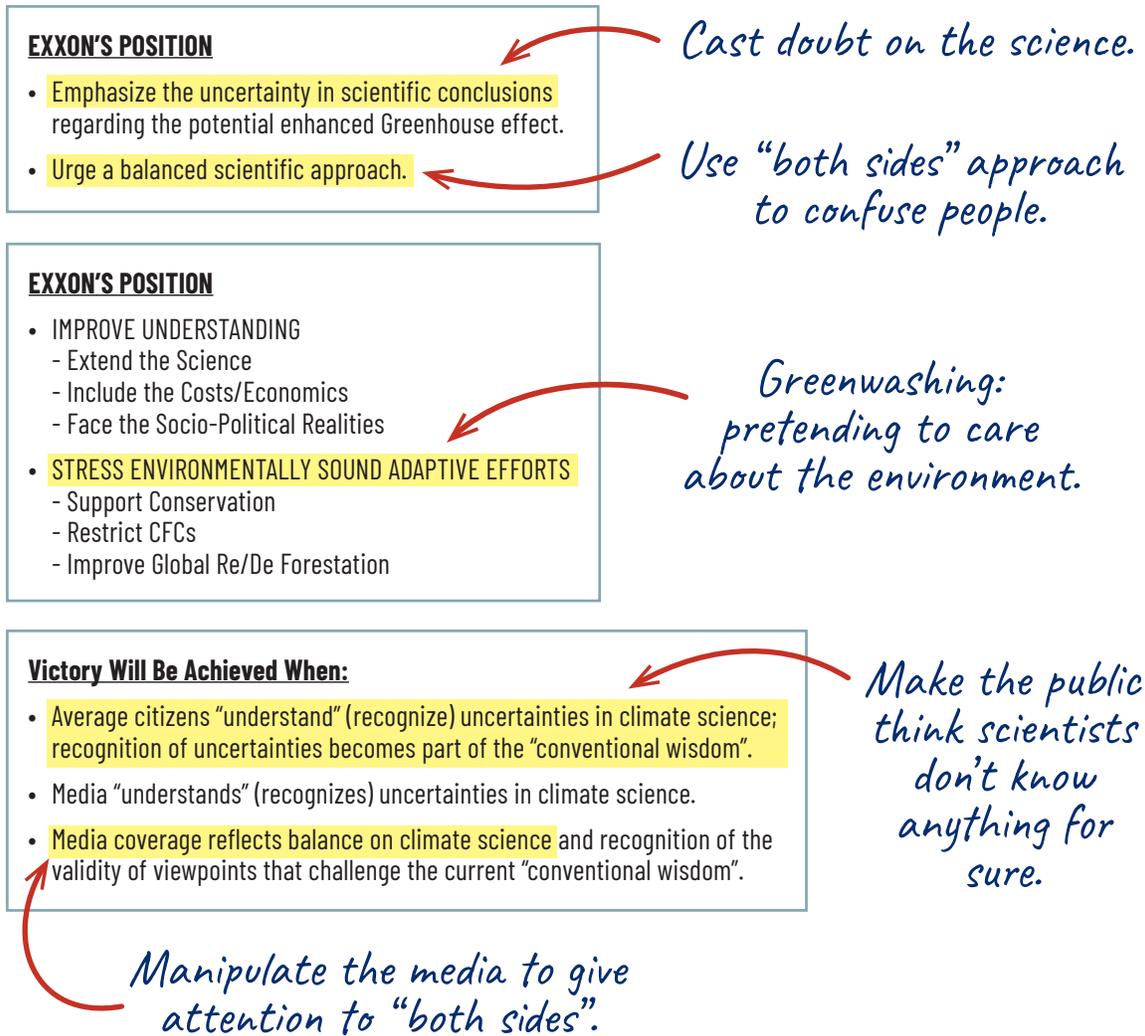


Figure 3: Top: Exxon 1988 internal memo. Middle: Exxon 1989 internal memo. Bottom: Exxon et al. 1998 internal memo. Fossil fuel industry documents show that they devised public relations strategies to promote doubt about climate science in the 1980s-90s.

Fossil fuel denied (1990s-2010s)

Falsely argues that because we don't know everything, we know nothing.

False: In the 1990s, scientists had already formed a consensus that humans were causing global warming.

Just because climate has changed naturally in the past does not mean it's natural now.

Unsettled Science

Knowing that weather forecasts are reliable for a few days at best, we should recognize the enormous challenge facing scientists seeking to predict climate change and its impact over the next century. In spite of everyone's desire for clear answers, it is not surprising that **fundamental gaps in knowledge leave scientists unable to make reliable predictions about future changes.**

A recent report from the National Research Council (NRC) raises important issues, including these still-unanswered questions: (1) Has human activity already begun to change temperature and the climate, and (2) How significant will future change be?

The NRC report confirms that Earth's surface temperature has risen by about 1 degree Fahrenheit over the past 150 years. Some use this result to claim that humans are causing global warming, and they point to storms or floods to say that dangerous impacts are already under way. **Yet scientists remain unable to confirm either contention.**

Geological evidence indicates that climate and greenhouse gas levels experience significant natural variability for reasons having nothing to do with human activity. **Historical records and current scientific evidence show that Europe and North America experienced a medieval warm period one thousand years ago, followed centuries later by a little ice age.** The geological record shows even larger changes throughout Earth's history. Against this backdrop of large, poorly understood natural variability, it is impossible for scientists to attribute the recent small surface temperature increase to human causes.

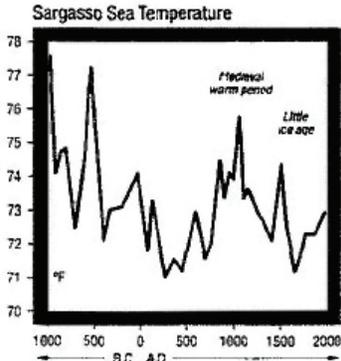
Moreover, computer models relied upon by climate scientists predict that lower atmospheric temperatures will rise as fast as or faster than temperatures at the surface. However, only within the last 20 years have reliable global measurements of temperatures in the lower atmosphere been available through the use of satellite technology. **These measurements show little if any warming.**

Even less is known about the potential positive or negative impacts of climate change. In fact, many academic studies and field experiments have demonstrated that increased levels of carbon dioxide can promote crop and forest growth.

So, while some argue that the science debate is settled and governments should focus only on near-term policies—that is empty rhetoric. **Inevitably, future scientific research will help us understand how human actions and natural climate change may affect the world and will help determine what actions may be desirable to address the long-term.**

Science has given us enough information to know that climate changes may pose long-term risks. Natural variability and human activity may lead to climate change that could be significant and perhaps both positive and negative. Consequently, people, companies and governments should take responsible actions now to address the issue.

One essential step is to encourage development of lower-emission technologies to meet our future needs for energy. We'll next look at the promise of technology and what is being done today.



Cast doubt on the scientific consensus on climate change.

Contradicts themselves: they already talk about 1 degree warming.

Uses the same delay argument as the tobacco industry: "Let's wait before we act".



Figure 4: ExxonMobil 2000 advertorial in The New York Times. The fossil fuel industry implemented their plans to promote climate denial in the 1990s-2010s.

Contradictory contrarianism

The most common denialist arguments have been shown to contain fatal assumptions or fallacies²⁶. Climate deniers do not offer any rational explanation for why our climate is changing. Rather, denialist arguments are incoherent and often contradictory²⁷. For example, deniers will seize on snowfall to claim that global warming is a hoax, while at the same time claiming that an extreme event such as a drought or wildfire cannot be attributed to climate change. This is incoherent because either extreme events can be a signal of climate change or they cannot be.

Climate denial lacks consistency because it is not about scientific evidence—it is about how to continue business as usual in the face of climate disruption. Climate deniers reject climate science because they are averse to proposed or perceived solutions to climate change²⁸.

“Climate denial lacks consistency because it is not about scientific evidence—it is about how to continue business as usual in the face of climate disruption.”

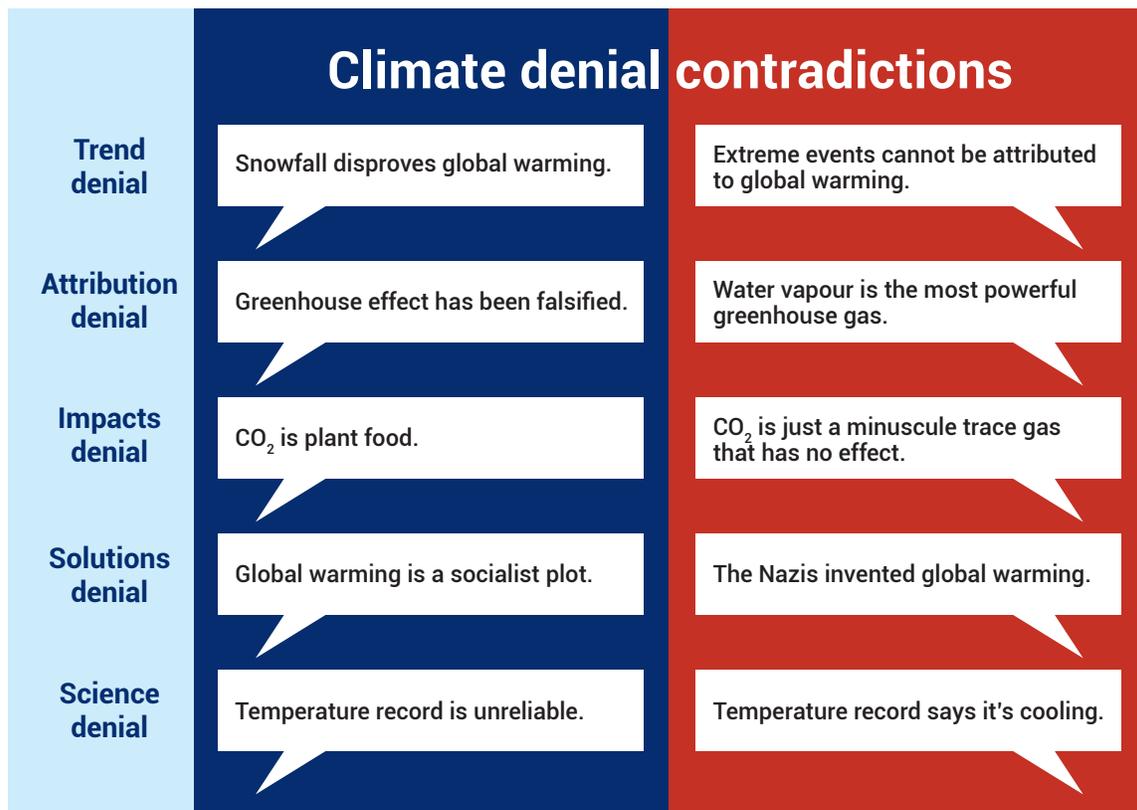


Figure 5: Examples of common climate denialist arguments that contradict each other.

Denialist techniques

Climate denial arguments can be summarized by the five techniques of science denial (summarized with the acronym FLICC): fake experts, logical fallacies, impossible expectation, cherry picking, and conspiracy theories^{29,30}.



Figure 6: FLICC: The techniques of science denial.

Understanding the techniques of denial is necessary to avoid being misled by disinformation. This is why explaining denialist techniques is effective in neutralizing disinformation³¹.

Common Fallacies



Fake Experts

Promoting dissenting non-experts as highly qualified while not having published any actual climate research and/or received any relevant education.



Logical Fallacies

Logically flawed arguments that lead to false conclusions. Common logical fallacies are red herrings, non sequiturs, and false dichotomies.



Impossible Expectations

Demanding unrealistic standards of certainty before acting on the science. A technique practised by the tobacco industry.



Cherry Picking

Selectively choosing data that supports a desired conclusion that differs from the conclusion arising from all the available data³².



Conspiracy Theories

Proposing a secret plan among a number of people, generally to implement a nefarious scheme such as conspiring to hide a truth or perpetuate misinformation. Climate deniers are more likely to be conspiracy theorists³³.

Deconstructing Denial

Figure 7 shows deconstructions of some of the most common myths about climate change. Determining the misleading techniques of a climate myth requires outlining the argument structure: listing any premises (starting assumptions) and the conclusion. This allows one to ascertain whether any premises are false, and/or whether the argument is logically invalid.

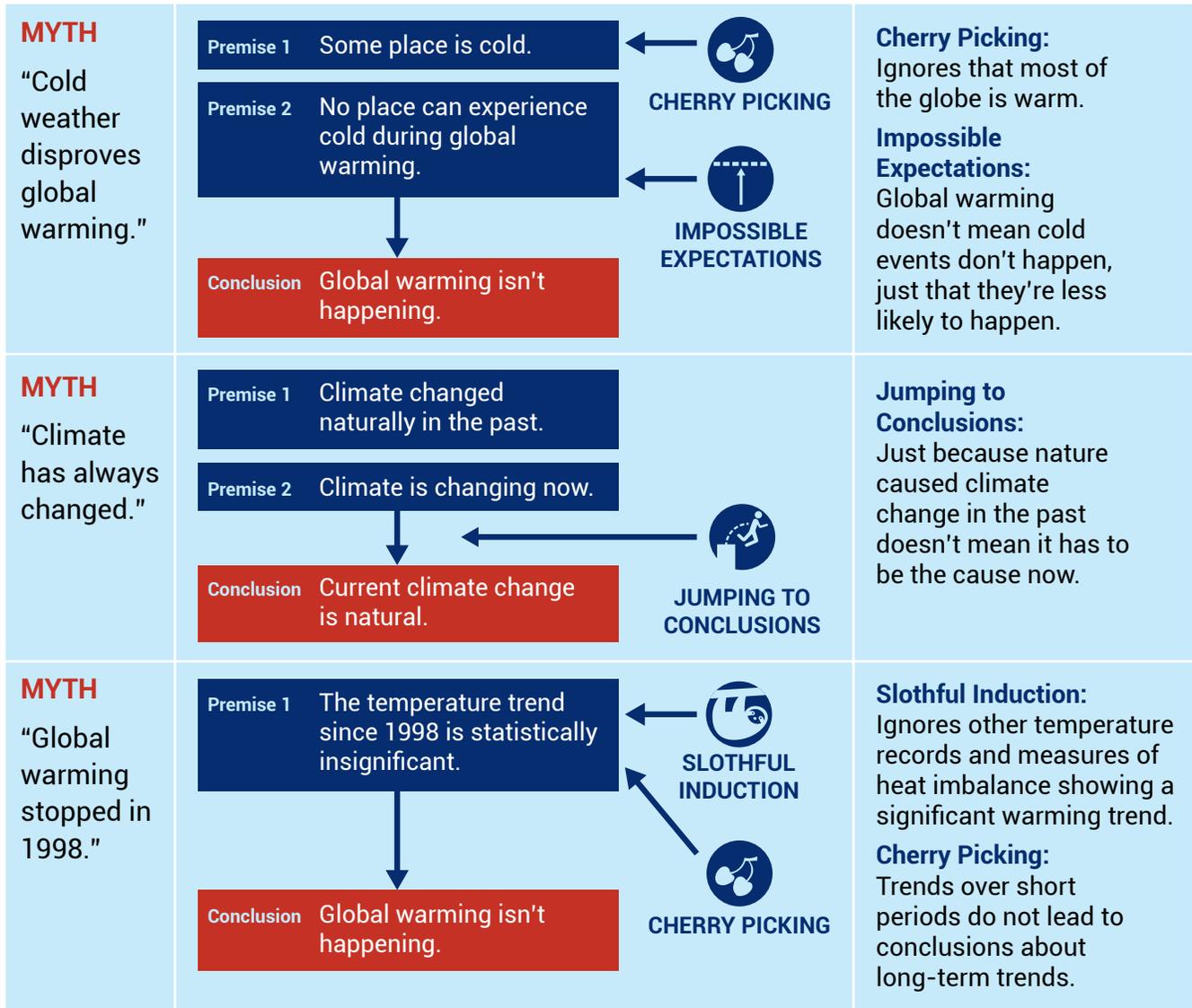


Figure 7: Deconstruction of common climate myths.

Conclusion

Disinformation about climate change has a straightforward purpose—to block action on climate change. In America, it has largely succeeded, with policies to mitigate climate change stymied or delayed for decades.

Meanwhile, climate change has intensified, causing impacts such as intensified extreme weather events, rising sea level, harmful effects on human health, and much more.

Climate denial has seriously hurt the American people. The damage, deaths, and harm to people will continue to worsen if we don't expose and discredit denial.

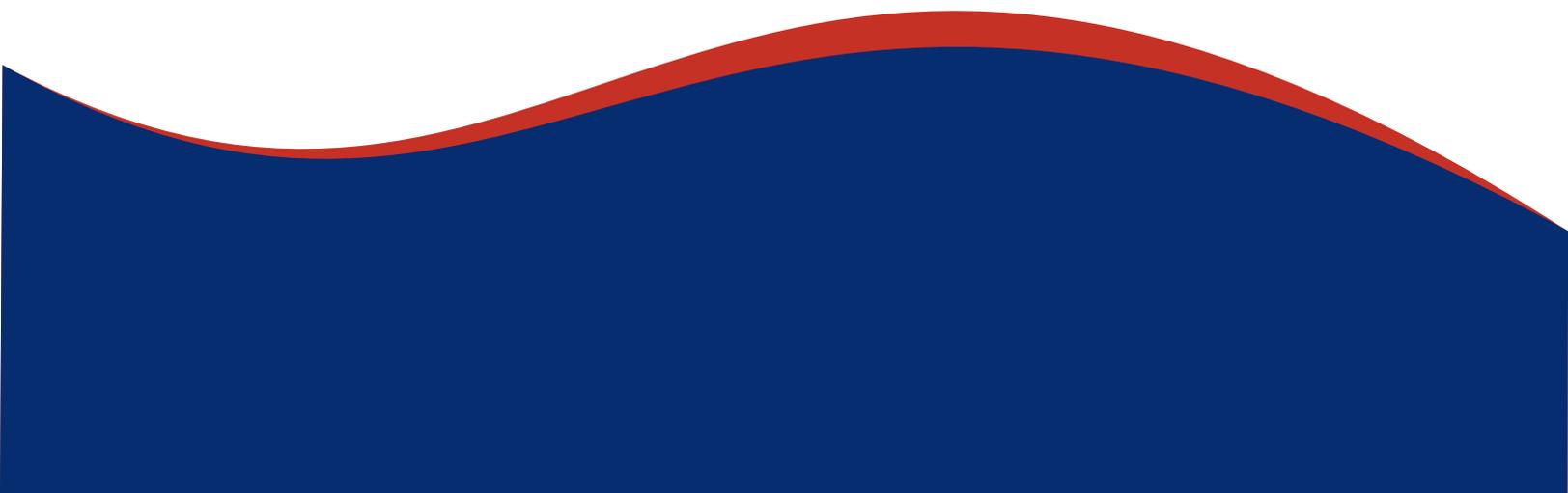
This is not the first time that corporations prioritizing profits over people have caused great harm. The tobacco industry spent hundreds of millions of dollars disinforming the public about the health impacts of smoking in order to undermine tobacco control^{34,35}. The World Health Organization estimates that six million people die every year from preventable tobacco-caused disease. Drawing on the tobacco industry's playbook, fossil fuel companies have done the same on climate change, spending hundreds of millions of dollars confusing the public and delaying life-saving action. Their legacy is the death, destruction, and injustices of irreversible global warming. Big Oil is the new Big Tobacco.

“
The legacy of the fossil fuel industry is death, destruction, and injustices of irreversible global warming. Big Oil is the new Big Tobacco.”

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Appendix B

**United States Court of Appeals
for the Eighth Circuit**

State of Minnesota,

Plaintiff-Appellee,

v.

American Petroleum Institute, et al.,

Defendants-Appellants.

On Appeal from the United States District Court
for the District of Minnesota
Case No. 0:20-cv-01636-JRT
(the Hon. John R. Tunheim, Chief District Judge)

**BRIEF OF AMICI CURIAE ROBERT BRULLE,
CENTER FOR CLIMATE INTEGRITY, JUSTIN FARRELL,
BENJAMIN FRANTA, FRESH ENERGY, STEPHAN
LEWANDOWSKY, MN350, MINNESOTA CENTER FOR
ENVIRONMENTAL ADVOCACY, NAOMI ORESKES, GEOFFREY
SUPRAN, and the UNION OF CONCERNED SCIENTISTS
IN SUPPORT OF PLAINTIFF-APPELLEE AND AFFIRMANCE**

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CORPORATE DISCLOSURE STATEMENT

In accordance with Federal Rule of Appellate Procedure 29(a)(4)(A), Amici Fresh Energy, MN350, Minnesota Center for Environmental Advocacy, Center for Climate Integrity, and Union of Concerned Scientists each certifies that it is a non-profit organization, that it does not have a parent corporation, and that no publicly held company has any ownership of the organization.

All other Amici are private individuals and not corporations.

IDENTITY AND INTEREST OF AMICUS CURIAE

Individual Amici are scholars and scientists with strong interests, education, and experience in the environment and the science of climate change, with particular interest in public information and communication about climate change and how the public and public leaders learn about and understand climate change.

Dr. Naomi Oreskes is Professor of the History of Science and Affiliated Professor of Earth and Planetary Sciences at Harvard University. Professor Oreskes' research focuses on the earth and environmental sciences, with a particular interest in understanding scientific consensus and dissent. **Dr. Geoffrey Supran** is a Research Associate in the Department of the History of Science at Harvard University. Working alongside Prof. Oreskes, Supran's applied social science research investigates the history of climate communications and denial by fossil-fuel interests. **Dr. Robert Brulle** is a Visiting Professor of Environment and Society at Brown University, and an Emeritus Professor of Sociology and Environmental Science at Drexel University. His research focuses on U.S. environmental politics, critical theory, and the political and cultural dynamics of climate change. **Dr.**

Justin Farrell is a Professor in the School of Forestry and Environmental Science, the School of Management, and the Department of Sociology at Yale University. He studies environment, misinformation, rural inequality, and social movements using a range of methods from large-scale computational text analysis, network science, machine learning, and qualitative and ethnographic fieldwork.

Dr. Benjamin Franta is a Ph.D. Candidate in the Department of History at Stanford University, where he studies the history of climate science and fossil-fuel producers. He holds a separate Ph.D. in Applied Physics from Harvard University and a J.D. from Stanford Law School.

Stephan Lewandowsky is a Professor and Chair in Cognitive Science at the University of Bristol. His research examines the potential conflict between human cognition and the physics of the global climate.

Fresh Energy is a non-profit organization that shapes and drives bold policy solutions that ensure Minnesota enjoys good health, a vibrant economy, and thriving communities today and for generations to come. The organization advances innovative, practical global warming solutions to achieve a zero-carbon energy economy.

MN350 is a non-profit organization that helps lead a movement of Minnesotans working to protect our climate for future generations, speed the transition to clean energy, and create an equitable and healthy future for all. MN350 is affiliated with the global organization 350.org and uses a range of methods, including policy advocacy, public events, political engagement, and direct action to dismantle the systems that led to the climate crisis.

Minnesota Center for Environmental Advocacy is a non-profit organization that uses science and the law to protect Minnesota's natural resources, its wildlife, and the health of its people. For over 40 years, MCEA has worked to protect and improve the quality of Minnesota's environment, including fighting climate change and its effects in the state.

The Center for Climate Integrity is a non-profit organization that works to empower communities and elected officials with the knowledge and tools they need to hold polluters accountable for their contributions to the climate crisis. Through campaigns, communications, and strategic legal support, the organization works to

ensure that the fossil-fuel industry pays its fair share of the costs of climate change.

The Union of Concerned Scientists is a national non-profit organization that puts rigorous, independent science to work to solve our planet's most pressing problems. The organization combines technical analysis and effective advocacy to create innovative, practical solutions for a healthy, safe, and sustainable future.

Amici submit this brief because they understand that the conduct at the core of the Plaintiff-Appellee's Complaint is that the Defendants knowingly concealed and denied the hazards that would result from the normal use of their fossil-fuel products by misrepresenting those products and deliberately discrediting scientific information related to climate change. It is therefore critical that full documentation of these misrepresentations is available to the Court as it considers the arguments and assertions made by Defendants-Appellants.

All parties have consented to the filing of this brief. No party's counsel authored the brief in whole or in part, no party or party's counsel contributed money that was intended to fund preparing of submitting the brief, and no person other than Amici or their counsel

contributed money that was intended to fund preparing or submitting the brief.

INTRODUCTION

At least 50 years ago, Defendants had information from their own internal research, as well as from the international scientific community, that the unabated extraction, production, promotion, and sale of their fossil-fuel products would endanger the public. Defendants failed to disclose this information or take steps to protect the public. Instead, they acted to conceal their knowledge and discredit climate science, running misleading marketing campaigns and funding scientists and third-party organizations to exaggerate scientific uncertainty and promote contrarian theories, in direct contradiction to their research and actions taken to protect their assets from climate change impacts.

Defendants' coordinated, multi-front effort, demonstrated by their own documents and actions, justifies the claims that the State of Minnesota has asserted here as Plaintiff. As early as the late 1950s and no later than 1968, Defendants had actual knowledge of the risks associated with fossil fuels. In the decades that followed, Defendants took affirmative steps to sow doubt and uncertainty, in part by funding contrarian science that advanced alternative theories. While they told

Minnesotans that there was no reason for concern, Defendants took climate risks into account in managing their own infrastructure—for example, by raising the height of their oil rigs to account for rising sea levels. In taking these fraudulent, deceptive, and misleading actions, Defendants violated Minnesota’s state consumer protection statutes, as alleged by Plaintiff, and therefore should be held liable.

I. DEFENDANTS HAD ACTUAL KNOWLEDGE OF THE RISKS ASSOCIATED WITH THEIR FOSSIL-FUEL PRODUCTS

A. Defendants had early knowledge that fossil-fuel products were increasing atmospheric CO₂ concentrations, with potentially “catastrophic” consequences.

Defendants ExxonMobil (Exxon) and Koch Industries, Inc. (Koch) knew about the potential risks associated with their products decades ago, independently and through their membership and involvement in trade associations, such as Defendant American Petroleum Institute (API), American Fuel and Petrochemical Manufacturers, and the National Association of Manufacturers.

API was aware of research on carbon dioxide as early as 1954. At that time, Harrison Brown and other scientists at the California Institute of Technology measured and assessed increased CO₂

concentrations in the atmosphere.¹ Although the results were not published, API and other researchers within the petroleum industry were aware of this research.² In 1957, Roger Revelle and Hans Suess at the Scripps Institute of Oceanography published a paper predicting large increases in atmospheric CO₂ if fossil-fuel production continued unabated.³ Shortly thereafter, H.R. Brannon of Humble Oil (now Exxon) published research on the same question. His conclusions were in “excellent agreement” with Brown’s findings: fossil-fuel combustion increased atmospheric CO₂.⁴

In 1959, physicist Edward Teller delivered the earliest known warning of the dangers of global warming to the petroleum industry, at a symposium held at Columbia University. Teller described the need to

¹ Benjamin Franta, *Early oil industry knowledge of CO₂ and global warming*, 8 *Nature Climate Change* 1024 (Nov. 19, 2018), <https://www.nature.com/articles/s41558-018-0349-9>.

² *Id.*

³ Roger Revelle and Hans Suess, *Carbon Dioxide Exchange Between Atmosphere and Ocean and the Question of an Increase of Atmospheric CO₂ during the Past Decades*, 9 *Tellus* 18 (1957), <http://www.tandfonline.com/doi/pdf/10.3402/tellusa.v9i1.9075?needAccess=true>.

⁴ H.R. Brannon, A.C. Daughtry, D. Perry, W.W. Whitaker, and M. Williams, *Radiocarbon evidence on the dilution of atmospheric and oceanic carbon by carbon from fossil fuels*, 38 *Trans. Am. Geophys. Union* 643 (Oct. 1957).

find energy sources other than fossil fuels to mitigate these dangers, stating

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.⁵

Then, in 1965, API President Frank Ikard delivered a presentation at the organization's annual meeting. Ikard informed API's membership that President Lyndon Johnson's Science Advisory Committee had predicted that fossil fuels could cause significant climatic changes by the end of the century.⁶ He issued the following warning about the consequences of CO₂ pollution:

This report unquestionably will fan emotions, raise fears, and bring demands for action. 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.⁷

⁵ Edward Teller, *Energy patterns of the future*, 38 *Energy and Man: A Symposium* 53, 58 (1960).

⁶ Frank Ikard, *Meeting the challenges of 1966*, Proceedings of the American Petroleum Institute 12-15 (1965), <http://www.climatefiles.com/trade-group/american-petroleum-institute/1965-api-president-meeting-the-challenges-of-1966/>.

⁷ *Id.* at 13.

Over the next few years, scientific research continued to bolster the conclusion that the combustion of fossil fuels would be the primary driver of climate change. A 1968 Stanford Research Institute (SRI) report—commissioned by API and made available to API’s members, including predecessors of Exxon and Koch—warned that “rising levels of CO₂ would likely result in rising global temperatures and that, if temperatures increased significantly, the result could be melting ice caps, rising sea levels, warming oceans, and serious environmental damage on a global scale.”⁸ The scientists acknowledged that the burning of fossil fuels provided the best explanation for an increase in atmospheric CO₂ levels.⁹

In 1969, API commissioned a supplemental report by SRI that provided a more detailed assessment on CO₂. The report stated that atmospheric concentrations of CO₂ were steadily increasing, that 90% of this increase could be attributed to fossil-fuel combustion, and that

⁸ *Smoke and Fumes: The Legal and Evidentiary Basis for Holding Big Oil Accountable for the Climate Crisis*, Center for International Environmental Law 12 (Nov. 2017), <https://www.ciel.org/wp-content/uploads/2017/11/Smoke-Fumes-FINAL.pdf>.

⁹ Elmer Robinson and R.C. Robbins, *Sources, Abundance, and Fate of Gaseous Atmospheric Pollutants*, Stanford Research Institute 3 (1968), <https://www.smokeandfumes.org/documents/document16>.

continued use of fossil fuels would further increase atmospheric CO₂.¹⁰ The report projected that, based on current fuel usage, CO₂ concentrations would reach 370 ppm by 2000—exactly what they turned out to be.¹¹ All of this research was summarized and shared with API members, including predecessors of Exxon and Koch.¹²

A 1977 presentation and 1978 briefing by senior Exxon scientist James F. Black warned the Exxon Corporation Management Committee that CO₂ concentrations were building in the Earth's atmosphere at an increasing rate, that CO₂ emissions were attributable to fossil fuels, and that CO₂ would contribute to global warming.¹³ Speaking to the emerging scientific consensus on climate change at the time, Black acknowledged that there was general scientific agreement that CO₂

¹⁰ *Smoke and Fumes*, *supra* note 8, at 12.

¹¹ *Global Mean CO₂ Mixing Ratios (ppm): Observations*, NASA Goddard Institute for Space Studies, <https://data.giss.nasa.gov/modelforce/ghgases/Fig1A.ext.txt> (last visited Jan. 25, 2019).

¹² *Environmental Research, A Status Report*, American Petroleum Institute (Jan. 1972), <http://files.eric.ed.gov/fulltext/ED066339.pdf>.

¹³ Memo from J.F. Black to F.G. Turpin re The Greenhouse Effect, Exxon Research and Engineering Company 3 (June 6, 1978), <http://www.climatefiles.com/exxonmobil/1978-exxon-memo-on-greenhouse-effect-for-exxon-corporation-management-committee/>.

released from the burning of fossil fuels was likely influencing global climate, and stated:

Present thinking holds that man has a time window of five to ten years before the need for hard decisions regarding changes in energy strategies might become critical.¹⁴

Black expressed no uncertainty as to whether the burning of fossil fuels would cause climate change. Former Exxon scientist Ed Garvey described the situation as follows: “By the late 1970s, global warming was no longer speculative.”¹⁵ In another interview, Garvey added: “The issue was not were we going to have a problem, the issue was simply how soon and how fast and how bad was it going to be. Not if.”¹⁶

In sum, through the 1950s and 1960s, there was agreement among industry, government, and academic scientists that the observed increase in CO₂ concentrations, caused by fossil-fuel combustion, would likely increase average global temperatures, and therefore a

¹⁴ *Id.* at 3.

¹⁵ James Osborne, *INTERVIEW: Former Exxon scientist on oil giant's 1970s climate change research*, Dallas News (Oct. 2015), <https://www.dallasnews.com/business/business/2015/10/02/interview-former-exxon-scientist-on-oil-giants-1970s-climate-change-research>.

¹⁶ Amy Westervelt, *Drilled: A True Crime Podcast about Climate Change*, Episode 1, The Bell Labs of Energy (interview with Ed Garvey at 11:10) (Nov. 14, 2018), <https://www.criticalfrequency.org/drilled>.

variety of climate-related impacts. By the late 1970s, there was a general scientific consensus that this would occur.

B. Defendants conducted their own climate science research confirming that fossil-fuel combustion was increasing atmospheric CO₂ concentrations, thereby heating the planet.

From the late 1970s through early 1980s, Defendants' own research repeatedly confirmed the findings of leading scientists and institutions studying climate change.¹⁷

Exxon was particularly active in the growing field of climate science. Following warnings by Black and others, Exxon launched an ambitious research program to study the environmental effects of greenhouse gases. The company assembled a team of scientists, modelers, and mathematicians to deepen the company's understanding of an environmental problem that posed an existential threat to its business interests.¹⁸ As Exxon senior scientist Morrel Cohen explained:

¹⁷ Between 1983-84, Exxon's researchers published their results in at least three peer-reviewed papers in the *Journal of the Atmospheric Sciences* and *American Geophysical Union*. A list of "Exxon Mobil Contributed Publications" from 1983-2014 is available at: https://cdn.exxonmobil.com/~media/global/files/energy-and-environment/climate_peer_reviewed_publications_1980s_forward.pdf.

¹⁸ Geoffrey Supran and Naomi Oreskes, *Assessing ExxonMobil's climate change communications (1977-2014)*, 12(8) Environmental Research

“Exxon was trying to become a research power in the energy industry the way the Bell Labs was in the communications industry.”¹⁹ The research program included both empirical CO₂ sampling and rigorous climate modeling, and was perceived by those within the industry as being at the cutting edge of research into what was then known as the “greenhouse effect.” By 1982, Exxon’s scientists, in collaboration with other industry scientists, had created climate models that confirmed the scientific consensus that the continued increase of CO₂ from fossil fuels would cause significant global warming by the middle of the 21st century, with “potentially catastrophic” effects, and they communicated these findings internally.²⁰

Letters 084019 (Aug. 23, 2017), <http://iopscience.iop.org/article/10.1088/1748-9326/aa815f>; see also Geoffrey Supran and Naomi Oreskes, *Addendum to ‘Assessing ExxonMobil’s climate change communications (1977–2014)’*, 15(11) Environmental Research Letters 119401 (Oct. 30, 2020), <https://iopscience.iop.org/article/10.1088/1748-9326/ab89d5>.

¹⁹ Westervelt, *supra* note 16 (interview with Morrell Cohen at 6:21); see also John Walsh, *Exxon Builds on Basic Research*, 225 Science 1001 (1984), <https://www.documentcloud.org/documents/5690867-1984-Walsh-Exxon-Builds-on-Basic-Reseach.html>.

²⁰ See e.g. Memo from M.B. Glaser to Exxon Management re CO₂ “Greenhouse” Effect, Exxon Research and Engineering Company 11 (Nov. 12, 1982), <http://insideclimatenews.org/sites/default/files/documents/1982%20Exxon%20Primer%20on%20CO2%20Greenhouse%20Effect.pdf>.

In 1979, W.L. Ferrall described the findings of an internal Exxon study, concluding that the “increase [in CO₂ concentration] is due to fossil fuel combustion,” that “[i]ncreasing CO₂ concentration will cause a warming of the earth’s surface,” and that the “present trend of fossil fuel consumption will cause dramatic environmental effects before the year 2050.”²¹ With a doubling of CO₂ concentration from an 1860 baseline, Ferrall predicted that “ocean levels would rise four feet” and the “Arctic Ocean would be ice free for at least six months each year, causing major shifts in weather patterns in the northern hemisphere.”²²

A 1980 presentation by Dr. John Laurman to the API Task Force on “The CO₂ Problem” identified the “scientific consensus on the potential for large future climatic response to increased CO₂ levels” as a reason for concern, and stated that there was “strong empirical evidence” that climate change was caused by fossil-fuel combustion.²³

²¹ Memo from W.L. Ferrall to R.L. Hirsch re “Controlling Atmospheric CO₂”, Exxon Research and Engineering Company 1 (Oct. 16, 1979), <http://insideclimatenews.org/sites/default/files/documents/CO2%20and%20Fuel%20Use%20Projections.pdf>.

²² *Id.*, Appendix A at 1.

²³ *AQ-9 Task Force Meeting Minutes*, American Petroleum Institute, Attachment B at 1-2 (Mar. 18, 1980), <https://insideclimatenews.org/sites/default/files/documents/AQ-9%20Task%20Force%20Meeting%20%281980%29.pdf>.

Laurman also warned the API Task Force that foreseeable temperature increases could have “major economic consequences” and “globally catastrophic effects.”²⁴

By 1981, Exxon had internally acknowledged the risks of climate change and the role that fossil-fuel combustion played in increasing CO₂ concentrations. In an internal memorandum outlining Exxon’s position on the CO₂ greenhouse effect, Exxon scientist Henry Shaw wrote that a doubling of CO₂ would result in a 3°C increase in average global temperature and a 10°C increase at the poles, causing major shifts in rainfall/agriculture and the melting of polar ice.²⁵ Also in 1981, Roger Cohen, director of Exxon’s Theoretical and Mathematical Sciences Laboratory, warned about the magnitude of climate change: “we will unambiguously recognize the threat by the year 2000 because of advances in climate modeling and the beginning of real experimental confirmation of the CO₂ effect.”²⁶ He added that “it is distinctly possible

²⁴ *Id.*, Attachment B at 5.

²⁵ Memo from Henry Shaw to Dr. E.E. David, Jr. re “CO₂ Position Statement”, Exxon Inter-Office Correspondence 2 (May 15, 1981), <https://insideclimatenews.org/sites/default/files/documents/Exxon%20Position%20on%20CO2%20%281981%29.pdf>.

²⁶ Memo from R.W. Cohen to W. Glass re possible “catastrophic” effect of CO₂, Exxon Corporation 1 (Aug. 18, 1981),

that [Exxon Planning Division's] scenario will later produce effects which will indeed be catastrophic (at least for a substantial fraction of the earth's population)."²⁷

In 1982, Cohen summarized the findings of Exxon's research in climate modeling, stating that "over the past several years *a clear scientific consensus has emerged* regarding the expected climatic effects of increased atmospheric CO₂."²⁸ Cohen acknowledged that Exxon shared the views of the mainstream science community, stating that 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," and that Exxon's findings were "consistent with the published predictions of more complex climate models" and "in accord with the scientific consensus on the effect of increased atmospheric CO₂ on climate."²⁹

<http://www.climatefiles.com/exxonmobil/1981-exxon-memo-on-possible-emission-consequences-of-fossil-fuel-consumption>.

²⁷ *Id.*

²⁸ Memo from R. W. Cohen to A.M. Natkin, Exxon Research and Engineering Company 1 (Sept. 2, 1982), <http://www.climatefiles.com/exxonmobil/1982-exxon-memo-summarizing-climate-modeling-and-co2-greenhouse-effect-research/> (emphasis added).

²⁹ *Id.* at 2.

Internal documents from the 1980s provide further evidence that Exxon and others acknowledged that the threat of climate change was real, that it was caused by fossil fuels, and that it would significantly affect the environment and human health. Notably, a 1982 corporate primer—circulated internally to Exxon management—recognized the need for “major reductions in fossil fuel combustion” to mitigate global warming. Absent such reductions, “there are some potentially catastrophic events that must be considered ... [O]nce the effects are measurable, they might not be reversible[.]”³⁰

The 1982 Exxon primer predicted a doubling of CO₂ concentrations (above pre-industrial levels) by 2060 and increased temperatures of 2-4°C (above 1982 levels) by the end of the 21st century. It also assessed, in detail, the “potentially catastrophic” impacts of global warming, including primary impacts on physical and biological systems and the secondary impacts of migration and famine.³¹

In the 1970s and 1980s, Exxon and API pursued cutting-edge research and amassed considerable data on climate change, which was

³⁰ Memo from M.B. Glaser to Exxon Management re CO₂ “Greenhouse” Effect, *supra* note 20, at 2 and 11.

³¹ *Id.* at 12-14.

widely distributed to Koch's predecessors and other API members. This body of research confirmed their earlier knowledge and led to the undeniable conclusion that continued fossil-fuel production and use would change the climate irreversibly and catastrophically. Armed with this information, Defendants faced a turning point in the early 1980s.

II. DEFENDANTS TOOK PROACTIVE STEPS TO CONCEAL THEIR KNOWLEDGE AND DISCREDIT CLIMATE SCIENCE

Despite acknowledging that an increasing level of atmospheric CO₂ due to fossil-fuel burning posed a considerable threat, Defendants decided not to take steps to prevent the risks of climate change. Instead, they stopped funding major climate research and launched a campaign to discredit climate science and delay actions perceived as contrary to their business interests.³² To carry out this campaign, Defendants employed multiple tactics. They developed public-relations strategies that contradicted what they themselves had learned from

³² Memo from A.M. Natkin to H.N. Weinberg re CRL/CO₂ Greenhouse Program, Exxon Corporation 1 (June 18, 1982), [http://insideclimatenews.org/sites/default/files/documents/Budget%20Cutting%20Memo%20\(1982\).pdf](http://insideclimatenews.org/sites/default/files/documents/Budget%20Cutting%20Memo%20(1982).pdf).

climate science. They unleashed communications campaigns that promoted public doubt and downplayed the threats of climate change. And they funded individuals, organizations, and research agendas that sought to discredit the growing body of publicly available climate science.

A. Defendants developed sophisticated public-relations strategies to deny the risks of climate change and create doubt about the scientific consensus of global warming.

Defendants responded to the public-policy issues raised by their products by concealing and denying the known hazards, in contradiction to earlier internal acknowledgments and statements by industry scientists and executives. The internal memoranda and statements described below demonstrate this marked shift in the industry's position on climate science.

In a 1988 internal memo, Exxon acknowledged that atmospheric CO₂ concentrations were increasing and could double in 100 years, that the combustion of fossil fuels was emitting five billion gigatons of CO₂ per year, and that the “[g]reenhouse effect may be one of the most

significant environmental issues for the 1990s.”³³ But in this same memo, Exxon identified that its position would be to “[e]mphasize the uncertainty in scientific conclusions regarding the potential enhanced Greenhouse effect[.]”³⁴

Industry-affiliated associations and groups, such as the Global Climate Coalition (GCC), exerted significant influence on their members through their communications and strategy. Established in 1989, the GCC identified itself as “an organization of business trade associations and private companies . . . to coordinate business participation in the scientific and policy debate on the global climate change issue.”³⁵ But in reality, the group opposed greenhouse gas regulation through lobbying, funding of front groups, denial and disinformation campaigns, and other tactics.

³³ Memo from Joseph Carlson to DGL re The Greenhouse Effect 2 (Aug. 3, 1988), <http://www.climatefiles.com/exxonmobil/566/>.

³⁴ *Id.* at 7.

³⁵ *Global Climate Coalition: An Overview*, Global Climate Coalition 1 (Nov. 1996), <http://www.climatefiles.com/denial-groups/global-climate-coalition-collection/1996-global-climate-coalition-overview/>.

In 1993, the GCC hired the public-relations firm E. Bruce Harrison to develop and execute a communications plan,³⁶ which was implemented by API, the National Association of Manufacturers, the Chamber of Commerce, and other associations or coalitions of which Exxon and Koch were members. The central elements of this plan were to emphasize the potential economic costs of mitigation and to cast doubt on the science.³⁷

In 1996, following publication of the United Nations' Intergovernmental Panel on Climate Change's (IPCC) Second Assessment Report, the GCC developed a primer that provided an overview of the group's position on climate change. While acknowledging that global warming was happening, the GCC claimed that there was significant uncertainty as to its cause:

The GCC believes that the preponderance of the evidence indicates that most, if not all, of the observed warming is part of a natural warming trend which began approximately 400 years ago. If there is an anthropogenic component to this observed warming, the GCC believes that it must be

³⁶ O'Dwyer's Directory of Public Relations Firms, J.R. O'Dwyer Co., New York, NY (1995), at 85.

³⁷ See e.g. Benjamin Franta, *Weaponizing economics: Big Oil, economic consultants, and climate policy delay*, Environmental Politics (2021) (in press).

very small and must be superimposed on a much larger natural warming trend.³⁸

This statement not only stands in contradiction to the internal memos and peer-reviewed papers published by the industry's own scientists but also to the final internal draft of the GCC primer itself, which stated that the "scientific basis for the Greenhouse Effect and the potential impacts of human emissions of greenhouse gases such as CO₂ on climate is well established and cannot be denied."³⁹ This language was removed before final publication. The internal draft also included a section discussing how contrarian theories failed to "offer convincing arguments against the conventional model of greenhouse gas emission-induced climate change."⁴⁰ This section was also removed by the GCC before final publication.

³⁸ *Global Climate Coalition: An Overview*, *supra* note 35, at 2.

³⁹ Memo from Gregory J. Dana to AIAM Technical Committee re Global Climate Coalition (GCC) – Primer on Climate Change Science – Final Draft, Association of International Automobile Manufacturers 5 (Jan. 18, 1996), <http://www.climatefiles.com/denial-groups/global-climate-coalition-collection/global-climate-coalition-draft-primer/>.

⁴⁰ *Id.*

As their memoranda and statements show, Defendants and the trade associations to which they belonged deliberately fled from their prior research efforts and embraced a strategy of uncertainty and delay.

B. Defendants engaged in public-communications campaigns designed to manufacture doubt and downplay the threats of climate change.

Public-communications efforts were a key part of Defendants' strategy. Defendants Exxon and Koch, individually and through their membership in trade associations including Defendant API, launched campaigns that directly contradicted earlier statements recognizing a general scientific consensus on climate change and the magnitude of its effects.

For example, in 1996, Exxon issued a publication titled "Global warming: who's right? Facts about a debate that's turned up more questions than answers," in which Exxon CEO Lee Raymond stated that "taking drastic action immediately is unnecessary since many scientists agree there's ample time to better understand climate systems." The publication misleadingly characterized the greenhouse effect as "unquestionably real and definitely a good thing," and as "what makes the earth's atmosphere livable." Directly contradicting the

company's internal reports and peer-reviewed science, the publication attributed the increase in global temperature to "natural fluctuations that occur over long periods of time" rather than to anthropogenic sources.⁴¹

Also in 1996, API published a book titled "Reinventing Energy: Making the Right Choices," which stated that "there is no persuasive basis for forcing Americans to dramatically change their lifestyles to use less oil."⁴² The book denied the human connection to climate change, stating that "no conclusive—or even strongly suggestive—scientific evidence exists that human activities are significantly affecting sea levels, rainfall, surface temperatures or the intensity and frequency of storms."⁴³

In addition to these public statements, Defendants developed, implemented and funded a strategy of shifting "America's social

⁴¹ *Global warming: who's right? Facts about a debate that's turned up more questions than answers*, Exxon Corporation 5 (1996), <http://www.climatefiles.com/exxonmobil/global-warming-who-is-right-1996/>.

⁴² Sally Brain Gentile et al., *Reinventing Energy: Making the Right Choices*, American Petroleum Institute 77 (1996), <http://www.climatefiles.com/trade-group/american-petroleum-institute/1996-reinventing-energy/>.

⁴³ *Id.*

consciousness” by targeting specific people or groups with tailored messages.⁴⁴ From 1972 through 2014, Exxon ran advertorials (paid advertisements styled like editorials) in newspapers.⁴⁵ The company bought these advertorials because they wanted the “public to know where [they] stand” on climate change and other issues.⁴⁶

In a peer-reviewed study, Dr. Supran and Dr. Oreskes compared Exxon’s internal and peer-reviewed scientific papers to its non-peer-reviewed external public communications (including 36 *Times* advertorials from 1989 to 2004), finding a stark contrast between the way that the two sets of documents characterized climate change. Dr. Supran and Dr. Oreskes found that 83% of peer-reviewed papers and 80% of internal documents acknowledged that climate change is real

⁴⁴ See e.g. *Evolution of Mobil’s Public Affairs Programs 1970-81*, Mobil 2, <https://www.documentcloud.org/documents/5396414-Reduced-Evolution-of-Mobil-Public-Affairs-Program.html> (last visited Jan. 25, 2019).

⁴⁵ *Exxon and Mobil Ads*, Polluter Watch, <http://polluterwatch.org/exxon-and-mobil-ads> (last visited Jan. 25, 2019).

⁴⁶ Mobil, *CNN and the value of instant replay*, New York Times (Oct. 16, 1997), <http://www.documentcloud.org/documents/705559-mob-nyt-1997-oct-16-cnnslam.html>.

and human-caused, yet only 12% of advertorials did so, with 81% instead expressing doubt.⁴⁷

In 1996, API created the Global Climate Science Communications Team (GCSCT), a small group of prominent representatives of fossil-fuel companies, public-relations firms, and industry front groups with the mission of undermining the global scientific consensus that climate change was real and human-caused. In 1998, after the Kyoto Protocol was signed, the GCSCT developed a plan to launch a “program to inform the media about uncertainties in climate science; to generate national, regional and local media on the scientific uncertainties, and thereby educate and inform the public, stimulating them to raise questions with policymakers.”⁴⁸

In contrast to what the industry’s scientists had acknowledged internally and in peer-reviewed literature for more than two decades, the API strategy memo declared “it is not known for sure whether (a)

⁴⁷ Supran and Oreskes, *supra* note 18, at 1.

⁴⁸ *Global Climate Science Communications Team Action Plan*, American Petroleum Institute 4 (Apr. 3, 1998), <http://www.climatefiles.com/trade-group/american-petroleum-institute/1998-global-climate-science-communications-team-action-plan/>.

climate change actually is occurring, or (b) if it is, whether humans really have any influence on it.”⁴⁹ The memo articulated the association’s intent to undermine the scientific consensus on climate change, stating that “Victory Will Be Achieved When”:

- Average citizens “understand” (recognize) uncertainties in climate science; recognition of uncertainties becomes part of the “conventional wisdom.”
- Media “understands” (recognizes) uncertainties in climate science.⁵⁰

Exxon and API contributed to the development of the plan through their representatives, Randy Randol and Joseph Walker, respectively. Exxon also exerted influence through Steve Milloy, the executive director of a front group called The Advancement of Sound Science Coalition, which was funded in part by the company. The roadmap further identified an array of industry trade associations and front groups, fossil-fuel companies, and think tanks that would underwrite and execute the plan, several of which were funded by Koch. These groups included API, the Business Round Table, the Edison Electric Institute, the Independent Petroleum Association of America,

⁴⁹ *Id.* at 1.

⁵⁰ *Id.* at 3.

the National Mining Association, the American Legislative Exchange Council, the Committee for a Constructive Tomorrow, the Competitive Enterprise Institute, Frontiers of Freedom, and the George C. Marshall Institute.⁵¹

Koch also launched campaigns and made its own statements to manufacture doubt and uncertainty in the public's understanding of climate science. As described in a 2006 memorandum, Koch worked to develop a film that would counter *An Inconvenient Truth* and to finance a coalition of front groups that would be administered through the National Association of Manufacturers.⁵² As recently as 2014, despite the overwhelming scientific consensus that human activity causes climate change, Koch lobbyist Phillip Ellender stated that “[w]hether or not the increases and fluctuations are anthropologic or not is still a question.” Another senior executive called global warming a “hoax

⁵¹ *Id.* at 2.

⁵² Memorandum from Stanley Lewandowski, Intermountain Rural Electric Association (July 17, 2006), <https://www.documentcloud.org/documents/4519366-2006-Intermountain-Rural-Electric-Assoc-IREA-Memo#document/p2/a433707>.

invented by liberal politicians” to unite the public against a common enemy in the aftermath of the fall of the Soviet Union.⁵³

While their strategies may have evolved, Defendants’ campaigns of deception continue to this day, in large part through social media. In August 2021, the organization InfluenceMap released a report analyzing an advertising campaign undertaken by 25 fossil fuel companies (led by Exxon). These companies put out a series of Facebook ads that were viewed millions of times in 2020 alone.⁵⁴ The report states that “[m]any of these ads either contained misleading content or present information that was misaligned with the science of climate change according to both the [IPCC]’s and the International Energy Agency’s reports on reaching net zero by 2050.”⁵⁵

⁵³ Christopher Leonard, *Kochland: The Secret History of Koch Industries and Corporate Power in America* (2019), 401.

⁵⁴ Bill McKibben, *The U.N. Climate Panel Tries to Cut Through the Smog*, *The New Yorker* (Aug. 11, 2021), <https://www.newyorker.com/news/annals-of-a-warming-planet/the-un-climate-panel-tries-to-cut-through-the-smog>.

⁵⁵ Influence Map, *Climate Change and Digital Advertising: The Oil & Gas Sector’s Digital Advertising Strategy* (Aug. 2021), https://influencemap.org/site/data/000/822/InfluenceMap_ClimateChange&DigitalAdvertisingReport_August2021.pdf.

C. Defendants funded individuals, organizations, and research to discredit the growing body of publicly available climate science.

Martin Hoffert, an Exxon scientist who authored several of Exxon's peer-reviewed papers on the CO₂ greenhouse effect, noted the conflict between those peer-reviewed papers and the funding that Exxon provided to deniers of climate change:

Even though we were writing all these papers which were basically supporting the idea that climate change from CO₂ emissions was going to change the climate of the earth according to our best scientific understanding, the front office which was concerned with promoting the products of the company was also supporting people that we call climate change deniers... they were giving millions of dollars to other entities to support the idea that the CO₂ greenhouse [effect] was a hoax.⁵⁶

Defendants advanced these arguments and contrarian theories to manufacture public uncertainty and undermine climate science. For example, Defendants funded aerospace engineer Dr. Wei-Hock Soon to publish and promote research asserting that solar variability is the primary cause of global warming, even though even the industry-affiliated GCC had previously dismissed this theory as “unconvincing.”

⁵⁶ Westervelt, *supra* note 16, Episode 2, The Turn (interview with Martin Hoffert at 11:07) (Nov. 15, 2018).

Between 2001 and 2012, Soon received more than \$1.2 million from the fossil fuel industry (\$838,717 of which came from Defendants) to conduct research purported to be independent and to promote climate change theories that Defendants knew were not supported by the peer-reviewed scientific literature, including publications by their own scientists.⁵⁷

From 1991 to at least 2007, API hired economic consultants to manipulate the public's perception of the cost of climate policy. These consultants used models that inflated the predicted costs while ignoring the benefits of avoiding climate change. The conclusions of these API-commissioned studies were then widely communicated to policymakers and the public, often without acknowledging API's role in creating them or the limitations of the models.⁵⁸

⁵⁷ Kathy Mulvey and Seth Shulman, *The Climate Deception Dossiers: Internal Fossil Fuel Industry Memos Reveal Decades of Corporate Disinformation*, Union of Concerned Scientists (July 2015), at 6; Sabrina Shankman, Willie Soon: 'Too Much Ice Is Really Bad for Polar Bears' (Feb. 24, 2015), Inside Climate News, <https://insideclimatenews.org/news/24022015/willie-soon-too-much-ice-really-bad-polar-bears/>.

⁵⁸ Franta, *supra* note 37.

In addition to providing funding to scientists and economists to promote invalid or contrarian theories, Defendants funded industry front groups that denied and sought to discredit climate science. From 1997 through 2018, Koch spent at least \$145 million funding 90 organizations—including the Cato Institute, the Competitive Enterprise Institute, the Heritage Foundation, and the Freedom Foundation of Minnesota—that misrepresented and persistently sought to discredit the scientific consensus that Defendants’ fossil-fuel products were causing climate change.⁵⁹

From 1998 through 2019, Exxon spent at least \$37 million funding 69 organizations that similarly denied and discredited climate science.⁶⁰ In June 2021, Exxon lobbyist Keith McCoy admitted to as much when he stated that the company “aggressively [fought] against some of the science” by using third-party “shadow groups.”⁶¹

⁵⁹ *Koch Industries: Secretly Funding the Climate Denial Machine*, Greenpeace, <https://www.greenpeace.org/usa/ending-the-climate-crisis/climate-deniers/koch-industries/>.

⁶⁰ *ExxonMobil Foundation & Corporate Giving to Climate Change Denier & Obstructionist Organizations*, UCS (2019), <https://ucs-documents.s3.amazonaws.com/clean-energy/exxon-mobil-grants-1998-2019.pdf>.

⁶¹ Lawrence Carter, *Inside Exxon’s Playbook: How America’s biggest oil company continues to oppose action on climate change*,

In 2007, Exxon pledged to stop funding climate-denier groups: “In 2008, we will discontinue contributions to several public policy research groups whose position on climate change could divert attention from the important discussion on how the world will secure the energy required for economic growth in an environmentally responsible manner.”⁶²

In direct contradiction to this commitment and more recent ones in which Exxon claims to “not fund or support those who deny the reality of climate change,”⁶³ the company continues to fund individuals and groups that spread misinformation on climate science.⁶⁴ From 2008 through 2019, Exxon spent more than \$14 million on think tanks and lobbying groups that reject established climate science, spread misinformation, and oppose the company’s public positions on climate

<https://unearthed.greenpeace.org/2021/06/30/exxon-climate-change-undercover/>.

⁶² *2007 Corporate Citizenship Report*, ExxonMobil 39 (2007), <http://www.documentcloud.org/documents/2799777-ExxonMobil-2007-Corporate-Citizenship-Report.html>.

⁶³ Suzanne Goldenberg, *Exxon knew of climate change in 1981, email says – but it funded deniers for 27 more years*, *The Guardian* (July 8, 2015), <https://www.theguardian.com/environment/2015/jul/08/exxon-climate-change-1981-climate-denier-funding>.

⁶⁴ See Riley Dunlap and Aaron McCright, *Organized Climate Change Denial*, *The Oxford Handbook of Climate Change and Society* (2011).

policy,⁶⁵ a clear indication that Exxon continues to fund climate-science misinformation through third parties.⁶⁶

Defendants' efforts to deny and discredit the scientific consensus on climate change have had their desired effect. A draft report authored by the IPCC (to be released in 2022) states:

Rhetoric on climate change and the undermining of science have contributed to misperceptions of the scientific consensus, uncertainty, unduly discounted risk and urgency, dissent, and, most importantly, polarized public support delaying mitigation and adaptation action, particularly in the US.⁶⁷

III. EXXON MOVED TO PROTECT ITS OWN ASSETS FROM CLIMATE IMPACTS BASED ON THE SCIENCE THE COMPANY PUBLICLY DISCREDITED

While running public campaigns to manufacture doubt about climate science and block regulatory action on climate change, Exxon

⁶⁵ *ExxonMobil Foundation & Corporate Giving to Climate Change Denier & Obstructionist Organizations*, *supra* note 60.

⁶⁶ See Pattanun Achakulwisut et al., *Ending ExxonMobil Sponsorship of the American Geophysical Union* (Mar. 2016), <https://www.documentcloud.org/documents/2803702-AGU-Report-Final-20160325.html>.

⁶⁷ Zack Colman and Karl Mathiesen, *Climate scientists take swipe at Exxon Mobil, industry in leaked report*, Politico, July 2, 2021, <https://www.politico.com/news/2021/07/02/climate-scientists-exxon-mobile-report-497805>

took affirmative steps to protect its own assets from climate risks through infrastructure improvements.

By the mid-1990s, efforts by Exxon and other Defendants, described above, were reaching maturity, with millions of dollars per year being paid to scientists, economists, and front groups to assert that climate change was not real, that fossil fuels had nothing to do with any temperature increases that were being observed, and that a range of speculative hypotheses, which the Defendants knew were not valid, were responsible for global warming.

Yet in 1994, when planning the Europipe project jointly owned and operated by Exxon and other major fossil-fuel companies, the companies took sea level rise and other climate impacts into account in designing the natural-gas pipeline leading from a North Sea offshore platform to the German coast. In a document submitted to European authorities, the companies noted the impacts of sea level rise and the likely increase in the frequency of storms that would accompany climate change. While recognizing climate change as a “most uncertain

parameter,” they determined that the pipeline should be designed to account for climate impacts.⁶⁸

In 1996, Mobil and Imperial Oil (now majority owned by Exxon), among others, took similar steps to protect their investments in the Sable gas field project off the coast of Nova Scotia, Canada. Company engineers designed and built a “collection of exploration and production facilities along the Nova Scotia coast that made structural allowances for rising temperatures and sea levels.”⁶⁹ As described in the design specifications, “[a]n estimated rise in water level, due to global warming, of 0.5 meters may be assumed” for the 25-year life of the Sable gas field project.⁷⁰

Exxon took climate risks into account in planning and building major engineering and infrastructure projects, all while publicly denying the hazards of its products.

⁶⁸ Amy Lieberman and Susanne Rust, *Big Oil braced for global warming while it fought regulations*, Los Angeles Times (Dec. 31, 2015), <http://graphics.latimes.com/oil-operations/>.

⁶⁹ *Id.*

⁷⁰ *Id.*

IV. CONCLUSION

Defendants had actual knowledge of the risks associated with their fossil-fuel products as early as the late 1950s and no later than 1968. Despite their knowledge of and expertise in climate science, Defendants promoted the use of their products to Minnesotans through fraudulent, deceptive, and misleading practices. In taking these actions, Defendants violated Minnesota's consumer protection statutes, as alleged by Plaintiff, and therefore should be held liable in Minnesota state courts. Amici urge this Court to affirm the decision below.

RESPECTFULLY SUBMITTED this 25th day of August, 2021.

By: *s/ Benjamin Gould*

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CERTIFICATE OF COMPLIANCE

8th Cir. Case Number 21-1752

I am the attorney or self-represented party.

This brief contains **6,336 words**, excluding the items exempted by Fed. R. App. P. 32(f). The brief's type size and typeface comply with Fed. R. App. P. 32(a)(5) and (6).

I certify that this brief is an amicus brief and complies with the word limit of Fed. R. App. P. 29(a)(5).

s/ Benjamin Gould

Benjamin Gould

CERTIFICATE OF SERVICE

8th Cir. Case Number 21-1752

I hereby certify that I electronically filed the foregoing/attached **Brief of Amici Curiae Robert Brulle, Center for Climate Integrity, Justin Farrell, Benjamin Franta, Fresh Energy, Stephan Lewandowsky, MN350, Minnesota Center for Environmental Advocacy, Naomi Oreskes, Geoffrey Supran, and the Union of Concerned Scientists in Support of Plaintiff-Appellee and Affirmance** on this date with the Clerk of the Court for the United States Court of Appeals for the Eighth Circuit using the Appellate Electronic Filing system.

s/ Benjamin Gould

Benjamin Gould

Appendix C



REVIEW SUMMARY

CLIMATE PROJECTION

Assessing ExxonMobil's global warming projections

G. Supran*, S. Rahmstorf, N. Oreskes

BACKGROUND: In 2015, investigative journalists discovered internal company memos indicating that Exxon oil company has known since the late 1970s that its fossil fuel products could lead to global warming with “dramatic environmental effects before the year 2050.” Additional documents then emerged showing that the US oil and gas industry’s largest trade association had likewise known since at least the 1950s, as had the coal industry since at least the 1960s, and electric utilities, Total oil company, and GM and Ford motor companies since at least the 1970s. Scholars and journalists have analyzed the texts contained in these documents, providing qualitative accounts of fossil fuel interests’ knowledge of climate science and its implications. In 2017, for instance, we demonstrated that Exxon’s internal documents, as well as peer-reviewed studies published by Exxon and ExxonMobil Corp scientists, overwhelmingly acknowledged that climate change is real and human-caused. By contrast, the majority of Mobil and ExxonMobil Corp’s public communications promoted doubt on the matter.

ADVANCES: Many of the uncovered fossil fuel industry documents include explicit projections of the amount of warming expected to

occur over time in response to rising atmospheric greenhouse gas concentrations. Yet, these numerical and graphical data have received little attention. Indeed, no one has systematically reviewed climate modeling projections by any fossil fuel interest. What exactly did oil and gas companies know, and how accurate did their knowledge prove to be? Here, we address these questions by reporting and analyzing all known global warming projections documented by—and in many cases modeled by—Exxon and ExxonMobil Corp scientists between 1977 and 2003.

Our results show that in private and academic circles since the late 1970s and early 1980s, ExxonMobil predicted global warming correctly and skillfully. Using established statistical techniques, we find that 63 to 83% of the climate projections reported by ExxonMobil scientists were accurate in predicting subsequent global warming. ExxonMobil’s average projected warming was $0.20^{\circ} \pm 0.04^{\circ}\text{C}$ per decade, which is, within uncertainty, the same as that of independent academic and government projections published between 1970 and 2007. The average “skill score” and level of uncertainty of ExxonMobil’s climate models (67 to 75% and $\pm 21\%$, respectively) were also similar to those of the independent models.

Moreover, we show that ExxonMobil scientists correctly dismissed the possibility of a coming ice age in favor of a “carbon dioxide induced ‘super-interglacial’”; accurately predicted that human-caused global warming would first be detectable in the year 2000 ± 5 ; and reasonably estimated how much CO_2 would lead to dangerous warming.

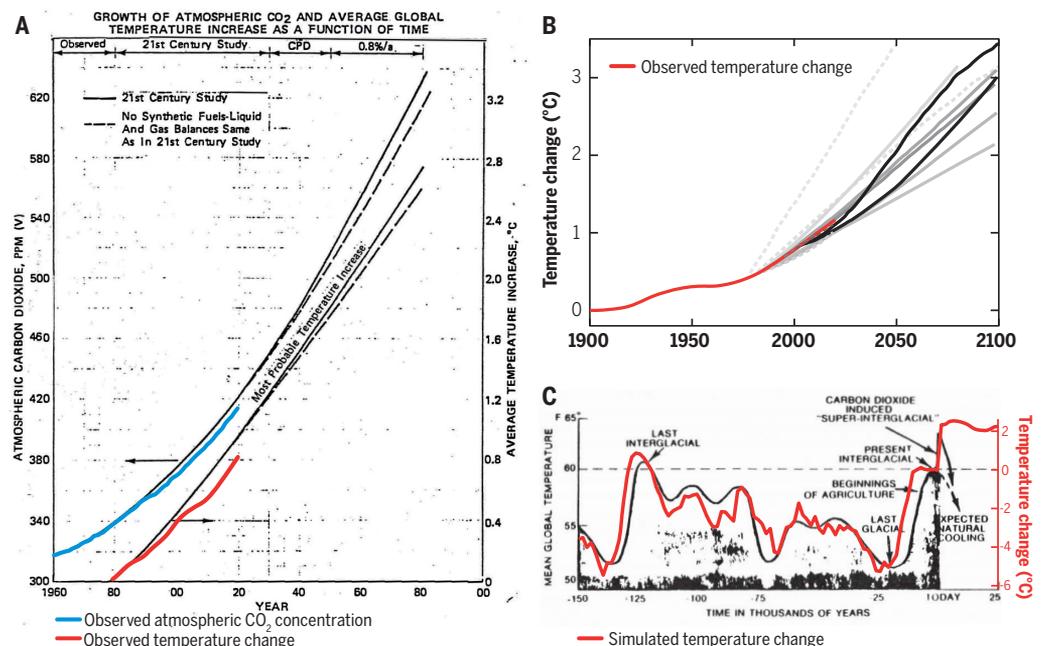
OUTLOOK: Today, dozens of cities, counties, and states are suing oil and gas companies for their “longstanding internal scientific knowledge of the causes and consequences of climate change and public deception campaigns.” The European Parliament and the US Congress have held hearings, US President Joe Biden has committed to holding fossil fuel companies accountable, and a grassroots social movement has arisen under the moniker #ExxonKnew. Our findings demonstrate that ExxonMobil didn’t just know “something” about global warming decades ago—they knew as much as academic and government scientists knew. But whereas those scientists worked to communicate what they knew, ExxonMobil worked to deny it—including overemphasizing uncertainties, denigrating climate models, mythologizing global cooling, feigning ignorance about the discernibility of human-caused warming, and staying silent about the possibility of stranded fossil fuel assets in a carbon-constrained world. ■

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S READ THE FULL ARTICLE AT
<https://doi.org/10.1126/science.abk0063>

Historically observed temperature change (red) and atmospheric carbon dioxide concentration (blue) over time, compared against global warming projections reported by ExxonMobil scientists.

(A) “Proprietary” 1982 Exxon-modeled projections. (B) Summary of projections in seven internal company memos and five peer-reviewed publications between 1977 and 2003 (gray lines). (C) A 1977 internally reported graph of the global warming “effect of CO_2 on an interglacial scale.” (A) and (B) display averaged historical temperature observations, whereas the historical temperature record in (C) is a smoothed Earth system model simulation of the last 150,000 years.



