

Annex to CIEL Opinion in Support of Petitioners’

**Oil Industry Knowledge of and Responses to Carbon Risk
and its Relevance to the Responsibilities of Carbon Majors under Human Rights
and other regimes**

*Submitted for the Consideration of the
Government of the Philippines Commission on Human Rights*

February 9, 2017

*“He who can but does not prevent, sins.”
--Antoine Loysel (1607)¹*

“Victory Will Be Achieved When ... Average citizens ‘understand’ (recognize) uncertainties in climate science; recognition of uncertainties becomes part of the ‘conventional wisdom’ [and] ... Those promoting the Kyoto treaty on the basis of extant science appear to be out of touch with reality.”

--American Petroleum Institute (1998)

¹ Franck Latty, “Actions and Omissions” in *The Law of International Responsibility* 355, (James Crawford, Alain Pellet & Simon Olleson eds. 2010) (quoting Antoine Loysel, 1607. (“*Qui peut et n’empesche, pesche.*”)).

In multiple legal domains, the concept of responsibility flows from three main elements: an ability to perceive a harm, an ability to prevent a harm, and a causal link between the responsible party and the harmed party. The pioneering work of Rick Heede and others has demonstrated that a small group of investor and state owned corporations—the Carbon Majors—have contributed measurably and disproportionately to climate change through their production of the fossil fuels that are the major driver of climate change.

This report reviews the factual background of the oil industry’s knowledge and awareness of climate change. We present the evolution of the petroleum industry’s understanding of climate change throughout the twentieth century and offer examples of the actions it took to confuse or mislead the public.

The evidence in this report comes from several sources, including the Center for International Environmental Law, InsideClimate News, the Union of Concerned Scientists, the Los Angeles Times and the Columbia School of Journalism, DeSmog Blog, and others. A more detailed description of these sources, their limitations, and their treatment in this synthesis, is set forth as Annex 1 to this Report.

Consolidated Findings of Fact

- *Theories regarding the potential link between fossil fuel combustion at atmospheric temperature increase were widely reported in scientific literature and academic texts relevant to the oil industry from the early decades of the 20th Century.*
- *The Oil Industry had incentives, opportunity, and relevant expertise to investigate and understand climate science*
- *Documentary evidence demonstrates the Oil Industry was on notice of potential climate risks by 1957*
- *Humble Oil, at the time a wholly-owned subsidiary of Esso (now ExxonMobil), published research acknowledging the link between fossil fuels and atmospheric CO₂ in 1957*
- *Industry Records document that Industry Research into air pollution issues was highly coordinated and shared widely within the industry*
- *Industry Records document that this Coordinated Industry Research program included research into fossil carbon in the atmosphere by no later than 1958*
- *Industry Records and Other Sources indicate that this Industry Research program was used to mobilize public opposition to regulation of air pollutants by sowing doubt regarding air pollution science*
- *The Oil Industry was expressly warned of the potential severity of climate risks by its own consulting scientists in 1968 and repeatedly thereafter*
- *The Oil Industry held early patents on numerous technologies that might have reduced climate change risk*
- *The Oil Industry funded climate misinformation efforts despite its own best information*
- *Even while blocking public action to address climate change, oil companies took steps to protect their own assets from climate risks*

The potential link between fossil fuel combustion at atmospheric temperature increase has been widely discussed in scientific literature and academic texts relevant to the oil industry for more than a century.

The earth receives a constant stream of radiant energy from the sun. This solar radiation is critical to maintaining planetary temperatures at a level which will support life. It has been equally critical to life and to a stable human civilization, however, that a significant portion of the radiation the earth receives from the sun is reflected back into space, thus ensuring that the planetary temperatures do not increase uncontrollably. Beginning with the work of John Tyndall in 1859, it has been widely recognized that certain “greenhouse gases”, such as carbon dioxide, make the earth’s atmosphere more opaque to that reflected radiation, trapping energy that would otherwise be released back into space.² At the same time, scientists and industry experts alike have long recognized the simple and irrefutable fact that the combustion of fossil fuels—including coal, oil, and natural gas—releases tremendous amounts of carbon dioxide (CO₂) into the atmosphere; and that, indeed, CO₂ comprises the largest waste stream by far from fossil fuel combustion processes.³

The proportion of carbon dioxide in the atmosphere has a strong positive correlation with planetary temperatures. For more than a century, this relationship between carbon dioxide and planetary temperatures has been routinely discussed in the scientific literature, including specialist journals and textbooks for the geology and mineralogy communities, in the general and popular scientific press, and even in newspaper reports.⁴ For decades, however, the relationship between fossil fuel combustion,

² SPENCER WEART, *THE DISCOVERY OF GLOBAL WARMING 3* (Revised ed., Cambridge, 2008).

³ See, e.g., THOMAS C. CHAMBERLIN & ROLLIN S. SALISBURY, *GEOLOGY*, vol 3. 444-45 (NY, Holt & Co. 1907) (discussing the work of Arrhenius, Angstrom and others); JW Gregory, *Climatic Variations: Their Extent and Causes*, International Geological Congress 1906, reprinted in *Annual Report of the Smithsonian Institution* 33944, at 347-48 (Smithsonian Inst., Wash. D.C., 1908) (discussing with approval the work of Arrhenius and Chamberlin on the role of atmospheric CO₂ in climate change); FRANK WIGGLESWORTH CLARK, *THE DATA OF GEOCHEMISTRY* (4th ed.) 48-49. (U.S. Dept. of Interior, Wash., D.C. 1920) (“At 3 parts in 10,000 the carbon dioxide in the atmosphere amounts to about 2,200,000,000,000 tons, equivalent to 600,000,000,000 tons of carbon. ... The annual consumption of coal, estimated by A. Krogh at 700,000,000 tons in 1902, adds yearly to the atmosphere about one-thousandth of its present content in carbon dioxide. In a thousand years, then, if the rate were constant and no disturbing factors interfered, the amount of CO, in the atmosphere would be doubled. If we take into account the combustion of fuels other than coal and the large additions to the atmosphere from the sources previously mentioned, the result becomes still more startling. Were there no counterbalancing of this increase in atmospheric carbon, animal life would soon become impossible upon our planet.”); Robert E. Swain, “Atmospheric Pollution by Industrial Wastes,” *Ind. Eng. Chem.*, 15 (3), p. 296–301 (1923) (“The greatest single waste product in industry is a gas, carbon dioxide, which is usually discharged as it is produced directly into the air...If all the coal consumed annually in this country were completely burned, there would be produced approximately nine hundred thousand billion cubic meters, or one billion eight hundred million metric tons of this gas. The combustion of petroleum would add two hundred million metric tons, and of natural gas ninety million metric tons, while the burning or decay of wood, and of plant products and tissues, would add an indeterminable but enormous total to these figures. ... But it is a remarkable fact that, rapidly disbursed as it is into the great ocean about us, this gas is present in the strikingly small and uniform amount of three parts by volume of carbon dioxide to ten thousand parts of air, or three hundred parts per million parts of air.”)

⁴ See, e.g., Charles JJ Fox, *On The Coefficients of Absorption of nitrogen and Oxygen IX Distilled Water and Seawater, and of Atmospheric Carbonic Acid in Sea-Water* 5, 68-86 (Trans. Faraday Soc., 1909), available at <http://pubs.rsc.org/en/content/articlelanding/1909/ tf/9090500068#!divAbstract> (“The object of the present series of measurements was primarily the determination of the absorption coefficients of nitrogen, oxygen, and atmospheric carbonic acid in sea-water. These coefficients have of late years acquired some special significance, notably in connection with that group of physical problems of which Arrhenius’s work on the diathermancy of the atmospheric gases, particularly carbonic acid, and its effect upon terrestrial temperatures, is typical, and again in

atmospheric CO₂ and global temperatures caused little concern because it was widely, but erroneously, assumed that the CO₂ released in this way would be safely absorbed by the world's oceans, thus reducing the impacts to the global climate.

This situation began to change, scientific attention to carbon dioxide began to intensify, and researcher Guy Callendar published a study entitled "The Artificial Production of Carbon Dioxide and its Influence on Temperature."⁵ In his study, Callendar observed that three quarters of the carbon dioxide released in the prior 50 years had, in fact, remained in the atmosphere. As a result, Callendar estimated, world temperatures had increased at 0.005°C per year for the previous fifty years.⁶

Callendar's study was not immediately accepted, but was widely cited and debated over the next two decades.⁷ Some, such as Giles Slocum of the U.S. Weather Bureau, determined that they could not detect a noticeable change in atmospheric carbon dioxide concentrations.⁸ Others postulated that the oceans would absorb so much of the carbon dioxide that "the amount of surplus CO₂ from artificial coal combustion will become insignificantly small as soon as equilibrium with marine carbonate is established."⁹ In 1955, however, Hans Suess provided the first clear proof that, as hypothesized by Arrhenius and theorized by Callendar, that carbon dioxide from the combustion of fossil fuels was accumulating in the atmosphere,¹⁰ a phenomenon that would thereafter be referred to as the "Suess effect."

