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A CLIMATE OF EXTREMES: TRANSBOUNDARY CONFLICT RESOLUTION

Elizabeth Burleson*

INTRODUCTION

Climate change threatens international peace and security.¹ Scientific and governmental consensus has been reached that humans have contributed to climate change and that there exists an urgent need for multilateral climate mitigation and adaptation.² The Supreme Court has clarified that the Environmental Protection Agency (EPA) has the authority to regulate greenhouse gases.³ Momentum is building for the United States to establish an effective national legal framework addressing climate change. EPA regulation of vehicle greenhouse gas emissions is better than inaction, but comprehensive national legislation that is compatible with a well-drafted international climate change framework is likely to be the most effective response to climate change.

This Article analyzes emerging climate change policies. Part I discusses the United States Supreme Court's decision in *Massachusetts v. EPA* and its ability to facilitate the reduction of greenhouse gas emissions in the United States. Part II addresses the obstacles and benefits of multilateral measures to reduce greenhouse gas emissions and adapt to climate extremes. It looks at the ways in which facilitating the

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1. E.g., Kofi Annan, United Nations Secretary-General, Address to the Nairobi Climate Change Conference: Climate Change Is Also a Threat to Peace and Security (Nov. 15, 2006), available at <http://www.un.org/News/Press/docs/2006/sgsm10739.doc.htm> (noting that "[c]hanging patterns of rainfall, for example, can heighten competition for resources, setting in motion potentially destabilizing tensions and migrations, especially in fragile States or volatile regions").

2. The Intergovernmental Panel on Climate Change was awarded the Nobel Peace Prize for clarifying scientific consensus on man-made climate change and providing a foundation for international climate change mitigation. The Nobel Foundation, The Nobel Peace Prize 2007, http://nobelprize.org/nobel_prizes/peace/laureates/2007/ (last visited Mar. 26, 2008). The series of IPCC reports are available at <http://www.ipcc.ch/>. See also James Kanter & Andrew C. Revkin, *Scientists Detail Climate Changes, Poles to Tropics*, N.Y. TIMES, Apr. 7, 2007, at A1, available at <http://www.nytimes.com/2007/04/07/science/earth/07climate.html?partner=rssnyt&emc=rss> (discussing the Intergovernmental Panel on Climate Change's recent findings that "the earth's climate and ecosystems are already being shaped by the atmospheric buildup of greenhouse gases and face inevitable, possibly profound, alteration").

3. *Massachusetts v. Env'tl. Prot. Agency*, No. 05-1120, slip op. at 32 (U.S. Apr. 2, 2007), available at <http://www.supremecourtus.gov/opinions/06pdf/05-1120.pdf>.

implementation of renewable energy and energy efficiency can help address climate change and achieve energy security. Part III assesses the prospect for climate change to become a national security priority. Part IV considers reasonable and equitable climate adaptation. It looks at food security and climate change-induced water scarcity. This Article concludes that the time has come for a multilateral legal organ to coordinate reasonable and equitable greenhouse gas reductions and climate adaptation measures.

I. MASSACHUSETTS V. EPA

The cogs of Washington nearly ground to a halt when record flooding washed out train tracks and streets in June 2006, causing the federal government to shut down such major District of Columbia offices as the Internal Revenue Service headquarters.⁴ Given the widespread and unpredictable impact of this weather pattern, the National Weather Service issued flood warnings for eight states.⁵ The high-water mark of June 26, 2006, was the Supreme Court's decision to hear a global warming case brought against the federal government.⁶ In a five-to-four ruling, the Supreme Court held that the EPA has authority to regulate greenhouse gases and that if it chooses not to do so, then that decision must be based upon reasons that are consistent with the Clean Air Act.⁷

In *Massachusetts v. EPA*, Massachusetts requested the Supreme Court to decide whether the EPA was required to regulate the carbon emissions of new motor vehicles pursuant to section 202(a)(1) of the Clean Air Act.⁸

4. Maria Newman, *Flooding in Washington Closes Some Federal Offices*, N.Y. TIMES, June 26, 2006, <http://www.nytimes.com/2006/06/26/us/26cnd-flood.html?ex=1308974400&en=65f4e32880631723&ei=5088&partner=rssnyt&emc=rss>.

5. Alan Feuer, *Mid-Atlantic States Reel Under Deluge; 10 Dead*, N.Y. TIMES, June 29, 2006, at A1, available at <http://www.nytimes.com/2006/06/29/nyregion/29flood.html?ex=1309233600&en=8f1619806775e6b5&ei=5088&partner=rssnyt&emc=rss>; see also Katie Zezima, *New England is Deluged by Worst Flooding in Decades*, N.Y. TIMES, May 16, 2006, at A16, available at <http://www.nytimes.com/2006/05/16/us/16flood.html?ex=1305432000&en=a17a600ac7f65d7d&ei=5088&partner=rssnyt&emc=rss> ("After days of record rainfall, rivers in Maine, Massachusetts and New Hampshire have spilled over their banks, causing thousands of residents to flee their homes and brace for what could be the region's worst flooding in 70 years.").

6. *Massachusetts v. Env'tl. Prot. Agency*, 415 F.3d 50 (D.C. Cir. 2005), cert. granted, 126 S. Ct. 2960 (U.S. June 26, 2006) (No. 05-1120).

7. *Massachusetts v. Env'tl. Prot. Agency*, No. 05-1120, slip op. at 25, 30, 32.

8. *Id.* at 1-2; 42 U.S.C. § 7521(a)(1) (2000). In 1999, the International Center for Technology Assessment and other organizations petitioned the EPA to set new vehicle standards regulating greenhouse gas emissions. Robert Barnes & Juliet Eilperin, *High Court Faults EPA Inaction on Emissions; Critics of Bush Stance on Warming Claim Victory*, WASH. POST, Apr. 3, 2007, at A1, available at <http://www.washingtonpost.com/wp-dyn/content/article/2007/04/02/AR2007040200487.html>. After four years, the EPA said that the agency did not have the authority to regulate greenhouse

Massachusetts was joined in the suit by California, Connecticut, Illinois, Maine, New Jersey, New Mexico, New York, Oregon, Rhode Island, Vermont, Washington, the City of Baltimore, New York City, Washington D.C., the Pacific Island of America Samoa, the Union of Concerned Scientists, and twelve other environmental organizations.⁹ This coalition asked the United States Supreme Court to determine “[w]hether the EPA Administrator may decline to issue emission standards for motor vehicles based on policy considerations not enumerated in section 202(a)(1) [of the Clean Air Act].”¹⁰ Furthermore, Massachusetts sought clarification on “[w]hether the EPA Administrator has authority to regulate carbon dioxide and other air pollutants associated with climate change under section 202(a)(1).”¹¹

The EPA’s position that the agency did not have authority to regulate carbon emissions contradicted the EPA’s own legal conclusion of April 10, 1998.¹² The Bush Administration argued that carbon dioxide was not a pollutant pursuant to federal clean air law and that if carbon dioxide was a pollutant, then the EPA could choose whether or not to regulate it.¹³ As a presidential candidate, George Bush supported carbon regulation but changed his position once in office.¹⁴ The EPA also reversed itself,

gases and that it would not do so even if it did have the authority. *Id.* Massachusetts joined the petitioners in bringing a lawsuit against the EPA. *Id.*

9. Petition for Writ of Certiorari, *Massachusetts v. Env’tl. Prot. Agency*, at 2 (No. 05-1120) (U.S. Mar. 2, 2006), 2006 WL 558353, available at <http://www.supremecourtus.gov/docket/05-1120.htm>.

10. *Id.* (Questions Presented).

11. *Id.*

12. *Massachusetts v. Env’tl. Prot. Agency*, No. 05-1120, slip op. at 7. Eleven states and nineteen industry groups have joined the EPA. Michael Janofsky, *2 Sides Do Battle in Court on Whether E.P.A. Should Regulate Carbon Dioxide*, N.Y. TIMES, Apr. 9, 2005, at A17, available at <http://www.nytimes.com/2005/04/09/politics/09emissions.html?ex=1270699200&en=7261f0439b71a6ca&ei=5090&partner=rssuserland>. Janofsky also notes that “[m]otor vehicles account for about a quarter of the nation’s carbon dioxide emissions. Yet automakers have fought efforts to force them to build more efficient engines, pointing to the extraordinary costs of altering their factories to meet any new standards.” *Id.*; see also Bernie Woodall, *Auto Industry Should Speed Fuel Economy Fixes-Expert*, REUTERS, Nov. 29, 2006, <http://www.reuters.com/article/scienceNews/idUSN2940149520061130> (noting that automakers can achieve substantial fuel efficiency by combining existing technologies, according to the Union of Concerned Scientists clean vehicles director, Jason Mark).

13. *Supreme Court to Hear Key Environment Case*, N.Y. TIMES, June 26, 2006, <http://www.nytimes.com/2006/06/26/washington/AP-Scotus-Greenhouse-Gases.html?ex=1308974400&en=8bc82d2632e28389&ei=5088&partner=rssnyt&emc=rss>.

14. The United States is concerned that its companies will not be able to compete in a global economy in which major emitting countries are not also required to reduce carbon emissions. Hon. Eileen Claussen, President, Pew Ctr. on Global Climate Change, Opening Statement at the Climate Conference of the Energy and Natural Resources Committee (Apr. 4, 2006), available at http://www.pewclimate.org/what_s_being_done/in_the_congress/april_4_06.cfm; see also Letter from

adopting the view that the Clean Air Act did not grant it authority to regulate greenhouse gases.¹⁵

Two out of three of the judges on the United States Court of Appeals for the District of Columbia Circuit agreed that the EPA acted properly in denying the petition.¹⁶ The court thus denied review. On appeal, the Supreme Court found that greenhouse gases are pollutants pursuant to the Clean Air Act and are subject to EPA regulation.¹⁷

The opinion by Justice John Paul Stevens held that Massachusetts had standing to sue the EPA, given its “stake in protecting its quasi-sovereign interests” as a state and the likely loss of Massachusetts territory caused by sea level rise.¹⁸ Justice Stevens noted that the “EPA does not dispute the existence of a causal connection between man-made greenhouse gas emissions and global warming.”¹⁹ The Court rejected the EPA’s claim that the Clean Air Act did not authorize the agency to regulate greenhouse gases since carbon dioxide and the other gases did not constitute “air pollutants”

the Chief Legal Officers of the following states: Alaska, California, Connecticut, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, Vermont to the Hon. George W. Bush, President (July 17, 2002), *available at* http://www.climatechange.ca.gov/documents/2002-07-17_AGs_LETTER.PDF (noting the “recent collapse of a portion of the Antarctic ice shelf the size of Rhode Island [and] the open water at the North Pole” and citing to the Bush Administration’s United States CLIMATE ACTION REPORT 2002, *available at* <http://www.gcrio.org/CAR2002/>).

15. Ben Winograd & Jess Bravin, *Justices’ Fall Agenda Includes Global-Warming, Antitrust Cases*, WALL ST. J., June 27, 2006, at A2.

16. *Massachusetts v. Env’tl. Prot. Agency*, 05-1120, slip op. at 10–11.

17. *Id.* at 26.

The Clean Air Act’s sweeping definition of “air pollutant” includes “any air pollution agent or combination of such agents, including any physical, chemical . . . substance or matter which is emitted into or otherwise enters the ambient air. . . .” §7602(g) (emphasis added). On its face, the definition embraces all airborne compounds of whatever stripe, and underscores that intent through the repeated use of the word “any.” Carbon dioxide, methane, nitrous oxide, and hydrofluorocarbons are without a doubt “physical [and] chemical . . . substance[s] which [are] emitted into . . . the ambient air.” The statute is unambiguous.

Id. (footnotes omitted).

18. *Id.* at 16–17. The majority noted that only one of the plaintiffs needed to meet the three-prong standing requirement: (1) suffering a concrete and particularized injury, (2) tracing the injury to the defendant, and (3) showing that a decision in favor of the plaintiff would likely redress that injury. *Id.* at 14–15 (citing *Lujan v. Defenders of Wildlife*, 504 U.S. 555, 560–561 (1992)). Massachusetts satisfied the standing threshold since climate change-induced sea level rise would inundate its coast, which would in turn pose a “risk of catastrophic harm” that government regulation could reduce to some extent. *Id.* at 23; *see also* Linda Greenhouse, *Justices Say E.P.A. Has Power to Act on Harmful Gases*, N.Y. TIMES, Apr. 3, 2007, at A1, *available at* <http://www.nytimes.com/2007/04/03/washington/03scotus.html?ex=1333252800&en=f966c12737f03a23&ei=5088&partner=rssnyt&emc=rss>.

19. *Massachusetts v. Env’tl. Prot. Agency*, 05-1120, slip op. at 20. “Prior to the order that provoked this litigation, EPA had never disavowed the authority to regulate greenhouse gases, and in 1998 it in fact affirmed that it *had* such authority.” *Id.* at 29.

pursuant to the statute.²⁰ The Court found that the EPA had violated the Clean Air Act's clear statutory command by providing merely a laundry list of reasons not to regulate.²¹ Justice Stevens pointed out that the "EPA has offered no reasoned explanation for its refusal to decide whether greenhouse gases cause or contribute to climate change."²² He explained that once the "EPA has responded to a petition for rulemaking, its reasons for action or inaction must conform to the authorizing statute."²³ The EPA violated the Clean Air Act by improperly refusing to regulate new-vehicle emissions standards impacting climate change.

This decision will have an impact upon pending litigation. For instance, auto manufacturers have brought suit against California, Rhode Island, and Vermont to prevent these states from requiring stronger fuel-economy standards than federal regulations.²⁴ The states have requested that the EPA issue them waivers, under the Clean Air Act, that would permit the states to set higher standards than the federal government. The EPA's claim that the waivers cannot be granted since Congress authorized the Department of Transportation (DOT) to set fuel-economy standards has been weakened by the Supreme Court's rejection of this DOT argument in *Massachusetts v. EPA*.²⁵ While the transportation sector is responsible for about thirty percent of the United States' greenhouse gas emissions, the

20. *Id.* at 25–26.

21. *Id.* at 26–29. The Court noted that the fact that "DOT sets mileage standards in no way licenses EPA to shirk its environmental responsibilities." *Id.* at 29. In response to the EPA's assertion that voluntary Executive Branch programs providing a response to global warming and EPA regulation would impair the President's ability to negotiate with developing nations, the majority concluded that "[t]hese policy judgments . . . have nothing to do with whether greenhouse gas emissions contribute to climate change" and do not "amount to a reasoned justification for declining to form a scientific judgment." *Id.* at 31. "Nor can EPA avoid its statutory obligation by noting the uncertainty surrounding various features of climate change and concluding that it would therefore be better not to regulate at this time. If the scientific uncertainty is so profound that it precludes EPA from making a reasoned judgment, . . . [it] must say so." *Id.* "The statutory question is whether sufficient information exists to make an endangerment finding." *Id.* at 32. Instead, EPA rejected the rulemaking petition based on impermissible considerations. *Id.* Its action was therefore "arbitrary, capricious, . . . or otherwise not in accordance with law." *Id.* (quoting 42 U.S.C. § 7607(d)(9) (2000)) (internal quotation marks omitted). On remand, EPA "must ground its reasons for action or inaction in the statute." *Id.*

22. *Id.* at 32.

23. *Id.*

24. John J. Fialka, *States Want Higher Emissions Bar—California Takes Lead in Seeking EPA Waiver for Stricter Standards*, WALL ST. J., Apr. 4, 2007, at A6; see also Barnes & Eilperin, *supra* note 8 ("California has passed a law seeking to cut carbon dioxide emissions from automobiles starting in 2009; its regulations have been adopted by 10 other states and may soon be adopted by Maryland.").

