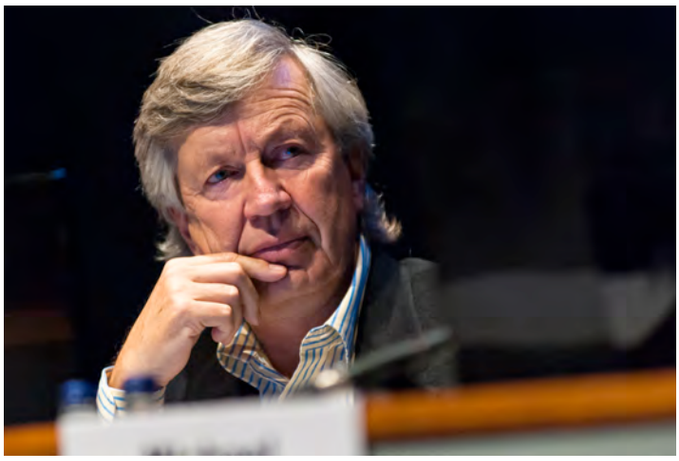
CLIMATE ACCOUNTABILITY INSTITUTE

PROFILE AND STATEMENT OF
Richard Heede
Climate Accountability Institute
7 August 2018

Preliminary Matters

Richard Heede leads Climate Accountability Institute's disruptive "Carbon Majors" project, which traces carbon dioxide and methane emissions to the largest corporations that produce and market carbon fuels worldwide. The initial work was published in *Climatic Change* in 2014 with a lead story in *The Guardian*. Rick has analyzed potential emissions from oil, gas, and coal companies' proven reserves vis-à-vis the remaining carbon budget, and with colleagues has modeled the temperature and sea level rise attributable to major carbon producers (Ekwurzel). Rick is analyzing how a responsible oil & gas company can align production and investment strategies with the Paris Accord's ≤2°C pathway, updating "Carbon Majors," and quantifying the carbon intensity of oil & gas company supply chains.

CAI was founded in 2011 to provide the scientific basis for leveraging climate stewardship by oil, gas, and coal producers. Rick published his thesis *A Geography of Carbon* with National Center for Atmospheric Research in 1984, worked on energy efficiency and climate mitigation with Rocky Mountain Institute 1984-2001. He created the consultancy Climate Mitigation Services in 2001 to inventory corporations, industrial facilities, municipalities, households, and aviation emissions. He has designed and built a low-carbon passive solar rammed earth house at 2,300 m in the Rocky Mountains. To offset his carbon savings he flies a 1958 Cessna 182.



Rick at INET conference, October 2017, Edinburgh.

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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 to present the ***"Carbon Majors"*** research, which includes the following publications:

1) Richard Heede (2014) **Tracing anthropogenic carbon dioxide and methane emissions to fossil fuel and cement producers, 1854-2010,** *Climatic Change*, vol. 122:229-241, January 2014 (online November 2013) (**Exhibit** "**D-3**");[1] Online, with "Supplementary Materials:" https://link.springer.com/article/10.1007/s10584-013-0986-y
2) Richard Heede (2013) **Carbon Majors: Accounting for carbon and methane emissions 1854-2010 Methods and Results Report**, published in 2013 and re-released in April 2014 (**Exhibit** "**D-2**");[2]
3) Richard Heede, **Climate Accountability Institute, Press Release on Update of Carbon Majors Project**, December 2014 (**Exhibit** "**D-1**")[3]; Online: http://climateaccountability.org/pdf/Media%20Outline%20Feb15.pdf
4) Frumhoff, Peter, Richard Heede, & Naomi Oreskes (2015) **The climate responsibilities of industrial carbon producers,** *Climatic Change*, vol. 132:157-171; online: link.springer.com/article/10.1007/s10584-015-1472-5
5) Heede, Richard, & Naomi Oreskes (2016) **Potential emissions of CO_2 and methane from proved reserves of fossil fuels: An alternative analysis,** *Global Environmental Change*, vol. 36:12-20. Online: www.sciencedirect.com/science/article/pii/S0959378015300637
6) Ekwurzel, B., J. Boneham, M.W. Dalton, R. Heede, R.J. Mera, M.R. Allen, & P.C. Frumhoff (2017) **The rise in global atmospheric CO_2, surface temperature and sea level from emissions traced to major carbon producers,** *Climatic Change*, vol. 144:579-590. (**Exhibit** "**H**");[4] Online: https://link.springer.com/content/pdf/10.1007%2Fs10584-017-1978-0.pdf
7) Richard Heede (2017) **Carbon producers' tar pit: dinosaurs beware: The path to accountability of fossil fuel producers for climate change & climate damages**, *Institute for New Economic Thinking Plenary Conference*, Edinburgh, 23 October 2017. Online: www.climateaccountability.org/pdf/Heede%20PathToAccountability%2018Oct17.pdf.