The research of Callendar, Slocum, Suess, and others was neither obscure nor hidden. Unsurprisingly, the earliest industry studies we have access to measuring the buildup of carbon dioxide in the atmosphere appear around this time.

connection with those matters of biological interest which are concerned with the dynamic processes of pelagic life." (emphasis added)). See also Clark, *supra* note 3, at 49-50 (discussing the existence and debate over Arrhenius' theory and stating "Both carbon dioxide and aqueous vapor serve as selective absorbents for the solar rays, and, by blanketing the earth, they help to avert excessive changes of temperature. On the physical side, and as regards carbon dioxide, this question has been discussed by S. Arrhenius, who argues that if the quantity of the gas in the atmosphere were increased about threefold, the mean temperature of the Arctic regions would rise 8° or 9°.").

⁵ See Guy S. Callendar, *The Artificial Production of Carbon Dioxide and its Influence on Temperature*, 64 Q. J. OF THE ROYAL METEOROLOGICAL SOC'Y 223 (1938), available at <http://onlinelibrary.wiley.com/doi/10.1002/qj.49706427503/full>.

⁶ *Id.*

⁷ Google Scholar Search Results, https://scholar.google.com/scholar?cites=14959323493014744928&as_sdt=20005&scioldt=0,9&hl=en (search "The artificial production of carbon dioxide and its influence on temperature", then click "Cited by").

⁸ See Giles Slocum, *Has the Amount of Carbon Dioxide in the Atmosphere Changed Significantly Since the Beginning of the Twentieth Century?*, 83 MONTHLY WEATHER REV. 225 (1955), available at <http://citeserx.ist.psu.edu/viewdoc/download?doi=10.1.1.173.1979&rep=rep1&type=pdf>.

⁹ See Hans E. Suess, *Natural Radiocarbon and the Rate of Exchange of Carbon Dioxide Between the Atmosphere and the Sea*, in NUCLEAR PROCESSES IN GEOLOGIC SETTINGS 52, 52 (1953), available at https://books.google.com/books?hl=en&lr=&id=RmMrAAAAYAAJ&oi=fnd&pg=PA52&ots=en6W_z00VE&sig=0PRe1KURGXwO_u1VKI17AXuZUPA#v=onepage&q&f=false.

¹⁰ See Hans E. Suess, *Radiocarbon Concentration in Modern Wood*, 122 SCIENCE 415 (1955), available at <http://science.sciencemag.org/content/122/3166/415.2>.

Documentary Evidence Demonstrates Oil Industry Was On Notice of Potential Climate Risks by 1957

In 1957, Suess and Roger Revelle, of the Scripps Institute of Oceanography in La Jolla, California, published a landmark paper that belied the longstanding assumption that the oceans would absorb a large majority of artificial carbon dioxide added to the atmosphere.¹¹ Revelle and Suess predicted large increases in atmospheric carbon dioxide, especially if fossil fuel combustion continued to increase exponentially.¹² They noted that “[w]ithin a few centuries we are returning to the atmosphere and oceans the concentrated organic carbon stored in sedimentary rocks over hundreds of millions of years.”¹³

Two months after the Revelle and Suess paper was published, scientists at Humble Oil (now ExxonMobil) submitted their own study for publication on the same question.¹⁴ Significantly, the Humble Oil study acknowledges not only rising levels of atmospheric CO₂, but also the evident contribution of fossil fuels to that increase.¹⁵ In acknowledged disagreement with Revelle, however, the paper suggests that CO₂ would be retained in the oceans much longer before returning to the atmosphere, which would delay by decades or centuries the impact of fossil fuel emissions.¹⁶

The Revelle and Suess study did not warn that climate change would definitely devastate the planet, but it did emphatically state that atmospheric carbon dioxide levels were likely to increase significantly over the following several decades. Moreover, the report provides definitive evidence that, by 1957, at least one oil company – a subsidiary of Standard Oil of New Jersey, now ExxonMobil – was aware of and actively researching the links between fossil fuel combustion and the accumulation of CO₂ in the atmosphere.

An internal account of industry-funded research projects from the following year, 1958, indicates that at least one project funded by the American Petroleum Institute was measuring the proportion of atmospheric carbon “of fossil origin,” i.e., the Suess effect.¹⁷ Funded under the auspices of the American Petroleum Institute’s Smoke and Fumes Committee, the research into atmospheric carbon was part of a broader research program targeting atmospheric pollutants of concern to the oil industry as a whole.

The Petroleum Industry Engaged in Coordinated Research and Communications on Air Pollution Issues from the 1940s onward

The petroleum industry has long been highly coordinated, acting through centralized industry associations. The Western Oil and Gas Association (WOGA) – now the Western States Petroleum

¹¹ See Roger Revelle & Hans E. 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), available at <http://www.tandfonline.com/doi/pdf/10.3402/tellusa.v9i1.9075?needAccess=true>.

¹² *Id.*

¹³ *Id.* at 19.

¹⁴ See H. R. Brannon, et al., *Radiocarbon Evidence on the Dilution of Atmospheric and Oceanic Carbon by Carbon from Fossil Fuels*, 38 TRANSACTIONS AM. GEOPHYSICAL UNION 643 (1957), available at <http://onlinelibrary.wiley.com/doi/10.1029/TR038i005p00643/full>.

¹⁵ *Id.* at 643.

¹⁶ *Id.* at 649.

¹⁷ See Charles A. Jones, *A Review of the Air Pollution Research Program of the Smoke and Fumes Committee of the American Petroleum Institute*, 8 J. OF THE AIR POLLUTION CONTROL ASS’N 268, 270 (1958), available at <http://www.tandfonline.com/doi/pdf/10.1080/00966665.1958.10467854> (“a recently placed project concerns the collection and analysis of gaseous carbon compounds in the atmosphere to determine the amount of carbon of fossil origin by analysis of carbon 14 in relation to total carbon present”).

Association (WSPA) – was founded in 1907 and represents petroleum companies in the western United States.¹⁸ The American Petroleum Institute (API) was later created in 1919 to represent the American petroleum industry as a whole.¹⁹ From the time API was founded, oil companies recognized pollution issues as an area of significant common concern; and by the 1930s, they had focused particularly on the industry’s shared concerns with air pollution and the public hostility and risk of regulation it presented.

In the 1940s, Los Angeles grappled with increasingly severe and debilitating smog. In late 1946, executives from the major petroleum companies represented by WOGA established the “Committee on Smoke and Fumes of the Western Oil and Gas Association” to fund research into the causes of air pollution in Southern California.²⁰ The committee was explicitly designed not just to conduct research, but to communicate that research and prevent regulation the industry deemed unnecessary.²¹ The early history of the Smoke and Fumes Committee, and particularly its engagement on the smog debate in California, offers insight into the context in which early oil industry research into climate change was undertaken.

In 1946, the year that the Smoke and Fumes Committee was founded, the Stanford Research Institute (SRI), an ostensibly independent scientific research organization, was founded in connection with Stanford University.²² One written history of SRI indicates that Atholl McBean, director of Standard Oil of California (now Chevron) was the “most important of the founding fathers.”²³ In 1947, the Smoke and Fumes Committee hired the newly-created SRI to conduct much of its air pollution research.²⁴ Indeed, in its early years, 74% of SRI’s research “went to petroleum and natural gas people.”²⁵

In 1952, the petroleum industry realized that the problem of smog and air pollution was poised to expand beyond Los Angeles, and the Smoke and Fumes Committee was reformed within API with W. L. Stewart, Jr., of Union Oil Company of California, as its Chairman.²⁶ The same year, Vance Jenkins, Executive Secretary of the Smoke and Fumes Committee, awarded Harold Johnston, an atmospheric chemist, a contract with SRI to review a theory of smog disfavored by the industry.²⁷ By the early 1950s, Arie Haagen-Smit had proposed a theory of smog that pointed to automobiles and gasoline as being responsible for the irritating pollution. Johnston vocally disagreed with Haagen-Smit’s theory and was “given the job of disproving the theory.”²⁸ When Johnston’s work confirmed Haagen-Smit’s theory, his

¹⁸ *What is WSPA?*, WESTERN STATES PETROLEUM ASS’N, <https://www.wspa.org/what-is-wspa>.

¹⁹ *About API*, AMERICAN PETROLEUM INSTITUTE, http://www.api.org/about#tab_history.

²⁰ See Vance N. Jenkins, *The Petroleum Industry Sponsors Air Pollution Research*, 3 *AIR REPAIR* 144, 146 (1954), available at <http://www.tandfonline.com/doi/pdf/10.1080/00966665.1954.10467615>.