25. *Massachusetts v. Env'tl. Prot. Agency*, 05-1120, slip. op. at 29 (U.S. Apr. 2, 2007); see also Fialka, *supra* note 24, at A6.

electric-utility sector contributes roughly forty percent.²⁶ *Massachusetts v. EPA* will strengthen a pending New York challenge to the EPA's refusal to regulate power-plant greenhouse gas emissions.²⁷ States have sought to fill the climate change regulatory vacuum.²⁸ *Massachusetts v. EPA* helps states that are seeking to mandate clean technology.²⁹ The corporate community seeks a comprehensive federal climate policy.³⁰ To pass federal climate change legislation, it will be important to gain support from states dependent upon coal, auto manufacturing, and agriculture.³¹

II. MULTILATERAL ACTION

The Bush administration remains concerned about the country's economic competitive edge vis-à-vis rapidly growing economies in developing nations.³² According to the World Bank, China consumes roughly twice as much energy per unit of Gross Domestic Product (GDP) when compared with Western economies.³³ As the second highest emitter of greenhouse gases, China could make significant carbon reductions via

26. Felicity Barringer & William Yardley, *Bush Splits With Congress and States on Emissions*, N.Y. TIMES, Apr. 4, 2007, at A1, available at <http://www.nytimes.com/2007/04/04/washington/04climate.html?ei=5088&en=2460afaf0817f45&ex=1333339200&adxnnl=1&partner=rssnyt&emc=rss&adxnnlx=1175693708-Hn0ktT0AboD1G2UX15PrA>.

27. See *New York v. Env'tl. Prot. Agency*, 443 F.3d 880 (D.C. Cir. 2006) (addressing the equipment replacement provision of the Clean Air Act). *Environmental Defense v. Duke Energy Corp.*, 127 S. Ct. 1423 (2007), a second Clean Air Act case issued the same day as *Massachusetts v. Environmental Protection Agency*. In *Duke Energy Corp.*, the Supreme Court held in part that annual emissions (rather than hourly emissions) are to be the controlling factor in determining whether factory and power plant emissions have risen and whether clean technology must be installed. *Id.* at 1434. The vote in *Duke Energy Corp.* was nine to zero. *Id.* at 1427; see also *Greenhouse*, *supra* note 18.

28. Barringer & Yardley, *supra* note 26.

California has been in the vanguard, first with its bill to regulate carbon dioxide emissions from vehicle tailpipes in 2002, and then with its landmark 2006 law requiring a 25 percent reduction in the state's carbon dioxide emissions by 2020. Arizona, New Mexico, Oregon and Washington have joined California to pursue a regional plan to cut emissions.

Id.

29. *Id.*

30. Barnes & Eilperin, *supra* note 8; see also *US 'Must Regulate Car Pollution'*, BBC NEWS, Apr. 2, 2007, <http://news.bbc.co.uk/2/hi/americas/6519923.stm> ("The Alliance of Automobile Manufacturers, an industry group representing the chief carmakers in the US, responded by calling for 'a national, federal, economy-wide approach to addressing greenhouse gases.'").

31. Barringer & Yardley, *supra* note 26.

32. *Id.*

33. Paul Wolfowitz, President, World Bank Group, Address at the Special Session of the Sao Paulo Forum on Climate Change: Environment and Development: Reaching for a Double Dividend (Dec. 20, 2005), available at <http://siteresources.worldbank.org/ESSDNETWORK/Resources/EnvironmentandDevelopmentReachingforaDoubleDividend.pdf>.

greater efficiency measures. Jeffrey Sachs notes that “[m]any larger countries, such as China, have prosperous regions that can help support their own lagging areas. Coastal eastern China, for instance, is now financing massive public investments in western China.”³⁴ Individual investors the world over have a stake in China’s economy, “one of the most vulnerable to a changing climate.”³⁵ John Ashton notes that

China is already planning to divert water hundreds of kilometres from the south, where it is currently abundant, to the arid but populous north, in order to maintain economic stability. But that plan will fail if the Himalayan glaciers that feed China’s southern rivers continue to melt at an accelerating rate because of a rising temperature.³⁶

China enacted the Cleaner Production Promotion Law in 2002, which established pilot pollution control programs in ten cities.³⁷ The World Bank and the Chinese Ministry of Finance have entered into a Memorandum of Understanding to develop a Clean Development Fund (CDF) that will generate sustainable development funding for China in proportion with China’s ability to reduce greenhouse gas emissions.³⁸ The World Bank has become a catalyst for carbon finance. Since 1990 the World Bank has invested \$6 billion in energy efficiency and renewable energy in developing countries, facilitating over \$10 billion from private and public sectors.³⁹ After its 1999 launch of the Prototype Carbon Fund, the World Bank has helped establish a series of Carbon Funds that enable participants to address

34. Jeffrey D. Sachs, *Can Extreme Poverty Be Eliminated?*, SCI. AM., Sept. 2005, at 56, 61; see also U.N. DEP’T OF ECON. & SOC. AFFAIRS, DIV. FOR SUSTAINABLE DEV., CASE STUDIES OF MARKET TRANSFORMATION: ENERGY EFFICIENCY AND RENEWABLE ENERGY 15–30 (2005), available at http://www.un.org/esa/sustdev/publications/energy_casestudies/full_rpt.pdf (discussing the rapid commercialization of renewable energy in China).

35. John Ashton, UK Climate Change Envoy, *World’s Most Wanted: Climate Change*, BBC NEWS, Sept. 8, 2006, <http://news.bbc.co.uk/2/hi/science/nature/5323512.stm>.

36. *Id.*

37. A.C. Valdez, *International Snapshot: Countries Target Carbon Emissions*, PBS NEWSHOUR, June 5, 2006, http://www.pbs.org/newshour/indepth_coverage/science/globalwarming/international.html; see also Law on the Promotion of Cleaner Production (P.R.C.) (promulgated by the Standing Comm. Nat’l People’s Cong., June 29, 2002) 2002 STANDING COMM. NAT’L PEOPLE’S CONG. GAZ. 291 (P.R.C.), available at <http://faolex.fao.org/docs/pdf/chn46926E.pdf>.

38. Robert Watson, World Bank Group, *Climate Change at a Glance: G8 and Climate Change Follow-up* (on file with *Vermont Law Review*); see also World Bank, News and Broadcast – Climate Change <http://web.worldbank.org/WBSITE/EXTERNAL/NEWS/0,,contentMDK:20432982~menuPK:344480~pagePK:64257043~piPK:437376~theSitePK:4607,00.html> (last visited Apr. 9, 2008).

39. *Id.*; see also WORLD BANK GROUP, BRIEF: SUSTAINABLE ENERGY 3 (2004), available at http://siteresources.worldbank.org/INTENERGY/Resources/Brief_Sustainable_Energy_110804.pdf.

market failures, gain confidence in emissions trading, and lower entry risks.⁴⁰ The World Bank's energy portfolio in China includes the China Renewable Energy Development Project that provides grants to companies that produce solar photovoltaic (solar PV) cells and sell them in rural China.⁴¹ Bank efforts are also underway to make Chinese coal-fired plants fifty percent more efficient, to experiment with carbon capture technology, and to promote the creation of a venture capital fund to support research and development of low carbon energy technologies.⁴² Sustained and harmonized government support of renewables and energy efficiency can redirect private funding from high to low carbon sources.⁴³

A. Technology Transfer

Transfer of environmentally sound technology is crucial to both greenhouse gas mitigation and climate adaptation.⁴⁴ Protection of intellectual property rights and worldwide diffusion of low carbon technologies are not irreconcilable goals. Patent owners do not want their technology to be stolen, impacting their willingness to transfer technologies in the absence of license agreements.⁴⁵ Drip irrigation, solar PV systems, wind turbines, and an array of other clean technologies need to be implemented as broadly as is practicable. Countries can negotiate a technology agreement as an amendment to the UN Framework Convention on Climate Change (UNFCCC) or as a freestanding environmentally sound technology transfer treaty.⁴⁶

40. The World Bank, *Climate Change: At a Glance*, <http://web.worldbank.org/WBSITE/EXTERNAL/NEWS/0,,contentMDK:20432982~menuPK:34480~pagePK:64257043~piPK:437376~theSitePK:4607,00.html> (last visited Feb. 17, 2008).

41. Press Release, The World Bank, *Ramping Up Renewable Energy* (May 28, 2006), <http://go.worldbank.org/MVR3OBURV0>.

42. *Id.*

43. *Id.*

44. See U.N. Conference on Environment and Development, June 3-14, 1992, *Agenda 21*, ¶ 34.18(e)(1), U.N. Doc. A/CONF. 151/26 (Aug. 12, 1992) (calling for the "[c]reation and enhancement by developed countries, as well as other countries which might be in a position to do so, of appropriate incentives, fiscal or otherwise, to stimulate the transfer of environmentally sound technology by companies, in particular to developing countries, as integral to sustainable development").

45. AARON COSBEY, WARREN BELL, DEBORAH MURPHY, JO-ELLEN PARRY, JOHN DREXHAGE, ANNE HAMMILL & JOHN VAN HAM, INT'L INST. FOR SUSTAINABLE DEV., *WHICH WAY FORWARD?: ISSUES IN DEVELOPING AN EFFECTIVE CLIMATE REGIME AFTER 2012*, at 25-26 (2005), available at http://www.iisd.org/pdf/2005/climate_which_way_forward.pdf.

46. United Nations Framework Convention on Climate Change, May 9, 1992, 31 I.L.M. 849, available at <http://unfccc.int/resource/docs/a/18p2a01.pdf> [hereinafter UNFCCC]; see also DANIEL BODANSKY, PEW CENTER ON GLOBAL CLIMATE CHANGE: INTERNATIONAL CLIMATE EFFORTS BEYOND

As the Bali Conference indicates, transparency and civil society participation can play a crucial role in achieving international agreement in keeping with scientific climate consensus. The building blocks of the Bali Roadmap include mitigating climate change by cutting emissions; facilitating clean technology transfer; adapting to such consequences of climate change as floods and droughts; and financing adaptation and mitigation measures. Bali delegates additionally agreed to support activities such as funding developing countries to prevent deforestation, and launched an Adaptation Fund.⁴⁷ Technology development and transfer will be facilitated by developed countries scaling up the use of environmentally sound technology in the developing world. Countries agreed to launch an investment program to transfer mitigation and adaptation technologies to developing countries. The Expert Group on Technology Transfer (EGTT) will be extended for another five years and will report to both the Subsidiary Body for Scientific and Technological Advice (SBSTA) and the Subsidiary Body for Implementation (SBI).⁴⁸

The European Union, Japan, and the United States are collaborating on the establishment of a new climate change body that can design conservation indicators and “transfer developed countries’ knowledge of energy conservation to other large energy consumers.”⁴⁹ It remains to be seen whether such a body will reside within the International Energy Agency, have other institutional affiliations, or be free standing. The *Financial Times* notes that

[b]y pooling our efforts to support a new clean technology fund, administered by the World Bank, we can help developing countries bridge the gap between dirty and clean technology. The fund will support publicly and privately financed projects that deploy technologies that can cut emissions and save energy.⁵⁰

2012: A SURVEY OF APPROACHES 2, 33 (2004), <http://www.pewclimate.org/docUploads/2012%20new%20Epdf>.

47. Personal observation based upon the author’s involvement as part of the UNICEF Delegation to the Bali Climate Conference. See generally *Bali Roadmap*, EARTH NEGOTIATIONS BULLETIN Vol. 12, No. 354 (Int’l Inst. For Sustainable Dev., New York, N.Y.), Dec. 18, 2007, at 15–17, available at <http://www.iisd.ca/download/pdf/enb12354e.pdf>.

48. *Id.* The author is involved in ongoing international technology transfer proceedings.

49. Masayuki Kitano & Roger Crabb, *Japan, US, EU Eye New Energy-Saving Body—Report*, REUTERS, Jan. 7, 2008, <http://www.planetark.com/dailynewsstory.cfm/newsid/46271/story.htm>.

50. Henry Paulson, Alistair Darling & Fukushima Nukaga, *Financial Bridge from Dirty to Clean Technology*, FIN. TIMES, Feb. 8, 2008, <http://www.ft.com/cms/s/0/43975af2-d5e7-11dc-bbb2-0000779fd2ac.html>.

Multilateral technology agreements among industrialized and non-industrialized nations can facilitate environmentally sound technology cooperation.⁵¹

Deployment of renewable energy technology is crucial over the next decade.⁵² Solar PV energy generation costs have fallen by sixty to seventy-five percent since 1980.⁵³ National Renewable Portfolio Standards would enable renewable energy generators to locate in environmentally optimal settings rather than being constrained to states with favorable legislation.⁵⁴ While the federal production tax credit has helped the wind power industry, the fact that it has been extended for such short durations has created boom-and-bust conditions for the wind sector.⁵⁵ Two-year extensions are too short for investing in energy producing infrastructure.⁵⁶ Congress has exacerbated uncertainty by allowing the credits to expire.⁵⁷

Government can be instrumental in facilitating the deployment of the renewable technology that can help prevent severe climate change.⁵⁸ Enacting efficiency standards can push new technologies into the marketplace.⁵⁹

In addition to R&D and technology standards, governments should augment pushing strategies with pulling renewable technologies across the threshold of cost-effectiveness into mass production. The latter can be accomplished via a carbon tax or emission regulation. Private public partnerships can occur throughout the process of basic R&D, applied R&D, demonstration, commercialization, and technology diffusion.⁶⁰

Just as larger carbon markets are better than smaller trading regimes, economies of scale will bring down the price of renewable technology.

51. Elizabeth Burleson, *Multilateral Climate Change Mitigation*, 41 U.S.F. L. REV. 373, 384 (2007) (citing BODANSKY, *supra* note 46, at 33); COSBY, BELL, MURPHY, PARRY, DREXHAGE, HAMMILL & VAN HAM, *supra* note 45, at 32.

52. WORLD RES. INST., TESTIMONY OF DR. JONATHAN PERSHING BEFORE THE U.S. SENATE ENVIRONMENT AND PUBLIC WORKS COMMITTEE CLIMATE ROUNDTABLE: EXPLORING GREENHOUSE GAS TECHNOLOGIES 8 (2006), available at http://pdf.wri.org/pershing_ewf_testimony.pdf.

53. *Id.* at 8–9.

54. *Id.* at 9.

55. *Id.*

56. *Id.*

57. *Id.*

58. *Id.*

59. *Id.* at 10.

60. Burleson, *supra* note 51, at 387 (citing WORLD RES. INST., *supra* note 52, at 5, 10).

Mass production of solar panels and batteries will make these carbon mitigation approaches more cost effective.

Once a technology has been developed, it will not necessarily be able to proceed from the pilot-program stage to commercialization. Subsidies play a significant role in the ability of a new concept to become widespread.⁶¹ In 2007, “the Energy Department plans to spend \$159 million on solar research and development. It will spend nearly double, \$303 million, on nuclear energy research and development, and nearly triple, \$427 million, on coal, as well as \$167 million on other fossil fuel research and development.”⁶² Governments and civil society need to assess the effects that subsidies have on the promotion or deterrence of environmentally sound technologies. Individuals holding public office need to show political leadership by raising public awareness about the advantages and disadvantages of competing energy strategies. Citizens need to be able to make informed decisions. In addition to a clear long-term plan, we must commit to intermediate targets and enact legislation that will facilitate short-term progress toward genuine atmospheric reduction of greenhouse gases.

Since each strategy involves environmental and social costs, it is important to comprehensively compare policy choices.⁶³ Socolow, Hotinski, Greenblatt, and Pacala note that

decisions that determine the energy efficiency of the world’s capital stock are particularly important, because they lock in a particular level of energy efficiency for many decades.

For example, the details of the construction of an apartment building can dictate its future CO₂ emissions for a century; of a power plant, for a half century; of a truck, for a decade.⁶⁴

The United Nations calls for “greater use of existing technologies like

61. See WORLD RES. INST., *supra* note 52, at 10 (observing that government can play a prominent role in commercializing and diffusing new technologies).

62. Andrew C. Revkin & Matthew L. Wald, *The Energy Challenge: Solar Power Wins Enthusiasts but Not Money*, N.Y. TIMES, July 16, 2007, <http://www.nytimes.com/2007/07/16/business/16solar.html?ex=1342238400&en=0c7b915f95c1c04a&ei=5088&partner=rssnyt&emc=rss>.