I agreed to be a witness and resource person for the petitioners and answer in writing questions to be asked of me. On 06 July 2018, one of the legal representatives of the petitioners, Attorney Hasminah Paudac, spoke with me via Skype and explained to me the process of Statement-taking. Attorney Kristin Casper, Greenpeace Canada's litigation counsel and international legal coordinator, was also in that call. On 10 July 2018, Ms. Anna Dominique Esmeralda, legal liaison for the petitioners, sent the questions that I answer below. I submit this Profile and Statement, along with my *Curriculum Vitae* and PowerPoint Presentation, to the Commission on Human Rights. I commit to elaborate and clarify this Statement during the scheduled public hearings.

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[1] Marked as **Exhibit** "**D-3**" during the pre-marking of exhibits
[2] Marked as **Exhibit** "**D-2**" during the pre-marking of exhibits
[3] Marked as **Exhibit** "**D-1**" during the pre-marking of exhibits
[4] Marked as **Exhibit** "**H**" during the pre-marking of exhibits

Questions and Answers

Q1: Mr. Heede, can you please provide an overview of your body of work, referred to as the "Carbon Majors" research?

A1: The Carbon Majors is a science-based project to detail and trace the quantities of carbon dioxide and methane from fossil fuel use and cement manufacturing attributable to specific extractive companies that produced and marketed the carbon fuels to end users worldwide. We take an historical approach and have attributed 65.7% of all fossil fuel and cement emissions since 1751 to the production activities of ninety Carbon Majors since as early as 1854 to 2015. Half of all fossil fuel and cement emissions — the so-called "industrial sources" of man-made CO_2 and methane (excluding land use and deforestation sources) — have been emitted since 1989. The ninety "Carbon Majors" include 51 investor-owned companies (IOCs, such as Chevron, Peabody, BP, ExxonMobil, BHP Billiton, and Royal Dutch Shell), 31 state-owned entities (SOEs, such as Saudi Aramco, Gazprom, Nigerian National Petroleum, and Coal India), and nine former or current government-run coal producing entities (such as coal production in Poland, Former Soviet Union, Kazakhstan, North Korea, and China). This thoroughly vetted and peer-reviewed project has thus documented the transfer of two-thirds of all fossil carbon that humanity has shifted from the lithosphere to the atmosphere since the Industrial Revolution began and attributed not only the emissions but also, crucially, the increased atmospheric concentration of CO_2 and the resulting temperature and sea level rise attributable to each of the ninety Carbon Majors.

Q2: What was the motivation, if any, in conducting this research?

A2: To document and trace the origin of the preponderance of human emissions of climate-altering gases such as carbon dioxide and methane to individual companies in the global fossil fuel sector. It has been known for decades that fossil fuels are responsible for the majority of all human-caused climate change (of which fossil CO_2 has risen from 55% in 1970 to 65% today, plus ~6% for fossil fuel-related methane), but no one had traced the emissions back to the producing companies, nor done so a long-term historical basis. It was *terra incognita*. As a geographer interested in in the science and consequences of carbon fluxes it was a scientific project worth doing.[5]

It has been clear to me since becoming aware of climate change, science, and economics in the 1970s that (a) companies are responsible for their products, (b) the industry would resist being held accountable, and (c) would mount a vigorous defense to perpetuate their financial interests and the carbon economy, come what may.

Q3: Why did you decide to research the historic responsibility of carbon producers and, specifically, the fossil fuel companies that are respondents in this National Inquiry?