²¹ See Jones, *supra* note 17, at 267 (“Through the efforts of the Publications Committee, the dissemination of information has a prominent place in the Smoke and Fumes Committee program.”).

²² See Ann C. Bauer and Harry M. Cleaver, “Minority Report,” *Campus Report Supplement* (Stanford University Relations Office), No. 5 (April 14, 1969), available at <http://la.utexas.edu/users/hcleaver/357L/StanfordMinorityReport.html>.

²³ *Id.*

²⁴ See Jenkins, *supra* note 20, at 146-47.

²⁵ See Bauer & Cleaver, *supra* note 22.

²⁶ See Jenkins, *supra* note 20, at 148.

²⁷ Harold S. Johnston, “Atmospheric Chemistry Research at Berkeley” an oral history conducted in 1999 by Sally Smith Hughes, Ph.D., Regional Oral History Office, The Bancroft Library, University of California, Berkeley, 2005, at 63, available at http://digitalassets.lib.berkeley.edu/roho/ucb/text/johnston_harold.pdf.

²⁸ *Id.*

presentation to the SRI board of directors was postponed, and his consultancy with SRI was terminated.²⁹ In 1954, when Vance Jenkins later recounted the history of industry sponsored air pollution research, he neglected to mention Johnston's confirmation of Haagen-Smit's theory and declared "[t]he work at Stanford Research Institute has shown that there are a number of apparent errors both in this theory and in its interpretation to account for the various phenomena associated with smog."³⁰

By 1958, the Smoke and Fumes Committee was funding research at a number of additional institutes, including the Armour Research Foundation, the Franklin Institute, and Truesdail Laboratories.³¹ In 1965, the Smoke and Fumes Committee was merged with other API committees and working groups to form the Committee for Air and Water Conservation (CAWC) of the American Petroleum Institute.³² The CAWC consisted of "representatives from 20 API member companies," while "major oil industry associations also send liaison representatives to CAWC meetings."³³

The industry undertook coordinated research into many subjects relevant to the causes and impacts of climate change

When the major petroleum companies started expanding their operations offshore into the Gulf of Mexico in the 1940s, they realized that hurricanes posed a significant challenge to the safe and reliable operation of offshore oil rigs. In 1947, Humble Oil (later Exxon) contracted with A. H. Glenn, a meteorological consultant, to develop wave and weather forecasting techniques.³⁴ In a paper from 1951, Glenn notes that "the oil industry is several years ahead of the other American industries in applying meteorology and oceanography."³⁵ He further comments that even the government's own services in the space are too broad for industry needs and typically trail industry's own science by years.³⁶

In 1956, API initiated a research program that would last until 1962 to investigate the causes of, and conditions preceding, hurricane formation.³⁷ The chairman of the program, Mercer Parks of Humble Oil, wrote a retrospective account of the project in 1963 where he outlined the advances made in the ability to predict hurricane formation based on current weather conditions.³⁸ Another paper by M. M. Patterson, of Shell Development Company, describes a then-ongoing eighteen-month project to collect ocean data from newly installed Shell oil platforms "for the development and calibration of environmental forecasting theories."³⁹ This joint project included participation from several major petroleum companies, including Shell Development Company, Esso Production Research Company (now ExxonMobil), Mobil Research

²⁹ *Id.*

³⁰ See Jenkins, *supra* note 20, at 147.

³¹ See Jones, *supra* note 17, 269-70.

³² See ENVIRONMENTAL RESEARCH: A STATUS REPORT, AMERICAN PETROLEUM INSTITUTE 6 (1972), available at <http://files.eric.ed.gov/fulltext/ED066339.pdf>.

³³ *Id.*

³⁴ See A. H. Glenn, *Forecasting for the Offshore Oil Boom*, 2 WEATHERWISE 6 (1949), available at <http://www.tandfonline.com/doi/abs/10.1080/00431672.1949.9925186?journalCode=vvws20>.

³⁵ See A. H. Glenn, *Economic Consideration of Certain Weather and Oceanographic Problems Arising in the Petroleum Industry* 7 (1951), available at <https://www.onepetro.org/conference-paper/SPE-152-G>.

³⁶ *Id.*

³⁷ See Herbert Riehl & Mercer H. Parks, *Hurricane Formation in the Gulf of Mexico* (1963), available at <https://www.onepetro.org/conference-paper/API-63-101>.

³⁸ See *id.*

³⁹ See M. M. Patterson, *An Ocean Data Gathering Program for the Gulf of Mexico* (1969), available at <https://www.onepetro.org/conference-paper/SPE-2638-MS>.

and Development Company (now ExxonMobil), Pan American Petroleum Corporation (now BP), Gulf Oil Corporation, Texaco Inc., the CAGC Marine Region, and Chevron Oil Field Research Company.⁴⁰

In addition to their research into hurricane formation, many of the major oil companies conducted research into paleoclimates and historical sea levels, to better predict where reserves of offshore oil may be found. Research into the historical temperature record was sponsored by API in 1950,⁴¹ and radiocarbon dating was being done at Humble Oil laboratories by 1957.⁴²

In 1956, the Madera Daily News ran an article, “Carbon Dioxide May Contribute to Hurricanes,” which discussed Revelle’s ongoing work and explained the theory that accumulating carbon dioxide in the atmosphere might be raising temperatures and contributing to an intensification of hurricanes.⁴³ The same year, an article in Time Magazine noted Revelle’s work and warned that rising temperatures could “melt the icecaps of Antarctica and Greenland, which would flood the earth’s coastal lands.”⁴⁴ Finally, in 1961, API funded a study into the trends in sea level from 30,000 years before present to 7,000 years before present. The author discussed the relationship between the size of glaciers, global temperatures, and sea level, noting specifically that a rapid rise in sea level coincided with a warming of the climate. “Sea level, on the other hand, rises during warm periods and falls during cold periods[.]”⁴⁵

It is clear that the *purpose* of the previously described research into hurricanes, sea level, and paleoclimate was not to investigate climate change, but to determine where offshore oil could be found and how best to obtain it. However, these research priorities armed the petroleum industry with cutting-edge knowledge about changes in sea levels and hurricanes, two natural phenomena implicated by climate change. The idea that accumulating carbon dioxide in the atmosphere could lead to increased hurricane formation and rising sea levels was being discussed openly in newspapers and magazines as early as 1956. While we cannot know for certain that the entire industry was aware of these theories, they had as much expertise in the field as any other industry, academia, or the government. Moreover, scientists hired by API explicitly connected temperatures, glaciers, and sea levels in research paid for by API. Given the advanced knowledge and expertise, it is fair to ask whether the major oil and gas companies, and the petroleum industry as a whole, should have known about the emerging science focused on the relationship between fossil fuel combustion, global temperatures, sea levels, and hurricanes.

⁴⁰ *Id.*

⁴¹ See HAROLD C. UREY, ET AL., THE MEASUREMENT OF PALEOTEMPERATURES; SCIENTIFIC REPORT TO THE GEOLOGICAL SOCIETY OF AMERICA, THE AMERICAN PETROLEUM INSTITUTE, AND THE OFFICE OF NAVAL RESEARCH (1950), available at <https://www.osti.gov/scitech/servlets/purl/4423471>.

⁴² See H. R. Brannon, et al., *Humble Oil Company Radiocarbon Dates II*, 125 SCI. 919 (1957), available at <http://science.sciencemag.org/content/125/3254/919>.

⁴³ See *Carbon Dioxide May Contribute to Hurricanes*, MADERA DAILY NEWS-TRIBUNE, Mar. 15, 1956.

⁴⁴ See Lily Rothman, *Scientists Have Known about Climate Change for a Lot Longer Than You May Think*, TIME (Nov. 30, 2015), <http://time.com/4122485/climate-change-history/>.

⁴⁵ Joseph Curray, *Late Quaternary Sea Level: A Discussion*, 72 GEOL. SOC. OF AMER. BULL. 1701-1712 (Nov. 1961), available at <https://www.smokeandfumes.org/documents/11>.