63. Robert Socolow, Roberta Hotinski, Jeffery B. Greenblatt & Stephen Pacala, *Solving the Climate Problem: Technologies Available to Curb CO₂ Emissions*, ENV’T, Dec. 2004, at 8, 10, available at http://www.princeton.edu/~cmi/resources/CMI_Resources_new_files/Environ_08-21a.pdf.

64. *Id.* at 10–11.

thermal insulation, solar shading and more efficient lighting and electrical appliances [M]ore than one-fifth of present energy consumption and up to 45 million tonnes of CO₂ per year could be saved by 2010 by applying more ambitious standards to new and existing buildings.”⁶⁵ Urban planning can facilitate safe, economically feasible public transport.⁶⁶ In addition to energy-efficient municipal modes of transportation, governments should subsidize hybrid car purchases and create viable bicycle path networks.⁶⁷ Roofs and walls can be utilized for solar electricity production, greatly reducing the space requirements for solar power.⁶⁸

The *Economist* notes that shortages of wind turbines and polysilicon for solar cells have substantially curtailed alternative energy development.⁶⁹ There are an insufficient number of refineries to transform plentiful sand into polysilicon.⁷⁰ Governments should be facilitating the production of solar power systems rather than fuels that emit high concentrations of greenhouse gases. The United States government is projected to invest roughly \$50 million in 2007 in vehicle battery development.⁷¹ This is an important first step towards a sensible energy policy.

The World Bank notes that “[e]xposure to soot and smoke causes about four million premature deaths and forty million new cases of chronic bronchitis every year. Women and children bear the greatest cost.”⁷² In the course of its relief work, the Office of the United Nations High Commissioner for Refugees (UNHCR) provides tents, blankets, and kitchen sets.⁷³ The international community has the capacity to distribute solar cookers across the globe. Such technology transfer could substantially reduce carbon emissions while increasing world health. Solar energy is no longer solely an off-the-grid solution to sustainable development. General

65. U.N. Envtl. Programme, *Building Sector Can Play Key Role in Combating Climate Change* (Mar. 29, 2007), <http://www.unep.org/Documents.Multilingual/Default.asp?DocumentID=502%20&ArticleID=5545&l=en>.

66. Socolow, Hotinski, Greenblatt & Pacala, *supra* note 63, at 8.

67. See U.S. Dep’t of Energy, *New Energy Tax Credits for Hybrids*, http://www.fueleconomy.gov/feg/tax_hybrid.shtml (last visited Feb. 3, 2007) (charting tax credits available for many makes and models of hybrid vehicles).

68. Socolow, Hotinski, Greenblatt & Pacala, *supra* note 63, at 12.

69. *Alternative Energy: Headwinds*, *ECONOMIST*, March 29, 2007, at 89, available at http://www.economist.com/printedition/displayStory.cfm?story_id=8935021&fsrc=RSS.

70. *Id.*

71. Neal E. Boudette & John D. Stoll, *Big Three Seek Battery Subsidies—Larger U.S. Outlay Would Speed Work on Electric Vehicles*, *WALL ST. J.*, Jan. 9, 2007, at A14.

72. Wolfowitz, *supra* note 33.

73. The Secretary-General, *Report of the Secretary-General on the Work of the Organization*, ¶ 171, delivered to the General Assembly, U.N. Doc. Supp. No. 1 A/60/1 (Aug. 5, 2005), available at <http://daccessdds.un.org/doc/UNDOC/GEN/N05/453/25/PDF/N0545325.pdf?OpenElement>.

Electric Energy Financial Services is funding the largest solar power station to date.⁷⁴ It will have the capacity to supply electricity to 8000 homes.⁷⁵ PowerTracker technology will rotate the solar modules to follow the sun throughout the day.⁷⁶

B. Energy Efficiency

In response to the G8 Gleneagles Plan of Action mandate to identify sustainable energy strategies, the International Energy Agency (IEA) has published a lighting assessment.⁷⁷ Executive Director of the IEA, Claude Mandil, points out that “the potential for energy savings in lighting is simply enormous and can be achieved with technologies that not only are readily available in the market but economically competitive during the life cycle of the product.”⁷⁸ The study found that a worldwide transfer to efficient lighting could reduce global electricity use by nearly one-tenth.⁷⁹ Mandil points out that

[w]orldwide, grid-based electric lighting consumes 19% of total global electricity production, slightly more electricity than used by the nations of OECD Europe for all purposes. Lighting requires as much electricity as is produced by all gas-fired generation and 15% more than produced by either hydro or nuclear power. The annual cost of this service including energy, lighting equipment and labour is USD 360 billion, which is roughly 1% of global GDP. Electricity accounts for some two-thirds of this.⁸⁰

74. *Portugal Starts Huge Solar Plant*, BBC NEWS, June 7, 2006, <http://news.bbc.co.uk/2/hi/europe/5056012.stm>.

75. *Id.*

76. *Id.*

77. Press Release, Int'l Energy Agency, “Light’s Labour’s Lost”—Policies for Energy Efficient Lighting (June 29, 2006) [hereinafter IEA, *Light’s Labour’s Lost*], available at http://www.iea.org/Textbase/press/pressdetail.asp?PRESS_REL_ID=182. The assessment is entitled INT’L ENERGY AGENCY, LIGHT’S LABOUR’S LOST: POLICIES FOR ENERGY-EFFICIENT LIGHTING (2006).

78. *Id.*

79. Richard Black, *Lighting the Key to Energy Saving*, BBC NEWS, June 29, 2006, <http://news.bbc.co.uk/2/hi/science/nature/5128478.stm> [hereinafter Black, *Lighting the Key to Energy Savings*].

80. IEA, *Light’s Labour’s Lost*, *supra* note 77; see also Black, *Lighting the Key to Energy Savings*, *supra* note 79 (“Nineteen percent of global electricity generation is taken for lighting—that’s more than is produced by hydro or nuclear stations, and about the same that’s produced from natural gas.”).

Light-emitting diodes (LEDs) are more energy efficient than other lights.⁸¹ With a ten-year lifespan, many LED panels far outlive the cell phones and other electronic goods to which they are attached.⁸² These semiconductor chip-based lights emit so little energy that they do not become hot.⁸³ LEDs are challenging the incandescent lighting dominance of companies.⁸⁴

Replacing appliances can be confusing, as can determining how low one can set a thermostat in the winter before risking frozen pipes. Insulating water pipes can help. Water heater wraps also are an inexpensive way to save energy, as is turning down a water heater thermostat to 120°F. It is neither expensive nor difficult to install water-efficient showerheads and faucet heads for kitchen and bathroom sinks. Making these changes requires recalibrating one's comfort zone rather than one's budget. Time and administrative hassle are obstacles to repairing leaky faucets and toilets or paying someone else to do so. If we are a service economy, then relying upon economic models that assume that people have perfect information becomes unrealistic. While economic models assume no information costs, often choices must be made without understanding the trade-offs. Most people would prefer to be informed decision-makers, but life is full of choices that must be made without a great deal of information. Some measures are common sense, such as turning off lights when leaving a room. Other measures require a calculation between the energy saved and the social good forgone.⁸⁵

The National Resources Defense Council (NRDC) observes that "[i]t takes only three to eight months for a wind energy farm to recoup its investment in building and installation—that's one of the shortest returns of any energy technology on the market."⁸⁶ NRDC notes that a fifty-megawatt

81. Burleson, *supra* note 51, at 396 (citing Evan Ramstad & Kathryn Kranhold, *Changing the Light Bulb: No Joke: LED Technology Fuels Fast Growth in Once-Staid Industry*, WALL ST. J., June 8, 2006, at B1).

82. Ramstad & Kranhold, *supra* note 81.

83. *Id.*

84. General Electric researchers use Consensus Point software to create decision markets that pool collective knowledge. Michael Totty, *Business Solutions*, WALL ST. J., June 19, 2006, at R9. Corporate meetings often generate the most vocal ideas rather than an optimal strategy. *Id.* Decision markets can facilitate information sharing between institutions and divisions of a single institution. *Id.* If the incentives are calibrated effectively, such markets can lead players to gather information, decide upon a feasible strategy, clarify favored outcomes in a transparent manner, and act upon collective knowledge. *Id.*

85. Lee Gomes, *Technology (A Special Report)—Technical Adviser*, WALL ST. J., June 19, 2006, at R14.

86. Natural Res. Def. Council, *Wind Power*, <http://www.nrdc.org/air/energy/renewables/wind.asp> (last visited Feb. 17, 2007).

wind power system can be built within eighteen to twenty-four months, a fraction of the time needed to construct a coal or natural gas power plant.⁸⁷ Natural gas is viewed by the World Bank as a bridging fuel as renewable sources become commercially viable.⁸⁸ Natural gas/wind hybrid systems can combine reliable power, an ability to increase or decrease electricity output quickly, and a capacity to substantially reduce fossil fuel consumption.⁸⁹ Careful siting can reduce the impact of turbines upon migratory birds as well as upon human populations committed to wilderness preservation.⁹⁰ Development of over a dozen wind power projects has been halted by a Defense Department study on wind turbine impact upon military radar.⁹¹ Senator Richard Durbin questioned the study in a letter to the Defense Department, noting that there are many existing wind farms operating in military radar areas.⁹² Enhancing rather than jeopardizing national security, wind offers a renewable, domestic option for energy security.

III. NATIONAL DEFENSE AND ENERGY SECURITY

Highlighting the importance of research on the scale of the Manhattan Project, Kammen and Nemet calculate that energy research and development (R&D) spending of \$15-30 billion/year could lead to carbon leveling off at twice that of pre-industrial concentrations.⁹³ Kammen and Nemet's figures are based upon 2002 dollars.⁹⁴ The Manhattan Project cost \$25 billion (\$10 billion of which was spent during its peak year).⁹⁵ Reagan defense cost \$445 billion (\$58.4 billion of which was spent during its peak

87. *Id.*

88. DEV. COMM'N (JOINT MINISTERIAL COMM'N OF THE INT'L MONETARY FUND AND THE WORLD BANK), CLEAN ENERGY AND DEVELOPMENT: TOWARDS AN INVESTMENT FRAMEWORK 10 (2006) [hereinafter THE WORLD BANK & IMF, CLEAN ENERGY AND DEVELOPMENT].

89. GRANGER MORGAN, JAY APT & LESTER LAVE, THE U.S. ELECTRIC POWER SECTOR AND CLIMATE CHANGE MITIGATION 66-67 (2005), available at http://www.pewclimate.org/docUploads/Electricity_Final.pdf.

90. Kari Lydersen, *Wind-Power Projects Halted: Supporters See Political Motive Behind Defense Dept. Study*, WASH. POST, June 10, 2006, at A2, available at http://www.washingtonpost.com/wp-dyn/content/article/2006/06/09/AR2006060901420.html?nav=rss_politics.

91. *Id.*

92. *Id.*

93. Daniel M. Kammen & Gregory F. Nemet, *Real Numbers: Reducing the Incredible Shrinking Energy R&D Budget*, ISSUES IN SCI. & TECH., Fall 2005, at 84, 84, available at <http://rael.berkeley.edu/files/2005/Kammen-Nemet-ShrinkingRD-2005.pdf>.

94. *Id.* at 85.

95. *Id.*

year).⁹⁶ The 2002–2004 leg of the War on Terror cost \$187.1 billion (\$67.7 billion of which was spent during its peak year).⁹⁷ Increasing energy R&D by a factor of five between 2005 and 2015 would cost \$47.9 billion (\$17.1 billion of which would be spent during a peak year).⁹⁸ Similarly, increasing energy R&D by a factor of ten between 2005 and 2015 would cost \$154.3 billion (\$34.0 billion of which would be spent during a peak year).⁹⁹ Daniel Kammen and Gregory Nemet note that “[i]nvestments in energy R&D by U.S. companies fell by fifty percent between 1991 and 2003.”¹⁰⁰ New York University physics professor Martin Hoffert observes that most of the private sector appears to be unwilling to pursue anything that will not turn a profit in three to five years.¹⁰¹ Cellular phones, communications satellites, and nuclear power resulted from heavy government R&D.¹⁰² Military jet airplanes led to commercial jet airplanes.¹⁰³ Lasers and radar also came from defense research, as did the Internet.¹⁰⁴ Hundreds of billions of dollars went into developing these technologies.¹⁰⁵

Geoffrey Landis of NASA describes the possibility of generating electricity from solar power satellites.¹⁰⁶ Solar modules orbit the earth, remaining in sunlight twenty-four hours a day.¹⁰⁷ Earth-based antennas could receive the solar energy via microwaves.¹⁰⁸ Martin Hoffert notes that “between eight and ten times as much solar energy per unit area exists in space as on Earth.”¹⁰⁹ Moreover, this light is constant, but the expense of launching satellites has delayed exploration of solar power in space.¹¹⁰

96. *Id.*

97. *Id.*

98. *Id.*

99. *Id.*

100. *Id.* at 84. Furthermore, “[s]ince 1980, energy R&D as a percentage of total U.S. R&D has fallen from 10 percent to 2 percent.” *Id.* at 85.

101. PBS, *Beyond Fossil Fuels: An Interview with Professor Martin Hoffert*, <http://www.pbs.org/wgbh/warming/beyond/> (last visited Feb. 6, 2008) [hereinafter PBS, *Beyond Fossil Fuels*].

102. *Id.*

103. *Id.*

104. *Id.*

105. *Id.*

106. GEOFFREY A. LANDIS, GLENN RESEARCH CTR., NASA, *REINVENTING THE SOLAR POWER SATELLITE 2* (2004), available at <http://gltrs.grc.nasa.gov/reports/2004/TM-2004-212743.pdf>.

107. *Id.* at 17. In contrast, an area of the Sahara 800 kilometers by 800 kilometers would be required to meet global electricity demand via solar PV panels. *Deserts Need Better Management*, BBC NEWS, June 5, 2006, <http://news.bbc.co.uk/2/hi/science/nature/5041988.stm>.

108. LANDIS, *supra* note 106, at 16.

109. PBS, *Beyond Fossil Fuels*, *supra* note 101.

110. Elizabeth Kolbert, *The Climate of Man—III*, NEW YORKER, May 9, 2005, at 7, available at <http://www.wesjones.com/climate3.htm>.

Hoffert suggests the use of a tightly focused microwave beam similar to the technology upon which cell-phone towers operate.¹¹¹ Alternatively, superconducting wires could be used to transmit electricity.¹¹² Whether or not satellites become an alternative energy source, investing in satellites that can generate climate quality data is crucial.¹¹³ The first space-borne instrument created specifically to determine global climate change indicators is the Atmospheric Infrared Sounder (AIRS).¹¹⁴ It was launched on NASA's weather and climate research satellite Aqua.¹¹⁵ AIRS measures global water vapor and other greenhouse gases, enabling scientists to map three-dimensional global distributions of various greenhouse gases.¹¹⁶ Climate is the average of weather calculations over many years.¹¹⁷ It is difficult to track tropospheric temperatures.¹¹⁸ Satellites record the temperature of the air between their sensors and the Earth's surface.¹¹⁹ This process is not able to fine-tune relative altitudes and can be unreliable due to drifting satellite orbit and aging instrumentation.¹²⁰ Operating satellites with an overlap of recordkeeping would facilitate calibration between satellites.¹²¹ Greater consistency would also be achieved by monitoring cloud formation, humidity, and wind.¹²² Weather balloons sense real-time temperatures as they rise.¹²³ Delineating reference sites for such measurements could enhance consistency across datasets.¹²⁴

The United States spent \$18 billion on climate research between 1990 and 2006.¹²⁵ A 2006 *New York Times* analysis noted that "[w]ar costs for

111. *Id.*

112. *Id.*

113. See Jet Propulsion Lab., NASA's New Satellite Takes on Global Change, [http://www-airs.jpl.nasa.gov/News/Features/FeaturesClimateChange/Severe Weather/](http://www-airs.jpl.nasa.gov/News/Features/FeaturesClimateChange/Severe%20Weather/) (last visited Jan. 23, 2008) [hereinafter JPL, NASA's New Satellite] (explaining that AIRS can measure weather patterns associated with global warming in order to better predict severe weather events).