A3: Insofar as the managers and officers of these corporations have both moral and fiduciary responsibilities to respect scientific limits on carbon emissions, as well as having control over the crucial issues of future production and acquisition of new carbon fuel reserves and investments therein, it was

[5] Heede, Richard (1983) *A World Geography of Recoverable Carbon Resources in the Context of Possible Climate Change*, NCAR Cooperative Thesis CT-72, National Center for Atmospheric Research & University of Colorado, Boulder, CO, 135 pp.

important to illuminate each company's *historic* responsibilities in light of opportunities to align investments, commitments, and strategies to the objectives of the Paris Accord on Climate Change. I believe fossil fuel companies have a unique and powerful role to play in acting to reduce production of carbon, and therefore on emissions, in line with climate stewardship, science, and survival.

Q4: What were the primary findings of the 2014 paper, "Tracing anthropogenic carbon dioxide and methane emissions to fossil fuel and cement producers," that was published in Climatic Change?

A4: That two-thirds of all carbon dioxide and methane emissions from fossil fuel and cement sources since the Industrial Revolution has been traced to the production activities of world's ninety largest oil, gas, coal, and cement companies.

Q5: How were you able to arrive at these findings, or what methods were used?

A5: I acquired annual data on each company's production of oil, natural gas, coal, and cement, chiefly from company 10-Ks (submitted to the Securities and Exchange Commission), from company Annual Reports (issued to shareholders and the public since the Securities Act of 1933 established disclosure requirements), from company histories, or other reliable sources of production data. This activity data was then run through a thorough set of calculations based on a peer-reviewed methodology that accounted for and deducted net non-energy uses of crude oil and natural gas liquids (for petrochemicals, lubricants, road oil, waxes, and for fertilizer, carbon fibers, steel-making, and pigments for non-energy uses of natural gas and coal) in order to quantify how much carbon dioxide and methane emissions could be attributed to each company's carbon production. This was done for each company and for each year of their documented production history going as far back as historic records were available (to as early as 1854 for the U.S.-based Westmoreland Coal Company).

Q6: Was this paper subject to peer-review? If so, could you please explain the peer-review process?

A6: Yes. The methodology was originally developed in 2003 (see Q10) and reviewed extensively by selected technical experts in 2012 & 2013, followed by minor improvements to the methodology (estimates of emissions from use of a company's own fuel production was added). In addition, the methodology and results were also extensively reviewed by anonymous expert reviewers as part of the normal peer-review process conducted by professional scientific journals.

Q7: Are there any internal or external corporate documents that have subsequently verified the findings?

A7: Many of the oil and gas companies included in my analysis also (and independently) report their CO_2 and methane emissions to CDP, an organization based in London that serves as the platform of corporate reporting on energy and climate issues (CDP acts on behalf of financial firms and investment companies with nearly *$100 trillion* in assets; see cdp.net). All member companies report on direct operational emissions, and several also report on estimated emissions from their carbon products. In other words, many companies self-report on the same emission sources as

included in my "Carbon Majors" analysis. However, these companies use differing and conflicting methodologies, whereas our analysis applies a consistent, comparable, and peer-reviewed methodology. That said, Royal Dutch Shell, Chevron, Statoil, Total, Hess, BP, and ConocoPhillips, do estimate and submit to CDP product-related emissions (ExxonMobil only estimates emissions for products sold in New Zealand, USA, and Quebec). Although each company's methodology differs, they are roughly comparable to my own internally consistent methodology. CDP and CAI collaborated on a guidance methodology report for calculating emissions from carbon production by fuel.[6]

Though not *subsequent* to my results, Royal Dutch Shell estimated in a 1988 confidential report[7] that came to light earlier this year[8] that in 1984 its products contributed 3.9% of world fossil fuel emissions. While Shell used a different methodology (counting its refinery outputs, not equity production, and not deducting for non-energy uses), this result roughly confirms but exceeds Climate Accountability Institute's result for Shell in 1984: 2.1% of global fossil fuel emissions.

My analysis is based on company-data (SEC Form 10-Ks or Annual Reports), and a robust and peer-reviewed methodology. There is little room for disputing our results – except for relatively minor uncertainties and variables that mostly arise from lack of company-reported data (e.g., historical data on their own fuel use, flaring rates, vented CO_2, methane leakage rates, etc.) The largest component of emissions attributed to major carbon producers — variable, but ~90% — is from combustion of the carbon in their extracted oil, gas, and coal, and those calculations are relative straightforward and unassailable.

