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Energy Policy, Intellectual Property, and Technology Transfer to Address Climate Change

Elizabeth Burleson*

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I. INTRODUCTION

An energy revolution capable of addressing climate change impacts a wide array of stakeholders that have disparate influences over energy policy. Global population is expected to reach seven billion by 2012, intensifying the struggle for natural resources.¹ The energy market is worth 6 trillion USD.²

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¹ *World News: World Watch*, WALL ST. J., June 20, 2008, at A8. See also Elizabeth Burleson, *Multilateral Climate Change Mitigation*, 41 U.S.F. L. REV. 373, 373 (2007) [hereinafter Burleson, *Mitigation*].

Year	1820	1930	1960	1974	1988	2000
World Population	1 billion	2 billion	3 billion	4 billion	5 billion	6 billion

CIA, WORLD FACTBOOK: WORLD (2008), <https://www.cia.gov/library/publications/the-world-factbook/index.html>.

A weather-beaten economy has become a wake-up call. Investors are requiring corporate disclosure of climate risks and insisting upon climate change resolutions on company proxy statements.³ Ceres President Mindy Lubber notes that “[c]limate is one of the most underestimated risks out there.”⁴ Pointing out that the subprime mortgage lending meltdown occurred because risk was underestimated, Lubber recommends that all sectors of the economy increase assessment of the risks presented by climate change.⁵

The International Energy Agency predicts that carbon emissions will rise 130 percent and that oil demand will rise 70 percent by 2050.⁶ Reducing global emissions by half by 2050 likely will cost 1.1 percent of the average annual global gross domestic product between 2008 and 2050.⁷ International Energy Agency Executive Director Nobuo Tanaka notes that, “[t]he most scarce resource on earth is not natural resources, nor the capital investment or money, but time. And now is the time for action.”⁸

This Article considers how multilateral cooperation can lead to environmentally sound technology transfer to address climate change within an appropriate timeframe. Part II addresses the challenge to transform energy policy and provides context for examining the role that insurance companies and other sectors of the economy play in policy outcomes. Part III discusses mechanisms that enable environmentally sound technology transfer. This Article concludes that a sound energy policy that addresses climate change relies upon responsible, widespread transfer and implementation of environmentally sound technology.

² Jeffery Ball, *Where the Money Is: Why Venture Capitalist John Doerr is Bullish on Green Investments*, WALL ST. J., Mar. 24, 2008, at R6.

³ Oxford Analytica, *States Focus on Environmental Policy*, FORBES, Oct. 11, 2007, at 1, available at <http://www.forbes.com/2007/10/11/emissions-regulation-bush-cx-1012oxford.html>.

⁴ Rachele Younglai, *Lifting The Lid: Banks Urged to Address Climate Change*, REUTERS, Jan. 14, 2008, at 1, available at <http://www.planetark.com/dailynewsstory.cfm/newsid/46393/story.htm>. See generally Patricia McCoy, *Rethinking Disclosure in a World of Risk-Based Pricing*, 44 HARV. J. LEGIS. 123 (2007) (discussing information barriers in fragile markets).

⁵ Younglai, *supra* note 4, at 1.

⁶ Chikafumi Hodo, *CO₂ Emissions to Double by 2050 Unless Govts Act—IEA*, REUTERS, June 9, 2008, at 1, available at <http://www.planetark.com/dailynewsstory.cfm/newsid/48692/story.htm>. See ENERGY TECHNOLOGY PERSPECTIVES 2008: SCENARIOS & STRATEGIES TO 2050 (2008), available at <http://www.iea.org/w/bookshop/add.aspx?id=330>.

⁷ Chikafumi Hodo, *IEA Urges US\$45 Trln “Energy Revolution” to Halve*, June 9, 2008, at 1, available at <http://www.planetark.org/dailynewsstory.cfm/newsid/48690/newsDate/9Jun2008/story.htm>.

⁸ *World Not Doing Enough on Climate Change—IEA*, REUTERS, Dec. 12, 2007, at 1, available at <http://www.planetark.com/dailynewsstory.cfm/newsid/45944/story.htm>.

II. TRANSITIONING TO A SOUND ENERGY POLICY

The U.S. Congress first mandated international climate negotiations in 1987 when it enacted the Global Climate Protection Act.⁹ In 1992, President George H.W. Bush signed, and the Senate approved, the United Nations Framework Convention on Climate Change that brought together a coalition of countries in a coordinated approach to climate change.¹⁰ At the 2007 United Nations Climate Change Conference in Bali, global consensus was reached to adopt deep reductions of greenhouse gas emissions in line with the Intergovernmental Panel on Climate Change's (IPCC) initial target of 25 to 40 percent reductions below 1990 levels by the year 2020, and a peak and decline within the next ten to fifteen years.¹¹ Representing the global reductions required to avert the most catastrophic effects of climate change, this scientific time frame is not flexible.¹² An effective and equitable response to climate change must address mitigation, adaptation, technology, and finance.

NASA Goddard Institute Director Dr. James Hansen notes that the United States

must define a course next year in which the United States exerts leadership commensurate with our responsibility for the present dangerous situation. . . . [i]f emissions follow a business-as-usual scenario, sea level rise of at least two meters is likely this century. Hundreds of millions of people would become refugees. . . . Polar and alpine species will be pushed off the planet, if warming continues. Other species attempt to migrate, but as some are extinguished their interdependencies can cause ecosystem collapse[,] . . . [t]he safe level of atmospheric carbon dioxide is no more than 350 ppm (parts per million) and it may be less. Carbon dioxide

⁹ Global Climate Protection Act of 1987, Pub. L. 100–204, tit. XI, 101 Stat. 1407 (1987) (codified as amended at 15 U.S.C. § 2901 (2008)).

¹⁰ U.N. Framework Convention on Climate Change, May 9, 1992, 31 I.L.M. 849 (1992), available at <http://unfccc.int/resource/docs/convkp/conveng.pdf> [hereinafter UNFCCC]. One hundred sixty-five countries ratified the UNFCCC. *Id.* The convention entered into force on March 21, 1994. *Id.*

¹¹ BALI ACTION PLAN 1 (2007) Decision -/CP.13, available at http://unfccc.int/files/meetings/cop_13/application/pdf/cp_bali_action.pdf (The Bali Action Plan preamble states: “[r]ecognizing that deep cuts in global emissions will be required to achieve the ultimate objective of the Convention and emphasizing the urgency to address climate change as indicated in the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.” The Bali Action Plan’s sole footnote states: “Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Technical Summary, pages 39 and 90, and Chapter 13, page 776.”).

¹² Elizabeth Burleson, *Climate Change and the Bali Roadmap*, 12 ASIL INSIGHT 4, 4 (2008), available <http://www.asil.org/insights/2008/03/insights080318.html>.

amount is already 385 ppm and rising about 2 ppm per year.¹³

Lord Stern notes that his 2006 Stern Review prediction of a global temperature rise of two to three degrees Celsius over the next 50 years and a 20 percent cut in global per capita consumption underestimated the risk of climate change in light of new scientific evidence.¹⁴ The Stern Review compared the threat of climate change to the Great Depression of the 1930s.¹⁵ Since its publication, Stern has explained that “[e]missions are growing much faster than we’d thought, the absorptive capacity of the planet is less than we’d thought, the risks of greenhouse gases are potentially bigger than more cautious estimates, and the speed of climate change seems to be faster.”¹⁶ Previous calculations must be considered in light of evidence that ocean saturation reduces the ability to absorb CO₂.¹⁷ Warmer oceans absorb less carbon.¹⁸ Furthermore, thawing permafrost rapidly increases methane emissions into the atmosphere.¹⁹ Stern calls for strong and urgent collective action to address climate change.²⁰ He explains that world carbon emissions must peak within fifteen years, then be reduced by half from the 1990 levels

¹³ *Global Warming Twenty Years Later: Tipping Points Near: Briefing Before the H. Select Comm. on Energy Indep. and Global Warming*, 110th Cong. 1 (2008) (statement of Dr. James E. Hansen, Dir., NASA Goddard Inst. for Space Stud.), available at http://www.columbia.edu/~jeh1/2008/TwentyYearsLater_20080623.pdf. See also Andrew C. Revkin, *Are Big Oil and Big Coal Climate Criminals?*, N.Y. TIMES, June 23, 2008, at 1, <http://dotearth.blogs.nytimes.com/2008/06/23/are-big-oil-and-big-coal-climate-criminals/>; *Adverts Urge World to Axe CO₂ to 1980s Levels*, REUTERS, June 24, 2008, at 1, available at <http://www.planetark.com/dailynewsstory.cfm/newsid/48945/story.htm>.