114. Jet Propulsion Lab., AIRS—Mission: A Greenhouse Gas Sensor, <http://www-airs.jpl.nasa.gov/Mission/Greenhouse/> (last visited Feb. 15, 2008).

115. Jet Propulsion Lab., Mission—What is AIRS?, <http://www-airs.jpl.nasa.gov/Mission/WhatIsAIRS/> (last visited Feb. 1, 2008).

116. *Id.*

117. JPL, NASA's New Satellite, *supra* note 113.

118. Richard Black, 'Clear' Human Impact on Climate, BBC NEWS, May 3, 2006, <http://news.bbc.co.uk/2/hi/science/nature/4969772.stm>.

119. *Id.*

120. *Id.*

121. *Id.*

122. *Id.*

123. *Id.*

124. *Id.*

125. Kathryn Cohen, *Consensus Elusive on U.S. Global Warming Policy*, PBS NEWSHOUR, June 5, 2006, http://www.pbs.org/newshour/indepth_coverage/science/globalwarming/policy.html.

Iraq and Afghanistan have totaled more than \$300 billion since 2003, and the Bush administration has not included any war costs in its budget estimates beyond next year.”¹²⁶ The World Bank estimates that “[t]he incremental costs of mitigating greenhouse gas emissions is estimated to range from less than \$10 billion per year to about \$200 billion per year depending on the stabilization target, and the pathway to stabilization.”¹²⁷ The statement that energy is a national security issue can lead to a wide array of policy outcomes. Diversifying supply enhances energy security.¹²⁸ Decentralized renewable energy sources, such as solar and wind, make the grid less vulnerable to war or terrorist targeting.¹²⁹ Military research led to the discovery that, in addition to shrinking, Arctic ice sheets have been thinning rapidly over two decades.¹³⁰ The ice has become forty percent thinner according to the recently declassified military records of Cold War era submarines that were stationed for long durations under the Arctic ice.¹³¹ Spillover effects from military research have not led to sufficient energy security.¹³² The Pew Center on Global Climate Change recommends dedicating one or more national weapons laboratories to energy efficiency and renewable energy projects.¹³³ The Pew Center additionally suggests that the Department of Defense’s research selection process consider greenhouse gas emissions in all of its decision-making processes.¹³⁴ Current levels of renewable energy support are inadequate to

126. Edmund Andrews, *Surprising Jump in Tax Revenues Is Curbing Deficit*, N.Y. TIMES, July 9, 2006, <http://www.nytimes.com/2006/07/09/washington/09econ.html?pagewanted=2&ei=5088&en=ec2d242da8699725&ex=1310097600&partner=rssnyt&emc=rss>.

127. THE WORLD BANK & IMF, CLEAN ENERGY AND DEVELOPMENT, *supra* note 88, at vii.

128. *Id.* at vi.

129. ANDREW BLAKERS, KLAUS WEBER & WERNIE EVERETT, CTR. FOR SUSTAINABLE ENERGY SYS., AUSTRALIAN NAT’L UNIV., SOLAR ELECTRICITY 7 (2006), available at http://www.abare.gov.au/publications_html/climate/climate_06/ol_climate.pdf.

130. Richard Black, *Earth—Melting in the Heat?*, BBC NEWS, May 18, 2007, <http://news.bbc.co.uk/1/hi/sci/tech/4315968.stm>.

131. *Id.*

132. MORGAN, APT & LAVE, *supra* note 89, at 49–50.

133. PEW CTR. ON GLOBAL CLIMATE CHANGE, AGENDA FOR CLIMATE ACTION 3 (2006) [hereinafter PEW, AGENDA FOR CLIMATE CHANGE], available at <http://www.pewclimate.org/docUploads/PCC%5FAgenda%5F2%2E08%2Epdf>.

134. *Id.* A seventy ton tank under desert combat conditions, for instance, has a fuel efficiency of less than one mile per gallon. Thom Shanker, *Military Plans Tests in Search for an Alternative to Oil-Based Fuel*, N.Y. TIMES, May 14, 2006, at A16, available at <http://www.nytimes.com/2006/05/14/us/14fuel.html?ex=1305259200&en=35f7d36ad391425d&ei=5088&partner=rssnyt&emc=rss>. An F-16 requires almost twenty-eight gallons of fuel per minute to light up its afterburners. *Id.* Consuming more than half of the fuel used by the United States government, the Air Force will begin testing a natural gas/oil-based fuel blend. *Id.* The Air Force plans to move on to a coal-based fuel blend given its availability and low cost. *Id.* This policy decision conflicts with greenhouse gas reduction. In

the task of bringing renewable technologies across the threshold to full marketability.

Federal government spending on energy totaled \$14 billion in 2004.¹³⁵ The United States spent \$553 billion on national defense and \$275 billion on all federal non-defense expenditures in 2004.¹³⁶ Roughly half of global national security spending is consumed by the United States.¹³⁷ The national accounts concept of national defense figure was roughly \$590 billion for 2005.¹³⁸ In contrast, China spent the second highest amount, \$50–200 billion in 2004. Russia has spent \$15–50 billion annually in recent years.¹³⁹ The global arms sale reached \$31.8 billion in 2005 with the United States, Russia, and the UK selling the most weapons to the developing world.¹⁴⁰

The ranking Republican on the Appropriations defense subcommittee, Senator Ted Stevens, noted that the “cost of this war is approaching \$15 billion a month.”¹⁴¹ In February 2007, the *Wall Street Journal* also noted that “[s]ince President Bush took office, he’s boosted annual defense spending by 50%—including \$500 billion over five years for fighting in Iraq and Afghanistan.”¹⁴² Annual defense spending in the United States is roughly four percent of the GDP.¹⁴³

the fiscal year of 2005 the Air Force used 3.2 billion gallons of aviation fuel. *Id.* Its jet fuel cost \$4.7 billion. *Id.* The Air Force has been authorized to purchase 100,000 gallons of synthetic fuel. *Id.* Working with the Naval Fuels Laboratory and the Automotive Tank Command of the Army, the Air Force seeks to develop a fuel that can be used by the entire military. *Id.* The decision to move towards coal as a fuel source is extremely controversial. *Id.*

135. William Nordhaus, Yale Univ., *The Problem of Excessive Military Spending in the United States 1* (Prepared for the Annual Meetings of the Am. Econ. Assoc., Boston, Mass. Jan. 8, 2005), available at http://nordhaus.econ.yale.edu/military_010405.pdf.

136. *Id.* at 2.

137. *See id.* (stating that every family in the United States spends approximately \$5000 annually on national security).

138. *Id.*

139. *Id.*

140. Thom Shanker, *U.S. Is Top Arms Seller to Developing World*, N.Y. TIMES, Oct. 1, 2007, <http://www.nytimes.com/2007/10/01/us/01weapons.html?hp=&pagewanted=all>.

141. Walter Pincus, *Wars Cost \$15 Billion a Month, GOP Senator Says*, WASH. POST, Dec. 27, 2007, at A7, available at http://www.washingtonpost.com/wp-dyn/content/article/2007/12/26/AR2007122601542.html?wpisrc=rss_nation/nationalsecurity; see also Jonathan Karp, *Defense Reloads; Rising Pentagon Spending Quells Talk of Profit Plateau*, WALL ST. J., Jan. 17, 2007, at A14 (noting that weapons purchases for 2007 Pentagon and supplemental war requests approximate \$135 billion.); Lolita C. Baldor, *Pay Soars to Keep People in Military*, WASH. POST, Apr. 11, 2007, <http://www.washingtonpost.com/wp-dyn/content/article/2007/04/11/AR2007041100198.html> (“The Pentagon poured more than \$1 billion into bonuses last year to keep soldiers and Marines in the military in the face of an unpopular war and battlefield deployments that are getting longer and more frequent.”).

142. Deborah Solomon, *Guns and Butter: How War's Expense Didn't Strain Economy; Foreign Lending, Lessons From LBJ; How Long Will It Last?*, WALL ST. J., Feb. 5, 2007, at A1.

143. *Id.*

A military advisory board, including eleven former United States generals and admirals, has assessed the likely national security threats presented by climate change. The military advisory board's findings and recommendations are as follows:

Findings:

1. Projected climate change poses a serious threat to America's national security.
2. Climate change acts increases the potential instability in some of the most volatile regions of the world.
3. Projected climate change will boost tensions even in stable regions.
4. Climate change, national security, and energy dependence are a related set of global challenges.

Recommendations:

1. Climate change should be integrated into national security and national defense strategies.
2. The United States should vow to help stabilize climate changes at levels that will avoid significant disruption to global security and stability.
3. The United States should commit to global partnerships that help less-developed nations better manage climate impacts.
4. The Department of Defense should speed adoption of improved business processes and innovative technologies that boost U.S. combat power through energy efficiency.
5. The Pentagon should assess the impact on U.S. military installations worldwide of rising sea levels, extreme weather events, and other possible climate change impacts over the next 30 to 40 years.¹⁴⁴

In its report, *Rising Above the Gathering Storm*, the National Academies urged the Department of Energy to create a research-financing body on the scale of the Defense Advanced Research Projects Agency (DARPA) to provide grants and coordination of climate change mitigation and adaptation.¹⁴⁵ The *New York Times* notes that DARPA,

144. David McNew, *Climate Change Worries Military Advisers*, (NPR radio broadcast Apr. 16, 2007), <http://www.npr.org/templates/story/story.php?storyId=9580815&ft=1&f=1001>.

145. Andrew C. Revkin, *Budgets Falling in Race to Fight Global Warming*, N.Y. TIMES, Oct. 30, 2006, at A1, available at <http://www.nytimes.com/2006/10/30/business/worldbusiness/30energy>

created after the Soviet Union launched Sputnik in 1957, was set up outside the sway of Congress to provide advances in areas like weapons, surveillance and defensive systems. But it also produced technologies like the Internet and the global positioning system [GPS] for navigation.¹⁴⁶

The United States needs to take adaptation seriously. The City of New Orleans is suing the U.S. Army Corps of Engineers (Corps), “seeking \$77 billion for damages sustained when the corps-built levees broke during Hurricane Katrina, flooding 80 percent of the city.”¹⁴⁷ Nearly fifty percent of the city’s residents were diagnosed with depression, panic disorders, and post-traumatic stress over the subsequent year.¹⁴⁸ By March 2008, New Orleans is still losing millions of gallons of fresh water a day from leaky pipes.¹⁴⁹ FEMA is buying back mobile homes sold to victims of Hurricane Katrina, but victims are responsible for transporting the formaldehyde-tainted trailers back to FEMA drop-off points.¹⁵⁰ According to *Fortune Magazine*, “Louisiana and the area off its coastline produce or transport 30 percent of the nation’s domestic crude oil and 34 percent of its natural gas; it also refines 16 percent of our petroleum.”¹⁵¹ United States energy security remains concentrated in a vulnerable stretch of Louisiana. John Ashton notes that

[o]n 28 August 2005, New Orleans was a prosperous, stable and relatively harmonious city. By the next evening, most of its

.html?ex=1319864400&en=3fe47b61ce91a7c1&ei=5088&partner=rssnyt&emc=rss.

146. *Id.*

147. *New Orleans Files \$77 Billion Claim Against Army Corps*, PBS NEWSHOUR, Mar. 2, 2007, http://www.pbs.org/newshour/updates/weather/jan-june07/neworleans_03-02.html. See generally John Solomon & Spencer S. Hsu, *Most Katrina Aid from Overseas Went Unclaimed*, WASH. POST, Apr. 29, 2007, at A1, available at http://www.washingtonpost.com/wp-dyn/content/article/2007/04/28/AR2007042801113.html?nav=rss_print/asection (noting that “while television sets worldwide showed images of New Orleans residents begging to be rescued from rooftops as floodwaters rose, U.S. officials turned down countless offers of allied troops and search-and-rescue teams”).

148. *Mental Disorders Rife After Hurricane Katrina—Study*, REUTERS, Dec. 4, 2007, <http://www.planetark.com/dailynewsstory.cfm/newsid/45717/story.htm>.

149. John Burnett, *Water Lines Remain Shattered in New Orleans*, (NPR radio broadcast Mar. 4, 2008), <http://www.npr.org/templates/story/story.php?storyId=87877841&ft=1&f=1001>.

150. Marc Kaufman, *More Katrina Fallout: FEMA Flip-Flops Again on Trailers*, WASH. POST, Jan. 18, 2008, at A17, available at http://www.washingtonpost.com/wp-dyn/content/article/2008/01/17/AR2008011702965.html?wpisrc=rss_politics/fedpage.

151. Charles C. Mann, *How the Energy Business is Drowning Louisiana*, FORTUNE MAG., Aug. 16 2006, at 1, available at http://money.cnn.com/2006/08/14/magazines/fortune/neworleans_oil.fortune/index.htm.

population had been driven from their homes and lacked access to electricity, food, fresh water and medical services.

Within a week, gunmen roamed the streets as law and order broke down; simmering racial and political tensions exploded as the buck for dealing with the catastrophe—as well as preventing it—was hurled about. For months, neighbouring cities and states were inundated with refugees as the political and racial stresses spilled across the country.¹⁵²

Ashton goes on to point out that the threat to security of climatic events in already fragile regions will be more striking; he further notes that “[a] major contributing factor to the conflict in Darfur has been a shift in rainfall that has put nomadic herders and settled pastoralists into conflict with each other.”¹⁵³ German Foreign Minister Frank-Walter Steinmeier pointed out that a Cold War is emerging in the Arctic that the international community needs to prevent, noting that “[c]limate change is a threat to worldwide peace and security.”¹⁵⁴

Ashton notes that military force is not an effective means of inducing all state and non-state actors to lower greenhouse gas emissions.¹⁵⁵ “No weapon system can halt the advance of a hurricane bearing down on a city, or stem the rising sea, or stop the glaciers melting. . . . [t]he politics and diplomacy have to work.”¹⁵⁶ Governments need to commit national security resources and negotiate cost-effective climate change agreements that reduce greenhouse gas emissions without divisive market distortions.¹⁵⁷ The next fifteen years are crucial.¹⁵⁸

IV. ADAPTATION

Adaptation requires behavioral changes on the part of an individual or group in response to altered conditions. The Nobel Prize-winning Intergovernmental Panel on Climate Change (IPCC) has concluded that anthropogenic climate change has impacted the natural world and human

152. Ashton, *supra* note 35.

153. *Id.*

154. Steinmeier: *Climate Change Growing Threat to Peace*, REUTERS Oct. 24, 2007, <http://www.planetark.com/dailynewsstory.cfm/newsid/44972/story.htm>.

155. Ashton, *supra* note 35.

156. *Id.*

157. *Id.*

158. *Id.*

societies. The 2007 IPCC report was compiled with the help of hundreds of scientists from around the globe and endorsed by government representatives.¹⁵⁹ The report states that

[o]bservational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases.

With regard to changes in snow, ice and frozen ground (including permafrost), there is high confidence that natural systems are affected.¹⁶⁰

The report says with high confidence that there will be “increased deaths, disease and injury due to heat waves, floods, storms, fires and droughts.”¹⁶¹ The IPCC calls for “education, health care, public health initiatives and infrastructure and economic development.”¹⁶² The international community needs to facilitate sustainable development and reduce developing country vulnerability to climate shocks.¹⁶³

The IPCC brings together scientists and government representatives in a process that provides a scientifically based, governmentally endorsed policy guide.¹⁶⁴ Governmental editing led to prolonged negotiations.¹⁶⁵ The United States, Saudi Arabia, China, and India insisted that the final language be less certain than the scientists’ draft.¹⁶⁶ The United States

159. Ban Ki-moon Urges States to Act Decisively to Mitigate Worst Effects of Climate Change, U.N. NEWS CTR., Apr. 6, 2007, <http://www.un.org/apps/news/story.asp?NewsID=22153&Cr=Climate&Cr1=>.

160. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (WORKING GROUP II TO THE FOURTH ASSESSMENT REPORT OF THE IPCC), CLIMATE CHANGE 2007: IMPACTS, ADAPTATION AND VULNERABILITY 8 (Martin Parry et al., eds. 2007) [hereinafter IPCC WORKING GROUP II CLIMATE CHANGE IMPACTS, ADAPTATION AND VULNERABILITY 2007 REPORT] (footnote omitted), available at <http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-spm.pdf>; see also Burleson, *supra* note 51, at 376 (discussing the previous report issued in February 2007, entitled INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (WORKING GROUP I), CLIMATE CHANGE: THE PHYSICAL SCIENCE BASIS (2007) [hereinafter IPCC WORKING GROUP I CLIMATE CHANGE IMPACTS, ADAPTATION AND VULNERABILITY 2007 REPORT], available at <http://www.ipcc.ch/ipccreports/ar4-wg1.htm>).

161. IPCC WORKING GROUP II CLIMATE CHANGE IMPACTS, ADAPTATION AND VULNERABILITY 2007 REPORT, *supra* note 160, at 12.

162. *Id.*

163. See Kanter & Revkin, *supra* note 2 (outlining the dangers of climate change and the need for international involvement).

164. *Id.*

165. *Id.*

166. Billions Face Climate Change Risk, BBC NEWS, Apr. 6, 2007, <http://news.bbc.co.uk/2/hi/science/nature/6532323.stm>.

delegation called for the elimination of a statement that parts of North America may experience “severe economic damage” from climate change.¹⁶⁷

The United States delegation tried to water down European scientists’ language that emphasized how much the economies of poor countries would be devastated and how small a contribution poor countries have made to greenhouse gas emissions in relation to industrialized countries.¹⁶⁸ According to the United Nations University, “[t]he richest 2 percent of people in the world own more than half of all household wealth, while the poorer half of the global population control just 1 per cent”¹⁶⁹ The final April 2007 IPCC report points out that “[p]oor communities can be especially vulnerable, in particular those concentrated in high-risk areas. They tend to have more limited adaptive capacities, and are more dependent on climate-sensitive resources such as local water and food supplies.”¹⁷⁰ The authors make it clear that

the impacts of future climate change will be mixed across regions. For increases in global mean temperature of less than 1-3°C above 1990 levels, some impacts are projected to produce benefits in some places and some sectors, and produce costs in other places and other sectors. It is, however, projected that some low-latitude and polar regions will experience net costs even for small increases in temperature. It is very likely that all regions will experience either declines in net benefits or increases in net costs for increases in temperature greater than about 2-3°C. These observations confirm evidence reported in the Third Assessment that, while developing countries are expected to experience larger percentage losses, global mean losses could be 1-5% GDP for 4°C of warming.¹⁷¹

Beyond adaptation to climate change, European delegates negotiated for a

167. *Climate Report Warns of Faster and Wider Damage*, N.Y. TIMES, Apr. 6, 2007, <http://www.nytimes.com/reuters/world/international-globalwarming.html?partner=rssnyt&emc=rss>.

168. Christopher Joyce, *U.N. Climate Report Predicts Droughts, Flooding*, (NPR radio broadcast April 6, 2007), <http://www.npr.org/templates/story/story.php?storyId=9433825&ft=1&f=1001>.

169. *Small Band of Rich Controls Majority of Global Wealth, UN Study Finds*, U.N. NEWS CTR., Dec. 5, 2006, <http://www.un.org/apps/news/story.asp?NewsID=20856&Cr=UN&Cr1=University>.

170. IPCC WORKING GROUP II CLIMATE CHANGE IMPACTS, ADAPTATION AND VULNERABILITY 2007 REPORT, *supra* note 160, at 12.

171. *Id.* at 17 (citation omitted).

clear statement calling for greenhouse gases to be reduced.¹⁷² The United States delegation obtained the removal of language in one section, calling for lowering greenhouse gas emissions.¹⁷³ The final report states that “[a]daptation alone is not expected to cope with all the projected effects of climate change, and especially not over the long term as most impacts increase in magnitude.”¹⁷⁴ The following sentence, “mitigation measures will therefore also be required,” was omitted from the final text.¹⁷⁵ China and Saudi Arabia negotiated for the deletion of the word “very” from the statement that it is very likely that global warming is impacting physical and biological systems.¹⁷⁶ The term “very high confidence” equates to at least ninety percent confidence rate in the scientific finding.¹⁷⁷ Juliet Eilperin of the *Washington Post* notes that “when China asked that the word ‘very’ be stricken, three scientific authors balked, and the deadlock was broken only by a compromise to delete any reference to confidence levels.”¹⁷⁸ Despite petro-politics, participants agreed upon a final report that is a clarion call for coordinated climate change mitigation and adaptation.

Western Europe and the United States have contributed two-thirds of the carbon dioxide that has accumulated in the atmosphere.¹⁷⁹ Countries responsible for climate change have spent billions adapting, yet have not acted upon treaty commitments to help poor nations adapt to climate extremes.¹⁸⁰ Africa has produced fewer than three percent of the world’s emissions of carbon dioxide from the burning of fuel since 1900.¹⁸¹ The April 2007 IPCC report indicates that “[b]y 2020, between 75 million and

172. Kanter & Revkin, *supra* note 2; see also *U.S. Has to Act on Climate Report*, BBC NEWS, Apr. 2, 2007, <http://news.bbc.co.uk/2/hi/science/nature/6528539.stm>.

173. Juliet Eilperin, *U.S., China Got Climate Warnings Toned Down*, WASH. POST, Apr. 7, 2007, at A5, available at http://www.washingtonpost.com/wp-dyn/content/article/2007/04/06/AR2007040600291.html?nav=rss_politics.

174. IPCC WORKING GROUP II CLIMATE CHANGE IMPACTS, ADAPTATION AND VULNERABILITY 2007 REPORT, *supra* note 160, at 19.

175. Eilperin, *supra* note 173.

176. Joyce, *supra* note 168.

177. IPCC WORKING GROUP I TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS, SUMMARY FOR POLICYMAKERS 3, available at http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_SPM.pdf.

178. Eilperin, *supra* note 173.

179. Andrew C. Revkin, *Poor Nations to Bear Brunt as World Warms*, N.Y. TIMES, Apr. 1, 2007, http://www.nytimes.com/2007/04/01/science/earth/01climate.html?_r=1&oref=slogin [hereinafter Revkin, *Poor Nations*].

180. *Id.*

181. *Id.*

250 million people are projected to be exposed to increased water stress due to climate change. If coupled with increased demand, this will adversely affect livelihoods and exacerbate water-related problems.”¹⁸² Farming and food availability are likely to become increasingly volatile.¹⁸³

A. Food Security

Food self-sufficiency is becoming implausible in whole regions around the globe. Many communities lack access to state of the art rapid planting methods and crop insurance.¹⁸⁴ American farmers have been using genetically modified (GM) seeds that can withstand a ten to fifteen percent decrease in rainfall.¹⁸⁵ Use of GM crops remains controversial around the world.¹⁸⁶

Aid organizations such as Oxfam would like to use food aid money to purchase food closer to where it is needed, a proposal that would threaten the delicate political balance between agri-business and humanitarian initiatives.¹⁸⁷ Requests for emergency food aid are increasing.¹⁸⁸ The United States represents the largest food donor, sending U.S.-grown food rather than funds.¹⁸⁹ The Bush administration has asked Congress for authorization to purchase food from farmers closer to humanitarian crises, using up to a quarter of the Food for Peace budget.¹⁹⁰ The United Nations Food and Agriculture Organization (FAO) predicts that global cereal production in 2007 will rise 4.3% but that at least thirty-three countries remain in food vulnerable positions due to armed conflicts, floods, and droughts.¹⁹¹ Even relatively stable countries are experiencing food insecurity as a result of volatile climate and energy policies.¹⁹²

182. IPCC WORKING GROUP II CLIMATE CHANGE IMPACTS, ADAPTATION AND VULNERABILITY 2007 REPORT, *supra* note 160, at 13.

183. *Id.*

184. Revkin, *Poor Nations*, *supra* note 179.

185. *Id.*

186. *Id.*

187. Dan Charles, *New Plan Calls for Buying Aid Foods Outside U.S.* (NPR radio broadcast Mar. 7, 2007), available at <http://www.npr.org/templates/story/story.php?storyId=7761652&ft=1&f=1001>.

188. *Id.*

189. *Id.*

190. *Id.*

191. *World Cereal Production on Track for Record Crop in 2007*, UN Agency Reports, U.N. NEWS CTR., Apr. 3, 2007, available at <http://www.un.org/apps/news/story.asp?NewsID=22104&Cr=cereal&Cr1=fao>.

192. See Revkin, *Poor Nations*, *supra* note 179 (noting that rich countries are not immune from effects of climate change).

Ethanol distillers are predicted to use 3.2 billion bushels of the 2007 corn crop—a one billion bushel rise from their portion of the 2006 crop.¹⁹³ Tens of thousands of Mexicans protested in Mexico City as the price of tortillas increased by more than four hundred percent.¹⁹⁴ Most commodity analysts suggest that the problem has stemmed from the recent United States subsidization of corn-based ethanol.¹⁹⁵ Federal and state ethanol subsidies in the United States amounted to roughly \$6 billion in 2006—about half its wholesale market price.¹⁹⁶ Farmers can now choose to sell corn to subsidized ethanol distilleries rather than food and livestock corporations.¹⁹⁷ Government-subsidized ethanol production in the United States and around the world has driven the price of corn higher than poor people can afford.¹⁹⁸ The rapid rise in the international price of corn as a result of the ethanol boom has quadrupled Mexican tortilla prices since last summer.¹⁹⁹ Poor Mexicans obtain more than forty percent of their protein from tortillas.²⁰⁰ Mexico subsidized tortillas until 1999 and in January 2007, President Calderón announced a non-binding price cap and approved emergency imports of over 800,000 tons of corn from the United States and elsewhere.²⁰¹

In an effort to reduce foreign oil dependence without jeopardizing food security, China has sought to use non-grain raw materials for fuel ethanol.²⁰² Thailand converts the root vegetable tapioca into cassava-based ethanol fuel.²⁰³ China seeks to supply as much as four million tons of fuel ethanol from tapioca.²⁰⁴

193. *Farmers to Plant Most Amount of Corn Since '44*, N.Y. TIMES, Mar. 30, 2007, <http://www.nytimes.com/2007/03/30/business/30wire-corn.html?ex=1332907200&en=f1dd40e611fc31a7&ei=5088&partner=rssnyt&emc=rss>.

194. *Mexicans Stage Tortilla Protest*, BBC NEWS, Feb. 1, 2007, <http://news.bbc.co.uk/2/hi/americas/6319093.stm>.

195. Mary Anastasia O'Grady, *Tortilla Facts*, WALL ST. J., Jan. 29, 2007, at A16.

196. *Very, Very Big Corn*, WALL ST. J., Jan. 27, 2007, at A8.

197. O'Grady, *supra* note 195.

198. *Id.*

199. Manuel Roig-Franzia, *A Culinary and Cultural Staple in Crisis: Mexico Grapples with Soaring Prices for Corn—and Tortillas*, WASH. POST, Jan. 27, 2007, at A1, available at http://www.washingtonpost.com/wp-dyn/content/article/2007/01/26/AR2007012601896.html?nav=rss_print/asection.

200. *Id.*

201. *Id.*

202. *China to Fill Cars with Cassava Ethanol*, REUTERS, June 16, 2006, <http://www.planetark.org/dailynewsstory.cfm/newsid/36881/story.htm>.

203. *Id.*

204. *Id.* “China is the world’s third-largest ethanol producer, after the United States and Brazil. It has four government-sponsored ethanol plants with a combined annual capacity of 1.02 million tonnes. They use corn or wheat as their raw material . . . China imported 127 million tons of crude oil

The food and livestock industries in the United States similarly fear that diverting corn to fuel will raise food prices. United States agricultural incumbents in the livestock and food processing sectors have a vested interest in low corn prices. The *Wall Street Journal* notes that

[t]he scientific literature is also divided about whether the energy inputs required to produce ethanol actually exceed its energy output. It takes fertilizer to grow the corn, and fuel to ship and process it, and so forth. Even the most optimistic estimate says ethanol's net energy output is a marginal improvement of only 1.3 to one. For purposes of comparison, energy outputs from gasoline exceed inputs by an estimated 10 to one.

And because corn-based ethanol is less efficient than ordinary gasoline, using it to fuel cars means you need more gas to drive the same number of miles.²⁰⁵

The *Wall Street Journal* goes on to note that existing pipelines cannot be used to transport ethanol since, as an alcohol, it will dissolve the seals.²⁰⁶ Building separate pipelines is sure to be controversial and transporting ethanol by train, truck, or boat is hardly carbon neutral.²⁰⁷ A car gets roughly a third greater fuel efficiency by running on traditional gasoline than running on E85 fuel (reformulated gasoline that is eighty-five percent ethanol).²⁰⁸ The *Washington Post* notes that

ethanol is a less stable compound than other additives, in the summer it evaporates easily and contributes to greater smog levels.

Meanwhile, an effective tariff protects American-made ethanol from cheaper imports from Brazil and elsewhere. . . . In December, when the Joint Committee on Taxation calculated the five-year cost of a tax break for the builders of cellulosic ethanol plants, the low cost suggested that it expected no more than one plant up and running by 2012. . . . Most experts say that distilleries produce slightly more energy than they consume. But growing more corn has other costs, such as greater soil erosion

in 2005." *Id.*

205. *Very, Very Big Corn*, *supra* note 196.

206. *Id.*

207. *Id.*

208. *Id.*

and pesticide use. The numbers vary widely depending on process and location.²⁰⁹

Science Magazine notes that corn-based ethanol will almost double greenhouse gas emissions rather than lower emissions²¹⁰ and that clearing land for biofuels will also increase emissions.²¹¹ The United States has been wrangling over how to increase fuel efficiency for decades. Multilateral cooperation is crucial to averting catastrophic climate change. This requires a fundamental change in the way that politics has been played thus far.

In 1990, Congress mandated a ten percent fuel supplement requirement as a means of reducing emissions.²¹² Natural gas-based methyl tertiary butyl ether (MTBE) is being phased out as the supplement of choice due to evidence that it contaminates groundwater and causes health problems.²¹³ Ethanol is rapidly replacing MTBE. Researchers hope to perfect a refining technology that can produce a fuel called cellulosic ethanol from agricultural waste, straw, and grasses.²¹⁴ A flex-fuel pickup that can run on E85, containing eighty-five percent ethanol, may move towards energy self-sufficiency, but it should not be promoted to the exclusion of alternative energy sources that do not require as much land and fossil fuel input. Climate variability and fuel efficiency factors should be integrated into transportation and associated infrastructure funding.²¹⁵ While moving away from fossil fuel-based transportation requires low greenhouse gas emission fuel and infrastructure investment, the United States Congress should enact an equitable and effective cap-and-trade program to reduce greenhouse gas emissions. A viable energy policy has eluded policy-makers reliant upon key constituents for re-election.

In 2005, developed countries gave farmers \$280 billion in subsidies:

209. Steven Mufson, *Ethanol Production Booming on Demand*, WASH. POST, Jan. 23, 2007, at A6, available at http://www.washingtonpost.com/wp-dyn/content/article/2007/01/22/AR2007012201306.html?nav=rss_print/asection.

210. Joseph Fargione, Jason Hill, David Tilman, Stephen Polasky & Peter Hawthorne, *Land Clearing and the Biofuel Carbon Debt*, 319 SCI. 1235, 1235 (2008).

211. Timothy Searchinger, Ralph Heimlich, R. A. Houghton, Fengxia Dong, Amani Elobeid, Jacinto Fabiosa, Simla Tokgoz, Dermont Hayes & Tun-Hsiang Yu, *Use of U.S. Croplands for Biofuels Increases Greenhouse Gases Through Emissions from Land-Use Change*, 319 SCI. 1238, 1238 (2008).

212. Alexei Barrionuevo, *For Good or Ill, Boom in Ethanol Reshapes Economy of Heartland*, N.Y. TIMES, June 25, 2006, <http://www.nytimes.com/2006/06/25/business/25ethanol.html?ex=1308888000&en=3db79885d5ce7f34&ei=5088&partner=rssnyt&emc=rss>.