REVIEW

CLIMATE PROJECTION

Assessing ExxonMobil's global warming projections

G. Supran^{1*}†, S. Rahmstorf^{2,3}, N. Oreskes^{1,4}

Climate projections by the fossil fuel industry have never been assessed. On the basis of company records, we quantitatively evaluated all available global warming projections documented by—and in many cases modeled by—Exxon and ExxonMobil Corp scientists between 1977 and 2003. We find that most of their projections accurately forecast warming that is consistent with subsequent observations. Their projections were also consistent with, and at least as skillful as, those of independent academic and government models. Exxon and ExxonMobil Corp also correctly rejected the prospect of a coming ice age, accurately predicted when human-caused global warming would first be detected, and reasonably estimated the “carbon budget” for holding warming below 2°C. On each of these points, however, the company's public statements about climate science contradicted its own scientific data.

In 2015, investigative journalists uncovered internal company documents showing that Exxon scientists have been warning their executives about “potentially catastrophic” anthropogenic (human-caused) global warming since at least 1977 (1, 2). Researchers and journalists have subsequently unearthed additional documents showing that the US oil and gas industry writ large—by way of its trade association, the American Petroleum Institute—has been aware of potential human-caused global warming since at least the 1950s (3); the coal industry since at least the 1960s (4); electric utilities, Total oil company, and General Motors and Ford motor companies since at least the 1970s (5–8); and Shell oil company since at least the 1980s (9).

This corpus of fossil fuel documents has attracted widespread scholarly, journalistic, political, and legal attention, leading to the conclusion that the fossil fuel industry has known for decades that their products could cause dangerous global warming. In 2017, we used content analysis to demonstrate that Exxon's internal documents, as well as peer-reviewed studies authored or coauthored by Exxon and ExxonMobil Corp scientists, overwhelmingly acknowledged that global warming is real and human-caused (10). By contrast, we found that the majority of Mobil and ExxonMobil Corp's public communications promoted doubt on the matter. Cities, counties, and states have accordingly filed dozens of lawsuits variously accusing ExxonMobil Corp and other companies of deceit and responsi-

bility for climate damages (11). The attorney general of Massachusetts, for instance, alleges that ExxonMobil has had a “long-standing internal scientific knowledge of the causes and consequences of climate change” and waged “public deception campaigns” that misrepresented that knowledge (12). Civil society campaigns seeking to hold fossil fuel interests accountable for allegedly misleading shareholders, customers, and the public about climate science have emerged under monikers such as #ExxonKnew, #ShellKnew, and #TotalKnew (13–15) (see Box 1 for more examples).

But what exactly did the fossil fuel industry understand about the role of fossil fuels in causing global warming, and how accurate did their understanding prove to be? Several of the documents in question include explicit projections of the amount of warming that could be expected to occur over time in response to rising atmospheric greenhouse gas concentrations. Yet, whereas the text of these documents has been interrogated in detail, the numerical and graphical data in them have not. Indeed, no one has systematically reported climate modeling projections by any fossil fuel interest, let alone assessed their accuracy and skill. This contrasts with academic climate models, whose performance has been extensively scrutinized (16–24).

In this Review, we report and analyze all known projections of global mean surface temperature (hereafter “temperature”) change reported by company scientists working for Exxon and/or for ExxonMobil Corp after Exxon's merger with Mobil Oil Corp in 1999. (Hereafter, we collectively refer to Exxon and ExxonMobil Corp as “ExxonMobil” or the “company.”) Some projections resulted from models built or run in-house by ExxonMobil scientists, sometimes in collaboration with independent researchers. Others were produced by third parties and then discussed by

ExxonMobil scientists in internal reports. Where relevant, we distinguish these provenances, but otherwise we collectively refer to these projections as “reported” by ExxonMobil scientists.

We test the accuracy and modeling skill of ExxonMobil's global warming projections by retrospectively comparing them against subsequent observed temperature changes. We also compare their performance against assessments of models published in independent scientific literature. [Here and throughout, we use the term “climate models” to generically refer to computer simulations of Earth's climate system. All of the models investigated here—both from ExxonMobil and from independent academic and government scientists—are variants of Energy Balance Models, rather than the higher-resolution, more comprehensive General Circulation Models that succeeded them in the late 1980s (25–27).] Having quantified ExxonMobil's early understanding of climate science, we contrast it with public claims made by the company and its allies. We then offer three illustrations of how quantitative historical analysis of the fossil fuel industry's documents can yield further historical insights into the disconnect between its private understanding of climate science and its public climate denial.

We focus on global mean surface temperature changes because they are a primary driver of climate impacts, are central to climate policy-making, are the most common output of early climate models, and are accurately captured by observational records. We limit our analysis to global warming projections reported by scientists at ExxonMobil, as compared to other companies, for several reasons. First, ExxonMobil's extensive climate research program is well documented. Second, ExxonMobil documents contain the largest public collection of global warming projections recorded by a single company, allowing us to develop a coherent picture of the early understanding of climate science by a specific industry actor. Third, the company has been active in challenging climate science in general and climate models specifically, such that its work on the matter may be of particular interest to researchers, reporters, advocates, shareholders, fund managers, politicians, and legal investigators examining corporate responsibility for climate change (Box 1).

Materials and methods

We analyzed 32 internal documents produced in-house by ExxonMobil scientists and managers between 1977 and 2002, and 72 peer-reviewed scientific publications authored or coauthored by ExxonMobil scientists between 1982 and 2014. The internal documents were collated from public archives provided by ExxonMobil Corp (28), *InsideClimate News* (29), and Climate Investigations Center (30).

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Box 1. Mounting calls for fossil fuel industry accountability

There are an increasing number of lawsuits, political investigations, and civil society campaigns seeking to hold ExxonMobil Corp and other companies accountable for allegedly misleading shareholders, customers, and the public about climate science.

Lawsuits

Cities, counties, and states have filed dozens of lawsuits accusing ExxonMobil Corp and others of deceptive marketing, misleading shareholders, and culpability for climate damages (two of the authors, G.S. and N.O., have provided expert input to some of these cases) (11).

Political mobilizations

- In 2019, the European Parliament held a first-of-its-kind hearing on climate change denial by ExxonMobil Corp and other actors (to which one author, G.S., testified) (64).
- In 2019, hearings were held in the House and Senate of the United States (US) Congress regarding “oil industry efforts to suppress the truth about climate change” and “dark money and barriers to climate change,” respectively (one author, N.O., testified to both) (65, 66).
- In 2021, the US House Committee on Oversight and Reform requested documents and testimony from ExxonMobil Corp and other oil and gas companies and trade associations as part of an ongoing investigation into the fossil fuel industry’s “coordinated effort to spread disinformation” about climate change (67).
- US President Joe Biden has issued repeated commitments to hold fossil fuel companies accountable, including a 2020 environmental justice plan to “strategically support ongoing plaintiff-driven climate litigation against polluters” (68); a 2020 statement that “We should go after” the fossil fuel industry “just like we did the drug companies, just like we did with the tobacco companies” (69); and a 2021 Executive Order “to hold polluters accountable” (70).
- In 2022, the Commission on Human Rights of the Philippines (to which one author, G.S., testified) ruled that the “Carbon Majors,” including ExxonMobil Corp, “engaged in willful obfuscation [of climate science] and obstruction to prevent meaningful climate action” and that all such acts “may be bases for liability” (71).

Civil society campaigns

- International fossil fuel divestment movement, including specific calls for—and institutional commitments to—divestment from climate denying fossil fuel companies (two of the authors, G.S. and N.O., have supported these campaigns) (72–74).
- “Pay Up Climate Polluters” campaign (75).
- Array of distributed activism under the moniker #ExxonKnew (13).

The peer-reviewed publications were obtained by identifying all peer-reviewed documents among ExxonMobil Corp’s lists of “Contributed Publications,” except for three articles discovered independently during our research (31) [see supplementary materials (SM) section S2 for details on the assembly of the corpus]. These constitute all publicly available internal ExxonMobil documents concerning anthropogenic global warming of which we are aware, and all ExxonMobil peer-reviewed publications concerning global warming disclosed by the company.

Using manual content analysis, we identify all documents that reported climate model outputs of (i) a time series of projected future temperature, and (ii) future external radiative forcings [including at least atmospheric carbon dioxide (CO₂) concentration] (see SM section S1.1 for coding details). For models driven by more than one forcing time series (i.e., for high- and low-CO₂ scenarios as well as a central, “nominal” one), each resulting temperature time series is treated as a separate

and individual projection. Our figures and tables therefore distinguish between “nominal,” “high,” and “low” model projections. By contrast, for a given CO₂ scenario, temperature time series accompanied by uncertainty bars (corresponding, for example, to different model climate sensitivities) are treated as single projections with uncertainty bounds given by those uncertainty bars. This yields 12 documents published between 1977 and 2003, which contain 16 distinct temperature projections presented in the form of 12 unique graphs and one table (summarized in SM section S2.2). The 12 documents comprise seven internal memos (1977 to 1985) and five peer-reviewed papers (1985 to 2003). Twelve of the 16 temperature projections came from models built or run in-house by ExxonMobil scientists, typically in collaboration with independent researchers. Once identified, all original temperature and forcing projections are converted for analysis by digitizing graphs and extracting tables.

We assess each model projection over the period from the publication year of its contain-

ing document through 2019 (or through the final projected year, if earlier). First, we overlay all original temperature time series with observed temperature changes. Observations are aligned with respect to the earliest reference year(s) for which model projection data are available and, unless noted otherwise, reflect the smoothed annual average of five historical time series. Following Hausfather *et al.* (2020) and the Intergovernmental Panel on Climate Change (IPCC), we compare observations to model projections in two quantitative ways: (i) change in temperature versus time; and (ii) change in temperature versus change in radiative forcing (the “implied transient climate response,” or iTCR) (16, 24). The iTCR metric enables us to assess model performance while accounting for any differences in the assumptions about future radiative forcings driving the models. For each projected and observed temperature time series, per-decade temperature changes are calculated by fitting an ordinary least squares model over the projection period and multiplying the resulting gradient coefficient by 10. Analogously, iTCR is calculated by regressing temperature against anthropogenic radiative forcing over the projection period and multiplying the result by the forcing associated with doubled atmospheric CO₂ concentrations, $F_{2x} = 3.7W/m^2$ (16):

$$iTCR = F_{2x}\Delta T/\Delta F_{anthro}$$

For model projections, ΔF_{anthro} was based on explicit external forcing values when provided and was otherwise estimated from model CO₂ concentration scenarios as

$$\Delta F_{anthro} = 5.35 \cdot \ln\left(\frac{p'_{CO_2}}{p_{CO_2}}\right)$$

where p_{CO_2} is the initial CO₂ concentration (in parts per million) at the start of the projection period and p'_{CO_2} is the CO₂ concentration during each subsequent year through 2019 (16). In the real world, of course, global temperature changes are driven by multiple natural and anthropogenic factors, including but not limited to CO₂. Nevertheless, even when model projections are driven by CO₂-only anthropogenic forcing scenarios, retrospectively comparing projections to observations offers a robust, independent, and established test of model skill. This is because (i) global warming has been almost entirely human-caused since the late 19th century (32, 33) and (ii) total anthropogenic forcing over the past 150 years has been, to first order, similar to the forcing of CO₂ alone, because the warming effects of other greenhouse gases and the cooling effects of other sources cancel one another out (34). For further discussion of the implications and limitations of model-versus-observation comparisons, see SM section S1.2.7. Observed

ΔF_{anthro} values, meanwhile, were based on a 1000-member ensemble of observationally informed forcing estimates reported by Dessler and Forster (2018) (35).

Evaluated in terms of each of the above metrics, we deem model projections and historical observations to be consistent if and only if the 95% confidence intervals of the differences between the two include zero. As detailed in SM sections S1.2.2 and S1.2.3, these confidence intervals were calculated to reflect two sources of uncertainty: (i) statistical uncertainty in regression coefficients and (ii) structural uncertainty due to different model climate sensitivities, as and when indicated by error

bars in projections reported by ExxonMobil scientists.

As an additional measure of performance, we calculate the “skill score” of each model by comparing the root-mean-squared errors of a model projection with those of a zero temperature change null hypothesis (20). For each projection, we calculate skill scores with respect to (i) each of the five observational temperature records for the temperature-versus-time metric and (ii) the 5000 estimates of $\Delta T/\Delta F_{\text{anthro}}$ for the iTCR metric. (See SM section 1.2 for details on graphical overlays and on calculation of consistency and skill scores and their accompanying uncertainties.)

Accurate and skillful climate modeling

Overall, ExxonMobil’s global warming projections closely track subsequent observed temperature increases.

Figure 1 reproduces all 12 identified unique graphs, which contain 15 of the 16 identified temperature projections (the 16th was reported as a table). For example, panel 3 of Fig. 1 is a graph showing “an estimate of the average global temperature increase” under the “Exxon 21st Century Study–High Growth scenario” for CO₂. It was included in a 1982 internal briefing on the “CO₂ ‘Greenhouse’ Effect” prepared by Exxon Research and Engineering Company and circulated widely to Exxon management

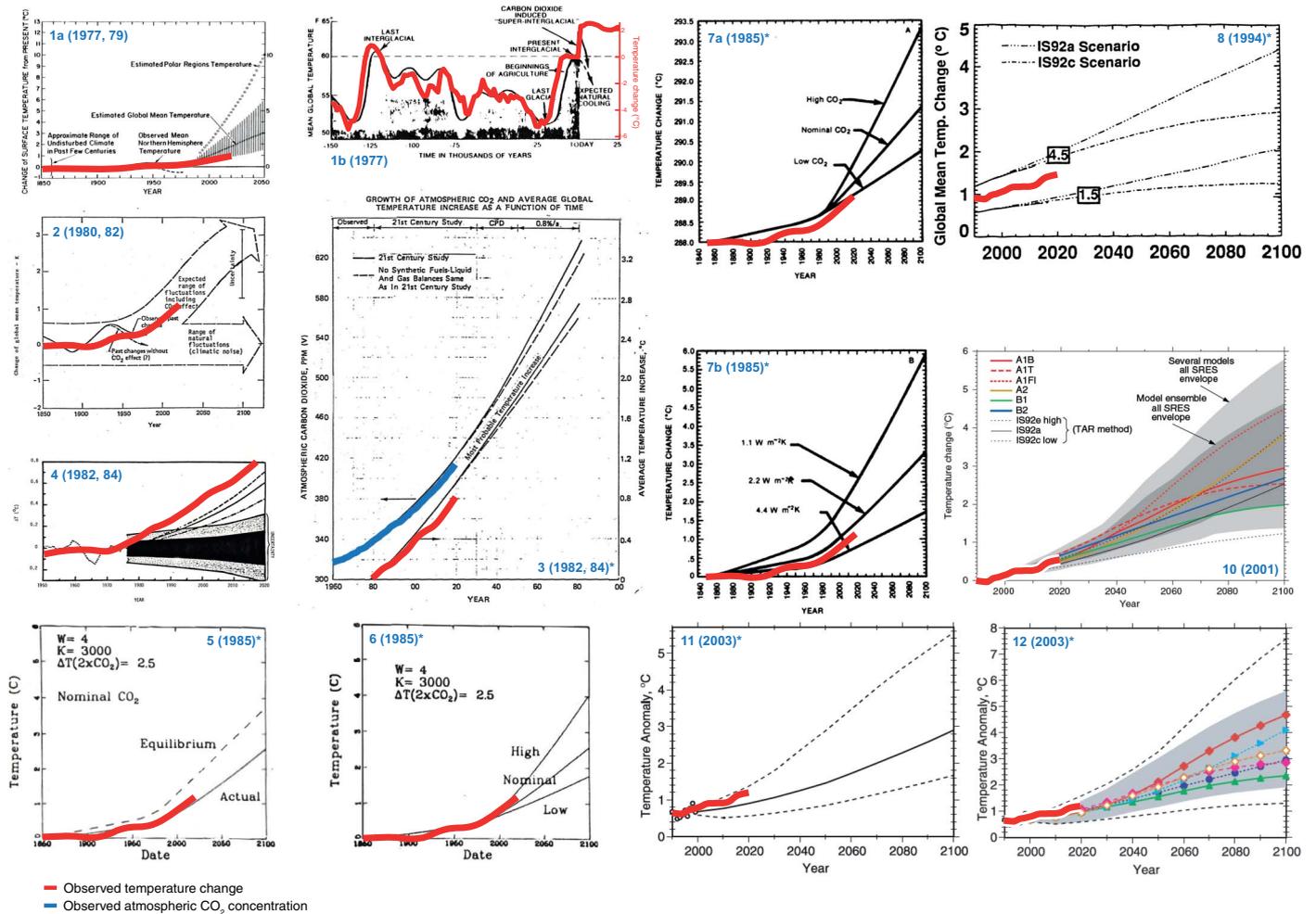


Fig. 1. Historically observed temperature change versus time (red) compared against global warming projections reported by ExxonMobil scientists in internal documents and peer-reviewed publications. Panel numbers indicate projections reported in internal documents: (1a, b) Black (1977, vugraphs 10 and 11, respectively) (54) and Mastracchio (1979) (88), (2) Shaw (1980) (89) and Glaser (1982, fig. 9) (36), (3) Glaser (1982, fig. 3) (36) and Shaw (1984) (37), (4) Weinberg *et al.* (1982) (42) and Callegari (1984) (41), (5, 6) Flannery (1985, pages 23 and 24, respectively) (39); and in peer-reviewed publications: (7a, b) Hoffert and Flannery (1985, figs. 5.16A and B, respectively) (38), (8) Jain *et al.* (1994) (40), (10) Albritton *et al.* (2001) (90), (11, 12) Khesghi and Jain (2003, figs. 7c and 8c, respectively) (91). Asterisks indicate global

warming projections modeled by ExxonMobil scientists themselves. Panels have been numbered to match the labels in Fig. 2; this means that (9) Khesghi *et al.* (1997) (92), which reports projections in tabulated rather than graphical form, is represented in Fig. 2 but is not included here. Temperature observations reflect the smoothed annual average of five historical time series. The only exception to this is the historical temperature record in (1b), which reflects a smoothed Earth system model simulation of the last 150,000 years driven by orbital forcing only, with an appended moderate anthropogenic emissions scenario. Panel 3 additionally compares projected atmospheric carbon dioxide concentrations against annual mean observations (blue). For data sources and plotting details, see SM sections S1 and S2.

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Fig. 2. Summary of all global warming projections (nominal scenarios) reported by ExxonMobil scientists in internal documents and peer-reviewed publications (gray lines), superimposed on historically observed temperature change (red). Solid gray lines (and asterisked numerical labels) indicate global warming projections modeled by ExxonMobil scientists themselves; dashed gray lines indicate projections internally reproduced by ExxonMobil scientists from third-party sources. Shades of gray and numerical labels scale with model start dates, from earliest (1977: lightest, "1") to latest (2003: darkest, "12"). Numerical labels correspond to panels in Fig. 1, which displays all original graphical projections reported by ExxonMobil scientists. Observations reflect the smoothed annual average of five historical time series. For data sources and plotting details, see SM sections S1 and S2.

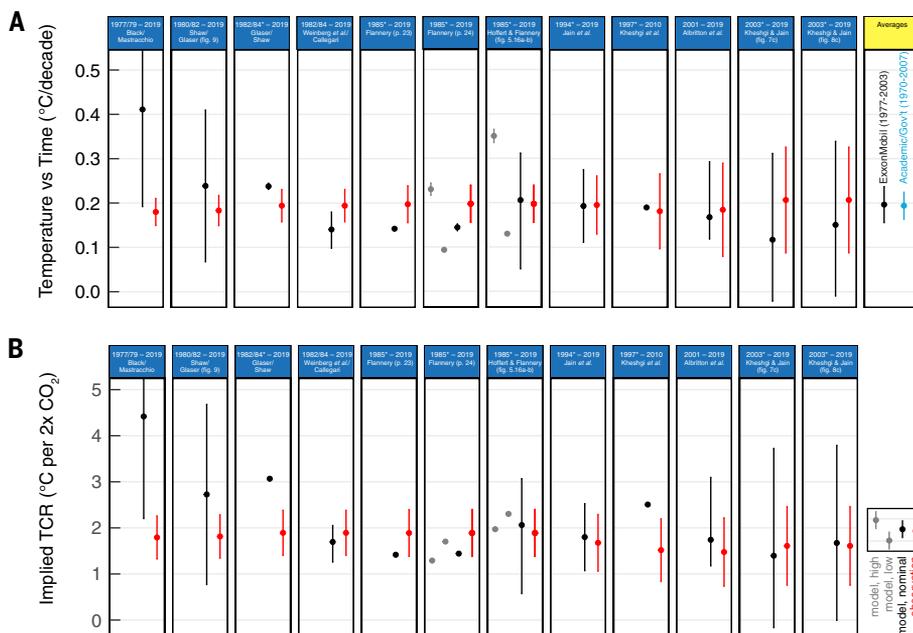
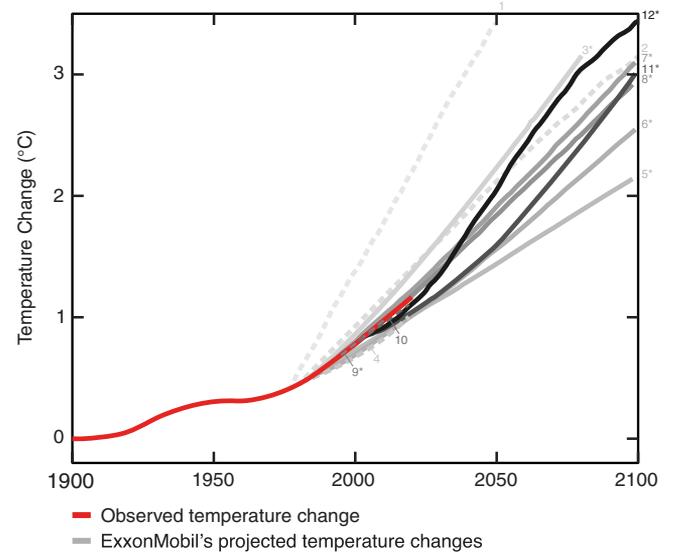


Fig. 3. Comparison of (red) temperature observations and (gray or black) global warming projections reported by ExxonMobil scientists in internal documents and peer-reviewed publications, as illustrated in Figs. 1 and 2. Observed and projected trends are compared in terms of (A) temperature change versus time and (B) temperature change versus change in radiative forcing ("implied TCR"). iTCR is defined as the change in temperature versus change in radiative forcing (see materials and methods and SM section S1.2.3 for details). The left-to-right order of panels corresponds to the numbering of projections ("1" to "12") in Figs. 1 and 2. Trends are computed over model projection periods indicated in the blue boxes above each panel. Asterisks indicate global warming projections modeled by ExxonMobil scientists themselves. The yellow-labeled box in (A) displays averages and bootstrapped standard errors of (black) the 16 projections reported by ExxonMobil scientists spanning 1977 to 2003 and (cyan) 18 academic and government climate model projections spanning 1970 to 2007 reported by Hausfather *et al.* (2020) (16).

(36). The briefing was labeled as "proprietary information for authorized company use only." The graph appeared a second time in an Exxon manager's presentation on "CO₂ greenhouse and climate issues" at an internal company environmental conference in 1984 (37).

Panel 3 of Fig. 1 displays one of 12 unique temperature projections (out of a total of 16 projections) that were output by models built or run in-house by ExxonMobil scientists (the 12 projections are indicated by asterisks in Figs. 1 to 3 and Table 1). To our knowledge,

the temperature projection in panel 3 was independently produced by Exxon scientists as part of "technology forecasting activities in 1981" operated by the company's Corporate Planning Department (37). The temperature projection was based on "calculations of future atmospheric CO₂ concentrations "recently completed at Exxon Research and Engineering Company" (36). The remaining 11 temperature projections were produced by models developed by ExxonMobil scientists in collaboration with academic coauthors. Specifically, the seven unique temperature projections shown in panels 5 to 7b in Fig. 1 derived from a one-dimensional upwelling-diffusion Energy Balance Model to study how the "climatic transient response from fossil fuel burning is damped...by heat storage in the world's oceans..." (38). The Exxon scientist leading the collaboration internally described their climate modeling as "sophisticated" and "state of the art" (39). The remaining four unique temperature projections (three in panels 8, 11, and 12 in Fig. 1 and the fourth designated by "9" in Fig. 2) were generated by an "Integrated Science Model which consists of coupled modules for carbon cycle, atmospheric chemistry of other trace gases, radiative forcing by greenhouse gases, energy balance model for global temperature, and a model for sea level response" (40).

In Fig. 1, we overlay the original graphs with observed atmospheric CO₂ concentrations and temperature changes, shown in blue and red, respectively. In general, observations closely track projections.

In Fig. 2, we digitize all of ExxonMobil scientists' temperature projections corresponding to "nominal" (i.e., central) CO₂ scenarios in all 12 graphs (and one table). These projections, shown in gray, are plotted from the observed temperature change, shown in red,

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Table 1. Skill scores of global warming projections reported by ExxonMobil scientists in internal documents and peer-reviewed publications. Scores are shown for ($\Delta T/\Delta t$) temperature change versus time; and ($\Delta T/\Delta F$) temperature change versus change in radiative forcing (“implied TCR”). Average skill scores are summarized for (i) all projections and (ii) projections modeled by ExxonMobil scientists themselves (indicated by asterisks). A skill score of 100% indicates perfect agreement with observations; a score less than zero indicates

worse performance than a zero temperature change null hypothesis. For each projection, median scores and 5th and 95th percentile confidence intervals are shown, all as percentages. For each average skill score, the mean and the 1σ standard error of the mean are shown. Confidence intervals for projections over short periods—such as Khesghi *et al.* (1997), Albritton *et al.* (2001), and Khesghi and Jain (2003)—are large, primarily owing to the substantial impact of interannual and subdecadal variability on short-term temperature trends.

Projection	Reference	Time frame	Skill $\Delta T/\Delta t$ (%)	Skill $\Delta T/\Delta F$ (%)
1977 Black (vugraph 10); 1979 Mastracchio nominal	(54, 88)	1977–2019	22 (–55 to –4)	–49 (–102 to 0)
1980 Shaw; 1982 Glaser (fig. 9) nominal	(36, 89)	1980–2019	73 (53 to 84)	49 (16 to 78)
1982* Glaser (fig. 3/table 4); 1984 Shaw nominal	(36, 37)	1982–2019	82 (61 to 92)	37 (1 to 68)
1982 Weinberg <i>et al.</i> ; 1984 Callegari nominal	(41, 42)	1982–2019	70 (64 to 82)	90 (73 to 99)
1985* Flannery (page 23) nominal	(39)	1985–2019	70 (63 to 83)	76 (61 to 92)
1985* Flannery (page 24) high	(39)	1985–2019	87 (66 to 97)	69 (55 to 84)
1985* Flannery (page 24) low	(39)	1985–2019	46 (42 to 55)	90 (73 to 99)
1985* Flannery (page 24) nominal	(39)	1985–2019	71 (64 to 84)	77 (62 to 94)
1985* Hoffert and Flannery (fig. 5.16) high	(38)	1985–2019	28 (–5 to 44)	92 (71 to 99)
1985* Hoffert and Flannery (fig. 5.16) low	(38)	1985–2019	64 (58 to 76)	77 (49 to 97)
1985* Hoffert and Flannery (fig. 5.16) nominal	(38)	1985–2019	99 (80 to 99)	89 (65 to 99)
1994* Jain <i>et al.</i> nominal	(40)	1994–2019	97 (71 to 99)	89 (54 to 99)
1997* Khesghi <i>et al.</i> nominal	(92)	1997–2010	93 (49 to 98)	34 (–43 to 80)
2001 Albritton <i>et al.</i> nominal	(90)	2001–2019	84 (60 to 98)	81 (18 to 98)
2003* Khesghi and Jain (fig. 7c) nominal	(91)	2003–2019	56 (41 to 85)	85 (55 to 98)
2003* Khesghi and Jain (fig. 8c) nominal	(91)	2003–2019	72 (51 to 95)	88 (37 to 99)
Average of all projections			67 (60 to 74)	67 (58 to 76)
Average of ExxonMobil models			72 (66 to 78)	75 (70 to 81)

Box 2. How ExxonMobil Corp exaggerated the uncertainties of climate science and modeling

- In 2000, ExxonMobil Corp CEO Lee Raymond wrote that “[W]e do not now have a sufficient scientific understanding of climate change to make reasonable predictions and/or justify drastic measures...the science of climate change is uncertain...” (76). The report speculated about a “natural period of warming,” “solar activity,” and “[v]olcanic eruptions, El Nino.” “With all this natural climate ‘noise’ and the complexities of measurement,” it said, “science is not now able to confirm that fossil fuel use has led to any significant global warming.”
- In 2001, an ExxonMobil Corp press release said of the “Hockey Stick” graph showing anthropogenic global warming: “The error bars are huge, yet some prefer to ignore them” (77).
- In 2005, Lee Raymond said in a television interview: “There is a natural variability that has nothing to do with man...It has to do with sun spots...with the wobble of the Earth...[T]he science is not there to make that determination [as to whether global warming is human-caused]...[T]here are a lot of other scientists that do not agree with [the National Academy and IPCC]...[T]he data is [sic] not compelling” (78).
- In 2007, ExxonMobil Corp’s website stated that “[G]aps in the scientific basis for theoretical climate models and the interplay of significant natural variability make it very difficult to determine objectively the extent to which recent climate changes might be the result of human actions” (79).
- In 2013, ExxonMobil Corp CEO Rex Tillerson said: “[T]he facts remain there are uncertainties around the climate...what the principal drivers of climate change are...[T]here are other elements of the climate system that may obviate this one single variable [of burning fossil fuels]...And so that’s that uncertainty issue...” (80).

at the start of each projection period. The darkness of the projection lines scales with their start years, from 1977 (lightest gray) to 2003 (darkest gray). Solid gray lines indicate projections modeled by ExxonMobil scientists themselves, whereas dashed gray lines indicate projections reproduced from third-

party peer-reviewed papers. With the exception of the earliest projection (designated by “1”), which overestimated future warming, projections lie close to and evenly distributed around observations.

In Fig. 3A, we compare trends in temperature change versus time for historical ob-

servations (in red) and for all 16 projections reported by ExxonMobil scientists (in gray or black). Over the course of their respective projection periods (indicated in blue boxes at the top of each panel in Fig. 3), the average predicted warming was $0.20^\circ \pm 0.04^\circ\text{C}$ per decade. Ten of the 16 projections are consistent with historical observations (differences between models and projections are shown in fig. S1A). Of the remaining six projections, two forecast more warming than observed and four forecast less. Treating each unique graph and table—rather than each forcing scenario—as independent, 10 out of the 12 unique projection datasets are consistent with observations. Of the remainder, one forecasts more warming than observed and one forecasts less. Notably, these two projections are among the only three (out of 12) that were reported without uncertainty bars. They therefore have less “room for uncertainty” in our consistency tests. Overall, the models perform very well.

When we account for mismatches between forecast and observed forcings by using the iTCR metric, 12 of the 16 projections reported by ExxonMobil scientists are consistent with observations. Figure 3B uses the iTCR metric to compare trends in observed and projected iTCRs, and fig. S1B shows their differences. Treating each unique graph and table as independent, 9 out of 12 datasets are consistent.

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Box 3. How Mobil and ExxonMobil Corp cultivated the myth of a 1970s global cooling scientific consensus

- In 1997, Mobil CEO Lee Raymond questioned whether “the Earth [is] really warming” by claiming that “In the 1970s, some of today’s prophets of doom from global warming were predicting the coming of a new ice age” (81).
- In 2001, an ExxonMobil Corp press release said: “[T]here is no consensus about long-term climate trends and what causes them...during the 1970’s [sic], people were concerned about global cooling” (82).
- In 2003, US Senator James Inhofe, who has to date received \$2.3 million in campaign contributions from oil and gas companies, including ExxonMobil, argued that the issue of human-caused global warming “is far from settled” by pointing to “those who warned us in the 1970s that the planet was headed for a catastrophic global cooling” (56, 83–85).
- In 2004, a report published by the ExxonMobil Corp-funded Cato Institute stated that “Thirty years ago there was much scientific discussion among those who believed that humans influenced the... reflectivity [which would] cool the earth, more than...increasing carbon dioxide, causing warming. Back then, the ‘coolers’ had the upper hand...But nature quickly shifted gears...Needless to say, the abrupt shift in the climate caused almost as abrupt a shift in the balance of scientists who predictably followed the temperature” (56, 86).

The three outliers forecast more warming than observed; two of them do not have uncertainty bars.

We also calculate skill scores for the temperature-versus-time and iTCR metrics (Table 1). A skill score of 100% indicates perfect agreement between projections and observations; a score between zero and 100% indicates some degree of skill; and a score less than zero indicates a performance worse than a zero-change null hypothesis (16, 20).

With respect to temperature change versus time, we find the average of the median skill scores of all 16 reported projections to be $67 \pm 7\%$. Across projections modeled by ExxonMobil scientists themselves, it is $72 \pm 6\%$. These scores indicate highly skillful predictions. The highest-scoring projection was a 1985 peer-reviewed publication [Hoffert and Flannery (1985, nominal CO₂ scenario)], with a skill score of 99% (38). The 1982/1984 projection discussed earlier (Fig. 1, panel 3) has a skill score of 82% [although it marginally failed the consistency test (Fig. 3 and fig. S1)]. Only three of the 16 projections have skill scores below 50%. For comparison, NASA scientist James Hansen’s global warming predictions presented to the US Congress in 1988 have been found to have skill scores ranging from 38 to 66% across the three different forcing scenarios that he reported (16, 20).

Using the iTCR metric, the average skill of the 16 projections is $67 \pm 9\%$. Among projections modeled by ExxonMobil scientists themselves, it is $75 \pm 5\%$. Seven projections score 85% or above. Hoffert and Flannery (1985, high CO₂ scenario) is again the highest scorer (92%), closely followed by two projections scoring 90%, which are featured in three internal reports in 1982/1984 and 1985, respectively (38, 39, 41, 42). Only four projections have skill scores below 50% for the iTCR

metric. Again, for comparison, Hansen’s 1988 projections had skill scores in terms of the iTCR metric ranging from 28 to 81% (16).

We can compare these metrics with Hausfather *et al.* (2020), who calculated the average skill scores of 18 academic and government climate model projections published between 1970 and 2007. They obtained a value of 69% for both temperature-versus-time and iTCR metrics (16). On average, therefore, global warming projections reported by ExxonMobil scientists were as skillful as those of independent scientists of their day, and their own models were especially skillful. (As described earlier, ExxonMobil scientists did not simply rerun existing models; they developed their own models, typically in collaboration with academic coauthors, which independently corroborated the findings of other climate scientists.) To the extent that these projections represented contemporary knowledge of the likely effects of fossil fuel burning on global temperature, we can conclude that Exxon knew as much in the 1970–1990s as academic and government scientists knew. The average warming projected by the 18 academic and government models was $0.19^\circ \pm 0.03^\circ\text{C}$ per decade, which is, within uncertainty, the same as ExxonMobil’s average of $0.20^\circ \pm 0.04^\circ\text{C}$ per decade.

We note that 2 of the 18 projections analyzed by Hausfather *et al.* (2020) are among those reported by ExxonMobil scientists. However, excluding these two projections has negligible effect on the average warming predicted by ExxonMobil or on the average skill scores of all ExxonMobil projections with respect to both temperature change versus time and iTCR (see sensitivity analyses, SM section S1.2.5 and table S1). Our conclusions also hold true when considering only the 12 (of 16) temperature projections from models built or run in-house

by ExxonMobil scientists, indicated by asterisks in Figs. 1 to 3 and Table 1 (see SM section S1.2.5 and table S1).

In summary, climate projections reported by ExxonMobil scientists between 1977 and 2003 were accurate and skillful in predicting subsequent global warming. Some projections suggested slightly too much warming and others not quite enough, but most (63 to 83%, depending on the metric used) were statistically consistent with subsequently observed temperatures, particularly after accounting for discrepancies between projected and observed changes in atmospheric CO₂ concentrations. ExxonMobil’s projections were also consistent with, and as skillful as, those of academic and government scientists. All told, ExxonMobil was aware of contemporary climate science, contributed to that science, and predicted future global warming correctly. These findings corroborate and add quantitative precision to assertions by scholars, journalists, lawyers, politicians, and others that ExxonMobil accurately foresaw the threat of human-caused global warming, both prior and parallel to orchestrating lobbying and propaganda campaigns to delay climate action (1, 2, 10, 11, 13, 43–48), and refute claims by ExxonMobil Corp and its defenders that these assertions are incorrect (49).

What ExxonMobil knew versus what they said

Our findings about the company’s early understanding of climate science contradict many of the claims that the company and its allies have made in public.

Emphasizing uncertainties

It has been established that, for many years, Exxon’s public affairs strategy was—as a 1988 internal memo put it—to “emphasize the uncertainty in scientific conclusions regarding the potential enhanced greenhouse effect” (10, 44, 50). However, our analysis shows that in their reports and briefings to management, ExxonMobil’s own scientists did not particularly emphasize uncertainty; on the contrary, the level of uncertainty indicated by their global warming projections (bootstrapped 2σ standard error of the mean = $\pm 21\%$) was commensurate with that reported by independent academics ($\pm 16\%$). Crucially, it excluded the possibility of no anthropogenic global warming; at no point did company scientists suggest that human-caused global warming would not occur. Nor did they conclude that the uncertainties were too great to permit differentiation of human and natural drivers. Yet publicly, ExxonMobil Corp made these claims until at least the early 2010s (see Box 2).

Denigrating climate models

ExxonMobil has often specifically claimed or suggested in public that climate models are

“unreliable” (51). In 1999, for example, ExxonMobil Corp’s chief executive officer (CEO) Lee Raymond said future climate “projections are based on completely unproven climate models, or, more often, sheer speculation.” (2) In 2013, his successor, Rex Tillerson, called climate models “not competent” (52). In 2015, he stated: “We do not really know what the climate effects of 600 ppm versus 450 ppm will be because the models simply are not that good” (53). The company’s own modeling contradicts such statements. Exxon’s 1982 projection shown in Fig. 1 (panel 3), for example, suggests that 600 ppm of atmospheric CO₂ would lead to 1.3°C more global warming than 450 ppm.

Quantifying ExxonMobil’s broader climate knowledge

We gain additional insights into how ExxonMobil misled the public and other stakeholders by further evaluating the company’s climate projections and comparing them to its public communications.

Mythologizing global cooling

Panel 1b of Fig. 1 is a graph of the global warming “effect of CO₂ on an interglacial scale” originally published by climate scientist J. Murray Mitchell Jr. in March 1977 and reproduced by Exxon scientist James Black in a private briefing to the Exxon Corporation Management Committee 4 months later (54, 55). This dataset was not included in our preceding analysis because its long time scale does not permit accurate digitization of its projected post-industrial anthropogenic global warming. Nonetheless, overlaying the original graph with the temperatures simulated by a modern Earth system model (in red) shows that Exxon scientists were accurate in warning their superiors of the prospect of a “carbon dioxide induced ‘super-interglacial,’” as Mitchell Jr. termed it, that would render Earth hotter than at any time in at least 150,000 years (56). This shows that Exxon scientists correctly sided with the majority of the peer-reviewed literature in the 1970s that foresaw human-caused global warming overwhelming any possibility of global cooling and a (natural) ice age. [According to Peterson *et al.* (2008), only ~14% of the peer-reviewed literature between 1965 and 1977 anticipated global cooling (56).] It also shows that “the myth of the 1970s global cooling scientific consensus” cultivated in public by Mobil in the 1990s and ExxonMobil Corp in the 2000s (see Box 3) was false and contradicted the conclusion of their own scientists that global cooling was unlikely (56).

Claiming ignorance about discernibility

A second insight involves ExxonMobil’s predictions as to when anthropogenic global warming would be discernible against the backdrop of natural climate fluctuations. Ten

internal reports and one peer-reviewed publication spanning 1979–1985 offered quantitative estimates, with a median year of 2000 ± 5. (For each document, we infer the predicted year from its corresponding supporting quotations, summarized in table S4; see SM section S1.2.6 for method details.) This is consistent with what in fact occurred. In 1995, the IPCC declared that a human effect on global temperatures had been detected, a conclusion they reiterated with higher confidence in 2000 and in all subsequent IPCC assessment reports (57, 58). In other words, ExxonMobil’s understanding of climate science was sufficient not only to project long-term warming accurately but also to predict when it would be discernible. Yet, ExxonMobil publicly asserted that the science was too uncertain to know when—or if—human-caused global warming might be measurable. In 2004, for example, they stated that “scientific uncertainties continue to limit our ability to make objective, quantitative determinations regarding the human role in recent climate change,” a claim that was contrary to the analysis of their own scientists (59).

Staying silent on stranded assets

A third insight concerns the “carbon budget”—the amount of CO₂ that can be added to the atmosphere—while holding anthropogenic global warming below 2°C. Five ExxonMobil studies published between 1982 and 2005 address the question. They conclude that to stabilize CO₂ concentrations below 550 ppm and/or limit warming to 2°C would impose a carbon budget of 251 to 716 gigatonnes of carbon (GtC) between 2015 and 2100 (10). For comparison, recent calculations have narrowed the uncertainty and place the figure at 442 to 651 GtC (60). Thus, ExxonMobil’s calculations of the carbon budget were consistent with today’s best estimates. Yet, to our knowledge, ExxonMobil did not alert investors, consumers, or the general public to this constraint.

Quantifying climate knowledge

The substantial body of literature documenting the history of climate lobbying and propaganda by fossil fuel interests has been described as a “vast blind spot” of major climate assessments—ignored, in particular, in all but the most recent IPCC assessment report (61–63). Yet bringing quantitative techniques from the physical sciences to bear on a discipline traditionally dominated by qualitative journalistic and historical approaches offers one path to remedying this blind spot. Here, it has enabled us to conclude with precision that, decades ago, ExxonMobil understood as much about climate change as did academic and government scientists. Our analysis shows that, in private and academic circles since the late 1970s and early 1980s, ExxonMobil scientists (i) accurately projected and skillfully mod-

eled global warming due to fossil fuel burning; (ii) correctly dismissed the possibility of a coming ice age; (iii) accurately predicted when human-caused global warming would first be detected; and (iv) reasonably estimated how much CO₂ would lead to dangerous warming. Yet, whereas academic and government scientists worked to communicate what they knew to the public, ExxonMobil worked to deny it.

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Data and materials availability: Raw data (original PDF internal

documents and peer-reviewed publications) for this study cannot be reproduced in full owing to copyright restrictions. However, a catalog of all analyzed documents, and links to public archives containing these data, are provided in SM section S2.1. Raw data resulting from digitization of all analyzed original PDF datasets are deposited on Harvard Dataverse at <https://doi.org/10.7910/DVN/R4MOAE> (87). The code used to generate the results of this study is provided in the same repository. **License information:** Copyright © 2023 the authors, some rights reserved; exclusive licensee American Association for the Advancement of Science. No claim to original US government works. <https://www.science.org/about/science-licenses-journal-article-reuse>

SUPPLEMENTARY MATERIALS

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Materials and Methods

Fig. S1

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Appendix D

Ending ExxonMobil Sponsorship of the American Geophysical Union

How ExxonMobil's past and present climate misinformation violates the AGU's Organizational Support Policy and scientific integrity



The Natural History Museum

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Lastly, we express our sincere thanks to the 271 fellow members of the Earth science community worldwide who share our concerns for the climate crisis and ExxonMobil's past and present perpetuation of climate science misinformation. Thank you for readily joining our call in asking the AGU to reject sponsorship from ExxonMobil in order to protect our scientific integrity.

The opinions expressed in this document do not necessarily reflect those of the individuals acknowledged here. The authors bear sole responsibility for the report's content.

SUMMARY: The case for ending ExxonMobil sponsorship

Since our Feb 22, 2016 letter, co-signed by more than 100 geoscientists, calling for the American Geophysical Union to reject sponsorship from ExxonMobil, over 160 additional geoscientists from around the world have signed on (an updated list of signatories is attached and [available online](#)). In this report, we present our case, given ExxonMobil's past - and notably present - involvement in climate misinformation.

AGU's Organizational Support Policy states "*AGU will not accept funding from organizational partners that promote and/or disseminate misinformation of science, or that fund organizations that publicly promote misinformation of science,*" and that Organizational Partners are bodies that "*do not harm AGU's brand and reputation, and that share a vested interest in and commitment to advancing and communicating science and its power to ensure a sustainable future*" [1]. President Leinen has also written to the AGU's membership to, "*assure you that if verifiable information becomes available that proves ExxonMobil is currently engaging in the promotion of misinformation about science or adopting positions that are in conflict with AGU's own, or supporting groups that do, we will end the relationship, as dictated by our policy – at least until the company is able to demonstrate that such actions have ceased*" [2].

As this report evidences, ExxonMobil is in clear violation of these principles because it has been - and still is - a leading sponsor of think tanks, advocacy groups, and trade associations that promote climate science misinformation. Moreover, ExxonMobil financially supports more than 100 climate-denying members of Congress and continues to generate its own misinformative comments about climate science.

There is overwhelming evidence of ExxonMobil's historical complicity in the orchestration, funding, and perpetuation of climate science misinformation; documented by numerous studies and investigative journalists, and acknowledged by President Leinen as not "in keeping with [AGU's] policy" [2]. The burden of proof therefore ultimately rests with ExxonMobil to satisfactorily demonstrate that it has ended its support of climate science misinformation, not with scientists such as ourselves.

We therefore strongly urge the AGU board to look beyond ExxonMobil's public statements on climate change. To limit our investigation only to this source is to virtually guarantee a proof-texted judgment, insensitive to ExxonMobil's diverse and broad spheres of influence, and naïve to its shrewd and undeniable past efforts to misinform.

To this end, we here present a spectrum of evidence derived from multiple lines of inquiry: distribution of scientifically false or misleading information by ExxonMobil itself; membership in and/or financial support of climate-denying organizations; donations to climate-denying politicians; and past misinformation campaigns. Most of this evidence relates to ExxonMobil's support of climate misinformation since 2007, after it publicly pledged to end such support [3]. Where possible, we focus on the period between 2013-2016, noting that these data reflect the most up-to-date information that is publicly accessible, and therefore the most contemporary evidence of ExxonMobil's "ongoing" support of misinformation. All of this evidence points to a singular conclusion: while ExxonMobil does today acknowledge the reality of anthropogenic climate change in its public statements, it also continues to support and perpetuate climate science misinformation through a variety of increasingly veiled initiatives. We fully acknowledge that our investigations are not exhaustive, but as with the science of climate change itself, the consilience of evidence points only one way.

The AGU leadership must decide whether ExxonMobil has truly and effectively reversed its position on climate change as a condition for accepting the company's continued sponsorship, which ExxonMobil uses to secure its legitimacy in the public's eye. This is not purely cynicism: within the past year, ExxonMobil has repeatedly cited its affiliations with institutions such as MIT and Stanford as an excuse for inaction and as a distraction to avoid accountability for its record of misinformation [4,5]. As one of the world's most highly respected organizations of Earth scientists, the AGU should seriously consider how its ongoing affiliation with ExxonMobil contradicts its own standards and undermines the scientific integrity of our community.

SUMMARY & KEY FINDINGS

AGU's Organizational Support Policy states "AGU will not accept funding from organizational partners that promote and/or disseminate misinformation of science, or that fund organizations that publicly promote misinformation of science," and that Organizational Partners are bodies that "do not harm AGU's brand and reputation, and that share a vested interest in and commitment to advancing and communicating science and its power to ensure a sustainable future."

In response to our Feb 22, 2016 letter calling for the AGU to reject sponsorship from ExxonMobil, President Leinen wrote to the AGU membership to, "assure [us] that if verifiable information becomes available that proves ExxonMobil is currently engaging in the promotion of misinformation about science or adopting positions that are in conflict with AGU's own, or supporting groups that do, we will end the relationship, as dictated by our policy – at least until the company is able to demonstrate that such actions have ceased."

This report demonstrates that ExxonMobil is in clear violation of these principles because it continues to generate its own misinformative comments, fund groups that promote climate science misinformation, and financially support more than 100 climate-denying members of Congress. We highlight some key examples below:

- "If you examine the temperature record of the last decade, it really hadn't changed." - ExxonMobil CEO Rex Tillerson (2013)
- "We don't really know what the climate effects of 600 ppm versus 450 ppm will be because the models simply are not that good." - ExxonMobil CEO Rex Tillerson (2015)
- "...the production and consumption of petroleum fuels is not dangerous and does not pose a risk to human health or safety" - ExxonMobil affiliate, Syncrude (2014)
- "Global Climate Change is Inevitable. Climate change is a historical phenomenon and the debate will continue on the significance of natural and anthropogenic contributions." - ExxonMobil-funded organization, ALEC (2016)
- "There is no scientific consensus on the human role in climate change." - ExxonMobil-sponsored Annual Meeting of ALEC (2014)
- The International Panel on Climate Change (IPCC) "is not a credible source of science or economics." - ExxonMobil-sponsored Annual Meeting of ALEC (2014)
- "CO₂ is not a pollutant. It is a benefit. It is the very elixir of life." - ExxonMobil-sponsored Annual Meeting of ALEC (2014)
- Climate scientists are biased because they are "deeply invested in the whole industry of global warming. When all of your grants to your university program depend on a state of national and international panic...it's a natural human tendency to, as you business guys say, 'talk your book'." - ExxonMobil-funded American Enterprise Institute (2014)
- "Take for example this whole '97% of scientists agree on global warming.' That is an utterly fraudulent number, and it's been looked at, and it's just simply not true." - ExxonMobil-funded American Enterprise Institute (2014)
- "No other field of science repeatedly embraces conclusions or seeks policy to be based upon models which have repeatedly delivered inaccurate predictions." - ExxonMobil-funded American Enterprise Institute (2015)
- "There is no sound science to support the claims of Global Warming." - ExxonMobil-funded National Black Chamber of Commerce (2016)
- "We keep hearing that 2014 has been the warmest year on record, I ask the Chair, "You know what this is?" It's a snowball, from just outside here, so it's very very cold out." - ExxonMobil-funded Chairman of the U.S. Senate Environment and Public Works Committee, Senator Jim Inhofe (R-OK) (2014)
- Climate change is "a pseudo-scientific theory". It is "not science, it's a religion." - ExxonMobil-funded presidential candidate, Senator Ted Cruz (R-TX) (2015)

ExxonMobil's present (2007-2016) climate misinformation

In September 2006, the Royal Society wrote to ExxonMobil to express “disappointment at the inaccurate and misleading view of the science of climate change” presented by the company’s own publications, and “concerns about the support that ExxonMobil has been giving to organizations that have been misleading the public about the science of climate change” [6]. This letter followed a meeting during which the Society raised concerns about Exxon’s position on climate change and the company’s funding of lobby groups that misrepresented the science. Although at the meeting ExxonMobil indicated that it intended to stop funding these organizations, the company never followed up with an explanation of how and when it would fulfill such a pledge, despite further requests from the Royal Society.

Thereafter, ExxonMobil’s 2007 Corporate Citizenship Report announced that the company would “discontinue contributions to several public policy research groups whose position on climate change could divert attention from the important discussion on how the world will secure the energy required for economic growth in an environmentally responsible manner” [7]. This public commitment to stop funding climate denial has been reaffirmed multiple times. “ExxonMobil does not fund climate denial” and “We do not fund or support those who deny the reality of climate change,” Exxon spokesman Richard Keil said on two separate occasions in July 2015 [8,9]. However, these claims by ExxonMobil are contradicted by publicly available evidence - some of which we include in this document for the AGU Board’s consideration.

In this report, we consider “climate (science) misinformation” to be the misrepresentation or mischaracterization of scientific findings about climate change and their degree of uncertainty, and the scientific consensus of human-caused climate change.

1. ExxonMobil’s direct involvement

A. Shareholder communications

Over the last two decades, ExxonMobil shareholders sought meetings, sent letters and wrote 62 resolutions asking the company to take action on climate change

[10]. Exxon has rejected all of the proposals [11], often dismissing shareholders’ concerns through climate misinformation or offering affiliations with academic institutions as an excuse for inaction:

i) ExxonMobil CEO Rex Tillerson, ExxonMobil Corporation Annual Shareholder Meeting, May 29, 2013 [excerpts from transcript; Ref. 12] –

MISINFORMATION (2013): “...notwithstanding all the advancements that have been made in gathering more data...our ability to project with any degree of certainty the future is continuing to be very limited.”

MISINFORMATION (2013): “If you examine the temperature record of the last decade, it really hadn’t changed...last 10 years’ temperatures had been relatively flat in a period when is [sic] been noted greenhouse gas concentrations have been rising.”

FACT CHECK: The first sentence is an unambiguous instance of climate science misinformation. Contrary to Tillerson’s claim, the peer-reviewed literature is in unanimous agreement that global warming has not stopped. Specifically, studies have consistently shown that global mean surface temperatures continued to rise over the decade to which Tillerson refers [13].

Tillerson’s second sentence requires contextualization. We readily acknowledge that the significant research of warming trends since 2000 has valuably contributed to the scientific community’s understanding of decadal-scale variations in the climate. Yet Tillerson’s statement lacks any further details or clarifications, and is immediately preceded by his observation that “our ability to project with any degree of certainty the future is continuing to be very limited.” As such, his remarks reinforce contrarian narratives by implying an unwarranted level of uncertainty in the ability of climate models to predict long-term global warming and in our understanding of the climate system: a textbook example of the long-established strategy, epitomized by ExxonMobil, of appealing to doubt to confuse society about the realities and seriousness of climate change [14]. Indeed, the framing of global warming as having “paused” appears to have adversely impacted public acceptance of climate

change in the United States [15]. It is in this context that we present five other instances of misinformation from Rex Tillerson, all consistently seeking to sow doubt about the reliability of climate models.

MISINFORMATION (2013): “I can’t conclude there is something magical about 350 [parts of million CO₂ atmospheric concentration] because that suggests these models are very competent, and **our examination about the models are that they’re not competent.**”

MISINFORMATION (2013): “...what’s the pathway we should be and how do we mitigate and prepare for the consequences as they present themselves? Because **our ability to predict the consequence is simply not that good.**”

ii) ExxonMobil CEO Rex Tillerson, ExxonMobil Corporation Annual Meeting of Shareholders, May 27, 2015 [extracted from a webcast presentation, duration: 1h 43m 50s; Ref. 16] –

MISINFORMATION (2015): “...It’s interesting that if you examine the most recent publication of the United Nations Intergovernmental Panel on Climate Change...one of the things we look into carefully every year is, **‘What level of progress has been made in the competency of those models to predict the future?’ And if you look at those reports, what you see is an extraordinarily broad range of predictive outcomes.**”

MISINFORMATION (2015): “**We don’t really know what the climate effects of 600 ppm versus 450 ppm will be because the models simply are not that good...they will get better...we anticipate, we hope that the competencies of the models begin to close and therefore you can have a higher confidence around the outcome.**”

FACT CHECK: Tillerson’s implication that the climate effects of 450 ppm versus 600 ppm (taken to refer to CO₂-equivalent concentrations in 2100) are essentially unknown, and therefore that these two scenarios and their impacts could be similar, substantially underplays the insights of the international climate science community (and its careful account of model uncertainties). According to the IPCC’s latest assessment [17], 450 ppm and 600 ppm CO₂-eq concentrations in 2100 correspond to entirely different Representative Concentration Pathways (RCPs), corresponding to substantially

different likelihoods of staying below 2°C over the twenty first century (Figure 1).

B. Materials on ExxonMobil’s website

In response to news coverage about the fact that ExxonMobil, informed by their in-house scientists, has known about the devastating global warming effects of fossil fuel burning since the late 1970s, ExxonMobil Vice President Ken Cohen countered with yet more climate misinformation on Oct 15, 2015 (Figure 2) [18].

MISINFORMATION (2015): “**As you can see, the scientific community that contributes to the IPCC report is, even today, still projecting a broad range of potential outcomes.**”

Cohen is misrepresenting the facts conveyed in this graph taken from IPCC AR5 Working Group I’s Technical Summary (Figure TS.14, p. 55) [19]. The graph shows the projection of 2005-2050 global surface temperature anomalies, relative to 1986-2005, as simulated by the CMIP5 climate models under the full range of Representative Concentration Pathways (RCPs) scenarios. Each RCP defines a specific greenhouse gas emissions trajectory and associated radiative forcing by 2100. However, Cohen does not provide any other context or technical background in his blog post. In particular, by comparing these IPCC projections “even today, still” against his posited lack of consensus about climate change “back in the 1970s and ‘80s”, Cohen implies that the graph’s “broad” range of future outcomes is mainly (or entirely) due to scientific (geophysical) uncertainty. He neglects to explain that the RCP scenarios constitute different future greenhouse gas emissions tied to different economic and socio-political choices.

MISINFORMATION (2015): “**This should refute the claim, central to activists’ conspiracy theories, that anyone had reached a firm conclusion about catastrophic impacts of climate change back in the 1970’s and 80’s.**”

In the late 1970s, as detailed by the *InsideClimate News* and *LA Times* investigative news reports [20,21], Exxon’s own in-house scientists informed its CEOs of the emerging scientific consensus on the devastating impacts of fossil fuel burning. For example, in July 1977, senior ExxonMobil scientist James F. Black said the following during his presentation to ExxonMobil’s Management Committee, according to a written version he recorded later: “In the first place, 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.” Likewise, head of theoretical sciences at Exxon Corporate Research Laboratories, Roger Cohen, wrote in September 1982, reporting on Exxon's own analysis of climate models: "Over the past several years a clear scientific consensus has emerged...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."

It was also in the 1980s that then NASA climate chief Dr. James Hansen testified before the United States Congress that “global warming is now large enough that we can ascribe with a high degree of confidence a cause and effect relationship to the greenhouse effect...the greenhouse effect has been detected, and it is changing our climate now” [22].

C. Statements by ExxonMobil's affiliates

In 2014, ExxonMobil affiliate, Syncrude, challenged the right of the Canadian federal government [23] to adopt a regulation designed to substitute fossil fuels with renewable energy technologies by arguing during court proceedings that “that the production and consumption of petroleum fuels is not dangerous and does not pose a risk to human health or safety” [24].

MISINFORMATION (2014): “...the production and consumption of petroleum fuels is not dangerous and does not pose a risk to human health or safety.”

Syncrude’s statement is grossly misinformative. For example, the U.S. Department of Defense has assessed that “climate change is an urgent and growing threat to our national security” [25] and medical experts have concluded that “climate change is the biggest global health threat of the 21st century” [26].

CO ₂ -eq Concentrations in 2100 (ppm CO ₂ -eq) ^f Category label (conc. range)	Subcategories	Relative position of the RCPs ^d	Change in CO ₂ -eq emissions compared to 2010 (in %) ^c		Likelihood of staying below a specific temperature level over the 21st century (relative to 1850–1900) ^{d,e}			
			2050	2100	1.5°C	2°C	3°C	4°C
<430	Only a limited number of individual model studies have explored levels below 430 ppm CO ₂ -eq ⁱ							
450 (430 to 480)	Total range ^{a,g}	RCP2.6	-72 to -41	-118 to -78	More unlikely than likely	Likely		
500 (480 to 530)	No overshoot of 530 ppm CO ₂ -eq		-57 to -42	-107 to -73	Unlikely	More likely than not	Likely	Likely
	Overshoot of 530 ppm CO ₂ -eq		-55 to -25	-114 to -90		About as likely as not		
550 (530 to 580)	No overshoot of 580 ppm CO ₂ -eq		-47 to -19	-81 to -59	Unlikely	More unlikely than likely ⁱ	Likely	Likely
	Overshoot of 580 ppm CO ₂ -eq		-16 to 7	-183 to -86				
(580 to 650)	Total range	RCP4.5	-38 to 24	-134 to -50				
(650 to 720)	Total range		-11 to 17	-54 to -21		Unlikely	More likely than not	
(720 to 1000) ^b	Total range	RCP6.0	18 to 54	-7 to 72	Unlikely ^h		More unlikely than likely	
>1000 ^b	Total range	RCP8.5	52 to 95	74 to 178		Unlikely ^h	Unlikely	More unlikely than likely

FIGURE 1. Table SPM.1 reproduced from IPCC AR5 Summary for Policymakers. See report for full details of this figure [Ref. 13]. Red boxes have been added to the table to highlight pathways corresponding to 450 ppm and 600 ppm CO₂-eq.

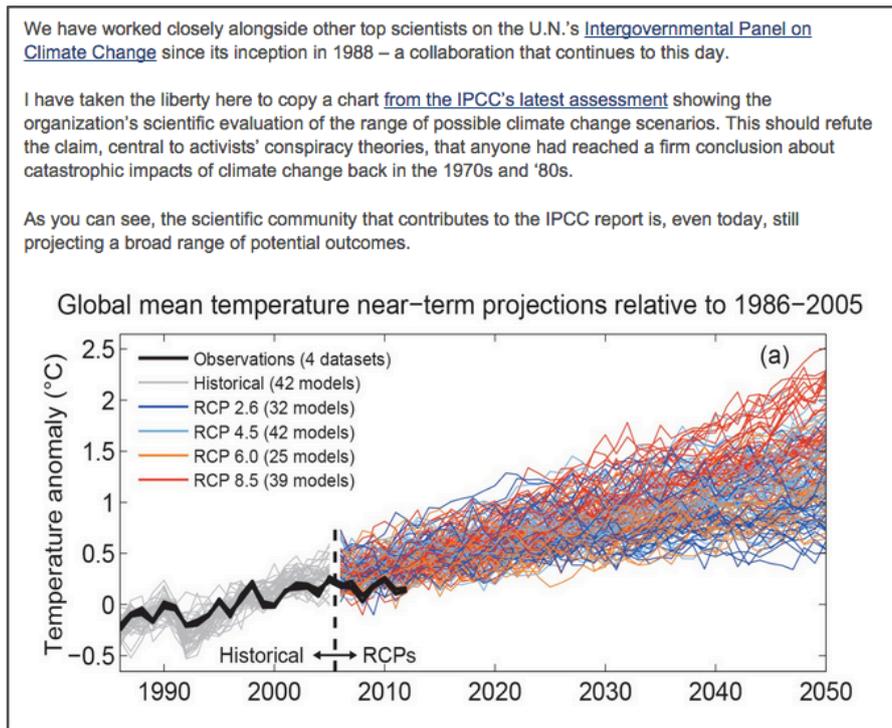


FIGURE 2. Excerpt of blog post by ExxonMobil Vice President Ken Cohen. Posted on Oct 15, 2015. Accessed on Mar 21, 2016. [<http://www.exxonmobilperspectives.com/2015/10/15/exxonmobils-commitment-to-climate-science/>]

2. ExxonMobil's funding of and/or membership in climate-denying organizations

For decades, ExxonMobil has played a significant role in funding and directing a coordinated strategy of climate misinformation and policy obstruction through a collection of think-tanks, advocacy groups, and trade organizations [27]. As Brulle et al. (2014) concluded, these organizations have “not only played a major role in confounding public understanding of climate science, but also successfully delayed meaningful government policy actions to address the issue.”

According to recent publicly available records, some of which are outlined below, ExxonMobil continues to fund organizations that promote climate denial. A full list of climate-denying organizations funded by ExxonMobil between 1998-2014, compiled by Greenpeace and the Union of Concerned Scientists, can be found in Appendix A.

A. American Legislative Exchange Council (ALEC)

The American Legislative Exchange Council, or “ALEC”, is an organization of legislators and corporations that continues to serve as an important

conduit for climate misinformation and policy proposals designed to block climate action today. Like other industry groups, ALEC provides a means for major fossil fuel companies to pay lip service to the realities of climate science in their public-facing materials while their behind-the-scenes memberships and sponsorships support misinformation and block climate mitigation policies.

According to ExxonMobil's corporate giving records, ExxonMobil has funded ALEC since at least 1981 and continues to do so today. Between 1998 and 2014, ExxonMobil has given at least \$1,730,200 to ALEC, although the actual total is likely higher [Appendices A-B]. In addition, ExxonMobil is currently represented on the ALEC corporate board by its U.S. Government Affairs Manager, Cynthia Bergman [28]. Records of ExxonMobil's involvement in ALEC's governing corporate board go back to at least 2002 [29].

With ExxonMobil's financial support and leadership, ALEC has adopted resolutions denying the science behind the causes of climate change, promoted legislation to undermine policies aimed at addressing climate change, such as efforts to promote renewable energy or limit carbon emissions, and held workshops for state legislators promoting climate change denial.

i) ALEC's current official position on climate change (one of its "Energy Principles"), which is publicly available on its website, is that [30]:

MISINFORMATION (2016): "Global Climate Change is Inevitable. Climate change is a historical phenomenon and the debate will continue on the significance of natural and anthropogenic contributions."

ii) In 2015, ExxonMobil spent at least \$25,000 to sponsor ALEC's Annual conference (Figure 3; Table 1; Ref. 31). During a session of that conference that was open to select reporters, Stephen Moore, a member of ALEC's Private Enterprise Advisory Board, asserted that [32, 33]:

MISINFORMATION (2015): "The biggest scam of the last 100 years is global warming...It's no surprise that when you give these professors \$10 billion, they're going to find a problem."

iii) ALEC frequently schedules prominent climate change deniers to speak at its conferences [34], which it has described as providing the "motivation" for legislators to promote the ALEC agenda. ExxonMobil funding for ALEC has coincided with the advance of the climate change denial agenda to powerful legislators across the country, arming them with climate misinformation from the ALEC national meetings. For example, in 2014, ExxonMobil disclosed that it gave \$61,500 to ALEC, which included \$25,000 to sponsor ALEC's Annual Conference, \$25,000 to join the 501(c)(4) "Jeffersonian Project," and \$11,500 in "other contributions" [Table 1; Appendix B]. At ALEC's ExxonMobil-sponsored Annual Meeting that year, Heartland Institute President Joseph Bast led an ALEC workshop for state legislators from across the country featuring a presentation claiming [Figure 4]:

MISINFORMATION (2014): "There is no scientific consensus on the human role in climate change."

MISINFORMATION (2014): "There is no need to reduce carbon dioxide emissions and no point in attempting to do so."

MISINFORMATION (2014): "Carbon dioxide has not caused weather to become more extreme, polar ice and sea ice to melt, or sea level rise to accelerate. These were all false alarms."

MISINFORMATION (2014): The International Panel on Climate Change (IPCC) "is not a credible source of science or economics."

MISINFORMATION (2014): "The likely benefits of manmade global warming exceed the likely costs."

Additionally, at that same ExxonMobil-funded meeting, the Committee for a Constructive Tomorrow (CFACT) handed legislators a worksheet called "Climate change talking points 2014" that coached ALEC legislative members on how to talk about "manmade climate fears." In that worksheet, legislators were told to respond to the question "how can you deny global warming?" by stating:

MISINFORMATION (2014): "We inhale oxygen and exhale CO₂" and that "higher atmospheric CO₂ levels cannot possibly supplant the numerous complex and interconnected forces that have always determined Earth's climate."

These arguments were echoed at ALEC's December 2014 meeting, when Craig Idso of the Center for the Study of Carbon Dioxide and Global Change led a workshop telling state legislators that:

MISINFORMATION (2014): "CO₂ is not a pollutant. It is a benefit. It is the very elixir of life."

iv) ExxonMobil has publicly indicated that it supports a carbon tax [35]. However, in 2013, the ALEC "Energy, Environment and Agriculture Task Force" and the "Tax and Fiscal Policy Task Force" jointly adopted a resolution at ALEC's Annual Meeting declaring the organization "opposes all Federal and state efforts to establish a carbon tax on fuels for electricity and transportation" [36]. That same year, ExxonMobil disclosed that it gave \$49,000 to ALEC, which included \$15,000 to sponsor the 2013 Annual Meeting and \$34,000 towards the ALEC "Energy, Environment and Agriculture Task Force" and the "Tax and Fiscal Policy Task Force" [Table 1; Appendix B]. Companies that fund ALEC task forces become members of that task force and are given a vote on bills and resolutions. In other words, the ALEC "Resolution in Opposition to a Carbon Tax" was adopted by the same ALEC task forces funded by ExxonMobil, and at the same Annual Meeting sponsored by ExxonMobil, even as Exxon Mobil told its shareholders and the public that it supports a

carbon tax. During this same period an ExxonMobil representative was also on the ALEC corporate board.

v) **ALEC has also aimed to promote climate change denial among school children.** ALEC’s “Environmental Literacy Improvement Act” requires that all environmental education programs and activities “provide a range of perspectives presented in a balanced manner” and “provide instruction in critical thinking so that students will be able to fairly and objectively evaluate scientific and economic controversies.” Yet because there is a strong scientific consensus that anthropogenic global warming presents significant risk, mandating a “balanced” approach to educating children about the issue has the effect of misleading students about the extent and reality of the problem. ALEC adopted this bill in 2000, the same year that Exxon Mobil reported giving \$70,000 to ALEC and the ExxonMobil Education Foundation reported giving \$10,000. ALEC re-approved the bill in 2013, the same year that ExxonMobil disclosed that it gave \$49,000 to the organization [Appendix B].