¹⁴ Fiona Harvey & Jim Pickard, *Stern Takes Bleaker View on Warming*, FIN. TIMES, Apr. 17, 2008, <http://www.ft.com/cms/s/0/f8e1377a-0c15-11dd-9840-0000779fd2ac.html>. See also Gerard Wynn, *Interview—Climate Expert Stern Says Underestimated Problem*, REUTERS, Apr. 17, 2008, at 1, available at <http://www.planetark.com/dailynewsstory.cfm/newsid/48012/story.htm>. See generally NICHOLAS STERN, STERN REVIEW: THE ECONOMICS OF CLIMATE CHANGE, at xi (2006), available at http://www.hm-treasury.gov.uk/d/Executive_Summary.pdf [hereinafter STERN REVIEW]. The review notes that “stabilisation of greenhouse gases at levels of 500–550ppm CO₂ will cost, on average, around 1 [percent] of annual global GDP by 2050. This is significant, but is fully consistent with continued growth and development, in contrast with unabated climate change, which will eventually pose significant threats to growth.” *Id.* at xiii.

¹⁵ STERN REVIEW, *supra* note 14, at 151, available at http://www.hm-treasury.gov.uk/d/Part_II_Introduction_group.pdf.

¹⁶ Wynn, *supra* note 14, at 1.

¹⁷ *Id.*

¹⁸ U.N. DEV. PROGRAMME, HUMAN DEVELOPMENT REPORT 2007/2008: FIGHTING CLIMATE CHANGE: HUMAN SOLIDARITY IN A DIVIDED WORLD 33 (2007), available at http://hdr.undp.org/en/media/hdr_20072008_en_complete.pdf [hereinafter HUMAN DEVELOPMENT REPORT].

¹⁹ Danny Fortson, *Stern Warns that Climate Change is Far Worse than 2006 Estimate*, INDEP. (U.K.), Apr. 17, 2008, <http://www.independent.co.uk/news/business/news/stern-warns-that-climate-change-is-far-worse-than-2006-estimate-810488.html>.

²⁰ STERN REVIEW, *supra* note 14, at xxvii.

to 20 billion tons annually by 2050, and finally be capped at 10 billion tons each year.²¹

A. *The Insurance Industry and Energy Policy*

Insurance companies can spur energy policy reform since the insurance industry has a larger stake in climate mitigation than many other sectors of the U.S. economy. The U.S. government's National Science and Technology Council states that "[i]t is possible that regions exposed to risks from climate change will see movement of population and economic activity to other locations. One reason is public perceptions of risk, but a more powerful driving force may be the availability of insurance."²² After reviewing their exposure to climate risks, insurance companies have been capping paid losses, thus shifting a greater share of risk to consumers, and refusing to insure high-risk regions.²³

²¹ Jeremy Lovell, *Rich World Must Back 80 Percent Carbon Cuts*—Stern, REUTERS, May 1, 2008, at 1, available at <http://www.planetark.com/dailynewsstory.cfm/newsid/48184/story.htm>. See also Mark Kinver, *Climate 'Clearly Out of Balance,'* BBC NEWS, Jan. 24, 2008, <http://news.bbc.co.uk/2/hi/science/nature/7207335>. The American Geophysical Union warns that climate change is

best explained by the increased atmospheric abundances of greenhouse gases and aerosols generated by human activities in the 20th Century. . . . Even the lower limit of impending climate change—an additional global mean warming of 1.0C (1.8F) above the last decade—is far beyond the range of climate variability experienced during the past 1,000 years.

Kinver, *supra*. See also Press Release, Ga. Inst. of Tech., Hurricanes Are Getting Stronger, Study Says (Sept. 15, 2005), available at <http://www.gatech.edu/news-room/release.php?id=654> (noting that the number of Category 4 and 5 hurricanes worldwide has nearly doubled over the past thirty-five years, according to a National Science Foundation (NSF) funded study conducted by Peter Webster of Georgia Tech's School of Earth and Atmospheric Sciences, who notes that hurricanes "cool the oceans by evaporating the water and then redistributing the oceans' tropical heat to higher latitudes").

²² U.S. NAT'L SCI. & TECH. COUNCIL, SCIENTIFIC ASSESSMENT OF THE EFFECTS OF GLOBAL CHANGE ON THE UNITED STATES: A REPORT OF THE COMMITTEE ON ENVIRONMENT AND NATURAL RESOURCES 13 (May 2008), available at <http://www.climate-science.gov/Library/scientific-assessment/Scientific-AssessmentFINAL.pdf>.

²³ Joe Palca, *In a Strategic Reversal, Dutch Embrace Floods* 1 (NPR Morning Edition broadcast, Jan. 22, 2008) (transcript available at <http://www.npr.org/templates/story/story.php?storyId=18229027>). For further details, see also the HUMAN DEVELOPMENT REPORT, *supra* note 18, at 79, noting

[o]ne of the side-effects of Hurricane Katrina has been to fuel the rise of catastrophic risk bonds, which transfer risk from insurers to capital markets: payments to bond holders cease in the event of a climate catastrophe. The market in 2006 stood at US\$3.6 billion, compared with US\$1 billion two years earlier.

Id. See also Liam Plevin, *As Premiums Rise, Homeowners Drop Wind Coverage*, WALL ST. J., Sept. 4, 2007, at B1 (noting that people are doing without insurance as "nearly three million Americans were dropped by their home insurers in the past two years—more than two-thirds of them in 16 Southeastern states").

In 1997, the United Nations Environment Program (UNEP) Executive Director Elizabeth Dowdeswell pointed out that “[t]he insurance industry has become a powerful and credible lobby for action[,] . . . an important counterweight to those who are working to slow progress.”²⁴ Insurance companies have pressed for increased public investment in storm and flood-defense systems and for an increased governmental role as an insurer of last resort.²⁵ “[C]limate change has implications for the fiscal health of the Federal Government,”²⁶ according to the U.S. Government Accountability Office. The Human Development Report notes that the U.S. National Flood Insurance Program exposure approaches 1 trillion USD while the Federal Crop Insurance Program exposure is roughly 44 billion USD.²⁷

The insurance industry’s viability depends on its ability to assess uncertainty. Insurance companies can play an influential role in changing the business community’s incentives regarding climate change mitigation. While whole cities have developed in flood plains, insurers play a role in curbing further development in vulnerable areas by not insuring new construction based upon climate change calculations. Strong economic forces work against such policy changes as efficiency standards, removal of subsidies, and funding technology transfer. Insurers can be a powerful lobbying force for the implementation of these measures or for such “no-regret” policies as reforestation. Even if insurance agencies choose not to enter into the arena of information gathering and coalition building, conventional incentive measures can change business behavior. Higher insurance premiums can offset price distortions like agricultural, fuel, and transportation entitlements. This would provide economic incentives to transition to more sustainable practices. For example, insurance companies could adopt policies to encourage efficient replacement investments at the end of the economic life of equipment or an entire plant. Incentive altering can also be accomplished by lowering premiums for firms that participate in tradable markets that mitigate greenhouse gas emissions.

B. Local, State, National, and International Energy Policy

California seeks to cut greenhouse emissions by 25 percent by 2020.²⁸ California’s Global Warming Solutions Act of 2006 seeks to jumpstart the

²⁴ Press Release, U.N. Env’tl. Programme, Insurance Executives Discuss Impact of Climate Change: International Conference on Environmental Issues in the Financial Services Sector (Dec. 2, 1997), available at <http://144.16.65.194/hpg/envis/doc97html/envunep1128.html> (noting more than 200 top level insurance executives and representatives of other financial institutions from more than ten countries met in Tokyo on December 2, 2007, to discuss climate change strategies).

²⁵ HUMAN DEVELOPMENT REPORT, *supra* note 18, at 79.

²⁶ *Id.*

²⁷ *Id.*

²⁸ John Rondo, *US Midwest Governors Sign Climate Change Accord*, REUTERS, Nov. 19, 2007, at 1, available at <http://www.reuters.com/article/environmentNews/idUSN1528878720071115>.

reduction of emissions.²⁹ At the local level, the Bay Area Air Quality Management District has established the first set of rules in the United States that require businesses to pay for the carbon that they emit.³⁰ Each company that is permitted by the district will have to measure and report their carbon emissions, then pay 4.4 cents per ton of carbon.³¹ While it may be easier for San Francisco as a single city, or California as a single state, to build energy policy consensus, companies will encounter administrative difficulties when confronting a patchwork of different policies on climate change rather than a single national approach.³² Low local-district air policies in some regions may make it harder to enact sufficiently tough emissions standards to achieve climate stabilization.³³ Yet, regional greenhouse gas reduction agreements have led to progressive energy policies capable of mitigating greenhouse gas emissions.

Almost half of the people in the United States will be living in areas covered by three regional greenhouse gas agreements.³⁴ The northeastern U.S. states and Canadian provinces were the first North American region to agree to address climate change collectively. After capping carbon emissions at 2006 levels through 2015, Regional Greenhouse Gas Initiative (RGGI) states and provinces in the northeast plan to cut emissions 10 percent by 2020.³⁵ Similarly, five western states have formed the Western Regional Climate Action Initiative to reduce greenhouse gases.³⁶ Most recently, midwestern U.S. states have agreed to cut greenhouse gases and promote

²⁹ CAL. HEALTH & SAFETY CODE § 38500 (2006).

