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Why 350? Climate Policy Must Aim to Stabilize Greenhouse Gases at the Level Necessary to Minimize the Risk of Catastrophic Outcomes

Matt Vespa[*]

INTRODUCTION

After years of inaction, the possibility of substantive federal and international climate policy is finally in sight. With so much time already squandered, insufficient action today will foreclose the ability to prevent catastrophe tomorrow. If we are to avoid saddling future generations with extreme economic and environmental hardships, emerging climate policy must ensure a high probability of keeping future warming below dangerous levels.

Unfortunately, proposed federal climate legislation, which aims at limiting temperature rise to 2–3°C above pre-industrial levels by stabilizing greenhouse gases in the range of 450–550 parts per million (ppm) CO_2eq,[1] poses significant and unacceptable risks. The best available scientific evidence now indicates that a warming of 2°C is not "safe" and would not prevent dangerous interference with the climate system. In addition, due to a number of climactic processes that are not fully understood, equating a particular atmospheric concentration of greenhouse gases with a specific temperature increase involves a significant degree of uncertainty. As the consequences of overshooting a 2°C threshold could include the displacement of millions due to sea level rise, irreversible loss of entire ecosystems, and the triggering of

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1. CO_2eq is a unit of measurement used to compare the climate effect of all greenhouse gases to each other. Currently, the effects of aerosol and land-use changes reduce radiative forcing so that the net positive forcing from all greenhouse gases is roughly equivalent to that of CO_2 alone. *See* H. H. Rogner et al., *Introduction*, *in* B. METZ ET AL., CLIMATE CHANGE 2007: MITIGATION. CONTRIBUTION OF WORKING GROUP III TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 102 (2007). However, assuming air quality improves as projected, the net negative forcing from aerosols will no longer offset the positive forcing of non-CO_2 greenhouse gases. *See* Malte Meinshausen, *What Does a 2°C Target Mean for Greenhouse Gas Concentrations? A Brief Analysis Based on Multi-Gas Emission Pathways and Several Climate Sensitivity Uncertainty Estimates*, *in* AVOIDING DANGEROUS CLIMATE CHANGE 268 (2006).

multiple climactic "tipping points," the risk tolerance for overshooting a 2°C temperature rise should be extremely low. Nonetheless, the risk of overshooting a 2°C threshold is 50–82 percent at stabilization levels of 450–550 ppm CO_2eq.[2] Thus, even the most aggressive federal climate change proposals seem, at best, content to flip a coin in the hopes that future generations are not left with few choices beyond mere survival. This is not risk management, it is recklessness and we must do better.

In order to avoid dangerous anthropogenic interference (DAI) with the climate system, sound climate policy must minimize the risk of severe and irreversible outcomes. A policy objective of stabilizing greenhouse gas emissions at 350 ppm CO_2eq, would reduce the mean probability of overshooting a 2°C temperature rise to 7 percent.[3] A 350 ppm CO_2eq stabilization level is also consistent with that proposed by leading climatologists, who have concluded that in order "to preserve a planet for future generations similar to that in which civilization developed and to which life on Earth is adapted... CO_2 will need to be reduced from its current 385 ppm to at most 350 ppm."[4] While current CO_2 levels exceed 350 ppm, a pathway toward 350 ppm is possible though the rapid phase-out of coal emissions, improved agricultural and forestry practices, and possible future capture of CO_2 from biomass power plants.[5]

I. BACKGROUND: WHAT IS "DANGEROUS" CLIMATE CHANGE

Article 2 of the United Nations Framework Convention on Climate Change (UNFCCC) calls for "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system."[6] Article 2 further provides that "[s]uch a [concentration stabilization] level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to