Given ExxonMobil’s stated acknowledgement of anthropogenic climate change and its support for a carbon tax, its ongoing financial support for influential misinforming groups such as ALEC demonstrates that such statements are extremely disingenuous. For example, ExxonMobil asserts that it “engage[s] with policymakers directly and through trade associations around the world to encourage sound policy solutions for addressing the risks of climate change” [37]. Do such associations include ALEC?

ExxonMobil’s funding of ALEC and leadership role within ALEC suggest that the company may be working behind-the-scenes to oppose policies that it tells the public and its shareholders that it supports — namely, the science behind climate change and policies aimed at addressing it, such as regulation of carbon emissions or a carbon tax. Moreover, the company has directly funded ALEC’s work on climate change, and at times has concealed this information from shareholders.

We note that there exist other organizations providing equivalent services to ALEC in terms of access to lawmakers, business networking, and lobbying etc., but whose activities do not include spreading climate misinformation. The National Conference of State Legislatures is one such example.

Finally, we also note that another sponsor of the AGU 2015 Fall Meeting, Chevron, is also known to be a current member of ALEC [31]. As of December 2015, at least 108 companies – including Shell, BP and Google – discontinued their ALEC membership [38], and many have cited ALEC’s climate change denial as the primary reason; Shell explained that ALEC’s “stance on climate change is clearly inconsistent with our own,” [39] and Google’s Eric Schmidt reflected, “Everyone understands climate change is occurring and the people who oppose it are really hurting our children and our grandchildren and making the world a much worse place. And so we should not be aligned with such people – they’re just, they’re just literally lying” [38].



FIGURE 3. Left – AGU 2015 Fall Meeting sponsors; Right – ALEC 2015 Annual Conference sponsors (original photo accessed from http://www.prwatch.org/files/alec_am_2015_sponsors.jpg).

TABLE 1. ExxonMobil's Funding of ALEC between 2007-2015 and the stated purpose, if disclosed [see Appendix B for details].

Year	Amount	Stated purpose	Source
2015	At least \$25,000	"Annual Conference" - \$25,000	Surgey 2015 [Ref. 31]
2014	\$61,500	"Annual Conference" - \$25,000; "Private Sector-Jefferson Club Membership" - \$25,000; "Other Contributions" - each under \$5,000 - \$11,500	2014 Worldwide Giving Report
2013	\$49,000	"2013 Annual Conference" - \$15,000; "Private Sector, Energy and Tax Task Forces" - \$34,000	2013 Worldwide Giving Report
2012	\$59,000	"2012 Annual Conference" - \$25,000; "Private Sector and Energy and Tax Task Force" - \$34,000	2012 Worldwide Giving Report
2011	\$86,500	(Undisclosed)	2011 Worldwide Giving Report
2010	\$64,000	"General Support" - \$39,000; "National Chairman's Reception" - \$25,000	2010 Worldwide Giving Report
2009	\$47,500	"Annual Conference" - \$15,000; "General Support" - \$31,000; Other - \$1,500	2009 Worldwide Giving Report
2008	\$56,000	(Undisclosed)	2008 Worldwide Giving Report
2007	\$31,000	(Undisclosed)	2007 Worldwide Giving Report

B. American Enterprise Institute (AEI)

From 1998-2014 (the latest year for which public records are available), ExxonMobil provided a total of \$3.77M to the American Enterprise Institute, including \$310,000 in 2014 [Ref. 40; Appendix A]. AEI has consistently contributed to climate misinformation, undermining the science and impugning the motives of scientists. In 2007, AEI offered payments of \$10,000 to scientists and other experts in exchange for articles critical of the IPCC's fourth assessment report [41]. In the solicitation, AEI asserted that [42]:

MISINFORMATION (2007): "The IPCC is susceptible to self-selection bias in its personnel, resistant to reasonable criticism and dissent, and prone to summary conclusions that are poorly supported by the analytical work of the complete Working Group reports."

More recently, in 2014, AEI Fellow Jonah Goldberg argued [43] that:

MISINFORMATION (2014): Climate scientists are biased because they are "deeply invested in the whole industry of global warming. When all of your grants to your university program depend on a state of national and

international panic...it's a natural human tendency to, as you business guys say, 'talk your book'."

MISINFORMATION (2014): "Take for example this whole '97% of scientists agree on global warming.' That is an utterly fraudulent number, and it's been looked at, and it's just simply not true...The whole point of this is to get one side to simply shut up, and that's what is so disgusting about this notion of settled science. Science by definition cannot be settled...To say that settled science [sic]; that is basically a subsidy for a certain group of rent-seeking group of people who are looking to profit off of government action."

The Fox news report where Goldberg made those arguments did not disclose ExxonMobil's support for the organization, so ExxonMobil was able to maintain the illusion of support for climate science while AEI undermined the reputation of scientists and misrepresented the state of science. As if these examples of attacks on science and scientists were not sufficiently direct, in 2015 AEI maligned the validity of climate models by stating [44]:

MISINFORMATION (2015): "No other field of science repeatedly embraces conclusions or

seeks policy to be based upon models which have repeatedly delivered inaccurate predictions.”

far, there is no pattern that seems to be very detrimental to our earth.”

C. National Black Chamber of Commerce (NBCC)

The NBCC is a small organization that holds conferences and produces reports purporting to represent the interests of African Americans, though it is primarily run by founder Harry Alford and his partner, Kay Debow Alford [45]. It has received upwards of \$1 million in support from ExxonMobil since 1998, including \$75,000 in 2014 [40,46]. The group publicly portrays climate change as a purely political issue, declaring on its website that [47]:

MISINFORMATION (2016): “There is no sound science to support the claims of Global Warming.”

MISINFORMATION (2016): “Certainly the climate changes as time goes on - sometimes for the better and sometimes for the worse. So

While recent “dark money” channels have made it increasingly difficult to trace monetary contributions, in the past, it can be seen that ExxonMobil has specified that their funding be used explicitly to address climate issues. For example, in 2005 it specified that the George Marshall Institute, a well-chronicled climate-denying organization, should use \$90,000 for “Climate Change” (as noted on the IRS Form 990; Ref. 48). At the same time, it masked this condition in its published 2005 Worldwide Giving report [49], which lists the \$90,000 as “General Operating Support” [Figure 5].

In addition, even when ExxonMobil does not necessarily specify how its monetary contributions should be directed, recent research has shown that funding from fossil fuel companies impacts the content of information that these recipient organizations produce, and that the new ideas become more prevalent in the public discourse [50].

ExxonMobil Foundation Schedule of 2005 Appropriations and Payments - by Program Area December 31, 2005						
Payee Organization	Tax Status	Beginning Balance	New Allocations	Amended	Amount Paid	Ending Balance
2005 George C. Marshall Institute 1625 K Street, NW, Suite 1030 Washington, DC 20006 Climate Change \$90,000.00 2005	501c(3)	\$0.00	\$90,000.00	\$0.00	\$90,000.00	\$0.00
George Mason University Foundation, Inc. 4400 University Drive, MS 1A3 Fairfax, VA 22030-4444 Law & Economics Center \$30,000.00 2005	501c(3)	\$0.00	\$30,000.00	\$0.00	\$30,000.00	\$0.00

George C. Marshall Institute, Washington, D.C.	
Awards Dinner and General Operating Support*	25,000
General Operating Support	90,000
George Mason University Foundation, Inc., Fairfax, Virginia	
Law & Economics Center	30,000
Georgetown University, Center Contemporary Arabic Studies, Washington, D.C.	30,000
Heartland Institute, Chicago, Illinois	
General Operating Support*	90,000
General Operating Support	29,000

FIGURE 5. Top - excerpt from ExxonMobil’s 2005 IRS Form 990 showing funds targeted for “Climate Change”. Bottom - excerpt from ExxonMobil’s 2005 Worldwide Giving report, which lists the \$90,000 donation simply as “General Operating Support.”



FIGURE 6. A leaked slide from a 2014 presentation by the President of the WSPA reveals the group's strategy, on behalf of its member fossil fuel companies - including ExxonMobil - to create "astroturf" organizations whose purpose is to derail climate and energy legislation (reproduced from UCS, 2015; Ref. 52).

3. ExxonMobil's funding of and/or membership in organizations that block climate legislation

As previously mentioned, President Leinen has stated, in response to our open letter, that *"if verifiable information becomes available that proves ExxonMobil is currently...adopting positions that are in conflict with AGU's own, or supporting groups that do, we will end the relationship, as dictated by our policy – at least until the company is able to demonstrate that such actions have ceased"* [2].

AGU's Organizational Support Policy also states that Organizational Partners are bodies that "share a vested interest in and commitment to advancing and communicating science and its power to ensure a sustainable future" [1]. Yet while science informs, in the words of AGU's Position Statement on Climate Change, a clear imperative for "urgent action" on climate change [51], ExxonMobil is moving in the opposite direction through its political spending and lobbying efforts to derail legislation for climate

mitigation commensurate with the scientific consensus of human-caused climate change.

For example, internal documents show that a key component of the major fossil fuel companies' climate deception campaigns, including that of ExxonMobil, is the cultivation of so-called "astroturf" organizations; groups created to falsely represent grassroots opposition to forward-looking policy on climate change and renewable energy [52].

ExxonMobil is a member of the Western States Petroleum Association (WSPA) [53], one of the most powerful oil and gas lobbies in the United States. **Publicly available lobbying disclosure reports indicate that WSPA has spent \$59.4 million on lobbying in California between 2005-2015. In 2015 alone, WSPA spent \$9.2 million** [54]. In November 2014, a leaked presentation by the President of WSPA revealed a stealth campaign to block climate mitigation policies through the construction of astroturf groups (with names such as "Oregon Climate Change Campaign" and "AB 32 Implementation Group") [Figure 6; Ref. 55]. The presentation details a plan to throttle California's

Assembly Bill 32 (AB 32, also known as the California Global Warming Solutions Act of 2006, requiring a statewide reduction in greenhouse gas emissions to 1990 levels by 2020) and low-carbon fuel standards in California, Oregon, and Washington State.

We note that other sponsors of the AGU Fall Meetings, Shell and Chevron, are also members of the WSPA [53].

Such activities conflict with ExxonMobil's public position that "Because the risks to society and ecosystems [of climate change] could prove to be significant, ExxonMobil believes that it is prudent now to develop and implement global strategies that address the risks, keeping in mind the central importance of energy to the economies of the world. This includes putting policies in place that start us on a path to reduce emissions..." [56]. We encourage the AGU to also consider whether ExxonMobil's support of organizations working to derail climate legislation is in violation of the broader expectations of AGU's policies.

4. ExxonMobil's funding of climate-denying politicians

From 2013 to 2014, ExxonMobil contributed \$724,500 to 110 members of the United States Congress who deny the basic realities of anthropogenic climate change. Indeed, Exxon's support of climate-denying members of Congress has risen dramatically even since its 2008 pledge to end support of climate denial: between 2007-08 and 2013-14, both Exxon's total monetary contributions to climate-denying Congresspersons and the number of funded climate-denying Congresspersons more than doubled (Figure 7). Although only a small portion of data for 2015-2016 is currently available, continued funding confirms that Exxon is still donating to climate-denying members of Congress through the present day.

In total, since 2007, ExxonMobil has given at least \$1.88 million to climate-denying members of Congress. We conservatively estimate that since 1999, ExxonMobil has given at least \$3.45 million to at least 208 individual climate-denying members of Congress. That is, a large portion - on the order of one half - of ExxonMobil's donations to climate-denying Congresspersons has occurred *after* it publicly pledged to end support for climate denial.

Among those members of Congress who ExxonMobil continues to support with its donations are several dozen who refuse to even accept that Earth is warming, according to their public statements.

For example, **Chairman of the U.S. Senate Environment and Public Works Committee, Jim Inhofe (R-OK), has repeatedly described [57,58] global warming as "the greatest hoax ever perpetrated on the American people" [59], compared environmentalists to Nazis [60], and insisted that climate change is impossible because "God's still up there" [61].** Inhofe has received at least \$35,000 from ExxonMobil, including in 2015; the same year that he attempted to refute 2014's then-record global temperature anomaly by producing a snowball on the Senate floor [62]. As of 2015, ExxonMobil evidently continues to financially support those perpetuating climate science misinformation.

Likewise, current prospective presidential candidate Senator Ted Cruz (R-TX) has taken at least \$24,050 from ExxonMobil, including within the last six months. Over the same time period, **Cruz has called climate change "a pseudo-scientific theory" [63] and dismissed it as "not science, it's a religion" [64]. He has previously attested that for "the last 15 years, there has been no recorded warming" [65].**

ExxonMobil has donated at least \$123,050 in support of Senator John Cornyn (R-TX), including \$34,400 in 2013-2014. **According to Cornyn, "Taxpayer funded research by NASA and the Goddard Institute for Space Studies (GISS) concerning the warmest years on record has been the subject of dispute and after challenges, has been changed and re-released. What is less known is why the changes were made and what inherent flaws existed in the original data, if any. It is important to understand the reasons behind these alterations and further to avoid suspicion that data was massaged to fit the prescribed theory that global warming is attributable to man-made greenhouse gas emissions" [66].**

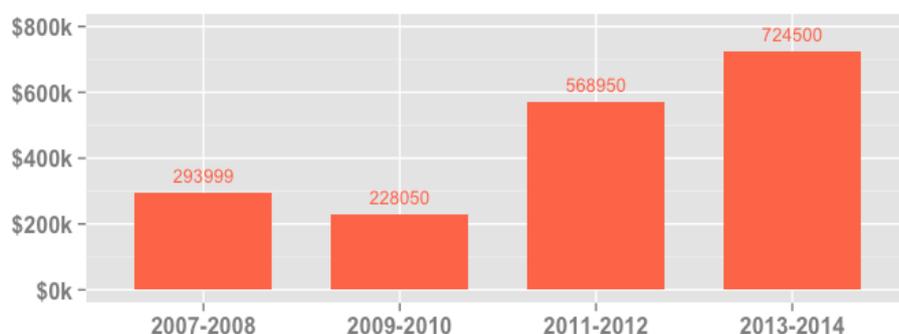
Correlation does not prove causation, and we do not presume to know or guess the motivations behind ExxonMobil's donations to any/all politicians. However, it appears indisputable that ExxonMobil continues to lend its financial support and social license to individuals who continue to spread climate science misinformation, and therefore, irrespective of the motivation or extent of this support, violates

AGU’s policy of not accepting funding from those who “publicly promote misinformation of science”.

Note: ExxonMobil’s donations to members of Congress were compiled by the Dirty Energy Money campaign [67] and are based on publicly available data from the Federal Election Commission. Our determination that a member of Congress denies the basic realities of anthropogenic climate change is based on the latest analysis by the Center for American Progress Action Fund [68]. The researchers classify as climate-deniers any lawmakers who have: questioned or denied the scientific consensus behind human-caused climate change; answered questions about climate change with the refrain, “I’m not a

scientist”; claimed that the climate is always changing; or questioned the extent to which human beings contribute to global climate change [66,69]. We note that our updated analysis of funding from 2007-present deviates almost negligibly from the recent analysis conducted by Oil Change International in collaboration with The Guardian [8]. Our estimates of earlier donations to climate denying Congresspersons (since 1999) are conservative, since the names of politicians funded by ExxonMobil since 1999 have only been cross-referenced against the Center for American Progress Action Fund’s database of climate deniers in the 114th Congress (2015-2017). We take full responsibility for any errors contained herein.

(a) Total donations from ExxonMobil to climate-denying politicians



(b) Number of climate-denying politicians receiving ExxonMobil funding

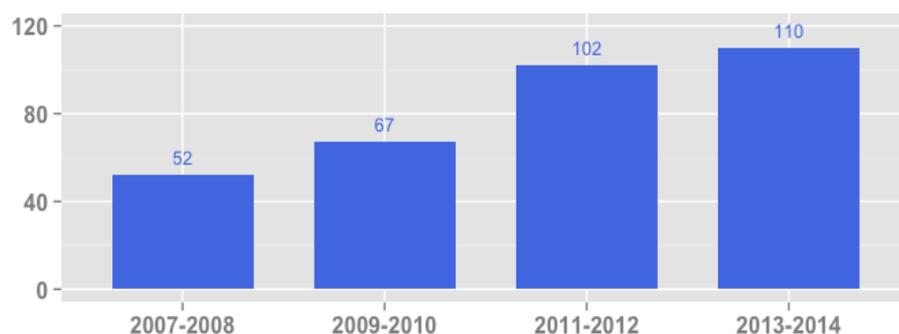


FIGURE 7. (a) Total donations (\$) from ExxonMobil to climate-denying members of Congress each year have more than doubled from 2007 to present. (b) The number of climate-denying members of Congress who have received financial support from ExxonMobil each year has more than doubled from 2007 to present.

Why ExxonMobil's past climate misinformation should not be overlooked

The question of ExxonMobil's recent and ongoing activities in scientific misinformation is the focus of this report, and AGU has stated that this, as opposed to past activities, will determine whether our society should continue to accept sponsorship from the company [2]. Identifying these ongoing activities is vital, for it shows that, despite official ExxonMobil statements declaring the validity of anthropogenic climate change and the necessity for political solutions [70,71], Exxon continues to actively work against the public understanding of climate science and political efforts to mitigate the threats of rising greenhouse gas levels in the atmosphere.

However, ExxonMobil's past activities are more than just cause for skepticism of the sincerity of their more recent statements. **The actions taken by ExxonMobil over the last three decades - to sow doubt in the public's eye about the reality and gravity of climate change, to frame attempts to change the energy system as futile, and to encourage politicians to do likewise - have done irreparable harm to the Earth system which supports human society.**

As geoscientists are well aware, barring colossal development and deployment of carbon capture and sequestration technologies, historical carbon emissions have “locked in” substantial and unavoidable warming, and therefore climate change consequences, for centuries and millennia to come [72]. Given the tremendous resources ExxonMobil has devoted to promoting an inaccurate view of climate science, it should at a minimum now be expected to correct this view among policymakers and politicians in line with the company's stated acceptance of anthropogenic climate change. We see no evidence of advertising or lobbying on ExxonMobil's part promoting sound climate science to mitigate the harm caused by their past misinforming advertising and lobbying campaigns. That ExxonMobil engaged in such obstructive tactics for so long, despite being aware of the risks of unabated carbon pollution from the international scientific community and the work of their own scientists, is ethically reprehensible. It warrants censure by scientific organizations, especially by AGU, one of the world's largest and most respected societies of Earth scientists.

The scientifically insupportable actions of ExxonMobil over the past decades have been extensively documented (e.g. 27, 52, 55, 73, 74, 75-77). When scientific opinion began to converge in the late 1980s on a significant and growing human impact on the global carbon budget, and the serious consequences to the Earth system that would result, ExxonMobil and its industry peers created the Global Climate Coalition (GCC; Ref. 78). The GCC's own internal documents make clear that its goal was to sow doubt and confusion about the science of climate change, despite the fact that a 1995 internal GCC memo (Figure 8; Ref. 79) from Mobil Oil (which merged with Exxon in 1998) stated that **“The scientific basis for the Greenhouse Effect and the potential impact of human emissions of greenhouse gases such as CO₂ on climate is well established and cannot be denied.”** From 1989-2002, the GCC employed advertising and political lobbying, as well as public attacks on individual scientists, to generate doubt among the public and policymakers about the validity of climate science.

Among the early members of the now-defunct GCC was the American Petroleum Institute (API), an active trade organization of the oil and gas industry, of which ExxonMobil is a member [80]. In 1998, the API circulated a Global Climate Science Communications Plan, outlining an extensive media and lobbying strategy for promoting an emphasis on the uncertainty of climate science (Ref. 52; full document available [here](#)). Randy Randol of ExxonMobil is acknowledged as a contributor to the document. The Plan states, **“In fact, it [sic] not known for sure whether (a) climate change actually is occurring, or (b) if it is, whether humans really have any influence on it.”** Describing the strategy to promote doubt, the Plan states, “A majority of the American public, including industry leadership, recognizes that significant uncertainties exist in climate science, and therefore raises questions among those (e.g. Congress) who chart the future U.S. course on global climate change.”

Introduction and Summary

Since the beginning of the industrial revolution, human activities have increased the atmospheric concentration of CO₂ by more than 25%. Atmospheric concentrations of other greenhouse gases have also risen. Over the past 120 years, global average temperature has risen by 0.3 - 0.6°C. Since the Greenhouse Effect can be used to relate atmospheric concentration of greenhouse gases to global average temperature, claims have been made that at least part of the temperature rise experienced to date is due to human activities, and that the projected future increases in atmospheric concentrations of greenhouse gases (as the result of human activities) will lead to even larger increases in future temperature. Additionally, it is claimed that these increases in temperature will lead to an array of climate changes (rainfall patterns, storm frequency and intensity, etc.) that could have severe environmental and economic impacts.

This primer addresses the following questions concerning climate change:

- 1) Can human activities affect climate?

The scientific basis for the Greenhouse Effect and the potential impact of human emissions of greenhouse gases such as CO₂ on climate is well established and cannot be denied.

FIGURE 8. Excerpt from a Global Climate Coalition (GCC) internal memo stating that the link between anthropogenic CO₂ emissions and warming “cannot be denied.”

THE SKY ISN'T FALLING
Despite decades of dire predictions by “environmentalists,” Earth’s future is greener than ever, reports the Competitive Enterprise Institute

Washington, D.C., April 18, 2005— The 1970’s brought us many things, including the idea that Earth was going to pot. Gloom and doom predictions by those supposedly in the know have kept “Earth Day” a main focus for the environment movement. But the **Competitive Enterprise Institute**, a public policy group based in Washington, D.C., and according to the Wall Street Journal, “the best environmental think tank in the country,” Earth Day is nothing more than a propaganda tool used to scare the public. As evidence, CEI cites the following advances, many of which go well beyond the 30-yr. history of “Earth Day.”

- There is no “scientific consensus” that **global warming** will cause damaging climate change. In fact, global average temperature is only about 0.6o higher than a century ago. Outlandish claims that our earth is warming at an extreme rate mischaracterize the scientific research by the Intergovernmental Panel on Climate Change and the National Academy of Sciences. The world is not in severe danger from **rising sea levels**. Research from Nils-Axel Morner of Stockholm University demonstrates that current sea levels are within the range of sea level oscillation over the past 300 years. And **extreme weather conditions** have no provable link to Global warming. Research by German scientists have demonstrated that the devastating floods in central Europe in 2002 were quite normal. And don’t blame climate on the **growth of vector-borne diseases such as malaria**. World experts agree that “other factors” are more important when it comes to the spread of diseases. *CEI Senior Fellow in International Policy, Ian Murray.*

FIGURE 9. A 2005 Competitive Enterprise Institute (CEI) press release denies a scientific consensus on global warming.

This document represents intentional climate disinformation, because it was released three years after the GCC memo described above acknowledging the fact of anthropogenic global warming. The API document is focused on averting the ratification of the Kyoto Protocol, but it also acknowledges that unless “there are no further initiatives to thwart the threat of climate change, there may be no moment when we can declare victory for our efforts.” Targets of the campaign include members of Congress, major media outlets, science writers, schoolteachers, and students. The API continues to work to thwart climate mitigation. For example, in 2011, API led a lawsuit against the U.S. Environmental Protection Agency contesting the agency's authority to regulate greenhouse gases as pollutants. API likewise opposed EPA rules to regulate carbon emissions from power plants in 2014 [81] and rules to regulate methane emissions from oil and gas production in 2015 [82]. We note that most oil and gas companies, including other sponsors of AGU, are also current members of API.

In addition to funding third party organizations, ExxonMobil has attempted to directly influence the public, and even the scientific process. In 2000, ExxonMobil placed an advertisement in the Washington Post criticizing the draft 2001 National Climate Assessment of the US Global Change Research Program [83] as insufficiently peer-reviewed and based on unreliable models. In 2001, ExxonMobil sent a fax to the White House asking explicitly for changes to the personnel representing the United States in the IPCC Third Assessment Report [84]. The fax implied that the current representatives were appointed with a political agenda by the previous administration and recommended specific replacements, who had either non-scientific backgrounds or held skeptical views of the human influence on climate. In less than two years, all four of the persons recommended by Exxon for removal were no longer in their posts. One of the targeted scientists, Michael MacCracken, directly criticized ExxonMobil: “to be in opposition to the key scientific findings is rather appalling for such an established and scientific organization” [85].

ExxonMobil gave \$676,500 to the Heartland Institute between 1998 and 2006. In 1998, Heartland released an “Instant Expert Guide” to global warming [86], which stated that, “Most scientists do not believe human activities threaten to disrupt the Earth’s climate.” The Heartland Institute’s “Nongovernmental International Panel on Climate Change” [87] purports to offer a “second opinion” on

the scientific and economic aspects of climate change, but is described by actual climate scientists as “dishonest” [88]. The Union of Concerned Scientists found that **nearly 40% of ExxonMobil’s donations to Heartland were specifically designated for climate-related work** [74].

From 1998-2005, ExxonMobil provided over \$2 million in funding to the Competitive Enterprise Institute (CEI), which in 1999 decried AGU’s new position statement on climate change, saying that, “It is nothing more than an underhanded attempt by some to use the AGU as a vehicle to promote their personal political views” [89]. **To be clear: AGU defines its Organizational Partners from whom it accepts funding as bodies that “do not harm AGU’s brand and reputation,” [1] yet ExxonMobil, an Organizational Partner of AGU, has financially supported CEI while CEI publicly attacked AGU.** In 2000, CEI released a report stating that, “If there is one thing certain about global warming, it is that the nature and extent of humanity’s impact on the global climate system is not yet known” [90]. In reviewing the conclusions of the 1995 IPCC report, the CEI report exclusively highlights statements describing scientific uncertainty, and remarks that “Since the [IPCC] report was issued, numerous studies have appeared in the peer-reviewed literature that further demonstrate the uncertainty of climate forecasts and the unlikelihood that human activity poses a serious threat of inducing a climate catastrophe.” In 2005, CEI published a press release stating that **“There is no ‘scientific consensus’ that global warming will cause damaging climate change”** (Figure 9; Ref. 91).

In 2005, ExxonMobil’s then-CEO Lee Raymond told attendees of the Asia Oil & Gas conference that **“We in ExxonMobil do not believe that the science required to establish this linkage between fossil fuels and warming has been demonstrated - and many scientists agree”** [92].

In short, while Earth scientists were becoming increasingly certain of the role of fossil fuel burning in climate change, ExxonMobil was leading the energy industry towards willful misinformation of this science. Acknowledging this is not simply a matter of pointing a finger at the company for bad behavior. In part because of their concerted efforts together with trade groups, industry peers, and obliging politicians, political action to mitigate climate change has been delayed by decades, during which time CO₂ from fossil fuel combustion has relentlessly accumulated in

the atmosphere and ocean. **Over half of industrial fossil fuel emissions have occurred since 1988, when NASA scientist James Hansen first brought anthropogenic climate change to the attention of the U.S. Senate** (Figure 10; Ref. 77).

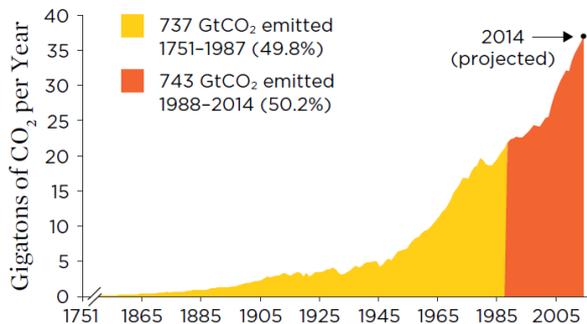


FIGURE 10. Cumulative global carbon emissions have doubled since 1988, when anthropogenic climate change was introduced to the US Senate (reproduced from UCS 2015).

Like other major fossil fuel companies, ExxonMobil has employed many highly capable scientists throughout its existence. Over the years, these scientists have contributed to important advances in a variety of fields, including climate science. Indeed, the company is currently under investigation from the Attorneys General of New York and California for allegedly having ignored the conclusions of their own scientists forewarning the dangers of unabated carbon emissions. Regardless of what is revealed by these investigations, as scientists, it is incomprehensible that the leaders of a company such as ExxonMobil, whose business activities are linked so tightly to scientific knowledge of the Earth system, would be sincerely ignorant of the scientific consensus on anthropogenic climate change, to the point of promoting contradictory claims. **The fact that they engaged in scientific misinformation about climate change for such a long period of time while the scientific community clearly refuted their public messaging is patently incompatible with the principle of scientific integrity.**

AGU has acknowledged that ExxonMobil's past activities have not been consistent with the scientific consensus on climate science, stating that, "It cannot be said that Exxon's past positions and actions regarding climate change were in keeping with our policy or with the company's current public positions" [1]. We believe that by granting ExxonMobil a "clean slate" and ignoring all of the damage they have knowingly contributed to but never remedied, AGU is failing to honor its values of "integrity in everything

we do" and the "benefit of science for a sustainable future" [93], or conveying to the public the significance of the ecological harm, human suffering, and expense that so much delay has ensured. AGU acknowledges the consequences of such inaction in its statement on climate change, noting that "our past, present, and future emissions will influence the climate system for millennia" [51]. In the words of Frumhoff et al. (2015), "We should make clear that [fossil fuel] companies operate with a social license, and consider ways to revoke that license for carbon producers who fail to act on their social responsibility" [77].

Examining ExxonMobil's history of climate science misinformation provides an opportunity for AGU to take an honest look at its own past complicity with organizational partners. The official grounds for terminating a sponsor partnership are only recently available through AGU's Organization Support Policy, adopted in 2015 [1]. Why are we only now seriously taking stock of our association, as scientists, with a company such as ExxonMobil, which has engaged in unethical behavior contributing to society's collective failure to adequately respond to climate change? Given that since 2008, funding for organizations that spread climate science misinformation has largely evolved into "dark money" contributions through untraceable foundations such as Donors Trust [27], discovering the financial links between companies like ExxonMobil and groups promoting misinformation is now more difficult. Had organizations such as AGU taken a more active stance in pushing back against ExxonMobil for its misinformation in the past, we may have been able to encourage more significant political progress towards climate mitigation. The past cannot be changed; however, we should consider the consequences of our own past actions, or inactions, to inform how we act today and in the future.

Whatever the specific motivations for ExxonMobil's recent statements in support of legitimate science and policy solutions, their concerted efforts over the course of decades have polluted their scientific reputation. Continuing to associate with such an entity tarnishes the public image of the AGU. ExxonMobil must bear responsibility for its knowingly harmful actions in the past, and AGU must acknowledge its past failure to compel ExxonMobil to end such behavior. **Disassociating from ExxonMobil now will help restore integrity to our society and signal to the public that scientifically and ethically pernicious actions are not welcome in the scientific community.**

CONCLUSION

The evidence presented in this report demonstrates that, despite stating publicly in 2008 that it would no longer support climate science misinformation, ExxonMobil has continued to make public statements disparaging the validity of climate science and to financially support others who do the same. In contrast to its industry peers, ExxonMobil continues to support groups such as the American Legislative Exchange Council (ALEC), which promote doubt and skepticism of accepted climate science. Recent examples include:

- ❖ At the 2013 ExxonMobil shareholders meeting, CEO Rex Tillerson claimed that the temperature record of the past 10 years “had been relatively flat” despite rising greenhouse gas concentrations, and described climate models as “not competent”. He reiterated his dismissal of climate models at the 2015 shareholders meeting, saying, “We don’t really know what the climate effects of 600 ppm versus 450 ppm will be because the models simply are not that good.”
- ❖ In 2014, ExxonMobil affiliate Syncrude stated that “...the production and consumption of petroleum fuels is not dangerous and does not pose a risk to human health or safety.”
- ❖ ExxonMobil continues to be a member, with company representation on the Board, of ALEC, whose official position on climate change states, “Global Climate Change is Inevitable. Climate change is a historical phenomenon and the debate will continue on the significance of natural and anthropogenic contributions.” ExxonMobil-sponsored ALEC conferences in recent years have featured workshops and literature for policymakers on denying the reality of anthropogenic climate change. ALEC also opposes a carbon tax, which ExxonMobil states it supports.
- ❖ ExxonMobil continues to support the American Enterprise Institute, whose fellow Jonah Goldberg in 2014 described scientists accepting the consensus on anthropogenic global warming as a “rent-seeking group of people who are looking to profit off of government action.”
- ❖ ExxonMobil supports the National Black Chamber of Commerce, whose official position on climate change states “There is no sound science to support the claims of Global Warming.”

When pressed to defend such actions, the company has pointed to its associations with scientific institutions as evidence of their sincere commitment to addressing the climate crisis. In short, the scientific community is being exploited: by providing funding for research and scientific meetings, ExxonMobil insulates itself against criticism from the public and scientists for its actions that perpetuate doubt and confusion about climate science and thereby promote global inaction in the face of the climate threat.

In addition to the evidence presented here of recent inconsistencies between ExxonMobil’s official statements on climate change and the company’s actions, we argue that past misinformation activities should also be considered when evaluating AGU’s partnership with Exxon. AGU has already acknowledged that ExxonMobil’s past activities have not been consistent with the scientific consensus on climate science or AGU’s policy. Documentation from groups of which Exxon was a member show that ExxonMobil was aware of the “undeniable” scientific consensus on anthropogenic global warming by the early 1990s, at the very latest. And yet the company continued to support misinforming think tanks such as the Competitive Enterprise Institute and the Heartland Institute for many years thereafter.

As the scientific consensus around climate change grows ever more robust, these positions have become public liabilities, and the company has changed its official posturing and ceased direct financial support to some of these groups over the past few years. However, as demonstrated in this report, the company still engages in willful misinformation of climate science, which constitutes a violation of AGU’s Organizational Support Policy. The onus lies on ExxonMobil to refute its engagement in such activity, and for AGU to assert that it will not accept sponsorship from the company until it has satisfactorily done so.

We further contend that it is not enough for ExxonMobil to simply cease casting doubt on legitimate science. The company bears a significant responsibility for the damage that has already been done and will continue to unfold as a result of their past actions. The misinformation tactics of ExxonMobil encouraged widespread political inaction on climate mitigation that continues today, and will not stop tomorrow if ExxonMobil quietly walks away

from groups such as ALEC. We urge AGU to exercise maximum diligence in acting on its Position Statement on Climate Change, by pressing ExxonMobil, and all organizational partners involved in fossil fuel production, to mobilize their tremendous resources towards correcting the public understanding of climate change. Actions such as this are necessary to mitigate the impacts of ExxonMobil's past misinformation activities and promote real progress towards a sustainable climate future.

We wholeheartedly share the desires of President Leinen and AGU's board to approach this matter thoughtfully, collaboratively, and with the integrity befitting our society and the ideals of the scientific process. In this vein, President Leinen has described the importance of "ensur(ing) that our discussions be representative of all sides of AGU's community" and that the AGU Council's "discussions and concerns" on this matter have reflected "pro(s) and con(s)." To this point, we respectfully note that AGU must be aware of the risk of status quo bias that might predispose a decision against cutting ties with ExxonMobil. In fact, the determination called for by President Leinen as to whether "ExxonMobil is currently engaging in the promotion of misinformation about science or adopting positions that are in conflict with AGU's own, or supporting groups that do" is essentially a factual one. It is our assessment that there should be no confusion: ExxonMobil evidently continues to engage in the promotion of climate science misinformation - both itself and through its support of groups and individuals - and is therefore in breach of AGU policy.

We urge the AGU Board to consider the following questions:

- ❖ **Why have ExxonMobil CEO Rex Tillerson and Vice President Ken Cohen continued to promote climate misinformation?**
- ❖ **Why has ExxonMobil continued to fund the American Legislative Exchange Council, the American Enterprise Institute, and the National Black Chamber of Commerce, (and in the case of ALEC, to help lead it, too): organizations that promote climate change denial and obstruction of climate mitigation policies?**
- ❖ **Why has ExxonMobil funded and participated in the ALEC task forces that promote climate change denial and undermine climate action?**
- ❖ **Why does ExxonMobil fail to notify its shareholders of the risks of climate change and climate policies to its business activities, as instructed by the SEC?**
- ❖ **Why does ExxonMobil only lobby to oppose climate mitigation policies without proposing any alternatives?**
- ❖ **What actions has ExxonMobil taken to correct the understanding of climate science among the public and policymakers to take accountability for its past misinformation activities?**

Finally, we reiterate that this work constitutes the efforts of a handful of scientists and should not be considered the complete story. Rather, we believe that the burden of proof lies with ExxonMobil to demonstrate that it is no longer supporting climate science misinformation, and with the AGU to leverage its influence and connections to access any information that may not be publicly available. As early career Earth scientists and AGU members who are deeply concerned about the climate crisis and our society's scientific integrity, we thank the AGU leadership for taking this matter into serious consideration.

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APPENDIX A

Copy of the Union of Concerned Scientists' record of
ExxonMobil's funding of climate-denying organizations (1998-2014)

ExxonMobil Foundation & Corporate Giving to Climate Change Denier & Obstructionist Organizations

Organization	2014	2007-2014	1998-2006	1998-2014
Acton Institute	-	\$50,000	\$315,000	\$365,000
Advancement of Sound Science Center	-	-	\$50,000	\$50,000
American Conservative Union Foundation	-	\$40,000	\$50,000	\$90,000
American Council for Capital Formation	\$55,000	\$135,000	\$1,619,523	\$1,754,523
American Council on Science and Health	-	\$40,000	\$125,000	\$165,000
American Enterprise Institute (AEI)	\$310,000	\$1,910,000	\$1,860,000	\$3,770,000
American Legislative Exchange Council (ALEC)	\$61,500	\$454,500	\$1,275,700	\$1,730,200
American Spectator Foundation	-	\$75,000	\$40,000	\$115,000
Annapolis Center	-	\$285,000	\$868,500	\$1,153,500
Atlas Economic Research Foundation	-	\$302,500	\$780,000	\$1,082,500
Capital Research Center/Greenwatch	-	\$50,000	\$215,000	\$265,000
Cato Institute	-	-	\$125,000	\$125,000
Center for a New Europe-USA	-	-	\$170,000	\$170,000
Center for American and International Law	\$42,000	\$227,600	\$224,550	\$452,150
Center for Defense of Free Enterprise	-	-	\$230,000	\$230,000
Center for the Study of CO2 and Global Change	-	-	\$100,000	\$100,000
Chemical Education Foundation	-	\$25,000	\$130,000	\$155,000
Committee for a Constructive Tomorrow (CFACT)	-	\$40,000	\$542,000	\$582,000
Communications Institute	-	\$315,000	\$200,000	\$515,000
Competitive Enterprise Institute (CEI)	-	-	\$2,005,000	\$2,005,000
Congress of Racial Equality	-	\$50,000	\$275,000	\$325,000
Consumer Alert	-	-	\$70,000	\$70,000
Environmental Literacy Council	-	\$50,000	\$50,000	\$100,000
Federal Focus	-	-	\$125,000	\$125,000
Federalist Society	\$15,000	\$120,000	\$105,000	\$225,000
Foundation for Research on Economics and the Environment (FREE)	-	\$210,000	\$240,000	\$450,000
Fraser Institute	-	-	\$120,000	\$120,000
Free Enterprise Action Institute	-	-	\$50,000	\$50,000
Free Enterprise Education Institute	-	-	\$80,000	\$80,000
FreedomWorks	-	-	\$380,250	\$380,250
Frontiers of Freedom	-	\$90,000	\$1,182,000	\$1,272,000
George C. Marshall Institute	-	\$150,000	\$715,000	\$865,000
George Mason University Law and Economics Center	\$30,000	\$230,000	\$215,000	\$445,000
Harvard-Smithsonian Center for Astrophysics	-	\$207,212	\$210,000	\$417,212
Heartland Institute	-	-	\$676,500	\$676,500
Heritage Foundation	-	\$340,000	\$490,000	\$830,000
Hoover Institution	\$50,000	\$50,000	\$295,000	\$345,000
Independent Institute	-	\$15,000	\$70,000	\$85,000
Independent Women's Forum	-	\$15,000	\$50,000	\$65,000
Institute for Energy Research/American Energy Alliance	-	\$95,000	\$242,000	\$337,000
Institute for Senior Studies	-	-	\$30,000	\$30,000
Institute for Study of Earth and Man	-	-	\$76,500	\$76,500
International Policy Network-North America	-	-	\$390,000	\$390,000
International Republican Institute	-	-	\$115,000	\$115,000
Landmark Legal Foundation	-	\$40,000	\$50,000	\$90,000
Lexington Institute	-	-	\$10,000	\$10,000
Lindenwood University	-	\$20,000	\$20,000	\$40,000
Manhattan Institute	\$100,000	\$475,000	\$325,000	\$800,000

Media Institute	-	-	\$120,000	\$120,000
Media Research Center/Cybercast News Service	-	\$160,000	\$202,500	\$362,500
Mercatus Center, George Mason University	\$25,000	\$260,000	\$120,000	\$380,000
Mountain States Legal Foundation	\$10,000	\$60,000	-	\$60,000
National Association of Neighborhoods	-	\$100,000	\$125,000	\$225,000
National Black Chamber of Commerce	\$75,000	\$800,000	\$225,000	\$1,025,000
National Center for Policy Analysis	-	\$150,000	\$495,900	\$645,900
National Center for Public Policy Research	-	\$110,000	\$335,000	\$445,000
National Legal Center for the Public Interest	-	-	\$216,500	\$216,500
National Taxpayers Union Foundation	\$75,000	\$630,000	\$70,000	\$700,000
Pacific Legal Foundation	\$10,000	\$155,000	\$120,000	\$275,000
Pacific Research Institute for Public Policy	-	\$235,000	\$430,000	\$665,000
Property and Environment Research Center	-	\$20,000	\$135,000	\$155,000
Reason Foundation/Reason Public Policy Institute	-	-	\$321,000	\$321,000
Regulatory Checkbook	-	-	\$50,000	\$50,000
Science and Environmental Policy Project	-	-	\$20,000	\$20,000
Tech Central Science Foundation/Tech Central Station	-	-	\$95,000	\$95,000
Texas Public Policy Foundation	-	\$50,000	\$30,000	\$80,000
U.S. Chamber of Commerce	\$1,000,000	\$1,000,000	-	-
Washington Legal Foundation	\$40,000	\$240,000	\$215,000	\$455,000
Totals	\$1,898,500	\$10,076,812	\$20,908,423	\$30,985,235

Sources: ExxonMobil Worldwide Contributions and Community Investments reports and ExxonMobil Foundation 990 tax forms compiled by Greenpeace (www.exxonsecrets.org) and the Union of Concerned Scientists.

APPENDIX B

Copy of the Center for Media and Democracy's letter to
the California Attorney General (dated January 21, 2016)

The Center for Media and Democracy

122 W. Washington Ave., Ste. 555
Madison, Wisconsin 53703
Phone: 608-260-9713

January 21, 2016

Attorney General Kamala Harris
Office of the Attorney General
California Department of Justice
P.O. Box 944255
Sacramento, CA 94244-2550

Dear Attorney General Harris,

We write to bring additional information to your attention that may be relevant to your office's investigation into whether Exxon Mobil deceived its shareholders and the public about the impact that burning fossil fuels has on climate change. In our view, the evidence strongly suggests it did.

Our organization, the Center for Media and Democracy, submitted a similar letter to New York Attorney General Eric Schneiderman.

Introduction

Since at least 1981, Exxon Mobil has funded the American Legislative Exchange Council, or "ALEC," a national lobbying organization that acts as a conduit for corporate interests to advance their legislative agenda with state legislators. An Exxon Mobil lobbyist sits on ALEC's corporate board.

With Exxon's financial support and leadership, ALEC has adopted resolutions denying the science behind the causes of climate change, promoted legislation to undermine policies aimed at addressing climate change, such as efforts to promote renewable energy or limit carbon emissions, and held workshops for state legislators promoting climate change denial.

By funding ALEC for decades Exxon has promoted numerous aspects of climate change denial and blocked legislative efforts to address climate change—while Exxon knew from its own scientific research that burning carbon was fueling climate change, a fact that it only belatedly admitted publicly.

Our organization, the Center for Media and Democracy, has conducted extensive research on ALEC via our “ALECexposed.org” project, and we are available to provide additional information that may assist you in conducting your investigation. Some of the information below is based on CMD’s in-depth investigation of ALEC including ALEC’s central role in climate change denial in the states, and some of the information below is based on investigative work by Kert Davies of the Climate Investigations Center.

Background on ALEC

ALEC describes itself as a “membership organization,” with members from the “public sector” (an estimated 2,000 state legislators from all 50 states) and the “private sector.” CMD has calculated that nearly 98 percent of its funding comes from private sources other than state legislators. In other words, ALEC’s core operations are made possible by funding from global corporations like Exxon Mobil.

Corporate and special interests pay between 50 and 500 times as much as a lawmaker to be part of the organization. Legislators pay just \$50 per year to join ALEC, whereas corporations pay between \$7,000 and \$25,000 for membership, plus additional fees to fund ALEC Task Forces or sponsor legislative workshops for lawmakers or meetings where corporate lobbyists push bills and resolutions that helped set the legislative agenda in state capitols across the country.

ALEC is quintessentially a pay-to-play operation that helps lobbyists obtain access to lawmakers and promote the agenda of the corporations for which they work.

For decades, corporate interests have paid to join an ALEC “Task Force” and get an equal vote with legislators on the adoption of bills and resolutions that are often introduced in state

legislatures at the behest of the state legislative leaders of ALEC, who are tasked with a duty to push the ALEC agenda into law. Until recently, ALEC’s corporate task force members could also directly propose bills to be voted on with legislators behind closed doors at ALEC meetings. For example, Exxon Mobil was behind an ALEC model bill from 2012 to hide the chemicals used in fracking.¹ (ALEC has claimed that only legislators can introduce bills, but CMD has debunked that by showing how that is largely a nominal process where legislators introduce bills at ALEC sought by corporate lobbyists.²)

Corporate interests also pay to sponsor workshops at ALEC meetings and can dictate the content of those workshops. Private interests also underwrite the reports presented by ALEC, such as the “EPA Regulatory Train Wreck,” which outlined 15 bills for state legislators to use to thwart the power of the EPA to regulate carbon emissions. Corporate interests also fund ALEC’s meetings of state legislators and lobbyists and have their logos prominently presented on the agenda.

ALEC is registered in California with the Attorney General’s Office as a charitable organization, and it has federal tax-exempt status under section 501(c)(3) of the Internal Revenue Code. However, ALEC’s tax-exempt status has been challenged in a series of complaints filed with the IRS alleging that ALEC operates primarily as a lobbying organization operating for the private benefit of its funders. CMD has submitted extensive evidence to the IRS in support of the filings of Common Cause.

Exxon Mobil’s Funding of ALEC and Leadership in ALEC Contradicts Its Public Positions on Climate Change

Exxon Mobil has cumulatively given at least \$1,730,200 to ALEC between 1998 and 2014, according to publicly-available information, although the actual total is likely higher. CMD has

¹ See Cora Currier, *ALEC and ExxonMobil Push Loopholes in Fracking Chemical Disclosure Rules*, PRO PUBLICA (Apr. 24, 2012), <http://www.propublica.org/article/alec-and-exxonmobil-push-loopholes-in-fracking>.

² See Matt DeFour, *Documents Released in Open Records Lawsuit Show Lobbying Group Pulling Legislators’ Strings*, WISCONSIN STATE JOURNAL (APR. 4, 2014), http://host.madison.com/wsj/news/local/govt-and-politics/documents-released-in-open-records-lawsuit-show-lobbying-group-pulling/article_1e33edf4-857d-507c-92c7-ec6948c5fc02.html.

identified records showing that Exxon has funded ALEC as far back as 1981,³ and that it sponsored ALEC’s meetings of legislators and lobbyists at least as early as 1984.⁴ Because ALEC has often sought to keep the public in the dark about the identities of the corporations driving its legislative agenda, records of its corporate membership each year are not complete, but CMD has also identified materials showing both Exxon and Mobil as corporate members of ALEC in 1992⁵ and 1994, as well as in the past seventeen years.⁶

Additionally, we know that between 2003 and 2005 Exxon Mobil earmarked \$428,000 of its funding to ALEC for “climate change” as ALEC peddled climate change denial and aimed to thwart regulation and legislation to address climate change. And Exxon’s continued funding in recent years, although not expressly earmarked for climate change on documents produced by the corporation or its foundation,, has nonetheless continued to help ALEC advance its climate denial policies, contradicting Exxon’s public statements on the issue.

Based on Exxon Mobil’s corporate disclosure reports and the Exxon Mobil Foundation’s IRS filings, the company’s known funding to ALEC in recent years includes:

Year	Amount	ExxonMobil funding entity	Stated purpose	Source
1998	\$15,000	Corporate	“Conference for freshman legislators”	1998 Exxon Education Foundation Dimensions report
2000	\$70,000	Foundation	“General Support”	2000 IRS Form 990
2001	\$70,000	Corporate	“Annual Conference” - \$50,000 “Annual Summit” - \$20,000	2001 Worldwide Giving Report
2001	\$10,000	Foundation	“General Support”	2001 Worldwide Giving Report

³ Letter from Kathleen Teague, Exec. Dir., American Legislative Exchange Council, to Mike Irish, Philip Morris USA (Oct. 14, 1981), *available at* http://www.alecexposed.org/w/images/c/cf/1981_ALEC_Exxon.pdf.

⁴ AMERICAN LEGISLATIVE EXCHANGE COUNCIL, ALEC’S ELEVENTH ANNUAL MEETING 1 (June 21-24, 1984), *available at* http://www.alecexposed.org/w/images/c/c1/ALEC_1984_Funders.pdf.

⁵ AMERICAN LEGISLATIVE EXCHANGE COUNCIL, 1993 ANNUAL MEETING 61 (1992), *available at* http://www.alecexposed.org/w/images/b/bf/ALEC_1992_Annual_Meeting_Partial.pdf.

⁶ AMERICAN LEGISLATIVE EXCHANGE COUNCIL, 1994 ANNUAL MEETING 46 (1994), *available at* http://www.alecexposed.org/w/images/4/4c/1994_ALEC_Meeting_page_46.pdf.

2002	\$163,200	Corporate	“Annual Conference” - \$50,000; “General operating Support” - \$80,000 “Membership” - \$5,000 “Project support” - \$25,000 “other” - \$3,200	2002 Worldwide Giving Report
2002	\$30,000	Foundation	“General Operating Support”	2002 Worldwide Giving Report
2003	\$78,000	Corporate	“Annual Conference”	2003 Worldwide Giving Report
2003	\$290,000	Foundation	”Energy and climate change”- \$50,000 “General Operating Support” - \$100,000 “Global Climate Change” - \$140,000	2003 Worldwide Giving Report
2004	\$55,000	Corporate	“Annual Conference”	2004 Worldwide Giving Report
2004	\$167,000	Foundation	“Energy and Climate Change”- \$62,000 “Climate Change”- \$75,000 “General Operating Support”-\$30,000	2004 Worldwide Giving Report
2005	\$90,000	Corporate	“Annual Conference”	2005 Worldwide Giving Report
2005	\$151,500	Foundation	“Energy sustainability project (climate change)” - \$80,000 “Climate change environmental outreach” - \$21,500 “General operating support” - \$30,000 “Project Support” - \$20,000	2005 IRS Form 990
2006	\$56,000	Corporate	“Annual meeting host committee sponsorship” - \$15,000 “Annual meetings sponsorship” - \$31,000 ”General Support” - \$10,000	2006 Worldwide Giving Report
2006	\$30,000	Foundation	None	2006 Worldwide Giving Report
2007	\$31,000	Corporate	None	2007 Worldwide Giving Report
2008	\$56,000	Corporate	None	2008 Worldwide

				Giving Report
2009	\$47,500	Corporate	"Annual Conference - \$15,000 General Support -\$31,000 other -\$1,500	2009 Worldwide Giving Report
2010	\$64,000	Corporate	"General Support -\$39,000; "National Chairman's Reception" - \$25,000	2010 Worldwide Giving Report
2011	\$86,500	Corporate	None	2011 Worldwide Giving Report
2012	\$59,000	Corporate	"2012 Annual Conference" \$25,000; "Private Sector and Energy and Tax Task Force" \$34,000	2012 Worldwide Giving Report
2013	\$49,000	Corporate	"2013 Annual Conference" \$15,000; "Private Sector, Energy and Tax Task Forces" \$34,000	2013 Worldwide Giving Report
2014	\$61,500	Corporate	"Annual Conference" - \$25,000; "Private Sector-Jefferson Club Membership" -\$25,000; "Other Contributions, each under \$5,000" - \$11,500	2014 Worldwide Giving Report
	\$1,730,200 =	Total Funding Exxon to ALEC, 1998-2014		
	\$428,000 =	Total Funding Earmarked for Climate Change		

This funding makes Exxon Mobil one of ALEC’s top financial supporters, even though it is only a small amount of the global corporation’s total profits.

In addition to directly funding ALEC, Exxon Mobil plays an important leadership role within the organization. Exxon Mobil has long had a representative on ALEC’s corporate board, which ALEC previously called its “Private Enterprise Board” and has recently rebranded as its “Private Enterprise Advisory Council.” The ALEC corporate board meets jointly with ALEC’s Board of

Directors (made up of a rotating cycle of legislators) to make decisions for the organization's operations. The Board of Directors ultimately approves ALEC model legislation.

Exxon Mobil is currently represented on the ALEC corporate board by its U.S. Government Affairs Manager Cynthia Bergman. Records of Exxon Mobil's involvement in ALEC's governing corporate board go back to at least 2002.⁷

Exxon Mobil has also long funded and been a voting member of ALEC's Energy, Environment, and Agriculture Task Force, the committee of legislators and lobbyists responsible for the majority of ALEC's climate denial resolutions and projects. Records additionally show that Mobil chaired the committee in 1995, when it was known as the Energy, Environment, and Natural Resources Task Force.⁸

Exxon Mobil's funding of ALEC and leadership role within ALEC suggests that the company may be working behind-the-scenes to oppose policies that it tells the public and its shareholders that it supports—namely, the science behind climate change and policies aimed at addressing it, such as regulation of carbon emissions or a carbon tax.

Moreover, the company has directly funded ALEC's work on climate change, and at times has sought to conceal this work from shareholders. In 2005, for example, Exxon Mobil gave ALEC a total of \$241,500 from its corporate and foundation arms. In its corporate "Worldwide Giving Report" published for shareholders, Exxon listed an \$80,000 grant for an "Energy Sustainability Project" and \$71,500 for "General Operating Support." From the 2005 Exxon Worldwide Giving Report:

⁷ See AMERICAN LEGISLATIVE EXCHANGE COUNCIL, IRS FORM 990 23 (2002), *available at* http://www.alecexposed.org/w/images/2/29/2002_ALEC_990.pdf (listing Walt Buchholz, Exxon Mobil's Government Relations & Issues Advisor, as a "P E Director").

⁸ AMERICAN LEGISLATIVE EXCHANGE COUNCIL, LEGISLATIVE BRIEFINGS 5 (1995), *available at* <http://www.alecexposed.org/w/images/9/9e/Alec-staff-and-board-1995.pdf>.

American Legislative Exchange Council, Washington, D.C.

Annual Conference*	90,000
Energy Sustainability Project	80,000
General Operating Support	71,500
Subtotal	\$ 241,500

Yet in documents submitted to the IRS from the Exxon Mobil Foundation, Exxon described the \$80,000 grant more specifically as “Energy Sustainability Project (Climate Change)” and also described a \$21,500 grant earmarked for “Climate Change Environmental Outreach.” From the Exxon Mobil Foundation 2005 Form 990:

ExxonMobil Foundation
Schedule of 2005 Appropriations and Payments - by Program Area
December 31, 2005

Payee Organization	Tax Status	Beginning Balance	New Allocations	Amended	Amount Paid	Ending Balance
2005 American Legislative Exchange Council 1129 20th Street, NW, Suite 500 Washington, DC 20036 Energy Sustainability Project (Climate Change) \$80,000.00	501c(3)	\$0.00	\$80,000.00	\$0.00	\$80,000.00	\$0.00
2005 American Legislative Exchange Council 1129 20th Street, NW, Suite 500 Washington, DC 20036 Project Support \$20,000.00	501c(3)	\$0.00	\$20,000.00	\$0.00	\$20,000.00	\$0.00
2005 American Legislative Exchange Council 1129 20th Street, NW, Suite 500 Washington, DC 20036 Climate Change Environmental Outreach \$21,500.00	501c(3)	\$0.00	\$21,500.00	\$0.00	\$21,500.00	\$0.00

As described in more detail below, that same year, ALEC issued a publication titled “10 Myths About Global Warming,” ALEC’s director stated in an op-ed that “the science was uncertain” around global warming, and ALEC’s website suggested that concern about climate change was driven by “junk science.” ALEC issued no publications that year or in nearby years supporting efforts to address climate change.

ALEC Has Been Described as a Component of the Exxon-Backed Plan to Promote Climate Change Doubt

The role of ALEC in peddling Exxon-funded climate denial is evidenced by a 1998 document called the “Global Climate Communications Action Plan,” which was developed by Exxon and

other fossil fuel interests to reframe climate science as “uncertain” following the December 1997 Kyoto Protocol to reduce greenhouse gas emissions.⁹

The plan notes that economic arguments about the impact of the Kyoto Protocol had failed to derail the treaty or undermine its public support, and that “those who oppose the treaty have done little to build a case against precipitous action on climate change based on the scientific uncertainty.”

“Upon this tableau, the Global Climate Science Communications Team (GCSCT) developed an action plan to inform the American public that science does not support the precipitous actions Kyoto would dictate, thereby providing a climate for the right policy decisions to be made,” the plan states.

Exxon was part of the “Global Climate Science Communications Team” that developed this plan to mislead the public about climate science, despite the company having identified the impact of carbon emissions on climate change more than twenty years earlier.

ALEC was described as one of five “potential fund allocators” for implementing the plan, along with the Committee for a Constructive Tomorrow (CFACT) and the Competitive Enterprise Institute, both of which continue to regularly participate in ALEC meetings. It is not known how much money Exxon or other companies provided to ALEC or any other group as part of this climate denial plan.

In 1998, the same year that the Exxon-backed “Global Climate Communications Action Plan” was developed with ALEC as a “potential fund allocator,” ALEC adopted at least four bills and resolutions for state legislators aimed at opposing Kyoto, claiming there is “scientific uncertainty” around the causes of climate change, and otherwise undermining greenhouse gas regulation. Those bills include:

⁹ See EXXON CORPORATION ET AL., GLOBAL CLIMATE COMMUNICATIONS ACTION PLAN (April 3, 1998) (draft) (obtained by the Climate Investigations Center), *available at* <https://www.documentcloud.org/documents/784572-api-global-climate-science-communications-plan.html#document/p8/a147247>.

- “State Responses to Kyoto Climate Change Protocol”¹⁰
- “Ozone Attainment State Implementation Plan Act”¹¹
- “Resolution on Environmental Justice”¹²
- “Interstate Research Commission Act on Climatic Change Act.”¹³

The “State Responses to Kyoto Climate Change Protocol” expressed opposition to the treaty and prohibited a state from adopting regulations on greenhouse gas prior to the treaty’s ratification by the U.S. Congress.¹⁴

The “Interstate Research Commission Act on Climatic Change Act” declared that human activity “may lead to deleterious, neutral, or possibly beneficial climatic changes” and that “a great deal of scientific uncertainty surrounds the nature of these prospective changes.”¹⁵ (ALEC re-approved the “Interstate Research Commission Act on Climatic Change Act” in 2013, the same year that Exxon Mobil disclosed that it gave \$49,000 to the organization, and well after Exxon Mobil had stated publicly that it acknowledged the science around climate change.)

In the following years, with the Kyoto treaty stalled in Congress and ultimately rejected by the George W. Bush administration, states increasingly began taking steps to regulate carbon emissions. ALEC framed these state regulatory efforts as “Son of Kyoto” bills and continued to deny that carbon emissions caused climate change. Ultimately, ALEC urged the repeal of Regional Greenhouse Gas Initiatives that states adopted to help address climate changes.

¹⁰ ALECExposed, *State Responses to Kyoto Climate Change Protocol Exposed*, http://www.alecexposed.org/wiki/State_Responses_to_Kyoto_Climate_Change_Protocol_Exposed (last visited Nov. 13, 2015).

¹¹ ALECExposed, *Ozone Attainment State Implementation Plan Act Exposed*, http://www.alecexposed.org/wiki/Ozone_Attainment_State_Implementation_Plan_Act_Exposed (last visited Nov. 13, 2015).

¹² ALECExposed, *Resolution on Environmental Justice Exposed*, http://www.alecexposed.org/wiki/Resolution_on_Environmental_Justice_Exposed (last visited Nov. 13, 2015).

¹³ ALECExposed, *Interstate Research Commission on Climatic Change Act Exposed*, http://www.alecexposed.org/wiki/Interstate_Research_Commission_on_Climatic_Change_Act_Exposed (last visited Nov. 13, 2015).

¹⁴ See supra note 10.

¹⁵ See supra note 13.

In 2003, the *New York Times* reported:

The rising level of state activity is causing concern among those who oppose carbon dioxide regulation.

"I believe the states are being used to force a federal mandate," said Sandy Liddy Bourne, who does research on global warming for the American Legislative Exchange Council, a group contending that carbon dioxide should not be regulated because it is not a pollutant. "Rarely do you see so many bills in one subject area introduced across the country."

The council started tracking state legislation, which they call son-of-Kyoto bills, weekly after they noticed a significant rise in greenhouse-gas-related legislation two years ago. This year, the council says, 24 states have introduced 90 bills that would build frameworks for regulating carbon dioxide. Sixty-six such bills were introduced in all of 2001 and 2002.¹⁶

The following year, ALEC released a report titled "Sons of Kyoto: Greenhouse Gas Regulation in the States," claiming the Kyoto treaty did "not have a scientific standing nor did it reflect economic realities" and warning about the spread of state climate regulation:¹⁷

"Regardless of the scientific uncertainty and the economic costs, there is an orchestrated movement to force the federal government and the American public to implement Kyoto-like regulation and develop a cap and trade carbon emission system," the report stated.

Based on public disclosures, the peak years of Exxon Mobil's funding for ALEC came during this same period, 2003 to 2005, at the height of state efforts to regulate carbon emissions. During those years Exxon Mobil earmarked \$428,500 in funding to ALEC for work on "climate change."

Throughout this period ALEC promoted efforts to thwart greenhouse gas regulation at the state level, in part by claiming there was "scientific uncertainty" about the role of CO₂ emissions in climate change—the same role described for ALEC a few years earlier in the Exxon-backed "Global Climate Communications Action Plan."

¹⁶ Jennifer Lee, "The Warming is Global but the Legislating, in the U.S., Is All Local," THE NEW YORK TIMES, Oct. 29, 2003, <http://www.nytimes.com/2003/10/29/us/the-warming-is-global-but-the-legislating-in-the-us-is-all-local.html>.

¹⁷ AMERICAN LEGISLATIVE EXCHANGE COUNCIL, *SONS OF KYOTO: GREENHOUSE GAS REGULATION IN THE STATES* (January 2004), available at http://www.alecexposed.org/w/images/7/7d/Sons_of_Kyoto.pdf.

Evidence of Exxon Mobil funding ALEC as it advanced climate change denial during these years include:

2003:

\$368,000 total from Exxon to ALEC, \$190,000 earmarked for “climate change.” In 2003, Exxon disclosed a \$50,000 contribution to ALEC for “energy and climate change” and another contribution in the amount of \$140,000 for “global climate change.”¹⁸

ALEC held “Energy Sustainability Academy” for state legislators featuring climate deniers.

In January 2003, ALEC organized a two-day “Energy Sustainability Academy” for state legislators at the Westin Hotel in Denver, Colorado, featuring known climate deniers such as James Taylor of the Heartland Institute and Marlo Lewis and Christopher Horner, who were then with the Competitive Enterprise Institute (another group described in the “Global Climate Communications Action Plan”).¹⁹

ALEC issues publication claiming “the science is uncertain” on climate change and warning against state CO2 regulation.

The foreword to a 2003 ALEC publication titled “Energy, Environment, and Economics” describes Kyoto as an “ill-founded international agreement” that “reflected neither scientific uncertainties nor economic reality” and warning that an “effort is underway in some states to promote legislation and regulation with Kyoto-like goals.”

¹⁸ EXXON MOBIL CORPORATION, 2003 CONTRIBUTIONS 40 (2003), *available at* <http://www.alecexposed.org/w/images/1/1e/2003-exxon-giving-report.pdf>.

¹⁹ AMERICAN LEGISLATIVE EXCHANGE COUNCIL, 2003 SUSTAINABILITY ACADEMY (2003), *available at* http://www.alecexposed.org/w/images/9/9a/ALEC_2003_Sustainability_Academy.pdf.

The publication repeats the mantra that “the science is uncertain” regarding the causes of climate change and provides state legislators with resources to push back on the “global warming scare” and model bills to thwart CO2 regulation and litigation.²⁰

ALEC’s executive director pushed climate denial in opinion piece.

In a 2003 *Washington Times* opinion piece, ALEC’s executive director stated the claim that carbon dioxide contributes to global warming was “no means agreed upon the scientific community.” From the op-ed:

“The claim that carbon dioxide contributes to global warming is highly controversial, and is by no means agreed upon in the scientific community. Plenty of evidence suggests global temperature changes during the last century have stemmed from natural causes, not man-made ones. The U.S. government, even after spending \$45 billion in global warming research over the last decade, still concedes the science is inconclusive.”²¹

ALEC published a summary of greenhouse gas regulations.

In 2003, ALEC published a summary of greenhouse gas legislation that sought to regulate carbon dioxide from 2001 to 2002 legislative sessions. The tracking document included bills passed and rejected as well as agency regulations.²² ALEC has used such lists to assess where it can try to stop or repeal standards or where it can promote legislation to advance its corporate funders agenda.

ALEC declared EPA cannot regulate carbon emissions.

In 2003, ALEC issued a press release opposing a state lawsuit urging the EPA to regulate carbon dioxide, claiming, “the suit is based on inconclusive logic and faulty science.” ALEC’s Energy, Environment, Natural Resources and Agriculture task force director stated in a quote: “If you

²⁰ Alexandra Liddy Bourne, *Energy Sustainability in the 21st Century*, in AMERICAN LEGISLATIVE EXCHANGE COUNCIL, ENERGY, ENVIRONMENT, AND ECONOMICS 4 (Jan. 2003), available at http://www.alecexposed.org/w/images/6/62/ALEC_Energy_Book_Split.pdf.

²¹ Duane Parde, *Skewed Road Map to Kyoto*, THE WASHINGTON TIMES, June 20, 2003, http://www.alecexposed.org/w/images/0/02/Skewed_road_map_to_Kyoto_-_The_Washington_Times_Commentary.pdf.

²² AMERICAN LEGISLATIVE EXCHANGE COUNCIL, 2003 LEGISLATION TO REGULATE GREENHOUSE GASES (2003), available at http://www.alecexposed.org/w/images/b/bc/ALEC_2003_Legislation_to_Regulate_Greenhouse_Gases.pdf.

begin to regulate carbon dioxide, who will prevent the government from regulating water vapor and oxygen – the two largest greenhouse gas concentrations in the atmosphere.”²³

Task force heard negative presentations on economic impact of climate policies.

In 2003, ALEC’s Energy, Environment, Natural Resources and Agriculture Task Force held a workshop on the “economic impact of climate change policies” and heard presentations from climate change deniers like Joe Bast of the Heartland Institute.²⁴

2004:

\$219,000 total from Exxon to ALEC, \$137,000 earmarked for “climate change.”

In 2004, Exxon disclosed a \$62,000 contribution to ALEC for “energy and climate change” and another contribution in the amount of \$75,000 for “climate change.”²⁵

ALEC “Sons of Kyoto” report claimed Kyoto Protocol did not have scientific standing.

In a 2004 publication titled “Sons of Kyoto: Greenhouse Gas Regulation in the States,” ALEC claimed the Kyoto Protocol to limit greenhouse gas emissions “was conceived under the auspices of concern about increased temperatures due to global warming” but “did not have a scientific standing nor did it reflect economic realities.”²⁶

2005:

\$241,500 from Exxon to ALEC, \$101,500 earmarked for “climate change.”

²³ Press Release, American Legislative Exchange Council, Attorneys General in Three States Sue EPA in Attempt to Regulate CO2 (June 5, 2003), *available at* http://www.alecexposed.org/w/images/e/ea/ALEC_Press_Release_Attorneys_General.pdf.

²⁴ American Legislative Exchange Council, “Natural Resources Task Force,” *available at* http://www.alecexposed.org/w/images/e/e8/ALEC_Natural_Resources_Taskforce.pdf.

²⁵ EXXON MOBIL CORPORATION, 2004 WORLDWIDE CONTRIBUTIONS AND COMMUNITY INVESTMENTS 2 (2004), *available at* <http://www.alecexposed.org/w/images/0/00/2004-exxon-giving-report.pdf>.