³⁰ See Bay Area Air Quality Mgmt. Dist., Reg. 3: Fees 3–44 (2008), available at http://www.baaqmd.gov/dst/regulations/rg0300_070108.pdf.

³¹ *Id.* at Reg. 3: Schedule T (“For each permitted facility emitting greenhouse gases, the fee shall be based on the following: 1. Carbon Dioxide Equivalent (CDE) Emissions \$0.044 per metric ton.”).

³² Timothy Aeppel, *Embracing the Change: the Chief Executive of PPG Industries Says It's Time for Business to Take the Lead on Environmental Issues*, WALL ST. J., Oct. 29, 2007, at R8.

³³ *Id.* See also Bernie Woodall, *Climate Registry Nears 1st US Emissions Reporting*, REUTERS, Jan. 21, 2008, at 1, available at <http://www.planetark.com/dailynewsstory.cfm/newsid/46535/story.htm>.

³⁴ Rondy, *supra* note 28, at 1.

³⁵ Matthew Dalton, *New CO2 Limits Cloud Mirant's Hopes for Sale*, WALL ST. J., July 11, 2007, at 1. Because the Northeast is a relatively ecologically homogeneous area, the inhabitants of various states and provinces share common risks from climate change. All of the states and provinces are coastal with the exception of Vermont. This puts the Northeast in a high risk category not only for sea level rise but also for more numerous and more severe storm patterns. Both can seriously damage highways, sewage treatment plants, port facilities, and urban infrastructure. The ramifications for the many cities located along the Northeastern Atlantic shore are frightening. *Id.*

³⁶ See Press Release, Governor's Comm. Offices of Ariz., Calif., New Mex., Or., and Wash., Five Western Governors Announce Regional Greenhouse Gas Reduction Agreement 1 (Feb. 26, 2007), available at <http://governor.oregon.gov/Gov/pdf/letters/022607NGA.pdf> (noting that in the absence of meaningful federal action, the governors of Arizona, California, New Mexico, Oregon, and Washington have agreed to track, limit, and mitigate greenhouse gases).

energy conservation.³⁷ If treated as a country, the Midwest represents the fifth largest greenhouse gas emitter globally.³⁸ State governments have much more leeway to establish land planning codes, regulate gases and electrical utilities, and a wide array of other policies than does the federal government. Similarly, countries can establish national policies more easily than international ones.

The United States is considering such national measures as cutting greenhouse gas emissions to 80 percent below 1990 levels by 2050 through a cap-and-trade system; reducing emissions to 1990 levels by 2020; requiring fuel suppliers to cut carbon content by 10 percent by 2020; requiring all publicly-traded U.S. companies to file reports on climate change risks with the Securities and Exchange Commission (SEC); doubling fuel economy standards; increasing the renewable fuel standard to at least 60 billion gallons of advanced biofuels such as cellulosic ethanol by 2030; and requiring U.S. utilities to obtain 25 percent of their electricity from renewable sources such as wind and solar by 2025.³⁹

The National Intelligence Council warns that, "[e]xpectations are that U.S. leadership will be pivotal in helping the international community set meaningful long-term goals for greenhouse gas emissions reductions and mitigating and adapting to climate change through technological progress and transfers, financial assistance, and support for climate migrants."⁴⁰ The World Bank estimates a 60 percent increase in carbon emissions from global energy production by 2030.⁴¹ Viable renewable energy options continue to become less expensive and more effective at meeting energy demand.

Increasing subsidies for renewable energy and reducing subsidies for energy generation that poses risk to health and the environment can support the development of environmentally clean technology. Yet as the Wall Street

³⁷ Midwestern Governor's Ass'n, Midwestern Energy Security & Climate Stewardship Summit, Midwestern Greenhouse Gas Accord, Nov. 15, 2007, *available at* <http://www.midwesternaccord.org/midwesterngreenhousegasreductionaccord.pdf>. The Midwest Greenhouse Gas Accord established the Midwestern Greenhouse Gas Reduction Program. *Id.* Signatories to the Accord are the U.S. states of Minnesota, Wisconsin, Illinois, Iowa, Michigan, Kansas, and the Canadian Province of Manitoba. *Id.* Observers of the Accord are Indiana, Ohio, and South Dakota. *Id.*

³⁸ Rondy, *supra* note 28, at 1.

³⁹ *US Presidential Candidates on Environment, Energy*, REUTERS, Apr. 17, 2008, at 1, *available at* <http://www.planetark.com/dailynewsstory.cfm/newsid/48022/story.htm>.

⁴⁰ *National Intelligence Assessment on the Natural Security Implications of Global Climate Change to 2030 Before the Permanent Select Comm. on Intelligence and the H. Select Comm. on Energy Independence and Global Warming*, 110th Cong. 17 (2008) (Statement of Dr. Thomas Fingar, Deputy Dir. of Nat'l Intelligence for Analysis and Chairman of the Nat'l Intelligence Council), *available at* http://www.dni.gov/testimonies/20080625_testimony.pdf [hereinafter *National Intelligence Assessment*].

⁴¹ DEV. COMM. OF THE WORLD BANK GROUP, CLEAN ENERGY AND DEVELOPMENT: TOWARDS AN INVESTMENT FRAMEWORK 18 (2006), *available at* [http://siteresources.worldbank.org/DEVCO/MMINT/Documentation/20890696/DC2006-0002\(E\)-CleanEnergy.pdf](http://siteresources.worldbank.org/DEVCO/MMINT/Documentation/20890696/DC2006-0002(E)-CleanEnergy.pdf).

Journal notes, “[t]he direction Congress takes on proposals to cap greenhouse gases could depend on coal-rich states such as West Virginia, which has some of the nation’s poorest households, but is rich in both coal and political clout.”⁴² West Virginia is the second-poorest state in the United States, and its economy depends upon coal, which still contributes half of the electricity used in the United States.⁴³ Coal-fired power plants emit double the carbon that comparable natural-gas-fired plants emit.⁴⁴ Technological innovation will play an important role in state acceptance of greenhouse gas limits. Directing proceeds from a carbon trading system to safe and effective carbon capture and sequestration development⁴⁵ could gain coal state support for cap-and-trade legislation. Yet, for every five coal plants using carbon sequestration, a sixth plant is needed to generate the energy needed to capture and bury carbon.⁴⁶

Texas is the highest carbon emitter in the United States and seventh worldwide (if treated as a country), according to the Energy Information Administration.⁴⁷ President George W. Bush’s goal has been to stop further increases in United States greenhouse gas emissions by 2025.⁴⁸ This approach allows U.S. greenhouse gas emissions to increase for the next seventeen years before any action would be taken. David Sandalow notes that, “we don’t have voluntary speed limits in this country and voluntary limits on heat-trapping gases won’t do the job either.”⁴⁹ Public support for caps on greenhouse gases depends upon an informed general public. The general public’s ability to become informed decision-makers depends upon coverage of the scientific, economic, political, and social implications of

⁴² Siobhan Hughes, *U.S. News: Coal States in Climate-Bill Fight: Miners Would Lose With Carbon Caps; Sen. Byrd Says ‘No,’* WALL ST. J., June 4, 2008, at A2.

⁴³ *Id.*

⁴⁴ *Id.*

⁴⁵ Timothy Gardner, *ADM Will Bury Carbon from US Ethanol Plant*, REUTERS, Jan. 7, 2008, at 1, available at <http://www.planetark.com/dailynewsstory.cfm/newsid/46273/story.htm>.

⁴⁶ Bruce Nichols, *Power Needed to Bury CO₂ a Coal Issue-Experts*, REUTERS, June 30, 2008, at 1, available at <http://www.planetark.com/dailynewsstory.cfm/newsid/49079/story.htm>.

⁴⁷ *World-Wide*, WALL ST. J., Jan. 17, 2008, at A1. See also ENERGY INFO. ADMIN., OFFICIAL ENERGY STAT. FROM THE U.S. GOV’T, STATE PROFILES: TEXAS 1 (2008), available at http://tonto.eia.doe.gov/state_energy_profiles.cfm?sid=TXCarbon (noting that Texas electric power industry emissions represent 10.5 percent of national carbon emissions); HUMAN DEVELOPMENT REPORT, *supra* note 18, at 43 (noting that overall Texas carbon emissions represent 12 percent of total U.S. carbon emissions).

⁴⁸ President George W. Bush, Speech on Climate Change (Apr. 16, 2008) (transcript reprinted in WALL ST. J., Apr. 16, 2008, at 1).