The Petroleum Industry was Unequivocally Warned of Climate Change Due Primarily to the Combustion of Fossil Fuels By 1968

In 1968, a report from the Stanford Research Institute called “Sources, Abundance, and Fate of Gaseous Atmospheric Pollutants” was delivered to W. A. Burhouse,⁴⁶ Assistant Director of the Committee for Air and Water Conservation.⁴⁷ The report addressed six pollutants, including carbon dioxide.⁴⁸ It cautioned 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.⁴⁹ Scientists acknowledged that burning fossil fuels provided the best explanation for rising CO₂. They further recognized that existing science was “detailed” and seemed “to explain adequately the present state of CO₂ in the atmosphere.”⁵⁰

The 1968 report from SRI did not state definitively that there was a scientific consensus on questions of climate, but concluded “[s]ignificant temperature changes are almost certain to occur by the year 2000 and these could bring about climatic changes.”⁵¹ Robinson and Robbins cautioned that these increased temperatures could result in melting ice caps, rising sea levels, warming oceans, and environmental damage on a global scale.⁵² Moreover, they acknowledged that fossil fuel combustion provided the best explanation for rising carbon dioxide levels, and recognized that existing science was “detailed” and seemed “to explain adequately the present state of CO₂ in the atmosphere.”⁵³

We know that industry scientists were aware, or should have been aware, of this report for two reasons. First, an internal API document titled “Environmental Research, A Status Report,” published in January 1972, outlines all of the research funded by the CAWC up to that point in 1972. The status report acknowledges both the original 1968 SRI report and the 1969 supplemental report, including explicit references to the discussions of carbon dioxide contained therein.⁵⁴

Second, the National Petroleum Council (NPC) submitted a report to the Department of Energy in 1972 entitled “Environmental Conservation.” The NPC is an advisory body, populated and funded by the petroleum industry, which advises the federal government on questions that concern the industry. In its submission, the NPC acknowledges Robinson & Robbins’ report, describing it as a “careful study” by “eminent scientists” and as an authoritative source on atmospheric pollution.⁵⁵

⁴⁶ See ELMER ROBINSON & R. C. ROBBINS, SOURCES, ABUNDANCE, AND FATE OF GASEOUS ATMOSPHERIC POLLUTANTS: FINAL REPORT AND SUPPLEMENT (1968), available at <https://www.osti.gov/scitech/biblio/6852325>.

⁴⁷ See H. H. Meredith, *Platitudes or Performance?*, 16 J. OF THE AIR POLLUTION CONTROL ASS’N 547, 549 (1966), available at <http://www.tandfonline.com/doi/pdf/10.1080/00022470.1966.10468517?needAccess=true>.

⁴⁸ See ROBINSON & ROBBINS, *supra* note 46.

⁴⁹ *Id.* at 108.

⁵⁰ *Id.* at 112.

⁵¹ See *id.* at 109.

⁵² *Id.*

⁵³ *Id.* at 112.

⁵⁴ See Environmental Research: A Status Report 103 (Jan. 1972) (staff paper prepared for the American Petroleum Institute), available at <http://files.eric.ed.gov/fulltext/ED066339.pdf>.

⁵⁵ See ENVIRONMENTAL CONSERVATION: THE OIL AND GAS INDUSTRIES / VOLUME 2, NATIONAL PETROLEUM COUNCIL 7 (1972), available at http://www.npc.org/reports/1972-Environmental_Conservation-Oil_and_Gas_Industries-Vol_II.pdf.

That submission to the NPC also contained a section on carbon dioxide as an atmospheric pollutant, but did not reference either the initial nor supplementary report from Robinson and Robbins. Instead, it relied almost entirely on a 1965 publication from the American Association for the Advancement of Science called “Air Conservation.”⁵⁶ The four-page section in “Air Conservation” on carbon dioxide—reproduced almost entirely in the NPC report—was considerably more equivocal than the 1968 assessment, and failed to mention Revelle’s landmark paper from 1957 as well as several other leading assessments.⁵⁷

We can say with confidence that, by 1968 the latest, the petroleum industry as a whole was on notice of climate change, what was causing it, and what its risks were. We know that the committee to which the report was submitted was comprised of 20 industry executives from member companies, and that the discussion of carbon dioxide in the report was acknowledged by internal API documents in 1972. Finally, we know that, also in 1972, the industry acknowledged the existence of the report in a submission to the government, but did not include its warnings regarding carbon dioxide.

From 1977 to 1982 Exxon Scientists Repeatedly Confirm the Science of Climate Change

Investigations and document releases have demonstrated that, by no later than the late 1970s, scientists employed by Exxon were reiterating to top management both the degree of certainty within the science and the scale of possible impacts. In 1977, Exxon scientist James Black informed the company’s management committee that climate change driven by fossil fuel use posed a significant global threat.⁵⁸ Later that same year, an interoffice memo from Henry Shaw, another Exxon scientist, noted that the “CO₂ problem . . . is the most important man-made weather problem that we have to contend with.”⁵⁹ In May 1978, Black gave a presentation that included a prediction that a doubling of CO₂ in the atmosphere would produce a temperature increase of two to three degrees Celsius. He noted that, despite any uncertainties about the state of science at the time, “there is no guarantee that better knowledge will lessen rather than augment the severity of the predictions.”⁶⁰ He reiterated that the growth in carbon dioxide in the atmosphere was due primarily to fossil fuel combustion, and concluded 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.”⁶¹

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By 1980, the scientific consensus was being openly acknowledged by Exxon scientists. Exxon’s December 1980 Technological Forecast warned that “most widely accepted calculations carried on thus

⁵⁶ *Id.* at 11.

⁵⁷ See AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, AIR CONSERVATION 78-82 (1965).

⁵⁸ See Memorandum from James F. Black, Scientific Advisor, Exxon Products Research Division, to F. G. Turpin, Vice President, Exxon research and Engineering Co. (Jun. 6, 1978) (on file with InsideClimate News) [hereinafter Black Memorandum], available at <https://insideclimatenews.org/sites/default/files/documents/James%20Black%201977%20Presentation.pdf>.

⁵⁹ See Memorandum from Henry Shaw to John W. Harrison, regarding “Environmental Effects of Carbon Dioxide” 3 (Oct. 31, 1977) (on file with InsideClimate News), available at <https://insideclimatenews.org/sites/default/files/documents/Government%20Meeting%20Memo%20%281977%29.pdf>.

⁶⁰ See Black Memorandum, *supra* note 58, at 1.

⁶¹ See *id.* at 2.

far on the potential impact of a doubling of carbon dioxide on climate indicate that an increase in the global average temperature of $3 \pm 1.5^{\circ}\text{C}$ is most likely ... with greater warming occurring at the ... polar regions.”⁶² The forecast also noted that projections calculating smaller temperature increases “are not held in high regard by the scientific community.”⁶³

This understanding was also communicated in a 1980 report from Imperial Oil, Exxon’s Canadian subsidiary, entitled “Review of Environmental Protection Activities for 1978-1979.” The report acknowledges “[t]here is no doubt that increases in fossil fuel usage and decreases in forest cover are aggravating the potential problem of increased CO₂ in the atmosphere.”⁶⁴

By 1981, Exxon had internally acknowledged the risks of climate change and the role fossil fuel combustion played in increasing carbon dioxide concentrations in the atmosphere. A position memo from Henry Shaw in May 1981 includes as Exxon’s current position on the CO₂ Greenhouse effect that a 3 degree increase in average temperatures will result in a 10 degree increase at the poles, “[m]ajor shifts in rainfall/agriculture,” and that “[p]olar ice may melt.”⁶⁵

By 1982, any lingering doubts were put to rest by a memo from Roger Cohen, then Director of Exxon’s Theoretical and Mathematical Sciences Laboratory. In this memo, Cohen noted that “a clear scientific consensus had emerged regarding the expected climatic effects of increased atmospheric CO₂.”⁶⁶ This consensus determined that doubling atmospheric CO₂ would result in a global temperature increase of three degrees Celsius, plus or minus 1.5 degrees Celsius.⁶⁷

In this memo, Cohen also acknowledged the work of a scientist who believed increased water evaporation and cloud cover would stymie global temperature increases. Cohen’s conclusions, however, found that this analysis was consistent with predictions that atmospheric temperature increases would be non-uniformly distributed across the globe, with little warming at the equator and greatest

“[in] summary, the results of our research are in accord with the scientific consensus on the effect on increased atmospheric CO₂ on climate.”

⁶² See Memorandum from Henry Shaw to T. K. Kett on “Exxon Research & Engineering Company Technological Forecast: CO₂ Greenhouse Effect” 2 (Dec. 18, 1980) (on file with InsideClimate News), available at <https://insideclimatenews.org/sites/default/files/documents/Technological%20Forecast%20on%20CO2%20Greenhouse%20Effect%201980.pdf>.

⁶³ *Id.*

⁶⁴ See Brendan DeMelle & Kevin Grandia, “There is no doubt”: Exxon Knew CO₂ Pollution Was A Global Threat By Late 1970s, DESMOG BLOG (Apr. 26, 2016, 9:19 AM), <http://www.desmogblog.com/2016/04/26/there-no-doubt-exxon-knew-co2-pollution-was-global-threat-late-1970s>.

⁶⁵ Memorandum from Henry Shaw, Exxon, to Dr. E. E. David, Jr., Exxon (May 15, 1981) (on file with InsideClimate News), available at <https://insideclimatenews.org/sites/default/files/documents/Exxon%20Position%20on%20CO2%20%281981%29.pdf>.

⁶⁶ Memorandum from Roger W. Cohen, Theoretical and Mathematical Sciences Laboratory, Exxon, to A. M. Natkin, Office of Science and Technology, Exxon (Sept. 2, 1982) (on file with InsideClimate News), available at <https://insideclimatenews.org/sites/default/files/documents/%2522Consensus%2522%20on%20CO2%20Impacts%20%281982%29.pdf>.