²⁶ AMERICAN LEGISLATIVE EXCHANGE COUNCIL, SONS OF KYOTO: GREENHOUSE GAS REGULATION IN THE STATES (January 2004), *available at* http://www.alecexposed.org/w/images/7/7d/Sons_of_Kyoto.pdf.

In 2005, Exxon disclosed a \$80,000 contribution to ALEC for “energy sustainability project (climate change)” and a \$21,500 contribution to ALEC for “climate change environmental outreach.”²⁷

ALEC publication addresses “10 myths about global warming.”

In 2005, ALEC issued a publication titled “[Top 10 Myths About Global Warming](#)” authored by the Director of ALEC’s Natural Resources Task Force, Kelli Kay. From the publication:

- MYTH 1: “Scientists have conclusively proven that human activity is causing the earth to warm”
- MYTH 2: “Earth’s temperature has risen to an unnatural level over the last century
- MYTH 3: “The ice caps are melting and sea levels are rising”
- MYTH 4: “Extreme weather phenomena are increasing due to global warming”
- MYTH 5: “Global warming threatens fragile ecosystems and may cause threatened and endangered species to become extinct”
- MYTH 6: “The U.S. Government believes the theory of global warming has been proven and supports capping greenhouse gas emissions”
- MYTH 7: “Adhering to the Kyoto Protocol and other carbon dioxide reduction schemes will decrease earth’s temperatures”
- MYTH 8: “Adhering to the Kyoto Protocol and other carbon dioxide reduction schemes will be relatively inexpensive”
- MYTH 9: “Multi-pollutant regulation, which includes both EPA criteria pollutants and greenhouse gases, is an inexpensive, ‘no-regrets’ method for improving air quality”
- MYTH 10: Renewable energy technology can immediately replace all fossil fuels”²⁸

ALEC’s website claimed science supporting the idea of climate change was “junk science”

In 2005, ALEC’s website stated:

“In Our Environmental Policy: Increasingly, ‘junk science’ has dictated the direction in which environmental policy is headed. Current regulations, restrictions, and government intervention are so pervasive that if no action is taken to counter this trend, economic progress and prosperity face near paralysis. The danger to our economic progress that the ‘precautionary principle’ presents far outweighs the perceived potential dangers to our environment.”²⁹

²⁷ EXXON MOBIL CORPORATION, 2005 WORLDWIDE GIVING REPORT 1 (2005), *available at* <http://www.alecexposed.org/w/images/5/51/2005-exxon-giving-report.pdf>.

²⁸ Kelli Kay, *Top 10 Myths About Global Warming*, AMERICAN LEGISLATIVE EXCHANGE COUNCIL 18-21 (2005), *available at* http://www.alecexposed.org/w/images/d/d9/ALEC_Climate_Myths.pdf.

²⁹ American Legislative Exchange Council, “Junk Science,” *available at* http://www.alecexposed.org/w/images/4/44/Junk_Science.pdf.

These are just a few examples of the numerous ways in which ALEC has been deployed to teach climate change denial to thousands of state legislators and block political action during a period that Exxon contributed substantial funding to ALEC's "climate change" efforts.

More recent examples show that Exxon Mobil's ongoing support for ALEC has continued to undermine the company's stated policy positions.

For example, Exxon Mobil has publicly indicated that it supports a carbon tax.³⁰ However, in 2013, the ALEC "Energy, Environment and Agriculture Task Force" and the "Tax and Fiscal Policy Task Force" jointly adopted a resolution at ALEC's Annual Meeting declaring the organization "opposes all Federal and state efforts to establish a carbon tax on fuels for electricity and transportation" (see ALEC "Resolution in Opposition to a Carbon Tax" available at <http://www.alec.org/model-legislation/resolution-opposition-carbon-tax/>).

That same year, Exxon Mobil disclosed that it gave \$49,000 to ALEC, which included \$15,000 to sponsor the 2013 Annual Meeting and \$34,000 towards the ALEC "Energy, Environment and Agriculture Task Force" and the "Tax and Fiscal Policy Task Force." Companies that fund ALEC task forces become members of that task force and are given a vote on bills and resolutions.

In other words, the ALEC "Resolution in Opposition to a Carbon Tax" was adopted by the same ALEC task forces funded by Exxon Mobil, and at the same Annual Meeting sponsored by Exxon Mobil, even as Exxon Mobil told its shareholders and the public that it supports a carbon tax. During this same period an Exxon Mobil representative was also on the ALEC corporate board.

In 2014, Exxon Mobil disclosed that it gave \$61,500 to ALEC, which included \$25,000 to sponsor ALEC's Annual Conference, \$25,000 to join the 501(c)(4) "Jeffersonian Project," and

³⁰ See Coral Davenport, *Large Companies Prepared to Pay Price on Carbon*, NEW YORK TIMES, Dec. 5, 2013, <http://www.nytimes.com/2013/12/05/business/energy-environment/large-companies-prepared-to-pay-price-on-carbon.html>.

\$11,500 in “other contributions.” At ALEC’s Exxon Mobil-sponsored Annual Meeting that year, Heartland Institute President Joseph Bast led an ALEC workshop for state legislators from across the country featuring a presentation claiming that:

- “There is no scientific consensus on the human role in climate change.”
- “There is no need to reduce carbon dioxide emissions and no point in attempting to do so.”
- “Carbon dioxide has not caused weather to become more extreme, polar ice and sea ice to melt, or sea level rise to accelerate. These were all false alarms.”
- The International Panel on Climate Change (IPCC) “is not a credible source of science or economics.”
- “The likely benefits of manmade global warming exceed the likely costs.”

Additionally, at that same Exxon Mobil-funded meeting, the Committee for a Constructive Tomorrow (CFACT) handed legislators a worksheet called “Climate change talking points 2014” that coached ALEC legislative members on how to talk about “manmade climate fears.” CFACT was one of the other organizations listed in the 1998 Exxon-backed “Global Climate Science Communications Plan,” along with ALEC.

In that worksheet, legislators were told to respond to the question “how can you deny global warming?” by stating “we inhale oxygen and exhale CO₂” and that “higher atmospheric CO₂ levels cannot possibly supplant the numerous complex and interconnected forces that have always determined Earth's climate.”

These arguments were echoed at ALEC’s December 2014 meeting, when Craig Idso of the Center for the Study of Carbon Dioxide and Global Change led a workshop telling state legislators that “CO₂ is not a pollutant. It is a benefit. It is the very elixir of life.”

Notably, there is no indication of any workshop ever held by ALEC where Exxon promoted the reality that burning carbon is contributing to climate change. Instead, Exxon funding for ALEC has coincided with the advance of the climate change denial agenda to powerful legislators

across the country, arming them with disinformation from the ALEC national meetings Exxon has underwritten.

ALEC has also aimed to promote climate change denial among school children. ALEC's "Environmental Literacy Improvement Act" requires that all environmental education programs and activities "provide a range of perspectives presented in a balanced manner" and "provide instruction in critical thinking so that students will be able to fairly and objectively evaluate scientific and economic controversies."

Yet because there is no serious scientific controversy about climate change, mandating a "balanced" approach to educating children about the issue has the effect of misleading students about the extent and reality of the problem. ALEC adopted this bill in 2000, the same year that Exxon Mobil reported giving \$70,000 to ALEC and the Exxon Mobil Education Foundation reported giving \$10,000. ALEC re-approved the bill in 2013, the same year that Exxon Mobil disclosed that it gave \$49,000 to the organization.

ALEC has been an aggressive opponent of any legislative or regulatory efforts to address climate change, whether reducing carbon pollution or increasing renewable energy. Several model bills oppose EPA efforts to reduce carbon pollution. These attacks on EPA include:

- Undermining EPA action to limit carbon pollution from power plants.
- Questioning EPA's authority to reduce carbon pollution, despite the Supreme Court's many decisions to uphold EPA authority.
- Castigating EPA's efforts to improve air quality and reduce carbon pollution as a "regulatory train wreck."

The full extent of Exxon's funding of ALEC is not known. What is known is that Exxon's continued funding of ALEC and its leadership role within the organization has made ALEC's decades of climate change denial possible.

We encourage you to seek answers to the following questions:

- What were the "deliverables" for Exxon Mobil's funding for ALEC?

- Who reviewed the deliverables on grants to ALEC?
- Does Exxon Mobil have any memoranda of understanding, contracts, grant agreements, or other communications with ALEC about legislation, resolutions, publications, and workshops to help lawmakers embrace climate change denial and attack, stop, or undermine efforts to address the climate changes underway?
- Why has Exxon Mobil continued to fund ALEC as the organization promoted climate change denial?
- Why has Exxon Mobil continued to lead ALEC through membership on its corporate Board as the organization worked to thwart policies aimed at addressing climate change?
- Why has Exxon Mobil funded and participated in the same ALEC task forces that promote climate change denial and undermine climate action?

Please do not hesitate to contact CMD if you need additional information about these matters.

Thank you for your consideration of our views and thank you for opening an investigation of Exxon Mobil about its public and private representations and actions regarding climate change.

Sincerely,



Lisa Graves

Executive Director



Brendan Fischer

General Counsel



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Appendices E & F

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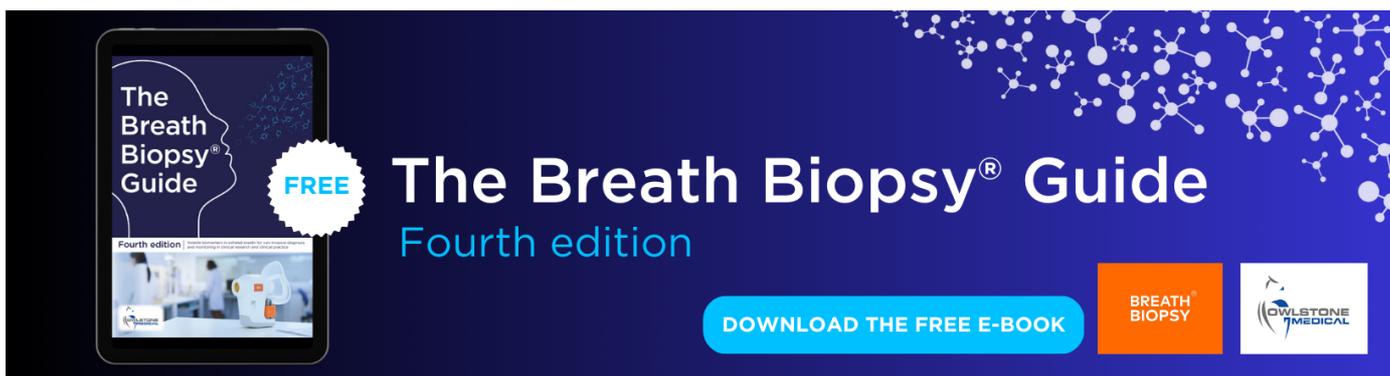
Assessing ExxonMobil's climate change communications (1977–2014)

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Addendum to ‘Assessing ExxonMobil’s climate change communications (1977–2014)’ Supran and Oreskes (2017 *Environ. Res. Lett.* **12** 084019)

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Supplementary material for this article is available [online](#)

Abstract

In our 2017 study ‘Assessing ExxonMobil’s climate change communications (1977–2014)’, we concluded that ExxonMobil has in the past misled the public about climate change. We demonstrated that ExxonMobil ‘advertorials’—paid, editorial-style advertisements—in *The New York Times* spanning 1989–2004 overwhelmingly expressed doubt about climate change as real and human-caused, serious, and solvable, whereas peer-reviewed papers and internal reports authored by company employees by and large did not. Here, we present an expanded investigation of ExxonMobil’s strategies of denial and delay. Firstly, analyzing additional documents of which we were unaware when our original study was published, we show that our original conclusion is reinforced and statistically significant: between 1989–2004, ExxonMobil advertorials overwhelmingly communicated doubt. We further demonstrate that (i) Mobil, like Exxon, was engaged in mainstream climate science research prior to their 1999 merger, even as Mobil ran advertorials challenging that science; (ii) Exxon, as well as Mobil, communicated direct and indirect doubt about climate change and (iii) doubt-mongering did not end after the merger. We now conclude with even greater confidence that ExxonMobil misled the public, delineating three distinct ways in which they have done so.

1. Introduction

In our recent article (Supran and Oreskes, 2017 *Environ. Res. Lett.* **12** 084019 [1]), we assessed whether ExxonMobil has in the past misled the general public about anthropogenic global warming (AGW) (we refer to Exxon Corporation as ‘Exxon’, Mobil Oil Corporation as ‘Mobil’, ExxonMobil Corporation as ‘ExxonMobil Corp’, and generically refer to all three as ‘ExxonMobil’). Presenting an empirical document-by-document textual content analysis of the company’s private and public climate change communications—including peer-reviewed and non-peer-reviewed publications, internal company documents, and paid, editorial-style advertisements (‘advertorials’) in *The New York Times* (NYT)—we concluded that it has.

After our study was published, we became aware of additional relevant ExxonMobil advertorials not included in our original analysis. Here, we present a

document-by-document content analysis of 1448 advertisements, which include these additional materials. Our original finding is reinforced: between 1989–2004, Mobil and ExxonMobil Corp advertorials overwhelmingly expressed doubt about AGW as real and human-caused, serious, and solvable. By including additional advertorials in this expanded analysis, we now conclude with even greater confidence that Exxon, Mobil, and ExxonMobil Corp misled the public.

We also address a critique that ExxonMobil Corp has raised about our original study: that it ‘obscur[ed] the separateness of the two corporations’, Exxon and Mobil, thereby rendering our conclusions invalid [2, 3]. This was never the case: our article’s citations explicitly attributed each individual advertorial to one of Exxon, Mobil, or ExxonMobil Corp; we did not obscure anything. It is the case that to avoid overcomplicating or belaboring the point, our original article focused on how the three companies—Exxon, Mobil,

and ExxonMobil Corp—have collectively misled the public. We considered this approach appropriate, because when Exxon and Mobil merged, ExxonMobil Corp inherited legal and moral responsibility for the parent companies. We reject the implied argument that ExxonMobil Corp is somehow not responsible for the actions of Exxon or Mobil, whatever they may have been. Here, we show ExxonMobil Corp's critique to be incorrect both statistically and at the level of individual documents. We delineate three distinct ways in which the data demonstrate that Exxon, Mobil, and ExxonMobil Corp have all, variously, misled the public about AGW.

2. Method

Previously we demonstrated that between 1989–2004, available advertorials—paid, editorial-style advertisements on the Op-Ed page of the *NYT*—published by Mobil and ExxonMobil Corp overwhelmingly expressed doubt about AGW as real and human-caused, serious, and solvable [1]. In this study, we analyze additional advertorials that came to light after our study was published.

We adopt the same methodology as in our prior study, characterizing each document's manifest content in terms of its (i) topic, (ii) position with respect to AGW, and (iii) position with respect to risks of stranded fossil fuel assets [1]. Results from our original analysis of the 32 Internal memos, 72 Peer-Reviewed articles, and 47 Non-Peer-Reviewed articles made available by ExxonMobil Corp are carried forward (see table 1). As before, our analysis compares these documents with Mobil and ExxonMobil Corp's public outreach in the form of advertorials in the *NYT*.

We previously analyzed 36 AGW-relevant advertorials from a collection of 97 compiled by PolluterWatch based on a search of the ProQuest archive [1, 6, 7]. Here, we add to this dataset of 36 by running two additional Boolean ProQuest searches (see section S1, supplementary information for details). In the first, we query for all advertisements in the *NYT* between 1923 and 2018 that refer to 'Mobil' or 'Exxon' or 'ExxonMobil' and to one or more of 13 keywords pertaining to AGW (based on a word frequency analysis of all advertorials included in [1]): 'climate' or 'climate change' or 'greenhouse' or 'global' or 'warming' or 'Kyoto' or 'carbon' or 'CO₂' or 'dioxide' or 'temperature' or 'GHG' or 'Fahrenheit' or 'Celsius'. This relevance sample search yielded 1412 documents [8]. In our second search, we query for all advertisements published in the *NYT* on Thursdays between 1970 and 2018, and that refer to 'climate change' or 'global warming' or 'greenhouse gas' or 'greenhouse gases' or 'greenhouse effect' or 'carbon dioxide' or 'CO₂'. (This search specifically targets Mobil and ExxonMobil Corp's 'every Thursday' (1972–2001) and 'every other Thursday' (2001+)

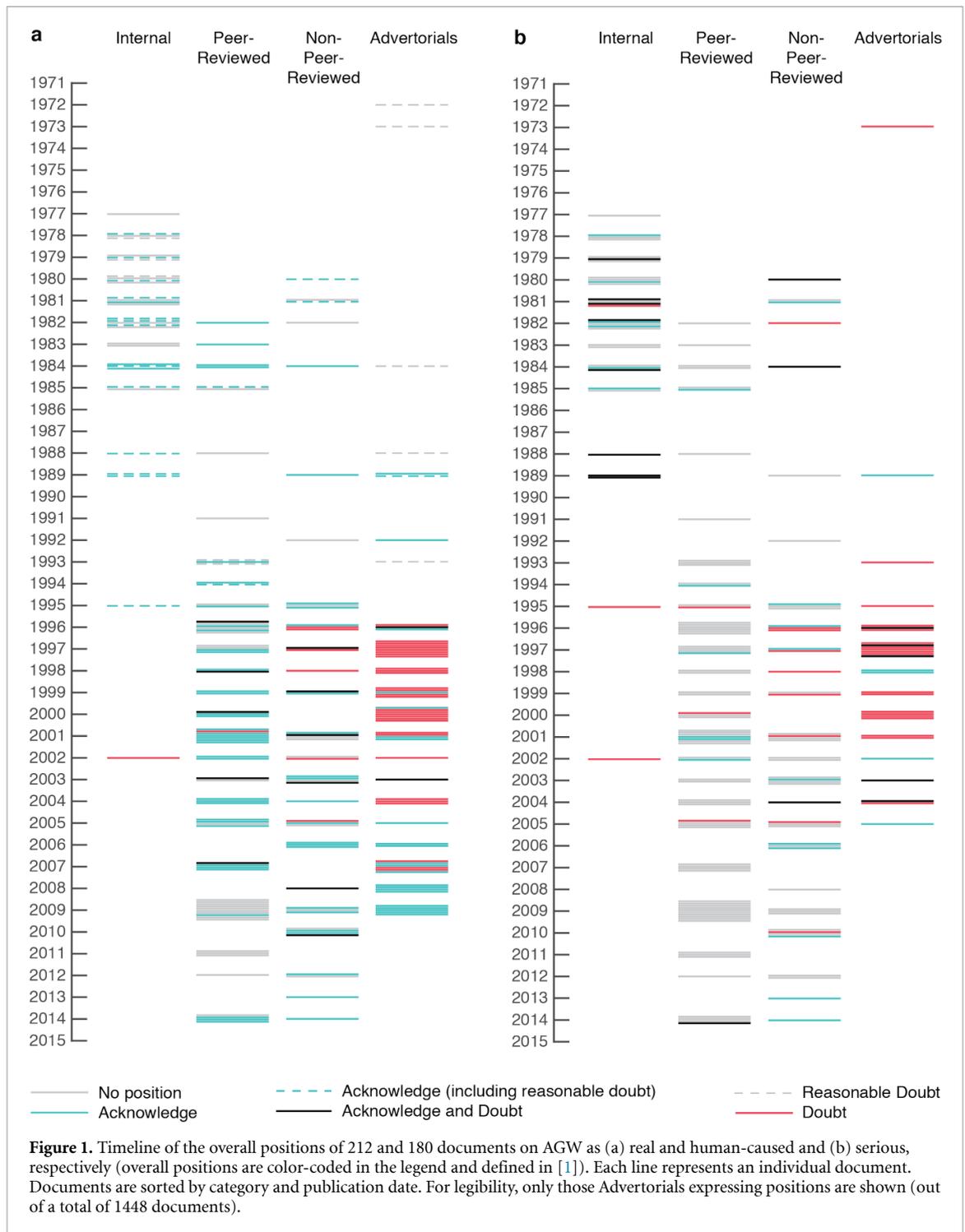
advertorials [9, 10].) This search yielded 138 documents. Combining the above three datasets and removing redundancies yielded a total of 1448 documents spanning 1924–2013 (see table S4, supplementary information). Despite our comprehensive search, additional unidentified advertorials may, of course, exist. We would welcome ExxonMobil Corp making publicly available a complete online database of its—and Mobil's—advertorials in all newspapers (archived versions of the company's website show that in the past, some—but not all—advertorials were listed, albeit misrepresented as 'Op-Eds' [11]).

Eight research assistants conducted an initial, high-level content analysis to filter for relevance the 1412 documents generated by the first ProQuest search. The assistants downloaded and inspected each individual document within assigned publication windows spanning one to ten years. Applying a standardized procedure, they binned each document as either 'irrelevant' or 'not irrelevant' (subcategories of 'relevant', 'generic', and 'ambiguous') to AGW, erring heavily on the side of caution (even most 'not irrelevant' documents do not, in fact, express any positions on AGW). The remainder of the 1448 documents were likewise binned by one of the authors. To verify intercoder reliability, each analyst independently coded a random subset of 100 documents (approximately 7% of the total number of documents; equivalent, on average, to 61% of the number of documents analyzed by each assistant). In sum, this yielded 267 'not irrelevant' advertorials (intercoder reliability: percentage agreement = 92%; Krippendorff's $\alpha = 0.77$; these are conservative lower-bounds owing to Type I errors, the true value is close to unity—for details see section S1, supplementary information). The authors then coded these 267 advertorials according to the content analysis scheme detailed in [1]. (This included occasional reevaluations of codes assigned in our original analysis.)

We have also obtained additional non-peer-reviewed documents not included in our original study, such as company reports, webpages, and speeches. These inform our interpretation of the results of our content analysis. The sources for these additional documents include the Climate Files archive maintained by Climate Investigations Center, ExxonMobil webpages, and digital archives (Wayback Machine) of earlier ExxonMobil webpages [12, 13]. Unlike other document categories, which are bound sets, non-peer-reviewed documents are virtually limitless in potential number and scope (see footnote on p. 2, [1]). Accordingly, while we introduce specific new non-peer-reviewed documents in this paper in order to inform our Discussion, we do not systematically assess their positions using content analysis. Table 1 and figures 1 and 2 reflect only those non-peer-reviewed documents included in our original study.

Table 1. Inventory of documents analyzed. Shown for each document category are the total number of documents, their date range, source(s), and assigned types. The internal, peer-reviewed, and non-peer-reviewed documents are those studied in [1]. Among peer-reviewed and non-peer reviewed documents, eight publications were found to be redundant, with similar or identical wording to seven other (strictly unique) publications. All 15 are included in our analysis. Among non-peer-reviewed documents, there are two citations provided by ExxonMobil Corp that are identical to two others. The identical two are not included in our analysis. Sources: ‘Peer-Reviewed’ and ‘Additional’ publications are cited in the ‘Exxon Mobil Contributed Publications’ list [4]; ‘Supporting Materials’ are internal documents offered by ExxonMobil Corp [5]; ‘Other’ sources refers to documents discovered independently during our research; ICN = *InsideClimate News*; NYT = *The New York Times*. NYT advertorials were collated from Polluter Watch and ProQuest [6, 7]; an initial relevance sample search yielded 1448 documents, from which 267 ‘not irrelevant’ advertorials were identified for further content analysis. For details on document types, see section S2, supplementary information (available online at <https://stacks.iop.org/ERL/15/119401/nmedia>), [1]. Miscellaneous Opinions include, for example, commentaries, opinion editorials, and speeches.

Category	No.	Dates	Sources										Document types									
			Provided by ExxonMobil Corp										Industry White Paper									
			‘Peer-reviewed’		‘Additional’		‘Supporting materials’		ICN		NYT		Other		Academic Journal	Conference proceeding	Workshop report	Gov. doc.	Book	Internal doc.	Ad	Misc. opinion (e.g. comment, op-ed, speech)
Internal documents	32	1977–1995	0	0	22	28	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Peer-reviewed	72	1982–2014	19	0	0	0	0	3	53	2	13	4	0	0	0	0	0	0	0	0	0	0
Non-peer-reviewed	47	1980–2014	3	29	0	3	0	12	0	24	5	2	2	0	0	0	0	0	0	0	0	13
Advertorials	1448	1924–2013	0	0	0	0	1448	0	0	0	0	0	0	0	0	0	0	0	0	0	1448	0

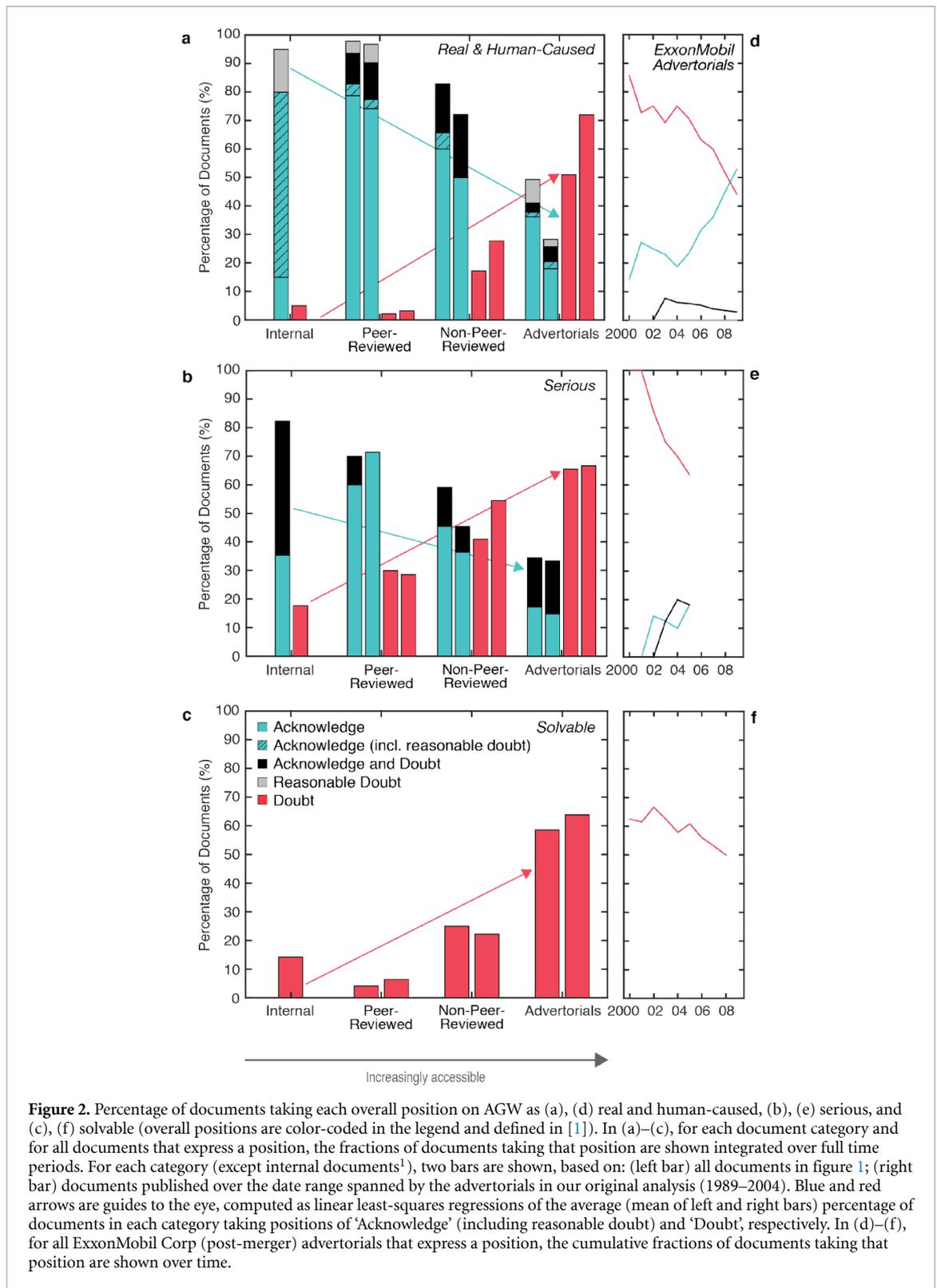


3. Results

3.1. Endorsement Levels (ELs)—AGW as real and human-caused

Figure 1(a) is a timeline of the overall positions of 212 documents on AGW as real and human-caused, sorted by publication date and into four categories: *Internal Documents*, *Peer-Reviewed*, *Non-Peer-Reviewed*, and *Advertorials*. Each line represents an individual document and is color-coded (see [1] for definitions): No position (grey); Acknowledge (blue);

Acknowledge and Doubt (black); and Doubt (red). Dashed lines indicate documents that have been filtered for reasonable doubt. ELs for Internal, Peer-Reviewed, and Non-Peer-Reviewed documents are reproduced from our original analysis. ELs are shown for 61 advertorials, spanning 1972–2009, found to express a position (for legibility, the remainder of the 1448 documents with no position are not shown). For each category and for all documents that express a position, figure 2(a) shows the fractions of documents that take that position. For each category (except



internal documents¹), two bars are shown: the left bar of each pair is based on all documents in figure 1; the right bar is based on documents published over

the date range spanned by the advertorials in our original analysis (1989–2004), allowing direct comparison to [1]. In both cases (1972–2014 and 1989–2004), positions on AGW as real and human-caused vary significantly across document categories (Fisher’s exact test, FET: $p = 8.8 \times 10^{-10}$ and $p = 7.0 \times 10^{-9}$, respectively; see section S2, supplementary information, for details and all probability values).

¹As in [1], only one bar is shown for internal documents, based on all internal documents (1977–2002), because only 4 of the 20 internal documents expressing a position fall between 1989–2004.

3.1.1. Peer-reviewed, non-peer-reviewed, and internal documents

For detailed descriptions of the positions of Exxon and ExxonMobil Corp's peer-reviewed, non-peer-reviewed, and internal documents, see [1]. Figures 1(a) and 2(a) show that Exxon and ExxonMobil Corp's peer-reviewed publications overwhelmingly acknowledge AGW as real and human-caused ('Acknowledge'). Over the timespan of all documents (left bars in figure 2(a)¹; see right bars for 1989–2004), of the 65% (47/72) of peer-reviewed documents that express a position, more than four-fifths hold an 'Acknowledge' position (39/47 = 83%). The predominant stance in non-peer-reviewed communications is also 'Acknowledge', although compared to peer-reviewed work, it loses ground to the 'Acknowledge and Doubt' and 'Doubt' stances in roughly equal measure ($p = 0.044$, FET). Of the 74% (35/47) that take a position, 66% (23/35) 'Acknowledge', 17% (6/35) 'Acknowledge and Doubt', and 17% (6/35) 'Doubt' that AGW is real and human-caused. Finally, the bulk of Exxon's internal documents also take the 'Acknowledge' stance. Of the 63% (20/32) that take a position, 80% (16/20) adopt 'Acknowledge', with most of the rest expressing 'Reasonable Doubt' (3/20 = 15%).

3.1.2. Advertorials

In contrast, the predominant stance in Mobil and ExxonMobil Corp advertorials between 1989 and 2004 is 'Doubt', consistent with our original results (e.g. peer-reviewed publications versus advertorials: $p = 2.9 \times 10^{-9}$, FET). Figures 1(a) and 2(a) (right bars) show that of the 8.5% (39/457) of advertorial search results over this period that take a position (including 13 new advertorials uncovered by our ProQuest searches), 72% (28/39) take the position of 'Doubt', with the remainder mostly split between 'Acknowledge' (8/39 = 21%) and 'Acknowledge and Doubt' (2/39 = 5%). Table 2 (top row) provides sample quotations (see section S4, supplementary information, for substantiating quotations for all advertorials). A characteristic example not included in our original dataset is a 2000 ExxonMobil Corp (not Mobil or Exxon) advertorial in the *NYT* and *The Washington Post*, in which the company criticized a US National Assessment report on climate change as putting the 'political cart before a scientific horse' and being based 'on unreliable models' that were 'not yet capable of predicting Earth's global climate' [14, 15]. The advertorial was condemned by the former director of the National Assessment Coordination Office: 'To call ExxonMobil's position out of the mainstream is...a gross understatement' [16]. Another 2000 ExxonMobil Corp advertorial says that 'climate change may appear as confusing as a maze' [17].

Expanding beyond our original analysis to include 4 and 18 new advertorials published pre-1989

and post-2004, respectively, figures 1(a) and 2(a) (left bars) show that 'Doubt' continues to account for half of all positions (31/61 = 51%), though it loses some ground to the 'Acknowledge' stance (23/61 = 38%). The remaining positions are shared between 'Reasonable Doubt' and 'Acknowledge and Doubt' (5/61 = 8% and 2/61 = 3%, respectively). Examples of 'Doubt' include three ExxonMobil Corp advertorials in 2007, which, despite acknowledging 'the risks of climate change', variously say that 'climate science remains extraordinarily complex', that it is 'evolving', and that 'areas of uncertainty do exist' [18–20]. Of those advertorials expressing 'Acknowledge' from 2005 onwards, 93% (14/15) do so only implicitly (EP3a), almost exclusively by discussing mitigation (such as energy efficiency and technology innovation) rather than climate science. None explicitly say that climate change is real and human-caused.

Accompanying the emergence of implicit acknowledgments is a rhetorical framework focused on 'risk'. 'Risk(s)' of AGW (or of greenhouse gases) becomes ExxonMobil Corp's watchword, appearing at least once in 87% (13/15) of these advertorials (table S4, supplementary information). A characteristic example is a 2007 advertorial entitled 'Saving Energy and Reducing Greenhouse Gas Emissions', which refers to 'steps ExxonMobil is taking to address the risk of climate change' and says that 'industry, consumers and policymakers all have a role to play in addressing the risks of climate change' [21]. A 2008 advertorial discusses lower-carbon fuels and other approaches to 'addressing the risks posed by rising greenhouse gas emissions', but without mentioning AGW [22].

These observations—of implicit acknowledgments and 'risk' rhetoric—are part of a wider trend. Regarding the former: across all advertorials in all years, only two express any form of explicit acknowledgment (EP2). One, a borderline case in 2005, does so only indirectly, by quoting a statement from the Group of Eight (G8) that does not address causation [23]. The other, in 1989, is not in fact an advertorial, but an advertisement in *The New York Times Magazine* that may or may not have actually included Exxon among its industry sponsors [24]. All other acknowledgments are implicit: they avoid directly addressing climate science and the issue of human causation, instead discussing emissions reductions strategies. Figure S1, supplementary information, shows that from the late 1990s onwards, advertorials focused on mitigation rapidly outnumbered those focused on methods and climate science—cumulatively, by more than three-to-one.

We shall address the wider trend concerning 'risk' rhetoric in a forthcoming study. See table 3, however, for examples of the pervasiveness of 'risk' language in ExxonMobil Corp's public communications about AGW.

Table 2. Example quotations (coding units) from Mobil/ExxonMobil Corp advertorials expressing (left) acknowledgment and (right) doubt that AGW is (top row) real and human-caused, (middle row) serious, and (bottom row) solvable. Quotations are sourced only from advertorials not included in [1]. For each position, two examples are given: the first typifies a relatively ‘strong’ quotation, the second a relatively ‘mild’ one (except AGW as serious, for which only one new advertorial expresses acknowledgment; and except for AGW as solvable, for which only ‘Doubt’ is coded). Substantiating quotations for all advertorials are provided in section S4, supplementary information.

	Acknowledge		Doubt	
AGW as real & human-caused (EP1,2,3)	2007	Title: ‘Saving Energy and Reducing Greenhouse Gas Emissions’. ‘Two weeks ago, we described some of the steps ExxonMobil is taking to address the risk of climate change. These included working to improve energy efficiency and fuel economy, and groundbreaking research into low-emissions technologies. This week, we focus on consumers...industry, consumers and policy-makers all have a role to play in addressing the risks of climate change’ [21].	2000	Title: ‘Political cart before a scientific horse’. ‘The Clinton administration has released a draft overview of the purported potential effects of climate change on specific U.S. geographic regions and economic sectors...But as climate scientists will tell you, we currently have neither the knowledge nor the tools to [produce an accurate assessment]...Climate models are evolving research tools but are not yet capable of predicting Earth’s global climate and are currently unsuitable for making national or regional assessments’. Advertorial cites ‘key scientific uncertainties’ and quotes Freeman J. Dyson, calling climate models ‘unreliable’. ‘Most of the underlying reports and analyses are not yet available for scientific peer review...’ [this was untrue—see [16]] [14].
	2008	‘To meet this [higher future global energy] demand, while addressing the risks posed by rising greenhouse gas emissions, we will need to call upon a broad mix of energy sources’ [22].	2007	‘Climate remains an extraordinarily complex area of scientific study. But the risks to society and ecosystems from climate change could prove to be significant—so despite the areas of uncertainty that do exist, it is prudent to develop and implement strategies that address the risks’ [20].

(continued)

Table 2. (Continued).

	Acknowledge		Doubt	
AGW as serious (IP1,3)	2005	<p>“Climate change is a serious and long-term challenge that has the potential to affect every part of the globe.” These quotes— with which we agree entirely— were among those endorsed by government leaders at the recent G8 meeting in Gleneagles, Scotland’ [23].</p>	1993	<p>Title: ‘Apocalypse no’. ‘For the first half of 1992, America was inundated by the media with dire predictions of global warming catastrophes... Unfortunately, the media hype proclaiming that the sky was falling did not properly portray the consensus of the scientific community. After the Earth Summit, there was a noticeable lack of evidence of the sky actually falling and subsequent colder than normal temperatures across the country cooled the warming hysteria as well’. ‘If nothing else, [The Heidelberg Appeal’s] message is illustrative of what’s wrong with so much of the global warming rhetoric. The lack of scientific data’. Quoting Robert C. Balling: “there is a large amount of empirical evidence suggesting that the apocalyptic vision is in error and that the highly touted greenhouse disaster is most improbable?” Quoting S. Fred Singer: “the net impact [of a modest warming] may well be beneficial.” ‘All of which would seem to suggest that the jury’s still out on whether drastic steps to curb CO₂ emissions are needed’ [25].</p>
			1996	<p>‘Such speed [of international climate action] may not be needed or even desirable given what we know and do not know about the economic and environmental impact of what climate change might produce’ [26].</p>
AGW as solvable (SP1)			1996	<p>UN-sponsored climate action ‘is likely to cause severe economic dislocations... If developed nations act <i>alone</i> to reduce emissions, the staggering cost imposed on energy-intensive industries will drive nations to export much of their industrial base to countries with less stringent controls. World economic health will suffer as nations are forced to switch from fossil fuels, saddled with large carbon taxes and driven to prematurely scrap many factories and machinery. The dislocations will be even more severe if the solutions are not implemented globally... Jobs and livelihoods are at stake [in deciding on climate policy]’ [26].</p>
			2007	<p>‘Businesses, governments and NGOs are faced with a daunting task: selecting policies that balance economic growth and human development with the risks of climate change’ [18, 19].</p>

3.2. Impact Levels (ILs)—AGW as serious

Figure 1(b) is a timeline of the overall positions of 180 documents on AGW as serious. ILs for Internal, Peer-Reviewed, and Non-Peer-Reviewed documents are reproduced from [1]. ILs are shown for 29 Advertorials, spanning 1973–2005, found to express a position. For each category and for all documents that take a position, figure 2(b) shows the fractions of documents that take that position. For both spans of documents shown in figure 2(b) (left bar: 1973–2014; right bar: 1989–2004), positions on AGW as serious vary significantly across document categories at $p < 0.1$ (FET: (1973–2014) $p = 0.066$; (1989–2004) $p = 0.061$).

3.2.1. Peer-reviewed, non-peer-reviewed, and internal documents

For detailed descriptions of the positions of Exxon and ExxonMobil Corp's peer-reviewed, non-peer-reviewed, and internal documents, see [1]. In summary, figures 1(b) and 2(b) show that over the timespan of all documents (left bars in figure 2(b)¹; see right bars for 1989–2004), of the 10 peer-reviewed publications that discuss the potential impacts of AGW, 60% (6/10) take a position of 'Acknowledge', 30% (3/10) of 'Doubt', and 10% (1/10) of 'Acknowledge and Doubt'. Non-peer-reviewed documents offer a mix of positions. Among the 47% (22/47) that take a position, 45% (10/22) 'Acknowledge', 41% (9/22) 'Doubt', and 14% (3/22) 'Acknowledge and Doubt'. Finally, internal documents also typically acknowledge the potential for serious impacts, but also highlight uncertainties. Of the 53% (17/32) of documents with a position, 35% (6/17) 'Acknowledge' and 47% (8/17) 'Acknowledge and Doubt'.

3.2.2. Advertorials

Mobil and ExxonMobil Corp's advertorials overwhelmingly take the position of 'Doubt', consistent with our original findings (e.g. peer-reviewed publications versus advertorials, FET: (1973–2014) $p = 0.043$; (1989–2004) $P = 0.014$). Figures 1(b) and 2(b) (right bars) show that over the period 1989–2004 covered in our original analysis, of the 5.9% (27/457) of advertorial search results that take a position (including six new advertorials from our ProQuest searches), 66.5% (18/27) express 'Doubt', with the remainder split between 'Acknowledge' and 'Acknowledge and Doubt' (4/27 = 15% and 5/27 = 18.5%, respectively). A characteristic example (table 2, middle row) not included in our original dataset is a 1996 Mobil advertorial saying that 'such speed [of international climate action] may not be needed or even desirable given what we know and do not know about the economic and environmental impact of what climate change might produce' [26]. The 2000 ExxonMobil Corp advertorial discussed earlier claims that the US National Assessment 'report's language and logic appear designed to

emphasize selective results to convince people that climate change will adversely impact their lives'—implying that it will not [14, 15]. A third example is a 1993 Mobil advertorial entitled 'Apocalypse No' [25], which claims that 'dire predictions of global warming catastrophes' in 1992 were 'media hype' that 'did not properly portray the consensus of the scientific community'. It goes on to argue that 'what's wrong with so much of the global warming rhetoric' is 'the lack of solid scientific data', and alleges 'a noticeable lack of evidence of the sky actually falling' and 'colder than normal temperatures' in the US. The advertorial quotes prominent climate contrarian Robert C. Balling, who argues 'that the apocalyptic vision is in error and that the highly touted greenhouse disaster is most improbable'. The advertorial also quotes physicist S Fred Singer, well known at the time for challenging the scientific evidence of stratospheric ozone depletion, claiming that: 'the net impact [of a modest warming] may well be beneficial' [27].

Expanding beyond our original analysis to include all years has little effect on the overall result: 'Doubt' continues to dominate (19/29 = 66%), while 'Acknowledge' and 'Acknowledge and Doubt' make up the difference (5/29 = 17% apiece). Post-2004, advertorials are virtually silent about the seriousness of AGW (beyond generic 'risk' statements—see [1]). In other public communications, however, this doubt has continued (a few examples are given in table 3—see ExxonMobil Corp statements from ~2008 onwards).

3.3. Solvable Levels (SLs)—AGW as solvable

Positions on AGW as solvable vary significantly across document categories (FET: (all years with positions, 1981–2008) $p = 9.0 \times 10^{-11}$; (1989–2004) $p = 6.9 \times 10^{-10}$). Expressed as a fraction of the total number of documents per category communicating any positions on AGW (real and human-caused, serious, or solvable), figure 2(c) (left bars¹) shows that over the timespan of all documents, only 4% (2/48) of peer-reviewed papers express 'Doubt' that AGW is solvable. Internal and non-peer-reviewed materials also express relatively low levels of doubt: 14% (3/21) and 25% (9/36), respectively. In contrast, 58% (45/77) of advertorials do so (e.g. peer-reviewed publications versus advertorials: $p = 9.1 \times 10^{-11}$, FET). Similarly, figure 2(c) (right bars) shows that over the period 1989–2004 covered in our original analysis, levels of 'Doubt' are: 6% (2/31) of peer-reviewed papers, 22% (4/18) of non-peer-reviewed documents, and 64% (37/51) of advertorials (e.g. peer-reviewed publications versus advertorials: $p = 2.2 \times 10^{-9}$, FET).

A characteristic example of doubt that AGW can be effectively addressed (table 2, bottom row) is a 2000 ExxonMobil Corp advertorial (not included in our original dataset) that says the Kyoto Protocol to the United Nations Framework Convention on

Table 3. Examples of public doubt about AGW either directly communicated or indirectly funded by ExxonMobil Corp following the merger of Exxon and Mobil. Quotations are sourced from documents not included in our content analysis, such as company reports, speeches, newspaper accounts, and archived websites. Although we do not formally code the positions of these statements on AGW, and the relative ‘strengths’ of doubt vary from statement to statement, ExxonMobil Corp’s direct representations through 2007/8 appear to express doubt about AGW as real and human-caused. Through to the present day, the company continues to itself question the ‘competency’ of climate models and the role of humans as the ‘principal drivers of climate change’, yet emphasis also shifts to promoting doubt about AGW as serious and solvable (as indicated, most statements also include ‘risk’ rhetoric). Examples are also given of third-party individuals and organizations funded by ExxonMobil Corp that have communicated doubt about AGW as real and human-caused, serious, or solvable in the recent past and/or present.

Year	Publication	Quotation
2000	Company report (preface by CEO Lee Raymond) [106]	Raymond: ‘[W]e do not now have a sufficient scientific understanding of climate change to make reasonable predictions and/or justify drastic measures...the science of climate change is uncertain...’ ‘[N]atural period of warming’ (ice ages), ‘solar activity’, ‘[v]olcanic eruptions, El Nino’: ‘With all this natural climate ‘noise’ and the complexities of measurement, science is not now able to confirm that fossil fuel use has led to any significant global warming...Currently, there does not appear to be a consensus among scientists about the effect of fossil fuel use on climate’. Risk rhetoric: ‘it may pose a legitimate long-term risk...’.
2001	‘Climate talking points’ in press release [44]	‘Misinformation exists over the role and membership of IPCC: it is not a research organization and its members are not scientists... scientists work together only in the small teams that draft individual chapters... [IPCC’s climate science models] have...fundamental gaps in basic understanding...’. Regarding the ‘Hockey Stick’ graph showing global warming: ‘The error bars are huge, yet some prefer to ignore them’. Risk rhetoric: ‘long-term risk(s)’.
2001	Lee Raymond, speech [105]	‘We need good, and better, climate science...if we cannot forecast the weather a week from now, I would be suspect of our ability to forecast the climate 100 years from today’. Risk rhetoric: ‘risks’.
2001	Press release [106]	‘[T]here is no consensus about long-term climate trends and what causes them...during the 1970’s [sic], people were concerned about global cooling’. Risk rhetoric: ‘long-term risks’.
2002	Lee Raymond, speech [107]	‘We in ExxonMobil do not believe that the science required to establish this linkage between fossil fuels and warming has been demonstrated—and many scientists agree... [T]his is because of incomplete data and methodology and the overarching role of natural variability’. Risk rhetoric: ‘risk’.
2004	Company report [108]	‘ExxonMobil recognizes that although scientific evidence remains inconclusive, the potential impacts of greenhouse gas emissions...may prove to be significant...Climate: Infinitely more complex than weather... [T]he cause of this [global warming] trend and whether it is abnormal remain in dispute... [T]he geological record...shows considerable variation’. Cites numerous non-human factors influencing climate. Risk rhetoric: ‘risks’.
2005	Academic article funded by ExxonMobil (also Charles G Koch Charitable Foundation and American Petroleum Institute) [109]	‘[T]he hypothesis of a CO ₂ -dominated warming of the Arctic is not likely consistent with the large decadal-and-multidecadal warming and cooling signals contained in the Arctic-wide SAT record’.
2005	Lee Raymond, television interview [96]	‘There is a natural variability that has nothing to do with man...It has to do with sun spots...with the wobble of the Earth... [T]he science is not there to make that determination [as to whether global warming is human-caused]... [T]here are a lot of other scientists that do not agree with [the National Academy and IPCC]... [T]he data is not compelling’.
2006–2007	ExxonMobil website & 2005 Corporate Citizenship Report [110]	‘Climate science is complex...the extent to which recent temperature changes can be attributed to greenhouse gas increases remains uncertain... [G]aps in the scientific basis for theoretical climate models and the interplay of significant natural variability make it very difficult to determine objectively the extent to which recent climate changes might be the result of human actions’. Risk rhetoric: ‘risk(s)’.
2007	Academic (non-peer-reviewed) article funded by ExxonMobil (also Charles G Koch Charitable Foundation and American Petroleum Institute) [111]	‘[I]t is highly premature to argue for the extinction of polar bear [sic] across the circumpolar Arctic within this century...It is certainly premature, if not impossible, to tie recent regional climatic variability in this part of central Canada to anthropogenic greenhouse gases and, further, to extrapolate species-level conditions on this basis... [T]here is no ground for raising public alarm about any imminent extinction of Arctic polar bears’.

(continued)

Table 3. (Continue).

Year	Publication	Quotation
2008	CEO Rex Tillerson, interview [112]	'...to not have a debate on [AGW] is irresponsible... To suggest that we know everything we need to know about these issues is irresponsible... Anybody that tells you that they got this figured out is not being truthful. There are too many complexities around climate science for anybody to fully understand all of the causes and effects and consequences of what you may chose to do to attempt to affect that. We have to let scientists to [sic] continue their investigative work, unencumbered by political influences'.
2010	Rex Tillerson, Congressional testimony [113]	'[T]here is no question climate is changing, that one of the contributors to climate change are greenhouse gases that are a result of industrial activities—and there are many greenhouse gases besides CO ₂ ... [T]he real challenge I think for all of us is understanding to what extent and therefore what can you do about it... [L]et us continue to support the scientific investigation... It is extremely complicated... So, yes, we acknowledge that it is a contributing factor. Where I think we have differences [is that] we understand the difficulties of modeling the science... [T]here is not a model available today that is competent... So we say keep studying it'. Risk rhetoric: 'risk management'.
2012	Rex Tillerson, speech [114]	'[T]he competencies of the [climate] models are not particularly good... We cannot model aerosols; we cannot model clouds, which are big, big factors in how the CO ₂ concentrations in the atmosphere affect temperatures... [O]ur ability to predict, with any accuracy, what the future's going to be is really pretty limited... I am not disputing that increasing CO ₂ emissions in the atmosphere is going to have an impact. It will have a warming impact. The—how large it is is [sic] what is very hard for anyone to predict. And depending on how large it is, then projects how dire the consequences are'.
2013	Rex Tillerson, television interview [115]	'[T]he facts remain there are uncertainties around the climate, climate change, why it is changing, what the principal drivers of climate change are. And I think the issue that I think is unfortunate in the public discourse is that the loudest voices are what I call the absolutist, the people who are absolutely certain that it is entirely man-made and you can attribute all of the climate change to nothing but man-made burning of fossil fuels... [T]here are other elements of the climate system that may obviate this one single variable that we are concentrating on because we are concentrating on a single variable in a climate system that has more than 30 variables. We are only working on one. And so that's that uncertainty issue...'. Risk rhetoric: 'risk(s)', 'serious risks', 'managing risks'.
2013	Rex Tillerson, speech [116]	'If you examine the temperature record of the last decade, it really had not changed... Our ability to project with any degree of certainty the future is continuing to be very limited... [O]ur examination about the models are [sic] that they are not competent'. Risk rhetoric: 'risk'.
2014	ExxonMobil affiliate, Syncrude [117]	Syncrude submits that the production and consumption of petroleum fuels is not dangerous and does not pose a risk to human health or safety'.
2015	Senator Jim Inhofe (R-OK), funded by ExxonMobil [118]	'[W]e keep hearing that 2014 has been the warmest year on record. I ask the Chair, 'You know what this is?' It's a snowball, and that's from just outside here, so it's very, very cold out'.
2015	Rex Tillerson, speech [119]	'We do not really know what the climate effects of 600 ppm versus 450 ppm will be because the models simply are not that good'. Risk rhetoric: 'risk management'.
2017	Rex Tillerson, Congressional testimony [120, 121]	'I understand these [greenhouse] gases [due to 'combustion of fossil fuels'] to be a factor in rising temperature, but I do not believe the scientific consensus supports their characterization as the 'key' factor'. Risk rhetoric: 'risk'.
1992-2018	American Legislative Exchange Council, funded by ExxonMobil [122–124]	'Global Climate Change is Inevitable. Climate change is a historical phenomenon and the debate will continue on the significance of natural and anthropogenic contributions'. (2020)
2002-present	National Black Chamber of Commerce, funded by ExxonMobil [125–127]	'There is no sound science to support the claims of Global Warming'. (2020)

Climate Change involved ‘highly unrealistic carbon reduction goals’ that were ‘not possible’ for the US to meet [28]. ‘Ambitious public policies and international treaties that assume very rapid change in total energy use are simply unrealistic’ and ‘attempts to mandate such change are fraught with risk’. Another ExxonMobil Corp advertorial, which appeared twice in 2007, says that ‘businesses, governments and NGOs are faced with a daunting task: selecting policies that balance economic growth and human development with the risks of climate change’ [18, 19]. These advertorials echo two of the prominent themes of ‘Doubt’ identified in our original analysis: (i) an alleged dichotomy between climate mitigation and poverty reduction, and (ii) the allegedly severe adverse economic impacts of mitigation [1]. A third example is a 1996 Mobil advertorial that states: ‘[UN-sponsored climate action] is likely to cause severe economic dislocations at a time when many nations are striving for growth and jobs...World economic health will suffer as nations are forced to switch from fossil fuels, saddled with large carbon taxes and driven to prematurely scrap many factories and machinery...Jobs and livelihoods are at stake’ [26].

As might be expected, the content and tone of advertorials change with time. As the scientific evidence of AGW strengthened in the early 2000s, advertorials began to include discussion of options for greenhouse gas emissions reductions, such as investment in energy efficiency and technology research and development. This is the context in which the third ‘Doubt’ argument we identified in our original study appears: insisting on the limitations of renewable energy [1]. A 2001 ExxonMobil Corp advertorial expresses a characteristic sentiment: ‘Though promising, renewable energy’s potential should be tempered with realism’ [29]. The advertorial points out that wind power ‘generally enjoys tax subsidies’, yet says nothing about the much larger subsidies that fossil fuels receive [30–32]. In various forms, the advertorials reinforce the presumed inevitability of continued fossil fuel dominance [33–36].

3.4. Stranded fossil fuel assets

As discussed in [1], 24 of the analyzed documents allude to the concept of stranded fossil fuel assets. Our updated analysis finds that, as before, no advertorials address the issue. Therefore, the contrast across document categories remains clear and statistically significant: the threat of stranded assets is recognized in internal and academic documents, but never mentioned in advertorials (FET: (all years) $p = 3.3 \times 10^{-7}$; (1989–2004) $p = 3.2 \times 10^{-6}$).

3.5. Summary of results

Our ProQuest searches described herein add 18 advertorials expressing positions on AGW (real and human-caused, serious, or solvable) to those included

in our original analysis spanning 1989–2004, and 26 outside of these years (these new documents are indicated by yellow highlights in table S4, supplementary information).

An updated analysis of the period 1989–2004 continues to yield statistically significant results, and our conclusions therefore remain unchanged: between 1989–2004, Mobil and ExxonMobil Corp advertorials overwhelmingly expressed doubt about AGW as real and human-caused, serious, and solvable. Indeed, having augmented our archive of advertorials, and with our prior document codings undisputed by ExxonMobil Corp’s critiques, our original conclusions are now strengthened [2, 3].

Expanding beyond the timeframe of our original analysis negligibly affects the overall positions of advertorials on AGW as serious and solvable: Over all years with advertorial positions (1973–2005 and 1988–2008, respectively), ‘Doubt’ remains the overwhelming position in both respects (sections 3.2.2 and 3.3). The predominant stance over all years on AGW as real and human-caused also remains ‘Doubt’ (section 3.1.2). From 2005–09 this is reduced, with the positions of advertorials transitioning from mostly ‘Doubt’ (1989–2004) to mostly ‘Acknowledge’, punctuated by doubt in 2007 (figure 1(a)).

Most of these recent ‘Acknowledgments’ are ambiguous. As described in section 3.1.2, the vast majority (93%) are implicit: in no case does ExxonMobil Corp state that climate change is real and human-caused. Nor do they acknowledge a change in their position. In this sense, the acknowledgments are asymmetric compared to the doubt promoted in earlier advertorials. Earlier advertorials *explicitly* challenged climate science; later ones merely sidestepped it, citing undefined ‘risk(s)’ of climate change (87% of post-2004 advertorials) and discussing options for emissions reductions without stating why they are necessary.

4. Discussion

Our results imply at least three ways in which Exxon, Mobil, and ExxonMobil Corp have, variously, misled the public about AGW. Sections 4.1–4.3 address each of these in turn.

4.1. Exxon and ExxonMobil Corp misled with discrepant communications

The first way the public was misled derives from the results of our content analysis and relies on a line of reasoning presented in our original paper: comparison across company document categories.

Figure 2(d) shows that from 2000 through 2004 (after the Exxon-Mobil merger), the overwhelming position of ExxonMobil Corp advertorials on AGW as real and human-caused continued to be ‘Doubt’ (12/16 = 75%). The discrepancy between this doubt and the predominant acknowledgment in Exxon

and ExxonMobil Corp peer-reviewed, non-peer-reviewed, and internal documents shown in figure 1(a) is statistically significant (FET: $p = 8.5 \times 10^{-8}$, $p = 0.0079$, and $p = 1.6 \times 10^{-5}$, respectively, for all peer-reviewed, non-peer-reviewed, and internal documents through 2004). From a statistical standpoint it is essentially certain that whereas Exxon and ExxonMobil Corp's private and academic documents predominantly acknowledge that climate change is real and human-caused, ExxonMobil Corp's advertorials disproportionately—and overwhelmingly—promote doubt on the same matter. This unambiguously reaffirms our original conclusion.

The contrast across document categories—that is, evidence of misleading communications—is also clear when analyzed at a year-to-year scale (figure 1(a)). During the early 2000s, ExxonMobil Corp's peer-reviewed publications and advertorials in the same years contradict one another. For instance, in 2004, one peer-reviewed ExxonMobil Corp publication refers to 'the fraction of anthropogenic CO₂ emissions that remains in the atmosphere, and contributes to the radiative forcing of climate'; another presents 'cumulative CO₂ emissions' for a '550 ppm stabilization trajectory'; and a third discusses 'CO₂ disposal as an option to mitigate climate change from an enhanced greenhouse effect' [37–39]. Yet, that same year, one ExxonMobil Corp advertorial stressed the alleged 'debate over climate change' and fostered uncertainty that AGW had been observed, saying 'last year's record summer heat in Europe does not confirm a warming world' (climate attribution assessments have since disproved this claim [40]). They insisted that 'in the face of natural variability and complexity, the consequences of change in any single factor, for example greenhouse gases, cannot readily be isolated and prediction becomes difficult... scientific uncertainties continue to limit our ability to make objective, quantitative determinations regarding the human role in recent climate change or the degree and consequences of future change' [41]. Another advertorial the same year emphasized the 'gaps and uncertainties that limit our current ability to know the extent to which humans are affecting climate and to predict future changes caused by both human and natural forces' [42].

Given these discrepancies it is clear that ExxonMobil Corp misled the public over this period. The historical record categorically refutes ExxonMobil Corp's recent claims that only Mobil was responsible for misleading advertorials (and for other misleading communications, as we discuss below). Misleading advertorials did not cease when Exxon and Mobil merged.

Figures 2(e) and (f) show that across all ExxonMobil Corp advertorials with positions on AGW as serious and solvable, respectively, levels of 'Doubt' outweigh those in peer-reviewed, non-peer-reviewed, and internal documents (Serious, FET: $p = 0.10$, $p =$

0.87, and $p = 0.093$, respectively; Solvable, FET: $p = 6.0 \times 10^{-6}$, $p = 0.063$, and $p = 0.0027$, respectively). These discrepancies again demonstrate that ExxonMobil Corp misled the public.

Additionally, peer-reviewed, non-peer-reviewed, and internal documents from Exxon and ExxonMobil Corp acknowledge the risks of stranded assets (24 times), whereas ExxonMobil Corp's advertorials do not ($p = 3.3 \times 10^{-7}$, FET). This imbalance has not been disputed by ExxonMobil Corp in its critiques of our original study [2, 3].

The significance of these discrepancies is compounded by the imbalance in the physical and intellectual accessibility of advertorials versus other document categories. As evidenced in our original study, ExxonMobil contributed to scientific articles with likely average readerships of tens to hundreds, yet raised doubts about that science in newspapers potentially read by millions of people [1].

Non-peer-reviewed Exxon and ExxonMobil Corp documents also communicate greater doubt about AGW as real and human-caused and solvable than peer-reviewed Exxon and ExxonMobil Corp publications (and, with respect to real and human-caused positions, than Exxon and ExxonMobil Corp internal documents) (figures 1(a) and (c)). Although this discrepancy is smaller, it is statistically significant at or below $p < 0.1$ (FET: (real and human-caused) $p = 0.044$ for peer-reviewed publications and $p = 0.077$ for internal memos; (solvable) $p = 0.0076$), suggesting that Exxon and ExxonMobil Corp's non-peer-reviewed communications, which tended to be more orientated towards non-scientific audiences (such as industry groups and journalists) than peer-reviewed papers, were sometimes misleading.

The non-peer-reviewed documents demonstrate that the doubt ExxonMobil Corp expressed in advertorials post-merger was not an unintentional or isolated incident: it was part of the company's broader public communications effort. As noted in our original paper, there are countless non-peer-reviewed materials beyond those included in our corpus [1]. Table 3 lists just a few examples, among them 'climate talking points' that ExxonMobil Corp distributed to reporters in 2001 as part of a press release specifically promoting their publication of two advertorials ('major ads') in the *Los Angeles Times*, *NYT*, *The Wall Street Journal*, and *The Washington Post* [43]. In step with the advertorials, the talking points question the scientific authority of the Intergovernmental Panel on Climate Change (IPCC) and the validity of the 'Hockey Stick' graph showing global warming, which was a centerpiece of the 2001 IPCC report [44].

4.2. Exxon, Mobil, and ExxonMobil Corp misled with misinforming advertorials and non-peer-reviewed publications

The second way the public was misled also derives from the results of our content analysis and relies

on a line of reasoning presented in our original paper: comparison of public company communications against available scientific information.

ExxonMobil Corp has not disputed any of our original document codings, including those identifying numerous expressions of doubt—some, factual misrepresentations—about AGW (notably in Mobil and ExxonMobil Corp advertorials and Exxon and ExxonMobil Corp non-peer-reviewed publications) [2, 3]. Using as proxies for mainstream climate science both the conclusions of the IPCC (our analysis filters for ‘reasonable’ doubt—see [1]) and the science of Exxon and ExxonMobil Corp itself (ExxonMobil Corp says its ‘researchers recognized the developing nature of climate science at the time...[and] mirrored global understanding’), it is evident that Exxon, Mobil, and ExxonMobil Corp’s public communications were inconsistent with available scientific information and therefore misled the public [45, 46].

4.2.1. What did Mobil know?

ExxonMobil Corp’s critiques of our original study imply that Mobil was oblivious to the insights and warnings of mainstream climate science, even as it ran advertorials attacking that science [2]. Yet a 1997 Mobil advertorial suggests otherwise: ‘We continue to sponsor research at universities...At Columbia’s Lamont-Doherty Geophysical Observatory, we supported work on the role that oceans play in the climate system’ [47].

Additional documents not included in our original analysis confirm that Mobil, like Exxon, had direct access to the insights of mainstream climate science [48–51]. For example, as a 1997 report by Mobil’s Anthony R. Corso summarized, ‘Over the past five years we have funded scientific and economic studies at The Massachusetts Institute of Technology, the Lamont-Dougherty [*sic*²] Geophysical Observatory of Columbia University, the Harvard-Smithsonian Astrological [*sic*] Observatory, and the Australian Bureau of Agricultural and Resource Economics’. [48] Mobil was ‘[f]unding [this] research to increase the understanding of the science and economics of global climate change’.

According to a newly discovered internal budget proposal, ‘1994 Mobil Foundation Grant Recommendations’, Mobil’s funding at Columbia University included \$25 000 per year in 1991 and 1992 and would continue at the same rate in 1993 and 1994 [49]. Mobil described the university’s Lamont-Doherty laboratory as ‘a world-wide leader in earth and atmospheric studies’ and said the purpose of the grant was to ‘develop an improved computer model [that] will become part of the larger models predicting the impact of increased greenhouse

gas emissions on global climate’. ‘Ultimately’, they noted, ‘these models will be the basis for regulatory action’. ‘Benefits to Mobil Foundation’ included ‘[t]echnical information and understanding...key to Mobil’s ability to participate in the debate on [potentially imminent greenhouse gas] regulations...Mobil scientists involved in the global warming issue can gain first hand understanding of the role of the oceans in global warming and develop personal relationships with some of the key experts...[P]articipating at this level is far more valuable to Mobil than merely reading papers...’.

In other words, Mobil had scientists studying AGW and learning from some of the same groups of independent climate experts as Exxon scientists. (For example, from the late 1970s through the mid-1980s, Exxon spent tens of thousands of dollars funding a ‘cooperative program with Lamont-Doherty’ in which scientists at Exxon and Columbia University collaboratively co-authored AGW project proposals and conducted AGW research [52–59]. ExxonMobil Corp has continued to fund the Lamont-Doherty Earth Observatory throughout most of the 2000s to present [60–71].) In turn, those Exxon scientists overwhelmingly acknowledged AGW as real and human-caused. Mobil’s access to these same mainstream scientific resources preceded and paralleled its publication of advertorials attacking climate science and its implications, further demonstrating that Mobil knowingly misled the public.

Mobil was also an active member of the American Petroleum Institute (API), and numerous documents record API’s early awareness of the potential AGW dangers of its products. These include API-commissioned research on carbon dioxide at the California Institute of Technology in 1955; an in-person warning to API by physicist Edward Teller in 1959; API monitoring of warnings about AGW by President Johnson’s Science Advisory Committee in 1965; and API-commissioned research on AGW at Stanford Research Institute in 1968 and 1969 [72–75].

4.3. Exxon and ExxonMobil Corp misled with additional direct and indirect climate denial

The third way the public was misled relies on an additional line of reasoning that was not explicitly discussed in our original paper: comparison of the results of our content analysis against an extensive literature of scholarly research and investigative journalism that has chronicled the company’s history of directly and indirectly perpetuating climate science misinformation.

ExxonMobil Corp has not disputed our document codings, which reveal overwhelming acknowledgement by both Exxon and ExxonMobil Corp scientists that AGW is real and human-caused [2, 3]. At the same time, it is well-documented (based on documents beyond those included in our analysis, as well as on some non-peer-reviewed documents

²Correct spelling is Lamont-Doherty.

included herein) that (i) from at least the 1990s until at least 2015 (and arguably to this day), Exxon and ExxonMobil Corp have sometimes publicly promoted doubt about climate science through direct company communications; and that (ii) from at least the late 1980s through to the present, Exxon and ExxonMobil Corp have funded groups and individuals and participated in organizations that cast doubt in public on climate science [27, 76–103] (table 3 provides a few examples). To our knowledge, ExxonMobil has never disputed its history of direct and indirect climate denial. Likewise, Exxon and ExxonMobil Corp have a track record of directly and indirectly promoting public doubts about AGW as serious and solvable that are inconsistent with the views of company scientists chronicled by our analysis (again, see table 3 for examples).

This comparison—between what ExxonMobil knew and its broader history of climate denial and delay—is an inherent, central line of reasoning in many journalistic and legal investigations of the company. It highlights an important point: Our work does not stand in isolation. At the onset of our study, substantial evidence already existed to suggest that ExxonMobil had misled the public on a variety of aspects of AGW and in a variety of ways [27, 77–82]. The purpose of our study was to bring to bear an additional, complementary empirical methodology to test the hypothesis that ExxonMobil misled the public. Our results show this to be the case.

5. Conclusion

We have updated our original analysis to include additional Mobil and ExxonMobil Corp advertorials in the *NYT*, and have also introduced new documents never previously analyzed in the peer-reviewed literature. Among other things, we have shown that misleading communications, direct and indirect, emanated from both Exxon and Mobil before their 1999 merger, and continued thereafter. We have also introduced new evidence that Mobil was aware of developments in mainstream climate science, even as they took out advertorials that challenged it. We now conclude with even greater confidence that Exxon, Mobil, and ExxonMobil Corp misled the public about climate change.

The history of ExxonMobil's communications about AGW is consistent with what scholars have labeled merchandising doubt, manufacturing doubt, or doubt-mongering [27, 128–135]. A party whose interests are threatened by scientific findings may seek to protect those interests by casting doubt on the science: 'emphasiz[ing] the uncertainty', as a 1988 Exxon strategy memo put it, focusing on 'debate', and suggesting that remedies are unavailable, unrealistic, too expensive, or otherwise undesirable [136]. Often these claims are not made outright, but are insinuations, which are harder to refute. They may also

attack scientists, suggesting they are unreliable or biased. Many of these strategies are evident in ExxonMobil's communications, as well as in their public and private critiques of our work that we have here addressed.