Q8: Could you please briefly describe the findings of 2013 report, "Carbon Majors: Accounting for carbon and methane emissions 1854-2010: Methods and Results Report"?

A8: This report was written concurrently with the paper published in *Climatic Change* (Heede 2014) and presents the same results in greater detail. A 46-page section on methodology (Annex B) elaborates on the quantitative process, data sources, workflow, accounting protocol, emission factors, accounting for non-energy uses, caveats and uncertainties, and calculation details for crude oil and natural gas liquids, natural gas, coal, and cement.

Q9: How were you able to arrive at these findings, or what methods were used?

A9: Same methods were employed in both reports, covering the same entities, data sources, fuels, and years. See Q5.

Q10: Was this report peer-reviewed?

A10: Yes. The methodology developed for the Heede 2014 paper in *Climatic Change* was originally peer-reviewed by Kornelis Blok and his colleagues at Ecofys, an independent and well-respected expert group focused on climate,

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[6] Griffin, Paul, Richard Heede, & Ian van der Vlugt (2017) *The Carbon Majors Database: Methodology Report 2017*, CDP & CAI, March, 9 pp.

[7] Shell Internationale Petroleum Maatschappij (1988) *The Greenhouse Effect*, Confidential Report, HSE 88-001, The Hague, 91 pp. https://www.documentcloud.org/documents/4411090-Document3.html#document/p32/a411303

[8] Mommers, Jelmer (2018) Advocaten in actie tegen klimaatverandering: deze golf rechtszaken verandert de wereld (Lawyers in action against climate change: this wave of lawsuits is changing the world), De Correspondent, 16 March. https://decorrespondent.nl/8048/advocaten-in-actie-tegen-klimaatverandering-deze-golf-rechtszaken-verandert-de-wereld/886962032-c29274df

inventories, and policy based in Utrecht, The Netherlands.[9] The methodology was also reviewed by technical staff of Greenpeace International's Scientific Unit in the United Kingdom.

Q11: What was the Climate Justice Programme's & Greenpeace International's connection to this research, if any?

A11: Climate Justice Programme, established by Peter Roderick and originally based in London, commissioned me to do a study of a single large oil and gas company over its history and to estimate the contribution of carbon dioxide and methane from its operations and from its production and distribution of carbon fuels to worldwide consumers. That study focused on Standard Oil, founded by John D. Rockefeller, from 1882 to 2002, then the ExxonMobil Corporation.[10] Friends of the Earth International published the results in January 2004.[11] My 2003 report became the foundation for extending the analysis to a number of other large fossil fuel and cement producers that culminated in the Climate Accountability Institute's work on the ninety Carbon Majors. Both Climate Justice Programme[12] and Greenpeace International provided funding and technical support for completing the research and the peer-review process described in Q10. Such funding — while essential for completing the research — had no influence on my focus or independence, nor on the choice of companies to investigate, nor on the structure, content, methodology, or results as later published in *Climatic Change* and other scientific journals.

Q12: To the best of your knowledge, has any "Carbon Major" entity commented on and/or challenged the findings in the paper that was published in Climatic Change and/or the Methods and Results Report?

A12: No. No peer-reviewed research has been published. Privately, and under non-disclosure, one company and its legal representatives reviewed my methodology and results with respect to the company's attributed historical emissions in a statement filed with the court but subsequently withdrawn. They did not challenge the validity of my historical results for the company in question. They did assert, however, that the company's *global* oil, gas, and coal emissions were not pertinent to the case, and sought to narrow the scope to the company's emissions from documented oil and gas production *in the state of California*, not globally. They also asserted that non-energy emissions, such as nitrous oxides, agricultural methane, cattle eructation, chlorofluorocarbons, and land use CO_2 emissions should be included in the denominator (divisor) in order to calculate (and minimize) the company's percentage of global emissions. These assertions are demonstrably irrelevant to my objectives, research protocol, and methodology.

Q13: The original research has been updated. Could you explain when and what changes were made?