⁶⁷ *Id.*

warming at the poles. He concludes that, “[in] summary, the results of our research are in accord with the scientific consensus on the effect on increased atmospheric CO₂ on climate.”⁶⁸

Later that year, on November 12, 1982, Exxon circulated a 43-page climate change primer to several members of Exxon management to “familiarize Exxon personnel with the subject.”⁶⁹ By this point, Exxon was fully aware and internally acknowledging that climate change was real, caused by burning fossil fuels, and would have significant impacts on the environment and human health and wellbeing.

By the Late 1980s, Climate Change Projections Were Being Used in Business and Operational Planning

Internal documents uncovered by the L.A. Times and the Columbia School of Journalism demonstrate that by the mid-1980s, Exxon was incorporating climate change projections into its Arctic operations planning while discounting the risks when communicating with the public.⁷⁰

In 1986, a team of researchers led by Ken Croasdale of Imperial oil – an Exxon subsidiary – was “trying to determine how global warming could affect Exxon’s Arctic operations and its bottom line.” In 1991, Croasdale reported to an engineering conference that “[c]ertainly any major development with a life span of say 30-40 years will need to assess the impacts of potential global warming,” and that “[t]his is particularly true of Arctic and offshore projects in Canada, where warming will clearly affect sea ice, icebergs, permafrost, and sea levels.”⁷¹

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Similarly, in 1989, Shell Oil announced that it was redesigning a \$3 billion natural gas platform it had been designing for use in the North Sea.⁷² The original design had the platform sitting 30 meters above the ocean’s surface, but the redesign would raise the platform by one to two meters to account for rising sea levels as a result of global warming.⁷³

By the early 1990s, we know that not only was the entire petroleum industry on notice of climate change, but internal documents from the largest oil company had confirmed and reaffirmed the reality of the problem. Moreover, at least two of the largest oil companies were actively incorporating expected changes into their engineering projects.

⁶⁸ *Id.*

⁶⁹ See Memorandum from M. B. Glaser, Manager, Environmental Affairs Programs, Exxon (Nov. 12, 1982) (on file with InsideClimate News), available at <https://insideclimatenews.org/sites/default/files/documents/1982%20Exxon%20Primer%20on%20CO2%20Greenhouse%20Effect.pdf>.

⁷⁰ See Sara Jerving, Katie Jennings, Masako Melissa Hirsch, & Susanne Rust, *How Exxon Went From leader to Skeptic on Climate Change Research*, L.A. TIMES (Oct. 9, 2015), <http://graphics.latimes.com/exxon-arctic/>.

⁷¹ *Id.*

⁷² See Amy Lieberman & Suzanne Rust, *Big Oil Braced for Global Warming While it Fought Regulations*, L.A. TIMES (Dec. 31, 2015), <http://graphics.latimes.com/oil-operations/>.

⁷³ *Id.*

In the 1990s, even as it acknowledged climate realities internally, the oil industry intensified its public campaigns against climate science

Even as they acknowledged climate realities internally, major oil companies continued and intensified their efforts to increase uncertainty regarding climate science and climate risks among the public and policymakers.

In 1990, a shareholder petitioned Exxon’s board of directors asking it to develop a plan to reduce carbon dioxide emissions from its operations facilities.⁷⁴ The board responded that its “examination of the issue supports the conclusions that the facts today and the projection of future effects is very unclear.”⁷⁵ That same year, Exxon scientist Brian Flannery reportedly urged the first Intergovernmental Panel on Climate Change (IPCC) to emphasize the uncertainties surrounding climate models in its first Scientific Assessment Report.⁷⁶

In 1989, companies including Respondent Carbon Majors BP, Chevron, Mobil, Exxon, Shell, and others organized the Global Climate Coalition (GCC).⁷⁷ Throughout the 1990s, the GCC lobbied aggressively against action on climate change not only within the United States but at the international level. In briefings provided to policymakers and reporters, the GCC routinely asserted that “[t]he role of greenhouse gases in climate change is not well understood.”⁷⁸ Internally, however, the GCC members acknowledged the reality of climate change, including the role of fossil fuels in climate impacts.⁷⁹ A 17-page “primer on global climate change science” distributed to GCC members acknowledged 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.”⁸⁰

“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.”

The stark dichotomy between the oil industry’s internal understanding of climate change and its public communications on climate science and climate policy is manifest in an internal “Global Climate Science Communications Plan” prepared by the American Petroleum Institute in 1998. The Plan outlined the

⁷⁴ *Id.*

⁷⁵ *Id.*

⁷⁶ Jeremy Leggett, *The Carbon War* (1999) (attributing the following statement to Exxon scientist Brian Flannery during the final drafting session for the IPCC’s Scientific Assessment Report: “The range of model results isn’t any better justified than it was ten years ago. The range is quite scientifically uncertain. This should be stated as such in the executive summary.”)

⁷⁷ See KATHY MULVEY & SETH SHULMAN, UNION OF CONCERNED SCIENTISTS, THE CLIMATE DECEPTION DOSSIERS: INTERNAL FOSSIL FUEL INDUSTRY MEMOS REVEAL DECADES OF CORPORATE DISINFORMATION 34 (2015), available at <http://www.ucsusa.org/sites/default/files/attach/2015/07/The-Climate-Deception-Dossiers.pdf>.

⁷⁸ Andrew Revkin, *Industry Ignored its Scientists on Climate*, *New York Times* (April 23, 2009) <http://www.nytimes.com/2009/04/24/science/earth/24deny.html>.

⁷⁹ *Id.*

⁸⁰ *Id.*

industry's goals and strategies for engaging in the climate debate in the future.⁸¹ It defined a successful industry campaign on climate change in the following language: "Victory Will Be Achieved When ... Average citizens 'understand' (recognize) uncertainties in climate science; recognition of uncertainties becomes part of the 'conventional wisdom'", and "Those promoting the Kyoto treaty on the basis of extant science appear to be out of touch with reality."⁸²

"Victory Will Be Achieved When ... Average citizens 'understand' (recognize) uncertainties in climate science; recognition of uncertainties becomes part of the 'conventional wisdom'"

The Oil Industry continued to fund and promote climate misinformation and oppose climate mitigation actions throughout the 2000s and into the current decade.

In 2000, ExxonMobil published an op-ed series entitled "Global Climate Change" which summarized the company's views on the issue. In one of the four op-eds, called "Unsettled Science," ExxonMobil describes the science as inherently unsettled, questions whether any changes in climate are due to human activities or natural variation, and suggests that uncertainties regarding climate impacts include *positive* uncertainties – uncertainties about how much crop yields will increase and how much faster forests will grow.⁸³ The op-ed ends saying that, "while some argue that the science debate is settled and governments should focus only on near-term policies—that is empty rhetoric."⁸⁴

Documents discovered via Freedom of Information Act requests demonstrate that from 2001 through 2012 Wei-Hock Soon, a scientist at the Smithsonian Institution, received more than \$1.2 million from fossil fuel interests to fund research.⁸⁵ This included ExxonMobil, API, the Charles Koch Foundation, and Southern Company.⁸⁶ Soon's research was touted as independent, and the Smithsonian was disallowed from disclosing the identity of the funders without their permission.⁸⁷ As explained by the Union of Concerned Scientists, "Soon has written about many aspects of climate change but is best known for his work on the role of solar variability, research that has broadly overstated the role the sun plays in climate change and has been largely discredited by his scientific peers Outcry from the climate science community over a 2003 paper published by Soon in *Climate Research* even resulted in the resignation of several of the journal editors and an admission by the journal's publisher that the paper should not have been accepted."⁸⁸

Leaked slides from a 2014 presentation from the Western States Petroleum Association (the successor to the Western Oil and Gas Association) outline the strategy the industry used to oppose climate change reduction efforts in the state of California, which has the second highest greenhouse emissions of any

⁸¹ Global Climate Science Communications Action Plan (1998), *available at* <https://insideclimatenews.org/documents/global-climate-science-communications-plan-1998>.

⁸² *Id.*

⁸³ EXXONMOBIL, GLOBAL CLIMATE CHANGE: THE OP-ED SERIES (2000), *available at* <https://www.documentcloud.org/documents/2805611-2000-Oped-Series-Global-Climate-Change-Exxon.html#document/p5>.

⁸⁴ *Id.*

⁸⁵ See MULVEY & SHULMAN, *supra* note 77, at 14.

