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UNITED STATES DISTRICT COURT
DISTRICT OF OREGON
EUGENE DIVISION

KELSEY CASCADIA ROSE JULIANA;
XIUHTEZCATL TONATIUH M., through
his Guardian Tamara Roske-Martinez; et al.

Plaintiffs,

v.

The UNITED STATES OF AMERICA;
BARACK OBAMA, in his official capacity as
President of the United States; et al.,

Federal Defendants.

Case No.: 6:15-cv-01517-TC

SUPPLEMENTAL DECLARATION OF DR.
JAMES E. HANSEN in Support of Plaintiffs'
Opposition to Defendants' Motion to Dismiss;

Oral Argument: February 17, 2016, 2:00 p.m.

I, Dr. James E. Hansen, hereby declare as follows:

1. I offer this supplemental declaration from a scientific perspective in order to address four points that I think are directly relevant to the claims Plaintiffs have brought in the instant action. These include the effect on this litigation of the 21st Conference of the Parties (“COP-21”) to the United Nations Framework Convention on Climate Change (“UNFCCC”).
2. **THE “AGREEMENT” RESULTING FROM COP-21**: First, the largely precatory agreement secured at COP-21 neither resolves nor ameliorates the unfolding crisis of dangerous, human-caused disruption of the climate system. The real and mounting harms to Plaintiffs’ fundamental interests remain, essentially, unabated.
3. **THE RESPONSIBILITY OF THESE DEFENDANTS**: Second, our Nation’s liability for the present danger – and thus our government’s corresponding special responsibility to forge a different and sustainable path – can be rendered more manifest than in my initial declaration, Doc. 7-1 (Declaration of Dr. James E. Hansen of Aug. 11, 2015) at 9-11.
4. **UNEQUAL IMPACTS**: Third, while it is true that the impacts of an increasingly disrupted climate system are and will be felt globally, the impacts will be unequally experienced, depending upon several key physical facts including, most prominently, physical geography and, in particular, residence in or reliance upon low-lying coastal regions. Other factors include a person’s generation since, unless emissions are soon arrested and phased out, the long-lived residence time of atmospheric CO₂ will ensure a compounding atmospheric concentration that, in turn, will yield increasingly intolerable consequences.
5. **BASED ON THE SCIENCE, IT IS VERY LATE**: Fourth, from a scientific perspective, immediate implementation of the remedy sought by Plaintiffs in this case, as I outlined in Doc. 7-1, can still relieve injury that present and future generations will otherwise suffer. A prompt phase out within decades of fossil fuel emissions, when coupled with a meaningful program to draw down excess atmospheric carbon and retain it in the terrestrial and forest systems, is the essential requirement for preservation of a planet whose fundamental features remain similar to that to which humanity is adapted. While much further delay in effective action will soon undermine a realistic chance, it is not yet too late for the federal government to act so as to protect the fundamental right of our children and future generations to a viable climate system.

THE “COMMITMENTS” MADE AT COP-21

6. By the time COP-21 commenced on November 30, 2015, most nations – including all of the so-called “G20 nations”¹ responsible for nearly 80% of global emissions – had presented their “intended nationally determined contributions” (“pledges”) to the UNFCCC. The United States, for example, submitted its pledge on March 31, 2015.
7. Independent analysis of the major nations’ pledges heading into COP-21 established that, when taken together, there remained a large gap between the aggregate emissions that would be allowed (even assuming that pledges constituted binding commitments) and the level of action, in terms of actual emissions reductions, required to hold global warming below 2°C.² The United States’ pledge had been independently assessed as “not yet consistent with limiting warming to below 2°C *unless other countries make much deeper reductions and comparably greater effort than the USA.*”³
8. It was therefore unsurprising that, by its own terms, the Paris Agreement cited the Parties’ “serious concern” with “the significant gap between the aggregate effect of Parties’ mitigation pledges” and what is required to preserve the planet. *See* Exhibit 1 (excerpts from FCCC/CP/2015/L.9/Rev.1) at 2.⁴
9. In that regard, the Paris Agreement properly “[t]akes note of the synthesis report on the aggregate effect of intended nationally determined contributions.” *Id.* at 4. That synthesis report, in turn, states, among other things, that even if the nations’ announced targets were to be “exactly met” then “global emissions are *likely to increase until 2030.*” *See* Exhibit 2 (excerpts from FCCC/CP/2015/7) at 41, par. 193 (emphasis added).⁵

