In the High Court of New Zealand
Wellington Registry
CIV-2015-

under the Judicature Amendment Act 1972 and under Part 30 of the High Court Rules

in the matter of an application for judicial review of decisions made under the Climate Change Response Act 2002 and public decisions made in relation to the United Nations Framework Convention on Climate Change

between

SARAH LORRANIE THOMSON
Plaintiff

and

THE MINISTER FOR CLIMATE CHANGE ISSUES
Defendant

AFFIDAVIT OF JAMES EDWARD HANSEN

Commonwealth of Pennsylvania
County of Bucks } **ss:**

ATTESTED AND SUBSCRIBED BEFORE ME
THIS 13th DAY OF November, 2015

NOTARY PUBLIC

COMMONWEALTH OF PENNSYLVANIA
NOTARIAL SEAL
Julianne W. Fleischer, Notary Public
Plumstead Twp., Bucks County
My Commission Expires March 18, 2019
MEMBER, PENNSYLVANIA ASSOCIATION OF NOTARIES

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EMAIL: davey.salmon@lsl.co.nz COUNSEL ACTING: DAVEY SALMON

Commonwealth of Pennsylvania
County of Bucks } ss:

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AFFIDAVIT OF JAMES EDWARD HANSEN

I, **Dr James Edward Hansen**, atmospheric scientist, of New York, swear:

1. I am presently an Adjunct Professor at Columbia University's Earth Institute, Director of the Earth Institute's program on Climate Science, Awareness and Solutions, and formerly the Director of the NASA Goddard Institute for Space Studies

2. I have read the code of conduct for expert witnesses and I agree to comply with it.

3. In this affidavit I comment on the affidavit of Dr James Renwick and on the action needed to avert catastrophic interference with the climate system.

Qualifications

4. My curriculum vitae is attached hereto as Exhibit "**A**".

5. I was trained in physics and astronomy in the space science program of Dr. James Van Allen at the University of Iowa. I received a B.A. degree in Physics and Mathematics in 1963, an M.S. degree in Astronomy in 1965, and a Ph.D. in Physics in 1967, all from the University of Iowa.

6. In my early research I used telescopic observations of Venus to extract detailed information on the physical properties of the cloud and haze particles that veil Venus. Since the mid-1970s, I have focused on studies and computer simulations of Earth's climate system, for the purpose of understanding the human impact on global climate. Some of that work informed my testimony on climate change to Congress in the 1980s, which testimony aimed at raising broad awareness of the global warming issue.

7. I was elected to the United States National Academy of Sciences in 1995 and, in 2001, received the Heinz Award for environment and the American Geophysical Union's Roger Revelle Medal. I received the World Wildlife Federation's Conservation Medal from the Duke of Edinburgh in 2006. In 2007 I won the Dan David Prize in the field of Quest for Energy, the Leo Szilard Award of the American Physical Society for Use of Physics for the Benefit of Society, and the American Association for the Advancement of Science Award for Scientific Freedom and Responsibility. In 2008, I received the Common Wealth Award for Distinguished Service in Science and was also awarded both the Ohio State University's Bownocker Medal and the Desert Research Institute's Nevada Medal. In 2009, I received the American Meteorological Society's Carl-Gustaf Rossby Research Medal. In 2010 I received the Sophie Prize and the Blue Planet Prize.

8. In recent years I have attempted to draw attention to the danger of passing climate "tipping points" -- irreversible climate impacts that could yield a different planet from the one on which civilization developed.

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9. In Hansen, et. al, *Assessing "Dangerous Climate Change": Required Reduction of Carbon Emissions to Protect Young People, Future Generations and Nature* (Dec. 3, 2013), attached hereto as Exhibit "**B**",[1] I helped to establish, along with 17 colleagues, that continued fossil fuel burning up to even 2°C above the preindustrial level[2] likely would cause large climate change with disastrous and irreversible consequences. Accordingly, action to rapidly phase out CO_2 emissions, along with efforts to increase the sequestration of carbon, are urgently required so as to reduce the atmospheric CO_2 concentration to no more than 350ppm and restore Earth's energy balance. I hereby incorporate by reference the analyses and conclusions from this study into the present Affidavit.