213. *Id.*

214. *Id.*

215. PEW, AGENDA FOR CLIMATE ACTION, *supra* note 133, at 5.

\$133.8 billion from the European Union, \$47.4 billion from Japan, and \$42.7 billion from the United States.²¹⁶ Corn is the most heavily subsidized crop in the United States.²¹⁷ A rush to produce corn-based ethanol is fueled by high energy prices and large government subsidies for corn, one of the most expensive crops to grow and bring to market.²¹⁸

Brazil produces sugar-based ethanol for approximately thirty percent less than the United States produces corn-based ethanol.²¹⁹ Brazil and the United States together produce twenty-two billion liters of ethanol annually.²²⁰ The *Wall Street Journal* points out that “intensive, subsidized sugar farming in Brazil—where the use of ethanol is most widespread—has displaced small tenant farmers, many of whom have taken to cutting down and farming land in the Amazon rain forest.”²²¹ Similarly, the *Financial Times* notes that

the energy required to grow and distil the grains reduces the benefit of using it as a fuel—a litre cuts emissions by less than half on average. Deforestation to clear farmland could contribute more to climate change than the resulting fuels save in emissions.²²²

The April 2007 IPCC report predicts that savannas will replace tropical forest in eastern Amazonia by mid-century and that in dry regions climate change will cause salinization and desertification of agricultural land.²²³

216. *A Mere \$280 Billion*, WALL ST. J., June 23, 2006, at A10; see also Michael Grubb & Robert Socolow, *Technological Development, Commercialisation, and Diffusion*, at para. 5 (Energy & Env't. Roundtable, London, U.K., Ministerial Briefing Paper, 2005), available at <http://www.princeton.edu/~cmi/research/Integration/Papers/Grubb%20and%20Solocow.pdf> (noting that annual agricultural subsidies worth \$450 billion are distributed by OECD countries).

217. Barrionuevo, *supra* note 212.

218. *Id.*

219. *Id.* See Wolfowitz, *supra* note 33 (noting also that Brazil's active carbon trade market creates an incentive to extract methane from landfills); see also *Emissions Exchange Program Aims to Reduce Greenhouse Gases*, PBS NEWSHOUR, June 7, 2006, http://www.pbs.org/newshour/bb/environment/jan-june06/global_warming_06-07.html (noting that some of the leading sources of methane are coal mines, cows, and landfills); James Hansen, *Defusing the Global Warming Time Bomb*, SCI. AM., Mar. 2004, at 68, 77 (noting that methane's fuel potential can substantially offset capture costs by farms, landfills, and mining facilities).

220. Socolow, Hotinski, Greenblatt & Pacala, *supra* note 63, at 13.

221. *Very, Very Big Corn*, *supra* note 196.

222. Andrew Bounds & Fiona Harvey, *EU Will Need Imports to Hit Biofuel Targets*, FIN. TIMES, Feb. 1, 2007, at 4, available at http://www.ft.com/cms/s/de96bff8-b198-11db-b901-0000779e2340,dwp_uuid=70662e7c-3027-11da-ba9f-00000e2511c8,_i_rssPage=70662e7c-3027-11da-ba9f-0000e2511c8.html.

223. IPCC WORKING GROUP II CLIMATE CHANGE IMPACTS, ADAPTATION AND VULNERABILITY

This will reduce productivity of some crops and affect food security.²²⁴

It is important to include the energy needed to produce energy when comparing power sources.²²⁵ Fossil resources cannot be called net positive energy sources if more energy is used to extract them than they ultimately provide.²²⁶ Currently corn-based ethanol requires roughly as much energy to produce as it generates.²²⁷ The grasslands of the Dakotas have been part of conservation reserve and security programs.²²⁸ Transferring 40 million acres of Great Plain Prairie to ethanol production would not constitute sound energy policy.²²⁹ Elsewhere, replacing soybeans with corn will likely cause more water pollution since “soybeans draw much of their nutrients directly from the atmosphere,” while “corn requires large amounts of commercial nitrogen-based fertilizer to achieve optimal yields.”²³⁰ In addition to increasing run-off of pollution into surface and groundwater, increased fertilizer use is not carbon-neutral.²³¹ In addition to impacting the price of food, such agriculture-based fuels as ethanol will likely contribute to water scarcity.²³² This is prompting farmers to plant jatropha, an oilseed that can be turned into fuel.²³³ Jatropha does not need a great deal of water and represents an inedible biodiesel that will not redirect a food crop into a fuel source.²³⁴

2007 REPORT, *supra* note 160, at 14. “Freshwater availability in Central, South, East and South-East Asia, particularly in large river basins, is projected to decrease due to climate change which, along with population growth and increasing demand arising from higher standards of living, could adversely affect more than a billion people by the 2050s.” *Id.* at 13.

224. *Id.* at 14.

225. Socolow, Hotinski, Greenblatt & Pacala, *supra* note 63, at 13.

226. *Id.*

227. PBS, *Emissions Exchange Program*, *supra* note 219; *see also* Socolow, Hotinski, Greenblatt & Pacala, *supra* note 63.

228. *Very, Very Big Corn*, *supra* note 196.

229. *Id.*; *see also* Juliet Eilperin, *Judge Suspends Administration Rules for Managing Forests*, WASH. POST, Mar. 31, 2007, at A2, available at <http://www.washingtonpost.com/wp-dyn/content/article/2007/03/30/AR2007033001905.html> (noting that Judge Phyllis J. Hamilton of the U.S. District Court for the Northern District of California has ruled “that the Bush administration illegally rewrote the rules for managing 192 million acres of federally owned forests and grasslands in 2005 and must consider the environmental impact of its plan before offering another policy blueprint”).

230. Gary Wulf, *Prices, Weather May Shift Tally on Corn Acreage*, WALL ST. J., Apr. 7, 2007, at B2.

231. *Id.*

232. Patrick Barta, *Alternative-Fuels Push May Inspire Some Better Bets*, WALL ST. J., Jan. 29, 2007, at A2.

233. *Id.*

234. *Id.*

B. Water Scarcity and Flooding

A stable climate is a public good the absence of which will thwart the provision of other public goods such as access to fresh water.²³⁵ The April 2007 IPCC report notes that “[c]hanges in precipitation patterns and the disappearance of glaciers are projected to significantly affect water availability for human consumption, agriculture and energy generation.”²³⁶ By 2100, annual rainfall in arid regions on both sides of the US-Mexico border is predicted to fall by ten to twenty percent.²³⁷ The Southwest has been suffering a drought since 1999.²³⁸ Richard Seager of Columbia University notes that governments need to develop “well-informed and fair deals for allocation of declining water resources.”²³⁹ He points out that the southwestern United States may experience the kind of drought conditions that led to the Dust Bowl of the 1930s.²⁴⁰ Seager explains that “the overall pattern, if you were going to distill it down to something very simple, is that the drier regions get drier and the wet regions get wetter.”²⁴¹ Fred Pearce notes that “[y]ou can’t irrigate the world’s ethanol needs without huge gains in irrigation efficiency.”²⁴² Drip irrigation can reduce salinity and save water but must be implemented in combination with a wide range of reasonable and equitable water measures.

Nevada has proposed a pipeline, Arizona has resorted to desalination, and water law litigation has increased.²⁴³ As the *New York Times* notes, “[t]he scramble for water is driven by the realities of population growth, political pressure and the hard truth that the Colorado River, a 1,400-mile-long silver thread of snowmelt and a lifeline for more than 20 million people in seven states, is providing much less water than it had.”²⁴⁴ The April 2007 IPCC report notes that in North America, “[w]arming in western

235. Ashton, *supra* note 35.

236. IPCC WORKING GROUP II CLIMATE CHANGE IMPACTS, ADAPTATION AND VULNERABILITY 2007 REPORT, *supra* note 160, at 14.

237. Marc Kaufman, *Southwest May Get Even Hotter, Drier: Report on Warming Warns of Droughts*, WASH. POST, Apr. 6, 2007, at A3, available at http://www.washingtonpost.com/wp-dyn/content/article/2007/04/05/AR2007040501180.html?nav=rss_print/asection.

238. *Id.*

239. *Id.*

240. *Id.*

241. Joyce, *supra* note 168.

242. David Brough, *Water Scarcity Seen Dampening Case for Biofuel*, REUTERS, Oct. 20, 2006, <http://www.planetark.com/dailynewsstory.cfm/newsid/38591/story.htm>.

243. Randal C. Archibold & Kirk Johnson, *An Arid West No Longer Waits for Rain*, N.Y. TIMES, Apr. 4, 2007, at A1, available at <http://www.nytimes.com/2007/04/04/us/04drought.html?ex=1333339200&en=91816ce0e28f4f44&ei=5088&partner=rssnyt&emc=rss>.

244. *Id.*

mountains is projected to cause decreased snowpack, more winter flooding, and reduced summer flows, exacerbating competition for over-allocated water resources.”²⁴⁵ Asia is also facing an increase in water scarcity combined with potential flooding. The Himalayas and other mountain ranges around the world store winter snowfall and gradually release water in the summer.²⁴⁶ Melting glaciers cause glacial lakes to flood and lead to heavy run-off from glacier/snow-fed rivers.²⁴⁷ Decreasing glaciers bring severe spring and autumn floods and the risk of summer droughts.²⁴⁸ The warming of lakes and rivers is also affecting water quality.²⁴⁹ The report notes that

annual average river runoff and water availability are projected to increase by 10-40% at high latitudes and in some wet tropical areas, and decrease by 10-30% over some dry regions at mid-latitudes and in the dry tropics, some of which are presently water-stressed areas. In some places and in particular seasons, changes differ from these annual figures.

Drought-affected areas will likely increase in extent. Heavy precipitation events, which are very likely to increase in frequency, will augment flood risk.

In the course of the century, water supplies stored in glaciers and snow cover are projected to decline, reducing water availability in regions supplied by meltwater from major mountain ranges, where more than one-sixth of the world population currently lives.²⁵⁰

Himalayan glacial melt will lower river flow into Bangladesh a great deal.²⁵¹ Dykes along the coast are protecting Bangladeshis from a rising sea

245. IPCC WORKING GROUP II CLIMATE CHANGE IMPACTS, ADAPTATION AND VULNERABILITY 2007 REPORT, *supra* note 160, at 14.

246. *Wrangling Delays Climate Report*, BBC NEWS, Apr. 6, 2007, <http://news.bbc.co.uk/2/hi/science/nature/6524251.stm> [hereinafter BBC, *Wrangling Delays*].

247. IPCC WORKING GROUP II CLIMATE CHANGE IMPACTS, ADAPTATION AND VULNERABILITY 2007 REPORT, *supra* note 160, at 8–9.

248. BBC, *Wrangling Delays*, *supra* note 246.

249. IPCC WORKING GROUP II CLIMATE CHANGE IMPACTS, ADAPTATION AND VULNERABILITY 2007 REPORT, *supra* note 160, at 8.

250. *Id.* at 11 (footnotes omitted).

251. Justin Huggler, *Retreating Himalayan Icefields Threatening Drought in Bangladesh*, INDEP., Mar. 29, 2007, at 8, available at http://news.independent.co.uk/environment/climate_change/article2401715.ece.

level but they have not been able to adapt to drought conditions.²⁵² Bangladesh is as vulnerable to drought as it is to flooding.²⁵³ The entire country is a delta and agriculture accounts for twenty-one percent of the economy.²⁵⁴ Bangladesh's annual carbon emissions are 0.172 tons per capita vis-à-vis the twenty-one tons per capita emitted annually by the United States.²⁵⁵ China has produced less than eight percent of the carbon dioxide emissions from energy use since 1850, the United States has produced twenty-nine percent, and Western Europe has produced twenty-seven percent.²⁵⁶ Pursuant to the legal principle that "the polluter pays," countries that are the largest greenhouse gas emitters are responsible for helping poorer countries adapt.²⁵⁷

Adaptability may be impacted by the rate of climate change, information gaps, and institutional obstacles.²⁵⁸ Lack of private incentives to protect publicly owned natural systems also limits the rate of adaptation.²⁵⁹ The EPA warns that

[i]f people respond by moving out of hazardous areas, there will be more undeveloped land in the floodplain where wetlands can form. If people respond by building dams, river levees, or other structures to prevent floods, both the structures and the decline in flooding will decrease the total area where floodplain wetlands can form.²⁶⁰

The Climate Change Science Program and Climate Change Technology Program should coordinate a national adaptation strategy and provide

252. *Id.*

253. *Id.*

254. *Id.*

255. *Id.*

256. Andrew C. Revkin, *Reports from Four Fronts in the War on Warming*, N.Y. TIMES, Apr. 3, 2007, at F4 [hereinafter Revkin, *Reports From Four Fronts*], available at <http://www.nytimes.com/2007/04/03/science/earth/03clim.html?ex=1333252800&en=44b06c0a12fbde36&ei=5088&partner=rssnyt&emc=rss>.

257. *Id.*

258. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, THE REGIONAL IMPACTS OF CLIMATE CHANGE: AN ASSESSMENT OF VULNERABILITY 13 (Robert T. Watson et al., eds. 1997), <http://www.ipcc.ch/pdf/special-reports/spm/region-en.pdf>.

259. *Id.*

260. U.S. Envtl. Prot. Agency, *Global Warming-Impacts: Non-tidal Wetlands*, <http://yosemite.epa.gov/oar/globalwarming.nsf/content/ImpactsNon-tidalWetlands.html>, (last visited Feb. 22, 2008); see also Christopher Drew & Joseph B. Treaster, *Politics Stalls Plan to Bolster Flood Insurance*, N.Y. TIMES, May 15, 2006, at A1, available at <http://www.nytimes.com/2006/05/15/us/15flood.html?ex=1305345600&en=e2cb7d7a3adb31e6&ei=5088&partner=rssnyt&emc=rss>.

models with which other countries can coordinate adaptation.²⁶¹ Effective networking and funding of early warning systems must become a higher priority for the United States government.²⁶² Infrastructure planning needs to account for water availability, extreme temperatures, and sea level rise.²⁶³

The EPA recognizes that rising temperatures will “increase the number of people who die on a given day.”²⁶⁴ Heat-related deaths will rise due to increased urbanization as well as the likelihood that heat events will be more frequent, severe, and last longer.²⁶⁵ Heat wave early warning systems are a crucial adaptation measure.²⁶⁶ Existing heart conditions are exacerbated when an individual’s cardiovascular system needs to go into overdrive to keep the body cool.²⁶⁷ Energy demand rises as the need for air-conditioning and heating increases. The overall impact will differ from one region to another. The EPA warns that

[s]ea level is rising more rapidly along the U.S. coast than worldwide. Studies by EPA and others have estimated that along the Gulf and Atlantic coasts, a one foot (30 cm) rise in sea level is likely by 2050. In the next century, a two foot rise is most likely, but a four foot rise is possible; and sea level will probably continue to rise for several centuries, even if global temperatures were to stop rising a few decades hence.

Nationwide, a two foot rise in sea level could eliminate 17-43 percent of U.S. wetlands, even if no additional bulkheads or dikes are erected, with more than half of the loss taking place in Louisiana alone.²⁶⁸

261. PEW, AGENDA FOR CLIMATE ACTION, *supra* note 133, at 11.

262. *Id.*

263. *Id.*

264. U.S. Env’tl. Prot. Agency, Global Warming-Impacts: Health, <http://yosemite.epa.gov/oar/globalwarming.nsf/content/ImpactsHealth.html>, (last visited Feb. 22, 2008); *see also* IPCC, REGIONAL IMPACTS, *supra* note 258, at 12 (“Climate can have wide-ranging and potentially adverse effects on human health via direct pathways (e.g., thermal stress and extreme weather/climate events) and indirect pathways (e.g., disease vectors and infectious agents, environmental and occupational exposures to toxic substances, food production).”).

265. U.N. Framework Convention on Climate Change [UNFCCC], *Application of Environmentally Sound Technologies for Adaptation to Climate Change*, ¶388, U.N. Doc. FCCC/TP/2006/2 (May, 10, 2006) (prepared by Richard J.T. Klein et al.), available at <http://unfccc.int/resource/docs/2006/tp/tp02.pdf>.

