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The Failure of International Global Warming Regulation to Promote Needed Renewable Energy

Steven Ferrey

THE FAILURE OF INTERNATIONAL GLOBAL WARMING REGULATION TO PROMOTE NEEDED RENEWABLE ENERGY

Steven Ferrey*

Abstract: Renewable power generation technologies exist today and comprise the foundation for the bridge to a sustainable international power generation infrastructure. However, the Kyoto Protocol (Kyoto) has failed to utilize these technologies. Kyoto also missed the forest for the trees: it disallowed forest preservation to count in its carbon currency. It also missed including the correct chemical base in developing countries. This Article examines what led international law not to focus on development in renewable power alternatives where they are most required in the international order: developing nations. It analyzes the critical role of international multilateral organizations to create the new architecture of carbon control before it is too late. This Article concludes by highlighting a little-noticed template for renewable power and carbon mitigation success that has been demonstrated in several developing countries. It highlights the changes to Kyoto and international law that are necessary to construct a bridge to the development of sustainable power generation infrastructure.

Some say the world will end in fire,
Some say in ice . . . .
And [either] would suffice.

—Robert Frost[1]

 Steven Ferrey, Professor of Law at Suffolk University Law School. Professor Ferrey has been Visiting Professor at Boston University School of Law and Harvard Law School. Professor Ferrey has served for the past fifteen years as the primary legal advisor to the World Bank and the U.N. on their carbon control and renewable energy projects in developing nations. He is the author of six books and more than seventy-five articles on the energy-environmental legal and policy interface. These books include *The Law Independent Power* (Thomson/West Pub., 2009) and *Renewable Power in Developing Countries: Winning the War on Global Warming* (Pennwell Pub., 2006). His articles on energy policy during the past five years have appeared in law reviews at Harvard, Duke, William & Mary, the University of Virginia, Boston College, the University of California Berkeley, and N.Y.U.

[1] Robert Frost, *Fire and Ice, in* The Poetry of Robert Frost 220 (Edward C. Lathem ed., 1969).

Introduction: Why the Renewable Energy Connection Matters in the Vernacular of Developing Nations

The world can perish with either fire or ice. The world is growing warmer from our universal use of fire to manipulate the universe.[2] In turn, this use of fire is causing the loss of massive quantities of the Earth's cryosphere, including polar ice,[3] which contains over 80% of the fresh water in the world.[4]

To slow global warming, there must be a fundamental shift of the technological base for power-generation from fossil fuels to renewable energy resources. The Kyoto Protocol (Kyoto), the multinational agreement on greenhouse gas (GHG) mitigation, is fundamentally unsuited to shift the balance of GHG emission in the energy sector; therefore it is inadequate to reduce global GHG emissions to sustainable levels. The urgency is increasingly apparent: the Fourth Report of the Intergovernmental Panel on Climate Change (IPCC), published in 2007, concluded that the evidence of human-made global warming is "unequivocal."[5] However, the nations that will soon make up the majority of the world's carbon-emitting countries are not covered parties to, or otherwise bound by, Kyoto.

There are at least two major international law problems. The first problem is that Kyoto is not shifting the world's energy base to renewable power in lieu of fossil-fuel-fired power resources. This is true in both developed countries that are subject to regulation under Kyoto and in the many developing countries that are not covered by Kyoto.

The second problem is that the Kyoto Protocol contains a legal void and does not speak the carbon language of the 80% of the world's nations, which may be characterized as developing countries. Kyoto does not contain provisions that provide carbon credits or offsets for preserving existing forests that absorb carbon in these developing countries.[6] Developing countries harbor many of the largest forest tracts in the world that, if preserved, could absorb and convert CO_2 to various sugars and oxygen during photosynthesis, thereby reducing at-

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[2] Working Groups I, II, & III of the Intergovernmental Panel on Climate Change [IPCC], Climate Change 2007: Synthesis Report 30, 37 (Rajenda K. Pachauri et al., eds. 2007) [hereinafter Synthesis Report].

[3] *Id.* at 30; Working Group I of the IPCC, Climate Change 2007: The Physical Science Basis 341 (Susan Solomon et al., eds. 2007) [hereinafter The Physical Science Basis].

[4] Physical Science Basis, *supra* note 3, at 341.

[5] Synthesis Report, *supra* note 2, at 30.

[6] *See infra* Part III.A.

mospheric CO_2 concentrations.[7] Kyoto also misses other opportunities to mitigate the emission of black carbon. Even though black carbon is one of the most significant GHG chemicals emitted in developing nations,[8] efforts to mitigate its emission are not eligible for any carbon credit under Kyoto. These oversights put blinders on international legal mechanisms and bias Kyoto's short- and long-term effectiveness.

This Article examines these legal and policy shortcomings of international law on global warming. Part I sets forth the chemistry and basic international policy regarding global warming, while the international regulatory structure of the Kyoto Protocol is analyzed in Part II.[9] Part III analyzes the regulatory omission of the critical role of forest preservation and the definitional omissions of international carbon policy for developing countries.[10] Part IV examines the evolving role of international multinational organizations.[11] Part V profiles the successful implementation of renewable-energy-generation infrastructure in developing countries that provides a critically important model that can be implement in other developing countries.[12] Developing countries in Asia have demonstrated experience on how to motivate the successful installation of a renewable energy base in lieu of a power-generation infrastructure that relies on more fossil fuel exploitation.[13] The Kyoto Protocol has ignored these successful models; therefore, it requires future reforms.

I. Time and Carbon Value: The Universal Reality

A. *Proverbial Reality*

The proverb states that time is money. Nowhere is it truer than with international efforts to abate carbon concentrations in the atmosphere. More than a decade has transpired in the effort to control carbon emissions. In 1990, the world emitted about 40 billion tons of carbon dioxide equivalence (CO_2e), while today it has increased by about

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[7] *See* Envtl. Prot. Agency, Carbon Sequestration in Agriculture and Forestry, http://www.epa.gov/sequestration/faq.html (last visited Feb. 10, 2010).

[8] *See infra* Part. III.B.

[9] *See infra* Parts I–II.

[10] *See infra* Part III.

[11] *See infra* Part IV.

[12] *See infra* Part V.

[13] *See infra* Part V.

40% to 55 billion tons annually.[14] There is no sign that world carbon emissions are decreasing. Global carbon concentrations in the atmosphere are now accelerating at nearly four times the rate that they did during the 1990s.[15]

The U.S. Department of Energy forecasts that a worldwide carbon *increase* of 54% over 1990 levels could occur by 2015.[16] The Energy Information Administration (EIA) forecasts a 50% world-wide increase of carbon emissions between 2005 and 2030 as the most likely reference scenario.[17] The Intergovernmental Panel on Climate Change (IPCC) forecasts a 25–90% increase over the same period.[18] The International Energy Agency (IEA) concluded that absent a major policy change, CO_2 emissions could increase 130% by 2050.[19] Most of the predicted increases will occur in developing countries, whose emissions are projected to grow five times as fast as those from industrialized countries over the next twenty-five years.[20] By 2030, developing countries are forecasted to exceed CO_2 emissions from developed countries by 72%.[21]

A major driver of the forecasted growth in CO_2 emissions is the expansion of the electric power generation infrastructure in developing countries. From any perspective, there is a fast growing problem, and the degree to which developing countries plan to rely on coal resources to expand power generation lies at the center of it. Between 1970 and 2004, total global emissions of GHGs regulated by Kyoto increased by 70%.[22] The combustion of fossil fuels accounted for 70% of GHG emissions and electric power generation accounted for 40% of these CO_2 emissions.[23] In 2003, coal-fired electric power generation

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[14] Tony Blair, The Climate Group, Breaking the Climate Deadlock: A Global Deal for Our Low-Carbon Future 9 (2008).

[15] Dean Scott, *Global Carbon Concentrations Accelerating at Almost Four Times Growth Rate of 1990s*, 39 Env't Rep. (BNA) 1967 (Oct. 3, 2008).

[16] Arnold W. Reitze, *Global Warming*, 31 Envtl. L. Rep. (Envtl. Law Inst.) 10,253, 10,266 (2001).

[17] Energy Info. Admin., U.S. Dep't of Energy, DOE/EIA-0484, International Energy Outlook 2008, at 98(2008) [hereinafter Energy Outlook 2008].

