

# HEALTH REGULATION AND GOVERNANCE

## Climate Change, Human Health, and the Post-Cautionary Principle

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*In this Essay, I suggest two different but related ways of reframing the public discourse on climate change. First, I propose that we move further in the direction of characterizing climate change as a public health threat and not only as an environmental threat. Second, I argue that we should stop thinking of responses to climate change in terms of the precautionary principle, which counsels action even in the absence of scientific consensus about a threat. We should speak instead in terms of a “post-cautionary” principle for a post-cautionary world, in which some very bad effects of climate change are unavoidable and others are avoidable only if we take dramatic steps, and soon. These points are related insofar as they together create a moral imperative both to adapt to the changes we cannot prevent and to mitigate those we can. Without these efforts, people will fall ill and many will die, and we know now that this will occur. No fancy moral theory is required to condemn, and to make every attempt to avert, this large-scale knowing killing.*

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## INTRODUCTION

In the summer of 2003, at least 20,000 people died in a heat wave that spanned Western Europe.<sup>1</sup> France lost the most: 14,802 lives, according to a government report produced in the aftermath of the tragedy.<sup>2</sup> Thousands of people also died in Great Britain, Spain, Portugal, Germany, Italy, Belgium, and the Netherlands.<sup>3</sup> The death toll mounted so stealthily, however, that news accounts written fully two weeks into the four-week heat wave focused more on the inconveniences and even economic advantages of the record-setting temperatures than on their lethal consequences.<sup>4</sup> Eventually the disaster was undeniable: heat-related deaths so overwhelmed French mortuaries, for example, that bodies were stored in refrigerated trucks and warehouses while awaiting burial or cremation.<sup>5</sup>

A study published in the prestigious scientific journal *Nature* in 2004 deemed it “likely” that human-induced increases in atmospheric concentrations of greenhouse gases had “more than doubled the risk of European mean summer temperatures as hot as 2003.”<sup>6</sup> The same study found, based on scenarios assuming unmitigated future greenhouse gas emissions, that every other year would be as warm as 2003 in Europe by the 2040s, and that by 2100, a summer like 2003 “would be classed as an anomalously cold summer relative to the new climate.”<sup>7</sup>

The European heat wave is a dramatic illustration of the two central factual premises of this Essay: climate change harms human health, and we know that climate change is happening. These facts justify reframing the public debate on climate change in two ways. First, we should do more to highlight the conse-

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1. See, e.g., Elisabetta Povoledo, *Heat in Europe May Have Killed 20,000*, INT’L HERALD TRIB. (Paris), Aug. 29, 2003, at 1, available at [http://www.iht.com/articles/2003/08/29/heat\\_0.php](http://www.iht.com/articles/2003/08/29/heat_0.php). Some accounts place the death toll as high as 35,000. See Janet Larsen, *Record Heat Wave in Europe Takes 35,000 Lives*, EARTH POL’Y INST., Oct. 9, 2003, <http://www.earth-policy.org/Updates/Update29.htm>.

2. *France Heat Wave Death Toll Set at 14,802*, USATODAY.COM, Sept. 25, 2003, [http://www.usatoday.com/weather/news/2003-09-25-france-heat\\_x.htm](http://www.usatoday.com/weather/news/2003-09-25-france-heat_x.htm) (last visited Oct. 16, 2007).

3. See J. P. Sardon, Letter to the Editor, *The 2003 Heat Wave*, EUROSURVEILLANCE, Mar. 2007, <http://www.eurosurveillance.org/em/v12n03/1203-226.asp> (last visited Oct. 16, 2007).

4. See, e.g., Angelique Chrisafis, *The Height of Summer: Heatwave Edges Close to Record*, THE GUARDIAN (London), Aug. 5, 2003, at 3 (reporting that the heatwave boosted domestic tourism and ice cream sales); Martin Wainwright, *Heatwave: Sun Shines on Retailers as Weather Experts Get It Right*, THE GUARDIAN (London), Aug. 8, 2003, at 7 (attributing “sale increases of 365% for home barbecues, 250% for suntan cream, 80% and growing for beer, and 62% for paddling pools” to the heatwave).

5. See Philip Delves Broughton, *Hundreds of Heatwave Bodies Unclaimed as Paris Struggles To Clear Backlog*, THE DAILY TELEGRAPH (London), Aug. 24, 2003, at 11; see also ‘Over 11,000’ Dead in French Heat, BBC NEWS, Aug. 29, 2003, <http://news.bbc.co.uk/1/hi/world/europe/3190585.stm> (last visited Oct. 16, 2007).

6. Peter A. Stott et al., *Human Contribution to the European Heatwave of 2003*, 432 NATURE 610, 613 (2004).

7. *Id.* at 612–13. For a more recent account, see Catherine Brahic, *Med To Get Five Times as Many Dangerously Hot Days*, NEWSIDENT.COM, June 18, 2007, available at <http://environment.newscientist.com/article/dn12086-med-to-get-five-times-as-many-dangerously-hot-days.html> (“[R]esearchers say governments should brace themselves for summer heatwaves like the one that struck Europe in 2005 to become commonplace, even if they adopt climate-friendly practices.”).

quences of climate change for human health. Second, we should recognize that the precautionary moment for action on climate change—the period in which we might have acted based on something less than a scientific consensus on the causes and consequences of climate change—has passed. We are in a post-cautionary world now. Together, the effects of climate change on human health and the undeniable fact that climate change is upon us have several implications for public policy. Perhaps most important, they create a moral imperative for action—dramatic action, now—on this problem.

