

PROFILE AND STATEMENT OF GEOFFREY SUPRAN, PH.D.

Preliminary Matters

My name is Dr. Geoffrey Supran. I am a Post Doctoral Fellow working with Professor Naomi Oreskes in the Department of the History of Science at Harvard University (Oreskes is a world-renowned historian of science who identified the scientific consensus on human-caused climate change. She is also a foremost authority on the fossil fuel industry's climate denial, chronicled in her and Erik Conway's book and film, *The Merchants of Doubt*). I am also a Post Doctoral Affiliate working with Professor Jessika Trancik at the Institute for Data, Systems and Society at Massachusetts Institute of Technology (MIT).

I received my PhD in Materials Science & Engineering at MIT. I also earned the MIT Graduate Certificate in Science, Technology and Policy. I grew up on the south coast of England, and as an undergraduate, obtained a First Class Honours degree in Natural Sciences (physics) from Trinity College, University of Cambridge.

My expertise and research background are twofold: the engineering and modeling of clean energy technologies; and the history of climate science disinformation by the fossil fuel industry.

I was invited by Ms. Desiree Llanos Dee, Climate Justice Campaigner of Greenpeace Southeast Asia (Philippines), one of the petitioners in the human rights and climate change case, to be a witness and resource person for the petitioners on August 29-30 public hearings by presenting the findings of a paper I co-authored with Harvard University Professor Naomi Oreskes. The title of the paper is "***Assessing ExxonMobil's climate change communications (1977–2014)***," and it was published in Environmental Research Letters on 23 August 2017.

I agreed to be a witness and resource person for the petitioners and answer in writing questions posed to me. On 03 July 2018, Attorney Hasminah Paudac, one of the legal representatives for the petitioners, spoke with me on Skype regarding the process of Statement-taking. Attorney Kristin Casper, Greenpeace Canada's litigation counsel and international legal coordinator, also participated in that call. On 04 July 2018, the legal representatives for the petitioners, Attorney Hasminah Paudac and Attorney Grizelda Mayo-Anda, through their legal liaison, Ms. Anna Dominique Esmeralda, sent me questions, which I personally answered. I submit this *Profile and Statement*, along with my *Curriculum Vitae* and *PowerPoint presentation*, to the Commission on Human Rights. I commit to elaborate on and clarify this *Statement* during the scheduled public hearing.

Questions and Answers

Q1: *Can you please give us a background about your studies and career at Harvard University and Massachusetts Institute Technology?*

A1: After obtaining a First Class Honours degree in Natural Sciences (physics) from Trinity College, University of Cambridge in 2009, I pursued a PhD in Materials Science and Engineering at Massachusetts Institute of Technology (MIT) under the supervision of Professor Vladimir Bulović. Matriculating as an MIT Energy Initiative Fellow, my studies centered on the materials science, electrical engineering, physics and economics of energy technologies. My research focused on addressing climate change by engineering next-generation light-emitting devices (LEDs) and solar cells using nanomaterials called quantum-dots. Among our findings, my colleagues and I discovered the origin of efficiency loss at high-voltages typical in quantum-dot LEDs (QD-LEDs), an essential finding in the development of high-efficiency, high-brightness lighting technologies. We also invented and patented the most efficient thin-film shortwave-infrared light source in the world. My review of QD-LEDs in the journal *Nature Photonics* is the most highly cited in its field (1,100 citations).

During my PhD, I also earned the MIT Graduate Certificate in Science, Technology and Policy. I studied science and environmental policy, with a focus on climate change and energy. Under the supervision of Professor Jessika Trancik, my research assessed the costs and carbon intensities of the 125 most popular light-duty vehicle models in America. Our study and accompanying online app for car buyers showed that low-carbon-emitting vehicles are also amongst the cheapest, and that by 2050, only electric vehicles fueled by carbon-free electric power will meet climate targets.

As a graduate student, I co-led a four-year fossil fuel divestment campaign at MIT, precipitating the Institute's first climate action plan. Accordingly, I was appointed by MIT's administration to represent MIT's 6,800 graduate students on the Institute's climate change committee, and our student group was awarded the MIT Martin Luther King Jr. Leadership Award. In 2011, I was one of two graduate students (out of 6,510) nominated by then-MIT President Susan Hockfield for the Academy of Achievement's International Achievement Summit. In 2014, I served as a youth delegate at the U.N. COP20 climate negotiations in Lima, Peru. In 2016, I helped organize the first major scientist protests against the Trump administration's science and climate policies. Also in 2016, I co-led a campaign of 300 geoscientists urging the world's largest Earth science organization to cut ties with ExxonMobil, co-authoring the most up-to-date account of the company's past and present climate science misinformation [1].