[18] Working Group III of the IPCC, Climate Change 2007: Mitigation of Climate Change 97 (Bert Metz et al., eds. 2007) [hereinafter Mitigation of Climate Change].

[19] Int'l Energy Agency, Energy Technology Perspectives: In support of the G8 Action Plan 1 (2008), *available at* http://www.iea.org/techno/etp/ETP_2008_Exec_Sum_English.pdf.

[20] Energy Outlook 2008, *supra* note 17, at 89.

[21] *Id.*

[22] Mitigation of Climate Change, *supra* note 18, at 97 n.1.

[23] *See* Joëlle de Sépibus, *The Liberalisation of the Power Industry in the European Union and Its Impact on Climate Change* 2, 3 (The Nat'l Ctrs. of Competence in Research, Working Paper No.

accounted for about 70% of the CO_2 emissions from that sector.[24] Global energy-related emissions are expected to increase by 57% from 2005 to 2030.[25]

According to a 2007 report from the United Nations Environment Programme, forecasters do not see the international mix of power generation sources changing appreciably over the next several decades.[26] Without a substantial change to renewable or other low-carbon technologies, the percentage of fossil fuels used in power generation—and thus the potential sources of additional GHGs emanating from the power sector—are forecast to remain relatively constant. The IEA forecasts that by 2030, world demand for energy will grow by 60% and fossil fuel sources will supply 85% of the increased demand and 82% of the total energy demand;[27] non-carbon renewable energy sources will supply only 6% of the global energy demand, with the largest increase in renewable power generation taking place in Europe because of governmental investments.[28]

A recent assessment concludes that in order to avoid catastrophic effects of global warming, we need to limit the increase in Earth "surface temperature to no more than 2[°C]–2.5[°C]" above the 15°C Earth temperature present during the decades preceding the American Revolution.[29] This will require a sharp reduction of GHG emissions "by 2050 and to near zero by 2100."[30] This will only be possible if we can demonstrate that a modern society can function without relying on CO_2-emitting technologies.[31]

Moreover, since the pace of reform has been slow, the atmospheric concentrations of GHGs may already be too high and it may already be too late for abatement actions to mitigate the effects of global warming.

2008/10, 2008), *available at* http://www.nccr-trade.org/images/stories/publications/IP6/de_Sepibus_EU_libCC_final.pdf.

[24] *Id.* at 4.

[25] U.S. Gov't Accountability Office, GAO-09-151, International Climate Change Programs: Lessons Learned from the European Union's Emissions Trading Scheme and the Kyoto Protocol's Clean Development Mechanism 48 (2008) [hereinafter Lessons Learned].

[26] The Physical Science Basis, *supra* note 3, at 17.

[27] Int'l Energy Agency, World Energy Outlook 2004, at 57 (2004).

[28] *Id.* at 225.

[29] Michael A. MacCracken & F. Moore, *Achieving Agreement and Climate Protection by Mitigation of Short-and-Long-Lived Greenhouse Gasses*, 6 IOP Conference Series: Earth & Envtl. Sci. 282,006 (2009), *available at* http://www.iop.org/EJ/article/1755-1315/6/28/282006/ees9_6_282006.pdf?request-id=77ab72a7-c8f6-467c-a203-353ead5e056f.

[30] *Id.*

[31] *See id.*

Climatologist and NASA scientist, James Hansen, notes that by merely waiting eight years until 2018 to stop the "growth of greenhouse gas emissions," we would have nearly no chance of avoiding the catastrophic effects of warming.[32] Hansen forecasts global warming to exceed the tipping point once the atmosphere concentration of GHGs exceeds 400–425 parts per million (ppm).[33] According to Hansen, there is no ice left on the planet when GHG concentrations reach 450 ppm.[34] Since the beginning of the Industrial Revolution, CO_2 has increased about a third to 382 ppm.[35] A top official with the IPCC has indicated that developed nations will need to slash CO_2 emissions by 80–95% by 2050 to hold GHGs to less than 450 ppm in the atmosphere.[36] Dr. John Holdren—advisor to President Barack Obama for Science and Technology, Director of the White House Office of Science and Technology Policy, and Co-Chair of the President's Council of Advisors on Science and Technology—calculates that if U.S. greenhouse emissions even somehow plateau as early as 2015, we will have reduced our chances to avoid climate catastrophes by only 50%.[37] Time is of the essence; time is money. The world is seizing neither.

B. *Addressing Fossil Fuel Emissions*

The scientific consensus is that there is a global warming problem.[38] Carbon dioxide is the best known GHG.[39] It is the main byprod-

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[32] *See* James Hansen et al., *Target Atmospheric CO_2: Where Should Humanity Aim?* 2 Open Atmospheric Sci. J. 217, 229 (2008) [hereinafter *Target CO_2*].

[33] *See* James Hansen, Dir., Nat'l Aeronautics & Space Admin. Goddard Inst. for Space Studies, Briefing before the Select Committee on Energy Independence and Global Warming: Global Warming Twenty Years Later: Tipping Points Near (June 23, 2008) [hereinafter Tipping Points].

[34] *See Target CO_2, supra* note 32, at 217.

> If humanity wishes to preserve a planet similar to that on which civilization developed and to which life on earth adapted, paleoclimate evidence and ongoing climate change suggest that CO_2 will need to be reduced from its current 385 ppm to at most 350 ppm. . . . If the present overshoot of this target CO_2 is not brief, there is a possibility of seeding irreversible catastrophic effects.

Id.; *See* Bill McKibben, *Civilization's Last Chance: The Planet Is Nearing a Tipping Point on Climate Change, and It Gets Much Worse Fast*, L.A. Times, May 11, 2008, at M1; Tipping Points, *supra* note 33.

[35] *See* Synthesis Report, *supra* note 2, at 37–38.

[36] *See* Rick Mitchell, *IPCC Official Says Industrialized Nations Must Cut Emissions Up to 95 Percent*, 39 Env't Rep. (BNA) 1917 (Sept. 26, 2008).

[37] Robin Chase, *Get Real on Global Warming Goals*, Boston Globe, Apr. 22, 2008, at A15.

[38] Synthesis Report, *supra* note 2, at 30.

[39] *Id.* at 36.

uct of fossil fuel combustion and results from any energy production that burns oil, coal, natural gas, or other solid waste fuels.[40] Eighty-one percent of anthropogenic CO_2 emissions are from combustion of fossil fuels, and 83% of GHG emissions in the United States are attributable to CO_2.[41] More than one-third of CO_2 emissions are attributable to the electric power sector.[42] Global CO_2 emissions are rising at the rate of approximately 10% per year.[43]

Prior to the Industrial Revolution, average Earth temperature had been naturally maintained at 59°F.[44] Since the Industrial Revolution, carbon emissions resulting from combusting fossil fuels to provide mechanical and electrical energy have poured into the atmosphere.[45] Current atmospheric CO_2 levels are approximately 33% higher than in pre-industrial times.[46] Temperature changes move in direct relation to atmospheric GHG concentrations.[47] Within a century, if all nations of the world do not limit GHG emissions, average global temperatures will climb anywhere from 1.4°C–5.8°C.[48] Consider the context: "In the last 10,000 years, the Earth's temperature hasn't varied by more than 1.8°F."[49] Global mean surface temperature rose 1.33°F over the last decade, and the rate of warming over the past fifty years has almost doubled.[50]

More than just numbers, the changes associated with these forecasts about global warming have discernible impacts. For instance, the

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[40] *Id.* at 30, 37.

[41] Energy Info. Admin., U.S. Dep't of Energy, DOE/EIA-0573(98), Emission of Greenhouse Gases in the United States 1998, at ix, x, 13 (1999).

[42] *See id.* at 22 tbl.5.

[43] *See* Ray Purdy, *The Legal Implications of Carbon Capture and Storage Under the Sea*, Sustainable Dev. L. & Pol'y, Fall 2006, at 22, 23 tbl.1.

[44] John Glenn, Program Manager, Wastewise Partner Forum—Using Climate Tools and Resources (Aug. 17, 2005), *available at* http://www.epa.gov/waste/partnerships/wastewise/events/pubs/clipf_sum.pdf.

[45] *See* Pew Ctr. on Global Climate Change, Global Warming Basics Introduction, http://www.pewclimate.org/global-warming-basics/about (last visited Feb. 10, 2010).