2. Meinshausen, *supra* note 1, at 270.

3. *Id.*

4. James Hansen et al., *Target Atmospheric CO_2: Where Should Humanity Aim?* 2 OPEN ATMOSPHERIC SCI. J. 217, 226 (2008). Because climate forcing from anthropogenic non-CO_2 greenhouse emissions is approximately offset by cooling affect of anthropogenic aerosol emissions, future CO_2 change should be considered as approximating the net human-made forcing change, with several caveats. *See id.* Operating under a different set of assumptions that appears to discount the negative forcing of aerosols over time,, Meinshausen states that 550 CO_2eq roughly corresponds to 475 ppm CO_2. Meinshausen, *supra* note 1, at 269. Under Meinshausen's analysis, 500 CO_2eq is approximately equivalent to 450 ppm CO_2 stabilization, 450 CO_2eq is approximately equivalent to 400 ppm CO_2 stabilization, and 400 CO_2eq is approximately equivalent to 350–375 ppm CO_2 stabilization. *Id.* at 305. Meinshausen does not state the CO_2 level equivalent to a 350 ppm CO_2eq stabilization level, but based on the ratio used for other CO_2eq levels, a 350 ppm CO_2eq would equate to somewhat less than 350 ppm CO_2. *Id.*

5. *See* Hansen et al., *supra* note 4, at 226–27.

6. United Nations Framework Convention on Climate Change, art. 2, May 9, 1992, *available at* http://unfccc.int/essential_background/convention/background/items/1349.php.

proceed in a sustainable manner."[7] With the United States and over 180 other countries as signatories, the UNFCCC's objective of avoiding DAI with the climate is widely viewed as the international standard for protecting the global climate.

Determining the greenhouse gas stabilization level needed to avoid DAI requires consideration of both the mean global temperature increase at which resulting harm is judged to be "dangerous," as well as the degree of uncertainty that a "dangerous" temperature threshold will be exceeded at a particular greenhouse gas stabilization level. While scientific analysis can provide data on the potential impacts and risks associated with particular levels of greenhouse gases and increases in global mean temperature, defining what "dangerous" means is ultimately a political question. Policy makers must weigh the relative importance of various impacts and risks to define what constitutes "unacceptable risk."[8]

II. CURRENTLY PROPOSED CLIMATE POLICIES AND TARGETS DO NOT AVOID DAI

In the last 100 years, the Earth has warmed by over 0.7°C.[9] Unabated, current trends suggest that increasing emissions will continue to raise the Earth's temperature by 4–6°C (7.2–10.8°F), if not more, by the end of the century.[10] Currently proposed federal climate policies aim to curtail this increase but still fall far short of preventing DAI. Neither the United States nor the international community as a whole has defined the point at which temperature rise can be said to be "dangerous." However, proposed federal legislation aims at limiting temperature rise to 2–3°C above pre-industrial levels by stabilizing greenhouse gases in the range of 450–550 ppm CO_2eq,[11] which roughly comports with the European Union's (EU) climate change objective to "[limit] global warming to less than 2°C above the pre-industrial temperature as there is strong scientific evidence that climate change will become dangerous beyond this point."[12] While the 2°C target set by the EU

7. *Id.*

8. Steven H. Schneider & Janica Lane, *An Overview of "Dangerous" Climate Change*, *in* AVOIDING DANGEROUS CLIMATE CHANGE 14 (2006).

9. W. L. Hare, *A Safe Landing for the Climate*, *in* WORLD WATCH INSTITUTE, 2009 STATE OF THE WORLD: INTO A WARMING WORLD 13 (2009).

10. *Id.* Despite existing efforts to curb emissions by a number of Kyoto Protocol signatory countries, anthropogenic CO_2 emissions have been growing about four times faster since 2000 than during the previous decade and at rate above even the IPCC's most fossil fuel intensive scenario. GLOBAL CARBON PROJECT, GROWTH IN THE GLOBAL CARBON BUDGET (2008), *available at* http://www.globalcarbonproject.org/carbontrends/index.htm.