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Data availability statement

The data that support the findings of this study are openly available.

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LETTER

Assessing ExxonMobil's climate change communications (1977–2014)

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Abstract

This paper assesses whether ExxonMobil Corporation has in the past misled the general public about climate change. We present an empirical document-by-document textual content analysis and comparison of 187 climate change communications from ExxonMobil, including peer-reviewed and non-peer-reviewed publications, internal company documents, and paid, editorial-style advertisements ('advertorials') in *The New York Times*. We examine whether these communications sent consistent messages about the state of climate science and its implications—specifically, we compare their positions on climate change as real, human-caused, serious, and solvable. In all four cases, we find that as documents become more publicly accessible, they increasingly communicate doubt. This discrepancy is most pronounced between advertorials and all other documents. For example, accounting for expressions of reasonable doubt, 83% of peer-reviewed papers and 80% of internal documents acknowledge that climate change is real and human-caused, yet only 12% of advertorials do so, with 81% instead expressing doubt. We conclude that ExxonMobil contributed to advancing climate science—by way of its scientists' academic publications—but promoted doubt about it in advertorials. Given this discrepancy, we conclude that ExxonMobil misled the public. Our content analysis also examines ExxonMobil's discussion of the risks of stranded fossil fuel assets. We find the topic discussed and sometimes quantified in 24 documents of various types, but absent from advertorials. Finally, based on the available documents, we outline ExxonMobil's strategic approach to climate change research and communication, which helps to contextualize our findings.

1. Introduction

In 2016, Attorneys General (AGs) of 17 US states and territories announced that they 'are exploring working together on key climate change-related initiatives, such as ongoing and potential investigations' into whether ExxonMobil Corporation and other fossil fuel companies may have violated, variously, racketeering, consumer protection, or investor protection statutes through their communications regarding anthropogenic global warming (AGW) [1, 2]. (Unless specified otherwise, we refer to ExxonMobil Corporation, Exxon Corporation, and Mobil Oil Corporation as 'ExxonMobil'.) As part of a probe that began in 2015, New York Attorney General Eric Schneiderman has issued multiple subpoenas to ExxonMobil under the

state's Martin Act and alleged that the company's accounting of climate risk 'may be a sham' [3–6]. Massachusetts Attorney General Maura Healey is simultaneously investigating ExxonMobil, stating, 'Fossil fuel companies that deceived investors and consumers about the dangers of climate change should be held accountable' [7, 8]. US Virgin Islands Attorney General Claude Walker has said that he is investigating ExxonMobil for potentially violating the territory's anti-racketeering law [9]. Also in 2016, the US Securities and Exchange Commission (SEC) began a federal investigation into whether ExxonMobil appropriately discloses the business risks of AGW, and how it values its assets and reserves [10]. We offer no view on the legal issues raised by ongoing investigations.

ExxonMobil has responded stating, ‘We unequivocally reject allegations that ExxonMobil suppressed climate change research contained in media reports that are inaccurate distortions of ExxonMobil’s nearly 40 year history of climate research. We understand that climate risks are real. The company has continuously, publicly and openly researched and discussed the risks of climate change, carbon life cycle analysis and emissions reductions’ [11]. In particular, ExxonMobil’s website and statements offer a ‘10 page document listing the over 50 peer-reviewed articles on climate research and related policy analysis from ExxonMobil scientists from 1983 to the present’ [11–15]. ExxonMobil argues that this list, entitled ‘Exxon Mobil Contributed Publications’, ‘undercuts the allegation . . . that ExxonMobil sought to hide our research.’ The company has also published some of its internal company documents, originally made public by journalists at *InsideClimate News (ICN)* [16, 17] (and simultaneously reported by Columbia University’s Graduate School of Journalism and the *Los Angeles Times* [18]), to demonstrate that ‘allegations are based on deliberately cherry-picked statements’ [14]. ‘Read all of these documents and make up your own mind,’ ExxonMobil has challenged [14].

This paper takes up that challenge by analyzing the materials highlighted by the company, and comparing them with other publicly available ExxonMobil communications on AGW. The issue at stake is whether the corporation misled consumers, shareholders and/or the general public by making public statements that cast doubt on climate science and its implications, and which were at odds with available scientific information and with what the company knew. We stress that the question is not whether ExxonMobil ‘suppressed climate change research,’ but rather how they communicated about it [11].

Our analysis covers the publication period of the documents made available by ExxonMobil: 1977–2014. These documents include peer-reviewed and non-peer-reviewed publications (academic papers, conference proceedings, reports, company pamphlets, etc) and internal documents. Our analysis compares these documents with ExxonMobil’s public outreach in the form of paid, editorial-style advertisements—known as ‘advertorials’—published on the Op-Ed page of *The New York Times (NYT)* [19]. We focus on advertorials because they come directly from ExxonMobil and are an unequivocally public form of communication ‘designed to affect public opinion or official opinion’ [20]. Kollman has found that advertorializing is second only to mobilizing group members as the most commonly used outside lobbying technique [20, 21]. We examine whether these communications sent consistent messages about the state of climate science and its implications, or whether there is a discernable discrepancy between the company’s public and private communications.

Our study offers the first empirical assessment and intercomparison of ExxonMobil’s private and public statements on AGW². By bringing to bear the quantitative methodologies of consensus measurement [22, 23] and content analysis [24–28], our results add to (i) earlier analyses of ExxonMobil’s communication practices [19, 20, 29–36], (ii) qualitative accounts of the company’s AGW communications [17, 18, 37–39], and (iii) the application of consensus measurement/content analysis to AGW communications [26–28, 40, 41]. In addition, this study contributes to the broader literature on climate change denial [42–48], corporate issue management [21, 35, 49, 50] and misinformation strategies [51–55], and the social construction of ignorance [56–58].

2. Method

We adapt and combine the methodologies used to quantify the consensus on AGW by Oreskes [23] and Cook *et al* [22] with the content analysis methodologies used to characterize media communications of AGW by Feldman *et al* and Elsasser and Dunlap [27, 28]. Developed to assess peer-reviewed scientific literature, cable news, and conservative newspapers, respectively, these offer generalizable approaches to quantifying the positions of an entity or community on a particular scientific question across multiple document classes.

Our study comprises 187 documents (see table 1): 32 internal documents (from *ICN* [16], ExxonMobil [59], and Climate Investigations Center [60]); 53 articles labeled ‘Peer-Reviewed Publications’ in ExxonMobil’s ‘Contributed Publications’ list [15]; 48 (unique and retrievable) documents labeled ‘Additional Publications’ in ExxonMobil’s ‘Contributed Publications’ list; 36 Mobil/ExxonMobil advertorials related to climate change in the *NYT*; and 18 ‘Other’ publicly available ExxonMobil communications—mostly non-peer-reviewed materials—obtained during our research. To our knowledge, these constitute the relevant, publicly available internal documents that have led to recent allegations against ExxonMobil, as well as all peer-reviewed and non-peer-reviewed documents offered by the company in response. They also include all discovered ExxonMobil advertorials in the *NYT* discussing AGW. Advertorials are sourced from a collection compiled by Polluter-Watch based on a search of the ProQuest archive [61].

² There are, of course, countless additional climate change communications from ExxonMobil that could be included in future work, including archived internal documents, advertorials published in newspapers beyond the *NYT*, and non-peer-reviewed materials such as speech transcripts, television adverts, patent documents, shareholder reports, and third-party communications (for example, from lobbyists, think-tanks, and politicians funded by ExxonMobil). These documents are potentially important, but are not the focus of the present study.

Table 1. Inventory of documents analyzed. Shown for each document category are the total number of documents, their date range, source(s), and assigned types. Among peer-reviewed and non-peer reviewed documents, eight publications were found to be redundant, with similar or identical wording to seven other (strictly unique) publications. All 15 are included in our analysis. Among non-peer-reviewed documents, there are two citations provided by ExxonMobil that are identical to two others. The identical two are not included in our analysis. Sources: ‘Peer-Reviewed’ and ‘Additional’ publications are cited in the ‘Exxon Mobil Contributed Publications’ list [15]; ‘Supporting Materials’ are internal documents offered by ExxonMobil [59]; ‘Other’ sources refers to documents discovered independently during our research; *ICN* = *InsideClimate News*; *NYT* = *The New York Times*. *NYT* advertorials were collated by Polluter Watch [61]. For details on document types, see section S2, supplementary information, available at stacks.iop.org/ERL/12/084019/mmedia. Miscellaneous Opinions include, for example, commentaries, opinion editorials, and speeches.

Category	No.	Dates	Sources					Document Types								
			Provided by ExxonMobil					Academic journal	Conference/workshop proceeding	Gov. report	Book	Industry white paper	Internal doc.	Ad	Misc. opinion	
			‘Peer-reviewed’	‘Additional’	‘Supporting materials’	<i>ICN</i>	<i>NYT</i>									<i>Other</i>
Internal Documents	32	1977–1995	0	0	22	28	0	1	0	0	0	0	0	32	0	0
Peer-Reviewed	72	1982–2014	50	19	0	0	0	3	53	2	13	4	0	0	0	0
Non-Peer-Reviewed	47	1980–2014	3	29	0	3	0	12	0	24	5	2	2	0	0	13
Advertorials	36	1989–2004	0	0	0	0	36	0	0	0	0	0	0	0	36	0

To characterize each document, we read its abstract, introduction, and conclusion, and either skim or read thoroughly the rest as necessary. In the case of long documents (over ~30 pages) in which executive summaries are provided, we rely on those summaries. The documents are binned into four categories as shown in table 1: *Internal*, *Peer-Reviewed*, *Non-Peer-Reviewed*, and *Advertorial*. This allows us to distinguish communications according to degree of accessibility—a key variable in assessing the consistency of ExxonMobil’s representations of AGW. Each document’s manifest content is then further characterized in four ways: type, topic, position with respect to AGW, and position with respect to risks of stranded assets. Details of document types and topics are discussed in sections S2–3, supplementary information.

2.1. Document position

Research has shown that four key points of understanding about AGW—that it is real, human-caused, serious, and solvable—are important predictors of the public’s perceived issue seriousness, affective issue involvement, support for climate policies, and political activism [62–66]. These four elements have also been found to underpin most narratives of AGW skepticism and denial (namely ‘it’s not happening’, ‘it’s not us’, ‘it’s not serious’, and ‘it’s too hard’) [28, 43, 67, 68]. We therefore use, *a priori*, these recognized elements as axes along which to characterize ExxonMobil’s positions on AGW in its communications; positions on each of these elements form the primary codes in our content analysis (table 2). Our coding scheme is summarized below (see section S1, supplementary information for further details).

One of the authors coded all of the documents, and ambiguities were resolved through discussion between authors. To verify intercoder reliability and intercoder agreement, both authors independently

coded a random subset of 36 documents (approximately 19% of the total number of documents in each category). Intracoder reliability was also calculated (see section S1.7, supplementary information).

2.1.1. ‘Real & human-caused’

Tailoring the approaches of Cook *et al*, Feldman *et al*, and Elsasser and Dunlap, each document is coded by assigning ‘Endorsement Points’ (EP1 to EP4b, defined in table 2) to pertinent text and figures based on whether each acknowledges or doubts the scientific evidence that AGW is real and human-caused (intercoder reliability of Endorsement Points: percentage agreement = 93%; Krippendorff’s (Kripp.) $\alpha = 0.84$) [22, 27, 28]. We recognize that all science involves uncertainties, and therefore that doubt is not, *ipso facto*, an inappropriate response to complex scientific information. Uncertainties are an innate and important part of reasonable scientific discourse. However, it has also been shown that uncertainty may be amplified or exaggerated in ways that are misleading and unreasonable, sustaining doubt about claims that are scientifically established [42, 52, 57, 69]. Therefore, to distinguish reasonable and unreasonable doubt, we apply two first-order filters to our Endorsement Point codings. First, in documents published on or before 1990, we exempt expressions of doubt that AGW is *real* (i.e. we deem such expressions to be reasonable at that time). Second, in documents published on or before 1995, we exempt expressions of doubt that AGW is *human-caused*. 1990 and 1995 are when the Intergovernmental Panel on Climate Change (IPCC) first concluded that AGW is real and human-caused, respectively (these are conservative thresholds insofar as many scientists had arrived at these conclusions prior to the IPCC reports; indeed, IPCC reports are based only on already-completed work) [70, 71]. Finally, based on its individual Endorsement Points, each document is assigned one overall Endorsement

Table 2. Definitions of the Endorsement, Impact, and Solvable Points used to code levels of acknowledgment of AGW as real and human-caused, serious, and solvable, respectively. See section S1, supplementary information, for details on the content analysis and coding scheme.

<i>AGW as Real and Human-Caused</i>		
Endorsement points (EPs)		Description
'Acknowledge' (EP1)	Explicit endorsement with quantification	Explicitly supports position that humans are the primary cause of global warming (with quantification)
	(EP2) Explicit endorsement without quantification	Explicitly supports position that humans are the primary cause of global warming (without quantification) or refers to anthropogenic global warming as a known fact
	(EP3a) Implicit endorsement	Implicitly supports position that humans are the primary cause of global warming. e.g. research assumes greenhouse gas emissions cause warming without explicitly stating humans are the cause
	(EP3b) Implicit endorsement of consensus	Implicitly supports position that humans are the primary cause of global warming by referring to a consensus of the scientific community
'No position' (EP4a)	No position	Does not address the cause of global warming
'Doubt' (EP4b- 1)	Uncertain of reality of AGW	Expresses position that the <i>reality</i> of recent global warming is uncertain/undefined, namely 'it's not happening'
	2) Uncertain of human contribution to AGW	Expresses position that the <i>human contribution</i> to recent global warming is uncertain/undefined, namely 'it's not us'
<i>AGW as Serious</i>		
Impact points (IPs)		Description
'Acknowledge' (IP1)	Acknowledgment	Acknowledges and/or articulates known or predicted negative impacts of global warming e.g. geophysical, economic, socio-political
'No position' (IP2)	No position	Does not address the negative impacts of global warming (beyond generic references to climate change as a 'risk')
'Doubt' (IP3)	Uncertain	Expresses position that the reality of negative impacts of global warming is uncertain/undefined/exaggerated, namely 'it's not bad'
<i>AGW as Solvable</i>		
Solvable points (SPs)		Description
'Doubt' (SP1)	Uncertain	Expresses position that the difficulties of mitigating global warming are potentially insurmountable and/or exceed the benefits, namely 'it's too hard'

Level (EL) (intercoder reliability of Endorsement Levels: 89%; Kripp. $\alpha = 0.85$): 'No Position' (all text and figures are EP4a only); 'Acknowledge' (EP1–3 only); 'Acknowledge and Doubt' (EP1–3 and EP4b); 'Reasonable Doubt' (EP4b only, deemed reasonable as defined above); or 'Doubt' (EP4b only, deemed unreasonable). 'Acknowledge and Doubt' reflects the fact that some communications acknowledge aspects of AGW yet emphasize other areas of doubt or uncertainty.

Our filtering of reasonable doubt (see also section S1.4.2, supplementary information) helps address the challenge of characterizing the positions of documents published during a period of rapidly evolving scientific opinion. Otherwise, however, our coding scheme is agnostic to each document's publication year.

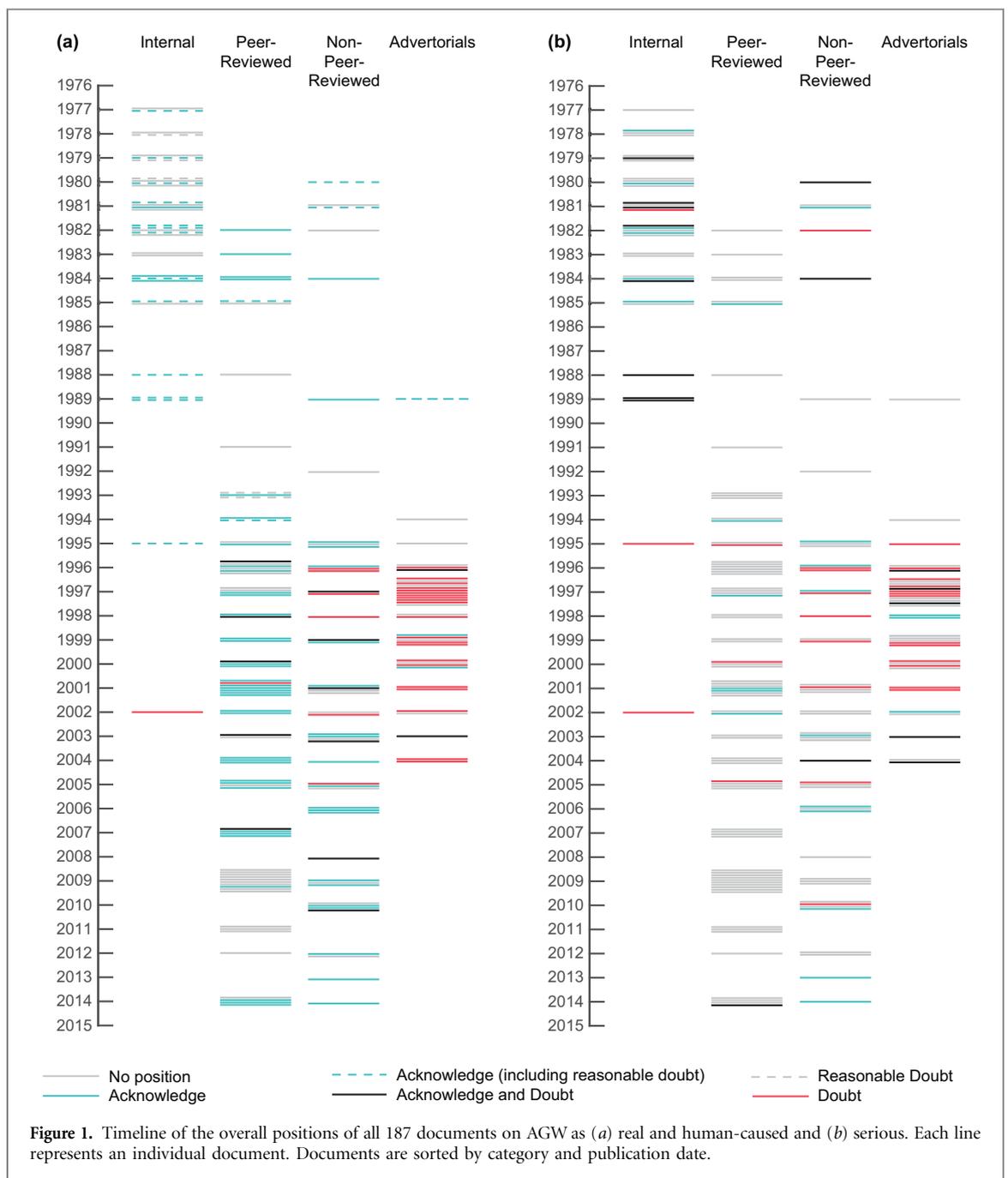
2.1.2. 'Serious'

We assign 'Impact Points' (IP1 to IP3, defined in table 2) throughout each document based on its

positions on AGW as having known or predicted negative impacts (for example, geophysical, economic, or sociopolitical) (intercoder reliability of Impact Points: 94%; Kripp. $\alpha = 0.86$). Each document is then assigned one of four overall Impact Levels (ILs): 'No Position' (all text and figures are IP2 only); 'Acknowledge' (IP1 only); 'Acknowledge and Doubt' (IP1 and IP3); or 'Doubt' (IP3 only) (intercoder reliability of Impact Levels: 89%; Kripp. $\alpha = 0.77$).

2.1.3. 'Solvable'

We identify documents that express 'Doubt' (SP1, defined in table 2) as to whether AGW can be mitigated or whether the costs of doing so exceed the benefits (intercoder reliability: 97%; Kripp. $\alpha = 0.84$). While the question of AGW's solvability is not resolvable on purely technical grounds, the relative extent to which documents promote doubt on the matter remains relevant to the character of climate communications, insofar as assertions that AGW



cannot be stopped are a common component of contrarian claims [42, 72].

2.2. Risks of stranded assets

AGs and the SEC are investigating ExxonMobil’s understanding and disclosures of the financial risks related to either AGW or future climate policy, and shareholders have questioned the adequacy of ExxonMobil’s disclosures on this point. We examine what, if anything, has been stated on this subject in the documents examined [10, 73–75]. Across all documents, we collate and chronicle ExxonMobil’s communications regarding the risks of stranded assets (intercoder reliability: 100%; Kripp. $\alpha = 1.0$). Financial documents from ExxonMobil, such as shareholder

reports, are beyond the scope of this study and a topic for future investigation.

3. Results

3.1. Endorsement levels (ELs)—AGW as real and human-caused

Figure 1(a) is a timeline of the overall positions of all 187 documents on AGW as real and human-caused, sorted by publication date and into four categories: *Internal Documents*, *Peer-Reviewed*, *Non-Peer-Reviewed*, and *Advertorials*. Each line represents an individual document and is color-coded: No position (grey); Acknowledge (blue); Acknowledge and Doubt (black); and Acknowledge (including reasonable doubt) (dashed blue). Dashed lines indicate documents that have

Table 3. Example quotations (coding units) expressing (left) acknowledgment and (right) doubt that AGW is real and human-caused. For each document category, two examples are given: the first typifies a relatively ‘strong’ quotation, the second a relatively ‘mild’ one. Substantiating quotations for all documents are provided in section S7, supplementary information.

	Acknowledge AGW is real and human-caused (EP1,2,3)	Doubt AGW is real and human-caused (EP4b-1,2)
INTERNAL	<p>1979 [82] ‘The most widely held theory is that:—The increase [in atmospheric CO₂] is due to fossil fuel combustion;—Increasing CO₂ concentration will cause a warming of the earth’s surface;—The present trend of fossil fuel consumption will cause dramatic environmental effects before the year 2050.’</p> <p>1982 [83] ‘The question of which predictions and which models best simulate a carbon dioxide induced climate change is still being debated by the scientific community. Our best estimate is that doubling of the current concentration could increase average global temperature by about 1.3° to 3.1 °C’</p>	<p>1982 [83] ‘There is currently no unambiguous scientific evidence that the earth is warming. If the earth is on a warming trend, we’re not likely to detect it before 1995.’^a</p> <p>2002 [84] ‘A major frustration to many is the all-too-apparent bias of IPCC to downplay the significance of scientific uncertainty and gaps’</p>
PEER-REVIEWED	<p>1996 [76] ‘The body of statistical evidence . . . now points towards a discernible human influence on global climate.’</p> <p>1995 [86] ‘We present a preliminary analysis of a geoengineering option based on the intentional increase of ocean alkalinity to enhance marine storage of atmospheric CO₂. Like all geoengineering techniques to limit climate change’</p>	<p>2001 [85] ‘A general statistical methodology . . . is proposed as a method for deciding whether or not anthropogenic influences are causing climate change.’</p> <p>2003 [81] ‘Currently, our ability to forecast future climate is in question. Models are used to make projections of future climate, based on scenarios of future human activities and emissions, by simulating each link in the causal chain relating these scenarios to changes in climate. The estimation of the uncertainty of this causal chain remains an important scientific challenge.’</p>
NON-PEER-REVIEWED	<p>1981 [87] ‘The conviction in the scientific community that the observed trend of increasing carbon dioxide, if it continues, will cause a global warming is based on a variety of theoretical studies . . . the results are now fairly consistent. For a carbon dioxide doubling the calculated mean surface-air temperature increase is approximately 2 °C to 3 °C. The warming is 2 to 3 times larger in the northern polar regions . . . Other model-predicted features are shifts of precipitation and soil moisture, retreat of polar snow and sea ice, and changes of large-scale circulation patterns.’</p> <p>2003 [89] ‘. . . a 2 °C warming target (which can still produce adverse climate impacts) requires non-CO₂-emitting primary power in the 10 to 30 TW range by 2050.’</p>	<p>1996 [88] Title: ‘Global warming: who’s right? Facts about a debate that’s turned up more questions than answers.’ ‘. . . a multinational effort, under the auspices of the United Nations, is under way to cut the use of fossil fuels, based on the unproven theory that they affect the earth’s climate.’</p> <p>2008 [90] ‘Nor are [the <i>Oil and Natural Gas Industry Guidelines for Greenhouse Gas Reduction Projects</i>] intended to imply a direct connection between GHG emissions from the oil and natural gas industry and the phenomenon commonly referred to as climate change.’</p>
ADVERTORIALS	<p>1999 [91] ‘Reasonable concerns about the buildup of greenhouse gases in the atmosphere and their effect on earth’s climate have prompted policymakers to search for a response.’</p> <p>2003 [93] ‘We humans are interacting with the geo-chemical systems of our planet on a global scale. The concentration of carbon dioxide in the atmosphere has increased by a third from its preindustrial level, and the resulting change in the acidity of the upper ocean can be detected.’^b</p>	<p>1997 [92] ‘Let’s face it: The science of climate change is too uncertain to mandate a plan of action that could plunge economies into turmoil . . . Scientists cannot predict with certainty if temperatures will increase, by how much and where changes will occur. We still don’t know what role man-made greenhouse gases might play in warming the planet . . . Let’s not rush to a decision at Kyoto. Climate change is complex; the science is not conclusive; the economics could be devastating.’</p> <p>1997 [94] Title: ‘Climate change: a degree of uncertainty.’ ‘. . . there is a high degree of uncertainty over the timing and magnitude of the potential impacts that man-made emissions of greenhouse gases have on climate . . . To address the scientific uncertainty governments, universities and industry should form global research partnerships to fill in the knowledge gap, with the goal of achieving a consensus view on critical issues within a defined time frame’</p>

^a Document filtered by our analysis as reasonable due to pre-1990 publication date.

^b Advertorial is signed by Stanford University Professor Lynn Orr, then-director of Stanford’s Exxon-funded GCEP alliance, and bears the seal of Stanford University. See section S7, supplementary information, for details.

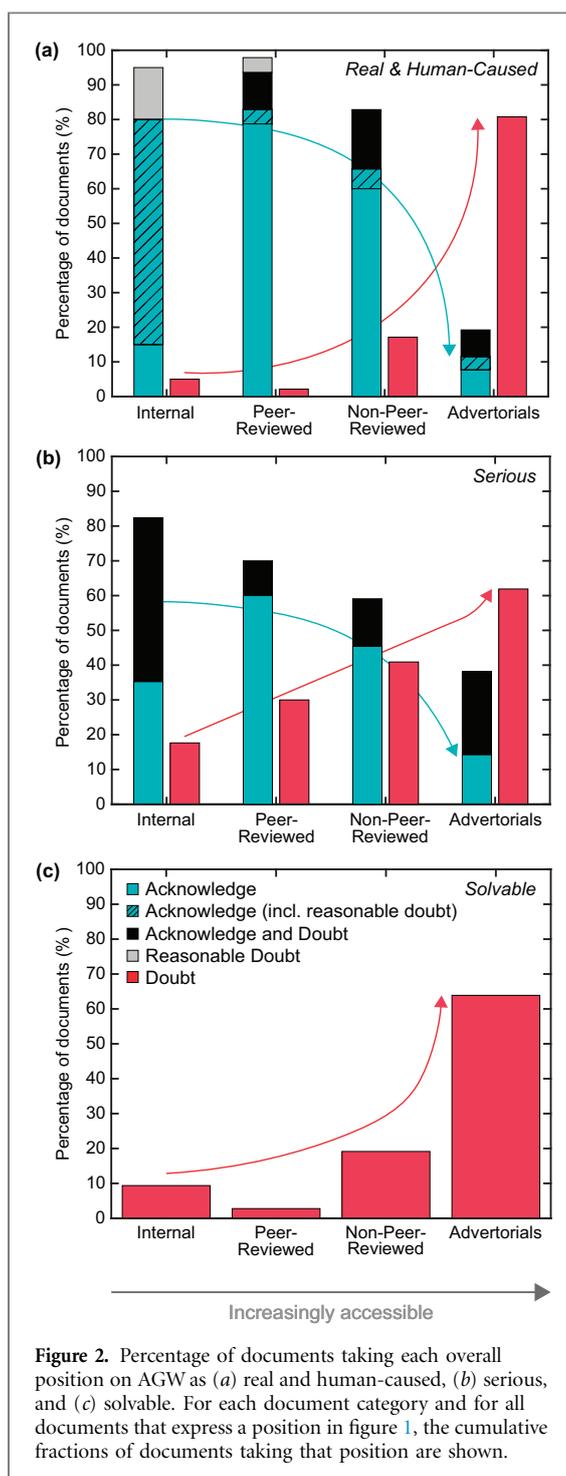


Figure 2. Percentage of documents taking each overall position on AGW as (a) real and human-caused, (b) serious, and (c) solvable. For each document category and for all documents that express a position in figure 1, the cumulative fractions of documents taking that position are shown.

been filtered for reasonable doubt. Table 3 presents exemplifying quotations (coding units) of varying ‘strength’ that illustrate the assigned positions for a selection of the documents. For each category and for all documents that express a position, figure 2(a) shows the cumulative fraction of documents that take that position. Positions on AGW as real and human-caused vary significantly across document categories ($p < 3.7 \times 10^{-13}$, Fisher’s exact test, FET; see table S3, supplementary information, for details and all probability values). Figure 2 is based on all documents in figure 1; the same trend is observed when only documents with an overlapping date range are considered (section S4, supplementary information).

3.1.1. Peer-reviewed publications

Figures 1(a) and 2(a) show that ExxonMobil’s peer-reviewed publications overwhelmingly acknowledge AGW as real and human-caused (‘Acknowledge’). Of the 65% (47/72) of peer-reviewed documents that express a position, more than three-quarters hold an ‘Acknowledge’ position (39/47 = 83%). Table 3 provides sample quotations (see section S7, supplementary information, for substantiating quotations for all documents). ExxonMobil’s listed publications include chapter 8 of the 1995 IPCC report (ExxonMobil’s principal climate scientist, Haroon Kheshgi, was a contributing author), which observed a ‘discernible human influence on global climate’ [15, 76]. Kheshgi also co-authored the Summary for Policymakers and several chapters of the next IPCC report in 2001, which found ‘there is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities’ [77–80]. Of the minority of peer-reviewed documents holding a position of ‘Acknowledge and Doubt’ (5/47 = 11%), ‘Reasonable Doubt’ (2/47 = 4%), or ‘Doubt’ (1/47 = 2%), we judge that most of the expressed doubt constitutes normal scientific discussion about uncertainties; for example, ‘the estimation of the uncertainty of this causal chain [linking human activities to changes in climate]’ [81].

3.1.2. Non-peer-reviewed documents

The predominant stance taken in non-peer-reviewed communications is also ‘Acknowledge’, although compared to peer-reviewed work, it loses ground to the ‘Acknowledge and Doubt’ and ‘Doubt’ stances in roughly equal measure ($p = 0.044$, FET). Figures 1(a) and 2(a) show that, of the 74% (35/47) that take a position, 66% (23/35) ‘Acknowledge’, 17% (6/35) ‘Acknowledge and Doubt’, and 17% (6/35) ‘Doubt’ that AGW is real and human-caused. The more frequent expressions of doubt in non-peer-reviewed documents, compared with peer-reviewed ones, reflect the mixed nature of these documents. Some are technical, academic analyses, while others are industry-targeted speeches, reports, conference proceedings, company pamphlets, etc (see sections S2, S3, and S6, supplementary information).

3.1.3. Internal documents

The bulk of ExxonMobil’s internal documents also take the ‘Acknowledge’ stance. Figures 1(a) and 2(a) show that, of the 63% (20/32) that take a position, 80% (16/20) adopt ‘Acknowledge’, with most of the rest expressing ‘Reasonable Doubt’ (3/20 = 15%). Unlike other document categories, however, our characterization of internal documents shifts dramatically if we remove filters for reasonable doubt from our analysis (see section 2). Then, 61% (11/18) take the mixed position (‘Acknowledge and Doubt’), with the remainder split between ‘Acknowledge’ and ‘Doubt’ (3/18 = 17% and 4/18 = 22%, respectively).

These results are explained by the early publication period of internal documents: all but two were published before the 1990 IPCC report, and are therefore subject to our filters for reasonable doubt. These results also reflect the predominant nature of the internal documents: they acknowledge the likelihood of AGW based on internal and external research, while also highlighting uncertainties.

In 1979, for instance (table 3), an internal Exxon study concluded that:

The most widely held theory is that:

- The increase [in atmospheric CO₂] is due to fossil fuel combustion
- Increasing CO₂ concentration will cause a warming of the earth's surface
- The present trend of fossil fuel consumption will cause dramatic environmental effects before the year 2050.

However, the memo notes: 'It must be realized that there is great uncertainty in the existing climatic models because of a poor understanding of the atmospheric/terrestrial/oceanic CO₂ balance' [82]. Likewise, an internal briefing on the 'CO₂ "Greenhouse" Effect' from 1982 states: 'There is currently no unambiguous scientific evidence that the earth is warming. If the earth is on a warming trend, we're not likely to detect it before 1995' (see table 3). Yet, the authors say, 'Our best estimate is that doubling of the current concentration could increase average global temperature by about 1.3°C to 3.1°C' [83]. Several internal documents make this distinction, acknowledging that increased CO₂ would likely cause warming, while expressing (reasonable) doubt that warming was already underway and large enough to be detected.

This cautious consensus is also evident in charts in internal ExxonMobil presentations and reports. (Due to copyright restrictions prohibiting the reproduction of figures owned by ExxonMobil, we instead provide hyperlinks to third-party websites at which relevant figures can be viewed.) For example, in a 1978 presentation to the Exxon Corporation Management Committee, Exxon scientist James Black showed a graph (see <https://perma.cc/PJ4N-T8SC>) of projected warming 'model[ed] with the assumption that the carbon dioxide levels will double by 2050 A.D.' [95]. Another case is the 1982 Exxon primer already mentioned, which includes a graph (see <https://perma.cc/PH4X-ZJBA>) showing 'an estimate of the average global temperature increase' under the 'Exxon 21st Century Study-High Growth scenario' [83]. A third example is a table (see <https://perma.cc/9DGQ-4TBW>) presented by Exxon scientist Henry Shaw at a 1984 Exxon/Esso environmental conference, which showed that Exxon's expected 'average temper-

ature rise' of 1.3°C–3.1°C was comparable to projections by leading research institutions (1.5°C–4.5°C) [96]. This shows that ExxonMobil scientists and managers were well informed of the state of the science at the time. But they also tended to focus on the prevailing uncertainties: Black stressed the alleged shortcomings of extant climate models before showing his results; Shaw emphasized the variable and 'unpredictable' character of some values.

We conclude that ExxonMobil's recent defense accurately characterizes the situation with respect to its peer-reviewed, non-peer-reviewed, and internal documents: 'Our researchers recognized the developing nature of climate science at the time . . . [and] mirrored global understanding' [14]. On several occasions during the early 1980s, the company's peer-reviewed and internal documents went as far as to refute 'calculations on a more limited scale by a number of climatologists' that projected much less global warming than the rest of the scientific community, including ExxonMobil [97–99]. 'In summary,' said a 1982 memo, 'the results of our research are in accord with the scientific consensus on the effect of increased atmospheric CO₂ on climate . . . and are subject to the same uncertainties' [99]. As a scientific consensus emerged in the early 1990s that AGW was underway, a 1995 'Primer on Climate Change Science' co-authored by Mobil as part of the Global Climate Coalition explicitly rejected contrarian claims that were beginning to circulate: 'Contrarian theories . . . do not offer convincing arguments against the conventional model of greenhouse gas emission-induced climate change' [100].

3.1.4. Advertorials

The predominant stance taken in ExxonMobil's advertorials is 'Doubt'. In essence, these public statements reflect only the 'Doubt' side of ExxonMobil's mixed internal dialogue. Figures 1(a) and 2(a) show that of the 72% (26/36) of climate change advertorials that take a position, 81% (21/26) take the position of 'Doubt', with the remainder split between 'Acknowledge' (3/26 = 11.5%) and 'Acknowledge and Doubt' (2/26 = 7.5%). A characteristic example is a 1997 Mobil advertorial (table 3), which stated: 'Let's face it: The science of climate change is too uncertain to mandate a plan of action that could plunge economies into turmoil . . . Scientists cannot predict with certainty if temperatures will increase, by how much and where changes will occur. We still don't know what role man-made greenhouse gases might play in warming the planet' [92]. Another, also from 1997, referred to a 'high degree of uncertainty,' 'debate,' and a 'knowledge gap,' and the need for further 'fact-finding' and 'additional knowledge' before UN negotiators in Kyoto could make decisions [94]. The advertorial stressed the goal 'of achieving a consensus view,' two years after the IPCC had presented one.

Our analysis is limited to advertorials in the *NYT* because those pertaining to climate change have already been compiled and are readily available. Brown *et al* report that ExxonMobil also ran advertorials in eight other major newspapers [19]. Some of these appear to have been the same or similar to those in the *NYT*. For example, in an advertorial in *The Washington Post* in 2000, ExxonMobil criticized a US National Assessment report on climate change as putting the ‘political cart before a scientific horse’ and being based ‘on unreliable models’ [101]. The advertorial was condemned by the former director of the National Assessment Coordination Office: ‘To call ExxonMobil’s position out of the mainstream is . . . a gross understatement’ [102].

3.1.5. Contrast between advertorials and other documents

Our analysis shows that ExxonMobil’s scientists and executives were, for the most part, aware and accepting of the evolving climate science from the 1970s onwards, but they painted a different picture in advertorials. The majority of ExxonMobil’s peer-reviewed publications acknowledge that climate change is real and human-caused, and internal documents reflect this scientific framework. Uncertainties are mentioned or even highlighted, but usually in the context of broader scientific understandings and broadly consistent with the evolving science. In contrast, ExxonMobil’s advertorials overwhelmingly focus on the uncertainties, casting doubt on the growing scientific consensus (e.g. peer-reviewed publications versus advertorials: $p = 4.1 \times 10^{-13}$, FET).

The contrast between advertorials and other documents is particularly evident in their accompanying figures. For instance, in a chapter of a 1985 US Department of Energy report co-authored by Exxon scientist Brian Flannery [103], a graph (see <https://perma.cc/A5WN-LKLS>) presents the results of future warming modeled for different CO₂ scenarios. ‘The foregoing results, with all their caveats,’ the report summarizes, ‘can be construed as an approximate bracketing of the consensus of transient model predictions for the next century’s CO₂ greenhouse effect. In this restricted sense, they are consistent with the EPA’s estimate of a 2 °C warming from fossil fuel CO₂ and other greenhouse gases by the middle of the next century.’ Their conclusion is entitled ‘Consensus CO₂ Warming.’ Compare this with figures from ExxonMobil advertorials in 1997 and 2000 (see <https://perma.cc/39CC-JTES> and <https://perma.cc/74BL-KL8A>, respectively), which downplay the human contribution to AGW and emphasize natural variability instead [104, 105]. Featured in an advertorial entitled ‘Unsettled Science’ in the *NYT* and *The Wall Street Journal*, the latter figure was taken from an article in *Science*

by Lloyd Keigwin of the Woods Hole Oceanographic Institution [105–107]. Keigwin called the use of his data ‘very misleading’ [106]. They were a historical reconstruction of sea-surface temperatures in the Sargasso Sea and, in his words, ‘not representative of the planet as a whole [as the advertorial could be taken to imply]. To jump from the western North Atlantic Ocean to the globe is something no responsible scientist would do . . . There’s really no way those results bear on the question of human-induced climate warming . . .’

The contrast across document categories is also clear when analyzed at a year-to-year scale (figure 1 (a)). The majority of advertorials promoting doubt follow a decade of numerous acknowledgments in the other three document categories. Between 1977 and 1996, of all peer-reviewed, non-peer-reviewed, and internal documents that take a position, 83% fully or partly (81% and 2%, respectively) acknowledge that AGW is real and human-caused (if we remove our filter for reasonable doubt, still 83% fully or partly (43% and 40%, respectively) acknowledge this). Thereafter, in 1997 alone, we see nine advertorials promoting ‘Doubt’. Significantly, throughout the late 1990s and early 2000s, ExxonMobil peer-reviewed publications and advertorials *in the same years* contradict one another (figure 1(a)).

3.2. Impact levels (ILs)—AGW as serious

Figure 1(b) is a timeline of the overall positions of all 187 documents on AGW as serious. For each category of document and for all documents that express a position, figure 2(b) shows the cumulative fraction of documents that take that position. Positions on AGW as serious vary significantly across document categories ($p = 0.11$, FET).

3.2.1. Peer-reviewed publications

ExxonMobil’s 72 peer-reviewed publications focus almost exclusively on methods and mitigation (section S3, supplementary information). Only 10 discuss the potential impacts of AGW (figure 1(b)), of which 60% (6/10) take a position of ‘Acknowledge’, 30% (3/10) of ‘Doubt’, and 10% (1/10) of ‘Acknowledge and Doubt’ (figure 2(b)). Hoffert *et al* (2002), for example (see table 4), warned that unchecked greenhouse gas emissions ‘could eventually produce global warming comparable in magnitude but opposite in sign to the global cooling of the last Ice Age . . . Atmospheric CO₂ stabilization targets as low as 450 ppm could be needed to forestall coral reef bleaching, thermohaline circulation shutdown, and sea level rise from disintegration of the West Antarctic Ice Sheet’ [108]. A 1994 paper defined ‘mean global warming of 2 °C from preindustrial time to 2100 as *Illustrative Reference Values* for climate and ecosystem protection,’ two years before the EU adopted this limit [109, 110].

Table 4. Example quotations (coding units) expressing (left) acknowledgment and (right) doubt that AGW is serious. For each document category, two examples are given: the first typifies a relatively ‘strong’ quotation, the second a relatively ‘mild’ one. Substantiating quotations for all documents are provided in section S7, supplementary information.

	Acknowledge AGW is serious (IP1)	Doubt AGW is serious (IP3)
INTERNAL	<p>1982 [83] ‘... there are some potentially catastrophic events that must be considered. For example, if the Antarctic ice sheet[,] which is anchored on land should melt, then this could cause a rise in sea level on the order of 5 meters. Such a rise would cause flooding on much of the US East Coast, including the State of Florida and Washington, DC.’</p> <p>1982 [99] ‘There is unanimous agreement in the scientific community that a temperature increase of this magnitude [(3.0 ± 1.5)°C] would bring about significant changes in the earth’s climate, including rainfall distribution and alterations in the biosphere.’</p>	<p>1981 [111] ‘... it has not yet been proven that the increases in atmospheric CO₂ constitute a serious problem that requires immediate action.’</p> <p>1989 [113] ‘We also know that the modeled projections are far from certain: potential impacts could be small and manageable or they could be profound and irreversible.’</p>
PEER-REVIEWED	<p>2002 [108] ‘Atmospheric CO₂ has increased from ~275 to ~370 parts per million (ppm). Unchecked, it will pass 550 ppm this century. Climate models and paleoclimate data indicate that 550 ppm, if sustained, could eventually produce global warming comparable in magnitude but opposite in sign to the global cooling of the last Ice Age ... Atmospheric CO₂ stabilization targets as low as 450 ppm could be needed to forestall coral reef bleaching, thermohaline circulation shutdown, and sea level rise from disintegration of the West Antarctic Ice Sheet.’</p> <p>1994 [109] ‘The rate of the climate change is thought to exert stress on ecosystems. While changes in, for example, precipitation or infrequent events such as droughts or storms may be more directly related to this stress, there remains great uncertainty in estimating these characteristics of climate.’</p>	<p>2000 [114] ‘... science cannot yet provide reliable guidance on what, if any, levels of greenhouse gas concentrations might be judged “dangerous,” ...’</p> <p>1995 [86] ‘Among the options that might become necessary to deploy at some time in the future, should climate change prove to be serious, are those that involve geoengineering techniques to control greenhouse gas concentrations or to limit potential impacts.’</p>
NON-PEER-REVIEWED	<p>1984 [115] ‘Clearly, there is vast opportunity for [global] conflict. For example, it is more than a little disconcerting the few maps showing the likely effects of global warming seem to reveal the two superpowers losing much of the rainfall, with the rest of the world seemingly benefitting.’</p> <p>1980 [117] ‘Findings. 1. While CO₂-induced changes in global climate may have certain beneficial effects, it is believed that the net consequences of these changes will be adverse to the stability of human and natural communities.’</p>	<p>1996 [116] ‘Is global warming good or bad? Let’s say human activity <i>does</i> contribute to warming the planet ... warming that occurs mostly during the winter would reduce extreme cold, increase cloud cover and moderate temperature fluctuations. This sort of warming is more likely to raise soil moisture levels than to produce severe droughts ... [T]he indications are that a warmer world would be far more benign than many imagine ... [M]oderate warming would reduce mortality rates in the US, so a slightly warmer climate would be more healthful ... We are faced with more questions than answers on almost every aspect of this issue, including whether possible changes could be both good and bad.’</p> <p>1998 [118] ‘Fortunately, all indications are that climate change is a very long-term phenomenon ... Do we need an insurance policy? Some people argue that the world needs to take out an insurance policy against the possibility of global warming just in case ... Because of the scientific uncertainties, we don’t have a clear understanding of the risks involved. The Kyoto agreement makes the cost of the policy high. No one can tell us with certainty what benefit we will gain. Thus, it doesn’t seem to be a good time to buy the policy.’</p>
ADVERTORIALS	<p>2002 [119] ‘The risk of climate change and its potential impacts on society and the ecosystem are widely recognized. Doing nothing is neither prudent nor responsible.’</p> <p>2004 [120] ‘... research has highlighted the risks to society and ecosystems resulting from the buildup of greenhouse gases.’</p>	<p>1995 [112] Title: ‘The sky is not falling.’ By-line: ‘The environment ... better than you think.’</p> <p>2000 [121] ‘Good news: The end of the Earth as we know it is not imminent ... [M]ore than 30 years have passed since the environmental movement began. They made their point. There is no longer a need for alarmists ... [T]o those who think industry and nature cannot coexist, we say show a little respect for Mother Nature. She is one strong lady, resilient and capable of rejuvenation. The environment recovers well from both natural and man-made disasters ... Does this justify or lessen the impact of industrial pollution? Of course not. Our point is that nature, over the millennia, has learned to cope. Mother Nature is pretty successful in taking on human nature.’</p>

3.2.2. Non-peer-reviewed publications

Non-peer-reviewed documents offer a mix of positions (figures 1(b) and 2(b)). Among the 47% (22/47) that take a position, 45% (10/22) ‘Acknowledge’, 41% (9/22) ‘Doubt’, and 14% (3/22) ‘Acknowledge and Doubt’. As with Endorsement Levels, several of the expressions of doubt in non-peer-reviewed documents reflect the industry-targeted communications included in this category (see sections S2, S3, and S6, supplementary information).

3.2.3. Internal documents

Internal documents typically acknowledge the potential for serious impacts but also highlight uncertainties. Of the 53% (17/32) of documents with a position, 35% (6/17) ‘Acknowledge’ and 47% (8/17) ‘Acknowledge and Doubt’ (figure 2(b)). A characteristic acknowledgement is found in a 1980 Exxon memo, which says, ‘There are some particularly dramatic questions that might cause serious global problems. For example, if the Antarctic ice sheet[,] which is anchored on land, should melt, then this could cause a rise in the sea level on the order of 5 meters. Such a rise would cause flooding in much of the US East Coast including the state of Florida and Washington D.C.’ [98] (see also [83]). An example of doubt is a 1981 report stating ‘that it has not yet been proven that the increases in atmospheric CO₂ constitute a serious problem that requires immediate action’ [111] (table 4).

3.2.4. Advertorials

In contrast, ExxonMobil advertorials overwhelmingly take the position of doubt (e.g. peer-reviewed publications versus advertorials: $p = 0.045$, FET). Of the 58% (21/36) of advertorials that take a position, 62% (13/21) express ‘Doubt’ (figure 2(b)). Most of the remainder express a mixed position (5/21 = 24%). Often, they express the opinion that concern over climate impacts is alarmist, such as a 1995 advertorial entitled ‘The sky is not falling,’ which asserted, ‘The environment recovers well from both natural and man-made disasters’ [112] (table 4).

3.3. Solvable Levels (SLs)—AGW as solvable

Positions on AGW as solvable vary significantly across document categories ($p = 3.4 \times 10^{-12}$, FET). Figure 2(c) shows that only 3% (2/72) of peer-reviewed papers express doubt that AGW is solvable. Internal and non-peer reviewed materials also express relatively low levels of doubt: 9% (3/32) and 19% (9/47), respectively. In contrast, 64% (23/36) of advertorials do so (e.g. peer-reviewed publications versus advertorials: $p = 2.8 \times 10^{-12}$, FET).

The ‘Doubt’ arguments are relatively consistent across document categories (table 5), typically suggesting that climate mitigation strategies will either fail or create bigger problems. The arguments point to one or more of: limitations of renewable energy and

other technologies such as carbon capture and storage; an (alleged) dichotomy between climate mitigation and poverty reduction; and potential adverse economic impacts of mitigation. However, there is a discernible difference in the prominence and emphasis that these concerns are given in advertorials compared to other documents. In particular, in advertorials, the remedies for AGW are presented as a grave threat, whereas climate change itself is not. For example, advertorials claimed that the Kyoto Protocol to the United Nations Framework Convention on Climate Change would be ‘financially crippling’ and ‘economy-wrecking’ [122, 123]. It, or strategies like it, would lead to ‘severe dislocations throughout the world economy,’ an ‘unprecedented transfer of wealth,’ and be a ‘blow to US prosperity’ [124–126]. One 1997 advertorial warns: ‘Flexibility will be constrained. Carpooling in; sport utility vehicles out. High fuel and electric bills. Factory closures. Job displacement. And could businesses and consumers cut their energy consumption by 30 percent without some form of tax or carbon rationing? Probably not’ [92]. A 2000 advertorial contrasts the unpredictability of AGW against the asserted ‘certainty that climate change policies, unless properly formulated, will restrict life itself’ [121] (table 5).

3.4. Stranded fossil fuel assets

The number of times the concept of stranded fossil fuel assets is mentioned varies significantly across document categories ($p = 0.0042$, FET). In total, 24 of the analyzed documents allude to the concept of stranded fossil fuel assets: seven peer-reviewed publications, ten non-peer-reviewed publications, and seven internal documents. No advertorials address the issue.

Stranded assets are discussed in two ways (see table 6 and section S5, supplementary information): (i) Implicit, qualitative connections between fossil fuel reserves/resources/use and either greenhouse gas limits or possible climate mitigation policies; and (ii) explicit quantifications of ‘cumulative emissions’ and/or ‘carbon budgets’ consistent with greenhouse gas stabilization.

3.4.1. Qualitative connections

These discussions imply limitations on fossil fuel use because of greenhouse gas limits or climate mitigation. ‘Mitigation of the “greenhouse effect,”’ says the 1982 internal Exxon primer, ‘would require major reductions in fossil fuel combustion’ [83]. Likewise, an internal 1979 Exxon study found that ‘should it be deemed necessary to maintain atmospheric CO₂ levels to prevent significant climatic changes . . . coal and possibly other fossil fuel resources could not be utilized to an appreciable extent’ [82].

3.4.2. Quantitative carbon budgets

These discussions introduce, with varying degrees of detail, ideas of ‘cumulative fossil fuel use,’ ‘cumulative

Table 5. Example quotations (coding units) expressing doubt that AGW is solvable. For each document category, two examples are given: the first typifies a relatively ‘strong’ quotation, the second a relatively ‘mild’ one. Substantiating quotations for all documents are provided in section S7, supplementary information.

Doubt AGW is solvable (SP1)		
INTERNAL	1989 [131]	‘Some key perceptions/misconceptions . . . Nuclear and/or renewable energy resources can solve the problem.’
	1982 [83]	‘Making significant changes in energy consumption patterns now to deal with this potential problem 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.’
PEER-REVIEWED	2002 [108]	‘Even as evidence for global warming accumulates, the dependence of civilization on the oxidation of coal, oil, and gas for energy makes an appropriate response difficult.’
	2001 [132]	‘Even for the higher stabilization levels considered, the developing world would not be able to use fossil fuels for their development in the manner that the developed world has used them.’
NON-PEER-REVIEWED	1998 [118]	‘To get to the [Kyoto] target, we would have to stop all driving in the US or close all electric power plants or shut down every industry. Obviously, these are not realistic options . . . meeting the Kyoto target would clearly have a huge economic impact.’ ‘Independent economists project that to get the targeted reductions in fossil-fuel use, price increases like these would be required: 40 percent for gasoline, 50 percent for home heating oil, 25 percent for electricity and 50 percent for natural gas. These and other price hikes could cost the average American family of four about \$2,700 a year. At least some developed countries would probably have to impose significantly higher fossil fuel taxes, rationing or both.’
	2005 [133]	‘[E]missions will continue to grow to meet the demands of society for prosperity and to meet basic needs . . . Countries like India, China and Indonesia are going to rely on domestic coal to meet growing needs . . . and their emissions are going to grow rapidly . . . [F]ossil fuels will remain the dominant source of energy supply over this period and beyond. Even with rapid year-to-year growth, intermittent renewable energy from wind and solar will remain a small contributor to global energy needs.’
ADVERTORIALS	1997 [92]	‘What is not moderate is the call [by the US government and other countries in the run up to UN Kyoto negotiations] to lower emissions to 1990 levels. A cutback of that size would inflict considerable economic pain . . . Committing to binding targets and timetables now will alter today’s lifestyles and tomorrow’s living standards. Flexibility will be constrained. Carpooling in; sport utility vehicles out. High fuel and electric bills. Factory closures. Job displacement. And could businesses and consumers cut their energy consumption by 30 percent without some form of tax or carbon rationing? Probably not.’
	2002 [134]	‘On an overall basis, many of today’s suggested alternative energy approaches are not as energy efficient, environmentally beneficial or economic as competing fossil fuels. They are often sustained only through special advantages and government subsidies. This is not a desirable basis for public policy or the provision of energy.’

CO₂ emissions,’ and ‘carbon budgets . . . for CO₂ stabilization’ and/or climate mitigation [81, 127]. Five of these ExxonMobil studies—one internal, three peer-reviewed, and one non-peer-reviewed—include data (see, for example, <https://perma.cc/EJ5A-EAZ7>) that indicate 2015–2100 CO₂ budgets consistent with limiting warming to 2°C and/or stabilizing CO₂ concentrations below 550 ppm in the range of 251–716 GtC [81, 83, 127–129]. These budgets are within a factor of two of contemporary estimates of roughly 442–651 GtC [130] (see caption, table 6).

4. Discussion

The question we have addressed in this study is not whether ExxonMobil ‘suppressed’ climate change research, ‘withheld’ it, or ‘sought to hide’ it, which is how ExxonMobil has glossed the allegations against it [11, 12, 135]. This is also how the allegations have occasionally been presented in the press [136]. Our assessment of ExxonMobil’s peer-reviewed publica-

tions and the role of its scientists supports the conclusion that the company did not ‘suppress’ climate science—indeed, it contributed to it.

However, on the question of whether ExxonMobil misled non-scientific audiences about climate science, our analysis supports the conclusion that it did. This conclusion is based on three factors: discrepancies in AGW communications between document categories; imbalance in impact of different document categories; and factual misrepresentations in some advertorials.

First, we have shown that there is a discrepancy between what different document categories say, and particularly what they emphasize, about AGW as real, human-caused, serious, and solvable. This discrepancy grows with the public accessibility of documents, and is greatest between advertorials and the other documents.

Second, in public, ExxonMobil contributed quietly to the science and loudly to raising doubts about it. ExxonMobil’s peer-reviewed and non-peer-reviewed publications have been cited an average (median (mean)) of 21(60) and 2(9) times, respectively,

Table 6. Example quotations (coding units) alluding to stranded fossil fuel assets. For each document category except advertorials, which do not discuss stranded assets, two examples are given: the first typifies an implicit, qualitative connection between fossil fuel reserves/resources/use and either greenhouse gas limits or possible climate mitigation policies; the second is characteristic of an explicit quantification of ‘cumulative emissions’ and/or ‘carbon budgets’ consistent with greenhouse gas stabilization. These quantitative examples are comparable to contemporary estimates; specifically, the IPCC indicates a carbon budget of 442 GtC (or 651 GtC) between 2015 and 2100 for limiting CO₂-induced AGW to below 2 °C relative to 1861–1880 with a probability greater than 66% (or 50%) [130]. Quotations from all 24 documents that refer to stranded assets are provided in section S5, supplementary information.

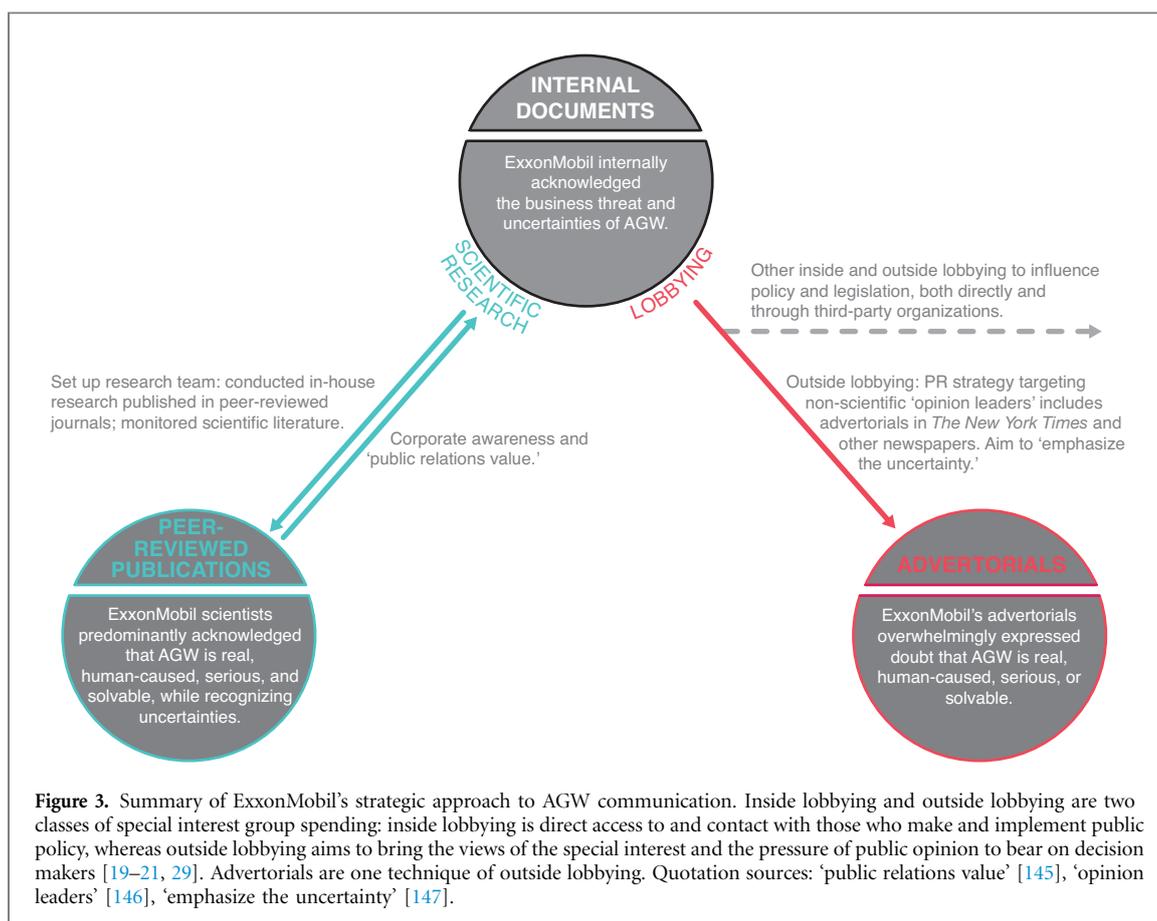
INTERNAL	1979 [82]	‘The major conclusion from this report is that, should it be deemed necessary to maintain atmospheric CO ₂ levels to prevent significant climatic changes, dramatic changes in patterns of energy use would be required. World fossil fuel resources other than oil and gas could never be used to an appreciable extent . . . Removal of CO ₂ from flue gases does not appear practical due to economics and lack of reasonable disposal methods. If it becomes necessary to limit future CO ₂ emissions without practical removal/disposal methods, coal and possibly other fossil fuel resources could not be utilized to an appreciable extent.’
	1982 [83]	‘Table 4 presents the estimated total quantities of CO ₂ emitted to the environment as GtC, the growth of CO ₂ in the atmosphere in ppm (v), and average global temperature increase in °C over 1979 as the base year.’ (Note that temperature anomalies appear to be calculated based on equilibrium climate sensitivity.) It also shows ‘cumulative’ CO ₂ ‘emitted, GtC’ as a function of time. Given roughly 0.3 °C warming by 1979 relative to 1861–1880, we read off (by interpolation) the cumulative emissions in table 4 (in [83]) corresponding to a further 1.7 °C warming, yielding a carbon budget for <2 °C of 624 GtC. Adjusting for emissions between 1979 and 2015, we obtain a carbon budget for <2 °C of 373 GtC between 2015 and 2100, which is comparable with contemporary estimates of roughly 442–651 GtC (see caption).
PEER-REVIEWED	1985 [103]	‘More complex scenarios . . . can be envisioned in which fossil fuel use is rapidly phased out by taxing or other policies, or in which fossil fuel use is decreased by societal feedbacks based on observations of global warming.’
	2003 [81]	Figure 9 (in [81]) shows that temperature anomalies of less than or equal to 2 °C (note that these appear to be calculated based on equilibrium climate sensitivity) are consistent with CO ₂ stabilization at concentrations of 450 ppm or 550 ppm. Table 3 (in [81]) explicitly quantifies fossil fuel ‘carbon budgets . . . for CO ₂ stabilization’ at these concentrations, with reference values of 485 GtC (450 ppm scenario) and 820 GtC (550 ppm scenario) between 2000 and 2099. Adjusting for emissions between 2000 and 2015, this yields carbon budgets for <2 °C of 357 GtC and 692 GtC, respectively, between 2015 and 2100, which are comparable with contemporary estimates of roughly 442–651 GtC (see caption).
NON-PEER-REVIEWED	2005 [133]	‘Without obligations by developing countries, stabilizing at 550 ppm would require a phase out in the use of fossil fuels by the middle of the century in the annex 1 countries. That’s a huge step.’
	2003 [129]	Author introduces the idea of ‘cumulative fossil fuel use’ and ‘cumulative CO ₂ emissions.’ Figure 3 (in [129]) shows that a ‘550 ppm stabilization trajectory’ requires a rapid decline in annual CO ₂ emissions, with cumulative emissions between 2015 and 2100 (integrating area beneath curve) of roughly 490 GtC. This is comparable to contemporary carbon budget estimates for <2 °C of roughly 442–651 GtC (see caption). Author also notes that ‘cumulative fossil fuel use of 2000 GtC might not exhaust global fossil fuel reserves, but limits to fossil fuel use might be driven by better alternatives that emerge over the next century.’ He refers to ‘notional scenarios for a fossil fuel era of limited duration.’

suggesting an average readership of tens to hundreds³. Most texts are highly technical, intellectually inaccessible for laypersons, and of little interest to the general public or policymakers. Most scientific journals and conference proceedings are only circulated to academic libraries and require a paid subscription, making them physically inaccessible for the general public, too. Obtaining academic documents for this study, for example, required access to libraries at Harvard University and Massachusetts Institute of Technology and international interlibrary loans. By contrast, Mobil/ExxonMobil bought AGW advertorials in the *NYT* specifically to allow ‘the public to know where we stand’ [137]. Readerships were in the millions [29]. The company took out an advertorial

every Thursday between 1972 and 2001 [29]. They paid a discounted price of roughly \$31 000 (2016 USD) per advertorial and bought one-quarter of all advertorials on the Op-Ed page, ‘towering over the other sponsors’ according to reviews of Mobil’s advertorials by Brown, Waltzer, and Waltzer [19, 29]. ‘After [experimentally] examining the effects of an actual ExxonMobil advertorial that appeared on the pages of *The New York Times*,’ Cooper and Nownes observed ‘that advertorials substantially affect levels of individual issue salience . . .’ [20]

Third, ExxonMobil’s advertorials included several instances of explicit factual misrepresentation. As discussed in section 3.1.5, an ExxonMobil advertorial in 2000 directly contradicted the IPCC and presented ‘very misleading’ data, according to the scientist who produced the data [105, 106]. Another advertorial, in 1996, claimed that ‘greenhouse-gas emissions, which have a warming effect, are offset by another

³ Citation counts were sourced predominantly from Google Scholar and, when occasionally not available there, from Web of Science. IPCC reports and a handful of non-applicable documents, such as drafts, were excluded.



combustion product–particulates—which leads to cooling' [138]. In 1985, ExxonMobil scientists had reported being 'not very convinc[ed]' by the argument that 'aerosol particulates . . . compensat[e] for, and may even overwhelm, the fossil-fuel CO₂ greenhouse warming' [103]. By 1995, the IPCC had rejected it [71].

We acknowledge that textual analysis is inherently subjective: words have meaning in context. Particular coding assignments may therefore be debatable, depending on how the meaning and context of individual quotations and figures are interpreted. However, the intercoder reliability and agreement of our content analyses are consistently high (section S1.7, supplementary information). While one might disagree about the interpretation of specific words, the overall trends between document categories are clear (table S3, supplementary information).

In figure 3, we summarize ExxonMobil's strategic approach to AGW research and communication. Internal documents show that by the early 1980s, ExxonMobil scientists and managers were sufficiently informed about climate science and its prevailing uncertainties to identify AGW as a potential threat to its business interests. This awareness apparently came from a combination of prior research and expert advice. For example, in 1979 and 1980, university researcher Andrew Callegari co-authored two peer-reviewed articles acknowledging that 'the climatic implications of fossil fuel carbon dioxide emissions have been recognized for some time' [139, 140]. The

authors articulated the 'climatically huge' temperature increases and ecological impacts that would result 'if a significant fraction of the fossil fuel reserve is burned' (section S5, supplementary information). In 1980, Callegari joined Exxon, and the next year took over its CO₂ research efforts [141]. His papers were frequently cited in company publications [97, 142–144].

Around this time, ExxonMobil set up two parallel initiatives: climate science research, and a complementary public relations campaign (left and right branches of figure 3). According to a 1978 'Request for a credible scientific team,' these initiatives targeted four audiences: the scientific community, government, Exxon management, and the general public and policymakers [145].

4.1. Scientific community

From approximately 1979 to 1982, the Exxon Research and Engineering (ER&E) Company pursued three major AGW research projects. ExxonMobil's 2015 statement that two of the projects 'had nothing to do with CO₂ emissions' [148] is contradicted by internal documents [111, 149, 150]. In the early 1980s, these major research initiatives were discontinued amidst budget cuts [111, 151]. In 1984, ER&E characterized its approaches: 'Establish a scientific presence through research program in climate modeling; selective support of outside activities; maintain awareness of new scientific developments' [152]. In 1986, scientist Haroon Khesghi joined ER&E [153], and was

henceforth ExxonMobil's principal (and only consistent) academic author, co-authoring 72% (52/72) of all analyzed peer-reviewed work (79% since his hiring). Indeed, the metadata title of the 'Exxon Mobil Contributed Publications' file is 'Haroon's CV' [15].

4.2. Government

As a 1980 'CO₂ Greenhouse Communications Plan' explained, 'The research is . . . significant to Exxon since future public decisions aimed at controlling the buildup of atmospheric CO₂ could impose limits on fossil fuel combustion' [146]. The scientific research, a 1982 letter described, helped 'to provide Exxon with the credentials required to speak with authority in this area' [99]. ExxonMobil appealed to its research credentials in communications with government officials [84].

4.3. Exxon management

A 1981 'Review of Exxon climate research' observes that 'projects underway and planned on CO₂ . . . are providing an opportunity for us to develop a detailed understanding of the total Federal atmospheric CO₂ program which the Corporation needs for its own planning . . .' [111].

4.4. Public and policymakers

The company's climate science research offered 'great public relations value,' observed a 1978 memo [145]. In 1980, with input from outside public relations counsel, Exxon developed a 'CO₂ Greenhouse Communications Plan,' including advertorials, to target 'opinion leaders who are not scientists' [146, 147]. By 1988–9, this plan explicitly aimed to 'extend the science' and 'emphasize the uncertainty in scientific conclusions regarding the potential enhanced Greenhouse effect' [131, 147]. That year, 1989, they ran their first AGW advertorial. ExxonMobil's interest in influencing the non-scientific public and policymakers helps explain our key observation: the discrepancy between internal and academic documents versus advertorials concerning AGW as real, human-caused, serious, and solvable.