⁴⁹ Deborah Zabarenko, *Bush Emission Plan Adds to Environmental Legacy*, REUTERS, Apr. 17, 2008, at 1, available at <http://www.planetark.com/dailynewsstory.cfm/newsid/48005/story.htm>.

climate change.⁵⁰ The Global Change Research Act of 1990 calls upon the federal government to publish a climate change assessment every four years.⁵¹ It took a court order to induce the second Bush administration to release the climate change assessment in May 2008.⁵² The report states that human-induced climate change is occurring.⁵³

To date, the United States has yet to enact a national target for lowering greenhouse gas emissions. The United Nations Development Program (UNDP) notes that the U.S. carbon-intensity goal has failed to halt an overall rise in emissions.⁵⁴ The Environmental Protection Agency states that U.S. greenhouse gas emissions rose 14.7 percent from 1990 to 2006.⁵⁵ Greenhouse gas emissions are rising in the United States by an average of about 1 percent a year.⁵⁶ The European Union has agreed to reduce EU emissions by

⁵⁰ Jacques Steinberg, *ABC, CBS and NBC Will Join Forces For a Prime-Time Cancer Fundraiser*, N.Y. TIMES, May 28, 2008, at E3. The media could coordinate climate stabilization efforts in a similar manner as ABC, CBS, and NBC have done by holding a joint benefit for cancer research.

⁵¹ Global Change Research Act of 1990, Pub. L. No. 101-606, 104 Stat. 3096 (codified at 15 U.S.C. §§ 2921-2961 (1990)).

⁵² *Ctr. for Biological Diversity v. Brennan*, 2007 WL 2408901, at *20 (N.D. Cal. 2007).

⁵³ U.S. NAT'L SCI. & TECH. COUNCIL, *supra* note 22, at 10. The report notes that

[t]he globally averaged concentration of carbon dioxide in the atmosphere has increased from about 280 parts per million (ppm) in the 18th century to 383 ppm in 2007. Emissions of carbon dioxide from fossil fuel use and from the effects of land use change are the primary sources of this increase. The current atmospheric concentration of carbon dioxide greatly exceeds the natural range of the last 650,000 years (180 to 300 ppm) as determined from ice cores.

Id. See also Timothy Gardner, *US Issues Climate Assessment Forced by Court Order*, REUTERS, May 30, 2008, at 1, available at <http://www.planetark.com/dailynewsstory.cfm/newsid/48564/story.htm>; *Judge Orders Reports on Global Warming*, N.Y. TIMES, Aug. 22, 2007, at A12; John Solomon & Juliet Eilperin, *Bush's EPA is Pursuing Fewer Polluters Probes and Prosecutions Have Declined Sharply*, WASH. POST, Sept. 30, 2007, at A1, available at <http://www.washingtonpost.com/wp-dyn/content/article/2007/09/29/AR2007092901759.html>.

⁵⁴ HUMAN DEVELOPMENT REPORT, *supra* note 18, at 10.

⁵⁵ News Release, EPA, EPA Publishes Annual National Greenhouse Gas Inventory 1 (Apr. 15, 2008), available at <http://yosemite.epa.gov/opa/admpress.nsf/0/109768980DDF452E8525742C005DD608>. The release notes that

[t]otal emissions of the six main greenhouse gases in 2006 were equivalent to 7,054.2 million metric tons of carbon dioxide. These gases include carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulfur hexafluoride. The report indicates that overall emissions have grown by 14.7 percent from 1990 to 2006, while the U.S. economy has grown by 59 percent over the same period.

Id. See also John D. McKinnon & Stephen Power, *Bush to Call for Greenhouse-Gas Curbs Pressured for Years, President Warm to Broad Regulation*, WALL ST. J., Apr. 16, 2008, at A1.

⁵⁶ Christopher Joyce, *What's Old, What's New in Bush's Climate Strategy*, NPR, Apr. 16, 2008, at 1, available at <http://www.npr.org/templates/story/story.php?storyId=89701672&ft=1&f=1001>.

20 percent by 2020, and 50 percent by 2050.⁵⁷ The second Bush Administration suggests that U.S. emissions should peak in 2025.⁵⁸ Greater commitment to greenhouse gas mitigation is imperative from such key emitters as the United States. Linking regional cap-and-trade systems is one of the best ways to realize global emissions reductions in a reasonable and equitable manner.

III. ENVIRONMENTALLY SOUND TECHNOLOGY TRANSFER AND INTELLECTUAL PROPERTY RIGHTS

While Japan has provided energy efficiency leadership and the European Union has provided carbon market leadership, the United States has provided leadership in research and development of innovative technologies.⁵⁹ The United States spent 18 billion USD on climate research between 1990 and 2006.⁶⁰ Stern points out that

[w]orld public sector R & D in technology fell by half between, roughly, the early 1980s and the early 2000s. Only in the last few years has it begun rising again. Private and public research activity are highly correlated, and much more of both is needed.⁶¹

Climate change offers the international community “our chance to usher in a new age of green economics and truly sustainable development,”⁶² according to U.N. Secretary General Ban-Ki Moon.

A. *The Clean Technology Fund: Facilitating Environmentally Sound Technology Transfer*

In 2008, the United States will launch a multi-billion dollar Clean Technology Fund with the goal of reducing trade barriers for environmental goods and services.⁶³ President George W. Bush supports making

⁵⁷ *Id.* See also Colum Lynch, *UN Chief Calls for ‘Real Breakthrough’ On Climate Change*, WASH. POST, Sept. 25, 2007, at A6, available at http://www.washingtonpost.com/wp-dyn/content/article/2007/09/24/AR2007092400128.html?nav=rss_print/asection.

⁵⁸ Joyce, *supra* note 56, at 1.

⁵⁹ INT’L INST. SUSTAINABLE DEV., *GOVERNING CLIMATE: THE STRUGGLE FOR A GLOBAL FRAMEWORK BEYOND KYOTO 9* (Taishi Sugiyama ed., 2005), available at http://www.iisd.org/pdf/2005/climate_governing.pdf.

⁶⁰ Kathryn Cohen, *Consensus Elusive on U.S. Global Warming Policy*, PBS NEWSHOUR, June 5, 2006, at 1, available at http://www.pbs.org/newshour/indepth_coverage/science/globalwarming/policy.html.

⁶¹ Nicholas Stern, *Prospect Magazine: Politics Essays Argument*, LONDON SCH. ECON. & POL. SCI., July 2008, at 1, available at http://www.prospectmagazine.co.uk/article_details.php?id=10256.

⁶² *Id.*

⁶³ *U.S. to Launch Clean Technology Fund in 2008*, REUTERS, Jan. 14, 2008, at 2, available at <http://www.reuters.com/article/environmentNews/idUSN1443011220080114?feedType=RSS&feedName=environmentNews>.

advanced technology affordable and available in the developing world—by lowering trade barriers, creating a global free market for clean energy technologies, and enhancing international cooperation and technology investment. . . . We will work toward the creation of an international clean technology fund that will help finance low-emissions energy projects in the developing world. We'll call on all nations to help spark a global clean energy revolution by agreeing immediately to eliminate trade barriers on clean energy goods and services.⁶⁴

That is not to say that all of these technologies are optimal for the environment. Clean coal and nuclear development have left people bitterly divided over how to reduce carbon emissions. This debate has spilled over into consensus-building efforts to fund technology transfer.⁶⁵ The Bali Action Plan calls for “scaling up of the development and transfer of technology to developing country parties in order to promote access to affordable environmentally sound technologies.”⁶⁶ It also calls for “[c]ooperation on research and development of current, new and innovative technology.”⁶⁷ The United Nations Development Program notes that

[t]he world has less than a decade to change course. No issue merits more urgent attention—or more immediate action. Climate change is the defining human development issue of our generation. All development is ultimately about expanding human potential and enlarging human freedom . . . Climate change threatens to erode human freedoms and limit choice. . . . The world lacks neither the financial resources nor the technological capabilities to act. If we fail to prevent climate change it will be because we were unable to foster the political will to cooperate.⁶⁸

In contrast to the Cold War, during which doing nothing was a containment strategy, delay on climate cooperation to reduce greenhouse gas emissions “lock[s] the future into a higher temperature.”⁶⁹ Rather than ramping up mechanisms for finance and technology transfers, “[c]urrent investment patterns are putting in place a carbon intensive energy infrastructure, with coal playing a dominant role. On the basis of current trends and present policies, energy-related CO₂ emissions could rise by more

⁶⁴ President Bush, *supra* note 48.

⁶⁵ BALI ACTION PLAN, *supra* note 11, at 1.

⁶⁶ *Id.* at 2.

⁶⁷ *Id.*

⁶⁸ HUMAN DEVELOPMENT REPORT, *supra* note 18, at 1–2.