¹ The G20 is comprised of Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Mexico, Russia, Saudi Arabia, South Africa, South Korea, Turkey, the United Kingdom, and the United States.

² *See*, for example, Climate Action Tracker, Update: G20 – all INDCs in, but large Gap remains, Nov. 13, 2015, available at http://climateactiontracker.org/assets/publications/briefing_papers/G20_gap.pdf.

³ Climate Action Tracker, USA Assessment (emphasis added) (indicating that the US climate plan is “at the least ambitious end of what would be a fair contribution” and that “if all countries would choose the least ambitious end of their respective range, global temperature increase would be well above 2°C.”), updated Sept. 4, 2015, available at <http://climateactiontracker.org/countries/usa.html>.

⁴ UNFCCC, Adoption of the Paris Agreement, Dec. 12, 2015, the full document of which is available at <https://unfccc.int/resource/docs/2015/cop21/eng/109r01.pdf>.

⁵ UNFCCC, Synthesis report on the aggregate effect of the intended nationally determined contributions, Oct. 30, 2015, the full document of which is available at <http://unfccc.int/resource/docs/2015/cop21/eng/07.pdf>.

10. Based on my experience and applying my scientific judgment, and consistent with the judgment of numerous other climate scientists, it is clear that allowing global CO₂ emissions to *increase* for another 15 years would likely consign future generations to a far different, largely unrecognizable, planet, one marked in vast reaches by unbearable summer heat, ecological collapse, species extinction, widespread famine, coastal cities lost to rising seas, mass human migration, and riven national and international conflict. That list is but a start of what will occur. My initial Declaration in this matter outlined such an unappealing, but increasingly likely, scenario. In that light, then, the Parties to the Paris Agreement were understated in noting “*with concern* that the estimated aggregate greenhouse gas emission levels in 2025 and 2030 resulting from the intended nationally determined contributions do not fall within least-cost 2°C scenarios.” Exhibit 1 at 3, par. 17 (emphasis added).
11. Also as discussed in my initial Declaration, based on multiple lines of inquiry, including analysis of the paleoclimate record, my colleagues and I have concluded that dangerous disruption of the climate system to which humanity is adapted likely will commence shy of the politically-driven 2°C warming target.⁶
12. Moreover, the Parties to the Paris Agreement did not agree to any binding commitments, only announced intentions and precatory exhortations to do more. These intentions and exhortations do not amount to binding, enforceable, emissions reduction commitments. As a result, the Paris Agreement – even if it encourages additional nationally determined emissions reduction pledges – cannot provide genuine assurance that even the inadequate 2°C target will be attained and not blown.
13. Accordingly, the substantive utility of the Paris Agreement must reside in the unanimous acknowledgment by the Parties, including by the United States and other major emitters, that their emissions reduction programs and pledges to date fall short of what is minimally required to preserve the fundamental features of a viable planet. Similarly, analysis of the United States’ carbon reduction programs and pledges coincident with the Paris Agreement establish that our national effort and pledges to date are inadequate from any reasonable scientific perspective. Indeed, even assuming that the U.S. pledge is converted to a binding program, our country’s efforts will fall short of a fair contribution even to halting global warming at 2°C, a target that is itself so lacking in ambition that, even if secured, would be unlikely in the long run to stave off catastrophic change.⁷

⁶ See, for example, Doc. 7-4 at 20121, concluding that “the 2°C global warming “guardrail,” affirmed in the Copenhagen Accord (2009), does not provide safety, as such warming would likely yield sea level rise of several meters along with numerous other disruptive consequences for human society and ecosystems.”