⁸⁶ *Id.*

⁸⁷ *Id.*

⁸⁸ *Id.*

U.S. state.⁸⁹ WSPA members include BP, Chevron, ExxonMobil, Shell, and Occidental Petroleum. The slides reveal that WSPA organized 16 “AstroTurf” organizations – organizations with innocuous and grassroots-sounding names – to deploy industry messaging against proposed regulation but in the guise of grassroots support.⁹⁰

While oil companies have been among the largest and most consistent funders of climate denial and misinformation efforts, they have not been alone. In 1991, for example, the coal trade associations created the Information Council on the Environment, which orchestrated a national campaign publicly downplaying the risks of climate change.⁹¹ They were also a part of the Global Climate Coalition, discussed above.⁹² Bankruptcy filings from three of the largest coal companies – Arch Coal, Alpha Natural resources, and Peabody Energy – demonstrate that even after GCC was closed, these coal companies continued funding a network of “denier groups,” including the Heartland Institute, the American Legislative Exchange Council, the Competitive Enterprise Institute, the Energy & Environmental Legal Institute, and the Free Market Environmental law Clinic.⁹³ In 2009, as the United States Congress was debating legislation designed to dramatically reduce greenhouse emissions nationwide, an alliance representing coal industry groups sent forged letters to members of Congress that falsely suggested several civil society groups opposed the legislation.⁹⁴

Most recently, the largest companies have adjusted their strategies from outright denial that climate change is happening to questioning the human contribution to climate change, the timing and severity of impacts, and economic feasibility of reducing emissions. In 2014, ExxonMobil released a report entitled “Energy and Climate” which “provide[s] comments on the topics of global energy and climate change.”⁹⁵ In its discussion, ExxonMobil describes itself as believing “that changes to the earth’s climate, *including those that may result from anthropogenic causes*, pose a risk.”⁹⁶ Moreover, as recently as January 2017, Rex Tillerson, who served as CEO of ExxonMobil until being nominated as U.S. Secretary of State by Donald Trump, downplayed the risks of climate change during his confirmation hearing. “The increase in the greenhouse gas concentrations in the atmosphere are having an effect, our ability to predict that effect is very limited.”⁹⁷

⁸⁹ *Id.* at 39.

⁹⁰ *Id.*

⁹¹ *See Id.* at 19.

⁹² *See id.* at 25.

⁹³ *See* Suzanne Goldenberg & Helena Bengtsson, *Biggest US Coal Company Funded Dozens of Groups Questioning Climate Change*, THE GUARDIAN (Jun. 13, 2016, 6:00 AM), <https://www.theguardian.com/environment/2016/jun/13/peabody-energy-coal-mining-climate-change-denial-funding>; Nick Surgey, *Bankruptcy Filing Shows Arch Coal Funding for Climate Denial Legal Group*, PRWATCH (Feb. 24, 2016, 8:33 AM), <http://www.prwatch.org/news/2016/02/13049/bankruptcy-documents-indicate-arch-coal-funding-climate-denial-legal-group>; *Coal Companies’ Secret Funding of Climate Science Denial Exposed*, UNION OF CONCERNED SCIENTISTS (Apr. 2016), <http://www.ucsusa.org/publications/got-science/2016/got-science-april-2016#.WJpclX8plVg>.

⁹⁴ MULVEY & SHULMAN, *supra* note 77, at 16-18.

⁹⁵ ExxonMobil, *Energy and Climate* (2014), available at http://cdn.exxonmobil.com/~/_media/global/files/energy-and-environment/report---energy-and-climate.pdf.

⁹⁶ *Id.* (emphasis added).

⁹⁷ *See* Dana Nuccitelli, *New Studies Show Rex Tillerson is Wrong About Climate Risks*, THE GUARDIAN (Jan. 16, 2017), <https://www.theguardian.com/environment/climate-consensus-97-per-cent/2017/jan/16/new-studies-show-rex-tillerson-is-wrong-about-climate-risks>.

The Petroleum Industry Was Researching Technologies That Could Have Been Used to Mitigate or Avoid Climate Change

Petroleum industry members knew about climate change decades ago and chose not to inform the public, and in fact misled the public. This raises a corollary question, namely, what could they, or we, have done differently? Patent filings and related documents demonstrate that, from as early as the 1950s, the petroleum industry was researching and patenting technology for carbon capture and fuel cells – all technologies which might have been deployed to reduce emissions and mitigate the impacts of climate change.

In 1954, the Standard Oil Development Company patented a process for the “Production of Pure Carbon Dioxide” from the combustion of fossil fuels.⁹⁸ A patent for removing carbon dioxide, among other gases, was assigned to Phillips Petroleum Company in 1966.⁹⁹ Another patent for the removal of acidic gases – including carbon dioxide – from gaseous streams, from 1973, is assigned to Shell Oil Company.¹⁰⁰

Carbon dioxide has important commercial uses, and it is not clear that these companies were patented processes for removing carbon dioxide and other gases for the purpose of carbon capture to reduce greenhouse gas emissions. Esso, for example, holds patents from 1965¹⁰¹ and 1970¹⁰² for processes of injecting carbon dioxide into wells to increase the recovery of petroleum. However, it is clear that regardless of the *purpose* of these patents, the industry was aware of, and actively researching, techniques to remove carbon dioxide from gaseous streams. In fact, a 1980 report from Imperial Oil (Exxon’s Canadian subsidiary) indicates that the company was eminently aware of both the ability to capture carbon and the relationship that technology had to climate change. “There is no doubt that increases in fossil fuel usage and decreases in forest cover are aggravating the potential problem of increase CO₂ in the atmosphere. Technology exists to remove CO₂ from stack gases but removal of only 50% of the CO₂ would double the cost of power generation.”¹⁰³

“There is no doubt that increases in fossil fuel usage and decreases in forest cover are aggravating the potential problem of increase CO₂ in the atmosphere. Technology exists to remove CO₂ from stack gases but removal of only 50% of the CO₂ would double the cost of power generation.”¹

In addition to carbon capture technology, we are aware of at least five patents assigned to Esso, between 1963 and 1970, for fuel cell technology.¹⁰⁴ Again, regardless of whether the interest in this research was to produce low-emissions vehicles for their emission profile, because they appeared to be a profitable

⁹⁸ Production of Pure Carbon Dioxide, U.S. Patent No. 2,665,971 (filed May 12, 1949).

⁹⁹ Method for Recovering a Purified Component from a Gas, U.S. Patent No. 3,228,874 (filed Aug 22, 1961).

¹⁰⁰ Process for the Removal of Acidic Gases from a Gas Mixture, U.S. Patent No. 3,760,564 (filed Mar. 20, 1972).

¹⁰¹ Petroleum Recovery with Inert Gases, U.S. Patent No. 3,193,006 (filed Nov. 3, 1961).

¹⁰² Recovery of Shale Oil, U.S. Patent No. 3,516,495 (filed Nov. 29, 1967).

¹⁰³ See DeMelle & Grandia, *supra* note 64.

¹⁰⁴ Direct Production of Electrical Energy from Liquid Fuels, U.S. Patent No. 3,113,049 (filed Jan. 3, 1961); Fuel Cell and Fuel Cell Electrodes, U.S. Patent No. 3,116,169 (filed Mar. 14, 1960); Fuel Cell Catalysts, U.S. Patent No. 3,239,382 (filed Sept. 27, 1960); Fuel Cell With Pr-Au Anode and Molybdate-Containing Electrolyte, U.S. Patent No. 3,443,998 (filed Jul. 5, 1963); Low-Polluting Engine and Drive System, U.S. Patent No. 3,513,929 (filed Aug. 25, 1967).

business venture, or for any other reason, these patents demonstrate that at least one company (now ExxonMobil) was not just aware of but developing technology for vehicles with fuel cells.

It is extremely difficult to assess how the path of development, electrification, and carbonization might have changed had the petroleum industry been forthright about the risks of climate change. It is not clear the degree to which we would have demanded low-carbon energy and transportation had we been properly warned. It is not clear how much damage would have been avoided if the petroleum industry continued developing carbon capture and fuel cell technology, or if they released the patents and allowed others to attempt to do the same. It is clear, though, that in addition to promoting the combustion of fossil fuels and the accumulation of carbon in the atmosphere, the petroleum industry – or at least several members of it – were keenly aware of low-carbon alternatives.

Summary of Industry Knowledge of and Action on Climate Change

The following essential facts can be drawn from the foregoing synthesis. The theory that accumulating carbon dioxide could cause global warming and large-scale climatic changes dates back to the nineteenth century. The fact that fossil fuel combustion releases tremendous amounts of carbon dioxide waste to the atmosphere has been undisputed for more than a century. In 1938, at least one scientist claimed to have measured a noticeable impact both on atmospheric carbon dioxide and global temperatures.

From no later than the 1940s, and continuing thereafter, the oil industry was actively engaged in pioneering research in an array of areas relevant to climate change and climate impacts. This included, *inter alia*, research into long-term changes in the earth's temperature; the relationship between global temperatures and sea level rise; changes in the concentration of CO₂ in the atmosphere; the nature, causes and history of hurricanes; and techniques, technologies, and consequences of intentional weather modification.