5. Conclusion

Available documents show a discrepancy between what ExxonMobil's scientists and executives discussed about climate change privately and in academic circles and what it presented to the general public. The company's peer-reviewed, non-peer-reviewed, and internal communications consistently tracked evolving climate science: broadly acknowledging that AGW is real, human-caused, serious, and solvable, while identifying reasonable uncertainties that most climate scientists readily acknowledged at that time. In contrast, ExxonMobil's advertorials in the NYT

overwhelmingly emphasized only the uncertainties, promoting a narrative inconsistent with the views of most climate scientists, including ExxonMobil's own. This is characteristic of what Freudenberg *et al* term the *Scientific Certainty Argumentation Method* (SCAM)—a tactic for undermining public understanding of scientific knowledge [57, 58]. Likewise, the company's peer-reviewed, non-peer-reviewed, and internal documents acknowledge the risks of stranded assets, whereas their advertorials do not. In light of these findings, we judge that ExxonMobil's AGW communications were misleading; we are not in a position to judge whether they violated any laws.

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Appendix G

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OPINION

Big Oil misleads Congress about its role in the climate crisis

In hearings convened about its role in ‘spreading climate disinformation,’ the CEOs of six of the world’s largest oil and gas companies and trade groups testified under oath. Much of what they said was demonstrably false.

By **Geoffrey Supran and Naomi Oreskes** Updated November 4, 2021, 3:19 p.m.



ExxonMobil's sprawling Baytown Complex in Baytown, Texas, in 2020. TAMIR KALIFA/NYT

[Fossil fuel companies were supposed to be excluded from any official involvement in the United Nations climate summit](#) in Glasgow this week. Yet dozens of oil industry representatives and hundreds of their trade group lobbyists [showed up](#) anyway; in part, new documents [suggest](#), to convince the United Kingdom government — the host of this year's talks — to integrate unproven carbon capture technologies into its net-zero emissions plans. At COP26 and elsewhere, fossil fuel companies present themselves as trustworthy partners who should have a seat at the table. But this is an industry with a [documented record](#) of dishonesty, which was on full display in Congress last week.

Patrick Galey is on [@patrickgaley.bsky.social](#)

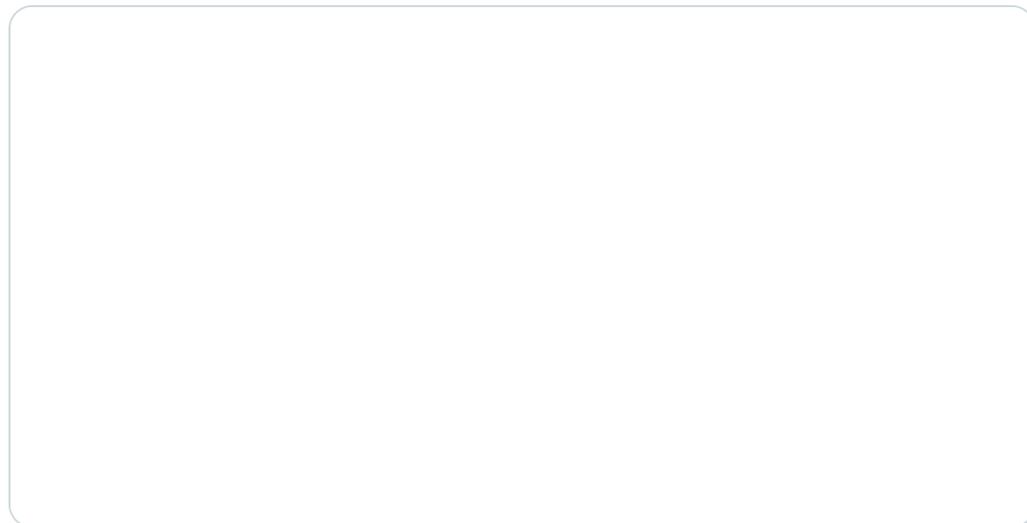


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[#COP26](#) participants list just dropped

IETA, which represents fossil fuel companies such as Chevron, Shell and BP has a delegation over 100-strong

There are dozens of fossil fuel representatives, either as themselves or part of trade group delegations
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In hearings convened by the House Oversight Committee as part of an [investigation](#) into the fossil fuel industry's role in "spreading climate disinformation," the CEOs of six of the world's largest oil and gas companies and trade groups [testified](#) under oath. Much of what they said was demonstrably false.

ExxonMobil CEO Darren Woods repeatedly [affirmed](#) that the company's public statements about climate change have always "been consistent with the general consensus in the scientific community." However, in 2017 and 2020, we [published](#) the first peer-reviewed [analyses](#) of ExxonMobil's 40-year history of climate change communications. We found that between 1996 and 2017, Mobil and ExxonMobil issued at least 45 advertisements and other public statements that contradicted mainstream science.

In 2000, for example, ExxonMobil ran an ad entitled "[Unsettled Science](#)." Against a "backdrop of large, poorly understood natural variability," they wrote, "it is impossible for scientists to attribute the recent small surface temperature increase to human causes." That was untrue. Five years earlier, the UN's Intergovernmental Panel on Climate Change had [concluded a "discernible human influence on global climate."](#) ExxonMobil went so far as to [claim](#) that the IPCC's conclusion was "not peer-reviewed." It was. In fact, the company's chief climate scientist was [a contributing author](#) to the report.

ADVERTISING



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Darren Woods, CEO of ExxonMobil, testifies via video conference during a House Committee on Oversight and Reform, on Oct. 28, with Representative Ralph Norman in the foreground, on Capitol Hill, in Washington. JACQUELYN MARTIN/ASSOCIATED PRESS

[ExxonMobil's misrepresentations of mainstream science](#) continued for more than a decade. In 2001, the company issued a press release that [claimed](#) “there is no consensus about long-term climate trends and what causes them” and presented global cooling as a legitimate alternative to warming, even though scientists [had debunked](#) that idea 23 years earlier. In 2015, the company’s then-CEO Rex Tillerson [stated](#): “We do not really know what the climate effects of 600 ppm [parts per million of greenhouse gases] versus 450 ppm will be because the models simply are not that good.” This had been refuted by the climate models developed by the company’s [own scientists](#), decades earlier.

When asked at last week’s hearing if ExxonMobil now accepts that climate change is real and human-caused, current CEO Woods [beat around the bush](#), saying, “Increased greenhouse gases *can contribute* to the effects of climate change.” “Can” suggests uncertainty; “contribute” implies additional significant causes. In contrast, the IPCC says that [“human influence on the climate system is now an established fact”](#) and that increased greenhouse gases have caused [98 percent](#) of global warming. Woods’s peers from Chevron, the American Petroleum Institute, and the US Chamber of Commerce all stuck to the same script.

Republican Representative James Comer of Kentucky [asked the CEOs if they themselves have “ever approved a climate disinformation campaign.”](#) All six executives [said](#) they have not. This was disingenuous at best.

This summer, we published a computational [analysis](#) of the language ExxonMobil has used to publicly talk about climate change as recently as 2019. Our study quantitatively showed that the company’s rhetoric has gradually evolved from outright climate denial to more subtle, insidious forms of propaganda. These “discourses of delay” include greenwashing, individualization of responsibility (which shifts blame away from companies and onto consumers; away from supply and onto demand), fossil fuel solutionism (which presents fossil fuels and their industry as essential and inevitable for the foreseeable future), and technological shell games (which play fast and loose with the

technological and economic realities of energy technologies). These misleading narratives [dominate](#) contemporary [marketing](#) by fossil fuel companies.

Over the past 15 months, for instance, Chevron has run television advertisements 29,591 times, 80 percent of which [focused](#) on the company's sustainability efforts. In contrast, [99.8](#) percent of Chevron's 2010-18 budget was invested in fossil fuels. Likewise, across more than 3,000 social media posts by six European fossil fuel companies over the past two years, 63 percent of content [positioned](#) the companies as environmentally concerned, even as, on average, 80 percent of the companies' operations remain in fossil fuels. This is greenwashing 101: talk clean, act dirty. Just as the fossil fuel industry [misled](#) the public about climate science, it is now misleading us about its commitment to doing something about it. This is why [numerous attorneys general have sued oil and gas companies](#), not just for their climate denial but also for deceptive marketing and greenwashing.

Each discourse of delay serves to misinform the public about the climate crisis and its solutions. Intentional misinformation is, by definition, disinformation, which is precisely what the six executives told Congress they have never authorized. Perhaps they personally did not approve such efforts, but someone at their companies did.

As scholars of disinformation, we do not use the word "lie" lightly. But no other word adequately describes the oil industry's brazen efforts to mislead the public about its history of misleading the public. Big Oil's bosses have left the door of accountability ajar with their dishonesty, and lawmakers should push it wide open.

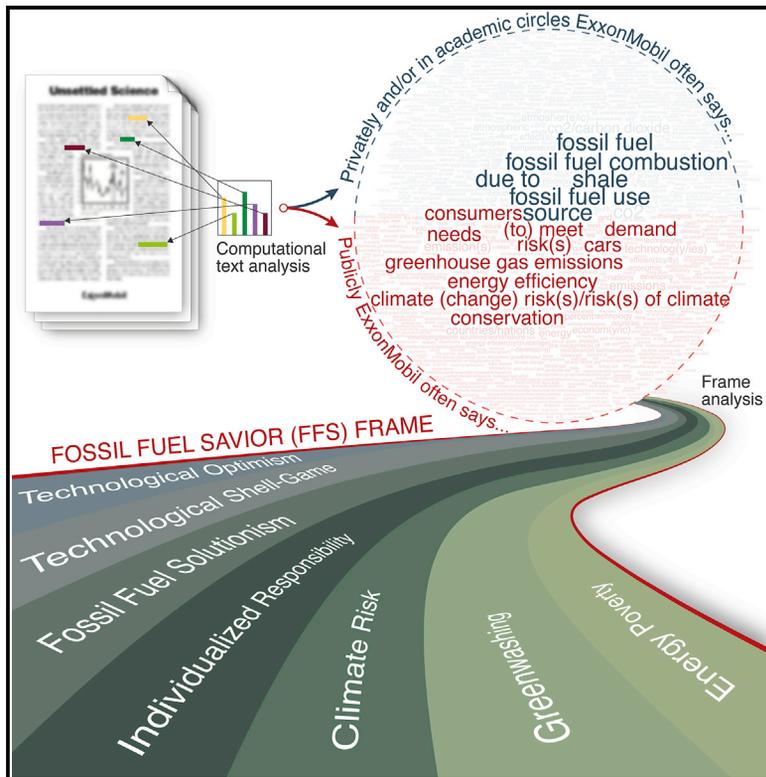
[Geoffrey Supran](#) is a research fellow in the Department of the History of Science at Harvard University and director of climate accountability communication for the Climate Social Science Network. [Naomi Oreskes](#) is a professor of the history of science at Harvard University and the author of, most recently, ["Science on a Mission: How Military Funding Shaped What We Do and Don't Know About the Ocean."](#)

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Appendix H

Rhetoric and frame analysis of ExxonMobil's climate change communications

Graphical abstract



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In brief

This is the first computational assessment of how ExxonMobil has used language to subtly yet systematically frame public discourse about climate change. We show that ExxonMobil uses rhetoric mimicking the tobacco industry to downplay the reality and seriousness of climate change, to present fossil fuel dominance as reasonable and inevitable, and to shift responsibility for climate change away from itself and onto consumers. Our work is relevant to lawsuits, policy proposals, and grassroots activism seeking to hold fossil fuel companies accountable for deceptive marketing.

Highlights

- ExxonMobil's public climate change messaging mimics tobacco industry propaganda
- Rhetoric of climate “risk” downplays the reality and seriousness of climate change
- Rhetoric of consumer “demand” (versus fossil fuel supply) individualizes responsibility
- Fossil Fuel Savior frame uses “risk” and “demand” to justify fossil fuels, blame customers



Article

Rhetoric and frame analysis of ExxonMobil's climate change communications

Geoffrey Supran^{1,2,*} and Naomi Oreskes¹¹Department of the History of Science, Harvard University, Cambridge, MA 02138, USA²Lead contact*Correspondence: gjsupran@fas.harvard.edu<https://doi.org/10.1016/j.oneear.2021.04.014>

SCIENCE FOR SOCIETY A dominant public narrative about climate change is that “we are all to blame.” Another is that society must inevitably rely on fossil fuels for the foreseeable future. How did these become conventional wisdom? We show that one source of these arguments is fossil fuel industry propaganda. ExxonMobil advertisements worked to shift responsibility for global warming away from the fossil fuel industry and onto consumers. They also said that climate change was a “risk,” rather than a reality, that renewable energy is unreliable, and that the fossil fuel industry offered meaningful leadership on climate change. We show that much of this rhetoric is similar to that used by the tobacco industry. Our research suggests warning signs that the fossil fuel industry is using the subtle micro-politics of language to downplay its role in the climate crisis and to continue to undermine climate litigation, regulation, and activism.

SUMMARY

This paper investigates how ExxonMobil uses rhetoric and framing to shape public discourse on climate change. We present an algorithmic corpus comparison and machine-learning topic model of 180 ExxonMobil climate change communications, including peer-reviewed publications, internal company documents, and advertorials in *The New York Times*. We also investigate advertorials using inductive frame analysis. We find that the company has publicly overemphasized some terms and topics while avoiding others. Most notably, they have used rhetoric of climate “risk” and consumer energy “demand” to construct a “Fossil Fuel Savior” (FFS) frame that downplays the reality and seriousness of climate change, normalizes fossil fuel lock-in, and individualizes responsibility. These patterns mimic the tobacco industry’s documented strategy of shifting responsibility away from corporations—which knowingly sold a deadly product while denying its harms—and onto consumers. This historical parallel foreshadows the fossil fuel industry’s use of demand-as-blame arguments to oppose litigation, regulation, and activism.

INTRODUCTION

In previous work, we have shown that Exxon, Mobil, and ExxonMobil Corp misled the public about anthropogenic global warming (AGW) by contributing to climate science through academic and internal research, while promoting doubt about it in advertorials and other propaganda.^{1–3} (We refer to Exxon Corporation as Exxon, Mobil Oil Corporation as Mobil, ExxonMobil Corporation as ExxonMobil Corp, and generically refer to all three as Exxon-Mobil.) We have also observed that, starting in the mid-2000s, ExxonMobil’s statements of explicit doubt about climate science and its implications (for example, that “there does not appear to be a consensus among scientists about the effect of fossil fuel use on climate”⁴) gave way to implicit acknowledgments couched in ambiguous statements about climate “risk” (such as discussion of lower-carbon fuels for “addressing the risks

posed by rising greenhouse gas emissions,”⁵ without mention of AGW). This invites research as to how, beyond outright disinformation, ExxonMobil may have employed rhetoric and framing to construct misleading public narratives about AGW. Here, we take up this question.

“Framing” is a term of art in communications science that refers to how an issue is portrayed and understood.^{6–9} Frames construct meaning by selecting “some aspects of a perceived reality” and making them “more salient in a communicating text, in such a way as to promote a particular problem definition, causal interpretation, moral evaluation, and/or treatment recommendation.”¹⁰ (Here and throughout, we strictly refer to “emphasis frames” rather than “equivalency frames.”)¹¹ Analyzing which frames are present and absent in public discourse helps to reveal how actors have tried to shape policy debates by setting agendas and legitimating certain participants



and responses, while discouraging or precluding others.^{12–15} Framing of responsibility, for example, can determine whether society calls upon individuals, industry, or government to take action.¹⁶

One of the fossil fuel industry's primary AGW frames has been scientific uncertainty.¹⁷ Researchers have documented in detail industry's over-emphasis of uncertainty to deny climate science and delay action.^{1,2,17–25} Subtler forms of rhetoric and framing, which dominate today's AGW discourse, are only just beginning to receive similar attention.^{7,26–29} Fossil fuel interests have spent billions of dollars on AGW public affairs, yet their role in perpetuating these narratives is underexplored.^{30,31}

In this paper, we analyze how ExxonMobil has publicly constructed AGW frames by selectively emphasizing some terms and topics while avoiding others. Our analysis compares the terms and topics between ExxonMobil's different AGW communications, including peer-reviewed publications, internal documents, and paid, editorial-style advertisements—known as advertorials—published on the Op-Ed page of *The New York Times* (NYT). We also identify frames in the latter. These well-defined, longitudinal corpora are conducive to a rigorous case study of fossil fuel industry messaging on AGW.

Our study offers the first computational assessment of how ExxonMobil has used language to frame public discourse about AGW. By bringing to bear the mixed-methods of computational linguistics and inductive frame analysis, our results add to (1) analyses of ExxonMobil's public affairs practices,^{32–44} (2) qualitative accounts of the company's AGW communications,^{23,45–49} and (3) the application of discourse and (algorithmic) content analysis to AGW communications by ExxonMobil and the wider climate countermovement.^{1,2,17–19,26,27,29,50–57} A “distant”—that is, quantitative, statistical, and macroscopic—reading of ExxonMobil's AGW communications offers three practical advantages.⁵⁸ First, it complements the qualitative and/or manual methodologies previously applied to the AGW communications of ExxonMobil and other fossil fuel interests, and corroborates our prior work, which used manual coding to demonstrate systematic discrepancies between ExxonMobil's private and public AGW communications.^{1,2} Second, automated methods of textual analysis allow detection of broad, sometimes subtle, patterns of language that would otherwise be unattainable. Third, by using existing corpora to establish the application of computational techniques to the analysis of AGW discourse, we help demonstrate the efficacy of these approaches, which researchers will be able to use to analyze the large numbers of documents that lawsuits against fossil fuel companies are anticipated to generate.

Our analysis is the first computational study illustrating how the fossil fuel industry has encouraged and embodied AGW narratives fixated on individual responsibility. Our findings corroborate the insights of qualitative discourse analyses about the role of fossil fuel interests, and add to what Kent⁵⁹ has called an “under-theorised” understanding “of why contemporary interest focuses on individual responsibility for climate change.”^{26,51} In so doing, this work helps to decrypt the fossil fuel industry's playbook of climate delay framings, illuminating how sense-making schema conveyed by subtle yet systematic deployments of language may have “penetrated public

discourse to become naturalized as common sense or unfortunate realities.”^{13,26} Although misleading frames that deceive the public may be defended on First Amendment grounds, the history of tobacco litigation shows that a misleading framework may also be held in some circumstances to be part of a pattern of fraudulent activities. Our work may, therefore, be relevant to ongoing lawsuits against ExxonMobil alleging “deceptive marketing” and “greenwashing,” as well as to calls for policymakers to ban fossil fuel industry advertisements or require that they come with tobacco-style warning labels.^{60–65} Our research also adds to an expanding scholarly and journalistic AGW literature—spanning emissions accounting and extreme weather attribution,^{66,67} supply-side policy analysis,^{68–70} decarbonization theory,^{71,72} the history of climate denial, lobbying, and propaganda by fossil fuel interests;^{73–83} ethical philosophy;^{84,85} and climate litigation^{86,87}—challenging the zeitgeist of individualized responsibility. Finally, this study contributes to broader literatures on discourse and content analysis;^{88–91} corporate issue management and advocacy marketing;^{56,92–96} and the cross-pollination of corporate strategies of public affairs, litigation, and deceit.^{13,86,97–100}

We adopt a mixed-method, computational approach to rhetorical frame analysis of 180 ExxonMobil documents previously compiled for manual content analysis^{1,2}: 32 internal company documents (1977–2002; from ExxonMobil Corp,¹⁰¹ *InsideClimate News*,¹⁰² and Climate Investigations Center),¹⁰³ 72 peer-reviewed publications (1982–2014; from ExxonMobil Corp),¹⁰⁴ and 76 advertorials in the NYT expressing any positions on AGW (real and human caused, serious, or solvable) (1972–2009; from PolluterWatch and ProQuest).^{105,106} To our knowledge, these constitute all publicly available internal and peer-reviewed ExxonMobil documents concerning AGW, including those made available by the company. They also include all discovered ExxonMobil advertorials in the NYT taking any positions on AGW. These corpora thus offer bound sets reflecting ExxonMobil's internal, academic, and public AGW communications, respectively.

Following text pre-processing and vectorization into document-term matrices, we first use frequency score (FS) and Dunning log-likelihood (LL) ratio corpus comparison algorithms to identify statistically distinctive keywords (“divergent terms”) that help locate rhetorical frames.^{107–110} The FS indicates how often a given term appears in corpus A versus corpus B (accounting for corpus sizes), and ranges from 0 (only in corpus A) to 1 (only in corpus B). The LL ratio (G^2) indicates the statistical significance of the relative frequencies of a given term between corpora A and B, and ranges from large and negative (term is disproportionately common in corpus A) to large and positive (disproportionately common in corpus B). Second, we complement this approach with latent Dirichlet allocation (LDA) topic modeling to identify statistically distinctive, thematically connected texts and vocabularies (“divergent topics”), which are commonly equated to either frames or frame elements.^{111–115} Third, we integrate these quantitative tools into an inductive, qualitative approach to constructing frames as “frame packages” in advertorials.^{17,116–118} In the **discussion**, we examine the congruence of our findings with the tobacco industry's rhetorical strategies in public relations and litigation.^{13,109,119,120}

Table 1. Rhetorical tropes and taboos: Highly divergent terms in (left) ExxonMobil Corp advertorials versus (right) Mobil advertorials, by LL ratio (G^2) and FS

	ExxonMobil Corp advertorials often say:				Mobil advertorials often say:				
	ExxonMobil Corp	Mobil	G^2	FS	ExxonMobil Corp	Mobil	G^2	FS	
energy	279	99	110.51	0.76	*nations*	4	79	-74.90	0.05
challenge(s)	52	4	54.33	0.94	plan	0	21	-26.84	0.00
(to) meet	51	14	26.70	0.80	senate	0	16	-20.45	0.00
demand	32	8	18.22	0.82	treaty	0	14	-17.89	0.00
use	60	27	16.78	0.71	in kyoto	0	13	-16.61	0.00
needs	27	9	11.53	0.77	the us [United States]	18	51	-12.99	0.28
risk(s)	46	3	50.30	0.94	*co2/carbon dioxide*	33	105	-31.90	0.26
climate (change) risk(s)/risk(s) of climate	26	0	39.02	1.00	emission(s)	97	197	-24.48	0.35
longterm	37	3	38.05	0.93	greenhouse gases	8	39	-18.96	0.19
research	75	21	38.53	0.80	effect	1	18	-16.67	0.06
gcep [Global Climate and Energy Project]	17	0	25.51	1.00	global warming	2	21	-16.25	0.10
technologies	55	18	24.00	0.77	evs [electric vehicles]	0	12	-15.34	0.00
solar	24	3	21.02	0.90					
stanford	14	0	21.01	1.00					
policies	27	5	19.17	0.86					
wind	18	3	13.62	0.87					

Terms that appear to be thematically related have been grouped (asterisked, high-scoring terms identify each group). ExxonMobil Corp advertorials often say terms (“tropes”) with large positive G^2 scores and rarely say terms (“taboos”) with FS scores near 0. Mobil advertorials often say terms with large negative G^2 scores and rarely say terms with FS scores near 1. p values < 0.001 for all G^2 and FS scores.

RESULTS

In the section entitled “[divergent terms and topics](#),” we compare divergent terms and topics between pairs of document categories. In “[rhetorical frames](#),” we summarize the findings of frame package analysis of advertorials: three dominant frames communicated by 11 constituent discourses. Other sections then focus on two of these complementary discourses, “[discourse of climate risk](#)” and “[discourse of individualized responsibility](#),” and analyze how they work alongside other discourses to construct one specific frame, Fossil Fuel Savior (FFS) (“[FFS frame](#)”).

Divergent terms and topics

Table 1 presents a selection of highly divergent terms in ExxonMobil Corp advertorials versus Mobil advertorials, as identified by LL and FS. Likewise, Tables 2 and 3 compare highly divergent terms between all advertorials (Mobil plus ExxonMobil Corp) and, respectively, Exxon internal documents (Table 2) and Exxon/ExxonMobil Corp peer-reviewed publications (Table 3). In all three tables, the highest $|G^2|$ -scoring terms, marked with asterisks, are suggestive of distinctive themes around which we group other relevant terms. These themes closely resemble the divergent topics shown in Table 4, which emerge from LL analysis of our LDA topic model solutions in all advertorials (top half of Table 4) and in combined internal and peer-reviewed documents (bottom half). The top 20 words associated with each topic are listed, together with assigned topic labels.

Mobil versus ExxonMobil Corp advertorials

We have previously shown that both Mobil and ExxonMobil Corp advertorials often promoted doubt about climate science.^{1,2} Terms conveying explicit doubt are therefore common to both corpora, and so do not appear in Table 1 (for examples, see S2.1, [supplemental information](#)). This undercuts ExxonMobil Corp’s suggestion that only Mobil, not ExxonMobil Corp, promoted doubt.^{2,3} Both did. Moreover, when Exxon and Mobil merged in 1999, ExxonMobil Corp inherited legal and moral responsibility for both parent companies.

Comparison of advertorials over time can nevertheless be insightful in revealing other rhetorical trends. In this regard, Mobil and ExxonMobil Corp advertorial corpora serve as well-defined longitudinal proxies.

Table 1 shows, for example, that earlier, Mobil advertorials disproportionately contested climate science head-on, discussing emission(s) of CO₂/carbon dioxide and the global warming effect (terms exhibiting statistically significant divergence are underlined throughout). Mobil advertorials also notably engaged in climate policy debates concerning the role of the US (and Senate) compared with other nations as part of the Kyoto treaty plan. By contrast, ExxonMobil Corp advertorials no longer referred to “global warming”: the term became taboo (FS = 0.10). Relative usage of “climate change” versus “global warming” went from 3-to-1 pre-merger to 34-to-1 post merger. Indeed, ExxonMobil Corp mostly sidestepped detailed discussions about climate science, acknowledging only the long-term risks of climate change before reframing it as a challenge to meet the public’s energy demand and needs. ExxonMobil

Table 2. Rhetorical tropes and taboos: Highly divergent terms in (left) advertorials versus (right) internal documents, by LL ratio (G^2) and FS

	Advertorials often say:				Internal documents often say:				
	Advertorials	Internal	G^2	FS	Advertorials	Internal	G^2	FS	
emission(s)	294	97	293.80	0.86	*co2/carbon dioxide*	138	1,053	-291.63	0.21
risk(s)	49	7	72.48	0.93	atmosher(e/ic)	36	458	-187.01	0.14
greenhouse gas emissions	42	7	58.90	0.92	fossil fuel	9	144	-66.26	0.11
climate (change) risk(s)/risk(s) of climate	26	0	57.89	1.00	ppm [parts per million]	0	78	-62.12	0.00
climate change	124	103	45.39	0.71	co2 concentration	1	61	-40.57	0.03
dont [don't]	24	2	40.93	0.96	fossil fuel combustion	1	48	-30.69	0.04
know	32	8	37.59	0.89	co2 increase	0	28	-22.30	0.00
longterm	40	17	33.14	0.83	source	6	39	-9.08	0.24
doom(sday/sdayers)/apocalypse/hype/scare	11	0	24.49	1.00	*effect(s)*	27	359	-150.31	0.13
debate	26	12	20.05	0.82	temperature	15	270	-130.89	0.10
(un)know(/n/ing/ledge)	57	66	9.63	0.64	doubling	2	83	-51.60	0.05
energy	378	222	227.73	0.78	greenhouse effect	10	119	-46.69	0.15
(to) meet	65	2	128.34	0.99	ocean	15	135	-43.38	0.19
challenge(s)	56	5	94.08	0.96	due to	5	89	-42.94	0.10
energy efficiency	30	1	58.76	0.98	ph [pH]	0	44	-35.04	0.00
electricity	29	1	56.60	0.98	radiation	1	44	-27.68	0.04
consumers	21	0	46.76	1.00	co2 greenhouse	0	33	-26.28	0.00
oil and natural gas	18	0	40.08	1.00	sea	6	65	-23.99	0.16
energy use	23	4	31.75	0.92	global temperature	0	30	-23.89	0.00
demand	40	21	27.24	0.80	2050	0	30	-23.89	0.00
needs	36	22	20.69	0.77	temperature increase	3	50	-23.44	0.11
for generations/foreseeable future/several decades/decades to come/next 25 years	12	3	14.10	0.89	polar	1	28	-15.83	0.07
countries/nations	157	17	251.77	0.95	*program*	12	195	-90.37	0.11
developing/poorer countries/world/nations	53	3	97.01	0.97	natuna [Natuna Island, Indonesia]	0	67	-53.36	0.00
kyoto	59	7	92.31	0.95	doe [Department of Energy]	0	38	-30.26	0.00
targets	26	4	37.52	0.93	tanker	1	35	-20.96	0.06
econom(y/ic)	148	22	216.08	0.93	*model(s)*	30	309	-110.12	0.17
economic growth/impact	29	2	51.34	0.97	figure	0	112	-89.19	0.00
prosperity	15	0	33.40	1.00	rate	2	122	-81.13	0.03
jobs	13	0	28.95	1.00	data	10	98	-33.68	0.17
prices	12	0	26.72	1.00	vugraph	0	41	-32.65	0.00
cost	33	17	22.92	0.80	scenario	1	42	-26.17	0.05
tax	15	2	22.68	0.94					
living standard(s)/standard(s) of living/quality of life	10	0	22.27	1.00					
steps	36	1	71.76	0.99					
reduce emissions	23	0	51.21	1.00					
voluntary	18	0	40.08	1.00					
wise(r)/prudent/reasonable/responsible/sound(er)	39	21	25.87	0.79					
technology(ies)	198	40	257.20	0.91					
vehicles	33	0	73.48	1.00					

(Continued on next page)

Table 2. Continued

	Advertorials often say:				Internal documents often say:			
	Advertorials	Internal	G ²	FS	Advertorials	Internal	G ²	FS
natural gas	48	18	43.87	0.85				
trees	24	2	40.93	0.96				
invest(ing/ment(s))	27	4	39.46	0.93				
gcep [Global Climate and Energy Project]	17	0	37.85	1.00				
evs [electric vehicles]	16	0	35.63	1.00				
gasoline	20	2	32.72	0.95				
innovat(e/ion(s))	17	1	30.93	0.97				
solutions	26	7	29.36	0.88				
renewables	13	0	28.95	1.00				
wind	21	5	25.29	0.90				

Terms that appear to be thematically related have been grouped (asterisked, high-scoring terms identify each group). Advertorials often say terms (“tropes”) with large positive G² scores and rarely say terms (“taboos”) with FS scores near 0. Internal documents often say terms with large negative G² scores and rarely say terms with FS scores near 1. p values < 0.001 for all G² and FS scores.

Corp advertorials emphasized the need for more climate and energy technologies research, such as the company’s sponsorship of the GCEP (Global Climate and Energy Project) at Stanford University. Current solar and wind technologies were presented as inadequate.

Advertorials versus internal documents

Comparing divergent terms in all advertorials against those in internal documents, a combination of the above advertorial themes emerges (Tables 2 and 4). Numerous Mobil and Exxon-Mobil Corp advertorials promoted explicit doubt about whether AGW is real and human caused. They emphasized debate and focused on what scientists “do and don’t know” [Climate science uncertainty] (topic labels from Table 4 are indicated in bracketed italics throughout). This eventually gave way to rhetoric about potential long-term risks of AGW (after several years of overlap in ~2000–2005 and 2007), juxtaposed against the challenge to meet demand [Energy/emissions challenge]. The energy use and needs of consumers, such as electricity and oil and natural gas, are presented as necessitating greater energy efficiency and new technologies [Energy/emissions challenge; Vehicles]. The public is told about how ExxonMobil Corp is partnering with GCEP at Stanford to develop solutions such as more efficient gasoline vehicles and “clean...natural gas” [Vehicles; Energy technologies]. ExxonMobil Corp touts its efforts to plant trees, but renewables such as wind and electric vehicles/EVs are given short shrift [Conservation; Energy technologies]. Algorithmic analysis also documents Mobil’s public rhetoric on the Kyoto Protocol: targets that exempt developing countries threaten American jobs, prosperity, and economic growth; instead, governments and industry should pursue market-based, voluntary steps to reduce emissions [Climate policy].

Compared with Mobil advertorials, which promoted debate about climate science, and ExxonMobil Corp advertorials, which did the same or ignored it, Exxon’s internal conversations focused on it. Internal documents are notable for their detailed articulation of the causes and consequences of AGW. The source of the observed CO₂ increase in the atmosphere was

fossil fuel combustion [AGW science/projections]. Effects of the resulting greenhouse effect would include a global temperature increase. Internal discussions adopted a rigor absent from the company’s public communications, including reference to climate models, scenarios, and rates of change [Climate modeling]. One scenario they examined—the doubling of atmospheric CO₂ concentration by 2050—threatened melting of the polar icecaps, a decrease in ocean pH, and rising sea levels [AGW science/projections]. ExxonMobil advertorials disputed or remained silent about not just this early knowledge of climate science and its implications but also Exxon’s “CO₂ program” that helped acquire and apply that knowledge [AGW science/projections]. Internal memos report that this program included measuring CO₂ with a tanker, monitoring DOE (US Department of Energy) climate science, and evaluating the CO₂ emissions from their natural gas project in Natuna, Indonesia [Climate research programs].

Advertorials versus peer-reviewed publications

Table 3 compares divergent terms in all advertorials against those in peer-reviewed publications. Advertorials are distinguished by the same rhetorical themes as in “advertorials versus internal documents”; indeed, the contrast against academic articles is more pronounced. Independently and collectively, Mobil and ExxonMobil Corp advertorials offset the risks of manmade climate change by also promoting debate about complex science [Climate science uncertainty]. Advertorials are again seen to frame AGW as a challenge to meet the needs of consumers for more energy from fossil fuels, while seeking to allay concerns by publicizing the promise of advanced technology innovation (including cogeneration) [Energy/emissions challenge; Energy technologies]. In comparison with peer-reviewed papers, advertorials stand out for their emphasis of corporate environmental programs to reduce emissions through energy efficiency and conservation [Conservation].

While advertorials talk about the scientific process—research, science, and the extent of scientists’ knowledge are disproportionately discussed—peer-reviewed publications

Table 3. Rhetorical tropes and taboos: Highly divergent terms in (left) advertorials versus (right) peer-reviewed documents, by LL ratio (G²) and FS

	Advertorials often say:				Peer-reviewed documents often say:				
	Advertorials	Peer reviewed	G ²	FS	Advertorials	Peer reviewed	G ²	FS	
energy	378	1,777	500.41	0.82	et al	0	4,001	-372.50	0.00
(to) meet	65	98	191.64	0.93	model	5	3,000	-236.23	0.03
challenge(s)	56	100	151.75	0.92	figure	0	1,475	-137.32	0.00
needs	36	71	92.45	0.91	table	1	909	-75.18	0.02
more energy	21	12	87.65	0.97	rate	2	823	-60.90	0.05
consumers	21	33	60.70	0.93	estimates	5	978	-59.17	0.10
energy use	23	83	39.00	0.85	observed	1	715	-57.60	0.03
energy efficiency	30	152	36.65	0.81	scenario	1	562	-43.84	0.04
for generations/foreseeable future/several decades/decades to come/next 25 years	12	28	27.91	0.90	noise	0	311	-28.95	0.00
fossil fuels	24	149	22.89	0.77	projections	0	273	-25.42	0.00
gasoline	20	117	20.61	0.78	ipcc [Intergovernmental Panel on Climate Change]	4	505	-25.00	0.14
demand	40	422	14.35	0.67	error	1	317	-22.17	0.06
research	96	209	232.87	0.91	*co2*	69	5,161	-172.61	0.22
science	61	74	198.02	0.95	ocean	15	2,412	-134.77	0.12
scientists	39	25	157.74	0.97	transport	0	825	-76.81	0.00
dont [don't]	24	0	148.34	1.00	carbon cycle	0	462	-43.01	0.00
greenhouse gas emissions	42	60	126.97	0.94	ghg [greenhouse gas]	0	446	-41.52	0.00
carbon dioxide	69	227	126.15	0.86	ppm [parts per million]	0	397	-36.96	0.00
know	32	25	121.96	0.96	atmospheric co2	1	480	-36.52	0.04
climate (change) risk(s)/risk(s) of climate	26	10	119.09	0.98	ch4	0	272	-25.32	0.00
debate	26	30	86.15	0.95	gt [gigaton]	0	243	-22.62	0.00
manmade	15	2	80.58	0.99	*temperature*	15	1,836	-89.31	0.15
climate change	124	1,122	63.41	0.70	anthropogenic	0	609	-56.70	0.00
(un)know(/n/ing/ledge)	57	330	59.52	0.78	effect(s)	27	1,727	-48.70	0.25
risk(s)	49	261	56.56	0.80	due to	5	731	-39.08	0.13
longterm	40	282	31.82	0.75	radiative forcing	0	338	-31.47	0.00
gap(s)	11	39	18.93	0.86	climate sensitivity	0	219	-20.39	0.00
better science/understanding	6	10	16.85	0.93	temperature change	0	198	-18.43	0.00
complex	14	120	7.97	0.71	*mitigation*	4	880	-55.49	0.09
technolog(y/ies)	198	1,016	238.49	0.80	injection	0	443	-41.24	0.00
gcep [Global Climate and Energy Project]	17	1	97.44	1.00	ccs [carbon capture and storage]	0	374	-34.82	0.00
promise	20	12	82.39	0.97	dissolution	0	270	-25.14	0.00
evs [electric vehicles]	16	11	63.42	0.97	alkalinity	0	260	-24.21	0.00
trees	24	48	61.15	0.91	caco3	0	251	-23.37	0.00
cars	24	59	54.00	0.90	budget	0	180	-16.76	0.00
solutions	26	78	51.00	0.87	cement	1	237	-15.31	0.08
nuclear	26	82	49.12	0.87					
renewables	13	18	39.86	0.94					
wind	21	82	33.25	0.84					
cogeneration	12	26	29.19	0.91					
innovat(e/ion(s))	17	93	19.02	0.79					
invest(ing/ment(s))	27	243	13.96	0.70					

(Continued on next page)

Table 3. Continued

	Advertorials often say:				Peer-reviewed documents often say:			
	Advertorials	Peer reviewed	G ²	FS	Advertorials	Peer reviewed	G ²	FS
steps	36	36	126.05	0.95				
programs	28	14	120.90	0.98				
reduce emissions	23	25	78.03	0.95				
wise(r)/prudent/reasonable/ responsible/sound(er)	39	119	75.54	0.87				
environmental	56	384	46.45	0.75				
conservation	15	66	21.23	0.83				
nations	83	110	259.48	0.94				
kyoto	59	182	113.35	0.87				
governments	36	62	99.41	0.92				
senate	16	0	98.89	1.00				
developing/poorer countries/ world/nations	53	196	88.01	0.85				
econom(y/ic)	148	714	190.67	0.81				
prosperity	15	1	85.32	1.00				
economic growth/impact	29	74	63.68	0.89				
living standard(s)/standard(s) of living/quality of life	10	0	61.81	1.00				
voluntary	18	32	48.89	0.92				
jobs	13	11	48.27	0.96				

Terms that appear to be thematically related have been grouped (asterisked, high-scoring terms identify each group). Advertorials often say terms (“tropes”) with large positive G² scores and rarely say terms (“taboos”) with FS scores near 0. Peer-reviewed documents often say terms with large negative G² scores and rarely say terms with FS scores near 1. p values < 0.001 for all G² and FS scores.

actually engage in it. As expected, academic articles—even more so than internal documents—are distinguished by their articulation of AGW science. Observed atmospheric CO₂ concentrations are reported in ppm (parts per million), anthropogenic temperature change due to radiative forcing by GHG (greenhouse gases) such as CO₂ and CH₄ is acknowledged, and AGW model projections are run for different scenarios based on climate sensitivity [AGW science/projections]. The academic language of estimates and noise and references to the IPCC (Intergovernmental Panel on Climate Change) are commonplace [Climate modeling]. While advertorials offer unfocused representations of technologies such as renewables, nuclear, and EVs as variously promising, hypothetical, or insufficient, Exxon/ExxonMobil Corp supported peer-reviewed studies that squarely centered AGW mitigation around approaches consistent with continued reliance on fossil fuels: CCS (carbon capture and storage); and the injection of CO₂ into oceans through dissolution of minerals such as CaCO₃ to increase alkalinity [CO₂ disposal/storage; Carbon cycles]. As a recent literature review observed, the “use of enhanced ocean alkalinity for C storage was first proposed by [chief Exxon climate scientist Haroon] Kheshgi.”¹²²

Like internal documents, peer-reviewed publications attribute GHG emissions and/or AGW to fossil fuels significantly more often than advertorials (p < 0.01–0.03). Common terms include fossil fuel emissions, fossil fuel CO₂, and fossil fuel combustion [AGW science/projections] (see Table 5).

Rhetorical frames

Frame package analysis leads us to identify three dominant frames in ExxonMobil’s advertorials, which we name (1) Scientific Uncertainty, (2) Socioeconomic Threat, and (3) Fossil Fuel Savior (FFS) (for details, see S4, supplemental information). The Scientific Uncertainty frame presents AGW as unproven and advocates additional climate science research. The Socioeconomic Threat frame argues that binding climate policies (such as the Kyoto Protocol) are alarmist and threaten prosperity, urging voluntary measures instead. The FFS frame describes AGW as the inevitable (and implicitly acceptable) risk of meeting consumer energy demand with fossil fuels for the foreseeable future, and presents technological innovation as the long-term solution.

These frames are constructed of reasoning and framing devices variously communicated by the 11 discourses listed in Figure 1. Figure 1 is a Venn diagram representing the chain of logic (i.e., reasoning devices) of each frame as defined by Entman:¹⁰ problem, cause, moral evaluation, and solution (as indicated, these reasoning devices are the logical bases challenged by denials that AGW is real, human caused, serious, and solvable, respectively).¹⁰ Discourses are manifest in one or more framing devices (e.g., lexical choices, catchphrases, depictions), and their positions in Figure 1 depict their contributions to the reasoning devices of each frame (definitions and examples of each frame’s reasoning and framing devices are provided in S4 and S5, supplemental information). For example, discourses of Technological

Table 4. Topical tropes: Highly divergent topics in (top) advertorials versus (bottom) internal and peer-reviewed documents, by LL ratio (G^2) of topics identified by LDA topic modeling

Category	Topic labels	G^2	Top terms
Advertorials	energy/emissions challenge	10,271.93	*energy, *technolog(y/ies), *emission(s), *efficien(t/ty/cy), *world, *global, <u>fuel(s)</u> , *improv(e/es/ed/ing/ements), *develop(ing), *environment(/al/ally), *econom(y/ic), *need(s), *challenge(s), *percent, *demand, *risk(s), *gas, *reduce, *invest(ing/ment/ments), <u>future</u> , [*meet, *longterm]
	climate policy	6,045.82	*countries/nations, *kyoto, *emission(s), *econom(y/ic), *protocol, *targets, *gases, *agree(ment)/consensus, *industrialized, *administration, <u>reduction</u> , *participat(e/tion/ing), *senate, *plan, <u>measures</u> , *governments, *developed, *develop(ing), *public, *treaty [*jobs/*employment, <u>cost(/s/ly/liar/liest)</u> , *bind(ing), <u>lifestyle(s)</u> , *voluntary]
	vehicles	1,992.81	*vehicles, *evs/electric vehicles, <u>vehicle</u> , *gasoline, *cars, <u>diesel</u> , *citizenship, *math, <u>corporate</u> , *engine, *performance, *road, *engines, *social, car, *science, *education, <u>balancing</u> , dieselpowered, spills
	energy technologies	1,627.41	<u>nuclear</u> , *power, solar/photovoltaic(s), *oil, *renewable(s), <u>trillion</u> , <u>natural</u> , cell, brooklyn, reserves, <u>barrels</u> , turbine, *wind, generate, *gas, petroleum, fine, hydropower, inexhaustible, vote [<u>offshore</u> , onshore, ethanol, biofuels]
	conservation	304.39	*tree(s), forest(s), *plant(/ing), *helped, buildings, lands, sequestration, star, *protect(/ion/ing), acres, eco(logical/system), enhance, conservancy, epas [EPA's], habitat, planted, threat, *conservation, agricultural, carefully [diversity, eagle, indigenous, preservation, restoring, wildlife]
	climate science uncertainty	201.47	<u>climate</u> , <u>change</u> , <u>research</u> , <u>scientific</u> , <u>science</u> , <u>human</u> , uncertain(ty/ties), (<u>un</u>)*know(/n/ing/ledge), national, *scientists, <u>earths</u> , predict, *debate, underst(and/anding/ood), variability, weather, <u>impacts</u> , <u>consequences</u> , ability, <u>development</u> [<u>program(s)</u> , *policy, compl(ex/exity/icated), *universit(y/ies)]
Internal and peer reviewed	AGW science/projections	-4,554.30	*co2/carbon dioxide, atmospher(e/ic), *effect(s), <u>fossil</u> , *temperature, fuel(s), *concentration, <u>increase</u> , *concentrations, carbon, *rate, global, *ocean, *ppm, <u>average</u> , level, *due, *oceans, combust(ion)/burn(ing), *biosphere [*scenarios, impact]
	climate modeling	-3,897.21	*model(s), <u>results</u> , <u>forc(e/ed/ing)</u> , climate, *data, *estimates, <u>response</u> , <u>variability</u> , *temperature, *shown, *flux, <u>anthropogenic</u> , <u>range</u> , *projections, emission(s), <u>detection</u> , <u>parameter</u> , *estimated, <u>studies</u> , <u>based</u>
	CO ₂ disposal/storage	-2,668.42	*co2/carbon dioxide, *ph [pH], *figure, <u>time</u> , *seawater, *depth, <u>km</u> , *vertical, <u>retention</u> , *model(s), seafloor, <u>sparger</u> , <u>degassing</u> , diffusive, <u>natuna</u> , <u>release</u> , flow, *mixed, *surface, <u>fraction</u> [*injection]
	mitigation assessments	-1,917.80	*transport, <u>mitigation</u> , price, cost(/s/ly/liar/liest), <u>biomass</u> , <u>waste</u> , *al [et al.], infrastructure, china, <u>usa</u> , wastewater, reduction, potentially, forestry, losses, sector, availability, capture, <u>direct</u> , sectors
	climate research programs	-1,259.86	<u>dr</u> [Dr.], <u>program(s)</u> , <u>exxon</u> , <u>tanker</u> , <u>ere</u> [Exxon Research and Engineering Company], <u>phase</u> , federal, fund(/ed/ing), plan, division, <u>weinberg</u> [Harold Weinberg], additional, mass, academy, interface, underway, wines, organization, <u>shaw</u> [Henry Shaw], engineering [<u>committee</u> , funds, scoping]
	carbon cycles	-1,215.66	*al [et al.], *ocean, <u>deep</u> , carbon, broecker [Wallace Broecker], upwelling, bbsr [Bermuda Biological Station for Research], <u>stocks</u> , <u>uptake</u> , <u>land</u> , <u>gt</u> [gigaton], vegetation, bermuda, landuse, <u>cycles</u> , jain [Atul Jain], station, transient, <u>biospheric</u> , <u>column</u> [dissolved, *water, <u>inventory</u>]
	oil and gas production	-1,034.26	*ccs [carbon capture and storage], hs [HS], gas, acid, <u>cement</u> , n2 [N ₂], processing, date, <u>natuna</u> [Natuna Island, Indonesia], park, project, earliest, eor [enhanced oil recovery], field, oil, mw [megawatt], recovery, describes, liquid, substantial [pipeline]

For each emergent topic, a topic label and its corresponding top 20 terms are listed (additional informative terms are in brackets at the end of each list). Top 20 terms are ordered according to the relevance metric proposed by Sievert and Shirley,¹²¹ which accounts for both per-term (w)-per-topic (k) probabilities ($\varphi_{w,k}$) and the marginal probability of each term in the corpus (ρ_w). We indicate divergent terms, as identified earlier by G^2 and FS, between advertorials versus (italics) internal documents, (underlining) peer-reviewed publications, and (asterisks) internal and peer-reviewed documents. p values < 0.001 for all G^2 and FS scores.

Shell Game, which, as Schneider et al.²⁷ define them, use “misdirection that relies on strategic ambiguity about the feasibility, costs, and successful implementation of technologies,” serve to downplay the need for public and political concern by trivializing the seriousness and solvability of AGW. Technological Shell

Game discourse is therefore placed in the overlapping areas of Moral evaluation (“Serious”) and Solutions (“Solvable”) in Figure 1.

The frame of Scientific Uncertainty—and its underlying taxonomy of explicit doubt about climate science and its

Table 5. Rhetoric of individualized responsibility: Highly divergent terms in (top) advertorials and (bottom) internal and/or peer-reviewed documents, by LL ratio (G^2) and FS

	Advertorials	Internal	Peer reviewed	G^2 (Int./P.r.)	FS (Int./P.r.)	Example
Advertorials often say:						
(to) meet	65	2	98	128.34/191.64	0.99/0.93	"To meet this demand, while addressing the risks posed by rising greenhouse gas emissions, we'll need to call upon broad mix of energy sources." ⁵
vehicles	33	0	240	73.48/25.02	1/0.74	"[T]he cars and trucks we drive aren't just vehicles, they're opportunities to solve the world's energy and environmental challenges." ¹²³
greenhouse gas emissions	42	7	60	58.9/126.97	0.92/0.94	"We're supporting research and technology efforts, curtailing our own greenhouse gas emissions and helping customers scale back their emissions of carbon dioxide." ¹²⁴
energy efficiency	30	1	152	58.76/36.65	0.98/0.81	"We have invested \$1.5 billion since 2004 in activities to increase energy efficiency and reduce greenhouse gas emissions. We are on track to improve energy efficiency in our worldwide refining and chemical operations." ^{125,126}
cars	24	0	59	53.44/54	1/0.9	"By enabling cars and trucks to travel farther on a gallon of fuel, drivers not only spend less money per mile, they also emit less carbon dioxide (CO ₂) per mile." ¹²⁷
reduce emissions	23	0	25	51.21/78.03	1/0.95	"During the fact-finding period, governments should encourage and promote voluntary actions by industry and citizens that reduce emissions and use energy wisely. Governments can do much to raise public awareness of the importance of energy conservation." ¹²⁸
consumers	21	0	33	46.76/60.7	1/0.93	"We also are developing new vehicle technologies that can help consumers use energy more efficiently." ^{125,126}
world	91	64	338	43.45/150.55	0.74/0.85	"By 2030, experts predict that the world will require about 60 percent more energy than in 2000 As a result, greenhouse gas emissions are predicted to increase too." ¹²⁹
developing countries	27	3	162	43/26.94	0.95/0.78	Through 2030, "developing countries ... will rely on relatively carbon-intensive fuels like coal to meet their needs." ⁵
transportation	23	2	121	38.87/26.93	0.96/0.8	"Ongoing advances in vehicle and fuel technology will be critical to meeting global demand for transportation fuels. They will also help address the risk posed by rising greenhouse-gas emissions." ¹²³
energy use	23	4	83	31.75/39	0.92/0.85	"Central to any future policy should be the understanding that man-made greenhouse gas emissions arise from essential energy use in the everyday activities of people, governments and businesses." ¹³⁰
people	30	11	61	27.87/75.73	0.85/0.91	"Thus, we're pleased to extend our support of ... American Forests ... whose 'Global Releaf 2000' program is mobilizing people around the world to plant and care for trees." ¹³¹
demand	40	21	422	27.24/14.35	0.8/0.67	"[I]n the electric power sector, growing demand will boost CO ₂ emissions." ¹³²

(Continued on next page)

Table 5. Continued

	Advertorials	Internal	Peer reviewed	G ² (Int./P.r.)	FS (Int./P.r.)	Example
needs	36	22	71	20.69/92.45	0.77/0.91	"[F]ossil fuels must be relied upon to meet society's immediate and near-term <u>needs</u> ." ¹³³
conservation	15	5	66	14.89/21.23	0.86/0.83	"Prudent measures such as <u>conservation</u> and investment in energy-efficient technology make sense, but embarking on regulatory [climate/energy] policies that may prove wasteful or counterproductive does not." ¹³⁴
energy demand	15	14	59	4.38**/23.59	0.69**/0.84	"[I]ncreasing prosperity in the developing world [is] the main driver of greater <u>energy demand</u> (and consequently rising CO ₂ emissions) over the coming decades." ¹³⁵
Internal and/or peer-reviewed documents often say:						
fossil fuel	9	144	359	-66.26/-4.48**	0.11/0.34***	"Release of this amount of CO ₂ to the atmosphere raises concern with respect to its effect on the CO ₂ greenhouse problem. Global <u>fossil fuel</u> emissions of CO ₂ currently amount to about 1.8 × 10 ¹⁰ metric tons per year." ¹³⁶ "Arrhenius put forth the idea that CO ₂ from <u>fossil fuel</u> burning could ... warm the Earth. ... fossil fuel greenhouse warming ... fossil fuel greenhouse effect ..." ¹³⁷
natuna	0	67	NA	-53.36/NA	0/NA	"This would make <u>Natuna</u> the world's largest point source emitter of CO ₂ and raises concern for the possible incremental impact of <u>Natuna</u> on the CO ₂ greenhouse problem." ¹³⁶
due to	5	89	731	-42.94/-39.08	0.1/0.13	"The CO ₂ concentration in the atmosphere has increased The most widely held theory is that: the increase is <u>due to</u> fossil fuel combustion." ¹³⁸ "About three-quarters of the anthropogenic emissions of CO ₂ to the atmosphere during the past 20 years is <u>due to</u> fossil fuel burning." ¹³⁹
fossil fuel combustion	1	48	NA	-30.69/NA	0.04/NA	"[T]here is the potential for our [climate] research to attract the attention of the popular news media because of the connection between Exxon's major business and the role of <u>fossil fuel combustion</u> in contributing to the increase of atmospheric CO ₂ ." ¹⁴⁰
shale	1	41	NA	-25.43/NA	0.05/NA	"The quantity of CO ₂ emitted by various fuels is shown in Table 1 They show the high CO ₂ /energy ratio for coal and shale ... ["Shale oil"] is not predicted to be a major future energy source due to ... rather large amounts of CO ₂ emitted per unit energy generated (see Table 1)." ¹³⁸
ccs	0	NA	374	NA/-34.82	NA/0	" <u>CCS</u> includes applying technologies that capture the CO ₂ whether generated by combustion of carbon-based fuels or by the separation of CO ₂ from natural gas with a high CO ₂ concentration." ¹⁴¹
source	6	39	322	-9.08*/-7.16**	0.24*/0.28**	"[F]ossil fuel combustion is the only readily identifiable <u>source</u> [of CO ₂] which is (1) growing at the same rate, (2) large enough to account for the observed increases ..." ¹⁴²

(Continued on next page)

Table 5. Continued

	Advertorials	Internal	Peer reviewed	G ² (Int./P.r.)	FS (Int./P.r.)	Example
fossil fuel use	0	13	NA	−10.35*/NA	0**/NA	Table 1 presents "coal combustion" and "natural gas combustion" as the "source[s]" of CO ₂ , CH ₄ , and SO ₂ ¹⁴³
fossil fuel CO ₂	0	NA	64	NA/−5.96**	NA/0***	"[F]or scenarios with higher fossil fuel use (hence, higher carbon dioxide emissions ..." ¹³⁹
fossil fuel emissions	0	NA	54	NA/−5.03**	NA/0***	"This long tail on the fossil fuel CO ₂ forcing of climate may well be more significant to the future glacial/interglacial timescale evolution of Earth's climate." ¹⁴⁴ "We use our Integrated Science Model to ... estimate the time variation fossil fuel emissions of CO ₂ ... required to match the [IPCC] concentration stabilization scenarios." ¹⁴⁵

Divergent terms in advertorials are identified by frame package analysis as framing devices of individualized responsibility discourse. Example quotations illustrate how advertorials use divergent terms to disproportionately present: (1) consumer demand for energy as the cause of—and culpable for—fossil fuel use, greenhouse gas emissions, and/or AGW; and (2) individual/demand-side actions as accountable for mitigating AGW. By contrast, divergent terms in internal and/or peer-reviewed documents often articulate the causality and culpability of fossil fuel combustion. p values < 0.001 for all G² and FS scores except: * <0.005; ** <0.05; *** ≥ 0.05. NA, not available.

implications—has previously received detailed scrutiny and is here discussed further only in S4.1, [supplemental information](#).^{1,2,17–24} By contrast, frames of Socioeconomic Threat and FFS—and the subtler discourses of delay that underpin them—are underexplored.^{17,26–28} For further discussion of the Socioeconomic Threat frame, see S4.2, [supplemental information](#). In the remainder of this paper, we focus on the role of two specific, complementary discourses, Climate Risk and Individualized Responsibility, in constructing the FFS frame. As [Figure 1](#) suggests, these discourses serve as rhetorical gateways connecting the problem and cause of the FFS frame to its moral evaluation and solution.

Discourse of climate risk

We have previously noted that, accompanying the emergence in the mid-2000s of implicit acknowledgments by some ExxonMobil Corp advertorials that AGW is real and human caused, there appeared to be a rhetorical framework focused on risk.² Algorithmic analyses here demonstrate that this was part of a wider trend in which, following the merger of Exxon and Mobil at the end of 1999, "risk" was incorporated into advertorials communicating explicit doubt. Specifically, LL and FS results in [Table 1](#) show that "risk(s)" is among the terms that most statistically distinguish Mobil advertorials from ExxonMobil Corp advertorials. Within all advertorials published prior to the merger and expressing any positions on AGW (as real and human caused, serious, or solvable), "risk(s)" appears three times, only once in reference to the risk(s) of AGW or greenhouse gases. By contrast, from 2000 onwards, such "risk(s)" are cited 46 times: an average of once per advertorial; 10 times higher than an average NYT article.¹⁴⁶ Permutations include "risk," "risks," "potential risks," "long-term risk," "long-term risks," "legitimate long-term risk," "legitimate long-term risks," and "potential long-term risks."

In 2000, for instance, ExxonMobil Corp's first post-merger advertorial in our corpus promoted "scientific uncertainty" that

AGW is real, human caused, serious, and solvable, acknowledging only that it "may pose a legitimate long-term risk, and that more needs to be learned about it."¹⁴⁷ By the time the company took out its last advertorial expressing a position on AGW in 2009, its tune had changed but "risk" rhetoric remained. The advertorial was entitled, "Tackling climate risks with technology," followed by the subtitle, "Support for oil and natural gas innovation can reduce emissions."¹⁴⁸

The function of "risk" rhetoric in moderating the conveyed status of AGW or greenhouse gases is unambiguous. First, "risks" is among the top terms characterizing the LDA-generated topic of *Energy/Emissions Challenge*, which is the primary topic that introduces readers to AGW (and compares it with energy demand; see "discourse of individualized responsibility") ([Table 4](#)). Second, "climate (change) risk(s)/risk(s) of climate" is, like "risk(s)" itself, a statistically distinctive term of ExxonMobil Corp advertorials versus Mobil advertorials, internal documents, and peer-reviewed publications ([Tables 1, 2, and 3](#)). Indeed, automated collocation analysis reveals that the highest scoring collocate of "climate change" and "global warming" in ExxonMobil Corp advertorials is "risk(s)." By contrast, in Mobil advertorials, it is "science" (followed by "gases" and "debate") ([Table S18](#)).

Discourse of individualized responsibility

[Table 5](#) (top half) collates terms that are (1) identified by frame package analysis as framing devices communicating Individualized Responsibility in advertorials, and (2) highly divergent between all advertorials and internal and/or peer-reviewed documents according to LL and FS analyses. Two patterns emerge.

First, we observe that advertorials disproportionately employ terms that present consumer demand for energy (rather than corporate supply of oil, coal, and gas) as the cause of fossil fuel production, greenhouse gas emissions, and/or AGW. A characteristic example of this "(energy) demand" rhetoric is a 2008 ExxonMobil Corp advertorial stating: "By 2030, global

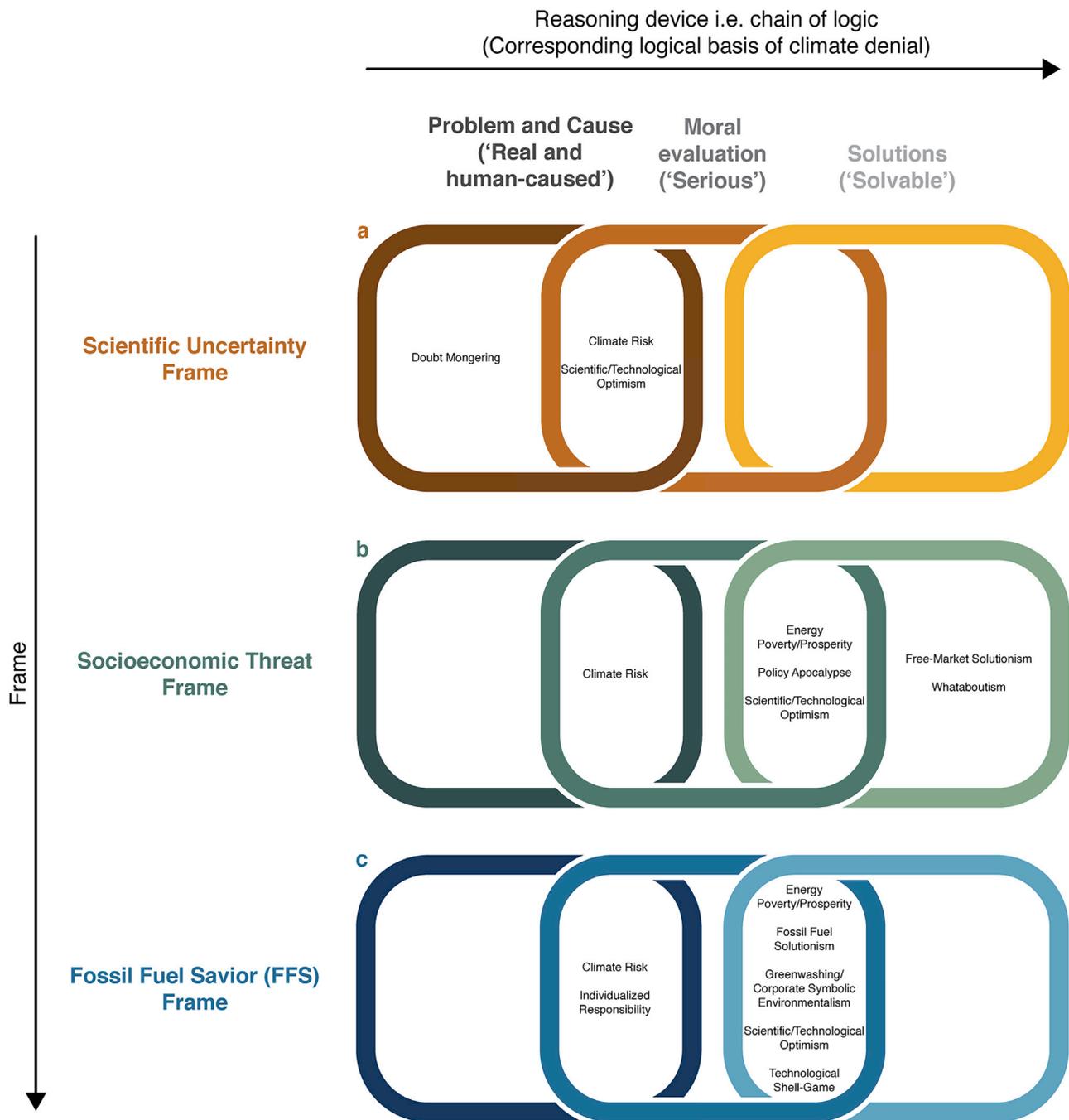


Figure 1. Typology of discourses of climate denial and delay

Using frame package analysis, we identify three dominant frames in ExxonMobil’s advertorials: (a, top) Scientific Uncertainty; (b, middle) Socioeconomic Threat; and (c, bottom) Fossil Fuel Savior (FFS). For each frame, a Venn diagram is presented corresponding to the reasoning devices (i.e., chains of logic) defined by Entman:¹⁰ (left) problem and cause; (middle) moral evaluation; and (right) solution (as indicated, these reasoning devices are the logical bases challenged by denials that AGW is real, human caused, serious, and solvable, respectively). Each reasoning device is communicated by one or more of the 11 discourses of climate denial and delay listed within each chain of logic. Although not shown, these discourses are manifest in one or more framing devices (e.g., lexical choices, catchphrases, depictions), as identified in S4, [supplemental information](#). As an example, discourses of Technological Shell Game, which, as Schneider et al.²⁷ define them, use “misdirection that relies on strategic ambiguity about the feasibility, costs, and successful implementation of technologies,” serve to downplay the need for public and political concern by trivializing the seriousness and solvability of AGW. Technological Shell Game discourse is therefore placed in the overlapping areas of Moral evaluation (“Serious”) and Solutions (“Solvable”) in the diagram. For definitions and examples of all reasoning devices, framing devices, and discourses, see S4 and S5, [supplemental information](#).

energy demand will be about 30 percent higher than it is today ... oil and natural gas will be called upon to meet ... the world's energy requirements."¹⁴⁹ Another, in 2007, says that "increasing prosperity in the developing world [will be] the main driver of greater energy demand (and consequently rising CO₂ emissions)."¹³⁵ A 1999 Mobil advertorial is even blunter: "[G]rowing demand will boost CO₂ emissions."¹³² In other words, they present growing energy demand as inevitable, and imply that it can only be met with fossil fuels.

Synonyms for "(energy) demand" include "needs" ("fossil fuels must be relied upon to meet society's immediate and near-term needs") and "energy use" ("man-made greenhouse gas emissions arise from essential energy use in the everyday activities of people, governments and businesses"). Fossil fuels are either presented as passively responding "to meet this demand" of consumers, developing countries, and the world; or they are left out of the equation entirely: "[A]s populations and economies have grown, energy use has increased, and so have greenhouse gas emissions."¹⁵⁰

Second, we observe that, to the extent that advertorials admit the need for AGW mitigation, they disproportionately introduce terms conveying individual and/or demand-side actions as the appropriate response. Even while promoting explicit doubt about the reality of AGW, advertorials focus on downstream energy efficiency and greenhouse gas emissions, rather than upstream supply of fossil fuels, as the appropriate target of mitigation efforts. "During the [climate science] fact-finding period," a 1997 advertorial states, "governments should encourage and promote voluntary actions by industry and citizens that reduce emissions and use energy wisely. Governments can do much to raise public awareness of the importance of energy conservation."¹²⁸ Twelve years later, advertorials continued to equate the "global environmental challenge" with "curbing greenhouse gas emissions," but not with constraining fossil fuel supply.¹⁵¹ As one 2000 advertorial put it: "Prudent measures such as conservation and investment in energy-efficient technology make sense, but embarking on regulatory [energy] policies that may prove wasteful or counter-productive does not."¹³⁴

Advertorials repeatedly highlighted ways the public could, as one in 1998 put it, "show a little voluntary 'can do.'"¹⁵² A 2008 advertorial suggested that the "cars and trucks we drive aren't just vehicles, they're opportunities to solve the world's energy and environmental challenges."¹²³ A 2007 advertorial offered readers "simple steps to consider": "Be smart about electricity use"; "Heat and cool your home efficiently"; "Improve your gas mileage"; "Check your home's greenhouse gas emissions" using an online calculator.¹⁵³ Mobil and ExxonMobil Corp presented themselves as facilitating, and participating in, such demand-side AGW mitigation. A 1997 advertorial laid the groundwork: "We're supporting research and technology efforts, curtailing our own greenhouse gas emissions and helping customers scale back their emissions of carbon dioxide."¹²⁴ In 1999, Mobil announced that "we're pleased to extend our support of ... American Forests ... whose 'Global Releaf 2000' program is mobilizing people around the world to plant and care for trees."¹³¹ This narrative was echoed by advertorials a decade later: "By enabling cars and trucks to travel farther on a gallon of fuel, drivers...emit less carbon dioxide (CO₂) per mile," said

a 2008 advertorial.¹²⁷ "We also are developing new vehicle technologies that can help consumers use energy more efficiently," said two more the following year.^{125,126}

By contrast, Exxon and ExxonMobil Corp's internal and/or academic communications recognized AGW and/or greenhouse gases as also an upstream problem caused by fossil fuel supply and burning (see also S2.2, supplemental information). "[F]ossil fuel combustion is the only readily identifiable source [of CO₂ consistent with the rate and scale of] observed increases..." observed Exxon scientist James Black¹⁴² in a 1978 presentation to the Exxon Corporation Management Committee. Other internal (1979) and peer-reviewed (2001) documents likewise attributed CO₂ accumulation in the atmosphere as "due to fossil fuel burning" and "fossil fuel combustion."^{138,139} A 1984 internal report and a 1994 academic article spoke of "fossil fuel emissions of CO₂," while a 1998 paper referred to "fossil fuel CO₂ forcing of climate."^{136,144,145} A 1982 internal memo went further, acknowledging "the connection between Exxon's major business and the role of fossil fuel combustion in contributing to the increase of atmospheric CO₂."¹⁴⁰ The 1979 and 1984 internal documents discuss the CO₂ emissions of specific fossil fuel sources such as shale oil and Exxon's natural gas reservoir off Natuna Island in Indonesia.^{136,138}

In sum, ExxonMobil's advertorials statistically overuse terms that reduce AGW to a downstream problem caused by consumer energy demand, to be solved primarily by energy efficiency to reduce greenhouse gas emissions. In contrast, their private and academic documents disproportionately recognize that AGW is an upstream problem caused by fossil fuel supply.