10. In Hansen, et. al., *Ice Melt, Sea Level Rise and Superstorms: Evidence from Paleoclimate Data, Climate Modeling, and Modern Observations that 2°C Global Warming is Highly Dangerous* (July 2015) (for administrative convenience this document will be separately produced and will be my Exhibit "**C**"[3]), I helped to establish, in conjunction with 16 colleagues, that if CO_2 emissions continue at a high rate, then multi-meter sea level rise will become practically unavoidable, with consequences that ultimately may threaten the very fabric of civilization. I hereby incorporate by reference the analyses and conclusions from this study into the present Affidavit.

11. I have read the affidavit of Dr. James Renwick. In general, Dr. Renwick accurately distills critical findings stemming from the two most recent assessment reports of the Intergovernmental Panel on Climate Change (AR 4 and AR 5). In particular, I agree with Dr. Renwick that, among other things, the IPCC assessments represent "a conservative consensus" of the relevant scientific community, that continued GHG emissions will cause "further warming and changes in all components of the climate system" -- thus "increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems," and that "signficant and potentially dangerous change may occur in association with temperature rises of less than 2°C."

12. Article 2 of the United Nations Framework Convention on Climate Change (Convention) states:

> The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame

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[1] Published by PLOS One and available, as well, at: http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0081648.

[2] We are already 0.9°C above the preindustrial temperature. Indeed, in 2015 global temperature is reaching a level ~1°C above the preindustrial level, but the high 2015 level is partly a temporary effect of a strong El Nino, a natural oscillation of tropical Pacific Ocean temperature.

[3] Published in Atmospheric Chemistry and Physics Discussions, at: http://www.atmos-chem-phys-discuss.net/15/20059/2015/acpd-15-20059-2015.pdf

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sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.

13. In my opinion what is required to meet this objective is a phaseout of carbon emissions over the next several decades coupled with significant efforts to drawdown CO_2 from the atmosphere so that we can return the atmospheric CO_2 concentration of no more than 350ppm.

14. The paleoclimate record shows that warming coincident with atmospheric CO_2 concentrations as low as 450 ppm may have been enough to melt most of Antarctica. Global fossil fuel emissions have already driven up the atmospheric CO_2 concentration to approximately 400 ppm – up from 280 ppm of the preindustrial era. I conclude from this, and other information, that the present level of CO_2 and its warming, both realized and latent, is already in the dangerous zone. Indeed, we are now in a period of overshoot, with early consequences that are already highly threatening and that will rise to unbearable unless action is taken without delay to restore energy balance at a lower atmospheric CO_2 amount.

15. Utilizing multiple lines of evidence – including satellite gravity measurement, surface mass balances, and satellite radar altimetry – it has become clear, regrettably, that ice mass losses from Greenland, West Antarctica and parts of East Antarctica are growing nonlinearly, with doubling times so far this century of approximately 10 years.

16. It further appears likely that Antarctic ice mass loss will continue to climb at its recent high exponential rate – again, if fossil fuel emissions are not rapidly abated. This prospect alone cries out for urgent national and international action to constrain carbon pollution, considering that complete disintegration of the Totten glacier in East Antarctica could raise sea levels by approximately 6-7m; that ice fronted by the Cook glacier in East Antarctica could add 3-4m of sea rise; and that West Antarctic ice fronted by Amundsen Sea glaciers have the potential to raise sea level an additional *3-4m*. Exhibit C at 41.

17. In the light of this and related information, we have concluded that humanity faces "near certainty of eventual sea level rise of at least . . . 5-9m if fossil fuel emissions continue on a business-as-usual course." *Id.* at page 31. Much of the U.S. eastern seaboard, as well as low-lying areas of Europe, the Indian sub-continent, and the Far East, would then be submerged. Parts of Wellington, Christchurch, and other New Zealand coastal communities may be exceptionally vulnerable.