## I. CLIMATE CHANGE AND HUMAN HEALTH

There has long been discussion of the implications of climate change for human health,<sup>8</sup> and the link between climate change and human health has been drawn ever more clearly in recent years.<sup>9</sup> But it is also true that widely circulated images of current harms from climate change—melting glaciers, collapsing ice shelves, drowning polar bears—do not have a human face. And it takes some reflection to see the connection between human health and, say, higher water temperatures—reflection that is not always encouraged in our busy world. Thus, although my suggestion that we frame the debate over responses to climate change in terms of effects on human health is by no means original, it is worthwhile to draw, directly and emphatically, the link between climate change and human health, and to think about the consequences of this linkage for policies addressing climate change.

### A. HEALTH CONSEQUENCES OF CLIMATE CHANGE

“The weakest are dropping like flies.”<sup>10</sup>

More frequent and intense heat waves are only one item on the long list of the consequences of climate change that will harm human health. According to the latest scientific research, we can expect the following in our warming world: disease-carrying insects will alter their ranges, appearing in places they have not been before and where humans have not developed immunities, causing more widespread incidence of vector-borne diseases such as malaria and dengue;<sup>11</sup> after a slight uptick, crop productivity will decline, causing a concomitant

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8. See, e.g., REID A. BRYSON & THOMAS J. MURRAY, *CLIMATES OF HUNGER: MANKIND AND THE WORLD'S CHANGING WEATHER* (1977).

9. See, e.g., WORLD HEALTH ORG. [WHO], *CLIMATE CHANGE AND HUMAN HEALTH: RISKS AND RESPONSES 20* (2003) (linking ozone depletion to higher rates of skin cancer).

10. Alex Duvall Smith, *France Accused of Complacency as 50 Die in Heatwave*, THE INDEPENDENT (London), Aug. 12, 2003, at 9 (quoting Patrick Pelloux, president of an association of French accident and emergency doctors).

11. See INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *CLIMATE CHANGE 2007: IMPACTS, ADAPTATION, AND VULNERABILITY: WORKING GROUP II CONTRIBUTION TO THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 408* (2007), available at <http://www.ipcc-wg2.org/> (follow “The Full Working Group II Contribution . . . Available Here” hyperlink) [hereinafter IPCC].

increase in the risk of malnutrition;<sup>12</sup> fish stocks will deteriorate, to the same effect;<sup>13</sup> ground-level ozone will worsen, causing adverse pulmonary and cardiovascular events;<sup>14</sup> water supplies will decrease due to reduced snowpack and increased drought;<sup>15</sup> storms will become more frequent and severe,<sup>16</sup> threatening Katrina-like consequences for human health and welfare; flooding will grow more frequent and severe due to storms and sea level rise;<sup>17</sup> diarrhoeal disease will increase due to floods and drought;<sup>18</sup> cholera will become more frequent and toxic due to higher water temperatures;<sup>19</sup> sanitation facilities will fail more often due to more frequent extreme weather events, leading to increased spread of infectious diseases;<sup>20</sup> ozone depletion will worsen with a changing climate,<sup>21</sup> leading to increased incidence of skin cancer, cataracts, and immune deficiency;<sup>22</sup> increased pollen production will exacerbate allergies;<sup>23</sup> hunger and malnutrition will rise due to drought and extreme weather events.<sup>24</sup>

Reviewing this list, it appears that there is almost no component of human health that will be untouched by climate change. And the list does not end here. The shrinking resource base of a warming world will also increase the likelihood of refugee crises, violent conflicts, and even wars. In this regard, it is notable that the U.S. Department of Defense appears to have cottoned on to the potentially catastrophic effects of climate change even while the Environmental Protection Agency was fighting hard not to do anything about them. A 2003 report commissioned by the Pentagon—dated a month after the EPA itself declined to regulate greenhouse gases under the Clean Air Act<sup>25</sup>—“imagine[s] the unthinkable” by describing the consequences of an abrupt shift in climate due to slowing of the ocean’s thermohaline circulation.<sup>26</sup> The report predicts that shortages in the basic necessities of life—food, water, and energy resources—

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12. *See id.* at 11.

13. *See id.* at 12.

14. *See id.* at 12, 401–02.

15. *See id.* at 11.

16. *See id.* at 12.

17. *See id.*

18. *See id.* at 418.

19. *See id.*

20. *See* Roger Few, *Health and Climatic Hazards: Framing Social Research on Vulnerability, Response and Adaptation*, 17 *GLOBAL ENVTL. CHANGE* 281, 281–83 (2007).

21. *See* Philip Ball, *Climate Change Set To Poke Holes in Ozone*, *NATURE NEWS*, Mar. 3, 2004, <http://www.nature.com/news/2004/040301/full/news040301-5.html> (last visited Oct. 9, 2007).

22. For the EPA’s description of the health effects of the increased exposure to ultraviolet radiation that comes from ozone depletion, *see* ENVTL. PROT. AGENCY, *HEALTH EFFECTS OF OVEREXPOSURE TO THE SUN*, <http://www.epa.gov/sunwise/uvandhealth.html> (last visited Oct. 9, 2007).

23. *See* IPCC, *supra* note 11, at 9, 82.

24. *See id.* at 18.

25. *See* Control of Emissions from New Highway Vehicles and Engines, 68 *Fed. Reg.* 52,922, 52,922 (Sept. 8, 2003).