In 1957, Roger Revelle and Hans Suess published research demonstrating that the world's oceans would not rapidly absorb this CO₂, and suggested carbon dioxide levels in the atmosphere were likely to increase significantly. Scientists working at Humble Oil (now ExxonMobil) were aware of this research at the time of its publication and published their own research in early 1958, in which they recognized the increase in atmospheric CO₂, acknowledged the connection between fossil fuel combustion and that increase, acknowledged the link between atmospheric CO₂ and potential temperature increases, and acknowledged Revelle's criticisms of their own conclusions on ocean absorption of CO₂. *By no later than 1957, therefore, at least one major oil company was clearly on notice that the most important waste product from oil and other fossil fuels might be accumulating in the earth's atmosphere with the potential to affect the climate on a planetary scale.*

By 1958, the oil industry as a whole, through the American Petroleum Institute's Smoke and Fumes Committee, was funding collective research into the accumulation of fossil carbon in the atmosphere. *By no later than 1958, therefore, the oil industry collectively was on notice that the most important waste product from oil and other fossil fuels might be accumulating in the earth's atmosphere, and was funding research into this question as part of an industry-wide air pollution program.*

Industry records, oral histories from persons involved, and analyses of its activities by independent researchers strongly indicate that the core mission of the Smoke and Fumes Committee was to combine

industry-funded research and public relations advocacy in order to increase public skepticism about air pollution science, with the express purpose of influencing legislation and regulation on pollution issues. Credible firsthand accounts suggest the manner in which research was conducted – in the case of Harold Johnstone, to discredit Arie Haagen-Smit’s theory of smog – and suggest that unfavorable results were neither welcomed nor shared.

In 1968, a Stanford Research Institute report commissioned by API, summarized the causes, nature, and consequences of global warming and climate change. The report warned the oil industry explicitly and in strong terms that the science underlying climate change was sound; that fossil fuel combustion provided the best explanation for climate change; that the impacts of climate change could be potentially significant on a global scale; and that the industry’s highest research priority should be identifying means and technologies for reducing emissions. This report was acknowledged as containing said discussion in the record of API-funded research and was relied upon in communications with the Department of the Interior, although the sections on carbon dioxide were not shared with DOI. *By no later than 1968, therefore, the oil industry was receiving warnings from its own scientists that evidence of climate change was credible and that, despite uncertainties about the scale and timing of impacts, the potential risks of climate change were real and serious.*

Between 1977 and 1982, scientists at Exxon repeatedly acknowledged the scientific consensus that climate change was happening, was caused primarily by the burning of fossil fuels, and had the potential to be globally catastrophic. Exxon understood and internally transmitted this understanding in a 43-page climate change primer. An Exxon subsidiary was conducting scientific research in the Arctic no later than 1986 which examined the effects climate change would have on intended operations. We know that in 1989, Shell Oil deliberately changed the design of their offshore oil drilling platform to account for sea level rise, and that in 1991 the leader of the Imperial Oil expedition acknowledged that internal planning would need to account for climatic changes in the Arctic. In 1995, fossil fuel interests were fully aware that climate science was indisputable and that a response was urgently needed. *From the 1970s forward, therefore, scientists within the oil industry not only acknowledged the scientific consensus that climate change was occurring, but took potential climate impacts into account in the companies’ own long-term plans.*

In 1998, the American Petroleum Institute developed a public relations strategy with the aim of sowing doubt about the certainty of climate science in the minds of the public, legislators, and regulators. We know that ExxonMobil, API, and others funded research into debunked theories to explain rising atmospheric temperatures without disclosing the source of funding. We know that in 2014, the Western States Petroleum Association fought against state-level regulation in California by misrepresenting public will through the use of “Astroturf” front groups. We know that many oil and gas companies continue to donate money to the American Legislative Exchange Council (ALEC), which promotes climate-denial to this day. Finally, ExxonMobil and its executives still continue their pattern of downplaying both the severity of climate change and the role of human emissions in it. *From the 1990s forward, therefore, the oil industry acknowledged climate science internally and took measures to incorporate climate risks into its own project planning, while maintaining active campaigns to promote skepticism of climate change science and climate risks among policymakers, journalists and the public.*

From the 1950s onward, oil companies developed and patented numerous technologies that might have been deployed to reduce greenhouse gas emissions, including fuel cells and advanced batteries, low emission vehicle technologies, and technologies for removing carbon dioxide from industrial waste streams. In 1980, an ExxonMobil subsidiary acknowledged the potential value of the company's patents in addressing climate risks, but noted that doing so would raise the costs of the company's patents unacceptably. *From the 1980s forward, therefore, one or more oil companies had the technical capacity and the opportunity to reduce climate risks associated with greenhouse gas emissions, but chose not to do so for commercial reasons.*

Prior Petroleum Industry Pollution Events Reveal a Pattern of Denial and Obfuscation

The pattern described above – discovery, investigation, concealment, obfuscation – does not apply only to the petroleum industry's engagement with climate science. In fact, it is only the most recent example of the same formula this industry has used when it discovers a potential health or environmental problem.

Meeting minutes and industry documents from the Tobacco Archives show that in November 1953, executives from several major cigarette companies met with a group of scientists from New York University (NYU).¹⁰⁵ During the meeting, Dr. C.P. Rhoads, one of the lead scientists with the NYU group, proposed a research project that had been inspired by work that group had done earlier for the petroleum industry.¹⁰⁶ Dr. Rhoads explained that the chemical industry had suffered a reputational disaster when a chemical was discovered to cause bladder cancer.¹⁰⁷ He noted that “[i]t took such a long time to correct this condition and to live it down that the petroleum industry took steps to forestall a similar occurrence in their industry.”¹⁰⁸

At the time, there was growing concern over the discovery of a mouse carcinogen present in cigarettes.¹⁰⁹ The NYU group could identify the carcinogen so the industry could neutralize or remove it.¹¹⁰ When asked whether a mouse skin carcinogen is known to cause cancer in human lungs, Dr. Rhoads indicated that “he did not expect any direct relationship between mouse carcinogens and human carcinogens would be established during his lifetime, that he didn't know whether there was any connection or not, and no one else knows Dr. Rhoads said that, nevertheless, the elimination or neutralization of this specific

¹⁰⁵ See notes from New York University meeting, 10:30 A.M., November 5, 1953 (Nov. 5, 1953) (on file with University of California, San Francisco), *available at* <https://www.industrydocumentslibrary.ucsf.edu/tobacco/docs/#id=yqpy0140>; Chronology of Events with Respect to Mr. Hamner and The American Tobacco Company Research Department (internal document for American Tobacco Company) (on file with university of California, San Francisco), *available at* <https://www.industrydocumentslibrary.ucsf.edu/tobacco/docs/ykgy0050>; Notes on Trip to NYU – Bellevue Medical Center Institute of Industrial Medicine (Jan. 28, 1953) (on file with University of California, San Francisco), *available at* <https://www.industrydocumentslibrary.ucsf.edu/tobacco/docs/krbp0140>.

¹⁰⁶ See Notes from New York University meeting, 10:30 A.M., November 5, 1953 (Nov. 5, 1953) (on file with University of California, San Francisco), *available at*

<https://www.industrydocumentslibrary.ucsf.edu/tobacco/docs/#id=yqpy0140>.

¹⁰⁷ *Id.*

¹⁰⁸ *Id.*

¹⁰⁹ *Id.*

¹¹⁰ *Id.*

mouse carcinogen ... would, in his judgment, relieve the cigarette industry of any responsibility for lung cancer in the minds of both the medical profession and the public.”¹¹¹

From the 1960s into the 1980s, a mathematician named Theodor Sterling was one of the tobacco industry’s most cited scientists. His work focused on issues of study design and epidemiological proof; namely, he was not arguing that a given pollutant *didn’t* result in some negative health outcome, but that it hadn’t been proven that it did.

In the early 1960s, Sterling was working on questions of lead exposure. We know of at least one study he conducted with scientists from Ethyl Corporation, a joint venture co-owned by General Motors and Standard Oil of New Jersey (Exxon).¹¹² In this study, Sterling and the Ethyl Co. scientists looked into occupational exposure to lead compounds, as an alternative to car exhaust as a source of lead exposure.¹¹³

Later, in 1968, Sterling prepared a report evaluating “the conditions under which findings and conclusions pertaining to the smoking and health issue may be reviewed best for the benefit of the Public Health Service, the scientific community, the tobacco industry, and, of course, the general public.”¹¹⁴ His recommendation was that “a permanent commission needs to be formed for the purpose of establishing a consensus on the results of various studies and what they mean.”¹¹⁵

Sterling’s accounts of the discussions indicate that this recommendation came to be in large part due to the contributions of Robert Eckardt, a member of the advisory committee for Sterling’s study and Medical Director of Esso Research (Exxon).¹¹⁶ Eckardt was a member of the petroleum industry’s Air Pollution Research Advisory Committee (APRAC), upon which the recommended commission was based.¹¹⁷ Later, a 1975 cigarette industry document would reveal how the petroleum industry used the APRAC, an ostensibly neutral body with government participation, to “launder” research that made its products seem safe when they were not.¹¹⁸

While the behavior of the petroleum industry in relation to lead, cancer, and smog does not directly implicate its liability for climate change, it does reveal a pattern. We know that scientists offered a solution to the cigarette companies that would appear scientific and alleviate their reputational concerns, and it was modeled off of research done previously for the petroleum industry. We know that Theodor Sterling, whose academic work supported the cigarette industry through three decades, worked with oil industry interests on questions of lead pollution, doing research that would absolve the lead in gasoline.