As we show in S6.2, supplemental information, this statistical dichotomy extends throughout all of ExxonMobil Corp's flagship reports concerning AGW spanning 2002–2019 compared with the firm's internal and academic publications.

FFS frame

In addition to Climate Risk and Individualized Responsibility, the FFS frame comprises the five other discourses shown in Figure 1 and defined in S5, supplemental information. Together, they establish the frame's chain of logic (i.e., reasoning devices, see Table S4).

First, as shown in the previous two sections, discourses of Climate Risk and Individualized Responsibility present AGW as the inevitable "risk" of meeting consumer energy demand.

In response to this problem definition and causal attribution, discourses of Scientific/Technological Optimism (which gives primacy to scientific or technological breakthroughs as the solutions to AGW) and Greenwashing/Corporate Symbolic Environmentalism (which is when companies make changes for environmental reasons that, in the case of greenwashing, are merely and deliberately symbolic) lend what Plec and Pettenger⁵² (2012) call "an aura of scientific and technical authority," which "resigns us to putting our faith in the power of industry, technology, and science" (see also Schneider et al.²⁶). "[W]e believe that technology provides the key avenue to solutions that manage long-term risk and preserve prosperity," says the voice of reason presented by a 2002 advertorial entitled "A responsible path forward on climate." "[This] will almost certainly require decades."¹⁵⁴ ExxonMobil asserts its leadership in this challenge with advertorials citing "our industry-leading investments in research and

development,”¹⁴⁹ such as “supporting climate-related research efforts at major universities, including Stanford and MIT.”¹⁵⁵ Visual images such as graphs, charts, and science iconography reinforce this impression.

This technocratic authority helps legitimize accompanying discourses of Fossil Fuel Solutionism and Technological Shell Game, which join the dots between energy demand and continued reliance on fossil fuels. An example of Fossil Fuel Solutionism (which presents fossil fuels and their industry as an essential and inevitable part of the solution to AGW) is a 2007 advertorial that unequivocally depicts the future: “Coal, oil, and natural gas will remain indispensable to meeting total projected energy demand growth” through 2030.¹⁵⁶ “Oil and gas will be essential to meeting demand,” reiterates another in 2008.⁵ “Meeting this growing long-term demand requires that we develop all economic sources of energy – oil, natural gas, coal, nuclear and alternatives,” says a third in 2009.¹⁵¹

The non-fossil fuel alternatives are then dismissed by Technological Shell Game discourse promoting doubt and confusion about AGW’s technological solvability, such as three advertorials in 2005 depicting, again unequivocally, how “Wind and solar ... meet about 1% of total world demand by 2030.”^{157–159} Another, 3 years later, updates the figure to “only 2 percent” (including bio-fuels).⁵ ExxonMobil also takes aim at clean energy subsidies and renewable energy’s “highly variable output” and “enormous land-use requirements.”^{133,154,160} Meanwhile, the three 2005 advertorials, and another in 2009, falsely promote natural gas as “clean-burning” and “clean,” respectively.^{157–159}

In a 2009 advertorial, ExxonMobil acknowledges that there is “a dual challenge” to “provide energy” and “protect the environment” (notably, they say that this challenge concerns energy rather than fossil fuels, and that it applies to “all of us”).¹⁵⁰ But then they tip the scales by pitting concrete, unequivocal benefits (“[Energy] lights our homes. Fuels our transportation. Powers our industries. ... [D]riv[es] our economy and rais[es] living standards”) against amorphous, uncertain costs (the “risks of climate change”). Two 2007 advertorials similarly compare “economic growth and human development” against undefined “risks of climate change.”^{161,162}

In cases such as these, discourses of Energy Poverty/Prosperity and Policy Apocalypse (which respectively articulate social justices of energy access and alleged socioeconomic tolls of decarbonization—the latter strictly assigned to the socioeconomic threat frame), contrasted against that of Climate Risk, work to affirm the moral evaluation of the FFS frame that fossil fuel lock-in is righteous and reasonable.

DISCUSSION

The patterns observed in “results” are similar to those documented in the tobacco industry. In “risk rhetoric facilitates ExxonMobil’s have-it-both-ways position on AGW” and “energy demand rhetoric individualizes AGW responsibility,” we discuss the strategic functions of AGW “risk” rhetoric and individualized responsibility framings, respectively, in comparison with the history of the tobacco industry. “Energy demand rhetoric individualizes AGW responsibility” distinguishes how consumer energy demand is presented in public (“demand as fossil fuel lock-in in public relations”) versus in legal defense (“demand as blame

in litigation”). “Historical contexts, ramifications, and trajectories of ExxonMobil’s communication tactics” explores the historical contexts, ramifications, and trajectories of ExxonMobil’s “risk” rhetoric (“risk”) and individualized responsibility framings (“individualized responsibility”).

Risk rhetoric facilitates ExxonMobil’s have-it-both-ways position on AGW

Our identification of ExxonMobil’s discursive shift to “risk” rhetoric (see “discourse of climate risk”) is broadly consistent with independent findings. Jaworska⁵¹ observes the emergence of “risk” as one of the most frequent collocations of “climate change” in the late 2000s within the corporate social responsibility reports of the world’s major oil corporations, including ExxonMobil. Grantham and Vieira,⁴⁴ examining “welcome letters” from ExxonMobil’s CEO in the company’s Corporate Citizenship Reports, note that “risk” is one of the most influential words coinciding with emphasis on the “planet.” Schlichting¹⁷ concludes that, over the course of the 2000s, industry actors increasingly adopted the framing that “climate change [might be/is] a risk.”

ExxonMobil’s rhetorical pattern of stressing “risk” is consistent with the company’s effort in the mid-2000s, chronicled by journalist Steve Coll,⁴⁸ “to reposition ExxonMobil’s arguments about warming to more fully account for consensus scientific opinion, without admitting that any of the corporation’s previous positions had been mistaken, for that might open a door to lawsuits.”

This approach resembles the tobacco industry’s well-documented response to the scientific consensus on the harms of tobacco use, described by historian Allen Brandt¹⁶³ as a “shift” in focus from scientific “uncertainty” to “(alleged) risks” of smoking (see also Proctor^{164,165}). This scientific hedging strategy was made explicit in a 1996 Reynolds training manual instructing new employees to tell reporters that smoking was “a risk factor” but “not a proven cause.”¹⁶⁵ In 1998, for example, Philip Morris’s CEO Geoffrey Bible conceded a “possible risk” but not a “proven cause,” the distinction being in what historian Robert Proctor¹⁶⁵ calls “a kind of legal having-it-both-ways: an admission strong enough to ward off accusations of having failed to warn, yet weak enough to exculpate from charges of having marketed a deadly product.” This carefully parsed conclusion became the industry’s new official position.¹⁶³

“Risk” facilitates ExxonMobil’s have-it-both-ways position on AGW. It is a “‘good’ candidate to serve various rhetorical purposes,” Jaworska⁵¹ notes, because it “opens up many semantic slots.” Fillmore and Atkins¹⁶⁶ work on the conceptual meaning of risk, for example, shows that “risk” has two dominant sub-frames, “Chance” and “Harm,” and many optional valence description categories. “Chance” is defined as “uncertainty about the future,” such that risk rhetoric (1) implies inherent uncertainty and (2) is subject to temporal discounting heuristics.^{167–169} “The essence of risk is not that it is happening, but that it *might* be happening.”^{170,171}

“Risk” is never clearly or consistently defined by ExxonMobil. The presence and absence of risk’s various sub-frames introduce so-called strategic ambiguity—and therefore flexibility—in contemporaneous and retrospective interpretations of what ExxonMobil wants us to see as a “risk” rather than a “reality.”^{27,172} For instance, does the “Chance” sub-frame of “risk”—and

therefore the implication of uncertainty—apply to whether AGW is happening, human caused, serious, or solvable? Sub-frames of Harm, Actor, Victim, and Valued Object are also rarely articulated: who assumes the risk(s) of AGW: the public, the company, its shareholders, or others? What might be the consequences, and when? In contrast, the “Gain,” “Beneficiary,” and “Motivation” sub-frames of risk taking, manifest in discourse of Policy Apocalypse, are stated explicitly, as discussed in [“demand as fossil fuel lock-in in public relations.”](#)

Like its weaponized rhetorical cousins—such as “uncertainty,” “sound science,” and “more research” and the hedging words “may,” “potential,” etc.—“risk” has the strategic advantage of not necessarily implying intent to deny or delay, because it is coopted from common academic, regulatory, journalistic, and colloquial parlance (S1.4.2, Supran and Oreskes¹).^{15,146,167,173,174} It can be used correctly (for example, to refer to expected *future* damages and stranded fossil fuel assets—a risk that we have previously shown ExxonMobil was publicly silent about) or incorrectly (for example, to describe AGW and past/present climatic changes such as sea level rise as risks rather than realities).¹

ExxonMobil employs almost identical “risk” language in advertorials promoting explicit doubt about AGW as in those that implicitly acknowledge it. For example, they refer to “the risk of global warming” in 1989 (accompanied by explicit doubt); the “risk(s)” “that climate changes may pose” in 2000 (alongside explicit doubt); and “the risks of climate change” in 2009 (which, in the absence of doubt, is coded as an implicit acknowledgment).^{150,175,176} This is not limited to advertorials (for wide-ranging examples, see table 3 of Supran and Oreskes²). In ExxonMobil Corp’s 2005 *Corporate Citizenship Report*, for instance, which extensively questions whether AGW is human caused and serious, a member of the public asks: “Why won’t ExxonMobil recognize that climate change is *real* ...?” The company replies: “ExxonMobil recognizes the *risk* of climate change and its *potential* impact” (emphases added).¹⁷⁷ By shifting the conversation from the semantics of reality to the semantics of risk, they inject uncertainty into the AGW narrative, even while superficially appearing not to.

Energy demand rhetoric individualizes AGW responsibility

Two dimensions of issue responsibility are commonly identified in communications and psychological research: causality and treatment.^{16,178} Causality responsibility addresses the source of a problem—who or what causes it. Treatment responsibility identifies who or what has the power to alleviate the problem, and should be held responsible for doing so. Studies of responsibility framing and attribution theory argue that attribution of these responsibilities broadly takes two conflicting forms: individual versus social.^{16,179,180} Expressing our findings in [“discourse of individualized responsibility”](#) through this analytical lens, ExxonMobil’s public advertorials are biased toward individualist framings of both causality and treatment responsibilities for AGW as compared with their private and academic representations.

Jaworska⁵¹ has observed similar appeals to energy demand as the driving force behind greenhouse gas emissions in the corporate citizenship reports of ExxonMobil Corp and other fos-

sil fuel companies, noting that they are “an example of differentiation, which shifts the responsibility to other constituencies.” Princen et al.⁷² similarly argue that a focus on carbon and greenhouse gases—and away from fossil fuels—is reductionist. “This chemical framing,” they note, “implies that the problem arises after a chemical transformation, after fuels are burned. It effectively absolves of responsibility all those who organize to extract, process, and distribute...So constructed...the burden of harm and responsibility for amelioration falls on governments and consumers rather than extractors.”

“The most effective propaganda,” Parenti¹⁸¹ contends, “is that which relies on framing rather than on falsehood.” As with the language of risk, a rhetorical power of narratives that individualize responsibility is that they do not require the statement of outright falsehoods. After all, consumer demand is one valid and universally recognized aspect of the AGW problem and its solution, and not all advertorials entirely disregard the role of fossil fuels. On balance, however, the disproportionate public fixation of ExxonMobil, a supplier company, on demand-side causation and accountability (as shown in [“discourse of individualized responsibility”](#)) fulfills the fundamental function of emphasis frames to “call attention to some aspects of reality while obscuring other elements.”¹⁰ It is in this selection process that the individualized responsibility framing device creates a false dichotomy, leading readers toward AGW problem definitions, evaluations, and solutions skewed toward consumer demand and away from industry supply.^{11,16,178}

ExxonMobil’s framing is reminiscent of the tobacco industry’s effort “to diminish its own responsibility (and culpability) by casting itself as a kind of neutral innocent, buffeted by the forces of consumer demand.”¹⁶⁵ It is widely recognized that the tobacco industry used, and continues to use, narrative frames of personal responsibility—often marketed as “freedom of choice”—to combat public criticism, influence policy debates, and defend against litigation and regulation.^{13,100,119,164,182–184} Friedman et al.¹³ recently demonstrated that tobacco companies use “freedom of choice” to imply two distinct concepts: liberty and blame. In their public relations messaging, industry asserts smokers’ rights as individuals who are at liberty to smoke. In the context of litigation, industry asserts that those who choose to smoke are solely to blame for their injuries.

In the following two subsections, we further explore the congruence between ExxonMobil’s public responsibility framing and these tobacco tactics ([“demand as fossil fuel lock-in in public relations”](#); [“demand as fossil fuel lock-in in public relations”](#)). We discuss how this Individualized Responsibility discourse is rationalized and reinforced by the semantic duality of “risk.”

[Demand as fossil fuel lock-in in public relations](#)

In [“FFS frame,”](#) we showed that ExxonMobil’s FFS frame insists—typically as self-fulfilling fact rather than opinion—upon society’s inevitable and indefinite reliance on fossil fuels. Rather than asserting that demand is a personal choice and liberty, ExxonMobil’s public “(energy) demand” rhetoric inverts the tobacco industry’s “freedom of choice” messaging. Liberty becomes lock-in.

Within this frame, discourses of Energy Poverty/Prosperity and Policy Apocalypse contrast against that of Climate Risk ([“FFS frame”](#)). The role of “risk” rhetoric here is to downplay the downside, namely AGW, of this alleged dichotomy: fossil

fuels are essential, whereas the potential effects—indeed realities—of AGW are uncertain.²⁶ Such assertions, St. John III³⁵ notes, extend Mobil's messaging in its "Observations" columns "about what constitutes reasonable risk." Observations were "pithy, easy-to-read" advertorials that Mobil ran in Sunday newspaper supplements between 1975 and 1980.^{35,185} In a 1980 "Observations" column, for example, Mobil lamented that "the country seems to be afflicted with the Chicken Little Syndrome" of "cry[ing] that 'The sky is falling!'"¹⁸⁶ "Hardly a day passes," they said, without "fresh perils" like "harmful rain" or "cancerous sunshine." But a "risk-free society" through government regulation is impossible, the advertorial reasoned, because "everything people do everyday involves a slight measure of risk" (emphasis in original). The company concluded with the warning that to "avoid risk, fight change" may be a short-term solution, "but for the long pull, it's a way to certain stagnation." Tobacco industry apologists made the same arguments, calling it "the menace of daily life."¹⁸⁷

To the extent that advertorials concede AGW may be a problem, the "risk" angle helps frame AGW as unpredictable, positioning the oil industry "not as a contributor but as a victim" alongside consumers.⁵¹ As a 2009 advertorial put it, "[we'll need] a global approach to managing the risks of climate change. Everyone has a role to play – industry, governments, individuals."¹⁵⁰ This complemented Mobil's broader use of advertorials to rhetorically reframe itself as what Kerr⁴² terms a "corporate citizen." "A citizen of many lands" is how Mobil described itself in a 1999 advertorial.¹³¹ "Climate change: we're all in this together," another was titled in 1996.¹⁸⁸ With this narrative of an "empathetic fellow traveler," St. John III³⁵ argues, "Mobil offers up the reasonable, risk-taking corporate persona who is willing to take the initiative to provide a beneficial product to all Americans...[B]y appealing to Americans' penchant for valorizing the self-starting individual, such a message of energy harvesting as never being 100% safe could well explain how a significant amount of Americans today do not see fossil fuel-induced climate change as a significant risk."³⁵

ExxonMobil's advertorials say almost nothing about the seriousness of AGW.^{1,2} Nor do they mention the concepts of carbon budgets and stranded fossil fuel assets, which are part of the argument for the fundamental incompatibility of unrestricted fossil fuel supply with climate mitigation.

Overall, the didactic framing of demand as fossil fuel lock-in communicates what Plec and Pettenger⁵² describe as "a rhetoric of resignation, naturalizing consumption of resources and teaching us to put our trust in industry solutions to energy problems." Or as Schneider et al.²⁷ and Cahill²⁶ put it, quoting the neoliberal bromide: "There is no alternative" to the *status quo*.

Demand as blame in litigation

Although the tobacco industry sells "freedom of choice" as *liberty* in public relations, in litigation they equate it with *blame* toward individuals who exercised their choice to smoke.^{13,164,183,184} Climate litigation is nascent, yet the fossil fuel industry has already successfully repackaged demand as *lock-in* to instead impute *blame* on customers for being individually responsible.

In 2018, arguing in defense of five oil companies (including ExxonMobil Corp) against a lawsuit brought by California cities seeking climate damages, Chevron lawyer Theodore Boutrous

Jr. offered his interpretation of the IPCC's latest report: "I think the IPCC does not say it's the production and extraction of oil that is driving these emissions. It's the energy use. It's economic activity that creates demand for energy." "It's the way people are living their lives."¹⁸⁹ The judge's dismissal of the case accepted this framing: "[W]ould it really be fair to now ignore our own responsibility in the use of fossil fuels and place the blame for global warming on those who supplied what we demanded?"¹⁹⁰

Even if plaintiffs prove their case, fossil fuel companies can invoke "affirmative defenses"—as tobacco companies often have—such as "common knowledge" and "assumption of the risk."^{164,183} These respectively argue (1) "that the plaintiff had engaged in an activity [such as smoking] that involved obvious or widely known risks," and (2) "that the plaintiff knew about and voluntarily undertook the risk."¹³ As Brandt¹⁶³ explains it, "If there was a risk, even though 'unproven,' it nonetheless must be the smoker's risk, since the smoker had been fully informed of the 'controversy.' The industry had secured the best of both worlds."

By way of the FFS frame, ExxonMobil appears to have constructed an ability to do the same. On the one hand, "risk" rhetoric is weak enough to allow the company to maintain a position on climate science that is ambiguous, flexible, and unalarming ("risk rhetoric facilitates ExxonMobil's have-it-both-ways position on AGW"). On the other, it is strong enough—and prominent enough, in NYT advertorials and elsewhere—that ExxonMobil may claim that the public has been well informed about AGW. This duality has been a cornerstone of the tobacco industry's legal position on the "risks" of smoking: "Everyone knew but no one had proof."^{163,164} Akin to early, tepidly worded warning labels on cigarette packages, ExxonMobil's advertorials in America's newspaper of record help establish this claim, sometimes explicitly: "*Most people acknowledge* that human-induced climate change is a long-term *risk*," a 2001 advertorial states^{13,130} (emphases added). "The *risk* of climate change and its *potential* impacts on society and the ecosystem are *widely recognized*," says another the following year.¹⁹¹ As Baker¹⁹² has pointed out about the socialization of risk, "a transfer of risk is also a transfer of responsibility [R]isk creates responsibility."

The fossil fuel industry's use of demand-as-blame framing is not limited to its legal defenses. As Schneider et al.²⁷ describe, fossil fuel interests have likewise sought to delegitimize AGW activism, such as the fossil fuel divestment movement, by deploying a rhetorical "hypocrite's trap [that] performs the disciplinary work of individualizing responsibility" (see also Ayling¹⁹³).

Historical contexts, ramifications, and trajectories of ExxonMobil's communication tactics

ExxonMobil's selective use of rhetoric and discourse to frame AGW epitomizes the first "general principle" of effective public affairs according to Herbert Schertz,¹⁸⁵ Mobil Oil's Vice President of Public Affairs (1969–1988) and the pioneer of their advertorials: "Grab the good words – and the good concepts – for yourself."¹⁸⁵ "[B]e sensitive to semantic infiltration, the process whereby language does the dirty work of politics...Be sensitive to these word choices, and be competitive in how you use them. Your objective is to wrap yourself in the good phrases while sticking your opponents with the bad ones."

Risk

ExxonMobil Corp's systematic introduction of "risk" rhetoric into its doubt-mongering advertorials coincided with the 1999 merger of Exxon and Mobil, suggestive of a strategic shift in public relations.

A second shift, in the mid-2000s, from explicit doubt to implicit acknowledgment confused by "risk" rhetoric, coincides with what one ExxonMobil Corp manager saw as "an effort by [then CEO Rex] Tillerson to carefully reset the corporation's profile on climate positions so that it would be more sustainable and less exposed."⁴⁸

To this day, ExxonMobil Corp's (also Chevron's and ConocoPhillips') refrain on AGW, and the primary basis on which the company is now widely perceived to accept basic climate science, is that it is a "risk."^{26,194,195} Across all of ExxonMobil Corp's flagship reports concerning AGW, by far the highest scoring collocates of "climate change" and "global warming" is "risk(s)" (S6.1, [supplemental information](#)). Compared with internal and peer-reviewed documents, terms in flagship reports invoking "risks of climate change" are highly divergent (S6.1). As with advertorials, none say that climate change is real and human caused.

Individualized responsibility

The findings in the [results](#) section lead us to conclude that ExxonMobil advertorials used frames of individualized responsibility and the rhetoric of "risk" to construct what St. John III³⁵ calls a "sense-making corporate persona" that appealed to the enduring principles of "rugged individualism" and self-reliance that pervade US culture and ideology.^{35,196–201} Their public affairs campaign coincided with solidifying, intertwined notions of distributed risks and individualized responsibility in western public policy debates since the 1970s, which have been driven by the global embrace of neoliberalism and globalization^{27,197,202,203} and encouraged by reductive, episodic news framings^{16,179} (and which are conceptualized by social theories^{59,204,205} such as Beck et al.'s "risk society,"^{170,206,207} Douglas et al.'s "risk culture,"²⁰⁸ and Foucault et al.'s "governmentality").^{209,210} ExxonMobil tapped into this trend toward the individualization of social risks, and brought it to bear on AGW.^{59,208,211}

ExxonMobil is part of a lineage of industrial producers of harmful commodities that have used personal responsibility framings to disavow themselves.^{212–214} Among them: tobacco companies;^{13,119,120} the National Association of Manufacturers;²¹⁵ plastics producers (including Exxon, Mobil, and ExxonMobil Corp), packaging and beverage manufacturers, and waste companies;^{197,216–222} and purveyors of sugar-sweetened beverages and junk food,^{98,99,214} leaded products,^{223,224} motor vehicles,^{94,225} alcohol,^{12,226} electronic gambling,²²⁷ and firearms.²²⁸

Among, in particular, the public AGW communications of major fossil fuel companies, individualized responsibility framings—and the accompanying narrative of fossil fuel lock-in—have become seemingly ubiquitous.^{26,51} The very notion of a personal "carbon footprint," for example, was first popularized in 2004–2006 by oil firm BP as part of its \$100+ million per year "beyond petroleum" US media campaign.^{229–235} Discourse analysis of this campaign led Doyle²³⁶ to conclude that "BP places responsibility for combatting climate change upon the individual consumer." Smerecnik and Renegar⁵⁷ have shown that subsequent BP branding activities similarly "plac[e] participatory emphasis

on consumer conservation behavior as opposed to corporate responsibility." This industry framing continues to dominate today.^{26,81} In 2019, for instance, BP launched a new "Know your Carbon Footprint" publicity campaign.²³⁷ In 2020, the CEO of Total said that "Change will not come from changing the source of supply. You have to reduce demand."²³⁸ Until 2020, all major oil and gas companies disregarded or disavowed accountability for all Scope 3 greenhouse gas emissions resulting from the use of their products. ExxonMobil Corp, Chevron, and ConocoPhillips continue to do so.²³⁹

The result is that fossil fuel industry discourse on AGW appears to have encouraged and embodied what Maniates¹⁹⁷ describes as "an accelerating individualization of responsibility" that "is narrowing, in dangerous ways, our 'environmental imagination'" by "ask [ing] that individuals imagine themselves as consumers first and citizens second."^{197,26,27,52,56} This depoliticized "capitalistic agency," Smerecnik and Renegar⁵⁷ argue, works to "prohibit fundamental social change that would disrupt the fossil fuel industry."^{57,59} Experimental evidence appears to support this conclusion. Palm et al.,²⁴⁰ for example, observe that messages framed in terms of individual behavior not only "decreased individuals' willingness to take personal actions" but also "decreased willingness to [take collective action such as to] support pro-climate candidates, reduced belief in the accelerated speed of climate change, and decreased trust in climate scientists." Illustrations of how narratives of individualized responsibility have protected fossil fuel interests from climate action are widespread. One is Yale University's 2014 refusal to divest from fossil fuel companies, which was "predicated on the idea that consumption of fossil fuels, not production, is the root of the climate change problem."²⁴¹ Another is the Republican Party's 2020 legislative agenda on AGW, whose premise was that "fossil fuels aren't the enemy. It's emissions."^{242,243} A third is that the Paris Agreement "is silent on the topic of fossil fuels."⁶⁸

Summary and conclusion

Available documents show that, during the mid-2000s, ExxonMobil's public AGW communications shifted from explicit doubt (a Scientific Uncertainty frame) to implicit acknowledgment couched in discourses conveying two frames: a Socioeconomic Threat frame, and a Fossil Fuel Savior (FFS) frame. According to the FFS frame:

- (1) Everything about AGW is uncertain: a "risk," as contrasted with a reality.
- (2) Fossil fuel companies are passive suppliers responding to consumer energy demand.
- (3) Continued fossil fuel dominance is (1) inevitable, given the insufficiency of low-carbon technologies; and (2) reasonable and responsible, because fossil fuels lead to profound, explicit benefits and only ambiguous, uncertain climate "risk(s)."
- (4) Customers are to blame for demanding fossil fuels, whose "risk(s)" were common knowledge. Customers knowingly chose to value the benefits of fossil fuels above their risks.

Ignored and obscured by these perspectives are fossil fuel interests' pervasive marketing, disinformation campaigns, and lobbying against climate and clean energy policies, all of which

have served to establish and reinforce infrastructural, institutional, and behavioral carbon lock-ins, thereby undercutting consumer choice and agency.^{244,245}

Propaganda tactics of the fossil fuel industry such as these have received less scrutiny than those of their tobacco counterparts. Further attention is needed, because although individualized narratives of risk, responsibility, and the like are less blatant than outright climate science denial, such “discursive grooming” is now pervasive in structuring the agenda of scholars, policymakers, and the public.^{59,68,69,197,246}

EXPERIMENTAL PROCEDURES

Resource availability

Lead contact

Further information and reasonable requests for resources by qualified researchers should be directed to and will be fulfilled by the lead contact, Geoffrey Supran (gjsupran@fas.harvard.edu).

Materials availability

This study did not generate new unique materials.

Data and code availability

Raw data (original PDF internal documents, peer-reviewed publications, and advertorials) for this study cannot be reproduced due to copyright restrictions. However, a catalog of all 180 analyzed documents, and links to public archives containing these data, are provided in S7, [supplemental information](#). Additionally, raw searchable .txt versions of all documents, as well as post-processed flattened text and document term matrices, are deposited on Harvard DataVerse: <https://doi.org/10.7910/DVN/XXQUKJ>. The datasets and code generated during this study are provided in the same repository. Access will be granted upon reasonable request by qualified researchers.

Corpora

For detailed descriptions of how we previously compiled the 180 ExxonMobil documents analyzed in this study, see Supran and Oreskes.^{1,2} For a catalog of all 180 documents, and links to their public archives, see S7, [supplemental information](#). In summary, the 32 internal company documents (1977–2002) were collated from public archives provided by ExxonMobil Corp,¹⁰¹ *InsideClimate News*,¹⁰² and Climate Investigations Center.¹⁰³ The 72 peer-reviewed publications (1982–2014) were obtained by identifying all peer-reviewed documents among ExxonMobil Corp’s lists of Contributed Publications, except for three articles discovered independently during our research. All 72 publications were (co-)authored by at least one ExxonMobil employee.¹⁰⁴ The 76 advertorials (1972–2009) expressing any positions on AGW (real and human caused, serious, or solvable) were identified by manual content analysis of 1,448 ExxonMobil advertorials (1924–2013) collated from PolluterWatch and ProQuest archives.^{105,106}

Pre-processing

To enable computational analysis, scanned documents were converted to searchable text files using optical character recognition. Text was stripped of formatting details and punctuation, tokenized, and lowercased (for details, see S1.1, [supplemental information](#)). This yielded internal, peer-reviewed, and advertorial corpora comprising 69,802 words, 716,477 words, and 34,141 words (16,121 in Mobil advertorials and 18,020 in ExxonMobil Corp advertorials), respectively.

For divergent term (topic) analysis, we added (substituted) several synthetic tokens that combine: terms of identical cognate form (e.g., “effect” and “effects” became “effect(s)”; and terms judged by the authors to be near-synonyms (e.g., “co2” and “carbon dioxide” became “co2/carbon dioxide”; “countries” and “nations” became “countries/nations”)—for all synthetic tokens, see `vectorize.R` script.^{109,247} Document collections were transformed into document-term matrices comprising all: 1- to 5-grams (unique, contiguous word strings of 1–5 tokens in length) for divergent term analysis; and 1-grams for divergent topic analysis.²⁴⁸

Divergent term analysis (FS and LL ratio)

Internal, peer-reviewed, and advertorial corpora were compared pairwise to identify rhetorical distinctiveness (or divergence) between the terms communicated in each text. (We combine all (Mobil plus ExxonMobil Corp) advertorials before comparing them against internal and peer-reviewed documents from Exxon and Exxon/ExxonMobil Corp, respectively. This simplifies the presentation of results without substantively affecting our findings.) To capture different forms of divergence, we applied two algorithms: FS and Dunning LL ratio (G^2) score.^{108–110} FS and LL are established, complementary tools for word frequency analysis in computational linguistics and digital humanities.^{110,249,250}

The FS indicates how often a given term appears in one corpus versus another. The score ranges from 0 (when only corpus A features the term) to 1 (when only corpus B includes the term). To account for the difference in word counts between corpora, we normalized scores by using relative frequencies. For example, a score of 0.8 means that 80% of all normalized instances of a term appear in corpus B. As Risi and Proctor observe, “FSs are useful for identifying taboos: terms generally avoided by one side or the other.”¹⁰⁹

FSs produce immediately interpretable results, yet their reliance on multiplicative ratios—versus additive differences—tends to over-represent rare words.¹⁰⁸ To identify subtle patterns that might otherwise escape notice, we also use the LL (G^2) statistic proposed by Dunning (1993), which is a parametric analysis that primarily identifies “surprising,” additively over-represented words, while also giving some weight to multiplication.^{108,110,251} Large $[G^2]$ scores indicate terms that have statistically significant relative frequency differences between two corpora. LLs are therefore useful for identifying tropes: terms used disproportionately by one side.

Divergent topic analysis (LDA)

In the field of automated text summarization, divergent terms identified by LL are referred to as “topic signatures.”^{249,252} In order to identify the topics represented by such terms, and to better understand the roles these terms play in framing each topic, we also examine the documents using topic modeling with LDA.¹¹¹ LDA is a computational, unsupervised machine-learning algorithm for discovering hidden thematic structure in collections of texts.²⁵³ *A priori* coding schemes are not supplied. Rather, ‘topics’ (clusters of words associated with a single theme) emerge inductively based on patterns of co-occurrence of words in a corpus.

We are specifically interested in identifying the topical distinctiveness (or divergence) between document categories. In the main text, we compare topics between (α) all advertorials and (β) combined internal and peer-reviewed documents.

To do so, we first model the distribution of topics over all document categories, by inputting to LDA an aggregated corpus comprising all advertorials, internal documents, and peer-reviewed publications (for details of LDA model selection, topic validation, and labeling, see section S1.2, [supplemental information](#)). Once topic-word distributions are obtained, we then take an approach analogous to that for finding divergent terms above, noting that just as LL ratios of term frequencies identify divergent terms, LL ratios of topic weights identify divergent topics. We compute LL ratios of topic weights by constructing document-topic matrices for each of sub-corpora α and β .

Although they are run independently, analyses of divergent terms (by FS and LL) and topics (by LL of LDA) are complementary. The former identifies the distinctive usage of individual n-grams by one corpus versus another. The latter helps contextualize the thematic role that these words together play in communicating and framing topics.

Frame package analysis

Van Gorp¹¹⁷ argues that the “strongly abstract nature of frames implies that quantitative research methods should be combined with the interpretative prospects of qualitative methods.” To this end, we use the distinctive terms and topics identified using computational techniques to then inform an inductive, qualitative approach to constructing frames as frame packages in advertorials. Van Gorp¹¹⁷ defines frame packages as an integrated structure of framing devices (manifest textual elements that function as indicators of a frame) and reasoning devices (logical chains of causal reasoning), and proposes Strauss and Corbin’s²⁵⁴ three-step coding scheme for identifying frame packages and

assembling them into a so-called “frame matrix.”^{6,10,17,116–118,254} We adopt this approach.

Open coding

The first step is to compile what Van Gorp¹¹⁶ calls an “inventory of empirical indicators that may contribute to the readers’ interpretation of the text,” comprising feasible framing or reasoning devices identified in each document. We used FS, LL, and LDA to systematize this process of locating frames and detecting how they are shaped by lexical composition (for details, see S1.3, [supplemental information](#)). We further investigated these discursive constructs by performing collocation searches.⁵¹ The logDice statistic was computed to measure collocational association because it permits meaningful comparison of different sized corpora.^{255,256}

Axial coding

The second step is to arrange coded devices along “axes of meaning” by comparing and contrasting open-coding results between documents and then reducing the results to broader meanings or dimensions.^{113,116} We do so with reference to an inventory of discourses that we assembled based on a literature review of past studies of AGW communications by fossil fuel interests (see S3, [supplemental information](#)).¹¹⁶

Selective coding

The last step is to enter axial codes into a “frame matrix” that summarizes the framing and reasoning devices of each frame package.¹¹⁶

SUPPLEMENTAL INFORMATION

Supplemental information can be found online at <https://doi.org/10.1016/j.oneear.2021.04.014>.

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AUTHOR CONTRIBUTIONS

Conceptualization, G.S.; methodology, G.S.; validation, G.S. and N.O.; formal analysis, G.S.; investigation, G.S.; writing – original draft, G.S.; writing – review & editing, G.S. and N.O.; visualization, G.S.; supervision, G.S. and N.O.; funding acquisition, G.S. and N.O.

DECLARATION OF INTERESTS

The authors have received speaking and writing fees (and N.O. has received book royalties) for communicating their research, which includes but is not limited to the topics addressed in this paper. The authors have no other relevant financial ties and declare no competing interests.

INCLUSION AND DIVERSITY

While citing references scientifically relevant for this work, we also actively worked to promote gender balance in our reference list.

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One Earth, Volume 4

Supplemental information

**Rhetoric and frame analysis of ExxonMobil's
climate change communications**

Geoffrey Supran and Naomi Oreskes

SUPPLEMENTAL INFORMATION

SUPPLEMENTAL FIGURES

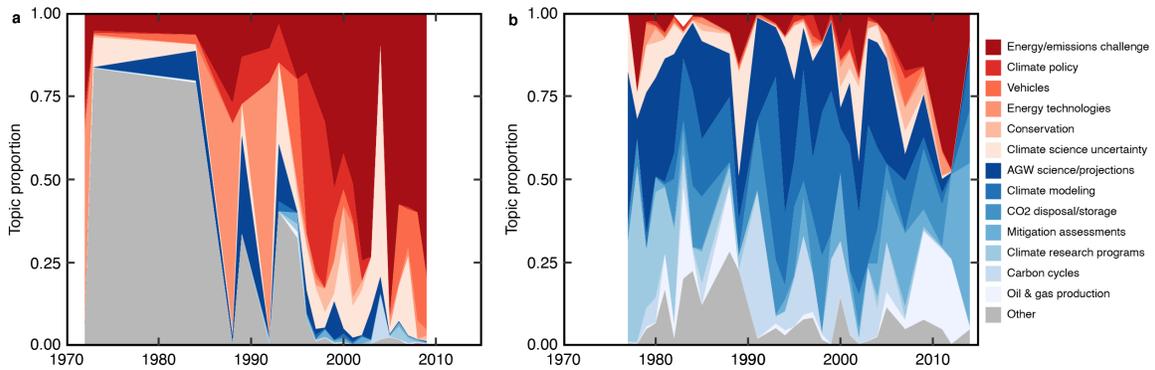


Figure S1. Topic prevalence over time in (a) advertorials and (b) internal and peer-reviewed publications. Topic proportions are calculated as the normalized sum of LDA per-document (d)-per-topic (k) probabilities ($\theta_{d,k}$) of all documents published each year. Note that, as documented in table S20, our corpus comprises only three advertorials published prior to 1988.

SUPPLEMENTAL TABLES

Table S1. Fossil fuel industry AGW discourses, based on a meta-analysis of existing academic literature. In some cases, discourses from individual studies straddle two or more discourses in our classification.

Author	Rowlands (2000) ³⁸	Livesey (2002) ³⁹	Smerecnik & Renegar (2010) ⁴⁰	Doyle (2011) ⁴¹	Plec & Pettenger (2012) ⁴²	Schlichting (2013) ²⁹
Corpus	Exxon and BP's public statements on AGW	Four advertorials in The New York Times	BP's "Helios Power" campaign	BP advertising campaigns	ExxonMobil's "Energy Solutions" TV advertisements	38 studies on industry actors' AGW communications
Time period	Unspecified (~1997-2000)	March-April 2000	2007	2005-06	2009, 2011	1990-2010
Focus	Positions of Exxon and BP Amoco on AGW	How ExxonMobil's public discourses construct social "reality"	Discourses in green marketing	Discursive strategies to create an environmental brand image	(Didactic) frames and discourses in green marketing	Strategic frames of industry actors
Analytic method	Review (not specifically defined)	Rhetorical and discourse analyses	Rhetorical analysis	Discourse analysis	Frame analysis	Frame meta-analysis
Discourses						
Climate Risk				"Risk" rhetoric channelling Beck's risk society. AGW as a future event rather than a present reality.		"Climate change might be/is a risk"
Doubt Mongering	Scientific uncertainty	Demonize most climate scientists		Scientific doubt-mongering		"Scientific uncertainty"
Free-Market Solutionism	Support "voluntary market-driven efforts"	Primacy of "the market", private sector, and economists.	Individual, capitalistic agency	Late capitalism economic discourse: global capitalism equals expanding global environmental good.		
Individualized Responsibility		Governments sidelined, regulatory controls rejected		Citizen as consumer. Blame on consumers for not buying BP's ostensibly environmentally friendly products. Responsibility for combating AGW placed on individual consumer.		"Industry is responsible for the climate. Consumers must also take responsibility".
Energy Poverty/Prosperity		"Lifestyle" protection		Prioritization of human needs and economic growth over the environment		
Energy Utopia			"Utopian fantasy world where fossil fuel-based transportation and a clean environment are harmoniously united"			
Fossil Fuel Solutionism		Responsible corporate actor pursuing "prudent", rationalist approach		BP as solution, rather than contributor, to AGW. Environmental leadership: Highlighting progressive and green values and investments.		"Fossil energy sources can be used sustainably"
Greenwashing/Corporate Symbolic Environmentalism	Reducing scope-1 GHG emissions				Alternative energy leader/expert solving environmental problems; Green energy	"Industrial leadership": "Corporate achievements in climate protection"; Green "visionaries"
Scientific/Technological Optimism	Support "continued research"	Scientific powerhouse and technological leader. Entrepreneurship and technology will provide solutions.		Technology as the solution	Technocratism: Scientific & technological solutions; authoritarian values	"Technological innovations are the solution"
Policy Apocalypse	Socioeconomic harm of "premature" climate policies (e.g. Kyoto Protocol)					"Socioeconomic consequences"
Technological Shell-Game				"Clean" natural gas presented as equivalent to renewable energy		
Whataboutism	Developing countries must participate in climate policies					
Other						

Table S1, continued.

Author	Robinson (2014) ⁴³	Gaither & Gaither (2016) ⁴⁴	Schneider <i>et al.</i> (2016) ⁴⁵	Cahill (2017) ⁴⁶	Ayling (2017) ⁴⁷
Corpus	Marketing campaigns of oil majors	Advertisements on APCCCE (coal) and API (petroleum) trade group websites	Five US coal industry corporate advocacy campaign case studies	Corporate websites, blogs, and social media channels of five oil and gas majors	Australian coal industry (Minerals Council of Australia) statements
Time period	N/A (Case studies span ~1998-present)	Spring 2014	N/A (Case studies span ~2008-present)	2016	2013-16
Focus	Brand lessons from oil industry image marketing campaign case studies	Discourses in trade group marketplace advocacy	Rhetorical strategies of US coal industry	Discourse and framing by oil and gas companies	Coal industry discourse in response to fossil fuel divestment activism
Analytic method	Review (not specifically defined)	Circuit of culture discourse analysis	Critical approaches from environmental communication, rhetoric, cultural studies	Critical discourse analysis	Content analysis
Discourses					
Climate Risk				"Risk management lens that downplays the material impact of climate change while foregrounding the economic impacts of mitigation"	
Doubt Mongering			"Corporate ventriloquism": "corporations transmit messages through other entities, usually of their own making, in order to construct and animate an alternative ethos, voice, or identity that advances their interests".		
Free-Market Solutionism				"Free markets = fair and efficient solutions"	
Individualized Responsibility	Employees as global citizenry present corporations as citizens		"Hypocrite's trap": "set of interrelated arguments that attempts to disarm critics of industries...based on the critics' own consumption of or reliance on those goods".	"The world needs more energy (increasing energy demand inevitable)". "Corporations as citizens vs Citizens as consumers".	Divestment activists are "hypocritical"
Energy Poverty/Prosperity			"Energy utopia": "particular energy source as the key to providing a "good life" that transcends the conflicts of environment, justice, and politics".	"Supplying energy is a humanitarian project".	"Contribution to the Australian community through exports, wages, jobs, investment, taxes, and royalties, as well as its provision of reliable and affordable electricity for Australian households and businesses". "Concern for the overseas poor".
Energy Utopia					
Fossil Fuel Solutionism				"Fossil fuels must continue to play an integral role in the global economy for the foreseeable future".	Coal is "essential to Australia's past and future development"
Greenwashing/Corporate Symbolic Environmentalism	Green rebranding: showcase investments in clean energy, climate research; conservation grants; scope-1 GHG emissions reductions			"Increasing efficiency and innovating new technologies". "Scientific knowledge and technical expertise".	"Support for indigenous youth through employment opportunities"
Scientific/Technological Optimism					Innovation: "progress is being made on carbon capture and storage (CCS) and new-generation technologies"
Policy Apocalypse		Industry supporter (America's everyman/everywoman) adversely impacted by environmental regulations. Industry as paternal caretaker for American citizens, under threat by regulation.	"Industrial apocalyptic": "imminent demise of a particular industry, economic, or political system and the catastrophic ramifications associated with that loss".		"Lack of support [for industry] will result in job losses, higher electricity bills, and loss of government revenues"
Technological Shell-Game	Natural gas as "climate-friendly"		"Technological shell game": "misdirection that relies on strategic ambiguity about the feasibility, costs, and successful implementation of technologies in order to deflect attention from environmental pollution and health concerns".	"Renewable energy is expensive and unreliable". "Natural gas is the new coal".	Australian coal "is the cleanest coal in the world"
Whataboutism					
Other					

Table S1, continued.

Author	Scanlan (2017) ⁴⁸	Grantham & Vieira Jr. (2018) ⁴⁹	Jaworska (2018) ²⁵	Lamb <i>et al.</i> (2020) ⁵⁰
Corpus	Oil and gas industry advertisements	12 CEO/President welcome letters	Corporate social responsibility and environmental reports of major oil companies	N/A (Theorized taxonomy of discourses of climate delay)
Time period	2000-15	2002 to 2013	2000-13	N/A
Focus	Frames in industry rhetoric on fracking	ExxonMobil's social responsibility communication	Discourses in corporate social responsibility	Discourses of climate delay
Analytic method	Content analysis	Text network analysis	Corpus-linguistic and discourse analyses	Expert elicitation
Discourses				
Climate Risk		"Planet" theme introduces keyword of "risk"	Industry as victim of unpredictable climate "risk"	
Doubt Mongering			Scientific doubt-mongering	
Free-Market Solutionism				"No sticks, just carrots": "we should only pursue voluntary policies ('carrots'), in particular those that expand consumer choices"
Individualized Responsibility			Differentiation: shifting responsibility to other stakeholders (consumers, governments)	"Individualism": "redirects climate action from systemic solutions to individual actions"
Energy Poverty/Prosperity	Natural gas offers "economic development and jobs"; "energy independence and security"		Downplay AGW urgency by foregrounding the economy and energy demand	"Appeal to social justice": "moves social impacts to the forefront of policy discussions, framing a transition to renewable energy as burdensome and costly to society"
Energy Utopia				
Fossil Fuel Solutionism			Non-radical changes proposed	"Fossil fuel solutionism": "the fossil fuel industry is "part of the solution to the scourge of climate change""
Greenwashing/Corporate Symbolic Environmentalism			Industry as technological leader of breakthrough solutions. Enthusiasm for breakthrough technological solutions.	"All talk, little action": "points to recent advances in lowering emissions or in setting ambitious climate targets, thus downplaying the need for more stringent or new types of additional action"
Scientific/Technological Optimism	"Faith in science and American ingenuity"			"Technological optimism": "technological progress will rapidly bring about emissions reductions in the future"
Policy Apocalypse				"Appeal to well-being": "climate policy threatens fundamental livelihoods and living standards"
Technological Shell-Game	Natural gas offers "environmental protection and sustainability"			
Whataboutism				"Whataboutism": "Actors [point to] their own small contribution to global emissions"
Other				"Free rider" excuse: "others will actively take advantage of those who lead on climate change mitigation". "Policy perfectionism": "argues for disproportional caution in setting ambitious levels of climate policy in order not to lose public support". "Change is impossible": "Reifies the current state of things and denies the ability of societies to organize large socio-economic transformations". "Doomism": "any actions we take are too little, too late. Catastrophic climate change is already locked-in"

S1. SUPPLEMENTAL EXPERIMENTAL PROCEDURES

S1.1. Corpora

The 180 ExxonMobil documents analyzed in this study were previously compiled in refs. ^{1,2}. One 1989 advertisement, however, was here omitted because, as noted in ref. ², it is not in fact an advertorial, but an advertisement in *The New York Times Magazine* that may or may not have actually included Exxon among its industry sponsors³.

Unlike advertorials in the *NYT*, peer-reviewed publications disclosed by ExxonMobil Corp, and internal documents recovered to date, all three of which are bound sets, ‘non-peer-reviewed’ documents analyzed in our original study are virtually limitless in potential number and scope and so are excluded in this study. Indeed, as noted in ref. ¹, there are countless additional climate change communications from ExxonMobil that could be included in future work, including as yet undiscovered internal documents, advertorials and advertisements published in outlets beyond the *NYT*, and non-peer-reviewed materials such as speech transcripts, television advertisements, social media posts, patent documents, shareholder reports, and third-party communications (for example, from lobbyists, think-tanks, and politicians funded by ExxonMobil). These documents are potentially important, but are not the focus of the present study.

See section S6, however, for algorithmic analysis of all ExxonMobil Corp flagship reports concerning AGW.

S1.2. Pre-processing

To enable computational analysis in *R*, scanned documents were converted to searchable text files using *Readiris Corporate 17* optical character recognition (OCR) software^{4,5}. We then used regular expression search algorithms and manual cleaning to strip out formatting details such as boilerplate archive timestamps and copyright statements; column breaks and whitespaces; author, journal, and publisher information; publication dates; and page numbers. Bibliographies, contents pages, disclosure and acknowledgment statements, appendices, and forewords (unless written by ExxonMobil representatives) were also removed from internal and peer-reviewed documents. In the case of advertorials, company logos and graphics (except for pullout quotations) were removed. Spellcheck was used to identify and correct common OCR-generated errors.

We did not use a stemmer or lemmatiser to reduce related words to their base forms, but we added several synthetic tokens that combine terms of similar cognate form (e.g. “co2” and “carbon dioxide” became “co2/carbon dioxide”; “effect” and “effects” became “effect(s)”).

For divergent term analysis (section 2.3), stopwords were not removed. For divergent topic analysis (section 2.4), stopwords were removed, after which word counts of internal and peer-reviewed corpora were respectively scaled down – by randomly sampling the same fraction of words from each document of each corpus – to match one another and to collectively match the word count of advertorials.

Only terms appearing at least 10 times in a corpus were included in document-term matrices.

S1.3 Topic Modeling

S1.3.1 Model selection

LDA topic modeling is performed using the *R* ‘topicmodels’ package by Grün and Hornik (2011)^{6,7}. The units of analysis were individual words. These words were itemized for LDA into ‘documents’ (as defined by Maier *et al.* (2018)) comprising the original 180 articles⁸. As prescribed by Maier *et al.*, hyperparameter α {0.001, 0.005, 0.01, 0.05, 0.1, 0.5, 1} was optimized

by maximizing *intrinsic topic coherence* (as defined by Mimno *et al.* (2011)) for fixed $\beta = 1/K$ and for a range of K values $\{10, 11, \dots, 30\}$ ⁸⁻¹⁰. For each value of K , models corresponding to the two top-scoring α values were retained. The most appropriate model was then selected based on intersubjective qualitative author judgment, using what Maier *et al.* (2018) term a *substantive search in coherence-optimized candidates*⁸. This involved assessing the interpretability and relative efficacy of the optimized models for each value of K (and two α values) in terms of (a) per-term-per-topic probability distributions ($\phi_{w,k}$) and (b) reordered lists of the top words assigned to each topic using Sievert and Shirley (2014)'s *relevance* metric¹¹. Models with $K < 15$ led topics to blur together, while $K > 20$ yielded diminishing returns due to excessive granularity. Final parameters based on this recursive process were $K = 16$, $\alpha = 0.1$, $\beta = 1/K = 10$.

SI.3.2 Topic validation and labeling

The semantics of each topic solution were examined on the basis of (a) authors' expert knowledge about climate (denial) communications and familiarity with the documents; (b) four metrics proposed by Maier *et al.* (2018): (i) *Rank-1*, which counts how many times each topic is the most prevalent in a document; (ii) *intrinsic coherence* of individual topics¹⁰; (iii) *relevance* (with weighting $\lambda=0.6$), which accounts for both per-term-per-topic probabilities ($\phi_{w,k}$) and the marginal probability of each term in the corpus (p_w)¹¹; and (iv) *concentration* (Hirschman-Herfindahl Index), which measures the extent to which topics are spread across documents⁸; and (c) LL ratio, which, as previously introduced, quantifies the distinctiveness of topics in one sub-corpus versus the other. Accordingly, three “junk” topics were excluded owing to semantically incoherent word lists, and/or low *Rank-1*, and/or low *coherence*, and/or low LL ratio, and/or high *concentration*.

Remaining topics were validated by intra-topic and inter-topic semantic validity. To evaluate the former, for each topic, we read all documents with relatively large per-document (d)-per-topic (k) probabilities $\theta_{d,k} > 0.2$, with particular attention to terms with high *relevance* scores and that are most exclusive to that topic^{8,12}. The guiding questions in our readings were: (i) Is the topic semantically coherent – communicating a substantive theme consistent with the qualitative meaning of the texts?; and (ii) What label should be given to the topic to describe the theme most comprehensively? Table 4 in the main text presents these validated, manually labeled topics. (Note that due to the relatively small corpora under investigation, and, accordingly, a relatively small number of topics emergent from our LDA model, semantic validation based on algorithmic clustering of topics into higher-order themes is not applicable here^{8,9,13}.)

Finally, following Boussalis and Coan (2016), we evaluated inter-topic semantic validity by comparing LDA model topic assignments against those identified by manual content analysis of a random sample of 72 documents (40% of all documents)⁹.

In the pilot phase of human coding, two coders – one author and a research assistant – independently coded 10 randomly selected documents. This involved assigning each document a primary topic of either: one of the 13 topics in table 4; or “other” if none of those LDA model-derived topics meaningfully captured the main theme. The coders then compared and discussed their coding choices. The coders then independently coded an additional 10 randomly selected documents and again reviewed their assignments. Finally, the coders independently coded another 36 randomly selected documents (20% of all documents); the results of this sample were used to calculate intercoder reliability in terms of percentage agreement (81%) and Krippendorff's α coefficient (0.79) using ReCal2 online software¹⁴⁻¹⁶. Through “negotiated agreement” of discrepancies between coders, intercoder agreement was also calculated (89%; $\alpha = 0.88$)¹⁷.

Having achieved satisfactory intercoder reliability and agreement, one of the coders proceeded to code an additional 36 randomly selected documents. These results, combined with those of the previous 36 coded documents, yielded a sample of 72 randomly coded documents (40% of all documents, including: 47% of internal documents; 44% of peer-reviewed publications; and 33% of advertorials). This sample was then compared against our LDA model's assignments. We find the microaveraged precision and recall for primary topic classifications to be 0.59 and 0.60, respectively. Although these values are lower than common cutoffs of 0.7 to 0.8, they are comparable to those reported by Boussalis and Coan (2016) and are considerably better than rolling a 13-sided dice^{9,18}.

Moreover, as Boussalis and Coan (2016) note, “assessing a topic model using only the primary topic offers a conservative estimate of performance. Several distinct themes often contribute to a document's composition and deciding which is ‘primary’ is often quite difficult for both human and machine. Indeed, allowing documents to be composed of multiple topics...is one of the major advantages of using the LDA”⁹. When we account for the two most probable topics identified by our LDA model, the proportion of documents correctly recalled rises to 0.74.

Figure S1 displays the relative prevalence of LDA-generated topics over time in (a) advertorials and (b) internal and peer-reviewed publications. Although, as noted in section S1.4.1, these trends fall short of a comprehensive longitudinal frame analysis and as such should be interpreted with caution, the topic proportions in fig. S1a nevertheless suggest some initial insights. We see, for example, that the topics of ‘Climate science uncertainty’ and ‘AGW science/projections’ are interwoven throughout both Mobil's advertorials in the 1990s and ExxonMobil Corp's advertorials in the 2000s. We also observe the strong emergence of the ‘Climate policy’ topic in the run up to and wake of the 1997 UN climate negotiations in Kyoto. Even more apparent is an ever-growing dominance of the ‘Energy/emissions challenge’ topic throughout the 2000s.

These trends are broadly consistent with (i) our observations during ‘frame package’ open-coding of shifts in the relative prevalence of ExxonMobil's public framing devices over time; (ii) our past codings of ExxonMobil's public positions on climate change over time (Supran and Oreskes (2017, 2020))^{1,2}; and (iii) Schlichting (2013)'s observations of industry actors' shifting climate change “master frames” over time²⁹. The trends we observe paint an overall picture of coevolving topics – and, by approximate extension, frames – whose center of mass has gradually shifted away from explicit attacks on science (represented by our Scientific Uncertainty frame) and towards subtler narratives about energy and emissions (represented by our Socioeconomic Threat and Fossil Fuel Savior frames).

S1.3.3 Log-likelihood ratios of topic weights

We compute LL ratios of topic weights by constructing document-topic matrices for each of sub-corpora α and β . In these matrices, we include only those topics whose weights correspond to $\geq 1\%$ of each sub-corpus's total word count.

S1.4 ‘Frame package’ analysis

As noted above, due to the relatively small corpora under investigation, a relatively small number of interpretable topics emerge from our LDA model. We therefore adopt a qualitative approach to inductive frame analysis rather than, for instance, algorithmically clustering topics into frames.

The units of analysis in our frame package analysis were individual advertorials. The unit of observation was the advertorial corpus.

SI.4.1 Open-coding

We conducted open-coding using *NVivo* digital annotation software, and used corpus linguistic tools to systematize the process in two ways¹⁹.

First, we used FS and LL as statistical methods for extracting central meanings and locating potential frames; and ran concordance searches to automatically collect text extracts for frame analysis^{20,21}. Although we analyzed each advertorial in its entirety, this approach helped us identify the loci for frames. Touri and Koteyko (2015) have previously demonstrated the efficacy of combining LL analysis with the frame package approach in this way²². Indeed, this was a mutually reinforcing process in that open-coding aided contextual interpretation of how divergent terms identified by FS and LL analysis construct meanings.

Second, and in parallel, we used LDA analysis to extract topics that may generally be regarded as “frame elements [or] a full frame package, or...a combination of the two” (Walter and Ophir (2019))¹². Just as divergent terms from FS and LL help extract central meanings and locate potential frames, “regularities of [word] co-occurrence” in topic models, write Klebanov *et al.* (2008), “are considered in some linguistic theories as the major building block for characterizing meaning; this idea is well expressed in the famous distributional hypothesis: “Know the word by the company it keeps””²³. Thus, in order to further help detect frames shaped by lexical composition, we also ran concordance searches based on LDA top words to automatically collect text extracts for frame analysis. As Van Gorp (2010) notes, “[t]he intention of an inductive framing analysis is to reconstruct the frames that are useful to define a certain topic”²⁴. We therefore open-coded together documents sharing similar LDA topic weightings, which tend to display recurring linguistic elements or framing/reasoning devices indicative of frame packages^{12,24}.

We further investigated discursive constructs by performing collocation searches using the logDice statistic applied to corpora tokenized by sentence²⁵⁻²⁷.

Our inventory resulting from open-coding comprised manifest framing devices such as catchphrases, lexical choices, visual images, depictions, metaphors, and exemplars; and (often latent) reasoning devices in the form of apparent definitions of the AGW problem, assignments of responsibility for causing it and/or solving it, identifications of solutions, and moral assessments. As Entman, Matthes, and Pellicano (2009) note, a defining feature of a frame is that it “repeatedly invokes the same objects and traits, using identical or synonymous words and symbols...”²⁸. The linguistic tools employed in this study are amenable to the detection of such cues, and therefore to the identification and differentiation of frames from other features such as themes, arguments, and assertions.

Digital annotation during open-coding allows us to code the dates of all entries in this inventory. Following Schlichting (2013), this offers insights into how ExxonMobil’s public frames have shifted over time²⁹. The primary contribution of our inductive frame analysis, however, is its frame matrix, which may serve as the basis for a coding scheme in future quantitative, deductive, and fully longitudinal content analyses^{24,30}.

SI.4.2 Axial coding

We codify our axial codings with reference to an inventory of discourses that we assembled based on an informal literature review of past studies of AGW communications by fossil fuel interests²⁴. A summary of discourses identified by this literature review is provided in section S3.

S2. SUPPLEMENTAL DIVERGENT TERM ANALYSIS RESULTS

S2.1. Mobil versus ExxonMobil Corp advertorials

In section 2.1.1, we note that because both Mobil and ExxonMobil Corp advertorials often promoted doubt about climate science, terms conveying explicit doubt are common to both corpora and so do not appear in table 1. One example of this is the term “debate”, which appears $n_{EM} = 9$ times in ExxonMobil Corp advertorials and $n_M = 17$ times in Mobil advertorials. This corresponds to $FS = 0.37$ and $G_2 = -1.69$, indicating statistically insignificant divergence ($p = 0.24$ and 0.19 , respectively). Likewise, “uncertain(/ty/ties)” appears $n_{EM} = 13$ and $n_M = 18$ times, equivalent to $FS = 0.44$ ($p = 0.59$) and $G_2 = -0.35$ ($p = 0.55$). Other common terms displaying statistically insignificant divergence include “(un)know(/n/ing/ledge)”, “believe”, “compl(ex/exity/icated)”, “answer(s)”, etc.

S2.2. Advertorials versus internal and peer-reviewed documents

In section 2.4, we observe that ExxonMobil’s advertorials statistically overuse terms that reduce AGW to a downstream problem caused by consumer energy demand. We here note that advertorials do, in fact, contain divergent terms of “oil and natural gas” (compared to internal and peer-reviewed publications – see tables 2 and 3) and “fossil fuels” (compared to peer-reviewed publications – see table 3). In the majority of cases, however, these terms are employed in discourses such as Energy Poverty/Prosperity (“Abundant and affordable, fossil fuels have contributed to unprecedented prosperity for much of the human race. In decades to come, the benefits of modern fossil fuel energy will extend even further”¹⁵²); Policy Apocalypse (“World economic health will suffer as nations are forced to switch from fossil fuels...”¹⁸¹); and Greenwashing/Symbolic Corporate Environmentalism (“ExxonMobil is also leading the way in increasing safety and reducing marine spills in the oil and natural gas industry.”^{137,138}). Such examples do not speak to the cause of – or accountability for – AGW or greenhouse gas emissions. If anything, they generally reinforce the narrative that fossil fuels passively satisfy demand; for example: “[F]ossil fuels...[f]or at least several decades, they will continue to be the major source of the world’s energy needs”¹²⁸. The number of cases concerning responsibility for AGW or greenhouse gases is statistically insignificant even at $p \leq 0.05$ levels (“oil and natural gas”: LL ~ 0.01 , FS ~ 0.53 ; “fossil fuels”: LL ~ 2.79 , FS ~ 0.63). Virtually all such cases appear in advertorials that simultaneously promote doubt about whether AGW is real and human-caused and/or serious and/or solvable.

S3. LITERATURE REVIEW OF FOSSIL FUEL INDUSTRY AGW DISCOURSES

As noted in section S1.3.2, frame package analysis was guided by an informal literature review of existing studies of AGW communications by fossil fuel interests. Table S1 summarizes the results of this meta-analysis of contemporary (~1990–present) discourses. The scope of this review was limited to publications concerning AGW communications by fossil fuel producers. 15 such studies were investigated. For studies regarding discourses of climate denial and delay by a broader range of actors, such as conservative news media, columnists, think tanks, and other industries, see for example refs. ^{9,13,31–36}. For a review of AGW framing and discourse literature as a whole, see for example ref. ³⁷. For detailed taxonomies of Doubt Mongering discourse, as labeled in table S1, see ref. ¹ and several of the foregoing references.

S4. FRAME PACKAGE ANALYSIS RESULTS

The following are frame matrices summarizing framing and reasoning devices of each identified frame package.

S4.1 Scientific Uncertainty Frame

Table S2. Frame matrix of Scientific Uncertainty frame package.

Scientific Uncertainty Frame Package		
Reasoning Devices	Description	
Problem	Global warming is unproven	
Cause	Global climate system is complex, science is unsettled	
Moral evaluation	We don't know enough	
Solutions	Wait for better climate science research	
Framing Devices	Discourse	Example/Description
Catchphrases & lexical choices	Climate Risk	"Risk(s) of climate change" "Longterm"
	Doubt Mongering	"Debate" "Gap(s)"
	Scientific/Technological Optimism	"Invest(ing/ment(s))" "Promise"
Visual images	Doubt Mongering	Graphs and charts
	Scientific/Technological Optimism	Graphs and charts
Exemplars	Doubt Mongering	Quotations of contrarian scientists (e.g. Heidelberg Appeal; S Fred Singer)
Depictions	Climate Risk	Amorphous "risk(s)" of AGW
	Scientific/Technological Optimism	Dynamic "breakthrough" university research collaborations
Metaphors	Doubt Mongering	"Weather and climate"; "Climate change: a degree of uncertainty"
Example discourse quotations		
Climate Risk	"[C]limate changes may pose long-term risks. Natural variability and human activity may lead to climate change that could be significant and perhaps both positive and negative." ⁵¹	
Doubt Mongering	"Weather and climate. In the debate over climate change, there is an understandable tendency to use recent weather events to draw conclusions about global warming." ⁵²	
Scientific/Technological Optimism	"To address the scientific uncertainty, governments, universities and industry should form global research partnerships to fill in the knowledge gap, with the goal of achieving a consensus view within a defined time frame." ⁵³	

The Scientific Uncertainty frame presents AGW as unproven and, accordingly, advocates additional climate science research before any policy action is taken.

Central to this frame's problem definition and causal attribution is the discourse of 'Doubt Mongering', which promotes false scientific debate about whether AGW is real and human-caused. One example, a 2004 ExxonMobil Corp advertorial entitled "Weather and climate", argued that "In the debate over climate change, there is an understandable tendency to use recent weather events to draw conclusions about global warming"⁵². At work here are the key framing devices of catchphrases (such as "debate") and metaphors (such as "weather and climate"). The advertorial goes on to insist that "in the face of natural variability and complexity, the consequences of change in any single factor, for example greenhouse gases, cannot readily be isolated and prediction becomes difficult... scientific uncertainties continue to limit our ability to make objective, quantitative determinations regarding the human role in recent climate change or the degree and consequences of future change". Visual images (such as graphs and charts) and exemplars (such as quotations of the minority opinions of contrarian scientists) help falsely legitimize such claims.

Discourses of 'Scientific/Technological Optimism' and 'Climate Risk' help further the impression of scientific debate while simultaneously prescribing the moral evaluation that enough is not yet known to take any policy actions, and the solution of further scientific research. "To address the scientific uncertainty", reasons a 2007 advertorial, "governments, universities and industry should form global research partnerships to fill in the knowledge gap, with the goal of

achieving a consensus view within a defined time frame.”⁵³ Such Scientific/Technological Optimism repeatedly alleges “gap(s)” in scientific knowledge and emphasizes the “promise” of “breakthrough” research collaborations. The “risk” rhetoric that emerges in ExxonMobil Corp advertorials serves similar dual functions of presenting AGW as a risk rather than a reality and of thereby rationalizing research rather than policy action, as discussed in section 3.1. As a 2000 advertorial entitled “Unsettled Science” puts it, “[C]limate changes may pose long-term risks. Natural variability and human activity may lead to climate change that could be significant and perhaps both positive and negative.”⁵¹ ExxonMobil Corp accordingly argue that “future scientific research will help understand how human actions and natural climate change may affect the world and will help determine what actions may be desirable to address the long-term”.

S4.2 Socioeconomic Threat Frame

Table S3. Frame matrix of Socioeconomic Threat frame package.

Socioeconomic Threat Frame Package		
Reasoning Devices	Description	
Problem	Climate policy threatens prosperity	
Cause	Alarmist policy and politics are outrunning science	
Moral evaluation	Binding climate policies are unwarranted and economically dangerous	
Solutions	Voluntary efforts, especially energy efficiency Technology R&D No policy exemptions for developing countries	
Framing Devices	Discourse	Example/Description
Catchphrases & lexical choices	Climate Risk	"Risk(s) of climate change"
		"Longterm"
	Energy Poverty/Prosperity	"Developing/poorer countries/world/nations" "Affordable"
	Free-Market Solutionism	"Voluntary steps" "Free market"
	Policy Apocalypse	"Economic impact" "Jobs/employment"
	Scientific/Technological Optimism	"Develop" "Innovat(e/ion(s))"
	Whataboutism	"Developing/poorer countries/world/nations" "All nations"
Exemplars	Policy Apocalypse	Projected hardships on U.S. economy and livelihoods
	Whataboutism	Projected emissions of developing countries
Depictions	Climate Risk	Amorphous "risk(s)" of AGW
	Energy Poverty/Prosperity	Concrete benefits of energy allegedly in jeopardy Dire forecasts for developing countries
	Free-Market Solutionism	Voluntary, free-market responses
	Policy Apocalypse	Concrete alleged costs of climate policy
	Scientific/Technological Optimism	Company scientists committed to "decades" of technology R&D University research collaborations
Example discourse quotations		
Climate Risk	"Businesses, governments and NGOs are faced with a daunting task: selecting policies that balance economic growth and human development with the risks of climate change." ^{54,55}	
Energy Poverty/Prosperity	"A global approach [to "addressing the risk of climate change"] is needed that recognizes...the need for developing countries to weigh emissions control against energy-intensive economic development which lowers poverty and improves public health." ⁵⁶	
Free-Market Solutionism	"Governments should...harnes[s] free markets and voluntary measures...[and] encourage and promote voluntary actions by industry and citizens that reduce emissions and use energy wisely." ⁵³	
Policy Apocalypse	"Committing to binding targets and timetables now will alter today's lifestyles and tomorrow's living standards...Carpooling in; sport utility vehicles out. High fuel and electric bills. Factory closures. Job displacement...[T]ax or carbon rationing..." ⁵⁷	
Scientific/Technological Optimism	"[W]e believe that technology provides the key avenue to solutions that manage long-term risk and preserve prosperity. [This] will almost certainly require decades..." ⁵⁸	
Whataboutism	"At what point will developing nations begin to participate in emission-reduction activities?" ⁵⁹	

The Socioeconomic Threat frame argues that binding climate policies (such as the Kyoto Protocol) are alarmist and threaten prosperity, urging voluntary measures instead.

Central to this frame is the discourse of 'Policy Apocalypse', which depicts dramatic socioeconomic decline due to climate policies on what Schlichting (2013) observes to be both national (macro) and individual (micro) economic levels²⁹.