26. PETER SCHWARTZ & DOUG RANDALL, *AN ABRUPT CLIMATE CHANGE SCENARIO AND ITS IMPLICATIONS FOR UNITED STATES NATIONAL SECURITY 1* (2003); *see also* Peter Schwartz & Doug Randall, *Future Global Warming Scenarios, Take 2*, Letter to the Editor, *SCIENCE*, Sept. 24, 2004. The thermohaline circulation is the “conveyor belt” that moves warm water “from the tropics toward the poles,” warming

would result from abrupt climate change,<sup>27</sup> and that these shortages would in turn either cause or exacerbate global conflict.<sup>28</sup> In the event of abrupt climate change drastically lowering the Earth's carrying capacity, the report bluntly states, "Humanity would revert to its norm of constant battles for diminishing resources, which the battles themselves would further reduce even beyond the climatic effects. Once again warfare would define human life."<sup>29</sup>

The Pentagon report deliberately looked at extreme possibilities, noting that "it is [the Department of Defense's] job to consider such scenarios."<sup>30</sup> But the report's dire predictions do not seem so extreme anymore. In April 2007, eleven retired U.S. generals and admirals acting as the "Military Advisory Board" to the largely federally funded CNA Corporation, signed a study describing the national security consequences of climate change.<sup>31</sup> Calling climate change a "threat multiplier for instability in some of the most volatile regions of the world," the study details the ways in which climate change may push already fragile nations over the brink and put strain on even the most developed nations.<sup>32</sup> "To live in stability," the study observes, "human societies need access to certain fundamental resources, the most important of which are water and food."<sup>33</sup> Yet, as the study makes clear, these basic resources—and thus the stability on which national security depends—are threatened by climate change.<sup>34</sup> Armed conflict,<sup>35</sup> mass migration,<sup>36</sup> and even terrorism<sup>37</sup> are among the national security consequences the study associates with climate change. The seriousness of these consequences, and their link to climate change, were highlighted just one day after this study was published when the United Nations Security Council met for the very first time to discuss climate change as a security issue.<sup>38</sup>

The human health consequences of climate change are not just worries for the remote future; they are happening here and now. In addition to the research on the relationship between Europe's disastrous heat wave and climate change, other studies have also suggested a connection between current adverse health

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Europe. ELIZABETH KOLBERT, *FIELD NOTES FROM A CATASTROPHE: MAN, NATURE, AND CLIMATE CHANGE* 56–57 (2006).

27. See SCHWARTZ & RANDALL, *supra* note 26, at 14–15.

28. See *id.* at 14, 16–18.

29. *Id.* at 16–17.

30. *Id.* at 8.

31. See CNA CORP., *NATIONAL SECURITY AND THE THREAT OF CLIMATE CHANGE* (Apr. 2007).

32. *Id.* at 44–45.

33. *Id.* at 18.

34. See *id.* at 13, 15, 20, 24, 27, 30, 32.

35. See *id.* at 15, 18, 20.

36. See *id.* at 29, 34; see also CHRISTIAN AID, *HUMAN TIDE: THE REAL MIGRATION CRISIS 1* (2007).

37. See CNA CORP., *supra* note 31, at 20, 22.

38. See Press Release, U.N. Security Council, Security Council Holds First-Ever Debate of Impact of Climate Change on Peace, Security, Hearing Over 50 Speakers, U.N. Doc. SC/9000 (Apr. 17, 2007), available at <http://www.un.org/News/Press/docs/2007/sc9000.doc.htm>; see also Ctr. for Naval Analysis, Climate Change Poses Serious Threat to U.S. National Security (Apr. 16, 2007), <http://www.energybulletin.net/28733.html>.

consequences and climate change.<sup>39</sup> For example, researchers have already found that the changing climate has likely influenced the geographic range of disease-carrying insects.<sup>40</sup> Perhaps more remarkably, climate change has also been cited as an underlying cause of current armed conflict. The genocide in Darfur, for example, is now regarded as having arisen at least in part from territorial disputes caused by persistent drought conditions associated with a warming world.<sup>41</sup>

As if all of this were not bad enough, the health consequences I have described will almost certainly be worst for the poorest among us, who are least able to fend off or bounce back from such stressors.<sup>42</sup> The world's poorest nations already suffer from the kinds of food and water shortages that will only worsen in the coming years; their capacity to handle further scarcity is limited.<sup>43</sup> They also lack the resources—such as funds for relocation necessitated by rising sea levels—and services—such as health care—that will be necessary in any effort to mitigate the effects of climate change.<sup>44</sup> Adding insult to injury, the poorest countries have contributed the least to the present problem.<sup>45</sup> This inequity might itself lead to a further downward spiral in human welfare by fueling conflicts, perhaps even armed conflicts, between the climate haves and have-nots.<sup>46</sup>

#### B. POLICY CONSEQUENCES OF HEALTH CONSEQUENCES OF CLIMATE CHANGE

“We have to give climate change a human face—it is not all about ‘sinks,’ ‘emission trading schemes’ and technology. Climate change is about people, children, families and . . . our relationship with the world around us.”<sup>47</sup>

What are the consequences, for public debate and public policy, of framing the problem of climate change in terms of human health? I believe framing the problem this way has at least three implications: motivating political action,

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39. See, e.g., WHO, *THE WORLD HEALTH REPORT 2002*, 72 (2002), available at [http://www.who.int/wht/2002/en/whr02\\_en.pdf](http://www.who.int/wht/2002/en/whr02_en.pdf).

40. See ROSS GELBSPAN, *BOILING POINT* 119–23 (2005); Stephen Y. Liang et al., *Climate Change and the Monitoring of Vector-borne Disease*, 287 *JAMA* 2286, 2286 (2002).

41. See CNA CORP., *supra* note 31, at 15 (“Darfur provides a case study of how existing marginal situations can be exacerbated beyond the tipping point by climate-related factors.”); Stephan Faris, *The Real Roots of Darfur*, *ATLANTIC MONTHLY*, Apr. 2007, at 67.

42. See Andrew C. Revkin, *The Climate Divide: Rich Nations Find It Easier To Adapt*, *INT’L HERALD TRIB.* (Paris), Apr. 2, 2007.

43. See HM TREASURY, *STERN REVIEW ON THE ECONOMICS OF CLIMATE CHANGE* 92 (2006), available at [http://www.hm-treasury.gov.uk/independent\\_reviews/stern\\_review\\_economics\\_climate\\_change/stern\\_review\\_report.cfm](http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm).