New Zealand's targets for emissions reductions

18. I understand that New Zealand has set or is proposing the following emissions reduction targets:

    (a) Its gazetted target under the Climate Change Response Act 2002 is to reduce emissions to 50% below 1990 levels by 2050.

    (b) New Zealand's proposed (non-binding) Intended Nationally Determined Contribution (**INDC**) in advance of negotiations in

Paris is a reduction to 30% below 2005 levels by 2030. This equates to 11% below 1990 levels by 2030.

19. I concur with Dr. Renwick's analysis as to the inadequacy of these proposed commitments and also with respect to current efforts.

20. The latter, as Dr. Renwick observed, presumes increased actual CO_2 emissions for a minimum of a decade, albeit offset on paper "by trading on the international carbon market and via unused emisisons credits from the first Commitment Period under the Kyoto Protocol." As Dr. Renwick noted, this "does nothing to reduce the atmospheric burden of CO_2 and other greenhouse gases."

21. As to the proposed INDC, even if it were achieved through actual reductions (and not merely through paper accounting gimmicks), the intention is insufficiently ambitious. As noted in our 2013 study, Exhibit B at 10, annual emissions reductions on the order of 6 percent, coupled with approximately 100 GtC of carbon sequestration through reforestation, would be capable of returning atmospheric CO_2 to the safe zone. Moreover, the date of commencement of fossil fuel emissions phaseout makes a huge difference.

22. We will not preserve a habitable climate system unless developed nations act without further delay, both to phase out their own carbon emissions and to aid the balance of nations in the development of their own carbon-free energy sources. In light of its population New Zealand remains a relatively small emitter, and yet the nation's economy is among the world's most advanced.[4] It is critical, therefore, that New Zealand be brought to do its part, as the Plaintiff in this action demands.

SWORN at Bucks County, Pennsylvania, USA this 13th day of November before me:

Julianne W. Fleischer

Dr. James Edward Hansen

A person authorised by the laws of Pennsylvania, USA, to administer oaths and declarations

COMMONWEALTH OF PENNSYLVANIA
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[4] IMF Advanced Economies List. World Economic Outlook, October 2015, p. 148.

Assessing "Dangerous Climate Change": Required Reduction of Carbon Emissions to Protect Young People, Future Generations and Nature

James Hansen[1]*, Pushker Kharecha[1,2], Makiko Sato[1], Valerie Masson-Delmotte[3], Frank Ackerman[4], David J. Beerling[5], Paul J. Hearty[6], Ove Hoegh-Guldberg[7], Shi-Ling Hsu[8], Camille Parmesan[9,10], Johan Rockstrom[11], Eelco J. Rohling[12,13], Jeffrey Sachs[1], Pete Smith[14], Konrad Steffen[15], Lise Van Susteren[16], Karina von Schuckmann[17], James C. Zachos[18]

1 Earth Institute, Columbia University, New York, New York, United States of America, **2** Goddard Institute for Space Studies, NASA, New York, New York, United States of America, **3** Institut Pierre Simon Laplace, Laboratoire des Sciences du Climat et de l'Environnement (CEA-CNRS-UVSQ), Gif-sur-Yvette, France, **4** Synapse Energy Economics, Cambridge, Massachusetts, United States of America, **5** Department of Animal and Plant Sciences, University of Sheffield, Sheffield, South Yorkshire, United Kingdom, **6** Department of Environmental Studies, University of North Carolina, Wilmington, North Carolina, United States of America, **7** Global Change Institute, University of Queensland, St. Lucia, Queensland, Australia, **8** College of Law, Florida State University, Tallahassee, Florida, United States of America, **9** Marine Institute, Plymouth University, Plymouth, Devon, United Kingdom, **10** Integrative Biology, University of Texas, Austin, Texas, United States of America, **11** Stockholm Resilience Center, Stockholm University, Stockholm, Sweden, **12** School of Ocean and Earth Science, University of Southampton, Southampton, Hampshire, United Kingdom, **13** Research School of Earth Sciences, Australian National University, Canberra, ACT, Australia, **14** University of Aberdeen, Aberdeen, Scotland, United Kingdom, **15** Swiss Federal Institute of Technology, Swiss Federal Research Institute WSL, Zurich, Switzerland, **16** Center for Health and the Global Environment, Advisory Board, Harvard School of Public Health, Boston, Massachusetts, United States of America, **17** L'Institut Francais de Recherche pour l'Exploitation de la Mer, Ifremer, Toulon, France, **18** Earth and Planetary Science, University of California, Santa Cruz, CA, United States of America