⁷ To be specific, based on my review of the paleoclimate record, among other factors, I am forced to conclude that, if sea level rise adds to migration pressures from regional climate change, the world could become nearly ungovernable even with global warming

THE CLIMATE RESPONSIBILITY OF OUR NATION

14. In my initial Declaration in this matter, I attempted to discern comparative responsibility for our present predicament. Subsequent to the date of my initial Declaration, I realized that I had not fully accounted for our nation's signal contribution.
15. Specifically, in Doc. 7-1 at 9, I illustrated that, while China's 2013 CO₂ emissions comprise 27.5% of global annual CO₂ emissions, as compared to the 14.5% share contributed by the U.S. in the same year, on the basis of cumulative CO₂ emissions over the period 1751-2013 the U.S. contributed over a quarter of total CO₂ emissions, approximately 25.7%. That share far outstripped the 11.2% total cumulative CO₂ emissions from China, 7.3% from Russia, 5.9% from Germany, 5.2% from the UK, and 16.9% from the rest of Europe and Eurasia. The latter comparison is important, as I then noted, because, "in light of the long residence of CO₂ following its injection into the atmosphere, it is a nation's sum total of its emissions that is the more proper measure of its responsibility for already-realized and latent climate change." *Id.* at 9, par. 26.
16. I then proceeded to reexamine annual CO₂ emissions in comparison with national populations, which calculation established that the U.S. per capita annual CO₂ emission rate is triple the global mean and exceeds that of the other major industrialized nations. *Id.* at 11, Chart 6.
17. However, my initial Declaration did not illustrate or discuss what, on reflection, I think is properly the most relevant international comparison, again in the light of the long residence time of atmospheric CO₂, namely, per capita CO₂ emissions over the time of the modern era (again, 1751 to present). I remedy that elementary oversight with Chart 1, below.⁸

of "only" 2°C. On that point, for example, *see* my recent comprehensive assessment concluding that "[f]ossil fuel emissions of 1000 GtC, sometimes associated with a 2°C global warming target, would be expected to cause large climate change with disastrous consequences." Hansen, et al, Assessing "Dangerous Climate Change": Required Reduction of Carbon Emissions to Protect Young People, Future Generations and Nature. PLoS ONE (Dec. 3, 2013), Doc. 1-3 (Exhibit 2 to Declaration of Dr. James E. Hansen) at 13.

⁸ Available from www.columbia.edu/~mhs119/CO2Emissions/Emis_moreFigs/

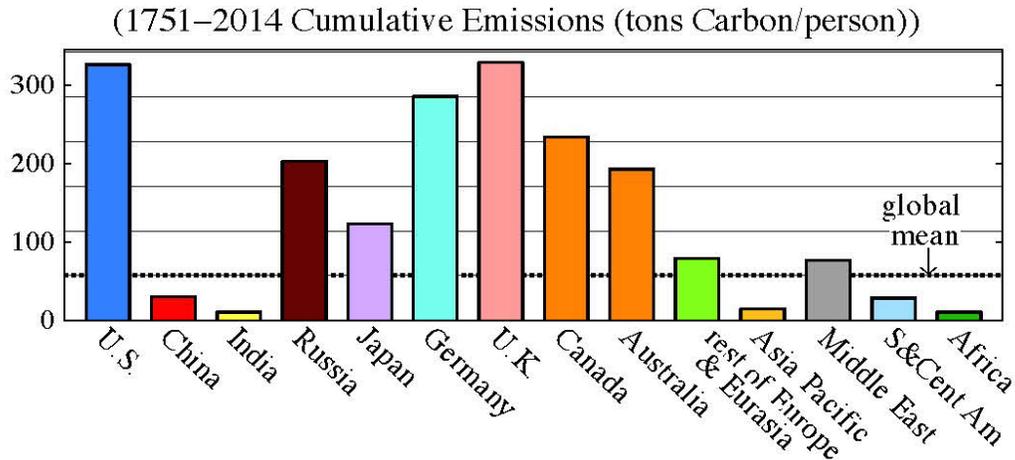


Chart 1: Per capita cumulative emissions in tons of carbon per person over 1751-2014, utilizing 2010 populations. *Source:* Climate Science, Awareness and Solutions, Earth Institute, Columbia University.