44. See *id.* at 99.

45. See *id.* at 29.

46. See SCHWARTZ & RANDALL, *supra* note 26, at 16.

47. *Human Face of Climate Change: Weather out of Its Mind*, CBC NEWS, Mar. 24, 2005, available at <http://www.cbc.ca/news/background/climatechange/weather.html> (quoting Sheila Watt-Cloutier, Chair, Inuit Circumpolar Conference, Nov. 2004).

enlarging the number and kinds of governmental institutions involved in the problem, and creating a strong moral case for action.

First, and most pragmatically, “environmental” threats rarely capture the attention of the public and policymakers unless and until they are linked to human health. People are worried about the polar bear, to be sure, but it is doubtful that the polar bear’s plight alone—or even the added plight of the many other species threatened by climate change—will prompt the kinds of large changes necessary to address climate change. To take an example from early in the environmental era, many studies connected the pesticide DDT with harm to wildlife,<sup>48</sup> even to harm to the beloved bald eagle,<sup>49</sup> but it was not until DDT was tied to cancer risk in humans that the federal government decided to ban the substance.<sup>50</sup> The same basic story holds for the regulation of many other pollutants.<sup>51</sup> Speaking in purely practical terms, therefore, it makes a great deal of sense to highlight the consequences of climate change for human health.

Second, emphasizing the consequences of climate change for human health will affect the way we think about responses to this problem. If we think of climate change as purely an “environmental” problem, we will likely turn, in the United States, to the EPA for an answer. But as important as the EPA is domestically, with respect to this problem, I believe it is equally vital that we turn to other non-environmental institutions for assistance. Framing climate change as a human health threat naturally encourages resort to agencies charged with a traditional public health mission, such as the Centers for Disease Control and the National Institutes of Health. It also prompts attention to even less obvious institutions, like the United Nations Security Council. We will think differently about solutions to climate change as an institutional matter if we frame the problem of climate change as a human health problem.

Finally, recognizing the current and future consequences of climate change for human health makes the moral case for aggressive action on climate change unimpeachable. If we were simply talking about a more uncomfortable climate, or even the destruction of other species, it might be easier to dismiss the moral imperative of action on climate change. But humans are dying and falling ill due to our collective actions, and will continue to do so in even larger numbers if we do nothing. Emphasizing the human dimension of climate change brings a moral clarity to the problem that is not matched by worries about the polar bear.

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48. See Stefan Bösch, *DDT and the Dynamics of Risk Knowledge Production*, 8 INT’L J. FOR PHIL. CHEMISTRY 79, 87–89 (2002), available at <http://www.hyle.org/journal/issues/8-2/boesch.html>.

49. See David A. Fahrenthold, *U.S. Declares Bald Eagles No Longer Threatened*, WASH. POST, June 29, 2007, at A3.

50. See Bösch, *supra* note 48, at 94–95.

51. Frequently, when the government regulates pollutants that have adverse effects on both humans and other species, it highlights the former in justifying the rules. See Lisa Heinzerling, *Regulatory Costs of Mythic Proportions*, 107 YALE L.J. 1981, 2060–64 (1998).

## II. THE POST-CAUTIONARY PRINCIPLE

The recognition that climate change is upon us and harming us now leads me to suggest one other way to reframe public discourse on this issue. We should cease discussing responses to climate change in terms of the “precautionary principle” and should begin to think instead in terms of a “post-cautionary” approach.

For a long time, climate change has been the exemplar for application of the precautionary principle.<sup>52</sup> This principle has taken many forms over the years, but in its simplest and perhaps most common formulation, it stands for the idea that we should not wait for scientific certainty before acting on a threat.<sup>53</sup> The underlying principle is that we are better off being safe than being sorry.<sup>54</sup>

At this moment in history, discussing climate change in terms of the precautionary principle is a serious mistake. As I discuss below, we probably blew past our precautionary opportunity sometime in the 1980s. We are now, and have been for some time, in a post-cautionary world. The scientific debate over whether climate change is happening, and whether it will hurt us, is over; the important questions are when it will get worse and by how much. I suggest, therefore, that we begin to discuss climate change in terms of a “post-cautionary principle.” Recognizing that we have hurtled past precaution into a post-cautionary world has several important implications for public policies concerning climate change.

### A. CLIMATE CHANGE’S PRECAUTIONARY PERIOD

“To do nothing when the situation is changing very rapidly is not a conservative thing to do.”<sup>55</sup>

In this section, I ask two famous questions, but about climate change rather than cover-ups: what did we know and when did we know it? My aim here is not to identify a single precautionary moment for climate change. My aim, instead, is to argue that climate change had not just a precautionary moment but a precautionary period, in which the evidence of an impending catastrophe was

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52. See, e.g., Douglas A. Kysar, *Climate Change, Cultural Transformation, and Comprehensive Rationality*, 31 B.C. ENVTL. AFF. L. REV. 555, 565 (2004) (advocating “the precautionary principle as an appropriate response to climate change, particularly with respect to its potentially catastrophic but currently inestimable risks”).

53. See, e.g., John S. Applegate, *The Taming of the Precautionary Principle*, 27 WM. & MARY ENVTL. L. & POL’Y REV. 13, 13 (2002) (“Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.”) (quoting the 1992 Rio Declaration of the UN Conference on Environment and Development).

54. Frank B. Cross, *Paradoxical Perils of the Precautionary Principle*, 53 WASH. & LEE L. REV. 851, 851 (1996).

55. SPENCER R. WEART, *THE DISCOVERY OF GLOBAL WARMING* 90 (2003) (quoting an unnamed scientist at the 1972 symposium on rising level of CO<sub>2</sub>).

strong enough—and the signs of even greater future calamity clear enough—that the precautionary principle, properly applied, should have inspired us to take aggressive action. I believe that period passed in the late 1980s.