A13: In 2018 I updated "activity data" (annual production of fossil fuels and cement) from company Form 10-Ks, Annual Reports, or standard industry sources to 2015 and 2016. The original Heede 2014 paper had activity data

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[9] K. Blok, Director of Science, www.ecofys.com/en/experts/blok

[10] Heede, Richard (2003) *ExxonMobil Corporation: Emissions Inventory 1882-2002: Methods & Results*, Climate Mitigation Services, Snowmass, Colorado, commissioned by Friends of the Earth Trust Limited, London; 30 pp., 4 charts.

[11] Friends of the Earth International (2004) *Exxon's Climate Footprint: the contribution of Exxon-Mobil to climate change since 1882*, London, 16 pp. https://www.foe.co.uk/sites/default/files/downloads/exxons_climate_footprint.pdf

[12] Moruya, NSW, Australia: www.climatejustice.org.au

through 2010. No methodological changes were made, with the exception that we adopted the IPCC global warming potential of methane to 28 times CO_2 (100-year time horizon) per IPCC's Fifth Assessment Report (the previous value was 21xCO_2).[13]

Q14: Could you please briefly describe the key findings of "The climate responsibilities of industrial carbon producer," a paper you co-authored?

A14: This paper, with my colleagues Peter Frumhoff (Union of Concerned Scientists) and Naomi Oreskes (Harvard University), shifts the principle established in the United Nations Framework Convention on Climate Change of "common but differentiated responsibilities" from consuming and emitting *nations*, particularly the wealthy Annex 1 countries whose development caused the preponderance of historical emissions, to the *corporations* that produced the carbon fuels for global consumers. We discussed the distinctive responsibilities of the major investor-owned producers of fossil fuels, assessed the actions these companies took and could have taken to act on the scientific evidence of climate change. We argued that major investor-owned fossil energy companies carry significant responsibility for climate change, and discussed how these companies have an obligation to effectively help avoid the worst of the prospective climate damages we now face. Companies must: 1) unequivocally communicate to the public, shareholders, and policymakers the climate risks resulting from continued use of their products, and therefore the need for restrictions on greenhouse gas emissions consistent with the 2°C global temperature target; 2) firmly reject contrary claims by industry trade associations and lobbying groups; and, 3) accelerate their transition to the production of low-carbon energy.

Q15: How was your group able to arrive at these findings, or what methods were used?

A15: We analyzed the contributions and commensurate responsibilities of major carbon producers and in view their public communications about known threat of their products to climate stability, and found their non-disclosure reprehensible in light of the global consequences of business-as-usual and, for that matter, given the outright efforts to sow doubt about climate science and policy action. We made specific recommendations on how companies could correct their historical inaction, obfuscation, deception, and denial.

Q16: In your professional opinion, why do you believe that carbon producers, as opposed to individuals, are responsible for climate change and be held accountable for the costs of climate change?

A16: Carbon producers make the decisions to increase production and distribution of carbon fuels with the knowledge – scientifically indisputable for decades — that their products contribute to climate change and climate damages. The producers make the decisions to invest capital to increase production, bring new projects on line, discover and develop new reserves, bid for leases, and develop the entire supply chain to assure uninterrupted consumption of carbon fuels. Many investor-owned companies lobby for subsidies, new or expanded leases, helpful government policies, tax benefits, pollution permits, deregulation, infrastructure (rail and port facilities) permits, lax

[13] Myhre, G., et al. 2013: Anthropogenic and Natural Radiative Forcing. In: *Climate Change 2013: The Physical Science Basis*. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press.

government oversight, and broadly lobby to eliminate potential barriers to a durable and profitable carbon economy.

More pervasive and effective, however, is the gradual build-up of global acceptance of carbon products as the fuels of choice, that elimination of non-carbon alternatives is fair game, and manipulation of the market and of public opinion in defense of profits is no vice. As a result, the global infrastructure of rules, regulations, and incentives (or outright subsidies) have been deeply imbedded to perpetuate the dominance and profitability of the carbon economy from extraction to end use. Had the fossil fuel companies acted forcefully on their own scientific knowledge gained in the 1970s and 1980s, the world would have avoided the worst of the climate havoc we now face. And, I might add, the companies before this national inquiry (as well as the state-owned companies that are not) would have been on the right side of history, helped usher in decarbonization years if not decades earlier, and not be facing the citizens of the Philippines and their grievous loss of life and livelihood. This is a marker, of course, for the deprivation of human rights that climate change and related extreme events that will follow in the footsteps of corporate, national, and international inaction, for centuries.