18. As can be seen, per capita historical cumulative CO₂ emissions from the U.S. eclipse those of China, even though China's annual aggregate CO₂ emissions, as discussed above, now substantially exceed those from the U.S. I am forced again to conclude, upon my review of the relevant materials, including those previously produced (*see* Doc. 7-1, Charts 4 and 6), that our nation bears disproportionate responsibility for the present crisis that now confronts our children and threatens their progeny.

DISPARATE IMPACTS

19. As I discussed in my initial Declaration, unabated climate change will impose multiple severe injuries on humanity and nature. These injuries include heating of land surfaces to levels exceeding the range to which humanity is adapted, and rising seas that will submerge low-lying coastal regions, including hundreds of major cities.
20. With respect to rising temperature, my colleague Makiko Sato and I have now determined that global warming of recent decades has been sufficient to shift the bell curve distribution of temperature anomalies (in units of standard deviation) above the climatological base period of 1951-1980 for the aggregate areas of the northern hemisphere as well as that of the southern hemisphere. This is true for most large sub-hemisphere geographical regions as well.
21. For instance, the summer bell curves for the United States and North and Central Europe are shifted more than one standard deviation (1σ).⁹ That shift is enough to increase the frequency of summers warmer than $+2\sigma$ from less than 1 percent to

⁹ The shift in the winter is only about half of a standard deviation.

greater than 10 percent. Even larger temperature distribution shifts are observed for the period 2005-2015 in China, India, the Mediterranean, the Middle East, the Sahara and Sahel, Southeast Asia, and the African rainforest. Within the continental United States, large summer warming has been experienced in much of the western region and, to a somewhat lesser but still significant extent, along the eastern seaboard. The large warming and dry conditions over the period exacerbated wildfire in the western United States, and I anticipate worse to come with continued global warming.

22. Other practical consequences include lost work capacity. Agricultural and construction workers in tropical developing countries may be most exposed to increasing heat stress and stroke, but workers in places such as Southeast and Southwest United States and Eastern China will also be affected by increasing temperature and, in places, increased absolute humidity.¹⁰
23. My initial Declaration also focused on the threat of multi-meter sea level rise in light of research undertaken with 16 colleagues¹¹ indicating that Earth's major ice sheets may be vulnerable to nonlinear disintegration, with doubling times of ice mass loss so far this century of approximately 10 years. That prospect, as I noted, "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 level rise; and that West Antarctic ice fronted by Amundsen Sea glaciers have the potential to raise sea level an additional 3-4m." Doc. 7-1 at 15, par. 42.
24. The rising seas will combine, in places, including especially in the North Atlantic region, with growing storminess to further threaten low-lying and other coastal regions. The phenomenon is a function not only of a warming atmosphere that renders additional water and energy available to any developing weather event, but also because melting ice sheets increase sea level pressure at middle (relative to polar) latitudes and thereby strengthen temperature gradients, supercharging storms with baroclinic sources. This growing climate chaos will increasingly lash regions within the storms' reach, including much of the North Atlantic seaboard. Persons within these regions who lack discretionary resources to flee and rebuild, or else to relocate, predictably will be among those most severely harmed.
25. Persons situated in low-lying regions therefore will predictably be disproportionately impacted by unarrested global warming. So too will future

¹⁰ Generally, as global warming increases, climatologically wet regions, such as the American Southeast, tend to get wetter, and dry regions, such as the American Southwest, tend to get hotter and drier.