11. UNION OF CONCERNED SCIENTISTS, HOW TO AVOID DANGEROUS CLIMATE CHANGE: A TARGET FOR U.S. EMISSIONS 3 (2007).

12. *See* Press Release, Europa, Climate change: Commission sets out proposals for global pact on climate change at Copenhagen (Jan. 28, 2009), *available at* http://europa.eu/rapid/pressReleasesAction.do?reference=IP/09/141.

may have seemed acceptable when first proposed in 1996,[13] research now indicates that much smaller increases in global mean temperature will result in substantial environmental and socio-economic consequences.[14] As the best available scientific information indicates that a 2°C mean global temperature rise from pre-industrial levels is far in excess of what can reasonably be considered "dangerous," a 2°C temperature rise is not an acceptable target from which to base climate policy.

Projected risks and damages from global warming are more serious than believed even a few years ago. In 2001, the Intergovernmental Panel on Climate Change (IPCC) used five Reasons For Concern (RFCs) in its Third Assessment Report (TAR) to illustrate the temperature range at which impacts may be considered dangerous.[15] Relationships between the impacts reflected in each RFC and increases in global mean temperature were portrayed in a "burning embers" diagram, which reflected the severity of risk from rising temperature through gradations in color from white (no or little risk) to yellow (moderately significant risk) to red (substantial or severe risk).[16] Depending on the RFC, the IPCC predicted that substantial impacts or risks (transition from yellow to red) would occur with a temperature rise 1–4°C above current levels.[17]

Since the release of the TAR, scientific understanding of the vulnerability of the climate to temperature rise has evolved considerably.[18] Based on new findings in the growing scientific literature since the TAR was released, the burning embers diagram was revised in 2008 to reflect the dangerous risks posed by smaller increases in temperature than identified in the original TAR.[19] In the updated burning embers diagram, the IPCC now predicts that substantial impacts or risks occur at or near current temperature levels for a number of

13. *See* Meinshausen, supra note 1, at 266. The EU has reiterated its 2°C objective as recently as January 2009 despite increasing scientific evidence that climate impacts would reach catastrophic proportions with a 2°C global mean temperature rise. *Id.*

14. *See, e.g.*, Joel B. Smith et al., *Assessing Dangerous Climate Change Though an Update of the Intergovernmental Panel on Climate Change (IPCC) "Reasons for Concern,"* PROC. OF THE NAT'L ACAD. SCI., Feb. 26, 2009, at 1, *available at* http://www.pnas.org/content/early/2009/02/25/0812355106.abstract.

15. IPCC, CLIMATE CHANGE 2001: SYNTHESIS REPORT, SUMMARY FOR POLICYMAKERS 11 (2001). The five RFCs identified in the TAR are: 1) Risks to Unique and Threatened Systems; 2) Risks of Extreme Weather Events; 3) Distribution of Impacts; 4) Aggregate Impacts; and 5) Risks of Large Scale Discontinuities. *Id.*

16. *Id. See also* Smith, *supra* note 14, at 1, 5.

17. IPCC, *supra* note 15, at 11. The RFC's assessed impacts from a baseline of 1990 temperature levels rather than pre-industrial levels. Because pre-industrial warming until 1990 was 0.6°C, an impact resulting from a temperature rise of 1°C equates to a 1.6°C rise from pre-industrial levels. *Id.*

18. *See* Smith, *supra* note 14, at 1, 5.

19. *See id.* An updated burning embers diagram was omitted from the 2007 Fourth Assessment Report due to opposition from the United States, China, Russia, and Saudi Arabia. Because the Assessment Report is a consensus document, these countries were able to prevent the inclusion of an updated diagram despite the insistence by New Zealand, small islands states, Canada, Germany, and the United Kingdom that inclusion of an updated burning embers was essential. *See* Andrew C. Revkin, *Why 2007 I.P.C.C. Report Lacked 'Embers'*, N.Y. TIMES, Feb. 26, 2009, http://dotearth.blogs.nytimes.com/2009/02/26/why-2007-ipcc-report-lacked-embers.