⁶⁹ *Id.* at 4.

than 50 percent over 2005 levels by 2030.”⁷⁰ Prices that relate to the use of greenhouse gases need to reflect their true social cost.⁷¹

Countries should enact legislation to achieve 20 percent environmentally sound renewable energy generation by 2020.⁷² Carbon taxation can occur without raising the overall tax burden if the revenue is used in a fiscally neutral manner, such as by lowering labor taxes.⁷³ The United Nations Development Program suggests the following framework. In 2010 a carbon tax could be introduced at 10–20 USD per ton of CO₂.⁷⁴ Such a tax could then increase by 5–10 USD per ton of CO₂ every year until it reached 60–100 USD per ton of CO₂.⁷⁵ Norway has had such a tax since the early 1990s.⁷⁶

The European Union’s Emissions Trading Scheme (ETS) has pioneered carbon trading, building upon the successes of acid rain and fishery tradable permit markets.⁷⁷ A carbon cap-and-trade system establishes an overall cap on emissions, then allocates tradable permits to emit a given unit of CO₂. Permit holders who lower their emissions by more than their allowance can sell permits. This allows entities that lower emissions in a cost-effective manner to trade permits with those for whom reducing emissions is more difficult. While carbon markets can lead to energy price instability, environmental certainty can be achieved regarding total emissions levels.⁷⁸ The United Nations Development Program notes that caps on emissions to date have been set too high due to special interest lobbying and that an insufficient number of permits were auctioned.⁷⁹ The EU commitment to reduce emissions by 20–30 percent by 2020 provides an opportunity to realign carbon market and climate mitigation figures.⁸⁰

⁷⁰ *Id.* at 8.

⁷¹ *Id.* at VII.

⁷² *Id.* at 17.

⁷³ HUMAN DEVELOPMENT REPORT, *supra* note 18, at 17.

⁷⁴ *Id.*

⁷⁵ *Id.*

⁷⁶ *Norwegian Industry Complains Over CO₂ Rules*, REUTERS, Nov. 1, 2007, <http://www.reuters.com/article/environmentNews/idUSL0145794120071101?feedType=RSS&feedName=environmentNews>. See also Wojciech Moskwa, *Norway Faces Tough Road to Zero Emissions in 2050*, REUTERS, Apr. 23, 2007, at 1, available at <http://www.planetark.org/dailynewsstory.cfm/newsid/41509/story.htm> (managing director of Norwegian oil industry association Per Terje Vold notes that, “[w]e have the best available technology to limit emissions because we have lived with the world’s highest CO₂ tax since the early 1990s”).

⁷⁷ See generally Elizabeth Burleson, *supra* note 1 (discussing the use of cap-and-trade systems to prevent acid rain and avert fisheries from collapsing).

⁷⁸ HUMAN DEVELOPMENT REPORT, *supra* note 18, at 11.

⁷⁹ *Id.*

⁸⁰ *Id.*

Emissions trading is a necessary but insufficient means by which to address climate change. Governments must augment carbon markets with the development and deployment of environmentally sound technology and efficiency measures. Environmentally sound technology has surged due to simultaneous advances in material sciences, biology, information technology, and industry drive.⁸¹ As patents concentrate in the hands of fewer entities, litigation may rise.⁸²

Governments can play a role in balancing the intellectual property rights crucial to innovation with widespread implementation of solutions to severe climate change. "Multilateral climate protection architecture will be left on an insecure foundation if it is not rooted in financial commitments,"⁸³ according to UNDP. "One section of humanity—broadly the poorest 2.6 billion—will have to respond to climate change forces over which they have no control, manufactured through political choices in countries, where they have no voice."⁸⁴ Mary Robinson points out that human rights and the environment are interdependent and interrelated.⁸⁵ "Climate shocks such as drought and floods can cause grave setbacks in nutritional status as food availability declines, prices rise and employment opportunities shrink. Deteriorating nutrition provides the most telling evidence that coping strategies are failing,"⁸⁶ according to UNDP. Countries that can afford to help nations with fewer resources to implement environmentally sound technology should do so as quickly and effectively as possible. Funding could be based on U.N. contribution levels. Collective implementation of truly environmentally sound technology is politically feasible and urgently required to avert climate chaos.

B. Encouraging Global Developments in Technology Transfer

Global cooperation is occurring. Nearly 200 countries have agreed to accelerate a treaty to freeze and phase out hydrochlorofluorocarbons (HCFCs) used in some refrigerators and air conditioners.⁸⁷ The agreement is designed to reduce by half the emission of chemicals that damage the ozone layer and to significantly lower greenhouse gas emissions.⁸⁸ Major companies including

⁸¹ Todd R. Miller, James W. Peterson, & T. Christopher Tsang, *Patent Trends in the Cleantech Industry*, 20 INTELL. PROP. & TECH. L.J. 1, 1 (2008).

⁸² *Id.*

⁸³ HUMAN DEVELOPMENT REPORT, *supra* note 18, at 52.

⁸⁴ *Id.* at 31.

⁸⁵ *Id.* at 82.

⁸⁶ *Id.* at 86.

⁸⁷ *Deal Will Speed Cuts in Greenhouse Gas*, ENVTL. NEWS NETWORK, Sept. 23, 2007, at 1, available at http://www.enn.com/top_stories/article/23306.

⁸⁸ *Id.*

IBM and Pitney-Bowes have agreed to allow free use of thirty-one patents that can reduce pollution.⁸⁹ The National Intelligence Council calls for

improved and better validated regional and local models (accounting for regional and local processes) of strategic climate change, particularly models that provide details on hydrological consequences and changes in the frequency and intensity of extreme events. Finally, there is a need for better information on physical, agricultural, economic, social, and political impacts from climate change at state and regional levels.⁹⁰

IBM and the Energy Department's Los Alamos National Laboratory have developed a supercomputer with a greatly advanced capacity to conduct climate change modeling. Before it is located in a classified environment, the government will use the supercomputer to test climate models with a higher degree of accuracy than has been available to date.⁹¹

Over the past decade, researchers have been able to agree that human-induced climate change is occurring thanks in part to increased accuracy in climate modeling. Now researchers can calculate the effects that atmospheric and oceanic conditions have on one another as long as aging NASA weather satellites can provide input data.⁹² These insights, fueled by technology and cooperative efforts, are critical to addressing climate change effectively.

C. *Technology, Environmental Law, and World Trade*

Technology transfer is not a new concept in international law. Article 4(5) of the United Nations Framework Convention on Climate Change (UNFCCC) calls for nations to transfer environmentally sound technology, defined by Agenda 21 as technologies that "protect the environment, are less polluting, use all resources in a more sustainable manner, recycle more of their wastes and products, and handle residual wastes in a more acceptable manner than the technologies for which they were substitutes."⁹³ Article 4(5) of the Framework Convention on Climate Change states:

⁸⁹ Diane Bartz, *IBM, Pitney-Bowes, Others Give Free Green Patents*, REUTERS, Jan. 15, 2008, at 1, available at <http://www.planetark.com/dailynewsstory.cfm/newsid/46422/story.htm>.

⁹⁰ *National Intelligence Assessment*, *supra* note 40, at 18.

⁹¹ John Markoff, *American Military Supercomputer Sets Speed Record*, N.Y. TIMES, June 9, 2008, at C7.

⁹² Christopher Lee, *Faster Computers Accelerate Pace of Discovery*, WASH. POST, Dec. 3, 2007, at A7, available at http://www.washingtonpost.com/wpdyn/content/article/2007/12/02/AR2007120201403_pf.html. See also Alistair Doyle, *Scientists Urge US\$2-3 Billion Study of Ocean Health*, REUTERS, Nov. 26, 2007, available at <http://www.planetark.com/dailynewsstory.cfm/newsid/45514/story.htm> (noting that additional research is needed in such areas as energy, climate, agriculture, biodiversity, water supplies, and weather).

⁹³ U.N. Dep't of Econ. & Soc. Affairs Div. for Sustainable Dev., Agenda 21: Earth Summit—The United Nations Programme of Action from Rio (Apr. 1993), available at <http://www.un.org/esa/>

The developed country Parties and other developed Parties included in Annex II shall take all practicable steps to promote, facilitate and finance, as appropriate, the transfer of, or access to, environmentally sound technologies and know-how to other Parties, particularly developing country Parties, to enable them to implement the provisions of the Convention. In this process, the developed country Parties shall support the development and enhancement of endogenous capacities and technologies of developing country

sustdev/documents/agenda21/english/agenda21chapter34.htm. Agenda 21, Chapter 34 on Transfer of Environmentally Sound Technology, Cooperation and Capacity-Building states:

34.1. Environmentally sound technologies protect the environment, are less polluting, use all resources in a more sustainable manner, recycle more of their wastes and products, and handle residual wastes in a more acceptable manner than the technologies for which they were substitutes.

34.2. Environmentally sound technologies in the context of pollution are "process and product technologies" that generate low or no waste, for the prevention of pollution. They also cover "end of the pipe" technologies for treatment of pollution after it has been generated.

34.3. Environmentally sound technologies are not just individual technologies, but total systems which include know-how, procedures, goods and services, and equipment as well as organizational and managerial procedures. This implies that when discussing transfer of technologies, the human resource development and local capacity-building aspects of technology choices, including gender-relevant aspects, should also be addressed. Environmentally sound technologies should be compatible with nationally determined socio-economic, cultural and environmental priorities.