[46] Reitze, *supra* note 16, at 10,254 ("CO_2 levels have increased from 270–280 ppm in pre-industrial times to more than 360 ppm in 1999, and continue to mount. Nitrous oxide levels increased from 270 ppm to 310 ppm and methane concentrations have increased from 770 ppb to 1700 ppb over the same period.").

[47] Synthesis Report, *supra* note 2, at 5, 7 fig.5.

[48] *Id.* at 8 tbl.SPM.1. The IPCC 4th Assessment Report, talks of temperature increases ranging from 2.4°C–6.4°C. This would yield a 7–23 inch rise in sea levels during the twenty-first century. *Id.*

[49] History.com, The Facts—Global Warming, http://www.history.com/states.do?action=detail&state=Global%20Warming&contentType=State_Generic&contentId=56815&parentId=earth (last visited Feb. 10, 2010).

[50] The Physical Science Basis, *supra* note 3, at 237.

extreme 5.8°C (approximately 10°F) increase in average global temperature would not only lead to the starvation of hundreds of millions of people, but is forecasted to result in the mass extinction of half of the species on Earth.[51] Global warming will reduce food production and crop yields in lower latitudes[52] and promote the rapid spread of infectious diseases and cardiovascular diseases,[53] while spurring competition for dwindling water resources.[54]

Long-term projections forecast no abatement in the warming trend associated with GHG emissions. Energy use and the construction of fossil-fuel-fired power generation facilities are increasing as populations grow and economic development continues, especially in developing nations.[55] Unabated, this increase in power demand in developing nations will tip the global environmental thermostat and render irreversible the risks and consequences associated with global warming, regardless of the measures that the United States and other developed nations take to reign in their carbon emissions.[56] If unaddressed, the annual increase in GHG emissions in India, China, Brazil, Indonesia, or any one of several dozen fast-growing nations, will swamp all of the collective GHG reductions of the developed nations complying with Kyoto's modest requirements.[57] In particular, most of the expansion in

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[51] James Hansen, *The Threat to the Planet*, N.Y. Rev. Books, July 13, 2006, at 12.

[52] *See* Working Group II of the IPCC, Climate Change 2007: Impacts, Adaptation and Vulnerability 296–97 (Martin Parry et al., eds. 2007).

[53] *Id.* at 407.

[54] *Id.* at 191.

[55] Int'l Energy Agency, *supra* note 28, at 31; World Bank, World Bank Statement, Ministerial Segment - COP11 - Montreal 4 (2005), *available at* http://siteresources.worldbank.org/ESSDNETWORK/Resources/MINISTERIALSEGMENTCOP11Montreal.pdf.

[56] The Physical Science Basis, *supra* note 3, at 33; Steven Ferrey, *Power Paradox: The Algorithm of Carbon and International Development*, 19 Stan. L. & Pol'y Rev. 510, 512 (2008) [hereinafter *Power Paradox*].

[57] Kyoto will not meet its target of achieving an average of 7% below 1990 GHG emission levels by 2012. It will not even be close. Between 1990 and 2004, the forty-one Annex I developed nations, excluding the countries with "economies in transition" (the failed former Soviet economies), increased GHG annual emissions by 12.1%. United Nations Framework Convention on Climate Change [UNFCCC], *National Greenhouse Gas Inventory Data for Period 1990–2004 and Status of Reporting*, 8 fig.4, U.N. Doc. FCCC/SBI/2006/26 (Oct. 19, 2006). These developed countries were responsible for 18.6 billion tons of GHGs emitted annually. *Id.* at 7 fig.2. One hundred twenty-two developing nations reported 11.7 billion tons of GHG emissions in 1994. UNFCCC, *Sixth Compilation and Synthesis of National Communications from Parties Not Included in Annex I to the Convention*, U.N. Doc. FCCC/SBI/2005/18 (Oct. 25, 2005). Therefore, approximately 40% of GHGs are from developing countries. This may actually understate the percentage because only 122 of about 160 developing nations are included in this U.N. report and database, and there may be data gaps and underreporting in some of the 122 countries that do report. Assuming that the Kyoto targets are achieved by 2020, a world reduction in carbon is only achieved if the

energy and power generation will occur in Asia during the next decades.[58]

Developed countries cannot solve the global warming problem alone. Even if all thirty-five developed Kyoto Annex I countries[59] could achieve a reduction of 80% of their GHG emissions by 2050, the reduction would be insufficient to achieve Kyoto's goals without vigorous participation by developing countries.[60] Therefore, it is essential that international law is amended to provide a mechanism to significantly reduce GHG emissions in developing countries, particularly those emissions that are associated with electric power generation.[61] Major developing countries will make their investments in energy infrastructure over the next decade; that provides a particularly tight window in which to make the best choices to achieve Kyoto's goals.[62] After all, energy choices and climate security are intertwined and must be addressed effectively at the same time.[63]

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developing nations of the world don't base their increasing electrification on carbon-based fuels. If the forty-one Annex I nations potentially regulated by Kyoto were to reduce their emissions by 20% from current levels, they would approximately achieve their Kyoto targets. Since these Annex I countries emit approximately 60% of global carbon, this would constitute an approximately 12% reduction in world carbon emissions. However, if the non-Annex I developing nations, representing about 40% of global carbon emissions, increase their electricity demand(and other GHGs) by the forecast 4% annually between 2007 and 2020, that is a cumulative compounded increase of about 60% of power use in that 40% share. World Energy Council, World Energy Assessment: Overview 2004, at 31 (2004). If those developing nations utilize predominately fossil fuels for this power sector expansion (and transportation fuels, etc.), it will increase their carbon emissions by 24%. Thus, the carbon increase in developing nations could totally negate the carbon reductions that Kyoto seeks to achieve in Annex I developed countries. The use of fossil fuels for power generation in developing countries often employs older combustion technologies that do not utilize the most effective emission control technologies. Moreover, it is important to note that Kyoto is *not* achieving its targets in the Annex I countries with a composite 12% increase since 1990; therefore, these assumptions of success in the developed countries may be optimistic. *See infra* Part. II.C–D.

[58] Int'l Energy Agency, *supra* note 28, at 66.

[59] UNFCCC, List of Annex I Parties to the Convention, http://unfccc.int/parties_and_observers/parties/annex_i/items/2774.php (last visited Feb. 10, 2010) (listing Kyoto Annex I countries).

[60] Mohamed T. El-Ashry, *Framework for a Post-Kyoto Climate Change Agreement*, Sustainable Dev. L. & Pol'y, Winter 2008, at 2, 2.

[61] *See* Charles Davis, *Energy Estimates Show Rise in CO_2 Emissions, Offer Mitigation Options*, Carbon Control News, June 30, 2008 (LEXIS) (noting that in 2008, the EIA concluded that the electric power generation sector offered the most cost-effective opportunities to reduce CO_2 emissions, compared to the transportation sector).

[62] Blair, *supra* note 14, at 10.

[63] El-Ashry, *supra* note 60, at 3.

II. The Failure of the Kyoto Protocol Legal Framework to Function in the International Context

A. *The Legal Choice of Global Chemicals*

Seven commonly recognized compounds augment the process of climate change, and thus are classified as GHGs. Four of these compounds are natural: (1) water vapor, which is not regulated; (2) CO_2, released during combustion; (3) nitrous oxide (N_2O), which mainly comes from animals; and (4) methane (CH_4).[64] Three other compounds are synthesized by humans.[65] One group consists of perfluorocarbons (PFCs), which are used in aluminum production, semi-conductors, and manufacturing.[66] Another is hydrofluorocarbons (HFCs), which are associated with refrigerants and fire extinguisher products.[67] The final compound is sulfur hexafluoride (SF_6),[68] the most potent GHG,[69] amounting to 22,000 times the warming effect, molecule-for-molecule, of CO_2 over a 100-year period.[70]

The history of fluorocarbons under international environmental controls is itself a fascinating transposition in international means and ends. In 1987, the Montreal Protocol sought to phase out chlorofluorocarbons (CFCs), such as Freon, in developed nations by 1996 and in developing nations by 2010 because they degraded the stratospheric ozone layer.[71] Hydrochlorofluorocarbons (HCFCs), which under the Montreal Protocol are to be phased out in developed nations by 2030 and in developing nations between 2016 and 2040,[72] are on a voluntary expedited phase out in the United States. Under section 606 of the Clean Air Act, HCFCs are to be phased out by 2010.[73]

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[64] Nat'l Climatic Data Ctr., U.S. Dep't of Commerce, Green-house Gases: Frequently Asked Questions, http://lwf.ncdc.noaa.gov/oa/climate/gases.html (last visited Feb. 10, 2010).