After finishing my PhD, I became a Post Doctoral Fellow with Professor Naomi Oreskes in the Department of the History of Science at Harvard University and with Professor Jessika Trancik at the Institute for Data, Systems and Society at MIT. In 2017, Oreskes and I published the first ever peer-reviewed, academic analysis of ExxonMobil's 40-year history of

climate change communications [2]. At MIT, we are currently conducting a meta-analysis of decarbonization scenarios through historical benchmarking. At Harvard, we continue to study the history of climate science disinformation by the fossil fuel industry, and also recently won a Harvard Climate Change Solutions Grant to co-author a science-based fiction book envisioning a fossil fuel-free future.

My research and organizing have been covered by major news outlets including *CNN*, *PBS*, *NPR*, *ABC*, *CNBC*, *The New York Times*, *The LA Times*, *The Washington Post*, *The Financial Times*, *The Boston Globe*, *The Guardian*, *Bloomberg*, *Scientific American*, *Nature*, *Science*, *Mashable*, *Grist*, *Vox*, *VICE*, *BuzzFeed*, and many others.

Q2: *Are you familiar with the Petition filed by Greenpeace Southeast Asia (Philippines), along with thirteen (13) non-profit organizations and eighteen (18) individuals, before the Philippine Commission on Human Rights requesting for an investigation of the Carbon Majors for human rights violations or threats thereof resulting from the impacts of climate change?*

A2: Yes, I am familiar with the Petition.

Q3: *How did you become familiar with said Petition?*

A3: Originally, by way of public news coverage. More recently, by reading the Petition itself and through conversations with the petitioners and legal representatives listed in the preamble to this *Profile and Statement*.

Q4: *Given your background, what can you say about the Petition, if any?*

A4: As a scholar who studies the history of climate science disinformation by the fossil fuel industry, I can speak to and support – with documentation evidencing both broad trends and specific examples – the Petition’s contention that “there are examples of fossil fuel companies, either directly or through trade associations, actively preventing action on climate change and renewable energy solutions by undermining the science and running campaigns aimed to confuse the public...similar to the tactics employed by the tobacco industry.” Specifically, my research and detailed familiarity with ExxonMobil’s history of climate change communications enable me to speak to and support the Petition’s contention that “Exxon and others have known about threats of climate change for decades, yet there are examples of members of the fossil fuel industry engaging in activities that undermine climate science and action.”

Additionally, as a scholar who studies scenarios for decarbonization, I can offer my opinion on the global significance of the Petition as a means for helping to build the legal and sociopolitical momentum necessary for achieving meaningful supply-side action on climate change.

Q5: *Can you please summarize the article or study you co-authored with Naomi Oreskes, “Assessing ExxonMobil’s climate change communications (1977–2014)”?*

A5: ExxonMobil is under scrutiny on several legal fronts. From investigations by the Attorneys General of New York and Massachusetts and by the Securities and Exchange Commission, to lawsuits by cities including New York City and San Francisco and some of ExxonMobil's own employees and shareholders, to this enquiry by the Philippines Commission on Human Rights, a common question has emerged: have ExxonMobil's communications about climate change misled its customers, shareholders, or the general public, including in ways that may have broken the law? (Unless specified otherwise, I refer to ExxonMobil Corporation, Exxon Corporation, and Mobil Oil Corporation as "ExxonMobil".)

ExxonMobil says the allegations are false and "deliberately cherry-picked" and that anyone who looks at the evidence will see that. They challenged the public to "Read all of these documents and make up your own mind."

At Harvard University, Professor Naomi Oreskes and I took up this challenge. Over the course of a year, we read all of the documents made available by ExxonMobil, as well as some additional relevant ones, and analyzed them according to established social science methods. The result of our study was, to our knowledge, the first peer-reviewed, academic analysis of ExxonMobil's 40-year history of climate change communications, published in the journal *Environmental Research Letters* [2].

Our findings are clear: ExxonMobil misled the public about the state of climate science and its implications. Available documents show systematic, quantifiable discrepancies between what ExxonMobil's scientists and executives discussed about climate change in private and in academic circles, and what it presented to the general public.

Our research was supported by Harvard University Faculty Development Funds and by the Rockefeller Family Fund. Neither Naomi Oreskes nor I have any other relevant financial ties, and we declare no conflicts of interest.

Q6: *How is your article or study unique?*

A6: To our knowledge, our study is the first peer-reviewed, academic analysis of ExxonMobil's 40-year history of climate change communications.