RFCs.[20] As reflected in the updated RFCs, a 2°C temperature increase from pre-industrial levels (or 1.4°C increase from 1990 levels) is well past the point where severe and irreversible impacts will occur.[21]

It is now estimated that a mean global temperature increase of 1.5°C above pre-industrial levels has the potential to trigger irreversible melting of the Greenland ice sheet, a process that would result in an eventual seven meter sea level rise over and above that caused by thermal expansion of the oceans, and potentially causing an additional sea level rise of 0.75 meters, as soon as 2100.[22] Specific consequences of a 2°C temperature rise from pre-industrial levels include the loss of 97 percent of the world's coral reefs and the transformation of 16 percent of global ecosystems. Indeed, given increased confidence that a 1–2°C increase poses significant risks to many unique and threatened systems, including many biodiversity hotspots, the updated burning embers diagram indicates substantial impacts and/or moderate risks from warming that has already occurred.[23] At a 2°C temperature rise, approximately one to three billion people would experience an increase in water stress, sea level rise and cyclones would displace millions from the world's coastlines, and agricultural yields would fall in the developed world.[24] In the Arctic, ecosystem disruption is predicted upon expectations of a complete loss of summer sea ice, with only 42 percent of the tundra remaining stable. This would destroy the Inuit hunting culture, cause the extinction of the polar bear, and result in large losses in global bird populations. Moreover, because Arctic ice functions to reflect heat back into the atmosphere, its loss would allow more sunlight to heat the Arctic Ocean and further accelerate the melting of the Greenland ice sheet. As the devastating and irreversible impacts resulting from a 2°C mean global temperature rise greatly exceed any reasonable definition of DAI, the 2°C target originally proposed in 1996 and reaffirmed by later EU policies is not an adequate objective for climate policy if DAI is to be avoided.

Not only are the climate impacts expected from a 2°C temperature increase far in excess of what should be considered "safe," but policies which propose greenhouse gas stabilization levels of 450–550 ppm CO_2eq present substantial risks of overshooting this target, thus exacerbating the problem. Equating a particular atmospheric concentration of greenhouse gases with a specific temperature increase involves a significant degree of uncertainty. Climate sensitivity—the extent to which temperatures will rise as a result of increasing concentrations of heat-trapping gases—depends on Earth's response

20. *See id.*

21. Smith, *supra* note 14, at 3.

22. Rachel Warren, *Impacts of Global Climate Change at Different Annual Mean Global Temperature Increases* in AVOIDING DANGEROUS CLIMATE CHANGE 95 (2006). Unlike the IPCC's RFC, Warren assessed impacts from temperature rise from pre-industrial levels, not 1990 levels.

23. Smith, *supra* note 14, at 3.

24. *See* Warren, *supra* note 22, at 98.

to certain physical processes that are not fully understood.[25] Thus, due to uncertainty in climate sensitivity, scientists estimate that the mean probability of exceeding 2°C where greenhouse gases are stabilized at a CO_2eq level of 550 ppm is 82 percent.[26] The mean probability of exceeding 2°C where greenhouse gases are stabilized at a CO_2eq level of 450 ppm is 54 percent with a 30 percent probability that global average temperature would rise more than 3°C.[27] At 400 ppm CO_2eq, the mean probability of exceeding 2°C is 28 percent.[28] If greenhouse gas emissions were stabilized at 350 ppm CO_2eq, the mean probability of exceeding 2°C would be reduced to 7 percent.[29]