[65] Energy Info. Admin., U.S. Dep't of Energy, DOE/EIA-0573(2002), Emissions of Greenhouse Gases in the United States 2002, at 63 (2003).

[66] *Id.* at 68–69.

[67] *Id.* at 64.

[68] *Id.* at 69.

[69] ScienceDaily, Sulfur Hexafluoride, http://www.sciencedaily.com/articles/s/sulfur_hexafluoride.htm (last visited Feb. 10, 2010).

[70] Energy Info. Admin., Comparison of Global Warming Potentials from the IPCC's Second and Third Assessment Reports, http://www.eia.doe.gov/oiaf/1605/archive/gg04-rpt/global.html (last visited Feb. 10, 2010); ScienceDaily, *supra* note 69.

[71] The Montreal Protocol on Substances that Deplete the Ozone Layer, art. 2.A, Sept. 16, 1987, S. Treaty Doc. No. 100-10 (1987), 1522 U.N.T.S. 3 [hereinafter Montreal Protocol].

[72] *Id.* art. 2.F.

[73] *See* Clean Air Act, § 606, 42 U.S.C. § 7671e (2006).

Given these phase outs, the refrigeration industry turned to hydrofluorocarbons (HFCs) as a substitute. HCFCs are 90% less damaging to the ozone layer than CFCs.[74] This transition to HCFCs addresses the stratospheric ozone problem under the Montreal Protocol; however HCFCs and HFCs have global warming potentials ranging from 90 to 11,700 times that of CO_2, depending on the specific HCFC or HFC compound.[75] The environmental solution of substituting refrigerants to preserve the stratospheric ozone layer—seemingly a victory for international environmental policy makers—may actually exacerbate global warming.[76]

Kyoto does not regulate all GHGs, but instead regulates six families of global warming chemicals.[77] The combustion of fossil fuels results in 64% of the total atmospheric CO_2 introduced into the atmosphere since 1850.[78] The regulated GHGs in Table 1 are displayed in descending order of their impacts on the environment, which is a function of their quantity released, their heat radiation properties, and their residence time in the atmosphere.

Table 1: Key Facts About Greenhouse Gases

GHG	Global Warming Potential [CO_2=1]	Residency Time [years]	Amount of U.S. Total GHG Release [%]*
Carbon Dioxide (CO_2)	1	100	85
Methane (CH_4)	21	12	11
Nitrous Oxides (NO_x)	310	120	2
Hydrochlorofluorocarbons (HFCs)	140-11,700	Varies	< 1
Chloroflurocarbons (CFCs)	6,500	Varies	< 1
Hexafluoride (SF_6)	23,900	Varies	< 1

See United Nations Environment Programme, IPCC, Climate Change 2007: The Physical Science Basis 237, 212–13 tbl.2.14 (2007)

[74] Steven Ferrey, The Law of Independent Power § 6:7.1(2009).

[75] The Physical Science Basis, *supra* note 3, at 212–13 tbl.2.14.

[76] *See* Sindya N. Bhanoo, *Ozone Hole Is Mending. Now for the 'But.,'* N.Y. Times, Jan. 26, 2010, at A7 (noting that some studies report that global warming may accelerate as the ozone hole mends due to changes in winds and cloud formation in the Antarctic).

[77] *See* Kyoto Protocol to the United Nations Framework Convention on Climate Change, Annex A, Mar. 16, 1998, 2303 U.N.T.S. 148, 37 I.L.M. 22 (1998) [hereinafter Kyoto Protocol] (listing regulated greenhouse gases). The regulated heat-trapping greenhouse gases do not include water vapor. *Id.* Water vapor in the atmosphere is created by the transpiration of cooler air passing over warmer water bodies. *Id.* Water vapor raises the temperature of Earth so that it is warm enough to be habitable. *See id.*

[78] Carbon Dioxide Info. Analysis Ctr., Frequently Asked Global Change Questions, http://cdiac.ornl.gov/faq.html (last visited Feb. 10, 2010).

The molecule-by-molecule global warming impact of many of the secondary and less prevalent GHGs is significantly greater than CO_2.[79] However, because these secondary GHGs are released in smaller quantities and/or have shorter residence times in the atmosphere before they dissipate, CO_2 remains the dominant GHG and therefore receives the greatest international policy focus.[80] Reducing the most potent, less prevalent chemicals produces greater value by creating additional offsets or credits.[81] Therefore, there is a choice of international law mitigation strategy that can look beyond regulating the emission of CO_2.[82]

The common assumption has been that control of carbon will result in the implementation of renewable energy technologies as the new world energy base.[83] Some form of renewable, power-generating resource is available to every party governed by the Kyoto Protocol (Kyoto). For instance, the amount of solar radiation reflecting off of the Earth is about 1000 times the Earth's commercial energy use.[84] This means that converting less than 1% of the appropriate land area of the Earth to utilize solar energy could satisfy much of the Earth's electricity requirements when solar radiation is available.[85] Storing that energy efficiently is another matter.[86]

However, this is not what the Kyoto Protocol is accomplishing.[87] Jim Hansen, widely regarded as the leading American climate scientist, gives the world less than a decade to dramatically reverse the growth and magnitude of global GHG emissions.[88] To do this, there must be a massive shift in the power generating base from CO_2-emitting fossil fuels to renewable power; this transition simply is not occurring under the Kyoto regime.

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[79] U.S. Envtl. Prot. Agency, EPA-230-R96-006, Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990–1994, ES-2 (1994).

[80] *See id.* at ES-3 ESTable.1.

[81] *See* Donald Kaniaru et al., *Strengthening the Montreal Protocol: Insurance Against Abrupt Climate Change*, Sustainable Dev. L. & Pol'y, Winter 2007, at 3, 5 (discussing perversion of the Kyoto Protocol's Clean Development Mechanism in destruction of HFCs).

[82] *See infra* Part III.B.

[83] *See* Steven Ferrey, *When 1 + 1 No Longer Equals 2: The New Math of Legal "Additionality" Controlling World and U.S. Global Warming Regulation*, 10 Minn. J. L. Sci. & Tech. 591, 592 (2009).

[84] Jeffrey Sachs, *U.S. Must Invest in Reinventing Energy*, Korea Herald (Seoul), Apr. 24, 2008 (LEXIS).

[85] *See* Posting of Ariel Schwartz to Sustainability Blog, http://www.fastcompany.com/blog/ariel-schwartz/sustainability/infographic-how-much-surface-area-would-it-take-power-world-compl (Sept. 2, 2009, 10:44 EST).

[86] *See generally* Ferrey, *supra* note 74, § 2:2.

[87] *See infra* Parts III–IV.

[88] *See* Jim Hansen et al., *Global Temperature Change*, 103 Proc. Nat'l Acad. Sci. 14,288, 14,293 (2006).

B. *The Relevant Legal Pieces of the Kyoto Protocol*

The Framework Convention on Climate Change treaty was agreed upon at the Rio de Janeiro United Nations (U.N.) Conference on Environment and Development in 1992 and the Kyoto convention in 1997.[89] The Rio Declaration articulated the principle of "common but differentiated responsibility" and created the U.N. Framework Convention on Climate Change (UNFCCC) to administer a carbon mitigation scheme.[90] One hundred seventy eight countries signed the Rio Declaration.[91] By February 2005, 55% of Annex I signatories (developed nations) adopted the Kyoto Protocol, triggering the minimum ratification provision and allowing Kyoto to go into effect.[92] More than 180 countries attended the Bali Conference in 2007,[93] and as of 2007, 175 of these nations had ratified Kyoto.[94] The United States has not ratified Kyoto, and Australia did not ratify it until December 2007.[95]

Developing nations successfully resisted efforts to include them in binding international obligations and opposed encouraging their voluntary commitments to GHG reduction.[96] The rationale behind this decision is that Kyoto reflects "common but differentiated" responsibilities between developed and developing countries.[97] Under Kyoto, there is no responsibility assigned to developing countries. China, which is

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[89] *See* U.N. Conference on Env't & Dev., June 3–14, 1992, *Rio Declaration on Environment and Development*, U.N. Doc A/CONF.151/26 (Aug. 12, 1992); UNFCCC, Kyoto Protocol, http://unfccc.int/kyoto_protocol/items/2830.php (last visited Feb. 10, 2010).