Part of the impetus for suspicions about ExxonMobil's knowledge and communications on climate change was reporting by the news organizations *Inside Climate News* and *Los Angeles Times* in 2015, which concluded ExxonMobil had long known about the risks of climate change but denied them in public [3,4]. Our research extends the journalists' work by providing an independent, empirical, and expansive corroboration of their finding that ExxonMobil has known for decades about the basics of climate science and its implications.

We further show that, both simultaneously and in subsequent years, the company communicated positions to the general public that were at odds with this knowledge. We identify systematic discrepancies between what

ExxonMobil said about climate change in private and academic circles, and what it said to the public. In other words, ExxonMobil didn't just *know* about climate science and its implications decades ago (the main finding of journalists), it publicly undermined public awareness and understanding of that knowledge.

The word “systematic” is key here. ExxonMobil has accused journalists of using “deliberately cherry-picked statements,” but when we analyze all relevant documents – including those that ExxonMobil claimed would exonerate them – with an independent, established social science method, we observe clear trends [5]. Our observations affirm the conclusions drawn by journalists in their investigative reporting.

Q7: *Was the study peer-reviewed? If so, could you please describe the peer-review process that took place?*

A7: Yes, our study was peer-reviewed. The study underwent peer-review at the journal *Environmental Research Letters*. For details on the peer-review process, please enquire with the journal. As far as I am aware, our paper was reviewed by the same process used by that journal for any submission: First, our submitted manuscript underwent preliminary assessment for suitability by the journal's Editorial Board and Editorial office. Then, it was sent to independent, anonymous referees for formal review. Our manuscript underwent two rounds of revisions based on critical reviews from three referees. The review process lasted roughly three-and-a-half months, from initial manuscript submission to acceptance for publication.

Q8: *Could you please describe the study's methodologies to assess ExxonMobil's communications?*

A8: For details on our study's methodologies, please consult our article's Method section and supplementary information.

We adapt and combine the methodologies used to quantify the consensus on human-caused climate change by Oreskes [6] and Cook *et al.* [7] with the content analysis methodologies used to characterize media communications about climate change by Feldman *et al.* and Elsasser and Dunlap [8,9].

We applied content analysis to 187 ExxonMobil (previously Exxon Corporation and Mobil Oil Corporation) documents generated between 1977 and 2014. These comprised all relevant, publicly available internal company files that have led to allegations against ExxonMobil, as well as all peer-reviewed and non-peer-reviewed publications publicly offered by the company in response. We also analyzed 36 of the company's so-called ‘advertorials’ about climate change – paid, editorial-style advertisements on the Op-Ed pages of *The New York Times* between 1989 and 2004 – as representative of the company's public communications.

To characterize each document, we read its abstract, introduction, and conclusion, and either skimmed or read thoroughly the rest as necessary. In the case of long documents (over ~30 pages) in which executive summaries

were provided, we relied on those summaries.

The documents were first binned into four categories: 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 human-caused climate change.

Tailoring the approaches of Cook *et al.*, Feldman *et al.*, and Elsasser and Dunlap, we then coded each document to characterize its positions on climate change as real, human-caused, serious, and solvable. (Research has shown that these four factors are key predictors of public support for climate policies. Not coincidentally, they also underpin most narratives of climate skepticism and denial.) We also characterized each document’s positions (if any) on the risks of stranded fossil fuel assets. (This is pertinent, because Attorneys General and the Securities and Exchange Commission are investigating ExxonMobil’s understanding and disclosures of the financial risks related to either climate change or future climate policy, and shareholders have questioned the adequacy of ExxonMobil’s disclosures on this point. We therefore examined what, if anything, has been stated on this subject in the documents.)

Q9: *Are the methodologies used the widely-accepted methodologies to assess these kinds of communications?*

A9: Yes, our methodologies are based on those that have been used to quantify the consensus on human-caused climate change by Oreskes [6] and Cook *et al.* [7] and those that have been used to characterize media communications about climate change by Feldman *et al.* and Elsasser and Dunlap [8,9]. 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.

More broadly, content analysis is a well-established social science method for investigating and characterizing mass media and other communication content [10]. Metag (2016), for example, observes that, “content analysis is one of the most frequently used methods in climate change communication research” [11]. Our methodologies, refined based on critical commentary by independent, anonymous referees, passed academic peer-review.

Q10: *Why did you choose these methodologies over other available methodologies?*

A10: A comprehensive answer to this question is beyond the scope of this document, primarily because there are many available methodologies, and because their definitions – including definitions of content analysis – are themselves typically inexact. For example, Titscher *et al.* delineate twelve distinct social-scientific methods of text analysis, including content analysis [10]. Other disciplines, such as history and investigative journalism, offer

additional approaches and methodologies. Moreover, the diverse methodologies are not mutually exclusive.