On the macro level, catchphrases of Policy Apocalypse articulating the "economic impact" that climate policies would bring, for example on "jobs/employment", were given added credence by exemplar figures from economic studies. One 1997 advertorial, for instance, cited a study by Charles River Associates predicting "an annual drop in gross domestic product ranging from \$105 billion in the year 2010 to \$460 billion in 2030", "depending on the timing and severity of the plan selected" to limit emissions⁶⁰. Another advertorial the following year warned that WEFA, Inc. "estimates the cost of achieving the Kyoto target by 2010 would result in a loss of 2.4 million jobs, a doubling of electricity prices and an annual loss in economic output of \$300 billion..."⁶¹. ExxonMobil also made broader moral appeals, such as a 2000 advertorial calling on

policymakers to “Do No Harm”⁶². A key thrust of their argument was that policies such as the Kyoto Protocol could “entail enormous transfers of wealth [from the United States] to other countries”.

On the micro level, advertorials depicted damage to individuals’ wealth and wellbeing. “Committing to binding targets and timetables now will alter today’s lifestyles and tomorrow’s living standards...”, said a 1997 advertorial⁵⁷. “Carpooling in; sport utility vehicles out. High fuel and electric bills. Factory closures. Job displacement...[T]ax or carbon rationing...”.

ExxonMobil’s scaremongering is offset by, at best, ‘Climate Risk’ discourse, and at worse, explicit climate denial (which was commonplace through the mid-2000s). As a result of this imbalanced alleged dichotomy, the frame’s moral evaluation is that any ambiguous, uncertain “risk(s)” of AGW are outweighed by severe economic damages threatened by mandatory climate policies. Such policies are therefore unwarranted and economically dangerous.

They are also ineffective, ‘Whataboutism’ discourse argues. For example, quoting a report by The Business Roundtable, Mobil wrote in a 1998 advertorial that “‘Without full participation by developing countries, the Kyoto Protocol will not lead to a net reduction of global...emissions.’ ...The Protocol uses ‘differentiated targets’ for countries to meet, which potentially could put the U.S. at a disadvantage.”⁶³ Thus, Whataboutism, which also displays elements of discourses that Lamb *et al.* (2020) term “The ‘free rider’ excuse” and “Policy perfectionism”, effectively extends the economic scaremongering arguments of Policy Apocalypse discourse, but does so by directly questioning the efficacy of proposed policies rather than simply highlighting their alleged societal costs⁵⁰. The issue is further confounded by Energy Poverty/Prosperity discourse, which tends to imply that alternative binding policies including developing countries would not be viable either. “Kyoto failed to include developing countries”, said an advertorial in 2000. “Yet poorer countries need more energy if they are to provide economic growth and a better life for their people”, implying that developing countries should not be included after all.

The only solutions, then, according to Discourses of ‘Science/Technology Optimism’ and ‘Free Market Solutionism’, are “voluntary steps”. “[I]t is time to move beyond Kyoto”, the 2000 advertorial above concludes. “[W]e believe that technology provides the key avenue to solutions...”, said a 2002 advertorial⁵⁸. “Governments should...harnes[s] free markets and voluntary measures...”, argued another in 2007⁵³.

S4.3 Fossil Fuel Savior frame

Table S4. Frame matrix of Fossil Fuel Savior (FFS) frame package.

Fossil Fuel Savior (FFS) Frame Package			
Reasoning Devices	Description		
Problem	Climate change is a (potential long-term) risk		
Cause	Consumer energy demand		
Moral evaluation	Climate risk is an energy technology/efficiency challenge in pursuit of energy prosperity		
Solutions	Continued fossil fuels for decades to come Technology innovation in a free-market Individualized energy efficiency improvements		
Framing Devices	Discourse	Example/Description	
Catchphrases & lexical choices	Climate Risk	"Risk(s) of climate change" "Longterm)"	
	Individualized Responsibility	"(Energy) demand" "Energy use" "Needs" "To meet"	
	Energy Poverty/Prosperity	"Prosperity" "Poor/poverty/lack"	
	Fossil Fuel Solutionism	"Oil and gas/natural gas" "For generations/foreseeable future/several decades/decades to come/next 25 years"	
	Policy Apocalypse	"Economic growth/impact" "Wise(r)/prudent/reasonable/responsible/sound(er)"	
	Greenwashing/Corporate	"Steps"	
	Symbolic Environmentalism	"Tree(s)"	
	Scientific/Technological	"New/advanced technolog(y/ies)"	
	Optimism	"Solutions"	
	Technological Shell-Game	"Natural gas" "Limitations/obstacles/barriers/cannot compete"	
	Visual images	Scientific/Technological	Graphs and charts
		Optimism	Science iconography
Exemplars	Fossil Fuel Solutionism	Conservative clean energy projections	
	Greenwashing/Corporate	Donations to environmental initiatives	
	Symbolic Environmentalism	Reports of company energy efficiency efforts Corporate social responsibility actions and pledges such as "math and science" "education" initiatives	
	Individualized Responsibility	Projected energy demand growth Personal energy conservation tips	
Depictions	Climate Risk	Amorphous "risk(s)" of AGW	
	Energy Poverty/Prosperity	Concrete benefits of energy allegedly in jeopardy World's poor reliant on fossil fuels for decades to come	
	Fossil Fuel Solutionism	Society reliant mostly on fossil fuels for decades to come	
	Technological Shell-Game	Renewable energy supply negligible for decades to come	
	Scientific/Technological	Photographs of company scientists as face of technology R&D	
	Optimism	Dynamic "breakthrough" university research collaborations	
Example discourse quotations			
Climate Risk	"[W]e'll need more energy to power our homes, businesses and industries, and to fuel our transportation needs...while addressing the risks posed by rising greenhouse gas emissions..." ⁶⁴		
Energy Poverty/Prosperity	"[G]lobal carbon-dioxide emissions are expected to rise through 2030. This is particularly true in developing countries, which will rely on relatively carbon-intensive fuels like coal to meet their needs." ⁶⁴		
Fossil Fuel Solutionism	"Oil and gas will be essential to meeting demand." ⁶⁵		
Individualized Responsibility	"[G]rowing demand will boost CO ₂ emissions." ⁶⁴		
Greenwashing/Corporate	"For five years we have partnered with the group American Forests to plant trees...this year the partnership planted its two millionth tree." ⁶⁶		
Symbolic Environmentalism	"[W]e believe that technology provides the key avenue to solutions that manage long-term risk and preserve prosperity. [This] will almost certainly require decades..." ⁵⁸		
Scientific/Technological	"[T]echnological progress in these conventional fuels ["oil and <u>natural gas</u> "] holds immediate potential to help reduce emissions on a significant scale...[T]his clean and abundant resource [of " <u>natural gas</u> "] is helping meet our energy and environmental goals." ⁶⁷		
Optimism			
Technological Shell-Game			

S5. DISCOURSES OF DELAY

Each of the following tables displays a selection of highly divergent terms in advertorials, by Log-Likelihood ratio (G^2) and Frequency Score (FS), identified by frame package analysis as framing devices of each of the discourses displayed in figure 1 of the main text. Definitions of each discourse are provided in the captions of respective tables (see table S1 for supporting literature). P-values: * <0.005; ** <0.05; *** \geq 0.05; otherwise, <0.001 for all G^2 and FS scores.

Table S5. Rhetoric of Climate Risk. Example quotations illustrate how advertorials use divergent terms to present AGW or greenhouse gases as a “(long-term) risk”.

Climate Risk rhetoric						
Advertorials often say:	Advertorials	Internal	Peer-reviewed	G^2 (Int./P.r.)	FS (Int./P.r.)	Example
risk(s)	49	7	261	72.48 / 56.56	0.93 / 0.8	"Enough is known about climate change to recognize it may pose a legitimate long-term <u>risk</u> , and that more needs to be learned about it." ⁶²
climate (change) risk(s)/ risk(s) of climate	26	0	10	57.89 / 119.09	1 / 0.98	"It is our view that better scientific understanding of climate change, human influence on it, and the associated risks and possible consequences are needed. We are heavily involved in such scientific research...But we are also taking other actions to minimize the <u>risks of climate</u> change." ⁶⁸
longterm	40	17	282	33.14 / 31.82	0.83 / 0.75	"In releasing this [National Assessment Synthesis] report, the [Clinton] administration seeks to gain support for its own [climate] policies, which could damage the economy and employment while accomplishing little in addressing potential <u>long-term</u> climate risks." ⁶⁹

Table S6. Rhetoric of Doubt Mongering. Example quotations illustrate how advertorials use divergent terms to promote doubt about climate science and its implications.

Doubt Mongering rhetoric						
Advertorials often say:	Advertorials	Internal	Peer-reviewed	G^2 (Int./P.r.)	FS (Int./P.r.)	Example
dont	24	2	0	40.93 / 148.34	0.96 / 1	"We still <u>don't</u> know what role man-made greenhouse gases might play in warming the planet." ⁵⁷
improv(e/es/ed/ing/ements)	73	54	500	32.35 / 60.65	0.73 / 0.75	"... <u>improve</u> our understanding of the science of this complex issue." ⁶⁸
doom(sday/sdayers)/apocalypse/ hype/scare	11	0	0	24.49 / 67.99	1/1	" <u>Apocalypse</u> no. For the first half of 1992, America was inundated by the media with dire predictions of global warming catastrophes..." ⁷⁰
debate	26	12	30	20.05 / 86.15	0.82 / 0.95	"Weather and climate. In the <u>debate</u> over climate change, there is an understandable tendency to use recent weather events to draw conclusions about global warming..." ⁵²
answer(s)	22	9	22	18.8 / 77.03	0.83 / 0.95	"Within a decade, science is likely to provide more <u>answers</u> on what factors affect global warming..." ⁷¹
believe	21	9	18	17.28 / 77.64	0.83 / 0.96	Quoting Freeman J Dyson: "[C]limate models...are unreliable...[W]e must continue to warn the politicians and the public don't <u>believe</u> the numbers just because they come out of supercomputer" ⁶⁹
(un)know(n/ing/ledge)	57	66	330	9.63* / 59.52	0.64* / 0.78	"[F]undamental gaps in <u>knowledge</u> leave scientists unable to make reliable predictions about future [climatic] changes." ⁵¹
gap(s)	11	7	39	6.01** / 18.93	0.76** / 0.86	"...better delineating <u>gaps</u> and uncertainties that limit our current ability to know the extent to which humans are affecting climate and to predict future changes caused by both human and natural forces." ⁷²
better science/understanding	6	NA	10	NA / 16.85	NA / 0.93	"Concern over global climate change is triggering actions... <u>Better science</u> and flexible timing also need to be part of the mix." ⁷³
agree(ment)/consensus	35	45	338	4.12** / 15.55	0.61** / 0.68	"[T]here is no <u>consensus</u> on what constitutes "dangerous levels" of emissions nor is there <u>agreement</u> on when, where and how best to reduce their impact." ⁶⁰
compl(ex/exity/icated)	18	NA	165	NA / 8.96*	NA / 0.7*	"Climate science remains extraordinarily <u>complex</u> ." ^{54,55}
natural causes/phenomen(on/a)/ climate/variability/and manmade	16	NA	159	NA / 6.66**	NA / 0.68**	Research "[p]rograms should concentrate on factors that seriously limit current understanding [of AGW]. These include the effects of clouds, aerosols, sea ice, deep-ocean circulation, hydrology and <u>natural climate variability</u> ." ⁷⁴

Table S7. Rhetoric of Energy Poverty/Prosperity. Example quotations illustrate how advertorials use divergent terms to present energy – and typically, by extension, fossil fuels – as essential to well-being and social justice.

Energy Poverty/Prosperity rhetoric						
Advertorials often say:						
	Advertorials	Internal	Peer-reviewed	G ² (Int./P.r.)	FS (Int./P.r.)	Example
developing/poorer countries/world/nations challenge(s)	53	3	196	97.01 / 88.01	0.97 / 0.85	"Energy demand is expected to be 35 percent higher in the year 2030...driven largely by people in the <u>developing world</u> seeking higher standards of living." ⁷⁵
	56	5	100	94.08 / 151.75	0.96 / 0.92	"A key goal of our citizenship strategy is addressing the <u>challenge</u> of sustainability balancing economic growth, social development and environmental performance while continuing to deliver superior shareholder returns so that future generations are not compromised by actions taken today." ^{76,77}
prosperity	15	0	1	33.4 / 85.32	1 / 1	"[G]lobal energy needs are rising, with increasing <u>prosperity</u> in the developing world the main driver of greater energy demand (and consequently rising CO ₂ emissions) over the coming decades." ⁵⁶
social	22	6	201	24.67 / 11.03	0.88 / 0.7	"[E]fforts to control emissions have important economic and <u>social</u> consequences." ⁷⁴
affordable	11	0	6	24.49 / 46.47	1 / 0.97	"Balancing the long-term risks of climate change against society's need for unsubsidized but <u>affordable</u> energy..." ⁵⁸
living standard(s)/ standard(s) of living/ quality of life	10	0	0	22.27 / 61.81	1 / 1	"[S]cientists work to provide more definitive answers on the impact that these [greenhouse] gases and other factors may have on our climate system. Let's wait for more answers before taking on obligations that could jeopardize better <u>living standards</u> for all." ⁷⁸
poor/poverty/lack	11	7	0	6.01** / 67.99	0.76** / 1	"A global approach [to "addressing the risk of climate change"] is needed that recognizes...the need for developing countries to weigh emissions control against energy-intensive economic development which lowers <u>poverty</u> and improves public health." ⁵⁶

Table S8. Rhetoric of Fossil Fuel Solutionism. Example quotations illustrate how advertorials use divergent terms to present fossil fuels and their industry as an essential and inevitable part of the solution to AGW.

Fossil Fuel Solutionism rhetoric						
Advertorials often say:						
	Advertorials	Internal	Peer-reviewed	G ² (Int./P.r.)	FS (Int./P.r.)	Example
oil and (natural) gas	28	3	92	45.02 / 51.24	0.95 / 0.86	"As Americans look for ways to access more supplies of reliable, affordable energy while at the same time reducing emissions, answers are emerging from what may seem an unlikely source - the <u>oil and natural gas</u> industry." ⁶⁷
clean(er)	14	0	36	31.17 / 30.59	1 / 0.89	"[D]iesel could become a viable player, providing motorists with a <u>clean</u> , efficient option." ⁷⁹
through/by/in the year 2030	22	9	113	18.8 / 26.47	0.83 / 0.8	"Wind and solar...meet about 1% of total world demand <u>by 2030</u> . Close to 60% to be met by oil and natural gas." ⁸⁰⁻⁸²
continued/continue to	23	10	123	18.69 / 26.43	0.82 / 0.8	"Oil, natural gas and coal will remain essential...In 2030, these fuels will <u>continue to</u> provide approximately 80 percent of the world's energy..." ⁶⁴
for generations/foreseeable future/several decades/decades to come/next 25 years	12	3	28	14.1 / 27.91	0.89 / 0.9	"Battery technology just cannot compete with internal combustion engines today or in the <u>foreseeable future</u> ..." ⁸³
fossil fuels	24	NA	149	NA / 22.89	NA / 0.77	" <u>Fossil fuels</u> must be relied upon to meet society's immediate and near-term needs." ⁸⁴
re(ly/ied)	8	NA	39	NA / 10.19*	NA / 0.81*	"Among the more promising approaches to addressing the risks of climate change are those that <u>rely</u> upon economically attractive actions and advanced technology. One good example is the increasing use of cogeneration units." ⁸⁵

Table S9. Rhetoric of Free-Market Solutionism. Example quotations illustrate how advertorials use divergent terms to denounce restrictive measures and instead promote voluntary/free-market policies.

Free-Market Solutionism rhetoric						
Advertorials often say:						
	Advertorials	Internal	Peer-reviewed	G ² (Int./P.r.)	FS (Int./P.r.)	Example
mandat(e/es/ed/ing)	15	1	10	26.72 / 59.99	0.97 / 0.97	"[w]e ask the Kyoto delegates to avoid <u>mandates</u> based on uncertain science..." ⁵³
voluntarily reduce(d) / voluntary initiative/step/measure/action/ effort/approache/use/usage(s)	12	0	7	26.72 / 49.81	1 / 0.97	"[W]e support <u>voluntary efforts</u> to reduce emissions." ⁶¹
bind(ing)/rigid	11	0	11	24.49 / 38.51	1 / 0.95	"Instead of <u>rigid</u> targets and timetables, governments should consider alternatives, including: adopt consensus objectives; encourage voluntary initiatives and government-industry partnerships..." ⁸⁶
market(place/-based)	5	NA	13	NA / 10.84	NA / 0.89*	"[G]overnment policies should support long-term research on alternatives but let the <u>marketplace</u> decide which technical approach will gain commercial and consumer acceptance." ⁸⁴
flexible	7	NA	33	NA / 9.24*	NA / 0.82*	"These suggestions...avoid regulatory strait-jackets and invite participation by all nations. Because they are <u>flexible</u> , policies can change as experience and knowledge are gained." ⁷⁴

Table S10. Rhetoric of Greenwashing/Symbolic Corporate Environmentalism. Example quotations illustrate how advertorials use divergent terms to communicate symbolic corporate environmentalism, including greenwashing. Bowen (2014) defines symbolic corporate environmentalism as “the shared meanings and representations surrounding” “changes made by managers inside organizations that they describe as primarily for environmental reasons”⁸⁷. Greenwashing is a subset of symbolic corporate environmentalism “in which the changes are both ‘merely symbolic’ and deliberately so”.

Greenwashing/Symbolic Corporate Environmentalism rhetoric						
Advertorials often say:						
	Advertorials	Internal	Peer-reviewed	G ² (Int./P.r.)	FS (Int./P.r.)	Example
percent	104	9	39	175.94 / 478.85	0.96 / 0.98	"Across our operations, we reduced the number of oil spills by 21 <u>percent</u> from 2005 and by an average of over 10 <u>percent</u> annually since 2000." ⁸⁸
energy efficien(cy/t)/us(e/age)	56	5	246	94.08 / 79.39	0.96 / 0.83	"We have developed global energy-management system to identify opportunities to further reduce <u>energy use</u> . <u>Energy efficiency</u> has already improved 35 percent in our refineries and chemical plants since the 1970s." ⁸⁸
new/advanced technolog(y/ies)	40	2	42	74.58 / 137.51	0.98 / 0.95	"[T]here men and women [at ExxonMobil] are developing amazing <u>new technologies</u> for finding and delivering energy, as well as innovations that will allow us to use energy more efficiently." ⁸⁹
steps	36	1	36	71.76 / 126.05	0.99 / 0.95	"[W]e have taken <u>steps</u> to reduce our own emissions and initiate reforestation programs." ⁹⁰
cut	19	0	9	42.31 / 83.11	1 / 0.98	"In the last three years, we've <u>cut</u> our carbon emissions by more than one million metric tons..." ⁹¹
invest(ing/ment(s))	27	4	243	39.46 / 13.96	0.93 / 0.7	"[W]e're now making the largest ever <u>investment</u> in independent climate and energy research that is specifically designed to look for new breakthrough technologies." ⁸⁰⁻⁸²
tree(s)	28	5	141	38.26 / 34.44	0.92 / 0.81	"In support of American Forests [charity], Mobil this year will fund the planting of 500,000 <u>trees</u> in watersheds, state and national forests and wildlife refuges..." ⁹²
gcep	17	0	1	37.85 / 97.44	1 / 1	The "Global Climate and Energy Project (<u>GCEP</u>) based at Stanford University...brings together some of the world's best scientific and engineering minds to address this pressing challenge...ExxonMobil is proud to be its lead developer and sponsor..." ⁹³
hydrogen/fuel cell(s)	26	5	314	34.48 / 6.29**	0.91 / 0.63**	At the "Global Climate and Energy Project (GCEP), initiated at Stanford University in 2002 with the intention of ExxonMobil...[r]esearchers are investigating the use of genetically engineered bacteria to capture solar energy and produce <u>hydrogen</u> ..." ⁹⁴
improv(e/es/ed/ing/ements)	73	54	500	32.35 / 60.65	0.73 / 0.75	"Mobil 1 AFE [gasoline] can <u>improve</u> fuel economy by up to 2 percent...if one-third of U.S. motorists reduced their gasoline by 2 percent, almost...8 million tons of CO ₂ emissions would be saved every year." ⁹⁵
innovat(e/ion(s))	17	1	93	30.93 / 19.02	0.97 / 0.79	"Other <u>innovations</u> are still emerging. One is a new engine technology...The result: up to 30 percent better fuel economy and lower emissions." ⁹⁶
fuel economy	13	0	63	28.95 / 16.67	1 / 0.81	"ExxonMobil is taking [steps] to address the risk of climate change. These include[e] working to improve <u>energy efficiency</u> and <u>fuel economy</u> ..." ⁹⁷
cogeneration	12	0	26	26.72 / 29.19	1 / 0.91	"We now have interest in 4300 megawatts of energy-efficient <u>cogeneration</u> facilities globally - enough to reduce global carbon-dioxide emissions by over 10.5 million metric tons annually..." ⁸⁸
education	12	0	28	26.72 / 27.91	1 / 0.9	"Over the long-term, investments such as these could also yield real progress in developing the new technologies needed to address global challenges such as climate change...By investing more in math and science <u>education</u> , we can...solve tomorrow's tough challenges..." ⁹⁸
stanford	14	1	0	24.62 / 86.53	0.97 / 1	"With initial funding of \$225 million [from ExxonMobil and other companies], the Global Climate and Energy Project (GCEP) will unleash the creativity of faculty and students at <u>Stanford</u> and other universities..." Advertorial signed by "Dr. Lynn Orr, GCEP Project Director, <u>Stanford</u> University." ⁹⁹
sav(e/ed/ing)	14	1	51	24.62 / 23.55	0.97 / 0.85	" <u>Saving</u> and preserving forests and trees are long-term endeavours. But we are hopeful, and optimistic, that planting trees now will be planting a better future around the world." ⁶⁶
protect(/ion/ing)	26	10	109	23.32 / 38.56	0.84 / 0.83	"Many groups work to <u>protect</u> and to expand forests. ExxonMobil is proud to say that we are one of them." ⁶⁶
math and science	10	0	0	22.27 / 61.81	1 / 1	"Sustainability means balancing economic, environmental and social goals...[W]e are a leading supporter of <u>math and science</u> education..." ^{76,77}
plant(ing)	21	7	NA	20.84 / NA	0.86 / NA	"We intend to sponsor several projects to <u>plant</u> and protect trees in the U.S. and internationally." ⁷⁸
partner(/ing/ship)	12	1	13	20.47 / 40.76	0.96 / 0.95	"[O]ur scientists and engineers are...[<u>Partnering</u> with with the U.S. Environmental Protection Agency and Department of Energy in the "Smartway" <u>partnership</u> to improve fuel economy and reduce emissions associated with the transportation of our products." ¹⁰⁰
initiative(s)	18	5	35	19.98 / 46.59	0.88 / 0.92	"Working with leading environmental groups, Mobil will underwrite international projects to plant and protect trees which absorb significant amounts of CO ₂ . <u>Initiatives</u> like these, which are good for the environment, can be taken while the debate continues." ¹⁰¹
operations	11	3	99	12.33 / 5.69**	0.88 / 0.77**	"At ExxonMobil, we are taking action...deploying energy-efficient technologies across our global <u>operations</u> ..." ⁵⁶
universit(y/ies)	23	16	9	11.15 / 104.97	0.75 / 0.98	"[W]e are supporting climate-related research at major <u>universities</u> , including Stanford and MIT." ⁷²
sponsor/fund/invest/underwrite/grant(ed/ing)	34	41	41	5.04** / 110.65	0.63** / 0.95	"We are <u>funding</u> research into the scientific and economic consequences of climate change." ¹⁰²
environment(/al/ally) effort(s) to	84	112	527	8.53* / 79.01	0.61* / 0.77	"We all share the same goal: protecting Earth's <u>environment</u> while raising living standards for all." ¹⁰¹
	18	11	44	10.34* / 40.65	0.77* / 0.9	"[W]e are a leading supporter of math and science education, including <u>efforts to</u> increase the number of women and minorities studying in these fields." ^{76,77}

Table S11. Rhetoric of Individualized Responsibility. Example quotations illustrate how advertorials use divergent terms to present: (a) consumer demand for energy as the cause of – and culpable for – fossil fuel use, greenhouse gas emissions, and/or AGW; and (b) individual/demand-side actions as accountable for mitigating AGW. By contrast, divergent terms in (bottom) internal and/or peer-reviewed documents often articulate the causality and culpability of fossil fuel combustion.

Advertorials often say:						
	Advertorials	Internal	Peer-reviewed	G ² (Int./P.r.)	FS (Int./P.r.)	Example
(to) meet	65	2	98	128.34 / 191.64	0.99 / 0.93	"To <u>meet</u> this demand, while addressing the risks posed by rising greenhouse gas emissions, we'll need to call upon broad mix of energy sources." ⁶⁴
vehicles	33	0	240	73.48 / 25.02	1 / 0.74	"[T]he cars and trucks we drive aren't just <u>vehicles</u> , they're opportunities to solve the world's energy and environmental challenges." ⁹⁶
greenhouse gas emissions	42	7	60	58.9 / 126.97	0.92 / 0.94	"We're supporting research and technology efforts, curtailing our own <u>greenhouse gas emissions</u> and helping customers scale back their emissions of carbon dioxide." ⁷⁸
energy efficiency	30	1	152	58.76 / 36.65	0.98 / 0.81	"We have invested \$1.5 billion since 2004 in activities to increase <u>energy efficiency</u> and reduce greenhouse gas emissions. We are on track to improve energy efficiency in our worldwide refining and chemical operations..." ^{76,77}
cars	24	0	59	53.44 / 54	1 / 0.9	"By enabling <u>cars</u> and trucks to travel farther on a gallon of fuel, drivers not only spend less money per mile, they also emit less carbon dioxide (CO ₂) per mile." ⁹⁵
reduce emissions	23	0	25	51.21 / 78.03	1 / 0.95	"During the fact-finding period, governments should encourage and promote voluntary actions by industry and citizens that <u>reduce emissions</u> and use energy wisely. Governments can do much to raise public awareness of the importance of energy conservation." ⁵³
consumers	21	0	33	46.76 / 60.7	1 / 0.93	"We also are developing new vehicle technologies that can help <u>consumers</u> use energy more efficiently." ^{76,77}
world	91	64	338	43.45 / 150.55	0.74 / 0.85	"By 2030, experts predict that the <u>world</u> will require about 60 percent more energy than in 2000...As a result, greenhouse gas emissions are predicted to increase too..." ⁹³
developing countries	27	3	162	43 / 26.94	0.95 / 0.78	Through 2030, " <u>developing countries</u> ...will rely on relatively carbon-intensive fuels like coal to meet their needs." ⁶⁴
transportation	23	2	121	38.87 / 26.93	0.96 / 0.8	"Ongoing advances in vehicle and fuel technology will be critical to meeting global demand for <u>transportation</u> fuels. They will also help address the risk posed by rising greenhouse-gas emissions." ⁹⁶
energy use	23	4	83	31.75 / 39	0.92 / 0.85	"Central to any future policy should be the understanding that man-made greenhouse gas emissions arise from essential <u>energy use</u> in the everyday activities of people, governments and businesses." ⁷⁴
people	30	11	61	27.87 / 75.73	0.85 / 0.91	"Thus, we're pleased to extend our support of...American Forests...whose "Global Releaf 2000" program is mobilizing <u>people</u> around the world to plant and care for trees." ⁹²
demand	40	21	422	27.24 / 14.35	0.8 / 0.67	"[I]n the electric power sector, growing <u>demand</u> will boost CO ₂ emissions..." ⁶⁵
needs	36	22	71	20.69 / 92.45	0.77 / 0.91	"...fossil fuels must be relied upon to meet society's immediate and near-term <u>needs</u> ." ⁸⁴
conservation	15	5	66	14.89 / 21.23	0.86 / 0.83	"Prudent measures such as <u>conservation</u> and investment in energy-efficient technology make sense, but embarking on regulatory [climate/energy] policies that may prove wasteful or counterproductive does not." ¹⁰³
energy demand	15	14	59	4.38** / 23.59	0.69** / 0.84	"[I]ncreasing prosperity in the developing world [is] the main driver of greater <u>energy demand</u> (and consequently rising CO ₂ emissions) over the coming decades." ⁵⁶
Internal and/or peer-reviewed documents often say:						
fossil fuel	9	144	359	-66.26 / -4.48**	0.11 / 0.34***	"Release of this amount of CO ₂ to the atmosphere raises concern with respect to its effect on the CO ₂ greenhouse problem. Global <u>fossil fuel</u> emissions of CO ₂ currently amount to about 1.8 x 10 ¹⁰ metric tons per year..." ¹⁰⁴
natuna	0	67	NA	-53.36 / NA	0 / NA	"Arrhenius put forth the idea that CO ₂ from <u>fossil fuel</u> burning could...warm the Earth...fossil fuel greenhouse warming...fossil fuel greenhouse effect..." ¹⁰⁵
due to	5	89	731	-42.94 / -39.08	0.1 / 0.13	"This would make <u>Natuna</u> the world's largest point source emitter of CO ₂ and raises concern for the possible incremental impact of <u>Natuna</u> on the CO ₂ greenhouse problem." ¹⁰⁴
fossil fuel combustion	1	48	NA	-30.69 / NA	0.04 / NA	"The CO ₂ concentration in the atmosphere has increased...The most widely held theory is that: the increase is <u>due to</u> fossil fuel combustion." ¹⁰⁶
shale	1	41	NA	-25.43 / NA	0.05 / NA	"About three-quarters of the anthropogenic emissions of CO ₂ to the atmosphere during the past 20 years is <u>due to</u> fossil fuel burning." ¹⁰⁷
ccs	0	NA	374	NA / -34.82	NA / 0	"[T]here is the potential for our [climate] research to attract the attention of the popular news media because of the connection between Exxon's major business and the role of <u>fossil fuel combustion</u> in contributing to the increase of atmospheric CO ₂ ." ¹⁰⁸
source	6	39	322	-9.08* / -7.16**	0.24* / 0.28**	"The quantity of CO ₂ emitted by various fuels in shown in Table 1...They show the high CO ₂ /energy ratio for coal and <u>shale</u> ...["Shale oil"] is not predicted to be a major future energy source due to...rather large amounts of CO ₂ emitted per unit energy generated (see Table 1)." ¹⁰⁶
fossil fuel use	0	13	NA	-10.35* / NA	0** / NA	"CCS includes applying technologies that capture the CO ₂ whether generated by combustion of carbon-based fuels or by the separation of CO ₂ from natural gas with a high CO ₂ concentration." ¹⁰⁹
fossil fuel co2	0	NA	64	NA / -5.96**	NA / 0***	"[Fossil fuel combustion is the only readily identifiable <u>source</u> [of CO ₂] which is (1) growing at the same rate, (2) large enough to account for the observed increases..." ¹¹⁰
fossil fuel emissions	0	NA	54	NA / -5.03**	NA / 0***	Table 1 presents "coal combustion" and "natural gas combustion" as the " <u>source[s]</u> " of CO ₂ , CH ₄ , SO ₂ . ¹¹¹
						"[F]or scenarios with higher <u>fossil fuel use</u> (hence, higher carbon dioxide emissions..." ¹⁰⁷
						"This long tail on the <u>fossil fuel CO₂</u> forcing of climate may well be more significant to the future glacial/interglacial timescale evolution of Earth's climate..." ¹¹²
						"We use our Integrated Science Model to...estimate the time variation <u>fossil fuel emissions</u> of CO ₂ ...required to match the [IPCC] concentration stabilization scenarios." ¹¹³

Table S12. Rhetoric of Policy Apocalypse. Example quotations illustrate how advertorials use divergent terms to allege that climate policies will be socioeconomically damaging.

Policy Apocalypse rhetoric						
Advertorials often say:						
	Advertorials	Internal	Peer-reviewed	G ² (Int./P.r.)	FS (Int./P.r.)	Example
econom(y)ic	148	22	714	216.08 / 190.67	0.93 / 0.81	"We ask the Kyoto delegates to...resist agreements that could inflict great <u>economic</u> pain." ⁵³
economic growth/impact	29	2	74	51.34 / 63.68	0.97 / 0.89	"The report shows how ill-timed or ill-considered [GHG emissions] abatement measures could stunt world <u>economic growth</u> , unsettle global trading patterns and set the stage for new era of trade protectionism." ⁶⁰
cost(s)/ly/liest/lier)	61	32	NA	41.58 / NA	0.8 / NA	"[A]s higher energy <u>costs</u> work their way through the economy, the annual loss in GDP could range from \$150 billion to \$400 billion." ⁶¹
jobs/employment	15	0	40	33.4 / 31.98	1 / 0.89	"WEFA estimates the cost of achieving the Kyoto target by 2010 would result in loss of 24 million <u>jobs</u> ..." ⁶¹
tax(es)	20	2	177	32.72 / 10.7*	0.95 / 0.7	"Most economists tell us that such a step [as the Kyoto Protocol] would damage our economy and almost certainly require large increases in <u>taxes</u> on gas and oil." ⁶²
livelihood(s)/lifestyle(s)	13	0	42	28.95 / 24.11	1 / 0.87	"How much prosperity are Americans willing to forgo? How many <u>lifestyle</u> changes will they have to make? How much more tax will they pay?" ⁵⁹
wise(r)/prudent/reasonable/responsible/sound(er)	39	21	119	25.87 / 75.54	0.79 / 0.87	A " <u>prudent</u> approach to the climate issue must recognize that there is not enough information to justify harming economies and forcing the world's population to endure unwarranted lifestyle changes by dramatically reducing the use of energy now." ⁶²
disruptive/dislocations/distortions/unsettled	11	0	8	24.49 / 42.87	1 / 0.97	"Concern about the impact of human activity on the global climate...is triggering actions that may create major <u>dislocations</u> unnecessarily." ¹⁴
suffer/saddled/havoc/pain(ful)/grave/fatal/turmoil/jeopardize/harm/hit/inflict/plunge/cripple/wreck(ing)impos(e)ing)	17	3	15	23.33 / 62.23	0.92 / 0.96	"Adopting quick-fix measures [for AGW] at this point could pose <u>grave</u> economic risks for the world." ⁷²
	16	6	9	14.62 / 67.06	0.85 / 0.97	"As gaps in climate science are being filled, these approaches can lead to real changes in emissions trends without <u>harming</u> economies and lifestyles." ¹⁵
	8	NA	16	NA / 20.38	NA / 0.91	"[T]he impact that some [AGW mitigation] measures could have on jobs and livelihoods will <u>impose</u> extensive burdens on the global community." ¹⁶
consequences	15	NA	81	NA / 17.04	NA / 0.8	"Because of the potentially serious <u>consequences</u> any such [climate action] plan would have on the U.S. economy and peoples livelihoods..." ¹⁷
drastic/rash/premature	6	NA	22	NA / 10.04*	NA / 0.85*	"[T]he jury's still out on whether <u>drastic</u> steps to curb CO ₂ emissions are needed." ⁷⁰

Table S13. Rhetoric of Scientific/Technological Optimism. Example quotations illustrate how advertorials use divergent terms to give primacy to scientific or technological breakthroughs as the solutions to understanding and/or mitigating AGW.

Scientific/Technological Optimism rhetoric						
Advertorials often say:						
	Advertorials	Internal	Peer-reviewed	G ² (Int./P.r.)	FS (Int./P.r.)	Example
new/advanced technolog(y)ies)	40	2	42	74.58 / 137.51	0.98 / 0.95	"[W]e are excited to be working on breakthrough technology that could advance the use of hydrogen fuel cells. This <u>new technology</u> ...converts traditional hydrocarbon fuels (such as gasoline or diesel) into hydrogen..." ⁹⁶
promise	20	0	12	44.53 / 82.39	1 / 0.97	"The <u>promise</u> of technology. One of the brighter hopes in the climate change debate has to be the benefits to be achieved through technology." ¹¹⁸
invest(ing/ment(s))	27	4	243	39.46 / 13.96	0.93 / 0.7	"[W]e're now making the largest ever <u>investment</u> in independent climate and energy research that is specifically designed to look for new breakthrough technologies." ⁸⁰⁻⁸²
innovat(e/ion(s)) solutions	17	1	93	30.93 / 19.02	0.97 / 0.79	"Support for oil and natural gas <u>innovation</u> can reduce emissions." ⁶⁷
	26	7	78	29.36 / 51	0.88 / 0.87	"[W]e believe that technology provides the key avenue to <u>solutions</u> that manage long-term risk and preserve prosperity." ⁵⁸
develop	29	32	69	5.64** / 66.62	0.65** / 0.9	"Many respected economists conclude that research to <u>develop</u> new technology offers the most effective near-term means to address the long-term response to climate change." ¹¹⁸

Table S14. Rhetoric of Technological Shell-Game. Example quotations illustrate how advertorials use divergent terms to communicate what Schneider *et al.* (2016) define as “misdirection that relies on strategic ambiguity about the feasibility, costs, and successful implementation of technologies in order to deflect attention from environmental pollution and health concerns”.

Technological Shell-Game rhetoric						
Advertorials often say:						
	Advertorials	Internal	Peer-reviewed	G ² (Int./P.r.)	FS (Int./P.r.)	Example
natural gas	48	18	334	43.87 / 38.95	0.85 / 0.75	"[T]echnological progress in these conventional fuels [“oil and <u>natural gas</u> ”] holds immediate potential to help reduce emissions on a significant scale...[T]his clean and abundant resource [of “ <u>natural gas</u> ”] is helping meet our energy and environmental goals." ⁶⁷
electric vehicles/EVs	16	0	11	35.63 / 63.42	1 / 0.97	"[T]he GAO basically concluded <u>EVs</u> aren't ready. Nor are they likely to become so even in the rosiest of scenarios." ⁸³
limitations/obstacles/barriers/cannot compete	14	NA	142	NA / 5.54**	NA / 0.67**	"Renewable forms of energy could play role [in the electric power sector], but they have <u>limitations</u> that make them impractical or expensive for most applications." ⁶⁵
solar/photovoltaic(s)	31	NA	393	NA / 6.34**	NA / 0.62**	" <u>Solar</u> power is dependent on sunlight availability and is space-intensive. Here again, its potential must be tempered with realism." ¹¹⁹

Table S15. Rhetoric of Whataboutism. Example quotations illustrate how advertorials use divergent terms to point to other actors that produce – or may in the future produce – more greenhouse gas emissions. It is thereby argued that those actors bear significant responsibility for taking action, and that without their participation, climate policies will be unjust (‘free rider’ excuse) or ineffective (policy perfectionism).

Whataboutism rhetoric						
Advertorials often say:						
	Advertorials	Internal	Peer-reviewed	G ² (Int./P.r.)	F5 (Int./P.r.)	Example
developing/poorer countries/world/nations	53	3	196	97.01 / 88.01	0.97 / 0.85	"Developing countries are not covered by the [Kyoto] Protocol. [Quoting a new report by The Business Roundtable:] "Without full participation by <u>developing countries</u> , the Kyoto Protocol will not lead to a net reduction of global...emissions." ⁶³ The Protocol uses "differentiated targets" for countries to meet, which potentially could put the U.S. at a disadvantage." ⁶³
all nations	11	0	3	24.49 / 53.72	1 / 0.99	"Clearly, curbing greenhouse gases is the responsibility of <u>all nations</u> ." ⁶⁶

S6. ALGORITHMIC TEXTUAL ANALYSIS OF EXXONMOBIL CORP'S FLAGSHIP REPORTS

Our key findings concerning ExxonMobil's advertorials are replicated in other ExxonMobil Corp public AGW communications.

We analyzed all of the company's known and available flagship reports concerning AGW spanning 2002-19. Specifically, from ExxonMobil Corp's 2020 listing of 'Publications and reports', we identified reports pertaining, in whole or in part, to AGW, AGW mitigation, and/or greenhouse gas emissions¹²⁰. By way of ExxonMobil Corp webpages (only recent years of reports are made available), digital archives of ExxonMobil Corp webpages (via Wayback Machine), and other online and private collections, we obtained and analyzed the following editions of those reports (see table S1):

- *Corporate Citizenship Reports*, 2002-16 (discontinued after 2016, replaced by *Sustainability Report*)
- *Sustainability Report*, 2017 (this is the only edition at the time of analysis)
- *Outlook For Energy*, 2005-19 (except 2008 and 2011, which could not be not located)
- *Energy & Carbon Summary*, 2017-18 (these are the only editions at the time of analysis)
- *Innovating Energy Solutions*, 2019 (this is the only edition at the time of analysis)

In the case of *Corporate Citizenship Reports* and *Outlook For Energy* reports, which are broad in scope, only sections primarily concerned with AGW, AGW mitigation, and/or greenhouse gas emissions were extracted for analysis, as indicated in table S1.

All documents were aggregated into a single corpus, pre-processed (this yielded a flagship report corpus comprising 113,695 words), and algorithmically analyzed according to the same protocols applied to advertorials: corpus comparison to internal and peer-reviewed publications (using frequency score (FS) and Dunning Log-Likelihood (LL) ratio G^2 score); and collocation analysis using the logDice statistic. Notable results of these analyses are summarized in the following subsections.

Table S16. Inventory of the five ExxonMobil Corp flagship reports analyzed: *Corporate Citizenship Reports/Sustainability Report*, *Outlook For Energy*, *Energy & Carbon Summary*, and *Innovating Energy Solutions*. Shown for each report are the editions (years) retrieved and the sections (chapter titles and corresponding pages) analyzed. “NA” = report not located. “-” = no report published, to our knowledge, at the time of analysis.

Year	<i>Corporate Citizenship Reports/Sustainability Report</i>	<i>Outlook For Energy</i>	<i>Energy & Carbon Summary</i>	<i>Innovating Energy Solutions</i>
2002	"Addressing climate-change risk"; "Energy research"; "Environmental performance" (p.9-14)	-	-	-
2003	"Greenhouse gas emissions"; "Advanced fuels and vehicle systems research"; "Fuel cell research"; "Global Climate and Energy Project (GCEP)" (p.10-12)	-	-	-
2004	"Climate change" indexed pages (p.3, 22, 24, 25, 29)	-	-	-
2005	"Environmental performance" (p.20-35)	"CO ₂ growth"; "Technology critical to efficiency improvements" (p.18-19)	-	-
2006	"Environmental performance" (p.14-23)	"Global CO ₂ emissions"; "Technology options for reducing CO ₂ "; "CO ₂ mitigation options"; "Meeting the world's energy needs" (p.22-25)	-	-
2007	"Environmental performance" (p.14-21)	"World energy and CO ₂ emissions"; "Global CO ₂ emissions" (p.22-23)	-	-
2008	"Managing climate change risks" (p.30-33)	NA	-	-
2009	"Managing climate change risks" (p.30-35)	"Managing emissions" (p.22-33)	-	-
2010	"Managing climate change risks" (p.32-37)	"Greenhouse gas emissions" (p.32-37)	-	-
2011	"Managing climate change risks" (p.22-25)	NA	-	-
2012	"Managing climate change risks" (p.28-33)	"Emissions" (p.32-35)	-	-
2013	"Managing climate change risks" (p.52-59)	"Emissions" (p.32-35)	-	-
2014	"Managing climate change risks" (p.33-39)	"Emissions" (p.32-33)	-	-
2015	"Managing climate change risks" (p.29-41)	"A shift in the power generation sector"; "Emissions" (p.36-41)	-	-
2016	"Managing climate change risks" (p.16-24)	"Lowering emissions" (p.48-51)	-	-
2017	"Managing climate change risks" (p.16-19)	"Emissions" (p.30-33)	-	-
2018	-	"Emissions"; "Pursuing a 2 °C pathway" (p.29-31, 44-53)	Full report	-
2019	-	"Dual challenge"; "Emissions" (p.3, 37-46)	Full report	Full report

S6.1. “Risk” rhetoric in ExxonMobil Corp’s flagship reports

FS and LL analyses identify “risk(s)”, “climate change risks”, “risks of climate change”, etc., to be among the most statistically overused terms in ExxonMobil Corp’s flagship reports, compared to both their internal and peer-reviewed publications (table S17). Collocation analysis reveals that across these flagship reports, by far the highest scoring collocate of “climate change” and “global warming” is “risk(s)” (table S18). (Note that, for clarity, we here present the results of FS, LL, and collocation analyses in which all flagship reports were aggregated into a single corpus. Substantively the same results are obtained by treating each type of report as a separate corpus.)

Table S17. “Risk” rhetoric: highly divergent terms invoking “risk” in ExxonMobil Corp flagship reports, versus internal and peer-reviewed publications, by Log-Likelihood ratio (G^2) and Frequency Score (FS). P-values <0.001 for all G^2 and FS scores.

ExxonMobil Corp’s flagship reports often say:						
	Flagship	Internal	Peer-reviewed	G^2 (Int./P.r.)	FS (Int./P.r.)	Example
risk(s)	396	7	261	322.03 / 768.61	0.97 / 0.91	"A global approach to the <u>risk</u> posed by rising greenhouse gas emissions is needed that recognizes energy’s importance to the world’s economies." ¹²¹
climate (change) risk(s)/ risk(s) of climate	213	0	10	203.92 / 768.25	1 / 0.99	"Recognizing the <u>risk of climate</u> change, we are taking actions to improve efficiency and reduce greenhouse gas emissions in our operations." ¹²²
managing climate change risks	52	0	0	49.78 / 206.76	1 / 1	" <u>Managing climate change risks</u> . Climate change risk management strategy. Society continues to face the dual challenge of meeting the world's growing energy demand, while simultaneously addressing the risks of climate change." ¹²³
longterm	100	17	282	31.61 / 41.46	0.78 / 0.69	"ExxonMobil is engaged in the public discussion to create national and international policies to address climate change risks. Recognizing the <u>long-term</u> nature of these risks..." ¹²⁴
address the risks of climate	19	0	0	18.19 / 75.55	1 / 1	"Many uncertainties exist concerning the future of energy demand and supply, including potential actions that societies may take to <u>address the risks of climate</u> change." ¹²⁵

Table S18. Three strongest collocates of “climate change” and “global warming” in Mobil advertorials, ExxonMobil Corp advertorials, and ExxonMobil Corp flagship reports, by logDice score.

Mobil advertorials		ExxonMobil Corp advertorials		Flagship reports	
Collocate	logDice	Collocate	logDice	Collocate	logDice
science	11.46	risk(s)	13.01	risk(s)	13.79
gases	11.31	address	11.86	managing	12.78
debate	11.24	human	11.57	policy	12.72

S6.2. Discourse of personal responsibility in ExxonMobil Corp’s flagship reports

Table S19 (top half) collates terms in ExxonMobil Corp’s flagship reports that (a) based on our frame package analysis of advertorials, are characteristic of a Personal Responsibility frame; and (b) are highly divergent between flagship reports and internal and/or peer-reviewed documents according to LL and FS analyses. As with advertorials, we observe that ExxonMobil Corp’s flagship reports disproportionately employ terms that present consumer demand for energy as the cause of fossil fuel production, greenhouse gas emissions, and/or AGW; and disproportionately introduce terms conveying individual and/or demand-side actions as accountable for mitigating AGW. By contrast, Exxon and ExxonMobil Corp’s internal and/or academic communications disproportionately recognize AGW and/or greenhouse gases as also an upstream problem caused by fossil fuel supply and burning.

Table S19. Rhetoric of Personal Responsibility: Highly divergent terms in (top) ExxonMobil Corp flagship reports, by Log-Likelihood ratio (G^2) and Frequency Score (FS), characteristic of a Personal Responsibility frame. Example quotations illustrate how flagship reports use these terms to disproportionately present: (a) consumer demand for energy as the cause of – and culpable for – fossil fuel use, greenhouse gas emissions, and/or AGW; and (b) individual/demand-side actions as accountable for mitigating AGW. By contrast, divergent terms in (bottom) internal and/or peer-reviewed documents often articulate the causality and culpability of fossil fuel combustion. P-values: * <0.005; ** <0.05; *** \geq 0.05; otherwise, <0.001 for all G^2 and FS scores.

ExxonMobil Corp's flagship reports often say:						
	Flagship	Internal	Peer-reviewed	G^2 (Int./P.r.)	FS (Int./P.r.)	Example
efficient(t/cy/tly)	570	14	809	440.63 / 634.69	0.96 / 0.82	"ExxonMobil is delivering solutions that enable our customers to reduce their emissions and improve their energy efficiency..." ¹²³
demand (to) meet	455	21	422	304.06 / 718.96	0.93 / 0.87	"Globally, rising energy demand will result in higher energy-related CO ₂ emissions through 2030..." ¹²⁶
challenge(s)	224	2	98	195.42 / 523.8	0.99 / 0.94	"As we seek to produce oil and natural gas to meet growing global energy demand..." ¹²⁷
vehicles	140	5	100	100.2 / 260.12	0.95 / 0.9	"This is society's dual challenge. Billions of people need reliable, affordable energy every day, but their use of energy is contributing to CO ₂ emissions." ¹²⁵
consumers	83	0	240	79.46 / 32.6	1 / 0.69	"As the number of vehicles in the world continues to rise, energy efficiency in the transportation sector will become increasingly important. According to the International Energy Agency, approximately 90 percent of petroleum-related GHG emissions are generated when customers use our products..." ¹²⁴
energy demand	69	0	33	66.06 / 155.66	1 / 0.93	"...the combustion of fuels by consumers generates the majority of GHG emissions..." ¹²¹
reduce emissions the world	135	14	59	63.45 / 315.82	0.86 / 0.94	"Increasingly, the world's CO ₂ emissions will be driven by developing nations. Overall, non-OECD emissions are likely to rise about 50 percent, as energy demand rises by about two-thirds." ¹²⁸
customers	61	0	25	58.4 / 146.24	1 / 0.94	"[P]rice stability...provides a clear incentive for all consumers to increase efficiency and reduce emissions." ¹²⁹
demand growth	149	26	132	45.83 / 242.82	0.78 / 0.88	"...rising greenhouse gas emissions resulting from the world's enormous requirements for fossil fuels..." ¹³⁰
global demand	42	0	3	40.21 / 145.84	1 / 0.99	"ExxonMobil develops and produces a range of petroleum-based products that help our customers reduce their greenhouse gas emissions and improve efficiency." ¹³¹
living standards	31	0	5	29.68 / 95.72	1 / 0.98	"Renewables and nuclear energy see strong growth...to meet demand growth through 2040. Natural gas grows the most of any energy type, reaching a quarter of all demand." ¹³²
natural gas demand	28	0	4	26.81 / 88.4	1 / 0.98	"The benefits of natural gas. Global demand for cleaner-burning natural gas is expected to increase by more than 50 percent by 2030, making it the fastest-growing major energy source for power generation." ¹²⁴
footprint	25	0	1	23.93 / 91.22	1 / 0.99	"Close to 85 percent of the increase in CO ₂ emissions [through 2030] will come from developing countries where economic growth and improved living standards are creating huge increases in energy demand." ¹³³
needs	23	0	1	22.02 / 83.43	1 / 0.99	"Natural gas will meet a growing share of our energy needs through 2030...Total natural gas demand in the United States and Europe will follow a similar pattern..." ¹²⁹
energy needs	20	0	3	19.15 / 62.6	1 / 0.98	"[T]he core sustainability challenge for the energy industry is how to provide the energy that enables economic development while reducing the environmental footprint associated with energy use." ¹²⁴
	89	22	71	17.2 / 155.02	0.71 / 0.89	"Fossil fuels – oil, natural gas and coal – will continue to meet most of the world's needs [through 2030]." ¹²⁹
	29	4	6	11.12 / 85.01	0.82* / 0.97	ExxonMobil is "taking action to position ourselves to help meet future global energy needs. For example, we are: Expanding supply of cleaner-burning natural gas..." ¹²⁷
Internal and/or peer-reviewed documents often say:						
fossil fuel(s)	15	198	508	-288.59 / -73.18	0.04 / 0.16	"[T]here 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." ¹¹⁰
natuna	2	67	NA	-113.33 / NA	0.02 / NA	"[T]he burning of fossil fuels is linked to both climate change and air pollution..." ¹³⁴
fossil fuel combustion	0	48	NA	-92.79 / NA	0 / NA	"This would make Natuna the world's largest point source emitter of CO ₂ and raises concern for the possible incremental impact of Natuna on the CO ₂ greenhouse problem." ¹⁰⁴
due to	44	89	731	-45.32 / -52.39	0.23 / 0.28	"[T]here is the potential for our [climate] 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 combustion in contributing to the increase of atmospheric CO ₂ ." ¹⁰⁸
shale	8	41	NA	-43.3 / NA	0.11 / NA	"The CO ₂ concentration in the atmosphere has increased...The most widely held theory is that: the increase is due to fossil fuel combustion." ¹⁰⁶
fossil fuel use	0	13	22	-25.13 / -6.48**	0 / 0***	"About three-quarters of the anthropogenic emissions of CO ₂ to the atmosphere during the past 20 years is due to fossil fuel burning." ¹⁰⁷
fossil fuel consumption	0	10	NA	-19.33 / NA	0 / NA	"The quantity of CO ₂ emitted by various fuels is shown in Table 1...They show the high CO ₂ /energy ratio for coal and shale..." ¹⁰⁶
fossil fuel emissions	0	NA	54	NA / -15.91	NA / 0	"[F]or scenarios with higher fossil fuel use (hence, higher carbon dioxide emissions..." ¹⁰⁷
fossil fuel co2	1	NA	64	NA / -12.5	NA / 0.09*	"The most widely held theory is that...[t]he present trend of fossil fuel consumption will cause dramatic environmental effects before the year 2050." ¹⁰⁶
fossil fuel burning	0	NA	40	NA / -11.78	NA / 0*	"We use our Integrated Science Model to...estimate the time variation fossil fuel emissions of CO ₂ ...required to match the [IPCC] concentration stabilization scenarios." ¹¹³
						"This long tail on the fossil fuel CO ₂ forcing of climate may well be more significant to the future glacial/interglacial timescale evolution of Earth's climate..." ¹¹²
						"CO ₂ emissions from fossil fuel burning are virtually certain to be the dominant factor determining CO ₂ concentrations during the 21 st century." ¹³⁵

S7. CATALOG OF ANALYZED DOCUMENTS

Raw data (original PDF internal documents, peer-reviewed publications, and advertorials) for this study cannot be reproduced due to copyright restrictions. However, tables S20-22 present catalogs of all 180 analyzed documents, which can be obtained at the following public archives:

- All analyzed advertorials can be downloaded from the ProQuest Historical Newspaper Database¹³⁶. Many can also be downloaded from PolluterWatch¹³⁷.
- All analyzed internal documents can be downloaded from (one or more of) ExxonMobil Corp¹³⁸, *InsideClimate News*¹³⁹, and Climate Investigations Center¹⁴⁰.
- All analyzed peer-reviewed documents can be obtained from corresponding journals and conference proceedings.

A catalog of analyzed flagship reports is presented in table S16 above.

Table S20. Catalog of analyzed advertorials.

Date	Authors	Title
21 December 1972	Mobil Oil	A trio glows in Brooklyn
05 April 1973	Mobil Oil	The profits of doom
16 August 1984	Mobil Oil	Lies they tell our children
03 November 1988	Mobil Oil	musings of a fossil fuel person...
06 July 1989	Mobil Oil	People Who Live in Greenhouses...
09 April 1992	Mobil Oil	Boy, we wish we'd said that!
25 February 1993	Mobil Oil	Apocalypse no
11 May 1995	Mobil Oil	Electric vehicles: a promise too far
28 September 1995	Mobil Oil	The sky is not falling
18 July 1996	Mobil Oil	Less heat, more light on climate change
25 July 1996	Mobil Oil	With Climate Change, What We Don't Know Can't Hurt Us
01 August 1996	Mobil Oil	Climate Change: We're all in this together
12 December 1996	Mobil Oil	A policy agenda for tomorrow
06 March 1997	Mobil Oil	Stop, look and listen before we leap
23 June 1997	Mobil Oil	Climate change: Let's get it right
31 July 1997	Mobil Oil	The Senate speaks
14 August 1997	Mobil Oil	When the facts don't square with the theory, throw out the facts
23 October 1997	Mobil Oil	Global climate change
30 October 1997	Mobil Oil	Reset the alarm
06 November 1997	Mobil Oil	Science: what we know and don't know
13 November 1997	Mobil Oil	Climate change: a prudent approach
20 November 1997	Mobil Oil	Climate change: where we come out
04 December 1997	Mobil Oil	Climate change: a degree of uncertainty
11 December 1997	Mobil Oil	Let's not forget the will of the senate
18 December 1997	Mobil Oil	The Kyoto Conference
29 January 1998	Mobil Oil	Post Kyoto, what's next?
02 April 1998	Mobil Oil	Voluntary 'can do'
10 September 1998	Mobil Oil	The Kyoto Protocol: too many gaps
05 November 1998	Mobil Oil	The Kyoto Protocol: a painful response
15 April 1999	Mobil Oil	Helping Earth breathe easier
10 June 1999	Mobil Oil	King of the road?
29 July 1999	Mobil Oil	Where we are and where we may be heading
05 August 1999	Mobil Oil	Some ways to make a difference
12 August 1999	Mobil Oil	Scenarios for stabilization
19 August 1999	Mobil Oil	Lessons learned
16 March 2000	ExxonMobil Corp	Do no harm
23 March 2000	ExxonMobil Corp	Unsettled Science
30 March 2000	ExxonMobil Corp	The Promise of Technology
06 April 2000	ExxonMobil Corp	The Path Forward on Climate Change
10 August 2000	ExxonMobil Corp	Political cart before a scientific horse
24 August 2000	ExxonMobil Corp	Facts and fundamentals
14 December 2000	ExxonMobil Corp	Fleet changes, but slowly
21 December 2000	ExxonMobil Corp	Planting the future
10 April 2001	ExxonMobil Corp	Moving past Kyoto...
17 April 2001	ExxonMobil Corp	...to a sounder climate policy

03 May 2001	ExxonMobil Corp	Renewable energy: today's basics
10 May 2001	ExxonMobil Corp	Renewable energy: tomorrow's promise
19 July 2001	ExxonMobil Corp	Action, not talk: cogeneration and climate
03 October 2002	ExxonMobil Corp	Managing greenhouse gas emissions
22 November 2002	ExxonMobil Corp	A responsible path forward on climate
06 February 2003	ExxonMobil Corp	The global climate and energy challenge
08 January 2004	ExxonMobil Corp	A century of deep-water research
22 January 2004	ExxonMobil Corp	Weather and climate
05 February 2004	ExxonMobil Corp	Directions for climate research
11 May 2005	ExxonMobil Corp	More Energy and Lower Emissions?
14 June 2005	ExxonMobil Corp	More Energy and Lower Emissions?
07 July 2005	ExxonMobil Corp	More Energy and Lower Emissions?
04 August 2005	ExxonMobil Corp	Research Into Climate Solutions
03 August 2006	ExxonMobil Corp	Changing the Game
19 December 2006	ExxonMobil Corp	Multiplier Effects
25 January 2007	ExxonMobil Corp	Taking action to reduce greenhouse gas emissions
09 February 2007	ExxonMobil Corp	Saving Energy and Reducing Greenhouse Gas Emissions
14 February 2007	ExxonMobil Corp	Let's Talk About Climate Change
15 February 2007	ExxonMobil Corp	Addressing the Risks of Climate Change
16 February 2007	ExxonMobil Corp	Let's Talk About Climate Change
24 May 2007	ExxonMobil Corp	Values at Work
18 October 2007	ExxonMobil Corp	answering energy questions
13 March 2008	ExxonMobil Corp	The Fuels of the Future
03 April 2008	ExxonMobil Corp	Energy Efficiency--Once Quart at a Time
03 June 2008	ExxonMobil Corp	More Energy. Fewer Emissions. With Technology, We Can Do Both
24 June 2008	ExxonMobil Corp	Vehicles of Change
20 January 2009	ExxonMobil Corp	Provide Energy. Protect the Environment. A dual challenge for all of us.
14 April 2009	ExxonMobil Corp	Many Parts Working Together
22 May 2009	ExxonMobil Corp	Citizenship for the Long Term
29 June 2009	ExxonMobil Corp	Citizenship For the Long Term
15 October 2009	ExxonMobil Corp	Tackling Climate Risks With Technology

Table S21. Catalog of analyzed internal documents.

Date	Authors	Title
31 October 1977	Shaw, H. to Harrison, J. W.	Environmental Effects of Carbon Dioxide
06 June 1978	Black, J. to Turpin, F. G. (cc: Alpert, N. et al.)	The Greenhouse Effect
07 December 1978	Shaw, H. to David Jr., E. E.	Untitled (request for a credible scientific team)
07 March 1978	Weinberg, H. N. to Gornowski, E. J.	CO2
26 March 1979	Garvey, E. A., Shaw, H., Broecker, W. S., Takahashi, T. presentation to Machta, L.	Proposed Exxon Research Program to Help Assess the Greenhouse Effect
16 October 1979	Mastracchio, R. L. to Hirsch, R. L. (cc: Black, J. F. et al.)	Controlling Atmospheric CO2
19 November 1979	Shaw, H. to Weinberg, H. N. (cc: Werthamer, N. R.)	Research in Atmospheric Science
29 January 1980	Eckelmann, W. R. to O'Loughlin, M. E. J. (cc: David, E. E. et al.)	Exxon's View and Position on "Greenhouse Effect"
09 June 1980	Weinberg, H. N. to Shaw, H. and Werthamer, N. R.	Greenhouse Program
08 July 1980	Werthamer, N. R. to Weinberg, H. N.	CO2 Greenhouse Communications Plan
18 December 1980	Shaw, H. to Kett, R. K. (cc: McCall, P. P. et al.)	Exxon Research and Engineering Company's Technological Forecast CO2 Greenhouse Effect
03 February 1981	Gervasi, G. R. to Northington, G. A. (cc: Preston, R. L. et al.)	CO2 Emissions Natuna Gas Project
05 February 1981	Long, G. H. to Lucceshi, P. J. et al. (cc: Barnum, R. E. et al.)	Atmospheric CO2 Scoping Study
15 May 1981	Shaw, H. to David Jr., E. E. (cc: Barnum, R. E. et al.)	CO2 Position Statement
18 August 1981	Cohen, R. W. to Glass, W. (cc: Weinberg, H. N. et al.)	Untitled (catastrophic effects letter)
18 June 1982	Natkin, A. M. to Weinberg, H. N. (cc: Forshee, M. E. et al.)	CRL/CO2 Greenhouse Program
14 July 1982	Cohen, R. W. to Kimon, P. (cc: Berner, R. et al.)	Untitled (Esso project terminated letter)
21 July 1982	Weinberg, H. N., Cohen, R. W., Callegari, A. J., Flannery, B., et al.	CO2-Greenhouse Effect; Corporate Research Climate Modeling
02 September 1982	Cohen, R. W., Levine, D. G. to Natkin, A. M. (cc: Callegari, A. J. et al.)	Untitled (consensus on CO2 letter)

12 November 1982	Glaser, M. B. to Cohen, R. W. et al.	CO2 "Greenhouse" Effect
17 October 1983	Natkin, A. M. to Preston, R. L. (Esso Eastern) (cc: Gervasi, G. R. et al.)	Untitled (ocean storage environmental concerns letter)
27 October 1983	Gervasi, G. R. to Downing, R. G. et al. (cc: Gates, D. F. et al.)	Background Paper Environmental Issues Natuna Gas Project
1984	Flannery, B., Callegari, A. J., Nair, B., Roberge, W. G.	The Fate of CO2 from the Natuna Gas Project if Disposed of by Subsea Sparging
02 February 1984	Callegari, A. J.	Corporate Research Program in Climate/CO2-Greenhouse
28 March 1984	Shaw, H.	CO2 Greenhouse and Climate Issues (EUSA/ER&E Environmental Conference, Florham Park, New Jersey)
07 May 1985	Shaw, H., Henrikson, F. W. to Lab Directors/Program Managers (cc: Cohen, R. W. et al.)	CR Interactions (handout for June 12th meeting with Lee Raymond)
04 October 1985	Flannery, B. P.	CO2 Greenhouse Update 1985
08 March 1988	Carlson, J. M. to Levine, D. G.	The Greenhouse Effect
02 February 1989	Levine, D. G.	Potential Enhanced Greenhouse Effects, Status and Outlook (Presentation to the Board of Directors of Exxon Corp)
Fall 1989	Flannery, B. P.	Greenhouse Science (CONNECTIONS ExxonMobil publication - "Proprietary information for company use only")
21 December 1994	Bernstein, L. S. to Members of Global Climate Coalition	Primer on Climate Change Science
18 March 2002	Flannery, B. P. to Cooney, P. and Marburger, J. (cc: Randol, A. G.)	Activities

Table S22. Catalog of analyzed peer-reviewed publications.

Year	Authors	Title	Publication
1982	Garvey, E. A., Prael, F., Nazimek, K., Shaw, H.	Exxon global CO2 measurement system	IEEE Transactions on Instrumentation and Measurement
1983	Hoffert, M.I., Flannery, B. P., Callegari, A. J., Hseih, C. T., Wiscombe, W.	Evaporation-limited tropical temperatures as a constraint on climate sensitivity	Journals of the Atmospheric Sciences
1984	Flannery, B. P.	Energy balance models incorporating transport of thermal and latent energy	Journals of the Atmospheric Sciences
1984	Flannery, B. P., Callegari, A. J., Hoffert M. I.	Energy balance models incorporating evaporative buffering of equatorial thermal response	Geophysical Monograph Series: Climate Processes and Climate Sensitivity
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1991	Kheshgi, H. S., Hoffert, M. I., Flannery, B. P.	Marine biota effects on the compositional structure of the world oceans	J. Geophys. Res.
1993	Kheshgi, H. S., White, B. S.	Effect of climate variability on estimation of greenhouse parameters: usefulness of a pre-instrumental temperature record	Quaternary Science Reviews
1993	Flannery, B. P., Kheshgi, H. S., Hoffert, M. I., Lapenis, A. G.	Assessing the effectiveness of marine CO2 disposal	Energy Convers. Mgmt
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1995	Kheshgi, H. S.	Sequestering atmospheric carbon dioxide by increasing ocean alkalinity	Energy
1996	Santer, B. D., Wigley, T.M.L., Barnett, T.P., Anyamba, E.,..., Kheshgi, H.S. (Contributor), et al.	Detection of Climate Change and Attribution of its Causes	Intergovernmental Panel on Climate Change Second Assessment Report, Chapter 8, Volume I
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1996	Kheshgi, H. S., Lapenis, A. G.	Estimating the accuracy of Russian paleotemperature reconstructions	Palaeogeography, Palaeoclimatology, Palaeoecology
1996	Kheshgi, H. S., Jain, A. K., Wuebbles, D. J.	Accounting for the missing carbon sink with the CO ₂ Fertilization Effect	Climatic Change
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2001	Prentice, C., Farquhar, G., Fasham, M., Goulden, M., Heimann, M., Jaramillo, V., Kheshgi, H., Quéré, C. L., Scholes, R., Wallace, D.	The carbon cycle and atmospheric CO ₂	Intergovernmental Panel on Climate Change Third Assessment Report, Working Group 1, Chapter 3
2001	Mitchell, J. F. B.,..., Kheshgi, H. S.	Detection of Climate Change and	IPCC TAR WGI Ch12

2001	(Contributing Author), et al. Albritton, D. L.,...,Kheshgi, H.S. (Contributing Author), et al.	Attribution of its Causes Technical Summary	Intergovernmental Panel on Climate Change Third Assessment Report, Working Group 1, Summary for Policymakers and Technical Summary
2001	Kauppi, P.,...,Kheshgi, H. S. (Contributing Author), et al.	Technical and Economic Potential of Options to Enhance, Maintain and Manage Biological Carbon Reservoirs and Geo-Engineering	Intergovernmental Panel on Climate Change Third Assessment Report, Working Group 3, Chapter 4
2001	Toth, F. L.,..., Flannery, B. (Lead Author), et al.	Decision Making Frameworks	Intergovernmental Panel on Climate Change Third Assessment Report, Working Group 3, Chapter 10
2002	Hayhoe, K. A. S., Kheshgi, H. S., Jain, A. K., Wuebbles, D. J.	Substitution of natural gas for coal: climatic effects of utility sector emissions	Climatic Change
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2007	Kheshgi, H. S. (eds. Schlesinger, M. E., Kheshgi, H., Smith, J. B., de la Chesnaye, F. C., Reilly, J. M., Wilson, T. and Kolstad, C.)	Probabilistic estimates of climate change: methods, assumptions and examples (p. 49-61)	Human-Induced Climate Change: An Interdisciplinary Assessment
2007	Kheshgi, H. S. (Coordinating Editor for Part 1) (eds. Schlesinger, M. E., Kheshgi, H., Smith, J. B., de la Chesnaye, F. C., Reilly, J. M., Wilson, T. and Kolstad, C.)	Part 1, Climate System Science (p. 2-3)	Human-Induced Climate Change: An Interdisciplinary Assessment
2007	Ribeiro, S. K.,..., Kheshgi, H. (Review Editor), et al.	Transport and its infrastructure	Intergovernmental Panel on Climate Change Fourth Assessment Report, Working Group 3, Chapter 5
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2009	Hershkowitz, F., Deckman, H. W., Frederick, J. W., Fulton, J. W., Socha, R. F.	Pressure swing reforming: a novel process to improve cost and efficiency of CO2 capture in power generation	Energy Procedia
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