266. *Id.*

267. EPA, Global Warming-Impacts: Health, *supra* note 264.

268. U.S. Env’tl. Prot. Agency, Global Warming-Impacts: Coastal Zones, <http://yosemite.epa.gov/oar/globalwarming.nsf/content/ImpactsCoastalZones.html> (last visited Feb. 22, 2008).

On average, New Orleans is roughly two meters below sea level and sinking.²⁶⁹ Long Beach, San Jose, and Texas City are also vulnerable at one meter below sea level.²⁷⁰ Heavier rains and higher sea levels also risk flooding such major port cities as Boston, Charleston, Miami, and New York.²⁷¹ Port cities along tidal rivers are also susceptible to the combined impact of heavy precipitation and sea level rise, threatening Alexandria, Philadelphia, Portland, and Washington, D.C.²⁷²

The European Union is building consensus and implementing mitigation and adaptation measures in response to rising sea levels. European Union ministers have established rules to increase coordination between countries to avoid upstream flood prevention measures from hurting downstream countries.²⁷³ From 1998 to 2004, European floods killed an estimated 700 people, displaced roughly half a million people, and caused at least €25 billion in insured economic losses.²⁷⁴ The European Commission explains that “[t]he new directive will require Member States to carry out preliminary assessments to identify the river basins and associated coastal areas at risk of flooding. Such zones then will be subject to flood risk maps and flood risk management plans.”²⁷⁵ This European Union framework is in keeping with the 2000 Water Framework Directive and seeks to guide countries towards such measures as restoring flood plains and wetlands.²⁷⁶ The United Kingdom has begun breaching 300 miles of sea wall for wetlands habitat that will increase flood protection.²⁷⁷

The United Nations is also trying to raise awareness regarding the importance of such natural buffers as coral.²⁷⁸ Rising ocean temperatures

269. *Id.*

270. *Id.*

271. *Id.*

272. *Id.*

273. *Proposal for a Directive of the European Parliament and of the Council on the Assessment and Management of Floods*, at 13–14, COM (2006) 15 final (Jan. 18, 2006), available at <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2006:0015:FIN:EN:PDF>.

274. *Id.* at 2.

275. Press Release, European Comm’n, Environment: Commission Adopts New Directive to Fight Floods (Jan. 18, 2006), <http://europa.eu/rapid/pressReleasesAction.do?reference=IP/06/50&format=HTML&aged=0&language=EN&guiLanguage=en> [hereinafter EC, New Directive].

276. Council Directive 2000/60, art. 1, 2000 O.J. (L 327) 1, 5 (EC); EC, New Directive, *supra* note 275.

277. *Huge Marine Wetland Starts Life*, BBC NEWS, July 4, 2006, http://news.bbc.co.uk/2/hi/uk_news/england/esssex/5143802.stm.

278. Ahmed Djoghlaif, *It’s Not Just About Climate*, BBC NEWS, Mar. 2, 2007, <http://news.bbc.co.uk/2/hi/science/nature/6408789.stm>.

are killing off coral reefs.²⁷⁹ Corals and mangroves soak up the impact of wind-generated waves by up to ninety percent.²⁸⁰ For every square kilometer of coral reefs, the United Nations Environmental Program (UNEP) estimates that the value is between \$100,000 and \$600,000 per year, while management expenses for safeguarding one square kilometer of coral reef is \$775 per year.²⁸¹ Restoring mangroves can help absorb the impact of tsunamis.²⁸² On December 26, 2004, a powerful earthquake launched a tsunami that enveloped coastal communities as widespread as Indonesia, Sri Lanka, Somalia, and Thailand; the wall of water killed more than 200,000 people and left roughly 1.5 million people homeless.²⁸³ Oxfam and the International Red Cross have begun projects to expand mangrove buffers to protect against storm surges.²⁸⁴

UNESCO is coordinating development of national warning systems.²⁸⁵ By June 2006 there were twenty-six national tsunami information centers with twenty-five new seismographic stations.²⁸⁶ The Pacific Tsunami Warning Centre in Hawaii has coordinated more than thirty countries in the Pacific Ocean region to test an early warning system.²⁸⁷ Largely a success, the only break in communication occurred when "an overloaded telephone system [in Thailand] delayed public text message alerts for several hours."²⁸⁸ Despite a real tsunami warning issued by the Pacific Tsunami Warning Center fifteen minutes after an earthquake occurred off the coast of Java in July of 2006, Indonesia "has not yet installed a warning system on the island of Java, the country's most populous."²⁸⁹ As Hurricanes

279. Paul Rincon, *Warming Set to "Devastate" Coral*, BBC NEWS, May 15, 2006, <http://news.bbc.co.uk/2/hi/science/nature/4772715.stm>; see also Richard Black, *"Hope for Coral" as Oceans Warm*, BBC NEWS, June 7, 2006, <http://news.bbc.co.uk/2/hi/science/nature/5053812.stm>.

280. Mark Kinver, *Tsunami: Mangroves 'Saved Lives'*, BBC NEWS, Dec. 25, 2005, available at <http://news.bbc.co.uk/1/hi/sci/tech/4547032.stm>.

281. Press Release, U.N. Env'tl. Program (UNEP), *Corals and Mangroves in the Front Line* (Jan. 24, 2006), <http://www.unep.org/Documents.Multilingual/Default.Print.asp?DocumentID=466&ArticleID=5112&l=en>.

282. Kinver, *supra* note 280.

283. *Asia Tsunami Warning System Ready*, BBC NEWS, June 28, 2006, <http://news.bbc.co.uk/2/hi/asia-pacific/5126710.stm>; see also The Secretary-General, *Work of the Organization*, *supra* note 73, at ¶ 5 ("An unprecedented Indian Ocean tsunami in December 2004 spread death and destruction over 14 countries on two continents.").

284. See Revkin, *Poor Nations*, *supra* note 179 (noting that these organizations are also coordinating efforts to plant trees to curb the erosion that causes landslides).

285. BBC, *Asia Tsunami Warning System*, *supra* note 283.

286. *Id.*

287. *Pacific States Hold Tsunami Test*, BBC NEWS, May 17, 2006, <http://news.bbc.co.uk/2/hi/asia-pacific/4988492.stm>.

288. *Id.*

289. Raymond Bonner, *Tsunami Hits Indonesian Java Coast, Killing More Than 150*, N.Y.

Katrina and Rita have shown, however, warning systems are not enough. These storms illustrate how low-lying settlements become more vulnerable when coastal wetlands disappear.²⁹⁰

Hurricane Katrina hit the Louisiana and Mississippi coasts on August 29, 2005.²⁹¹ Devastating hurricanes can have both social and environmental costs. Ten months after the levees gave way, the suicide rate in New Orleans had risen to nearly triple pre-Hurricane Katrina rates.²⁹² United States taxpayers have spent \$2 billion on fraud and improper payments for Hurricane Katrina damage.²⁹³ Professor John Day of Louisiana State University's Department of Oceanology and Coastal Studies notes over the last century a loss of twenty-five percent of the wetlands that helped protect against hurricane surges.²⁹⁴ He explains that a mile of wetlands through which a storm surge passes lowers flooding by one foot.²⁹⁵ Spending \$20 to \$25 billion to restore Mississippi Delta wetlands could have significantly lowered the impact of Hurricane Katrina.²⁹⁶ Hurricane Katrina submerged over eighty percent of New Orleans and cost an estimated \$96 billion.²⁹⁷ Ninety percent of New Orleans had dried out by the time Hurricane Rita brought heavy rain and breached levies again three weeks after Hurricane Katrina.²⁹⁸

The Corps found that faulty design and construction of its levees had contributed to the catastrophe.²⁹⁹ The Corps failed to take sinking soil into

TIMES, July 18, 2006, at A3, available at http://www.nytimes.com/2006/07/18/world/asia/18indo.html?_r=1&hp&ex=1153281600&en=42a5a58164a380f8&ei=5094&partner=homepage&oref=slogin.

290. Djoghla, *supra* note 278.

291. Patrick Jackson, *Lake Faces Aftermath of City Catastrophe*, BBC NEWS, Sept. 8, 2005, <http://news.bbc.co.uk/1/hi/sci/tech/4223426.stm>.

292. Susan Saulny, *A Legacy of the Storm: Depression and Suicide*, N.Y. TIMES, June 21, 2006, at A1, available at <http://www.nytimes.com/2006/06/21/us/21depress.html?ex=1308542400&en=c1af78f3e8a426c3&ei=5088&partner=rssnyt&emc=rss>.

293. Eric Lipton, *Breathtaking Waste and Fraud in Hurricane Aid*, N.Y. TIMES, June 27, 2006, at A1, available at <http://www.nytimes.com/2006/06/27/washington/27katrina.html?ex=1309060800&en=1683ee0271eebb90&ei=5088&partner=rssnyt&emc=rss>.

294. Jackson, *supra* note 291.

295. *Id.*

296. *Id.*

297. "Above Normal" Hurricanes in 2006, BBC NEWS, May 22, 2006, <http://news.bbc.co.uk/2/hi/science/nature/5005806.stm>.

298. Verity Murphy, *Fixing New Orleans' Thin Grey Line*, BBC NEWS, Oct. 4, 2005, <http://news.bbc.co.uk/2/hi/americas/4307972.stm>.

299. The full report of the Interagency Performance Evaluation Taskforce (IPET) New Orleans Hurricane Protection Projects Data is available at <https://ipet.wes.army.mil/> and the executive summary is available at http://www.nytimes.com/packages/pdf/national/20060601_ARMYCORPS_SUMM.pdf. See also John Schwartz, *Army Builders Accept Blame Over Flooding*, N.Y. TIMES, June 2, 2006, at A1, available at <http://www.nytimes.com/2006/06/02/us/nationalspecial/02corps.html?ex=1306900800&en=>

account and did not respond to subsequent warnings about subsidence.³⁰⁰ A 400-foot section of newly constructed levee south of New Orleans shifted and bulged in June 2006.³⁰¹ The muddy soil was not capable of supporting the weight of the levee.³⁰² Professor Tim Kusky suggests that “[w]e should be thinking about a gradual pullout of New Orleans, and starting to rebuild people’s homes, businesses and industry in places that can last more than eighty years.”³⁰³ The Census Bureau’s first study of the City of New Orleans after Hurricanes Katrina and Rita found that the city had shrunk by almost sixty-four percent.³⁰⁴

The Supreme Court’s decision on eminent domain in *Kelo v. City of New London* may impact reconstruction in New Orleans.³⁰⁵ The city is demolishing homes pursuant to its public safety police powers but may resort to eminent domain takings.³⁰⁶ Since the Supreme Court has upheld takings for shopping malls in *Kelo*; taking land to prevent development in vulnerable areas may also occur.³⁰⁷ The 1993 floods of almost 150 major rivers in the upper Mississippi region prompted the government to move buildings out of the floodplain.³⁰⁸ Balancing equitable and reasonable land use management is an increasingly complex yet core ingredient of good government.

Oliver Houck points out that the Dutch have concluded that bit-levee and big-drainage schemes are not viable and that we should let nature have the space it needs to rebuild a natural coastal protection system.³⁰⁹ The Netherlands Water Partnership notes that

ae00c01a3e49a614&ei=5088&partner=rssnyt&emc=rss.

300. *Id.*

301. *Id.*

302. *See id.* (stating that “the corps had failed to take into account the tendency of the local soil to sink over time, leaving some sections of levee lower than they should have been”).

303. *New Orleans Is Sinking*, CBS NEWS, Nov. 20, 2005, <http://www.cbsnews.com/stories/2005/11/18/60minutes/main1056304.shtml>.

304. Rick Lyman, *Reports Reveal Hurricanes’ Impact on Human Landscape*, N.Y. TIMES, June 7, 2006, at A16, available at <http://www.nytimes.com/2006/06/07/us/nationalspecial/07census.html?ex=1307332800&en=992967dd2a1ea844&ei=5088&partner=rssnyt&emc=rss>.

305. Emily Chamlee-Wright & Daniel Rothschild, *Government Dines on Katrina Leftovers*, WALL ST. J., June 15, 2006, at A15; *see also Kelo v. City of New London*, 545 U.S. 469, 489–90 (2005) (holding that New London’s proposed disposition of Kelo’s property meets the requirements of a public use pursuant to the Takings Clause).

306. Chamlee-Wright & Rothschild, *supra* note 305.

307. *Kelo*, 545 U.S. at 490; *see also* Oliver Houck, *Can We Save New Orleans?* 19 TUL. ENVTL. L.J. 1, 51 (2006).

308. Houck, *supra* note 307, at 51–52.

309. *Id.* at 49, 54; *see also* Marguerite Holloway, *Reviews: What Makes a Revolution?*, SCI. AM., May 2006, at 92 (noting that the Dutch are creating amphibious houses).

[t]he Netherlands is changing its approach to water. This change involves the idea that the Netherlands will have to make more frequent concessions. We will have to relinquish open space to water, and not take back existing open spaces, in order to curb the growing risk of disaster due to flooding.³¹⁰

The Dutch “Room for the Rivers Policy” increases existing floodplains and establishes new ones by altering zoning laws to prevent urban development in critical flood-prone regions.³¹¹ The Dutch have accomplished this political feat in the third most densely populated nation in the world.³¹² Using thermal infrared spectroscopy, the Dutch monitor groundwater flows that may impact flood barriers.³¹³ Their levee strength database and data collection system encompasses a digital levee component, using glass fiber optics to track levee changes.³¹⁴ Dutch river basin management encompasses GIS-supported mapping of integrated flood protection levels.³¹⁵ Strategic environmental assessment of large coastal and floodplain projects as well as environmental impact statements for all coastal reinforcements can help ensure that management is effective.³¹⁶ Dutch Ambassador Boudewijn van Eenennaam points out that “water management is more than levees and flood control. It is a comprehensive, integrated approach that brings all stakeholders—public and private—into the process of design, execution and maintenance of the water-land interface.”³¹⁷ He notes that Rotterdam, one of the world’s largest ports, is twenty-three feet below sea level and that seventy percent of Dutch GDP is produced at or below sea level.³¹⁸ Continued habitation of areas likely to be inundated by the Meuse is being made possible through small-scale construction of amphibious homes, buoyant roads, and floating greenhouses.³¹⁹

310. NETH. WATER P'SHIP, DUTCH EXPERTISE: WATER MANAGEMENT AND FLOOD CONTROL 8 (2005), available at http://www.netherlands-embassy.org/files/pdf/DutchWaterExpertise_Nov05.pdf.

311. H.E. Boudewijn van Eenennaam, Ambassador of the Netherlands to the United States, Remarks at the Wyndham New Orleans Hotel (Nov. 27, 2005), available at <http://kernn.org/pdf/Eenennaam.pdf>.

312. *Id.*

313. NETH. WATER P'SHIP, *supra* note 310, at 11.

314. *Id.*

315. *Id.*

316. *Id.* at 12.