[90] *Id.* princ.7.

[91] World Res. Inst., Principle 10 of the Rio Declaration, http://www.wri.org/publication/content/8078 (last visited Feb. 10, 2010).

[92] UNFCCC, Status of Ratification, http://unfccc.int/kyoto_protocol/status_of_ratification/items/2613.php (last visited Feb. 10, 2010). Russia's adoption of the treaty provided the required number of countries for the treaty to having binding effect. *See* Steven Lee Myers, *Russia's Lower House Approves Kyoto Treaty on Emissions*, N.Y. Times, Oct. 23, 2004, at A2.

[93] *See* UNFCCC, United Nations Climate Change Conference in Bali, http://unfccc.int/meetings/cop_13/items/4049.php (last visited Feb. 10, 2010).

[94] Cameron Ferrey & Steven Ferrey, *Past is Prologue: Recent Carbon Regulation Disputes in Europe Shape the U.S. Carbon Future*, 16 Mo. Envtl. L. & Pol'y Rev. 651, 659 (2009).

[95] *Australia Ratifies Kyoto Protocol*, Sydney Morning Herald, Dec. 3, 2007, http://www.smh.com.au/news/environment/australia-ratifies-kyoto-protocol/2007/12/03/1196530553203.html; UNFCCC, United States of America, http://maindb.unfccc.int/public/country.pl?country=US (last visited Feb. 10, 2010).

[96] Paul G. Harris, *Common but Differentiated Responsibility: The Kyoto Protocol and United States Policy*, 7 N.Y.U. Envtl. L.J. 27, 34 (1999).

[97] United Nations Conference on Climate Change: Framework Convention on Climate Change, art. 4, May 9, 1992, S. Treaty Doc. No. 102-38 (1992), 31 I.L.M. 849 ("All Parties, taking into account their common but differentiated responsibilities . . . ."). The concept was originally part of the Montreal Protocol. *See* Montreal Protocol, *supra* note 71, art. 5.

considered a developing country under Kyoto even though it is the largest CO_2 emitter in the world, is not an Annex I country.[98] India is not an Annex I country either.[99] The Copenhagen Conference in December 2009 ended in no consensus on this issue.[100]

Kyoto requires the thirty-five Annex I nations to reduce CO_2 emissions by an average of 5% below 1990 baseline levels by 2012.[101] The other GHGs must also be reduced to 5% below either their 1990 or 1995 baseline levels between 2008 and 2012.[102] Kyoto seeks to achieve these reductions through a cap-and-trade regulatory system. Each of the thirty-five developed, Annex I nations is allocated a national emissions cap, which applies to certain large industrial emitters of carbon within these nations. In 1997, Kyoto assigned to each Annex I country a maximum quantity of GHG emissions for the period 2008 to 2012.[103] At the end of each compliance period, each emitter must have acquired—through allocation from their governments or through purchase or trade of additional allocation credits—enough credits to cover its carbon emissions during that period. In essence, each emitter must cover its emissions with regulatory allowances or newly created offset credits to emit carbon.

Annex I countries must set up national registries to issue their assigned amount units (AAUs), which correspond to their legally binding cap under Kyoto.[104] Registry removal units (RMUs), which reflect removal of GHGs due to forestry and land-use practices, are tracked as

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[98] *See* UNFCCC, List of Non-Annex I Parties to the Convention, http://unfccc.int/parties_and_observers/parties/non_annex_i/items/2833.php (last visited Feb. 10, 2010) (including China in non-Annex I parties to Kyoto).

[99] *Id.*

[100] *See* Eric J. Lyman & Dean Scott, *Delegates Reach Agreement in Copenhagen But Look to 2010 for Resumption of Talks*, 41 Env't Rep (BNA) 40 (Jan. 1, 2010).

[101] *See* Kyoto Protocol, *supra* note 77, art. 3, para. 1. While most countries have committed to achieve an 8% reduction below 1990 levels for CO_2, there has been a reallocation among European Union countries so that some countries are allowed to emit more than these baseline levels while others are required to reduce up to 28%, with the weighted average for the European Union overall being an 8% reduction. *Power Paradox*, *supra* note 56, at 549 n.77.

[102] *See* Kyoto Protocol, *supra* note 77, art. 3, para. 1.

[103] *See generally id.*

[104] UNFCCC, Marrakesh, Morocco, Oct. 29–Nov. 10, 2001, *Report of the Conference of the Parties on Its Seventh Session*, ¶ 21, U.N. Doc. FCCC/CP/2001/13/Add.2 (Jan. 21, 2002) [hereinafter *Marrakesh Accords*]; Zygmunt J.B. Plater et al., Environmental Law and Policy: Nature, Law, and Society 1283 (4th ed. 2004); *see* Kyoto Protocol, *supra* note 77, art. 7, para. 4.

well.[105] Each AAU and RMU is tracked with a unique serial number. AAUs and RMUs are converted into emission reduction units (ERUs) to facilitate international trade, which is allowed under Kyoto.[106] For instance, any party can purchase European Union (E.U.) credits, even if the purchaser does not require them for compliance.[107]

Kyoto also includes the creation of offsets. The inclusion of offsets in a cap-and-trade system offers several advantages: First, they allow lower-cost reduction opportunities outside the capped countries to be pursued as lower-cost reduction options. Second, economic sectors that are covered by the carbon emissions caps can be the source for reductions. This can include emission sources not otherwise cost-effectively addressed. Third, offsets can promote technology transfer to developing countries.

The use of offsets increases the compliance options by decreasing the total costs of compliance.[108] Industrial emitters in each country are able to trade emission credits.[109] They may also create new credits through mechanisms that allow for the possession of additional credits. Clean Development Mechanisms (CDMs) and Joint Implementation (JI) projects are two such avenues for GHG emitters to accrue these additional credits.

CDMs allow projects that reduce GHGs in developing nations to earn CERs for each ton of CO_2e of GHGs reduced.[110] Those CERs are then traded or sold to entities in Annex I countries, which increases that country's emissions cap allocation under Kyoto.[111] CERs—other

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[105] *See* Conference of the Parties Serving as the Meeting of the Parties to the Protocol, Montreal, Can., Nov. 28–Dec. 10, 2005, *Report of the Conference of the Parties Serving as the Meeting of the Parties to the Kyoto Protocol on Its First Session*, Add., U.N. Doc. FCCC/KP/CMP/2005/8/Add.1 (Mar. 30, 2006) [hereinafter *Montreal Report 1*].

[106] *See* Kyoto Protocol, *supra* note 77, art. 6.

[107] This includes those traders who wish to speculate in these regulatory commodities.

[108] U.S. Gov't Accountability Office, GAO-08–1048, Carbon Offsets: The U.S. Voluntary Market Is Growing, but Quality Assurances Poses Challenges for Market Participants 33 (2008) [hereinafter Carbon Offsets].

[109] Plater et al., *supra* note104, at 1283.

[110] Kyoto Protocol, *supra* note 77, arts. 12, 17; UNFCCC, Conference of the Parties Serving as the Meeting of the Parties to the Protocol, Montreal, Can., Nov. 28–Dec. 10, 2005, *Report of the Conference of the Parties Serving as the Meeting of the Parties to the Kyoto Protocol on Its First Session*, Add., FCCC/KP/CMP/2005/8/Add.2 (Mar. 30, 2006) [hereinafter *Montreal Report 2*]; UNFCCC, Emissions Trading, http://unfccc.int/kyoto_protocol/mechanisms/emissions_trading/items/2731.php (last visited Feb. 10, 2010) [hereinafter Emissions Trading].