34.4. There is a need for favourable access to and transfer of environmentally sound technologies, in particular to developing countries, through supportive measures that promote technology cooperation and that should enable transfer of necessary technological know-how as well as building up of economic, technical, and managerial capabilities for the efficient use and further development of transferred technology. Technology cooperation involves joint efforts by enterprises and Governments, both suppliers of technology and its recipients. Therefore, such cooperation entails an iterative process involving government, the private sector, and research and development facilities to ensure the best possible results from transfer of technology. Successful long-term partnerships in technology cooperation necessarily require continuing systematic training and capacity-building at all levels over an extended period of time.

34.5. The activities proposed in this chapter aim at improving conditions and processes on information, access to and transfer of technology (including the state-of-the-art technology and related know-how), in particular to developing countries, as well as on capacity-building and cooperative arrangements and partnerships in the field of technology, in order to promote sustainable development. New and efficient technologies will be essential to increase the capabilities, in particular of developing countries, to achieve sustainable development, sustain the world's economy, protect the environment, and alleviate poverty and human suffering. Inherent in these activities is the need to address the improvement of technology currently used and its replacement, when appropriate, with more accessible and more environmentally sound technology.

Parties. Other Parties and organizations in a position to do so may also assist in facilitating the transfer of such technologies.⁹⁴

Likewise, Article 66 of Trade-Related Aspects of Intellectual Property Rights (TRIPS) requires developed member nations to help facilitate technology transfer to least-developed countries and gives such countries greater latitude concerning the agreement, stating

Least-Developed Country Members

1. In view of the special needs and requirements of least-developed country Members, their economic, financial and administrative constraints, and their need for flexibility to create a viable technological base, such Members shall not be required to apply the provisions of this Agreement, other than Articles 3, 4 and 5, for a period of 10 years from the date of application as defined under paragraph 1 of Article 65. The Council for TRIPS shall, upon duly motivated request by a least-developed country Member, accord extensions of this period.

2. Developed country Members shall provide incentives to enterprises and institutions in their territories for the purpose of promoting and encouraging technology transfer to least-developed country Members in order to enable them to create a sound and viable technological base.⁹⁵

Thus, the TRIPS agreement need not be an obstacle to environmentally sound technology transfer. International environmental law and international economic legal institutions can coordinate effective efforts to cap and reduce greenhouse gas emissions in a reasonable and equitable manner.

Capacity-building assistance should accompany environmentally sound technology transfer to enable recipients of cutting-edge methods and equipment to learn how to use such technologies. The UNFCCC treaty obligations of developing countries turn on the fulfillment of treaty obligations by developed countries. Most environmentally sound technology is not in the public domain. Referring to such technology as ESTs, Gaetan Verhoosel notes that, “[m]ore than ninety percent of existing ESTs involve proprietary knowledge, often developed by Transnational Corporations.”⁹⁶

⁹⁴ UNFCCC, *supra* note 10, at art. 4, para. 5.

⁹⁵ Agreement on Trade-Related Aspects of Intellectual Property Rights pt. 4, art. 66, § 12, Apr. 15, 1994, 33 I.L.R. 1197, available at http://www.wto.org/english/tratop_e/trips_e/t_agm7_e.htm.

⁹⁶ Gaetan Verhoosel, *Beyond the Unsustainable Rhetoric of Sustainable Development: Transferring Environmentally Sound Technologies*, 11 GEO. INT'L ENVTL. L. REV. 49, 66 (1998).

Until recently, transfer of technology has largely been left to market forces and the decisions of transnational corporations regarding foreign direct investment, licensing agreements, purchases, joint ventures, and management contracts.⁹⁷ These forces have prioritized protection of intellectual property rights over widespread environmentally sound technology transfer.⁹⁸ In addition to supply-side restrictions, demand-side limitations have resulted in transfers failing to work in practice due to the "lack of supporting institutional capacity, infrastructure, and human capital."⁹⁹

Since intellectual property rights fuel the innovation necessary for the development of environmentally sound technology, protecting intellectual property rights leads to advances in environmentally sound technology.¹⁰⁰ Thus, environmentally sound technology transfer requires a careful balancing act that includes both fair treatment for innovators and energy policies that stimulate global diffusion of environmentally sound technology to address climate change. Countries can remove export restrictions on environmentally sound technologies and facilitate their export through tax relief/rebates for income or sales taxes on environmentally sound technologies exported.¹⁰¹ This can be achieved in a manner consistent with supporting international trade.¹⁰² The law is unsettled regarding the degree to which environmentally sound technology transfer initiatives conflict with such regulations as the Agreement on Subsidies and Countervailing Measures of the World Trade Organization. International environmental law and international economic law have important core objectives that need not be mutually exclusive. This is the crux of sustainable development.

D. *Trade and the Environment Controversies*

The use of technology is not without controversy. For instance, genetic modification remains an issue that has polarized the international community. Scientists are working to develop rice that can survive flooding.¹⁰³ Rice generally dies if entirely submerged by flooding for more than three or four days. People in Bangladesh eat roughly two million tons of

⁹⁷ *Id.* at 66–67.

⁹⁸ *Id.* at 67.

⁹⁹ *Id.*

¹⁰⁰ *Id.*

¹⁰¹ Verhoosel, *supra* note 96, at 71.

¹⁰² See, e.g., Agreement on Subsidies and Countervailing Measures (ASCM), Marrakesh Agreement Establishing the World Trade Organization Annex 1A, Apr. 15, 1994, 33 I.L.M. 229.

¹⁰³ Jon Hamilton, *Waterproof Rice May Help Asia Cope with Flooding 1* (NPR Morning Edition broadcast, Oct. 9, 2007) (transcript available at <http://www.npr.org/templates/story/story.php?storyId=15032263&ft=1&f=1025>). See also Richard Black, *Plant Vault Passes Billion Mark*, BBC NEWS, Apr. 26, 2007, <http://news.bbc.co.uk/2/hi/science/nature/6593333.stm>.

rice a month.¹⁰⁴ Researchers have developed a new strain of rice that can survive up to two weeks in water,¹⁰⁵ useful in a country where monsoon rains flood one-fifth of the land.¹⁰⁶ This year's floods have caused 290 million USD worth of damages.¹⁰⁷ Invinsa is a spray that reduces a plant's response to mild drought, used to keep supermarket apples appealing.¹⁰⁸ Syngenta is developing a resilient sugar beet with hopes of it becoming a reliable biofuel option.¹⁰⁹ Yet, the spread of genetically modified crops has been problematic. For instance, genetically modified grain approved only for animal feed has been consumed directly by people, leading to recalls.¹¹⁰ While biotechnology promises brought tolerance and less chemical spraying,¹¹¹ Bill Freese points out that, "biotech companies have developed mainly chemical-dependent GM [genetically modified] crops that have increased pesticide use, reduced yields and have nothing to do with feeding the world."¹¹² Genetic modification offers the potential to reduce the uptake of arsenic in rice¹¹³ and alleviate hunger, but it also threatens to reduce the availability of safe, quality food, leaving the international community divided regarding its use.

The United Nations Food and Agriculture Organization (FAO) reports that the global livestock sector produces more greenhouse gas emissions than the transportation sector.¹¹⁴ Clearly, vegetarians and people who do not drive cars have low carbon footprints. Driving less and modifying one's diet to include less meat are individual choices that people can make responsibly. Brian O'Neill notes that, "in the end, this is a value judgment, it's not a

¹⁰⁴ Mark Dummett, *New Rice Strain 'Survives Floods,'* BBC NEWS, Sept. 18, 2007, http://news.bbc.co.uk/2/hi/south_asia/7001494.stm.

¹⁰⁵ *Id.*

¹⁰⁶ *Id.*

¹⁰⁷ *Id.*

¹⁰⁸ Holman Jenkins, *Business World: Future Farmer,* WALL ST. J., Jan. 30, 2008, at A16.

¹⁰⁹ *Id.*

¹¹⁰ *Id.*

¹¹¹ *UK Seeks GMO Debate But Safety Still Paramount,* REUTERS, June 20, 2008, at 1, available at <http://www.planetark.com/dailynewsstory.cfm/newsid/48901/story.htm>. See also Carey Gillam, *Biotech Crops Seen Helping to Feed Hungry World,* REUTERS, June 20, 2008, at 1, available at <http://www.planetark.com/dailynewsstory.cfm/newsid/48893/story.htm> (noting that, "DuPont believes it can increase corn and soybean yields by 40 percent over the next decade").

¹¹² Gillam, *supra* note 111, at 1.

¹¹³ Tan Ee Lyn, *Experts Detail How Rice Absorbs So Much Arsenic,* REUTERS, July 16, 2008, at 1, available at <http://www.planetark.com/dailynewsstory.cfm/newsid/49371/story.htm>.