That said, there were several reasons why we adopted the methodology we did:

- (a) Any analysis of words is subject to interpretation. Thus, we used an established social science method of content analysis to minimize interpretive uncertainty, and subjected our analysis to peer review to verify that our claims are supported by evidence, were analyzed according to tested methods, and were inter-subjectively valid and not just a matter of subjective opinion.
- (b) Quantitative consensus measurement and content analysis permit a standardized approach – for example, a typology for coding – thereby making our work transparent and reproducible. Notably, our study made publicly available as supplementary material all substantiating quotations for all document codings.
- (c) Our method is empirical, and thereby amenable to statistical tests of significance.
- (d) As discussed above, our empirical approach offers an alternative line of enquiry to the historical and journalistic methods previously brought to bear on ExxonMobil’s climate change communications.

Q11: How many ExxonMobil communications or documents assessed or reviewed for this study?

A11: Our study comprised 187 documents generated between 1977 and 2014: 32 internal ExxonMobil documents; 53 articles labeled ‘Peer-Reviewed Publications’ in ExxonMobil’s ‘Contributed Publications’ list [12]; 48 (unique and retrievable) documents labeled ‘Additional Publications’ in ExxonMobil’s ‘Contributed Publications’ list; 36 Mobil/ExxonMobil advertorials related to climate change in *The New York Times*; and 18 other publicly available ExxonMobil communications – mostly non-peer-reviewed materials – obtained during our research.

Q12: What were your findings and conclusions, if any?

A12: Our key findings were as follows:

- (a) **We found that from as early as the 1970s, ExxonMobil not only knew about emerging climate science, but also contributed research to it.** Scientific reports and articles written or cowritten by ExxonMobil employees acknowledged that global warming was a real and serious threat. They also noted it could be addressed by reducing fossil fuel use, meaning that fossil fuel reserves might one day become stranded assets.

- (b) **We found that there is a discrepancy between what different ExxonMobil document categories say, and particularly what they emphasize, about climate change science and its implications.**
- i. *On climate change as real and human-caused, serious, and solvable, we observed that the more publicly accessible documents were, the more they tended to communicate doubt. That is, available documents show a systematic, quantifiable discrepancy between what ExxonMobil's scientists and executives discussed about climate change in private and in academic circles, and what it presented to the general public. 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.*
 - ii. *On the risks of stranded fossil fuel assets, we found this topic discussed and sometimes quantified in 24 documents of various types, but absent from advertorials.*
- (c) **We found an imbalance in impact of different document categories: ExxonMobil contributed to and acknowledged climate science in private and in academic journals read only by a small number of academics; whereas ExxonMobil promoted doubt about that science in advertorials in *The New York Times* read by millions of people.**
- (d) **We found ExxonMobil's advertorials (and other more public communications) to include several instances of explicit factual misrepresentation.**

Based on these findings, our key conclusion is that ExxonMobil misled non-scientific audiences about the state of climate science and its implications. The company contributed to advancing climate science – by way of its private research and its scientists' academic publications – but promoted doubt about it in advertorials and other direct and indirect public communications. This overwhelming emphasis on uncertainties, promoting a narrative inconsistent with the views of most climate scientists, including ExxonMobil's own, is characteristic of what Freudenberg *et al.* term the *Scientific Certainty Argumentation Method* (SCAM) – a tactic for undermining public understanding of scientific knowledge [13,14]. We are not in a position to judge whether ExxonMobil violated any laws.

Q13: Can you please elaborate on these findings and conclusions by specifically giving examples?

A13: Below I provide examples pertaining to the findings outlined in A12:

Finding: We found that from as early as the 1970s, ExxonMobil not only knew about emerging climate science, but also contributed research to it.

Examples:

- Internal documents show that by the early 1980s, ExxonMobil scientists and managers were sufficiently informed about climate science and its prevailing uncertainties to identify global warming 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” [15,16]. 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.” In 1980, Callegari joined Exxon, and the next year took over its CO₂ research efforts. His papers were frequently cited in company publications.
- From approximately 1979 to 1982, the Exxon Research and Engineering (ER&E) Company pursued three major climate change research projects. ExxonMobil’s 2015 statement that two of the projects “had nothing to do with CO₂ emissions” is contradicted by internal documents [17]. In the early 1980s, these major research initiatives were discontinued amidst budget cuts. 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” [18].