To early climate scientists, the idea of significant “climate change” was something of an oxymoron. Climate was “stable *by definition*.”<sup>56</sup> Indeed, one of the great puzzles for early climate scientists was the cause and course of the ice ages: how could such a dramatic change in climate have happened, and how long did it take?<sup>57</sup> Perhaps ironically, scientists’ search for the answer to the mystery of the long-ago ice ages helped spur the research that led to the “discovery” of climate change in our own time.<sup>58</sup>

Scientific understanding of the past and present climate proceeded fitfully at best during the nineteenth and early twentieth centuries, yet several discoveries from the nineteenth century were seminal in the study of climate. In the early 1800s, Joseph Fourier, likening the Earth’s atmosphere to a “hothouse,” speculated that the gases in the atmosphere prevented the sun’s radiation from escaping entirely back into space.<sup>59</sup> In 1859, John Tyndall found that carbon dioxide was opaque to infrared radiation, and thus trapped some of the Earth’s infrared radiation in the atmosphere.<sup>60</sup> In 1896, the Swedish scientist Svante Arrhenius undertook a computational project fit for a modern computer when he calculated the potential effect on average global temperature of changing the level of carbon dioxide (CO<sub>2</sub>) in the atmosphere.<sup>61</sup> His calculations were based, of necessity, on a highly simplistic view of the drivers of climate.<sup>62</sup> Remarkably, however, his estimate of the effect of a doubling of CO<sub>2</sub> in the atmosphere—an increase in average global temperature of between nine and eleven degrees Fahrenheit—was not far off from today’s estimates.<sup>63</sup> Nevertheless, Arrhenius’s work slipped into obscurity, picked up here and there by other climate scientists in the first half of the twentieth century, but not seriously pursued.<sup>64</sup>

Scientific findings that would lead to the discovery of climate change in our time began to steadily appear in the mid-twentieth century. In 1957, Roger Revelle and Hans Suess published a paper concluding that the then-widely accepted view that the oceans could be counted upon to absorb any amount of CO<sub>2</sub> we belched into the atmosphere was mistaken; most of the CO<sub>2</sub> that ended

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56. *Id.* at 10.

57. *See id.* at 9–11.

58. *See generally id.* “It was not the vague possibility of global warming that intrigued the few people who thought about climate change, but the stupendous advance and retreat of continental ice sheets.” *Id.* at 11.

59. *Id.* at 2–3.

60. *See id.* at 3–4.

61. *See id.* at 5–6.

62. *See id.* at 6.

63. *See* KOLBERT, *supra* note 26, at 41.

64. *See* WEART, *supra* note 55, at 5–11 (tracing development of Arrhenius’s calculations); David M. Hart & David G. Victor, *Scientific Elites and the Making of US Policy for Climate Change Research 1957-74*, 23 *SOC. STUD. SCI.* 643, 647 (1993) (noting scientific community’s lack of interest in Arrhenius’s work).

up in the oceans “would promptly be evaporated.”<sup>65</sup> At about the same time, another turning point in the development of climate science occurred when Charles David Keeling received funding to measure atmospheric concentrations of CO<sub>2</sub> at the Mauna Loa Observatory in Hawaii and in Antarctica.<sup>66</sup> With the exception of a brief hiatus in these studies as a result of a funding cutoff in the early 1960s, Keeling’s measurements provided us with the first careful and consistent record of actual, year-by-year CO<sub>2</sub> concentrations in the atmosphere at a specific location.<sup>67</sup> What they showed proved indispensable to the development of modern climate science: CO<sub>2</sub> concentrations were on a steady upward path.<sup>68</sup>

Climate scientists also began to apprehend how quickly climate could change. Early climate scientists were loathe to admit that the climate could change significantly over a short period of time; they thought in terms of geological time, with changes occurring over tens of thousands of years.<sup>69</sup> Ice core samples from Greenland tested and eventually debunked this long-held assumption of stability.<sup>70</sup> A study published in 1972, for example, reported that a cold spell that happened some 12,000 years ago—dubbed the Younger Dryas—had happened in as little as one or two centuries.<sup>71</sup> Ice core samples also bore evidence of rapid warming and cooling periods.<sup>72</sup> Studies such as these upended the comfortable assumption of climate scientists (and perhaps the rest of us) of a stable climate, changeable only over many millennia.

Another venerable assumption of climate scientists was that of a balance of nature, which would lead the climate to take self-correcting actions tending in the direction of stability rather than instability.<sup>73</sup> Scientists in the second half of the twentieth century began serious study of the possibility of bad as well as good feedbacks. Climate models indicated that a rise in temperature could, for example, cause melting of ice which would increase the albedo effect of the oceans, which in turn would lead to further warming, and so on.<sup>74</sup> The models suggested that spiraling bad effects, rather than self-correcting reactions tending toward stability, would make a bad situation even worse.

By the late 1980s, then, this much was clear: the greenhouse effect was a plausible scientific theory. Manmade greenhouse gas emissions were increasing.

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65. WEART, *supra* note 55, at 27–29; see also Roger Revelle & Hans E. Suess, *Carbon Dioxide Exchange Between Atmosphere and Ocean and the Question of an Increase of Atmospheric CO<sub>2</sub> During the Past Decades*, 9 TELLUS 18 (1957).

66. See WEART, *supra* note 55, at 36.

67. See *id.* at 38; Hart & Victor, *supra* note 64, at 651.

68. See JAMES RODGER FLEMING, *HISTORICAL PERSPECTIVES ON CLIMATE CHANGE* 126–28 (1998); WEART, *supra* note 55, at 38.

69. See generally WEART, *supra* note 55, at ch.1.

70. See, e.g., *id.* at 78.

71. See *id.*; see also TIM FLANNERY, *THE WEATHER MAKERS: HOW MAN IS CHANGING THE CLIMATE AND WHAT IT MEANS FOR LIFE ON EARTH* 61 (2005).