[111] Kyoto Protocol, *supra* note 77, arts. 12, 17; *Montreal Report 2*, *supra* note 110, add.; Emissions Trading, *supra* note 110. "Credits earned after 2000 can be used to achieve compliance during the first commitment period[,] which begins in 2008. Two and a half

than those for afforestation—have a seven-year lifetime, with the possibility of either two renewals for a total of twenty-one years or a single term of ten-years.[112] CDM projects may only be pursued by Annex I countries.[113] As of the end of 2006, the World Bank reports that 61% of CDM projects were located in China, 12% were in India, 7% were in other Asian countries, 10% were in Latin America, most significantly Brazil, and 3% were in Africa.[114]

The Kyoto Protocol process to register and verify CERs requires between eighteen to twenty-four months.[115] It is estimated that the cost of developing a new methodology for approval of CDM projects is approximately $150,000.[116] Methodologies often require an average of 280 days for approval.[117] The E.U. has announced that it may reduce CDM imports from outside the E.U. after 2012.[118]

A second mechanism for compliance is JI. JI allows developed nation signatories to implement projects in their or other Annex I nations that remove GHGs or create additional carbon sinks.[119] The carbon emission reductions are then quantified in an ERU.[120] An ERU transfers a unit of allowed carbon emissions from a selling country's cap to the purchasing country's cap. Unlike a CDM CER, which creates an additional emission unit added to the cap,[121] a JI project transfers a

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percent of ERUs and CERs may be carried over to the second phase of implementation after 2012." Ferrey, *supra* note 83, at 638 n.266.

The CDM apparatus emerged as a last-minute compromise to the 1997 Kyoto conference. *See* Peter D. Cameron, *History of Climate Change Law and Policy*, *in* Climate Change: A Guide to Carbon Law and Practice 23, 29 (Paul Q. Watchman ed., 2008). It is patterned on the American experience trading sulfur dioxide. Steven Ferrey, *Auctioning the Building Blocks of Life: Carbon Auction, the Law, and Global Warming*, 23 Notre Dame J.L. Ethics & Pub. Pol'y 317, 355 & n.262 (2009).

[112] *Montreal Report 1*, *supra* note 105, add.

[113] Kyoto Protocol, *supra* note 77, art. 6.

[114] *See* Lauren Etter, *In China, a Plan to Turn Rice into Carbon Credits*, Wall St. J., Oct. 9, 2007, at A-1; *see also* Andrew Schatz, Note, *Discounting the Clean Development Mechanism*, 20 Geo. Int'l Envtl. L. Rev. 703, 724 & nn.156–57 (2008) (providing additional figures on CDM allocation and distribution).

[115] Craig A. Hart, *The Clean Development Mechanism: Considerations for Investors and Policymakers*, Sustainable Dev. L. & Pol'y J., Spring 2007, at 41, 46.

[116] *Id.*

[117] *Id.*

[118] *See* Press Release, Eur. Union, Questions and Answers on the Commission's proposal to revise the E.U. Emissions Trading System (Jan. 23, 2008), *available at* http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/08/35&format=H.

[119] *See* Kyoto Protocol, *supra* note 77, art. 6.

[120] *See id.*

[121] Plater et al., *supra* note 104, at 1283–84.

credit under the existing cap from one nation to another nation.[122] Whereas the CDM process creates additional room in the envelope of permissible carbon emissions by developed nations, the JI process transfers a static quantity of existing allocated credits under the cap from one developed nation to another. "However, JI projects have less burdensome transaction costs than CDM projects" because "the former are approved and administered by the parties involved rather than the U.N. Kyoto Executive Board."[123] In addition, "they are not subject to detailed periodic monitoring."[124]

CDM CERs and JI ERUs are required to be "additional" to baseline project emissions.[125] This involves establishing an individual emissions baseline as well as taking account of sector reform initiatives, barriers to expansion, and sector expansion plans.[126] Early entrants in the CDM protocol established guidelines of additionality that are not as stringent as the guidelines that are now in place.[127] There are at least eight different tests of additionality, none of which are widely accepted as credible.[128] Offset retailers often provided little information or claimed that their offsets were additional, but the U.S. GAO found that some sellers could not explain how they defined additional and could not provide a meaningful amount of verifiable information to buyers.[129] This undermined the credibility of offsets, and could compromise the integrity of a carbon reduction system going forward.[130]

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[122] *See id.*

[123] Ferrey & Ferrey, *supra* note 94, at 664–65 & n.59.

[124] *Id.*; *see* Jonathan Baert Wiener, *Global Environmental Regulation: Instrument Choice in Legal Context*, 108 Yale L.J. 677, 789–92 (1999) (discussing the transaction costs of JIs and CDMs).

[125] *See* Kyoto Protocol, *supra* note 77, art. 3; Ferrey, *supra* note 83, at 639.

[126] *Montreal Report 1*, *supra* note 105, add.

[127] *See* Schatz, *supra* note 114, at 725. *See generally* Ferrey, *supra* note 82 (providing background on the additionality requirement).

[128] Carbon Offsets, *supra* note 108, at 26–27 & tbl.2. The eight additionality tests that the GAO describes are:

- barriers,
- common practice,
- investment or financial,
- legal, regulatory or institutional,
- performance bench mark,
- project in, project out,
- technology,
- timing.

Id.

[129] *Id.* at 30–31. The lack of a single standard may further erode offset credibility. *Id.* at 28.

[130] *Id.* at 31.

The requirement for CDM CERs also includes the certification by the host developing nation that the project supports its goals for sustainable development.[131] Sustainable development has been defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."[132] Long-term renewable energy developments clearly satisfy this definition, while many of the other CDM projects that have created CERs may be more questionable.[133]

Taken together, these different forms of credits and offsets form a country's emission cap. This cap includes assigned Kyoto credit units; RMUs from forestation projects that remove CO_2 from the atmosphere; and JI ERUs and CDM CERs. Under the Kyoto Protocol CDM CERs, and JI ERUs can be used in future compliance to satisfy up to 2.5% of the party's annual allowed emissions. However, CERs and ERUs obtained prior to 2008 can be fully banked for use in the 2008–2012 compliance period.[134] Kyoto does not place limits on the use of excess allowances other than that tradable allowances must be supplemental to significant domestic measures to reduce GHG emissions.[135]

In summary, the Kyoto Protocol collects thirty-five developed nations into a voluntary agreement to limit their carbon emissions. Each of these nations decides how to impose these limitations on its local industries. The covered carbon emitters that need additional allowances can either create or purchase them through JI or CDM projects. In both Kyoto Annex I countries and in the United States, trading platforms have arisen in private markets allowing offsets trading.[136]

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[131] Kyoto Protocol, *supra* note 77, art. 12. Under the Kyoto Protocol this certification by the host nation is embodied in a Letter of Approval (LoA) from the host country's Designated National Authority. UNFCCC, CDM-Glos-05, Glossary of CDM Terms 7/31 (2009). After receiving the LoA and verification by an authorized third party, the CDM project is ready to be certified as creating CERs. *Id.* This is done by the CDM Executive Board, or for a JI project, the JI Supervisory Committee. *See id.*; CDM Rulebook, What is the Letter of Approval, http://cdmrulebook.org/92 (last visited Feb. 10, 2010).

[132] World Comm'n on Envtl. Dev., U.N. General Assembly, *Report: Our Common Future*, 54, *transmitted to the General Assembly as an Annex to Development and International Co-operation: Environment*, U.N. Doc. A/42/25 (Aug. 4, 1987).

[133] *See infra* Part II.D.

[134] Ferrey, *supra* note 74, § 6:7.1; *see* Kyoto Protocol, *supra* note 77, art. 12.

[135] Ferrey, *supra* note 74, § 6:7.1.

[136] *See* Niles Anger, *Emissions Trading Beyond Europe: Linking Schemes in a Post-Kyoto World*, 30 Envtl. Econ. 2028, 2029 (2008); *see, e.g.*, European Energy Exch., EEX Start, http://www.eex.de (last visited Feb. 10, 2010); European Climate Exch., Welcome to the European Climate Exchange, http://www.ecx.eu (last visited Feb. 10, 2010); Nord Pool, Portal, http://www.nordpool.com (last visited Feb. 10, 2010). "Selling carbon emission credits typically is done through forward contracts." Ferrey & Ferrey, *supra* note 94, at 666.