Properly accounting for climate sensitivity in climate policy is critical because, as dire as the projected impacts resulting from a 2°C mean temperature increase, increases above 2°C would result in apocalyptic impacts. If a 2–3°C increase in mean global temperature occurred, feedbacks in the climate system would cause a shift in the terrestrial carbon cycle. Currently, land-based carbon acts as a sink for CO_2, buffering the effects of anthropogenic climate change. If CO_2 concentrations continue to rise, this sink will release stored CO_2 through increased soil respiration, further exacerbating climate change. The most dramatic impacts will be a widespread loss of forests and grassland, including the Amazon rainforest. The transition of these areas to savannah would trigger wide spread implications for local population, global biodiversity, and the global carbon cycle.[30] At a global increase in temperature of 3°C above pre–industrial levels, many additional impacts in human and natural systems would occur in ways exponentially more devastating that those predicted for a 2°C temperature increase. Few ecosystems can adapt to such a large temperature rise: 22 percent would be transformed, losing 7 percent to 74 percent of their extent.[31] An additional 25 to 40 million people would be displaced from coasts due to sea level rise, an additional 1200 to 3000 million would suffer an increase in water stress, and 65 countries would lose 16 percent of their agricultural gross domestic product.[32]

As much as the threats posed by global warming are unfathomable, equally unfathomable is the degree of risk that current climate policy appears willing to accept. None of the proposed federal climate change legislation

25. *See, e.g.*, CALIFORNIA CLIMATE CHANGE CENTER, OUR CHANGING CLIMATE: ASSESSING THE RISKS TO CALIFORNIA 4 (2006), *available at* http://meteora.ucsd.edu/cap/pdffiles/CA_climate_Scenarios.pdf.

26. Meinshausen, *supra* note 1, at 268–69. Meinshausen operates under assumptions that do not roughly equate CO_2 eq with CO2 concentrations. 550 CO_2eq roughly corresponds to a stabilization of 475 ppm CO_2 only. *Id.* at 269. Meinshausen notes that 500 CO_2eq is approximately equivalent to 450 ppm CO_2 stabilization, 450 CO_2eq is approximately equivalent to 400 ppm CO_2 stabilization, and 400 CO_2eq is approximately equivalent to 350–375 ppm CO_2 stabilization. *Id*.

27. *Id. See also* UNION OF CONCERNED SCIENTISTS, *supra* note 11, at 3.

28. Meinshausen, *supra* note 1, at 270.

29. *Id*.

30. *See* Warren, *supra* note 22, at 98–99.

31. *Id.* at 99.

32. *Id.* at 96–97.

comes close to meeting the lower end of a U.S. emissions budget consistent with a 450 ppm CO_2eq stabilization objective.[33] For example, the Lieberman-Warner proposal is consistent with a 500 ppm CO_2eq stabilization target, which has a 70 percent chance of resulting in temperature increases above 2°C and a 50 percent chance of a greater than 3°C increase.[34] The United States gambles with proposed policies that only have at a 30 percent chance of meeting a target that itself is too high to avoid severe and irreversible impacts. Even California's more aggressive emission reduction targets, which call for emissions reductions to 1990 levels by 2020 and then to 80 percent below 1990 levels by 2050, is still only consistent with a stabilization scenario in the 450 ppm range,[35] This target, however, provides only a fifty-fifty chance of averting the severe and irreversible outcomes that would occur with a 2°C temperature rise from pre-industrial levels. While a significant improvement from business-as-usual, proposed climate policies are insufficient to minimize the risk of catastrophic outcomes.

III. CLIMATE POLICY MUST AIM TO STABILIZE CO_2 AT NO MORE THAN 350 PPM

The assessment of what constitutes DAI with the climate requires: (1) a consideration of climate sensitivity and its uncertainty; (2) the range of possible temperature changes above which unacceptably large negative impacts occur; and, (3) determination of a morally acceptable tolerance for risk.[36] As set forth above, stabilization objectives in the 450–550 ppm CO_2eq far exceed levels that can be considered safe. Indeed, based on observed impacts and expected future impacts likely to occur from existing emissions, current climate conditions