72. See WEART, *supra* note 55, at 74, 80.

73. See *id.* at 8–9.

74. See *id.* at 85–86.

Atmospheric concentrations of greenhouse gases were increasing. The world was getting warmer. Climate could change abruptly. Once the climate started to change, it might deteriorate rapidly due to positive feedback effects.

Other important points were less clear. Was the world's present warming a result, at least in part, of human greenhouse gas emissions? What did the future hold? Answers to these questions were complicated by scientists' growing recognition that we might not discern the effects of climate change until they were upon us and more drastic future effects had become inevitable.<sup>75</sup>

In discussing scientific research spanning a century or more, involving many thousands of researchers and untold numbers of studies, it is risky to pinpoint any one moment of clarity.<sup>76</sup> But in a scientific field as fraught with political meaning as climate science is, one can perhaps identify moments when existing scientific research made its way into the public consciousness in such a way that public policy might have reacted to the emerging understanding. I believe such a moment happened, among other times, in the summer of 1988. That summer, which saw terrible droughts in the U.S. Midwest and unprecedentedly hot weather in the Northeast,<sup>77</sup> veteran NASA scientist James Hansen came before Congress and announced that global warming was upon us and that the greenhouse effect was likely the cause.<sup>78</sup> It was time to "stop waffling so much," he said in an interview after his testimony, and to "say that the evidence is pretty strong that the greenhouse effect is here."<sup>79</sup>

Congress did not act on Hansen's advice. It passed laws authorizing more research on climate change,<sup>80</sup> but did nothing to regulate the causes of climate change. Indeed, instead of bringing aggressive action on climate change, the years following Hansen's testimony witnessed what I regard as a retrenchment in climate policy. Scientists retreated to the newly formed Intergovernmental Panel on Climate Change (IPCC)<sup>81</sup> to develop careful consensus statements on

75. See *id.* at 120–22, 137–38; KOLBERT, *supra* note 26, at 11.

76. See WEART, *supra* note 55, at 196 ("The discovery of global warming was patently a social product, a consensus of judgments arising in countless discussions among thousands of experts.").

77. See, e.g., *id.* at 155; see also Peter Kerr, *The Great Flood of Heat: 42 Days and 42 Nights and Life Is Altered*, N.Y. TIMES, Aug. 14, 1988, Metropolitan at 1; Thomas W. Schierholz, *Heat Wave, Drought Put Double Squeeze on Utilities*, CHRISTIAN SCI. MONITOR (Boston), Aug. 18, 1988, at 3.

78. See *The Greenhouse Effect: Impacts on Current Global Temperature and Regional Heat Waves: Hearing Before S. Comm. on Energy and Natural Resources*, 100th Cong. 43 (1988) (statement of James E. Hansen, NASA); see also *id.* at 2 (statement of Hon. J. Bennett Johnston, S. Comm. on Energy and Natural Resources) ("The greenhouse effect has ripened beyond theory now. We know it is fact.").

79. Philip Shabecoff, *Global Warming Has Begun, Expert Tells Senate*, N.Y. TIMES, June 23, 1988, at A1.

80. See, e.g., Global Change Research Act of 1990, Pub. L. No. 101-606, 104 Stat. 3096; Food, Agriculture, Conservation and Trade Act of 1990, Pub. L. No. 101-624, 104 Stat. 3359; Energy Policy Act of 1992, Pub. L. No. 102-486, 106 Stat. 2776.

81. The IPCC was formed in 1988. Background information on the IPCC is available at <http://www.ipcc.ch/about/about.htm>.

climate change and its effects.<sup>82</sup> The fossil fuel industry began to wage a years-long, multi-million dollar effort to persuade the public of the shakiness of climate science.<sup>83</sup> Scientific ignorance became official government policy.<sup>84</sup>

Into this stew of an emerging scientific consensus and a growing political backlash stepped the international environmental community. In 1992, at the “Earth Summit” in Rio, nations agreed to the United Nations Framework Convention on Climate Change, which for the first time officially linked responses to climate change to the precautionary principle. Article 3 of the Convention, setting forth the “principles” of the document, stated:

The Parties should take precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing such measures, taking into account that policies and measures to deal with climate change should be cost-effective so as to ensure global benefits at the lowest possible cost.<sup>85</sup>

Similarly, the Rio Declaration, agreed to at the same time, stated that “in order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.”<sup>86</sup> In the years following the Earth Summit, public discourse on climate change and public discourse on the precautionary principle almost inevitably merged: in a typical formulation, the Canadian government recently stated that climate change policy should be developed with the precautionary

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82. See WEART, *supra* note 55, at 161–62 (“Under pressure from the industrial interests, as well as from the mandate to make only statements that virtually every knowledgeable scientist would endorse, the IPCC’s consensus statements were highly qualified and cautious.”).

83. See ROSS GELBSPAN, *THE HEAT IS ON* 33–61 (1997) (“In their efforts to challenge the consensus scientific view about the escalating turmoil of the global atmosphere, the public relations apparatus of the oil and coal industries has publicized weather reports, and funded and distributed books and videos and self-proclaimed journals of science that are dismissed by the vast majority of scientists.”); WEART, *supra* note 55, at 168.

84. See GELBSPAN, *supra* note 40, at 37–61 (documenting the continuing denial of climate change and continuing assertion of scientific uncertainty by the Republican Party); CHRIS MOONEY, *THE REPUBLICAN WAR ON SCIENCE* 78–101 (2005) (documenting the Bush Administration’s policy of stressing scientific uncertainty and denying climate change); WEART, *supra* note 55, at 168 (“A White House memorandum, inadvertently released in 1990, proposed that the best way to deal with concern about global warming would be ‘to raise the many uncertainties.’”).