C. *The Actual Response to Kyoto Requirements*

A cap-and-trade system is generally deemed a more cost-effective means of eliminating carbon than a specific requirement to adopt renewable technologies.[137] The Kyoto Protocol does not require the installation of renewable technologies, but rather requires the reduction of carbon emissions, which may or may not involve the installation of renewable power generation technologies.[138] The installation of typical renewable technologies costs more than other options to reduce carbon emissions;[139] therefore, this higher cost for renewable offset options is not the "low hanging fruit" for someone speculating in carbon offsets.[140] Renewable options are estimated to require an investment of $200 billion over the next two decades just to hold world carbon emissions at current levels, let alone reduce them.[141]

Electric power is the crucial carbon-emitting sector of world economies because of its contribution to global warming and, more importantly, because of its rate of growth. Electric power production accounts for 34% of fossil fuel consumption in the United States, it and accounts for 40% of the carbon released from the burning of such fuels.[142] These emissions from stationary power production sources are increasing more quickly each year than emissions from other fossil fuel sources, including the transportation sector.[143] At current rates of en-

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[137] Mandating the adoption of renewable technologies is deemed to raise the cost of carbon reduction by as much as 400%. *See* Neal Cabral, *The Role of Renewable Portfolio Standards in the Context of a National Carbon Cap-and-Trade Program*, Sustainable Dev. L. & Pol'y J., Fall 2007, at 13, 14–15, 16. (describing Australia's debate between the options).

[138] Renewable Portfolio Requirements, as employed in about half of the United States, actually reward the installation of renewable electric generation technologies. *See* Steven Ferrey, *Sustainable Energy, Environmental Policy, and States' Rights: Discerning the Energy Future Through the Eye of the Dormant Commerce Clause*, 12 N.Y.U. Envtl. L.J. 507, 646-47 tbl.3 (2004). They typically require the distributing retailer of power to satisfy a retail portfolio standard, and with deregulation of power resources in many states, many utilities no longer own generation resources to satisfy these standards as the distributing retailer. *See generally id.*

[139] Cabral, *supra* note 137, at 14.

[140] *See* Schatz, *supra* note 114, at 719.

[141] Press Release, U.N. General Assembly, Private Finance Will Play Key Role in Massive Investment Needed to Shape Transitioning to Low-Carbon Economy, U.N. Doc. GA/10718 (June 9, 2008), *available at* http://www.un.org/News/Press/docs/2008/ga10718.doc.htm.

[142] U.S. Envtl. Prot. Agency, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2004, ES-7 to -8 (2006), *available at* http://epa.gov/climatechange/emissions/downloads06/06_Complete_Report.pdf.

[143] Energy Info. Admin., U.S. Dep't of Energy, U.S. Carbon Dioxide Emissions from Energy Sources 2008 Flash Estimate 6 (May 2009), *available at* http://www.eia.doe.gov/oiaf/1605/flash/pdf/flash.pdf (noting that emissions are down for 2008 due to the economic downturn).

ergy development, energy-related CO_2 emissions in 2050 will be 250% higher than their current levels.[144] At that rate, the battle against warming will be lost.[145]

Deployment of renewable energy generation bases will be required to alter this trend. Renewable power is one of the few win-win scenarios for developing nations. Renewable energy can provide opportunities for poverty alleviation and enhances energy security by relying on domestic resources.[146] Renewable power generation in developing nations can also qualify to create additional CDM allowances through offsets.[147]

However, the CDM provision in the Kyoto Protocol has not generated these kinds of benefits. CDM projects to date have been limited to a small number of countries and only a few gases while making little contribution to the transition to sustainable, renewable technologies.[148]A report prepared by the Öko-Institut for the World Wildlife Fund found that many Kyoto CDM programs fail to support sustainable development in host CDM countries.[149] Additionally, many of the CDM projects would have occurred notwithstanding CDM credit qualification.[150] The report highlighted that numerous projects in India failed to demonstrate their additionality from what would have been implemented without CDM credit qualification.[151] The report charged that future multilateral agency investments will be targeted at countries with the largest emissions, rather than those most needing a transition to renewable energy resources.[152] This focus will result in the production of a large quantity of cheap carbon credits that allow businesses and developed countries to avoid a fast transition to renewable resources and/or to keep discharging copious quantities of CO_2.[153]

Renewable power investments are not recognized as carbon offsets because "the emission reduction doesn't occur at the site of the renewable generator," but rather, it occurs in backing out other carbon-

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[144] El-Ashry, *supra* note 60, at 4.

[145] *See* Hansen, *supra* note 51, at 12, 16.

[146] El-Ashry, *supra* note 60, at 3.

[147] *See supra* Part. II.B.

[148] Lamber Schneider, Öko-Institut, Is the CDM Fulfilling Its Environmental and Sustainable Development Objectives? An Evaluation of the CDM and Options for Improvement 10, 47 (2007).

[149] *Id.*

[150] *Id.*

[151] *Id.* at 46.

[152] *Id.* at 10.

[153] *See id.* at 10–11.

intensive generation.[154] The intermittent nature of several renewable power sources and their integration with the power grid make each situation different. Environmental groups have questioned the additionality of renewable energy projects if their construction is not because of the value of the offset sale.[155] The media has also questioned the credibility of CDM carbon offset projects[156] and the efficacy of such offsets.[157]

It is not clear whether Kyoto's goals translate to the logical deployment of an expanded renewable energy base. There are enough available conventional fossil fuel resources in the intermediate term to make this a real choice.[158] Resource economists believe that Asia has fossil fuel reserves that are sufficient to last for over 100 years.[159] However, more than 90% of these fossil fuel reserves are coal, and several of these nations, most notably China and India, are already highly dependent on coal as their principal energy source.[160] In 2003 alone, China's oil consumption jumped by nearly one-third, domestic coal production increased by 100 million tons, and electricity consumption rose by fifteen percent.[161] India, in the latter part of 2008, sought to acquire ownership of existing coal mines in the United States and elsewhere to fuel its coal-fired power industry.[162] Looking to spend $4 billion, India stated that "money [was] not a problem."[163]

The average annual growth rate in primary energy use in developing countries from 1990 to 2001 grew by 3.2% per year, compared to industrialized countries where growth over the same period was 1.5% annually.[164] U.S. Department of Energy (DOE) predicts a 2.3% per year increase in demand by developing countries over the next twenty

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[154] *See Environmentalists Split over Support of Offsets for Plant Closures*, Carbon Control News, Aug. 25, 2008 (LEXIS).

[155] *See* Schneider, *supra* note 148, at 19, 40–41.

[156] Andrew Revkin, *Carbon-Neutral Is Hip, but Is It Green?*, N.Y. Times, Apr. 29, 2007, at WK1.

[157] Ben Elgin, *Little Green Lies*, Bus. Wk., Oct. 29, 2007, at 44, 45.

[158] *See* Steven Ferrey & Anil Cabraal, Renewable Power in Developing Countries: Winning the War on Global Warming 22–24 (2006).

[159] *See* Int'l Energy Agency, World Energy Outlook 2006, at 88, 115, 127 (2006) (summarizing fossil fuel reserves and estimating years of supply).

[160] *See* Ferrey & Cabraal, *supra* note 158, at 21–24.

[161] Jim Yardley, *China's Economic Engine Needs Power (Lots of It)*, N.Y. Times, Mar. 14, 2004, at WK3.

[162] Posting of Tom Zeller, Jr. to Green Inc., *India Shopping for Coal Mines in Appalachia*, http://greeninc.blogs.nytimes.com/2008/10/23/india-shopping-for-coal-mines-in-appalachia/ (Oct. 23, 2008 13:47 EST).

[163] *Id.*

[164] World Energy Council, *supra* note 57, at 31.

years.[165] DOE also forecasts that energy demand in developing Asia will double over the next twenty-five years.[166] The International Energy Agency (IEA), with its headquarters in Paris, forecasts that over half of all future energy demand will originate in China and India.[167]

"China and India harbor around one-quarter of the world's coal reserves, and they are deploying them rapidly to fire electric power plants."[168] China is currently installing 1000 megawatts (MW) of coal power generation each week,[169] and predictions are that by the year 2030, coal-fired power in India and China will add 3000 million extra tons of CO_2 to the atmosphere every year.[170] Therefore, the additional CO_2 emissions from China and India's electric power sectors will total approximately 34% of all world CO_2 emissions from all sources in 2030.[171]

Urbanization and population growth in India have driven growth in India's energy consumption during the last twenty years.[172] By 2025, one-quarter of the world's population will be living in Asian cities.[173] Some projections estimate that by 2030, China's GHG emissions will more than triple,[174] and Asia alone will emit 60% of the world's carbon emissions.[175] "China currently meets 70% of its electricity demand through coal plants, the most prolific emitters among fossil fuel plants in terms of both CO_2 and particulate matter."[176] India also relies on coal, generating 57% of its electricity in coal-fired plants,[177] and it has ambitions to add 90,000 MW in new capacity by 2012.[178] In July 2009,

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[165] Energy Info. Admin., U.S. Dep't of Energy, International Energy Outlook 2009, at 7–8 & fig.11 (2009) [hereinafter Energy Outlook 2009].