Finding: We found that there is a discrepancy between what different ExxonMobil document categories say, and particularly what they emphasize, about climate change science and its implications. *On climate change as real and human-caused, serious, and solvable, we observed that the more publicly accessible documents were, the more they tended to communicate doubt.*

Examples: Before providing examples, I note that individual exemplifying quotations cannot fully reflect the spectrum of positions expressed by the documents. The reader is directed to tables 3-5 and the supplementary information of Supran and Oreskes (2017) for a more comprehensive set of examples. That said, as we have previously described, the discrepancies in ExxonMobil’s climate change communications are *systematic*. ExxonMobil has accused journalists of using “deliberately cherry-picked statements,” but when we analyze all relevant documents (and the full spectrum of positions expressed therein), we observe clear trends [5]. Below, I therefore provide examples substantiating these trends.

On climate change as real and human-caused, characteristic examples in ExxonMobil’s peer-reviewed publications include:

- A chapter of a 1985 US Department of Energy report co-authored by Exxon scientist Brian Flannery, which modeled future temperatures for different CO₂ forcing scenarios (figure 5.16 of [19]), showing a range of 1.5-6 °C warming by 2100. “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 GHG by the middle of the next century.” Their conclusion is entitled “Consensus CO₂ Warming.”

- Exxon’s principal climate scientist, Haroon Kheshgi, was a contributing author to Chapter 8 of the 1995 Intergovernmental Panel on Climate Change (IPCC) report, which observed a “discernible human influence on global climate” [20]. 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” [21–23].
- 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” [24–26].

Characteristic examples in ExxonMobil’s internal documents include:

- A 1979 Exxon study, which 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.”

The memo does, however, note the “great uncertainty in the existing climatic models”, which was reasonable in 1979 [27].

- 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.” [28]. Unsurprisingly in 1978, Black also stressed the alleged shortcomings of extant climate models.
- An internal Exxon briefing on the “CO₂ ‘Greenhouse’ Effect” from 1982 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” [29].
- A table (see <https://perma.cc/9DGQ-4TBW>) presented by Exxon scientist Henry Shaw at a 1984 Exxon/Esso environmental conference showed that Exxon’s expected “average temperature rise” of 1.3 °C–3.1 °C was comparable to projections by leading research institutions (1.5°C– 4.5°C) [30]. Shaw made

clear the variable and “unpredictable” character of some values.

In contrast, characteristic examples in ExxonMobil’s advertorials in The New York Times (an example of a non-peer-reviewed document is also given) include:

- A 1997 Mobil advertorial entitled “Reset the Alarm,” which argues “Let’s face it: The science of climate change is too uncertain to mandate a plan of action that could plunge economies into turmoil” [31]. The company added, “We still don’t know what role man-made greenhouse gases might play in warming the planet.”
- A 2000 ExxonMobil advertorial entitled “Unsettled Science” (also in *The Wall Street Journal*) says “fundamental gaps in knowledge leave scientists unable to make reliable projections about future changes” [32]. “Scientists remain unable to confirm,” it claims, “that humans are causing global warming”: “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.”
- A 2004 ExxonMobil advertorial focuses on uncertainty, stressing 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” [33].
- A 1998 non-peer-reviewed Exxon pamphlet, whose preface was written by then CEO Lee Raymond, stated that the IPCC’s “discernible human influence” conclusion was “not peer-reviewed,” though it was [34]. This was despite the fact that Exxon’s chief climate researcher, Haroon Kheshgi, was a contributing author to the IPCC chapter in question.

Finding: *On the risks of stranded fossil fuel assets, we found this topic discussed and sometimes quantified in 24 documents of various types, but absent from advertorials.*

Examples: The number of times the concept of stranded fossil fuel assets is mentioned varies statistically significantly across document categories. 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 supplementary information of Supran and Oreskes (2017) for all examples): (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.

Examples of (i) include:

- A 1982 internal Exxon primer, which says, “Mitigation of the ‘greenhouse effect’ would require major reductions in fossil fuel combustion” [29].
- 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” [27].

Examples of (ii) include:

- Five ExxonMobil studies – one internal, three peer-reviewed, and one non-peer-reviewed – include data 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 [25,35–37]. These budgets are within a factor of two of contemporary estimates of roughly 442–651 GtC.

Finding: We found an imbalance in impact of different document categories: ExxonMobil contributed to and acknowledged climate science in private and in academic journals read only by a small number of academics; whereas ExxonMobil raised doubts about that science in advertorials in *The New York Times* read by millions of people.

Examples:

- On the one hand, most of ExxonMobil’s research was highly technical, hidden behind the walls of ExxonMobil offices, or reported in academic publications with access only through a paywall. ExxonMobil’s peer-reviewed and non-peer-reviewed publications have been cited an average (median (mean)) of 21(60) and 2(9) times, respectively, suggesting an average readership of tens to hundreds. ExxonMobil’s principal (and only consistent) academic author was scientist Haroon Khesghi, who co-authored 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’ [12].
- In contrast, the company bought climate change advertorials in *The New York Times* specifically to allow “the public to know where we stand” [38]. Readerships were in the millions. 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 [39,40]. “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...” [41].