33. UNION OF CONCERNED SCIENTISTS, *supra* note 11, at 16.

34. *Id.* The American Clean Energy and Security Act of 2009 (ACESA), recently introduced by Congressmen Henry Waxman and Ed Markey, aims to reduce emissions from capped sectors by 83 percent below 2005 levels by 2050. *See* U.S. HOUSE OF REPRESENTATIVES, DISCUSSION DRAFT, THE AMERICAN CLEAN ENERGY AND SECURITY ACT OF 2009 3 (2009), *available* at http://energycommerce.house.gov/Press_111/20090331/acesa_summary.pdf. It was not evaluated in the Union of Concerned Scientists report. *See* UNION OF CONCERNED SCIENTISTS, *supra* note 11, at 16. While an improvement over Lieberman-Warner, which aimed to reduce emissions from capped sectors to 71 percent below 2005 levels by 2050, the ACESA would likely still be far from the lower end of a U.S. emissions budget consistent with a 450 ppm CO2eq stabilization objective. *See id.* (finding that the most aggressive climate proposal, H.R. 1590 (Waxman), which aims to reduce emissions to 80 percent of 1990 levels by 2050, was still at the upper end of an emission budget aimed at stabilizing greenhouse gases at 450 ppm); The Lieberman-Warner Climate Security Act (S. 2191) (2008), *available at* http://lieberman.senate.gov/documents/lwcsaonepage.pdf.

35. Cal. Exec. Order S-3-05 (June 1, 2005). An emissions pathway whereby developed countries would reduce emissions to 80 percent below 1990 levels as envisioned under California Executive Order S-3-05 would cap atmospheric concentrations of CO_2 at approximately 450 ppm. *See, e.g.*, U.N. DEV. PROGRAM, HUMAN DEVELOPMENT REPORT 2007/2008: FIGHTING CLIMATE CHANGE: HUMAN SOLIDARITY IN A DIVIDED WORLD 46–50 (2007), *available at* http://hdr.undp.org/en/reports/global/hdr2007-2008/chapters/.

36. *See* L.D. Danny Harvey, *Dangerous Anthropogenic Interference, Dangerous Climate Change, and Harmful Climatic Change: Non-Trivial Distinctions with Signifcant Policy Implications*, 82 CLIMATIC CHANGE 1, 14 (2007).

already constitute DAI. In order to avoid continued DAI, CO_2 concentrations must be reduced to a level no greater than 350 ppm.

Current conditions already constitute DAI and are in violation of the UNFCCC. As an initial matter, the rapid and significant impacts observed to date are already serious enough to be deemed "dangerous." Atmospheric concentrations of CO_2 have risen from a pre-industrial concentration of 280 ppm to 383 ppm in 2007.[37] Annual mean global temperature has increased by 0.76°C relative to pre-industrial times and is increasing at a rate of 0.17°C per decade.[38] Impacts from this anthropogenic interference with the climate has already resulted in tens of thousands of climate-related deaths, species extinction, ocean acidification and loss of coral reefs, and the significant retreat of glaciers and sea ice.[39] The effects of this relatively small climate change are already being observed around the world: sea level is increasing at the rate of 1.8 millimeters per year, oceans have already acidified by 0.1 pH units (equating to a 30 percent increase in acidity), glaciers are retreating worldwide, and local temperature has increased in the Arctic by 1.8°C, which has accelerated the loss of sea ice and permafrost.[40] Across the globe, species are changing their lifecycles and distribution in a direction consistent with their expected response to climate change.[41] Unprecedented heat waves in large cities, intensifying drought in many regions, and substantial and increasing damage due to extreme weather events are also attributed, in part, to climate change.[42]

In addition to the impacts already observed, additional warming already "in the pipeline"—due to inertia in the climate system and identified feedback loops—will result in further increases in temperature that pose significant risks of severe and irreversible impacts.[43] We are already locked into anywhere from 0.3°C to 0.7°C additional warming relative to late 20th century levels due to the eventual impacts of past historical emissions.[44] On account of additional warming to which cannot be avoided, Ramanathan and Feng noted there is a "high probability that the DAI threshold is already in our rearview mirror."[45] Similarly, on the basis of paleoclimate evidence and ongoing climate change, James Hansen and other leading climate scientists concluded the present CO_2

37. Global Carbon Project, *supra* note 9.

38. Kevin E. Trenberth et al., *2007: Observations: Surface and Atmospheric Climate Change, in* SUSAN SOLOMON ET AL., CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS, CONTRIBUTION OF WORKING GROUP I TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 253 (2007).