¹¹¹*Id.*

¹¹² See Robert T. P. DeTreville, et al., Occupational Exposure to Organic Lead Compounds, 5 J. OF OCCUPATIONAL AND ENVTL. MED. 229 (1963), available at http://journals.lww.com/joem/Citation/1963/04000/Occupational_Exposure_to_Organic_Lead_Compounds.48.aspx.

¹¹³ *Id.*

¹¹⁴ See Theodor Sterling, Report and Recommendations of the Advisory Panel to the Feasibility Study (report commissioned by tobacco industry) (on file with University of California, San Francisco), available at <https://www.industrydocumentslibrary.ucsf.edu/tobacco/docs/#id=pkyx0119>.

¹¹⁵ See Theodor Sterling, The Feasibility of a Definitive Evaluation of the Data Concerning Smoking and General Morbidity and Disability: Status Report (report commissioned by tobacco industry) (on file with University of California, San Francisco), available at <https://www.industrydocumentslibrary.ucsf.edu/tobacco/docs/#id=xxh10040>.

¹¹⁶ See Sterling, *supra* note 114.

¹¹⁷ *Id.*

¹¹⁸ See Laundered Research (Feb. 11, 1975) (on file with University of California, San Francisco), available at <https://www.industrydocumentslibrary.ucsf.edu/tobacco/docs/#id=rybl0004>.

We also know that when Theodor Sterling made recommendations after a feasibility study for the cigarette companies, he based those recommendations on a model developed by the petroleum companies – a model the cigarette companies would later lambast for its effectiveness in legitimizing shoddy, industry-favoring research.

We also know, directly, that the Smoke and Fumes Committee of the American Petroleum Institute was designed deliberately to affect regulation, and that we have one personal account of the methods by which the industry would use seemingly independent research institutes to produce favorable science. It should not be surprising that the cigarette industry also contracted extensively with Stanford Research Institute.¹¹⁹

¹¹⁹ See, e.g., Memorandum from David E. Townsend, RJR, to M. E. Stowe, (Nov. 30, 1978) (on file with University of California, San Francisco), available at <https://www.industrydocumentslibrary.ucsf.edu/tobacco/docs/#id=pkylf0082>; memorandum from R. L. Johnson to W. L. DeWitt (Mar. 13, 1975) (on file with University of California, San Francisco), available at <https://www.industrydocumentslibrary.ucsf.edu/tobacco/docs/#id=tspm0139>; proposal for research prepared by Edward M. Liston, et al., Stanford Research Institute (Dec. 9, 1975) (on file with University of California, San Francisco), available at <https://www.industrydocumentslibrary.ucsf.edu/tobacco/docs/#id=mzbn0088>.

Appendix I

A Note on Sources

This synthesis draws or builds on documentary evidence compiled from a number of sources, including: early and pioneering research by Greenpeace's *Exxon Secrets* project; pathbreaking research by Dr. Naomi Oreskes and of Harvard University and Erik Conway of Jet Propulsion Laboratory, California Institute of Technology; multi-part investigations published in 2015 and 2016 by *Inside Climate News*, *Los Angeles Times* and the *Columbia School of Journalism*; documents unearthed by non-profit organizations, including *DeSmog Blog*, the Climate Investigations Center and the Union of Concerned Scientists; and CIEL's own *Smoke and Fumes* project, a multi-year investigation into the early history of climate science with particular attention to the oil and gas industries' awareness of, engagement in and communications about that science. Preliminary results from that investigation were shared with the Commission in April 2016. The present synthesis draws on the more extensive material released during the ensuing months. To the greatest extent feasible links to the documents themselves are provided therein.

The volume of documentary evidence arising from these various research initiatives is now staggering. CIEL's database alone includes more than 200 documents, spanning more than seven decades, not including books and archival documents not available online. The Inside Climate News investigations include at least 12 separate articles supported by scores of primary documents. Research by the Union of Concerned Scientists has unearthed more than 340 pages of documents in seven dossiers addressing various aspects of the climate. Accordingly, the present synthesis can only highlight key findings to date. It is indicative of the available evidence, but by no means exhaustive.

More fundamentally, it should be noted that the great majority of relevant documents, including more than one million pages of documents produced by Exxon pursuant to an investigation in New York State, have yet to be publicly disclosed. Untold numbers of additional documents remain undiscovered and as yet undisclosed by the corporate actors involved, including by the Carbon Majors themselves.

Appendix II

A Note on Industries and Companies Addressed in this Synthesis

The documents referenced in this Synthesis report offer insights into specific activities undertaken by several Respondent companies, including all five of the largest Carbon Majors as measured by aggregate emissions. The majority of Respondent companies, however, are not referenced specifically at this time.

Both the Synthesis and the Opinion focus disproportionately on Carbon Majors from the oil and gas industries and on companies headquartered in or with substantial operations in the United States. This emphasis arises from the greater availability of public information regarding industry research activities and engagement on denial efforts in the United States; and the historically smaller number of very large actors in the oil and gas industry as compared to coal or cement industries. A detailed discussion of these factors follows.

(1) Climate misinformation campaigns have been actively carried out for many years in Australia, the United Kingdom and across Europe. Based on the best information currently available, however, climate denial campaigns within the United States have been among the largest, longest-lived, and best funded such efforts on a global basis; as a result, they have drawn significantly more media and investigative attention than climate misinformation efforts with the result that a much greater number of primary materials, including eyewitness accounts, are available for analysis.

(2) For the first six decades of 20th Century, the global oil and gas industries were vertically integrated and heavily concentrated among a very small number of companies that exercised substantial control over all phases of research, exploration, production, transportation, refining, and marketing of petroleum and petroleum products on a global basis. These companies—known colloquially as the Seven Sisters—routinely entered into partnerships and joint ventures in countries around the world. As a result, the largest oil and gas companies evinced a greater than usual degree of coordination and collaboration than was common in many other industries. Beginning in the 1960s, waves of nationalization by oil-rich countries reduced industry concentration and control to a significant degree. Since the 1970s, States and State-Owned Enterprises have accounted for a significant proportion of oil reserves and production (thus the representation of SOEs among the Carbon Major respondents). Nonetheless, the largest oil companies remained key service providers in the oil exploration and production space; and waves of mergers and acquisitions again reduced the number of key investor-owned companies in the industry from the 1980s onward.

(3) The oil industry began operating internationally very early in its history. Consequently, almost all of the largest US-based firms operated internationally. Correspondingly, the largest investor-owned oil companies from Europe, including notably British Petroleum and Royal Dutch Shell maintained significant commercial ties with and operations within the United States. As a result, British Petroleum and Royal Dutch Shell, or their corporate predecessors, do appear regularly in documents and research originating in the U.S. Further, documents addressed in the report periodically address the international role or operations of the U.S. based Carbon Majors, such as ExxonMobil and Chevron.

(4) Notwithstanding the smaller size of individual coal companies relative to the largest oil and gas companies, particularly in the United States, coal companies exercised significant political influence in

the United States throughout the 20th Century and into the 21st. Documents disclosed during recent bankruptcy procedures indicate that at least three U.S. based coal companies among the respondents—Peabody Coal, Arch Coal, and Alpha Natural Resources--continued to fund climate misinformation efforts well into the present decade. Reputable news reports on these disclosures are cited in the synthesis.

Given the comparative paucity of widely available public documents addressing the activities of Carbon Majors based outside the U.S., the absence of specific reference to activities of non-U.S. Respondents should not be construed as evidence of absence. As investigations continue, both within the Commission and before bodies in other jurisdictions, it is likely that additional documents will come to light and that some of these documents may offer insights into the specific knowledge of other Carbon Majors with respect to climate change, and with respect to their actions in light of that knowledge. At the same time, and until such new information becomes available, no activities in this Synthesis report should be imputed to companies for which documentation does not exist, with one exception:

In the view of CIEL, and in the absence of compelling evidence to the contrary, it is reasonable to infer that, at all relevant times, every Carbon Major was aware or should have been aware of the state of and climate science and the existence of potentially significant climate risks associated with its products to a degree generally commensurate with other companies in its industry and/or national context.