Finding: We found ExxonMobil’s advertorials (and other more public communications) to include several instances of explicit factual misrepresentation.

Examples:

- The 2000 ExxonMobil advertorial entitled “Unsettled Science,” introduced above, attempts to emphasize natural variability by including a figure taken

from an article in *Science* by Lloyd Keigwin of the Woods Hole Oceanographic Institution [32]. Keigwin called the use of his data “very misleading” [42]. 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....”

- A 1996 advertorial claimed that “greenhouse-gas emissions, which have a warming effect, are offset by another combustion product – particulates – which leads to cooling” [43]. 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” [19]. By 1995, the IPCC had rejected it.

Q14: What are the impacts, if any, of your findings and conclusions to the body of climate science and current discourse on climate change?

A14: Our work does not stand in isolation, but complements and corroborates earlier investigations. At the onset of our study, substantial evidence from investigative journalism and scholarly research suggested that ExxonMobil had misled the public on a variety of aspects of climate change and in a variety of ways [1,44–53].

The purpose of our investigation was to bring to bear an additional, complementary empirical methodology to test the hypothesis that ExxonMobil had misled the public; namely, the first empirical assessment and intercomparison of ExxonMobil’s private and public statements on climate change. It may therefore be relevant to ongoing and/or future climate litigation or investigations.

Our study was also designed to respond to ExxonMobil’s claim that relevant documents (supplied by ExxonMobil) would exonerate the company. Our results affirm the reverse: the documents that ExxonMobil proffered provide strong evidence that journalistic investigations of this matter have been largely correct.

By applying the quantitative methodologies of consensus measurement and content analysis, our results add to (i) earlier analyses of ExxonMobil’s communication practices, (ii) qualitative accounts of the company’s climate change communications, and (iii) the application of consensus measurement/content analysis to climate change communications. In addition, this study contributes to the broader literature on climate change denial, corporate issue management and misinformation strategies, and the social construction of ignorance. Our study was reportedly one of the ten “most talked-about climate change-related papers” of 2017 [54].

Q15: Based on your findings and conclusions, would you say that ExxonMobil’s communications, specifically its “advertorials” about climate change,

misled its customers, shareholders, or the general public in the United States or any other country?

A15: **Yes, based on our findings, we conclude that ExxonMobil misled non-scientific audiences about the state of climate science and its implications.** It did so in three ways:

(1) *Exxon and ExxonMobil Corp misled with discrepant communications:*

- Both statistical and document-to-document discrepancies between advertorials and other documents lead us to conclude that ExxonMobil Corp misled the public about climate change as real and human-caused, serious, and solvable, and about the risks of stranded fossil fuel assets.
- Statistically significant discrepancies also suggest that Exxon and ExxonMobil Corp’s non-peer-reviewed communications, which tended to be more orientated towards non-scientific audiences than peer-reviewed papers, were also sometimes misleading.

(2) *Mobil, Exxon, and ExxonMobil Corp misled with misinforming advertorials and non-peer-reviewed publications.* Using as proxies for mainstream climate science both the conclusions of the IPCC 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 Mobil, Exxon, and ExxonMobil Corp’s public communications were inconsistent with available scientific information and therefore misleading to public audiences [5,55].

(3) *Exxon and ExxonMobil Corp misled by funding climate denial.* Our study reveals overwhelming acknowledgement by both Exxon and ExxonMobil Corp scientists that climate change is real and human-caused. At the same time, it is well documented that from at least the late 1980s through to today, Exxon and ExxonMobil Corp have funded groups and individuals and participated in organizations that cast doubt in public on climate science [1,44–53]. This is a third way in which Exxon and ExxonMobil Corp misled the public.

Q16: Do you recall if any of ExxonMobil’s private or public communications discussed impacts of anthropogenic climate change in the Philippines or any other countries? If so, could you describe what was said and whether there were any discrepancies between internal and public communication?

A16: Yes, some of ExxonMobil’s communications discussed impacts of anthropogenic climate change. With a few exceptions, most of these discussions were geographically generalized. To my knowledge, the Philippines was not specifically discussed in any of the documents investigated.

Our study coded the positions of documents on climate change as “serious” by assigning ‘Impact Points’ throughout each document based on its positions on climate change as having known or predicted negative impacts (for example, geophysical, economic, or sociopolitical). The reader is directed to table 4 and the supplementary information of Supran and Oreskes (2017) for all individual references to such impacts, and to section 3.2 of the study for a detailed discussion of our results.