317. H.E. Boudewijn van Eenennaam, *supra* note 311.

318. *Id.*

319. Kolbert, *supra* note 110, at 63.

The Dutch Government spends \$500 million on water protection annually and has spent \$18 billion over forty years.³²⁰ The Dutch Delta Works has been able to protect high-density and economically vital regions of the Netherlands.³²¹ Its lowest protection level substantially surpasses the protection needed to withstand a category five hurricane.³²² After the devastating storm that breached Dutch levees in 1953, New Orleans provided water pumps and helicopters to the Dutch.³²³ In the wake of Katrina and Rita, the Dutch provided New Orleans with pumps, helicopters, and ships.³²⁴ Such water cooperation between the Corps and the Dutch Rijkswaterstaat has been formalized in a 2004 memorandum of agreement.³²⁵

Unlike the Dutch Coast, the continental shelf along Louisiana's shore is subsiding.³²⁶ The marshy soils of the Gulf are less suited to levies than those of the Netherlands.³²⁷ With one third of the Netherlands below sea level, water management has become a national priority.³²⁸ While the Gulf Coast is very important to the economy of the United States,³²⁹ New Orleans must compete with other national priorities.³³⁰ While Louisiana has

320. H.E. Boudewijn van Eenennaam, *supra* note 311.

321. *Id.*

322. *Id.*

323. *Id.*; LYNNE T. EDGERTON, *THE RISING TIDE: GLOBAL WARMING AND WORLD SEA LEVELS* 75 (1991). The Dutch have been constructing dikes since the thirteenth century. EDGERTON, *supra*. In the eighteenth century these walls were connected into an integrated system. *Id.* With the aid of technologies like windmills and later mechanical and electric devices, engineers were able to pump water from behind the dikes. *Id.* Yet, this battle with the sea has come at the expense of thousands of lives and billions of dollars. *Id.* In 1953 most of Southern Holland was submerged leading to the deaths of 1,850 people. *Id.* The Dutch subsequently built a wall that would have only a 1 in 10,000 chance of failing. *Id.* To achieve this, the builders tried to account for tidal oscillations, long waves and storm surges. *Id.* They did not factor in a steady increase in sea levels due to global warming. *See id.* (noting that the new walls "incorporated historically observed sea level rise and attempted to predict a water level that would be exceeded only by a 1 in 10,000 chance").

324. H.E. Boudewijn van Eenennaam, *supra* note 311.

325. *Id.*

326. Houck, *supra* note 307, at 48.

327. *Id.*

328. NETH. WATER P'SHIP, *supra* note 310, at 3. Founded in 1200 A.D., the public water boards were the first Dutch democratic institutions. *Id.* Today, eight million people live below sea level in the Netherlands. *Id.*

329. *See* Press Release, Dept. of Energy, Short-Term Energy Outlook (June 6, 2006), available at <http://www.eia.doe.gov/pub/forecasting/steo/oldsteos/jun06.pdf> (discussing the importance of the gulf coast for crude oil and natural gas production). Nine months after hurricanes Katrina and Rita swept through the Gulf, thirty percent of a normal year's crude oil and twenty-one percent natural gas production from the federal offshore fields were shut down. *Id.*

330. *See* Houck, *supra* note 307, at 48-49.

received most of the national water resources funding,³³¹ Tulane University law professor Oliver Houck points out that developed urban area flood control received the lowest priority because “it doesn’t make money for anyone.”³³² He notes that the Mississippi River Gulf Outlet (MRGO) contributed to the flooding of St. Bernard Parish during Hurricane Katrina³³³ and that oil/gas production did not have to lead to wetlands destruction if states had required industry to take such measures as using over-marsh vehicles and backfilling canals.³³⁴ Almost half the victims of Hurricane Katrina lacked flood insurance, and those that did make claims bankrupted the federal flood insurance program when requesting \$25 billion.³³⁵ The government pledged \$15 billion of additional funds for Louisiana and Mississippi reconstruction.³³⁶

The Bush Administration predicts United States greenhouse gas emissions to increase at roughly the same rate in the coming decade as they rose in the last decade.³³⁷ This analysis was leaked to the *New York Times* because the document should have been submitted to the United Nations over a year ago.³³⁸ The Bush Administration analysis, entitled the *United States Climate Action Report*, explains that risks to water supplies will increase as a result of greenhouse gas emissions: “Warmer temperatures expected with increasing concentrations of greenhouse gases are expected to exacerbate present drought risks in the United States by increasing the rate of evaporation.”³³⁹ The draft concludes that “[b]ecause changes in the climate system are likely to persist into the future regardless of emissions mitigation, adaptation is an essential response for future protection of climate-sensitive ecosystems.”³⁴⁰ The April 2007 IPCC report indicates that the capacity of many ecosystems is likely to be surpassed within this century by climate change-induced heat, flooding, drought, wildfire, insects, and ocean acidification.³⁴¹ The report points out that

331. *Id.* at 15.

332. *Id.* at 16.

333. *Id.* at 16–17.

334. *Id.* at 19.

335. Drew & Treaster, *supra* note 260.

336. *Id.*

337. Andrew C. Revkin, *U.S. Predicting Steady Increase for Emissions*, N.Y. TIMES, Mar. 3, 2007, at A1, available at <http://www.nytimes.com/2007/03/03/science/03climate.html?ex=1175918400&en=52447108ccb9b47f&ei=5070>.

338. *Id.*

339. *Id.*

340. *Id.*

341. IPCC WORKING GROUP II CLIMATE CHANGE IMPACTS, ADAPTATION AND VULNERABILITY 2007 REPORT, *supra* note 160, at 11.

[s]ome countries have made efforts to adapt, particularly through conservation of key ecosystems, early warning systems, risk management in agriculture, strategies for flood drought and coastal management, and disease surveillance systems. However, the effectiveness of these efforts is outweighed by: lack of basic information, observation and monitoring systems; lack of capacity building and appropriate political, institutional and technological frameworks; low income; and settlements in vulnerable areas, among others.³⁴²

Policy coherence continues to be a significant concern between development and climate objectives. Shardul Agrawala of the Organization for Economic Co-operation and Development (OECD) notes that “National Development plans, Poverty Reduction Strategy Papers, Donor Country Assistance Strategies, and project documents generally do not pay attention to climate change, or often not even to current climate risks.”³⁴³ Agrawala goes on to point out that climate change is seen as a matter needing multilateral negotiations rather than domestic policy reform.³⁴⁴

V. A MULTILATERAL FORUM FOR CLIMATE CHANGE MITIGATION AND ADAPTATION

The United Nations should hold a global Climate Change Summit at the level of heads of state, according to the head of the United Nations Framework Convention on Climate Change (UNFCCC).³⁴⁵ French President Jacques Chirac has suggested an import tax on states that are unwilling to ratify a post-Kyoto climate agreement.³⁴⁶ President Yoweri Museveni of Uganda has stated that industrialized countries are engaged in acts of aggression by causing climate change.³⁴⁷ The head of the UN Convention on Biological Diversity (CBD), Ahmed Djoghlaif, points out

342. *Id.* at 14.

343. Shardul Agrawala, A Development Co-operation Perspective on Mainstreaming Climate Change: Key Findings from OECD Work, at slide 11, <http://www.oecd.org/dataoecd/15/55/35883005.pdf> (last visited Feb. 5, 2008).

344. *Id.* at slide 12.

345. *UN Official Proposes Global Summit on Climate Change to Plan Next Steps*, U.N. NEWS CTR., Jan. 16, 2007, <http://www.un.org/apps/news/story.asp?NewsID=21244&Cr=climate&CrI=change>.

346. Francois Murphy, *U.N. Official Wants World Summit on Global Warming*, REUTERS, Jan. 8, 2007, <http://www.alertnet.org/thenews/newsdesk/L08837741.htm>.

347. Revkin, *Poor Nations*, *supra* note 179.

that there is much to be gained by coordinating responses to environmental issues such as climate change and rapid loss of species.³⁴⁸ People will have to adapt to climate extremes. Refugees will continue to be displaced by rising waters and other ramifications of climate instability.³⁴⁹ Noting that climate change could displace 200 million people by the middle of the century, the British government has obtained the unanimous agreement of all fifteen of the Security Council's members to consider those parts of climate change that relate to the work of the Security Council.³⁵⁰

Issues placed on the Security Council's agenda must involve a "threat to . . . international peace and security."³⁵¹ The British government notes that climate change poses such a "threat" and points to the fact that the Security Council has similarly addressed AIDS.³⁵² U.N. Secretary General Ban Ki-Moon has declared climate change as large a threat to mankind as war and noted that "the danger posed by war to all of humanity and to our planet is at least matched by the climate crisis and global warming."³⁵³ He described global warming as a "grave and growing problem."³⁵⁴ This is the same language that Bush used to justify the 2003 United States invasion of Iraq.³⁵⁵ Ban Ki-Moon stated that "I hope that the United States, while they have taken their role in innovative technologies as well as promoting cleaner energies, will also take the lead in this very important and urgent issue."³⁵⁶

CONCLUSION

Lowering greenhouse gas emissions may strike many as a daunting prospect, but it is far less daunting than contending with the ramifications of not responding to an increase of climate extremes. From the increase in

348. Djoghla, *supra* note 278.

349. James Bone, *Britain Puts Climate Change on UN Agenda*, TIMES (London), Mar. 8, 2007, at 6, available at http://www.timesonline.co.uk/tol/news/world/us_and_americas/article1485323.ece.

350. *Darfur, Climate Change Lead Issues for Security Council Discussion this Month*, UN NEWS CTR., Apr. 4, 2007, <http://www.un.org/apps/news/story.asp?NewsID=22135&Cr=Security&Cr1=Council>; see also Bone, *supra* note 349.

351. U.N. Charter art. 39, available at <http://www.un.org/aboutun/charter/chapter7.htm>.

352. S.C. Res. 1308, U.N. Doc. S/RES/1038 (July 17, 2000), available at <http://daccessdds.un.org/doc/UNDOC/GEN/N00/536/02/PDF/N0053602.pdf?OpenElement>.

353. *U.N. Chief Warns on Climate Change*, BBC NEWS, Mar. 2, 2007, http://news.bbc.co.uk/1/2/hi/in_depth/6410305.stm; Bone, *supra* note 349.

354. Colum Lynch, *U.N. Secretary General Calls Global Warming a Priority*, WASH. POST, Mar. 2, 2007, at A14, available at http://www.washingtonpost.com/wp-dyn/content/article/2007/03/01/AR2007030101484.html?nav=rss_print/asection.

355. *Id.*

356. *U.N. Chief Warns on Climate Change*, *supra* note 353.

mortality from diseases such as malaria to the loss of low-lying nation states, climate change threatens international peace and security. Climate extremes and resulting resource depletion are already causing social unrest. Rather than simply reacting to climate change-induced armed conflict, the Security Council could establish a subsidiary organ to work on greenhouse gas mitigation and climate adaptation. It could require countries to submit annual reports on implementation of climate change measures. A subsidiary organ of the Security Council could also investigate and publish reviews of state progress. The cross-border consequences of unmitigated climate change are apparent and widely recognized by United Nations members. These consequences clearly surpass the threshold of political instability that led to Security Council action in Haiti and numerous other locations. The U.N. Charter has already been invoked in response to such non-traditional security measures as counter-terrorism. International law was previously silent on the legality of freezing terrorist assets in the absence of an attack until the Security Council passed Resolution 1373.³⁵⁷ The evolving threat by non-state actors to international peace and security has led to a more effective legal framework at the international level. Resolution 1373 has forced states to take measures to curb terrorism even when they do not know who will be harmed by a future terrorist attack or the precise manner in which an attack will occur. If international, peaceful negotiating cannot culminate in collective action to address climate change then the Security Council has the capacity to implement Chapter VII measures.³⁵⁸ According to Article 27 of the U.N. Charter, substantive Security Council decisions must receive the “affirmative vote of nine members including the concurring votes of the permanent members.”³⁵⁹ Since the key players delaying international cooperation are permanent members of the Security Council, a global warming debate within the Security Council remains a powerful catalyst for climate consensus-building.

Greater multilateral action is needed to achieve climate stability. G8 leaders have committed to promoting “tradable certificates and trading of credits” as well as “project-based and voluntary offset mechanisms” to finance the transition to cleaner energy.³⁶⁰ In addition to greenhouse gas

357. S.C. Res. 1373, ¶ 1(c), U.N. Doc. S/RES/1373 (Sept. 28, 2001), *available at* <http://daccessdds.un.org/doc/UNDOC/GEN/N01/557/43/PDF/N0155743.pdf?OpenElement>.

358. *See* U.N. Charter art. 41, *available at* <http://www.un.org/aboutun/charter/chapter7.htm>.

359. *Id.* art. 27, para. 3, *available at* <http://www.un.org/aboutun/charter/chapter5.htm>.

360. Press Release, The World Bank, G8 Summit Statements: Gleneagles Plan of Action: Climate Change, Clean Energy and Sustainable Development, at para. 22(c) (July 8, 2005)

mitigation, human ingenuity has come up with such adaptations as amphibious houses and wind-powered desalination plants that can turn salt water into drinking water.³⁶¹ The April 2007 IPCC report calls for a

mix of strategies that includes mitigation, adaptation, technological development (to enhance both adaptation and mitigation) and research (on climate science, impacts, adaptation and mitigation). Such portfolios could combine policies with incentive-based approaches, and actions at all levels from the individual citizen through to national governments and international organisations.³⁶²

Maintaining international peace and security requires soft power, the kind that can facilitate low carbon economies around the world. Adaptation and greenhouse gas reductions must both be on the agenda and implemented

<http://web.worldbank.org/WBSITE/EXTERNAL/NEWS/0,,contentMDK:20576902~menuPK:34463~pagePK:34370~piPK:34424~theSitePK:4607,00.html>. At the St. Petersburg G8 Summit, leaders reaffirmed their commitment to implement measures set out in the Gleneagles Plan of Action. G8/Saint Petersburg Russia 2006 Summit, Global Energy Security, at para. 53–55 (July 16, 2006), <http://en.g8russia.ru/docs/11.html>. The leaders stated:

We reaffirm our intention to deliver on commitments made in Gleneagles in order to meet our shared and multiple objectives of reducing greenhouse gas emissions, improving the global environment, enhancing energy security and cutting air pollution in conjunction with our vigorous efforts to reduce poverty. We also affirm our commitment to the UNFCCC's ultimate objective of stabilizing greenhouse gas concentrations in the atmosphere at a level that prevents dangerous anthropogenic interference with the climate system.

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We welcome the progress made at the XI Conference of the Parties to the UNFCCC (Montreal, December 2005) where we committed to engage in a dialogue on long-term cooperative action to address climate change by enhancing implementation of the convention

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We look forward to the next Ministerial meeting in Mexico in October 2006, where we will continue to identify opportunities for greater collaboration to tackle climate change, while pursuing energy security and sustainable development through deployment of cleaner, more efficient and low-carbon energy technologies, finance and market mechanisms, including, as appropriate, Clean Development Mechanism, Joint Implementation, emissions trade, and adaptation.

Id.; see also COSBEY, BELL, MURPHY, PARRY, DREXHAGE, HAMMILL & VAN HAM, *supra* note 45, at 33 (arguing for a “Global Climate Agreement” that “includes funding . . . for building the adaptive capacity of vulnerable countries in line with the ‘polluter-pay’ principle”).

361. Australia is experimenting with wind powered desalination plants. Revkin, *Reports From Four Fronts*, *supra* note 256.

362. IPCC WORKING GROUP II CLIMATE CHANGE IMPACTS, ADAPTATION AND VULNERABILITY 2007 REPORT, *supra* note 160, at 20 (citation omitted).

within a meaningful timeframe to avert catastrophic climate change. At a Washington summit in February 2007, delegates agreed that both developed and developing countries would have to meet targets for reducing greenhouse gas emissions.³⁶³ The non-binding declaration produced at the summit states that a global carbon market should be established.³⁶⁴ Agreement to a cap-and-trade program by the G8 countries, Brazil, China, India, Mexico and South Africa marks substantial progress.³⁶⁵ Wangari Maathai won the Nobel Peace Prize for starting the Greenbelt Movement—planting trees across Africa.³⁶⁶ She points out that “[c]onflicts and wars are not accidents. They happen because we have worked towards them rather than work to prevent them. Ensuring that we live in a clean and healthy environment is one way we can pre-empt conflict.”³⁶⁷ International institutions, governments, businesses, non-governmental organizations, and civil society can transcend politics to maintain international peace and security. The time has come to implement multilateral greenhouse gas mitigation and climate adaptation.

363. *Politicians Sign New Climate Pact*, BBC NEWS, Feb. 16, 2007, <http://news.bbc.co.uk/2/hi/science/nature/6364663.stm>.

364. *Id.*

365. *Id.*

366. The Greenbelt Movement, <http://greenbeltmovement.org/w.php?id=59> (last visited Feb. 24, 2008).

367. Wangari Maathai, Statement at the Launch of the United Nations Human Rights Council: Protect Human Rights, Protect Planet Rights 3 (June 19, 2006), available at http://www2.ohchr.org/english/bodies/hrcouncil/docs/wangari_maathai.pdf.