It is my opinion that carbon producers (both investor-owned and state-owned) have a moral (and perhaps legal) obligation to act to reduce the threat of climate change and climate damages. These corporations have the technical skills, resources, financial wherewithal to assure that their investment and production strategies align with science-based targets for reducing global emissions as well as to compensate communities for the costs of adapting to the expected climate changes that will afflict humanity for decades to come. The costs of climate change should not be borne by taxpayers alone. Companies held accountable should pay their fair share.

I do not mean to lay the full force of accountability on the oil, gas, and coal companies, or on trade associations, or on the nations whose dysfunctional policies have helped perpetuate carbon dominance. Individuals, consumers, non-energy corporations, cities, and states are also partially responsible for historical emissions, and also bear a share of the burden of addressing the climate problem. By and large, individuals, municipalities, companies, and many progressive nations are taking the lead in reducing carbon fuel use and emissions. Fossil fuel companies are not solely responsible for the climate problem, or for the use of their products — fossil fuels have, after all, propelled economic growth, prosperity, health, comfort, and longevity for billions of us — but these companies do have, in my mind, substantial responsibility for climate change, and must now address the problem and help pay for adaptation and damages.

Q17: Could you please describe how your research has been used by third parties, including plaintiffs in climate cases?

A17: My original paper in *Climatic Change* (Heede 2014) has been cited and used by authors of 98 other peer-reviewed papers. Significantly, my published and posted research results has been cited and used in more than a dozen lawsuits filed by cities, counties, and states in the United States (such as City of New York vs BP et al. {Case 18 cv 182}, and County of Marin vs Chevron et al. {Case cv 1702586}) and Germany (Saúl Luciano Lliuya vs

RWE). I have, in response to several plaintiff attorney's requests, shared my results on selected oil, gas, and coal companies that are defendants in these cases with respect to emissions attributed to each company for certain periods of years, such as 1988 to 2015. The dataset has been publicly available since 2014 on a third-party website (www.carbonmajors.org), and accessible at no cost to any academic, attorney, analyst, citizen, media outlet, or oil & gas company who wishes to review and/or use the results.

Q18: Could you please briefly describe the key findings of "Potential emissions of CO_2 and methane from proved reserves of fossil fuels: An alternative analysis," Global Environmental Change, a paper you co-authored?

A18: The world's largest oil, natural gas, and coal producers possess proven recoverable fossil fuel reserves equal to 1.6 times the amount of carbon that can be emitted to the atmosphere in this century — 275 GtC (billion tonnes carbon) — if we are to restrict global warming to 2ºC. Most of these reserves are owned by twenty-eight state-owned companies studied (210 GtC, or 76% of the "remaining carbon budget," RCB), whereas forty-two investor-owned companies own relatively small reserves with potential emission totaling 44 GtC (15% of RCB). Thus the global imperative is to limit production of reserves owned by state-owned companies such as Saudi Aramco, Gazprom, and Petroleos de Venezuela, and to curtail the investment in additional reserves by investor-owned companies such as ExxonMobil, Shell, and BHP Billiton — at least to the extent that they invest only in new carbon reserves that will not be stranded in the event the world gets serious about policies to assure we do not exceed the 2ºC threshold (or, quite possibly, less than 2ºC). The companies have an obligation, and are increasingly subject to resolutions by their shareholders, to fully and transparently assess their reserves, capital investment options (including in renewable energy), and production strategies in light of aggressive policies to limit global emissions or disruptive technologies that displace carbon altogether.

Q19: How was your group able to arrive at these findings, or what methods were used?

A19: We used the same methodology developed in Heede 2014 to estimate potential emissions from the production of declared quantities of reserves of oil, natural gas, and coal. We only quantified emissions from proved reserves (not additional resources), and gathered reserves data from company publications. We deducted non-energy uses such as road oil, petro-chemicals, and lubricants when estimating potential emissions from reserves.

Q20: What are the primary differences between the historical research and the future reserves research?

A20: Historical research quantifies operational and product-related emissions from each entity's annual extraction of fossil fuels based on company-reported annual equity production, deducting for non-energy uses, and applying standard emission factors to barrels of crude oil and natural gas liquids (NGL), volumes of natural gas, and tonnes of coal (by rank). Our reserves research, on the other hand, while focused on attributable *future* emissions, does so in the aggregate and does not model specific scenarios for each company's annual depletion rates of their reserves or reserve replacements. This is the subject of ongoing work at Climate Accountability Institute.