In short, yes, we observed systematic discrepancies between document categories on climate change as serious. **The more publicly accessible documents were, the more they tended to communicate doubt:**

- ExxonMobil’s peer-reviewed publications focus almost exclusively on methods and mitigation. Only 10 discuss the potential impacts of climate change, of which 60% take a position of ‘Acknowledge’, 30% of ‘Doubt’, and 10% of ‘Acknowledge and Doubt’. Hoffert *et al.* (2002), for example, 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” [56].
- Internal documents typically acknowledge the potential for serious impacts but also highlight uncertainties. Of the documents with a position, 35% ‘Acknowledge’ and 47% ‘Acknowledge and Doubt’. 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” [57]. 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.” [58] (see also [29]). A 1979 Exxon memo summarizes several points about potential impacts, for example [27]:
 - “The most widely held theory is that...the present trend of fossil fuel consumption will cause dramatic environmental effects before the year 2050.”
 - “Recognizing the uncertainty, there is a possibility that an atmospheric CO₂ buildup will cause adverse environmental effects in enough areas of the world to consider limiting the future use of fossil fuels as major energy sources.”
 - “This study reviews various world energy consumption scenarios to limit CO₂ atmospheric buildup”, referring to its appendix summary of “Ecological consequences of increased CO₂ levels” reproduced from a 1969 peer-reviewed article. The study’s “No Limit on CO₂ Emissions” scenario anticipates that “a doubling of the pre-industrial concentration occurs around

2050. The doubling would bring about dramatic changes in the world's environment.” Among these, the appendix states, “ocean levels would rise four feet.” Also, “the melting of the polar ice caps...could trigger major increases in earthquakes and volcanic activity resulting in even more atmospheric CO₂ and violent storms. The Arctic Ocean would be ice free for at least six months each year, causing major shifts in weather patterns in the northern hemisphere. The present tropics would be hotter, more humid, and less habitable....”

At a 1984 Exxon/Esso environmental conference, Exxon scientist Henry Shaw's presentation noted that “a 2 to 3 °C increase in global average temperature can be amplified to about 10 °C at the poles [30]. This could cause polar ice melting and a possible sea-level rise of 0.7 meter by 2080. The time scale for such a catastrophe is measured in centuries. Other potential effects associated with a high atmospheric CO₂ concentration and a warmer climate are:

- redistribution of rainfall
 - positive and negative changes in agricultural productivity
 - accelerated growth of pests and weeds
 - detrimental health effects
 - population migration”
- Non-peer-reviewed documents offer a mix of positions. Among the documents that take a position, 45% ‘Acknowledge’, 41% ‘Doubt’, and 14% ‘Acknowledge and Doubt’. Several of the expressions of doubt in non-peer-reviewed documents reflect the industry-targeted communications included in this category. An example of acknowledgment is a 1997 book chapter co-authored by Exxon scientists, which acknowledges that “Although model projections of a warmer Earth are uncertain, it appears that the intensity and tracks of storms may change. In addition, it has been suggested that severe storms such as hurricanes may increase in frequency and/or intensity...Projections suggest a potential sea level rise of up to about 1 m by 2100” [59]. A 2014 report, “Addressing adaptation to climate risks in the oil and gas industry,” discusses “a range of risks from current and future climate variability” faced by the industry, such as “changes in storm strength” [60].
 - ExxonMobil advertorials overwhelmingly take the position of doubt. Of the advertorials that take a position, 62% express ‘Doubt’. Most of the remainder express a mixed position (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” [61]. “Just as changeable as your local weather forecast,” says a 2000 advertorial, “views on the climate change debate range from seeing the issue as serious or trivial, and from seeing the possible future impacts as harmful or beneficial” [62]. Another advertorial in 2000 states that “Some use [the 1 degree Fahrenheit rise in Earth's surface temp over the past 150 years] 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” [32].

Q17: Do you know if ExxonMobil publicly commented on or issued any statement regarding your study?

A17: Yes, to my knowledge ExxonMobil has publicly commented twice on our study [63,64]. We published a response to these statements in the *Los Angeles Times* [65].

Q18: Has ExxonMobil reached out to you or to Naomi Oreskes about your study?

A18: No.

Q19: Has your study been updated since it was first published by Environmental Research Letters? And if so, could you please describe any changes, if any, to the analysis?

A19: Yes, we are in the process of publishing peer-reviewed updates and so will not be making any detailed comments until they have passed muster with independent, anonymous experts. We fully stand by the conclusions of our original study.

Q20: Has your study been referenced in any other ongoing litigation concerning climate change?