Abstract: We assess climate impacts of global warming using ongoing observations and paleoclimate data. We use Earth's measured energy imbalance, paleoclimate data, and simple representations of the global carbon cycle and temperature to define emission reductions needed to stabilize climate and avoid potentially disastrous impacts on today's young people, future generations, and nature. A cumulative industrial-era limit of ~500 GtC fossil fuel emissions and 100 GtC storage in the biosphere and soil would keep climate close to the Holocene range to which humanity and other species are adapted. Cumulative emissions of ~1000 GtC, sometimes associated with 2°C global warming, would spur "slow" feedbacks and eventual warming of 3–4°C with disastrous consequences. Rapid emissions reduction is required to restore Earth's energy balance and avoid ocean heat uptake that would practically guarantee irreversible effects. Continuation of high fossil fuel emissions, given current knowledge of the consequences, would be an act of extraordinary witting intergenerational injustice. Responsible policymaking requires a rising price on carbon emissions that would preclude emissions from most remaining coal and unconventional fossil fuels and phase down emissions from conventional fossil fuels.

Introduction

Humans are now the main cause of changes of Earth's atmospheric composition and thus the drive for future climate change [1]. The principal climate forcing, defined as an imposed change of planetary energy balance [1–2], is increasing carbon dioxide (CO_2) from fossil fuel emissions, much of which will remain in the atmosphere for millennia [1,3]. The climate response to this forcing and society's response to climate change are complicated by the system's inertia, mainly due to the ocean and the ice sheets on Greenland and Antarctica together with the long residence time of fossil fuel carbon in the climate system. The inertia causes climate to appear to respond slowly to this human-made forcing, but further long-lasting responses can be locked in.

More than 170 nations have agreed on the need to limit fossil fuel emissions to avoid dangerous human-made climate change, as formalized in the 1992 Framework Convention on Climate Change [6]. However, the stark reality is that global emissions have accelerated (Fig. 1) and new efforts are underway to massively expand fossil fuel extraction [7–9] by drilling to increasing ocean depths and into the Arctic, squeezing oil from tar sands and tar shale, hydro-fracking to expand extraction of natural gas, developing exploitation of methane hydrates, and mining of coal via mountaintop removal and mechanized long-wall mining. The growth rate of fossil fuel emissions increased from 1.5%/year during 1980–2000 to 3%/year in 2000–2012, mainly because of increased coal use [4–5].

The Framework Convention [6] does not define a dangerous level for global warming or an emissions limit for fossil fuels. The

Citation: Hansen J, Kharecha P, Sato M, Masson-Delmotte V, Ackerman F, et al. (2013) Assessing "Dangerous Climate Change": Required Reduction of Carbon Emissions to Protect Young People, Future Generations and Nature. PLoS ONE 8(12): e81648. doi:10.1371/journal.pone.0081648

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Competing Interests: The authors have declared that no competing interests exist.

* E-mail: jimehansen@gmail.com

This is the exhibit marked "A" referred to in the affidavit of Dr. James Edward Hansen sworn at Bucks County, Pennsylvania (USA) this 13th day of November, 2015, before me: Julianne W. Fleischer, notary public

A person authorized by the laws of the State of Pennsylvania to administer oaths and declarations.

James E. Hansen

Columbia University Earth Institute, Climate Science, Awareness and Solutions
Interchurch Building, 475 Riverside Drive, Room 239T, New York, NY 10115 jimehansen@gmail.com

1-paragraph bio/introduction:

Dr. James Hansen, formerly Director of the NASA Goddard Institute for Space Studies, is an Adjunct Professor at Columbia University's Earth Institute, where he directs a program in Climate Science, Awareness and Solutions. Dr. Hansen is best known for his testimony on climate change in the 1980s that helped raise awareness of global warming. He is a member of the U.S. National Academy of Sciences and has received numerous awards including the Sophie and Blue Planet Prizes. Dr. Hansen is recognized for speaking truth to power and for outlining actions needed to protect the future of young people and all species on the planet.