¹¹⁴ See H. STEINFELD ET AL., U.N. FOOD & AGRIC. ORG., LIVESTOCK'S LONG SHADOW: ENVIRONMENTAL ISSUES AND OPTIONS 272 (2006), available at <http://www.fao.org/docrep/010/a0701e/a0701e00.htm>. See also Claudia H. Deutsch, *Trying to Connect the Dinner Plate to Climate Change,* N.Y. TIMES, Aug. 29, 2007, at C3, available at <http://www.nytimes.com/2007/08/29/business/media/29adco.html?partner=rssnyt&emc=rss>.

scientific question.”¹¹⁵ The idea of shifting to a carbon-free society, he added, “appears to be technically feasible. The question is whether it’s politically feasible or economically feasible.”¹¹⁶ Tensions run high when food safety is pitted against soaring food costs.

Even the United States has banned some forms of genetically modified planting. The Sierra Club’s lawsuit against the U.S. Department of Agriculture for its approval of Monsanto’s Roundup-resistant sugar beet follows a U.S. ban of Monsanto’s genetically altered alfalfa.¹¹⁷ The federal judge that issued the nationwide ban against planting Roundup Ready alfalfa found that U.S. regulators improperly permitted commercialization of the biotech alfalfa without a thorough examination of its effects.¹¹⁸ Wind-pollinated biotech plants cross-pollinate with natural crops as well as increasing herbicide-resistant weeds.¹¹⁹ In response to a French suspension of genetically modified crop planting, Monsanto states that the protein in its corn is selectively toxic but not harmful to humans, fish, or wildlife.¹²⁰ The genetically modified food controversy continues to morally divide Europeans from farmers across the Atlantic.¹²¹ Biofuels also loom large in the debate.

¹¹⁵ Juliet Eilperin, *Carbon Output Must Near Zero to Avert Danger, New Studies Say*, WASH. POST, Mar. 10, 2008, at A1, available at http://www.washingtonpost.com/wp-dyn/content/article/2008/03/09/AR2008030901867.html?nav=rss_politics/congress.

¹¹⁶ *Id.*

¹¹⁷ Gillam, *supra* note 111.

¹¹⁸ *Id.*

¹¹⁹ *Id.*

¹²⁰ Sybille de La Hamaide, *France Suspends Planting of GMO Crops*, REUTERS, Oct. 26, 2007, at 1, available at <http://www.planetark.com/dailynewsstory.cfm/newsid/45009/story.htm>. See also Valerie Parent, *French State Body Upholds Decision on GM Crop Ban*, Mar. 19, 2008, <http://uk.reuters.com/article/environmentNews/idUKL1775647420080319>. The author notes

France’s top legal authority on Wednesday upheld a government decision to ban commercial use of the only genetically modified (GM) crop grown in the country by rejecting an emergency injunction filed by the pro-GM camp. France issued decrees banning the use of MON 810 maize seeds in February after a government-appointed committee said it unearthed new evidence of damage GM products could inflict on the environment. . . . In February, France followed through on its decrees by invoking a legal mechanism, known as the safeguard clause, at EU level to secure a more long term ban. To succeed, France will need to provide new, scientific proof of the risks posed by the GM seed.

Id.

¹²¹ Jonathan Lynn, *EU Wins WTO Extension to End GMO Bans*, REUTERS, Nov. 23, 2007, at 1, available at <http://www.planetark.com/dailynewsstory.cfm/newsid/45510/story.htm>. See also Cartagena Protocol on Biosafety to the Convention on Biological Diversity, opened for signature May 15, 2000, 39 I.L.M. 1027 (entered into force Sept. 11, 2003), available at <http://www.cbd.int/doc/legal/Cartagena-protocol-en.pdf> (allows countries to prohibit the importation of food containing genetically modified organisms); Nigel Hunt, *UK Consumers Unwittingly Eating GMO Food—Survey*, REUTERS, Nov. 19, 2007, at 1, available at <http://www.planetark.com/dailynewsstory.cfm/newsid/45389/story.htm> (noting that “British consumers are unwittingly eating food produced from genetically modified crops with nearly all milk, dairy products and

Holman Jenkins of the Wall Street Journal states, "Washington is keen to shovel protectionism and subsidies at corn ethanol, which is neither cost-effective nor climate friendly."¹²² The Doha Round of trade talks stalled in part due to U.S. agricultural subsidies.¹²³

Neither Democrats nor Republicans feel that they can afford to lose the support of farmers.¹²⁴ Production-distorting agricultural subsidies could become non-distorting agricultural subsidies if funds were given to farmers to set aside land for conservation easements.¹²⁵ Instead, sod saver conservation provisions were gutted from the most recent Farm Bill.¹²⁶ The Food, Conservation and Energy Act of 2008 only allots 27 billion USD out of 290 billion USD to conservation.¹²⁷ The legislation will facilitate the development of next-generation biofuels from wood chips, switch grass, and agricultural waste rather than food grains.¹²⁸ Funding for this measure will come from scaling back the existing tax credit for corn-based ethanol.¹²⁹ The Farm Bill

pork produced from GMO-fed animals."); Niu Shuping & Vivi Lin, *US GMO Rice Found in China Supermarkets Greenpeace*, REUTERS, Nov. 21, 2007, at 1, available at <http://www.planetark.com/dailynewsstory.cfm/newsid/45447/story.htm>; Claire R. Kelly, *Power, Linkage and Accommodation: the WTO as an International Actor and Its Influence On Other Actors and Regimes*, 24 BERKELEY J. INT'L L. 79 (2006).

International regimes can defer to the decisions, understandings, or rules of another regime . . . WTO language parroting the language of 'sustainable development' implicitly defers to environmental norms. Further, the AB has in some sense deferred to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) with respect to whether sea turtles are an exhaustible natural resource for purposes of an Article XX analysis.

Kelly, *supra*, at 101–02.

¹²² Jenkins, *supra* note 108, at A16.

¹²³ Alan Beattie & Frances Williams, *US Blamed as Trade Talks End in Acrimony*, FIN. TIMES, July 24, 2006, <http://www.ft.com/cms/s/0/dfa460d0-1afd-11db-b164-0000779e2340.html>. See also World Trade Organization, Subsidies and Countervailing Measures, http://www.wto.org/english/tratop_e/scm_e/scm_e.htm (last visited Feb. 11, 2009) (providing a gateway to a wide array of WTO materials); World Trade Organization, Subjects Treated Under the Doha Development Agenda, http://www.wto.org/english/tratop_e/dda_e/dohasubjects_e.htm (last visited Feb. 11, 2009) (providing links to the original mandate agreed at the Doha Ministerial Conference in 2001 and to subsequent refinements made in Geneva on Aug. 1, 2004); Q&A: *The Doha Round of World Trade Organisation*, LONDON TIMES, July 21, 2008, <http://www.timesonline.co.uk/tol/news/world/europe/article4369216.ece> (noting that a "deal is the best chance to end the crisis over food prices").

¹²⁴ Jagdish Bhagwati & Arvind Panagariya, *Why the Trade Talks Collapsed*, WALL ST. J., July 7, 2007, at A7.

¹²⁵ *Id.*

¹²⁶ Food, Conservation, and Energy Act of 2008, Pub. L. No. 110–234, 122 Stat. 923 (2008).

¹²⁷ *Newshour: Congress Passes \$290B Farm Bill Despite White House Opposition* (PBS television broadcast, May 15, 2008) (transcript available at http://www.pbs.org/newshour/bb/politics/jan-june08/farmbill_05-15.html).

¹²⁸ Greg Hitt, *Farm-Bill Pact Adds \$10 Billion for Nutrition*, WALL ST. J., Apr. 26, 2008, at A3.

¹²⁹ *Id.*

will include: 67 percent for food stamps, 14 percent for crop subsidies, 8 percent for crop insurance, 9 percent for programs to conserve farmland, and 2 percent for other uses.¹³⁰ President George W. Bush pointed out that such protectionist provisions as “an egregious new sugar subsidy program” would impact trade relations.¹³¹

Brazil and Canada have requested that the WTO set up a panel to determine whether U.S. agricultural subsidies violate WTO rules.¹³² The panel is likely to issue an initial ruling in 2008. The Wall Street Journal notes that

[t]he dispute over farm subsidies could become a landmark for the WTO because Brazil's complaint includes objections to payments for ethanol production. The trade body has largely steered clear of energy issues in its 12-year history, but it will now have to rule on the legality of U.S. tax exemptions on diesel-fuel and gasoline production.¹³³

The National Intelligence Council notes that developing countries may call for an amendment of TRIPS to allow for the development of generic copies of green technologies based upon the precedent of HIV-AIDS drugs.¹³⁴ The European Parliament has already requested an examination of whether TRIPS presents a significant barrier to technology transfer.¹³⁵

Food and fuel do not have to divide the international community. Differences regarding sustainable agriculture, renewable energy, support for innovation, and coordination between international trade and the environment must be resolved responsibly to avert extreme climate change.