A20: Our study was cited in a lawsuit filed by New York City against five fossil fuel companies in 2018 [66]. I am not aware of other references, though they may exist.

Q21: Is your study relevant to any other ongoing investigation concerning ExxonMobil?

A21: I am not a lawyer, but yes, it appears that our study may be relevant to most climate investigations and lawsuits concerning ExxonMobil, including investigations by the Attorneys General of New York, Massachusetts, and the US Virgin Islands, an investigation by the Securities and Exchange Commission, lawsuits filed by some of ExxonMobil’s employees and shareholders, and lawsuits filed by communities (cities, counties, and states) such as San Mateo County (CA), Marin County (CA), Imperial Beach (CA), San Francisco (CA), Oakland (CA), Santa Cruz (CA), Santa Cruz County (CA), New York City (NY), Richmond (CA), Boulder (CO), Boulder County (CO), San Miguel County (CO), King County (WA), Rhode Island, and Baltimore (MD).

Q22: Did this study indicate that any other similar companies or fossil fuel industry associations misled their customers, shareholder, or the general public in the United States or any other country?

A22: Although our study focuses on ExxonMobil, yes, one of the documents included in our analysis does suggest that other various fossil fuel companies and trade associations may also have knowingly misled the public about climate science and its implications.

As a scientific consensus emerged in the early 1990s that human-caused climate change was underway, Mobil Oil Corp scientist Leonard Bernstein drafted a 1995 internal ‘Primer on Climate Change Science’ for the industry’s Global Climate Coalition (GCC), which 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” [67]. GCC members included dozens of corporation and trade associations, such as Exxon, Chevron, BP, Shell, the National Coal Association and the American Petroleum Institute. Although the report argued against the IPCC’s conclusion that year that “a discernable human influence on global climate” had already been detected, it emphasized 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.”

There are clear discrepancies between this private acknowledgment and numerous contemporary and subsequent public communications by both GCC and its member fossil fuel companies and trade associations that promoted doubt about the potential for human-caused greenhouse gas emissions to impact the climate. There is a large literature compiled by journalists and academics demonstrating this broad spectrum of communications, from direct public statements to indirect funding or orchestration of climate disinformation through third-party individuals and organizations. As just one example, in 2009 *The New York Times* reported the discrepancy between the GCC’s private acknowledgment and the GCC’s public assertion, in a scientific “Backgrounder” provided to lawmakers and journalists through the early 1990s, that “the role of greenhouse gases in climate change is not well understood” [68,69].

Q23: Are you currently undertaking similar studies for other fossil fuel companies?

A23: Yes, but will not discuss these until they have passed peer-review.

Q24: Is there anything else you would like to say about your research that may be relevant to this national inquiry?

A24: I have three additional observations about our research and relevant context:

(1) We are confident in our results.

Any analysis of words is subject to interpretation. It is for this reason that we used established social science methods and subjected our analysis to peer review, to verify that our claims are supported by evidence, were analyzed according to tested methods, and are not just a matter of subjective opinion. The statistical tests of our content analyses are consistently high. While one might disagree about the interpretation of specific words, the overall trends are clear even on casual inspection.

(2) Our results do not stand in isolation, but compliment and

corroborate existing findings.

It is the overwhelming consensus of experts studying the history of fossil fuel interests – such as investigative journalists, historians of science, and social scientists – that fossil fuel companies and trade associations, including ExxonMobil, have variously orchestrated, funded, and perpetuated direct and indirect climate change misinformation (see, for example, [1,3,4,44–53,70]). The historical evidence is incontrovertible, and to my knowledge has never been challenged by ExxonMobil.

As journalistic and academic research continues to reveal, there is also substantial evidence that many of these companies and trade associations – including ExxonMobil, Shell, the Global Climate Coalition, and the American Petroleum Institute – have variously known about the basics of climate science and its implications for decades [3,4,47,48,69,71–74].

Put together, the evidence points to a singular conclusion: fossil fuel companies and trade associations, including ExxonMobil, have variously promoted disinformation about climate change so as to stifle action by misleading the public and policymakers. As with the science of climate change itself, the burden of proof rests with ExxonMobil and other fossil fuel interests to disprove all supporting evidence and lines of reasoning.

- (3) **ExxonMobil continues to promote climate change misinformation.** Based on non-peer-reviewed research published by my colleagues and I, it is my opinion that 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 [1]. A spectrum of evidence supports this conclusion, including: 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 ExxonMobil's track record of past climate denial.

Q25: *Are you ready and willing to swear this Profile and Statement under oath before the Philippine Commission on Human Rights, if required to do so?*

A25: Yes.



02 August 2018

GEOFFREY SUPRAN, PH.D
Signature and Date of Signing

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