Q21: Could you please briefly describe the key findings of "The rise in global atmospheric CO_2, surface temperature, and sea level from emissions traced to major carbon producers," a paper you co-authored?

A21: We estimated that the major carbon producers contributed ~57% of the observed rise in atmospheric CO_2, ~46% of the observed rise global mean surface temperature, and ~29% of global sea level rise *since 1880*, and ~43%, ~32%, and ~12% of CO_2, temperature, and sea level rise *since 1980*, respectively. We quantified the contributions of each major carbon producer in percent of the global increase in CO_2, temperature rise, and sea level rise. For example, the largest carbon producer from 1980 to 2010 is Saudi Aramco, to which my research attributed emissions of 36 $GtCO_2$, and our modeling study attributed CO_2 rise of 3.23 ppm (parts per million), a 0.017 degree Celsius rise, and 1.43 mm of sea level rise (SLR). Gazprom followed as #2, with SLR of 1.14 mm, and ExxonMobil #3 with SLR of 0.92 mm.

Q22: How was your group able to arrive at these findings, or what methods were used?

A22: We used a simple climate model to quantify the contribution of historical (1880–2010) and recent (1980–2010) emissions traced to these producers to the historical rise in global atmospheric CO_2, surface temperature, and sea level. We used the emissions of CO_2 and methane traced to the ninety major industrial carbon producers as discussed in the peer-reviewed *Climatic Change* (Heede 2014) as input data to the model.

Q23: How do you think this type of research will be advanced in the future?

A23: The significance of the findings is that climate impacts — such as a proportion of observed rise of sea levels globally — can be attributed to the emissions traced to individual fossil fuel producing companies. In the context of responsibility for climate change and for climate damages — such as inundated coastal areas, threatened private and public property, marginal costs of severe storms and storm surges, abatement costs by cities and corporations to protect assets, populations increasingly at risk from floods, forest fires, crop failures, and disease vectors — we can begin to understand not only which energy companies have a quantifiable responsibility for the climate effects of the carbon fuels they have extracted and marketed globally, but also link attributed emissions to anthropogenically-*exacerbated* damages. A rich set of scientific literature is now emerging that is refining the attribution models and with increasing confidence able to quantify the human fingerprint on the frequency and severity of extreme weather events and similar attributable climate-related impacts. (Some impacts are not strictly global warming related, such as impacts on coral reefs, marine biodiversity, and shell-fisheries from the acidification of the oceans caused by increased uptake of atmospheric CO_2; carbon dioxide is a mild acid, leading to decrease in surface water pH.)

Q24: Could you please briefly describe the key findings of your recent paper, "Carbon producers' tar pit: dinosaurs beware: the path to accountability of fossil fuel producers for climate change & climate damages"?

A24: This is a survey paper submitted to the *Plenary Conference of the Institute for New Economic Thinking* at Edinburgh in October 2017 in which I discuss the arc and objectives of my work, from the tracing of two-thirds of global industrial CO_2 emissions to fossil fuel and cement producers to our common

aspirational objective that oil, gas, and coal companies take seriously their obligation to align future production and investments with science-based targets to not exceed warming of 2ºC. I also cover industry actions and reactions to the prospect that climate change may affect their business plans, that their projections of global fossil fuel emissions far exceed the remaining carbon budget (and therefore a costly transgression of the 2ºC target), their history of denials to shareholders and the public that climate science is too unsettled for any policy action,[14] and the sobering effects of the proliferating lawsuits and investigations of the major carbon companies.

Q25: How were you able to arrive at these findings, or what methods were used?

A25: I analyze and cogitate on the work of several dozen colleagues and thinkers in order to discern the emerging imperative that major carbon producers have unique responsibilities for creating and perpetuating the climate crisis, and therefore bear commensurate responsibilities to help solve the crisis that ignoring the impacts of their products will not absolve them of. I conclude the survey paper by quoting Henry Shue from his insightful *Commentary*[15] to our paper (Ekwurzel et al. 2017) that:

> *"Investor-owned companies have long understood the harm of their products, yet carried out a decades long campaign to sow doubts about those harms in order to ensure fossil fuels would remain central to global energy production. Companies knowingly violated the most basic moral principle of 'do no harm,' and now they must remedy the harm they caused."*

Q26: In light of your years of research and expertise on the subject matter, are investor-owned carbon producers aligning production and investment with science-based targets that will ensure the global temperature rise is limited to safe levels? Please explain.