85. United Nations Framework Convention on Climate Change, art. 3, ¶ 3, May 9, 1992, S. TREATY Doc. No. 102-38, 1771 U.N.T.S. 170.

86. U.N. Conference on Environment and Development, June 3–14, 1992, *Rio Declaration on Environment and Development*, U.N. Doc. A/CONF.151/26 (Vol. I) (Annex 1, princ. 15) (June 14, 1992), 31 I.L.M. 874, 879.

principle as a guiding framework.<sup>87</sup>

The irony—even tragedy—in this is that the precautionary principle swept onto the climate change scene almost at the same moment it could have, and should have, departed the field. Before the Earth Summit, the IPCC—the largest peer-reviewed scientific collaboration in the history of the world—had already declared that the world was warming and that it was likely that additional warming of several degrees would occur by 2050.<sup>88</sup> This statement that the world was indeed warming was exactly the kind of scientific consensus the precautionary principle declared unnecessary to justify action on an impending threat of potentially grave proportions.<sup>89</sup> By 1995, of course, the IPCC had gone further and identified a “discernible human influence” on the climate,<sup>90</sup> and the long battle over the basic outlines of climate change science could have been declared over.

Yet things only got worse from there. The Senate in 1998 announced its intention to reject any international agreement on climate change that did not include binding requirements for developing nations,<sup>91</sup> and in 2001 the Bush Administration withdrew from the Kyoto Protocol entirely.<sup>92</sup> President Bush dismissed a 2002 report conducted by his own agencies linking anthropogenic greenhouse gas emissions and climate change as a “report put out by the bureaucracy.”<sup>93</sup> In 2003 the White House edited out five of the six paragraphs referring to climate change in what was billed as a comprehensive report on the environment.<sup>94</sup> At the same time, critics of government regulation seized on the precautionary principle as a misguided, even dangerous, idea.<sup>95</sup> Thus, the battlefield over climate policy moved from the scientific arena, where all but a few, mostly industry-funded,<sup>96</sup> skeptics accepted the ever-more dire predictions of a coming climate catastrophe to the abstract realm of organizing principles for public policy. Perhaps, the critics hinted between the lines, one could reject

87. See REPORT OF THE COMMISSIONER OF THE ENVIRONMENT AND SUSTAINABLE DEVELOPMENT TO THE HOUSE OF COMMONS 26 (2006), available at [http://www.oag-bvg.gc.ca/domino/reports.nsf/html/c20060900se01.html/\\$file/c20060900se01.PDF](http://www.oag-bvg.gc.ca/domino/reports.nsf/html/c20060900se01.html/$file/c20060900se01.PDF).

88. See WEART, *supra* note 55, at 162 (referring to the report the IPCC issued in 1990).

89. Applegate, *supra* note 53, at 27 (noting that precautionary principle is not “relevant” once “science reveals a well characterized risk”).

90. Intergovernmental Panel on Climate Change, IPCC Second Assessment: Climate Change 1995, 5 ¶ 2.5 (1995), available at [http://www.ipcc.ch/pub/sa\(E\).pdf](http://www.ipcc.ch/pub/sa(E).pdf).

91. See Byrd-Hagel Resolution, S. Res. 98, 105th Cong., S. REP. NO. 105–54, at 3 (1997).

92. See, e.g., Edmund L. Andrews, *Bush Angers Europe by Eroding Pact on Warming*, N.Y. TIMES, Apr. 1, 2001, at 1.

93. Katherine Q. Seelye, *President Distances Himself from Global Warming Report*, N.Y. TIMES, June 5, 2002, at A23.

94. See GELSPAN, *supra* note 40, at 42.

95. One of the most prominent critics of the precautionary principle has been Cass Sunstein. See, e.g., Cass R. Sunstein, *Beyond the Precautionary Principle*, 151 U. PA. L. REV. 1003, 1003 (2003) (“[T]he precautionary principle should be rejected, not because it leads in bad directions, but because it leads in no direction at all.”).

96. See, e.g., Chris Mooney, *Some Like It Hot*, MOTHER JONES, May–June 2005, at 36 (tracing funding of many anti-global-warming scientists and think tanks to Exxon-Mobil).

action on climate change by rejecting the precautionary principle—without ever taking a close look at the scary scientific consensus on the subject.

If my account is correct, then the precautionary principle as applied to climate change was, at best, an anachronism as soon as it was adopted. At worst, it inadvertently played into the hands of critics of swift and aggressive action on climate change, feeding the industry-funded view that the science of climate change was too uncertain to justify such action.

Subsequent reports of the IPCC, and subsequent events in the world, including the collapse of Antarctic ice sheets, melting of glaciers, and thawing of Arctic permafrost,<sup>97</sup> have only deepened the case for my argument that we have moved from a precautionary to a post-cautionary period. I close with a brief discussion of several implications of this development for public policy.

#### B. PUBLIC POLICY AND PRIVATE CONDUCT FOR A POST-CAUTIONARY WORLD

“It may be time to act up.”<sup>98</sup>

Acknowledging that we have passed the precautionary moment with respect to climate change has several implications for public policy.

First, stressing the now-inevitable human health consequences of climate change makes untenable certain arguments that have been raised against doing much of anything at all to address this problem. All around us appear scare stories about what will happen to our economy, and even to our way of life, if we act aggressively against climate change.<sup>99</sup> But, as we have seen, the consequences of not acting are terrible indeed. As the renowned climate researcher James Hansen has put it, if we continue on our present course with respect to greenhouse gas emissions, we will soon, quite simply, live on “a different planet.”<sup>100</sup> Focusing on the human consequences of climate change reveals the dangerous ludicrousness of industry’s calls for “business as usual”<sup>101</sup>—as well as the frequent suggestion that this scenario bears zero costs. Climate change is having and will have profound effects on the economy, with enormous costs. It is a lie to pretend that inaction on climate change is a “no-cost” scenario—for anyone.