¹¹ These include M. Sato, P.J. Hearty, R. Ruedy, M. Kelley, V. Masson-Delmotte, G. Russell, G. Tselioudis, J. Cao, E. Rignot, I. Velicogna, E. Kandiano, K. Von Schuckmann, P. Kharecha, A.N. Legrande, M. Bauer, and K.-W. Lo

generations be severely harmed. Our children and their progeny will be the ones to experience the full impact of slow feedbacks that, only now, are coming into play, including ice sheet disintegration, as well as changes in the global vegetation distribution, melting of permafrost, and possible release of methane from hydrates on continental shelves. Indeed, our country is on the verge of imposing an overwhelming burden – intergenerational injustice in the extreme – upon young people and future generations who stand to inherit a climate system that is not at all conducive to their well-being or survival, through no fault of their own.

26. To illustrate that risk, I showed in my initial declaration graphics of several major land regions – the U.S., Europe, Central Asia, and the Far East – with blue highlighting over current land surfaces that would be submerged with 25m of sea level rise (“SLR”). However, the large scale of those small graphics may not have sufficiently conveyed the impact of anticipated sea level rise in the event of continuing high CO₂ emissions. Accordingly, in **Exhibit 3**, attached hereto and incorporated herein by this reference, produced with the aid of a sophisticated publicly available tool developed by the independent group Climate Central, I have conservatively illustrated the impact on several US coastal cities and communities of moderate sea level rise, with attention to locations that may be of particular continuing concern to some Youth Plaintiffs and this Court in the instant matter.

THE EFFECTS OF SEA LEVEL RISE ON THE HOMES AND SCHOOLS OF THE YOUTH PLAINTIFFS

27. Graphic 1(a) and 1(b) depicts Manhattan and environs at 0.5m and 5m of SLR. In Graphic 1(a), much of the shoreline of Manhattan and environs remains intact. In Graphic 1(b) that is not the case, with the Hudson River overtopping its banks to 57th Street and the East River to 42nd Street. Much of Battery Park, Tribeca, Soho, East Village and the Bronx will be submerged. So too will much of Brooklyn and Jersey City be submerged.
28. One of the Youth Plaintiffs attends The Notre Dame School of Manhattan. That school will be submarine. Another Youth Plaintiff attends Columbia University. Columbia University’s old campus would become a tiny island if SLR rose beyond 20m and the expansion into Harlem would be submarine.
29. Graphics 2(a) and 2(b) illustrate the loss of Melbourne Beach, along the central east coast of Florida, as SLR climbs from 0.5m to 5m.
30. Graphics 3(a) and 3(b) show the inundation risk to Lafayette, LA and environs. At 5m SLR, Lafayette remains largely intact, though smaller seaward communities to its south, including Jeanerette, Lydia, Delcambre, Erath, Abbeville, Kaplan, and Gueydan and largely would be submerged. At 10m SLR, Lafayette also would be submerged.

31. Graphic 4(a) and 4(b) illustrate the impact of SLR on a portion of picturesque Nehalem State Park, namely its spit south of Manzanita on the northern coast of Oregon. At 0.5m, the beach is largely intact, while at 5m nearly all of it is lost to the sea.
32. Graphics 5(a) and 5(b) illustrate the impact of SLR on a reach of the north shore of Kauai. Most of State Highway 560 (Kuhio Highway) in the area would be submerged, as would be the town of Hanelei and Ke'e Beach at the western tip of Hā'ena State Park.
33. Graphics 6(a) and 6(b) illustrate the impact of SLR on the small central Oregon coast community of Yachats, Oregon. At 0.5m, the mouth of the Yachats River has expanded, but much of the town remains largely intact, while at 10m the sea has submerged much of Ocean View Dr. and neighborhood to the west and south of Highway 101. At 20m SLR, Yachats is fully submarine.