39. Warren, *supra* note 22, at 94–97.

40. *Id.* note 22.

41. *Id.* at 95, 97.

42. *See id.*

43. *See* V. Ramanathan & Y. Feng, *On Avoiding Dangerous Anthropogenic Interference With the Climate System: Formidable Challenges Ahead*, 105 PROC. OF THE NAT'L ACAD. SCI. 14245,14249 (2008); Hansen et al., *supra* note 4, at 226.

44. Michael E. Mann, *Defining Dangerous Anthropogenic Interference*, 106 PROC. OF THE NAT'L ACAD. SCI. 4065, 4066 (2009).

45. V. Ramanathan & Y. Feng, *supra* note 43, at 14245, 14249.

levels of 385 ppm are "already in the dangerous zone" and that "[i]f humanity wishes to preserve a planet similar to that on which civilization developed and to which life on Earth is adapted, paleoclimate evidence and ongoing climate change suggest that CO_2 will need to be reduced from its current 385 ppm to at most 350 ppm, but likely less than that." [46]

In looking at dangerous climate change though the lens of risk tolerance, Harvey concluded that, at a 10 percent risk tolerance, atmospheric CO_2 concentrations close to present levels "violates the UNFCCC" for a range of assumptions of climate sensitivity.[47] Similarly, in Meinchausen's analysis, only CO_2eq concentration of 350 ppm is less than 10 percent likely to result in a temperature increase in excess of 2°C.[48] Given the extreme consequences for future generations if a 2°C threshold is exceeded, higher levels of risk tolerance are unacceptable.

In order to achieve a 350 CO_2 ppm atmosphere, atmospheric CO_2 concentrations must be reduced quickly: "[i]ndeed, if the world continues on a business-as-usual path for even another decade without initiating phase-out of unconstrained coal use, prospects for avoiding a dangerously large, extended overshoot of the 350 ppm level will be dim."[49] While stabilization at 350 ppm CO_2 requires a drawdown from existing CO_2 levels, a pathway to 350 ppm is possible. According to Hansen and his colleagues, "[a]n initial 350 ppm CO_2 target may be achievable by phasing out coal use except where CO_2 is captured and adopting agricultural and forestry practices that sequester carbon.... With simultaneous policies to reduce non-CO_2 greenhouse gases, it appears still feasible to avert catastrophic change."[50]

While stabilization at 350 ppm present significant challenges, the "[r]ealization that we must reduce the current CO_2 amount has a bright side: effects that had begun to seem inevitable, including impacts of ocean acidification, loss of fresh water supplies, and shifting of climatic zones, may be averted by the necessity of finding an energy course beyond fossil fuels sooner than would otherwise have occurred."[51]

CONCLUSION

The decisions we make today on the national and international level will determine the health and livability of the planet for generations to come. It is critical that policymakers recognize the great danger to humankind from policies that fail to set temperature thresholds at levels necessary to avoid severe and irreversible outcomes and that accept significant risks that a targeted greenhouse gas stabilization level will result in temperature rises greater than

46. Hansen et al., *supra* note 4, at 217–18.

47. Harvey, *supra* note 36, at 20.

48. Meinshausen, *supra* note 1, at 268. Under the assumptions used in this study, 350 ppm CO_2eq is equivalent to CO_2 concentration of slightly less than 350 ppm. *Id.*

49. Hansen et al., *supra* note 4, at 227.

50. *Id.* at 217, 229.

51. *Id.* at 228.

expected. In order to ensure that future generations are left with a functioning planet, climate policies must be established to immediately execute an emission reduction pathway consistent with stabilization at CO_2 levels of no greater than 350 ppm.