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97. See generally KOLBERT, *supra* note 26 (documenting the impact of global warming on the natural world).

98. James E. Hansen, *The Threat to the Planet: How Can We Avoid Dangerous Man-Made Climate Change?*, Remarks on Acceptance of WWF Duke of Edinburgh Conservation Medal at St. James Palace, London (Nov. 21, 2006), available at <http://www.columbia.edu/jeh1/>.

99. For recent examples, see BJØRN LOMBORG, *COOL IT: THE SKEPTICAL ENVIRONMENTALIST’S GUIDE TO GLOBAL WARMING* (2007); Eric Peters, *Seppuku for the U.S. Auto Industry*, AM. SPECTATOR, July 6, 2007, [http://www.spectator.org/dsp\\_article.asp?art\\_id=11687](http://www.spectator.org/dsp_article.asp?art_id=11687) (arguing that government-mandated carbon dioxide output reductions would require the manufacture of smaller cars, causing an industry change that would put domestic auto manufacturers at a disadvantage as compared to their Japanese competitors).

100. Andrew C. Revkin, *Climate Expert Says NASA Tried To Silence Him*, N.Y. TIMES, Jan. 29, 2006, at A1 (quoting Dr. James Hansen).

101. See, e.g., Peters, *supra* note 99.

Second, acknowledging our post-cautionary status means that we cannot hope that reduction of greenhouse gas emissions alone will avert the harmful consequences of climate change. We must also adapt to the consequences that we cannot now avoid. Some environmentalists have eschewed the idea of adapting to climate change, preferring instead to talk only in terms of mitigating the problem through the reduction of greenhouse gases.<sup>102</sup> They worry, apparently, that if we talk about adapting to climate change, we will have less motivation to address the problem in a more preventive and fundamental way. But the problem is upon us, causing harm now. We no longer have the luxury of choosing between adaptation and mitigation; we must do both.

Third, acknowledging our post-cautionary status means that we cannot afford to discard any of the actions we are already taking to reduce greenhouse gases. In the United States, in the absence of any federal action on the matter, states and local governments have adopted numerous laws and policies aimed at reducing greenhouse gases.<sup>103</sup> As Congress debates its own potential responses to the issue of climate change, it must be careful not to undo any of the steps states and local governments have already taken. It would be easy enough, in a period when the Supreme Court has expanded its preemption jurisprudence,<sup>104</sup> for Congress—even inadvertently—to displace state and local laws on climate change. I would go so far as to say that unless Congress is willing to pass a very aggressive law or laws on greenhouse gases, it should simply stay out unless it also enacts language unmistakably disclaiming any preemptive intent. If Congress were to pass a weak law that at the same time is held by the current conservative Court to preempt state and local efforts on climate change, it would be worse than not acting at all.

Fourth, in making public policy on climate change, especially in a post-cautionary world, we must not make the best the enemy of the good. Many academics have devoted loving attention to exactly which kind of regime—international or domestic, market-based or technology-based, and so on—is ideal for the problem of climate change. We do not have the luxury of waiting for the ideal solution now, especially when the likely favorite among theoreticians—an international trading regime with participation by the United States and developing countries such as China—would entail a significant lead time. In this setting, we may do well to use non-obvious second-best solutions, including state and local actions to reduce greenhouse gases. Indeed, time appears to be so short for effective action on climate change that I believe we

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102. See Bret Schulte, *Temperature Rising*, U.S. NEWS & WORLD REP., June 5, 2006, at 36–40 (noting that some environmentalists have long been reluctant to talk about adaptation “for fear it would pull the focus away from fixing the problem”).

103. For discussion, see Kirsten H. Engel & Scott R. Saleska, *Subglobal Regulation of the Global Commons: The Case of Climate Change*, 32 ECOLOGY L.Q. 183, 213–14 (2005).

104. See, e.g., David C. Vladeck, *Preemption and Regulatory Failure*, 33 PEPP. L. REV. 95, 105–07 (2005) (noting that the Court’s decision in *Cipollone v. Liggett Group, Inc.*, 505 U.S. 504 (1992), significantly expanded the extent to which federal legislation can preempt state and local laws).

should stop waiting around for the government to act on this issue and take the matter into our own hands. We are all implicated in climate change. We drive cars, switch on the lights, turn up the AC, boot up our computers, and so on. We don't have to wait for action on climate change; we can use our own inaction—less driving, less electricity use, and so on—to start tackling the problem.

Finally, and most importantly, passing from a precautionary to a post-cautionary world has serious consequences for the moral status of the debate over climate change. In the first part of this Essay, I described how gravely human life and health are now and will continue to be affected by climate change. In this second part of the Essay, I have explained that we now know that humans will die and fall ill as a result of this problem. The first describes a consequence; the second describes our knowledge of its occurrence. Knowledge that death and suffering will result from our actions leads uncontroversially to a moral obligation to change our behavior. In the United States, knowing killing is condemned in the criminal laws of all fifty states, in modern regulatory laws at the federal level, and in civil jury awards in tort cases.<sup>105</sup> These laws embody a moral commitment against knowing killing that, in traditional criminal contexts, is uncontroversial. It should be no more controversial when it occurs on a global scale.

#### CONCLUSION

Climate change is a public health threat of the highest order. Almost every facet of human health is being or will be affected by this phenomenon. Unfortunately, we long ago frittered away climate change's precautionary period. We are at a stage now when we can expect large-scale human health consequences from a warming world. Perhaps the worst of these consequences can be avoided. We have a moral imperative to try.

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105. See Lisa Heinzerling, *Knowing Killing and Environmental Law*, 14 N.Y.U. ENVTL. L.J. 521, 521–26 (2006).