THE EFFECTS OF SEA LEVEL RISE ON THE JORDAN COVE LIQUIFIED NATURAL GAS TERMINAL

34. Graphics 7(a) and 7(b) illustrate the impact of SLR on the peninsula northwest of North Bend across the inlet of Coos Bay on the southern coast of Oregon. It is at that location that Jordan Cove Energy intends to construct its massive liquefied natural gas export facility that was recently authorized by the Department of Energy and that is, in part, at issue in this case. The spit to its south will be intermittently inundated at 5m SLR, potentially turning the company's anticipated clear and protected 7-mile shipping channel to the sea into a welter of shifting sand and sea. Moreover, while the presently proposed site for development of the Jordan Cove industrial facility may be accessed via the nearby Southwest Oregon Regional Airport, and Highway 101 via the Jordan Cove Road, these likely will be submerged at 5m SLR.

THE URGENT NEED FOR AN EFFECTIVE REMEDY FROM THIS COURT

35. A rapid transition off fossil fuels would have numerous near-term and long-term social benefits, including improved human health and outstanding potential for job creation. There are, accordingly, reasons beyond the mere avoidance of catastrophe for our federal government to institute the necessary changes, such as my colleagues and I have repeatedly urged.¹² But, based on recent history, mere exhortation to voluntary action, whether directed to nations, as discussed above, or to fossil fuel corporations, is unlikely to be effective in time to secure the fundamental interests of Plaintiffs here and those for whom they stand.

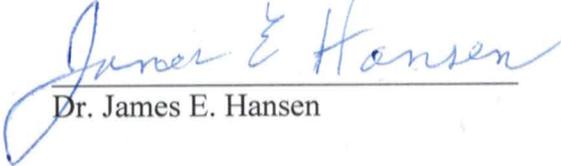
¹² See, for example, Doc. 7-3 (Assessing Dangerous Climate Change)

36. What can be stated with reasonable scientific certainty is that a rapid phase out of fossil fuel emissions by the federal government, accompanied by widespread improvements in land use aimed to naturally draw down a portion of the excess atmospheric carbon into the terrestrial system, is fully within our technological reach. In Doc. 7-3, my colleagues and I laid out scientifically defensible global temperature and atmospheric CO₂ concentration targets and suggested a glide path to achieve these targets.
37. Based on currently existing science, it is urgent that this Court order our federal government to develop and present to you a reasonable plan to extricate our nation and unburden our children from the ravages of climate chaos that its choices to date have done so much to ensure. Either that, or this Court should maintain the status quo by preventing the Federal Defendants from permitting, underwriting, and subsidizing new fossil fuel developments that, at this late stage, serve only to ruin these Plaintiffs' future and violate their fundamental rights.
38. Immediate, effective action to restore Earth's energy balance in time to avert wider disintegration of the major ice sheets would achieve multiple benefits, virtually at the same time. These benefits include slowing and eventually stopping sea level rise, averting further acidification of the oceans and consequential disruption of the marine food chain, slowing and in time stemming the loss of terrestrial species, preserving a viable agricultural system, stemming the growth in wildfires, securing essential water resources – the list goes on.¹³
39. What must be recognized is that atmospheric CO₂ functions now as the control knob for the planet's climate system. Within the remaining period prior to the full manifestation of slow feedbacks and the crossing of climate tipping points of no return, it remains within the power of the Federal Defendants to dial it back so as to secure a viable future for our children and their progeny. At this late stage an order from this Court is manifestly necessary to turn this thing around.
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¹³ Such action also should avert the feared shutdown of the Atlantic Meridional Overturning Circulation. *See* James Hansen and Makiko Sato, Predictions Implicit in "Ice Melt" Paper and Global Implications, Sept. 21, 2015, available at <http://csas.ei.columbia.edu/2015/09/21/predictions-implicit-in-ice-melt-paper-and-global-implications/>.

I declare under penalty of perjury under the laws of the State of Oregon that the foregoing is true and correct.

Executed this 5th day of January, 2016, in New York City, New York


Dr. James E. Hansen