A26: No. The only carbon producers that are arguably "aligning" their production with science-based targets are those companies that are in or emerging from bankruptcy (Arch Coal), forced to divest producing assets (BP), reservoir depletion (Pemex), or war (Syrian Petroleum). All major carbon producers are, as far as I can tell, aiming to expand investment in and production of future supplies to assure steady or growing production. That said, some oil and gas companies are more responsive to the emerging imperative for carbon producers to align with the Paris Accord, lead by European companies, particularly Equinor/Statoil, Royal Dutch Shell, and Total SA. American, African, Arabian Gulf, and Asian companies are generally lagging in this regard.[16] Note that many companies have committed to reduce direct operational emissions (Scope 1) through efficiency, methane leakage prevention, and flaring reduction, but the crucial question is whether any company has committed to reduce carbon *production* in line with the Paris Accord. The answer is "no," although Royal Dutch Shell made an important (if incomplete) step in that direction by committing to monitor and

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[14] Center for International Environmental Law (2017) *Smoke and Fumes: The Legal and Evidentiary Basis for Holding Big Oil Accountable for the Climate Crisis*, by Carroll Muffett & Steven Feit, CIEL, Nov, 42 pp. https://www.ciel.org/wp-content/uploads/2017/11/Smoke-Fumes-FINAL.pdf

[15] Shue, Henry (2017) Responsible for What? Carbon Producer CO_2 Contributions and the Energy Transition, Commentary on Ekwurzel et al., *Climatic Change*, vol. 144:591-96. https://link.springer.com/article/10.1007/s10584-017-2042-9. Prof Shue: University of Oxford, Dept. of Politics and International Relations.

[16] Mulvey, Kathy, Jayne Piepenburg, Gretchen Goldman, & Peter C. Frumhoff (2016) *The Climate Accountability Scorecard: Ranking Major Fossil Fuel Companies on Climate Deception, Disclosure, and Action*, Union of Concerned Scientists, Cambridge MA, 40 pp. https://www.ucsusa.org/sites/default/files/attach/2016/10/climate-accountability-scorecard-full-report.pdf

reduce its company-wide *carbon-intensity* (including products sold) by 50% by 2050. Reducing carbon-intensity is not the same as absolute targets that meet the emission reduction pathway to 2050 insofar as sales of carbon fuels can *increase* over time as long as offset by carbon capture, renewables, or other credits. Other companies, especially the dominant U.S. companies, should evaluate how they can meet or exceed Shell's climate stewardship commitment.

Q27: Based on your extensive research, do you have any insights on what steps respondent Carbon Majors should take to remedy, eliminate, and prevent human rights harms resulting from the fossil fuel products they extract and sell?

A27: Assess their historical responsibilities in light of the global requirement to reduce net emissions of carbon dioxide and methane, develop clear plans to align production, full supply chain emissions, and investment with the 2ºC pathway (or less), monitor progress and adjust net emissions as necessary, commit to full transparency on operational and product-related emissions, resign membership in trade associations that engage in climate deception and obfuscation, renounce disinformation on climate science to shareholders and the public, clearly support legislation and policies at state, regional, national, and international levels that promote reasonable climate action, disclose material risks of climate change to corporate assets (including possible stranded reserves or resources) as well as potential liability for climate damages in ongoing litigation, and be financially prepared to pay damage awards to plaintiffs. Last, but not least, carbon producers must firmly acknowledge that anthropogenic climate change — and their contributions — does inflict human rights harms on many populations and regions of the world, including on those not yet born.

Q28: Is there anything else you would like to say about your research that may be relevant to this national inquiry?

A28: I want to thank the members of the Commission on Human Rights individually and collectively for your fortitude and wisdom in launching this national inquiry.

Q29: 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?

A29: I am ready to swear to the truth of my Profile and Statement.

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Richard Heede

7 August 2018
Date