1-long-paragraph bio:

Dr. James Hansen, formerly Director of the NASA Goddard Institute for Space Studies, is an Adjunct Professor at Columbia University's Earth Institute, where he directs a program in Climate Science, Awareness and Solutions. He was trained in physics and astronomy in the space science program of Dr. James Van Allen at the University of Iowa. His early research on the clouds of Venus helped identify their composition as sulfuric acid. Since the late 1970s, he has focused his research on Earth's climate, especially human-made climate change. Dr. Hansen is best known for his testimony on climate change to congressional committees in the 1980s that helped raise broad awareness of the global warming issue. He was elected to the National Academy of Sciences in 1995 and was designated by Time Magazine in 2006 as one of the 100 most influential people on Earth. He has received numerous awards including the Carl-Gustaf Rossby and Roger Revelle Research Medals, the Sophie Prize and the Blue Planet Prize. Dr. Hansen is recognized for speaking truth to power, for identifying ineffectual policies as greenwash, and for outlining actions that the public must take to protect the future of young people and other life on our planet.

3-paragraph bio:

Dr. James Hansen, formerly Director of the NASA Goddard Institute for Space Studies, is an Adjunct Professor at Columbia University's Earth Institute, where he directs a program in Climate Science, Awareness and Solutions. He was trained in physics and astronomy in the space science program of Dr. James Van Allen at the University of Iowa, receiving a bachelor's degree with highest distinction in physics and mathematics, master's degree in astronomy, and Ph. D. in physics in 1967. Dr. Hansen was a visiting student, at the Institute of Astrophysics, University of Kyoto and Dept. of Astronomy, Tokyo University, Japan from 1965-1966. He received his Ph.D. in physics from the University of Iowa in 1967. Except for 1969, when he was an NSF post-doctoral scientist at Leiden Observatory under Prof. H.C. van de Hulst, he has spent his post-doctoral career at NASA GISS.

In his early research Dr. Hansen used telescopic observations of Venus to extract detailed information on the physical properties of the cloud and haze particles that veil Venus. Since the mid-1970s, Dr. Hansen has focused on studies and computer simulations of the Earth's climate, for the purpose of understanding the human impact on global climate. He is best known for his testimony on climate change to Congress in the 1980s that helped raise broad awareness of the global warming issue. In recent years Dr. Hansen has drawn attention to the danger of passing climate tipping points, producing irreversible climate impacts that would yield a different planet from the one on which civilization developed. Dr. Hansen disputes the contention, of fossil fuel interests and governments that support them, that it is an almost god-given fact that all fossil fuels must be burned with their combustion products discharged into the atmosphere. Instead Dr. Hansen has outlined steps that are needed to stabilize climate, with a cleaner atmosphere and ocean, and he emphasizes the need for the public to influence government and industry policies.

Dr. Hansen was elected to the National Academy of Sciences in 1995 and, in 2001, received the Heinz Award for environment and the American Geophysical Union's Roger Revelle Medal. Dr. Hansen received the World Wildlife Federation's Conservation Medal from the Duke of Edinburgh in 2006 and was designated by Time Magazine as one of the world's 100 most influential people in 2006. In 2007 Dr. Hansen won the Dan David Prize in the field of Quest for Energy, the Leo Szilard Award of the American Physical Society for Use of Physics for the Benefit of Society, and the American Association for the Advancement of Science Award for Scientific Freedom and Responsibility. In 2008, he won the Common Wealth Award for Distinguished Service in Science and was also awarded both the Ohio State University's Bownocker Medal and the Desert Research Institute's Nevada Medal. In 2009, Dr. Hansen received the American Meteorological Society's Carl-Gustaf Rossby Research Medal. In 2010 he received the Sophie Prize and the Blue Planet Prize.