E. Reducing Black Carbon Through Technology Transfer

Transferring environmentally sound technology in the form of solar cookers could respond to both climate change and the threat that indoor air pollution poses to health. The World Health Organization has “found that in 23 countries, more than 10 percent of deaths are due to just two

¹³⁰ Dan Morgan, *Farm Bill Passes by Veto-Proof Margin*, WASH. POST, May 15, 2008, at A2, available at http://www.washingtonpost.com/wpdyn/content/article/2008/05/14/AR2008051400371.html?nav=rss_politics. See also Dan Morgan, *Negotiations On Farm Bill Add Billions For Nutrition*, WASH. POST, Apr. 26, 2008, at A3, available at http://www.washingtonpost.com/wpdyn/content/article/2008/04/25/AR2008042503280.html?nav=rss_politics (“[T]he bill also includes a provision that would require the labeling of imported meat and vegetables for the first time, a response to rising concerns about food safety.”).

¹³¹ *Id.*

¹³² *Subsidies in U.S. Farm Bill Trigger Investigation by WTO*, WALL ST. J., Dec. 18, 2007, at A10.

¹³³ *Id.*

¹³⁴ *National Intelligence Assessment*, *supra* note 40, at 16–17.

¹³⁵ *Id.*

environmental risk factors: unsafe water, including poor sanitation and hygiene, and indoor air pollution due to solid fuel use for cooking.”¹³⁶ United Nations Children’s Fund (UNICEF) school kits include solar lamps to replace kerosene lamp use.¹³⁷ Rainwater harvesting and carbon-free merry-go-round water pumps that make use of the energy of children playing can mean the difference between life and death for communities, according to UNICEF.¹³⁸ “[S]olar stoves save women time and energy in searching and gathering scarce wood. They also reduce the felling of trees and thereby might help to reduce the rate of desertification,”¹³⁹ UNICEF explains.

Soot reduction is an important strategy for climate stabilization and is readily achievable with existing technologies.¹⁴⁰ Black carbon emissions come from cooking with such biofuels as wood, dung, and crop residue. Burning such fossil fuels as diesel and coal also produces black carbon, as does burning fields and forests.¹⁴¹

Ramanathan and Carmichael note that climate models prior to 2008 neither took into account the amplification of black carbon’s warming effect when mixed with other aerosols nor represented the full range of altitudes at which the warming effect occurs.¹⁴² Ramanathan and Carmichael explain that

Black carbon in soot is the dominant absorber of visible solar radiation in the atmosphere. Anthropogenic sources of black carbon, although distributed globally, are most concentrated in the tropics where solar irradiance is highest. Black carbon is often transported over long distances, mixing with other aerosols along the way. The aerosol mix can form transcontinental plumes of atmospheric brown clouds, with vertical extents of 3 to 5 km. Because of the combination of high absorption, a regional distribution roughly aligned with

¹³⁶ *Cutting Environmental Hazards Can Save 13 Million Lives Each Year—UN*, U.N. NEWS SERV., June 13, 2007, at 1, available at <http://www.un.org/apps/news/story.asp?NewsID=22888&Cr=health&Cr1=>.

¹³⁷ UNICEF, *OUR CLIMATE, OUR CHILDREN, OUR RESPONSIBILITY: THE IMPLICATIONS OF CLIMATE CHANGE FOR THE WORLD’S CHILDREN* 33 (2008), available at www.unicef.org.uk/campaigns/publications/pdf/climate-change.pdf.

¹³⁸ *Id.* at 11.

¹³⁹ *Id.* at 33.

¹⁴⁰ V. Ramanathan & G. Carmichael, *Global and Regional Climate Changes Due to Black Carbon*, *NATURE GEOSCI.*, Mar. 23, 2008, at 226, available at <http://www.nature.com/ngel/journal/v1/n4/pdf/ngel156.pdf>. See also COMM. ON ENV’T & NAT. RES., NAT’L SCI. & TECH. COUNCIL, *SCIENTIFIC ASSESSMENT OF THE EFFECTS OF CLIMATE CHANGE ON THE UNITED STATES* (2008), available at <http://www.climate-science.gov/Library/scientific-assessment/ScientificAssessmentFINAL.pdf>.

¹⁴¹ COMM. ON ENV’T & NAT. RES., *supra* note 140, at 221.

¹⁴² *Id.*

solar irradiance, and the capacity to form widespread atmospheric brown clouds in a mixture with other aerosols, emissions of black carbon are the second strongest contribution to current global warming, after carbon dioxide emissions. In the Himalayan region, solar heating from black carbon at high elevations may be just as important as carbon dioxide in the melting of snowpacks and glaciers. The interception of solar radiation by atmospheric brown clouds leads to dimming at the Earth's surface with important implications for the hydrological cycle, and the deposition of black carbon darkens snow and ice surfaces, which can contribute to melting, in particular of Arctic sea ice.¹⁴³

Climate change is likely to increase the risk and geographic spread of vector-borne infectious diseases¹⁴⁴ and could lead to the displacement of 200 to 250 million people by mid-century.¹⁴⁵ While New Zealand has already taken in a handful of people from the Pacific island state of Tuvalu, the international community lacks consensus as to the legal status of people displaced due to climate change, let alone a strategy to help climate refugees.¹⁴⁶

As people turn to human smugglers to flee drought or flood stricken lands, Michelle Leighton notes that, "[i]f the climate change predictions come true, and we see much more pressure on agricultural lands in sub-Saharan Africa, we are likely to see an increase in illegal smuggling as well."¹⁴⁷ The National Intelligence Council reports that

We judge that the most significant impact for the United States will be indirect and result from climate-driven effects on many other countries and their potential to seriously affect US national security interests. We assess that climate change alone is unlikely to trigger state failure in any state out to 2030, but the impacts will worsen existing problems—such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions. Climate change could threaten domestic stability in some states, potentially contributing to intra- or, less likely, interstate conflict, particularly over access to increasingly

¹⁴³ *Id.* See also U.S. NAT'L SCI. & TECH. COUNCIL, *supra* note 22, at 50.

¹⁴⁴ U.S. NAT'L SCI. & TECH. COUNCIL, *supra* note 22, at 50.

¹⁴⁵ Megan Rowling, *Climate Refugees In Political Pass-The-Parcel*, REUTERS, Mar. 14, 2008, at 1, available at <http://www.planetark.com/dailynewsstory.cfm/newsid/47513/story.htm>. See also Reuters, *Tuvalu: A Cry for Help*, N.Y. TIMES, Sept. 14, 2007, at 1, available at <http://www.nytimes.com/2007/09/14/world/asia/14briefs-tuvalu.html?partner=rssnyt&emc=rss>.

¹⁴⁶ Rowling, *supra* note 145, at 1.

¹⁴⁷ Laura MacInnis, *Climate Change Threatens Human Rights Of Millions—UN*, REUTERS, Feb. 20, 2008, at 1, available at <http://www.alertnet.org/thenews/newsdesk/L19123778.htm>.

scarce water resources. We judge that economic migrants will perceive additional reasons to migrate because of harsh climates, both within nations and from disadvantaged to richer countries.¹⁴⁸

Reducing the emissions of greenhouse gases and aerosols such as black carbon can go a long way to prevent the geo-political instability described above by the U.S. intelligence community.

IV. CONCLUSION

The IPCC predicts with high confidence that climate change will bring "increased deaths, disease and injury due to heat waves, floods, storms, fires and droughts."¹⁴⁹ Countries can negotiate a technology agreement as an amendment to the UNFCCC or as a freestanding clean technology transfer treaty that can facilitate the transfer of wind turbines, solar panels, drip irrigation, and a wide range of other crucial environmentally sound technologies. Greenhouse gas mitigation should involve quantified emission limitations and reductions, taking into account differences in national circumstances. Meaningful action that establishes collective standards with individual country implementation can address global climate change. Resolving equity and efficiency aspects of tradable permits and clean technology transfer can achieve sustainable development. We must mitigate climate change by cutting greenhouse gas emissions, financing adaptation and mitigation measures, and implementing widespread environmentally sound technology transfer.

¹⁴⁸ *National Intelligence Assessment*, *supra* note 40, at 45. The report notes

[w]e judge that economic refugees will perceive additional reasons to flee their homes because of harsher climates. Besides movement within countries, especially to urban areas, many displaced persons will move into neighboring developing countries, sometimes as a staging ground for subsequent movement onward to more developed and richer countries with greater economic opportunities. Many likely receiving nations will have neither the resources nor interest to host these climate migrants.

Id.

¹⁴⁹ IPCC WORKING GROUP II CLIMATE CHANGE IMPACTS, ADAPTATION AND VULNERABILITY 2007 REPORT 12 (Martin Parry et al., eds. 2007), available at <http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-spm.pdf>. See also Elizabeth Burleson, *A Climate of Extremes: Transboundary Conflict Resolution*, 32 VT. L. REV. 477, 499 (2008).