[166] *Id.*

[167] Int'l Energy Agency, World Energy Outlook 2008, at 4 (2008).

[168] Steven Ferrey, *The Missing International Link for Carbon Control*, Elec. J., Apr. 2009, at 17, 19.

[169] *Id.*

[170] Sci. & Tech. Comm., H.C.578–1, Meeting UK Energy and Climate Needs: The Role of Carbon Capture and Storage, 2005–06, at 11. (2006).

[171] Energy Outlook 2009, *supra* note 165, at 110.

[172] *See generally* Energy Info. Admin., India Country Analysis Brief (2009), http://www.eia.doe.gov/emeu/cabs/India/Full.html [hereinafter India Brief].

[173] Susan Sim, *Overtaking the West: Asia's Teeming Urbanites*, Straits Times (Singapore), Dec. 9, 1996, at 41.

[174] Deborah E. Cooper, Note, *The Kyoto Protocol and China: Global Warming's Sleeping Giant*, 11 Geo. Int'l Envtl. L. Rev. 401, 405 (1999).

[175] Ferrey, *supra* note 168, at 19.

[176] *Id.*; *see* Energy Info. Admin., China Country Analysis Brief (July 2009), http://www.eia.doe.gov/emeu/cabs/China/Full.html.

[177] Ferrey, *supra* note 168, at 19; India Brief, *supra* note 172.

[178] India Brief, *supra* note 172; *see* Ferrey, *supra* note 168, at 19.

just before the G8 climate talks in L'Aquila, Italy, China and India renewed their refusals to commit to any mandatory GHG emission cuts.[179] Furthermore, chaos, rather than consensus, ended the Copenhagen Conference, held in December of 2009.[180]

Before recently surpassing the United States for the highest gross carbon emissions, China's total installed electric generation capacity grew from 65 gigawatts (GW) in 1980 to 353 GW in 2002, at the time making it the second largest carbon emitter in the world after the United States.[181] China's electricity demand between 1996 and 2000 grew at an average rate of 6.3% annually, and it is expected to almost match this pace into the future.[182] In order to avoid shortages and satisfy demand, China will have to increase electric capacity by approximately 40 GW annually.[183] At the December 2009 Copenhagen Conference, China stated only that it would reduce carbon intensity for production, while ambitiously increasing total carbon output.[184]

It is essential that renewable energy projects worldwide—especially those located in fast-growing and industrializing Asian countries—re-

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[179] James Kirkup, *G8 Summit: China and India Reject G8 Calls for Climate Targets*, TELEGRAPH (London), July 8, 2009, http://www.telegraph.co.uk/news/worldnews/g8/5780617/ G8-summit-China-and-India-reject-G8-calls-for-climate-targets.html.

[180] *See* Eric J. Lyman, *U.N. Officials Say Climate Change Process 'Taking Stock' After Copenhagen Summit*, 41 Env't Rep (BNA) 110 (Jan. 15, 2010); John Vidal et al., *Low Targets, Goals Dropped: Copenhagen Ends in Failure: Deal Thrashed out at Talks Damned as Climate Change Denial in Action*, GUARDIAN (Manchester, U.K.), Dec 19, 2009 at 1, *available at* http://www.guardian.co.uk/environment/2009/dec/18/copenhagen-deal.

[181] Boon-Siew Yeah & Rajesh Rajaraman, *Electricity in China: The Latest Reforms*, ELEC. J., Apr. 2004, at 60, 61. China has since surpassed the United States are the largest emitter of GHGs. John Vidal & David Adam, *China Overtakes US as World's Biggest CO_2 Emitter*, GUARDIAN (Manchester, U.K.), June 19, 2007, http://www.guardian.co.uk/environment/2007/jun/19/china.usnews.

[182] Yeah & Rajaraman, *supra* note 181, at 61. Despite this growth in demand, China's per capita installed generation of 0.25 kilowatt with per capita annual consumption of 1078 kilowatt-hour is fairly meager by global standards. *Id.* These figures are "less than half [the value] of world averages and only about 1/6 to 1/10" of the average consumption in developed countries. *Id.*

[183] *Id.* at 62.

[184] *See* John J. Tkacik, Jr., *World Watch: China's Imprints All Over Copenhagen Talks Fiasco*, WASH. TIMES, Jan. 14, 2010, at A1, *available at* http://www.washingtontimes.com/news/2010/jan/14/ china-imprints-all-over-copenhagen-talks-fiasco/.

> China demanded that the United States, Europe and Japan cut carbon emissions immediately and continue reductions over the next 40 years, while China—and any other "developing" country—may continue to increase emissions until such time as they reach the total 150-year "per capita aggregate" that the Western citizens—both dead and alive—have enjoyed thus far.

Id.

ceive funding in order to prevent these nations from becoming even more reliant on a high-carbon fossil fuel-based energy generation infrastructure. At the Bonn International Conference on Renewable Energies in June 2004, China committed to adding about 6 GW of renewable energy annually until 2020.[185] The IEA projected that it will require an investment of $16 trillion by 2030 to meet the world's energy requirements, with $5 trillion of this amount allocated to electric power production, primarily in Asia and Africa.[186] In the ten years since the ratification of the Kyoto Protocol, energy demand has expanded much more vigorously than the transition to renewable sources of power generation.

D. *CDM Projects: Investor Interests Versus Renewable Resources Needed in Developing Nations*

CDM projects dominate the action compared to JI projects under Kyoto: the volume of CDM CERs created was approximately forty times that of JI ERUs in 2006.[187] There are almost one thousand CDM projects, with twice that many in the project development pipeline.[188] The existing CDM projects have generated 117 million issued CERs, with an estimated 2.6 billion CERs to be generated by 2012.[189]

The economic value of trading offsets for a price provides a market incentive for both host CDM countries[190] and CDM investors to maximize the number of CERs created rather than invest in a needed technological transition to new power sources.[191] By 2012, the CDM mechanism will have produced enough carbon offsets to equal the carbon emissions of the United Kingdom over three years.[192] By 2020, the

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[185] *See* Mark Landler, *China Pledges to Increase Use of Alternative Energy Sources*, N.Y. Times, June 5, 2004, at C3.

[186] *See* Int'l Energy Agency, World Energy Investment Outlook 2003, at 42, 46–47 (2003).

[187] Karan Capoor & Philippe Ambrosi, World Bank Inst., State and Trends in the Carbon Market 2007, at 20 (2007), *available at* http://www.ieta.org/ieta/www/pages/getfile.php?docID=2281.

[188] Capoor & Ambrosi, *supra* note 187, at 22.

[189] Christina Voigt, *Is the Clean Development Mechanism Sustainable?*, Sustainable Dev. L. & Pol'y, Winter 2008, at 15, 15.

[190] Under the Kyoto scheme, the host country for the CDM project gets to determine whether the project satisfies its sustainable development goals. UNFCCC, Nairobi, Nov. 6-17, 2006, *Report of the Conference of the Parties to the Protocol*, 3, U.N. Doc. FCCC/KP/CMP/2006/10/Add.1 (Mar. 2, 2007).

[191] Voigt, *supra* note 189, at 15.

[192] Carbon Rating Agency, Carbon Ratings: The Performance of CDM and Offset Projects 3 (2008).

value of carbon credits and offsets is forecast to increase in value from $11.8 billion currently to $278 billion.[193]

Moreover, the impact of CDM projects has not been to promote appropriate renewable investments in developing countries, as much as it has served to create additional credits for Annex I countries.[194] CDM projects to date have been limited to a number of countries and only a few gases, "with little contribution to sustainable development."[195] There is no mandatory environmental or sustainability assessment in Kyoto CDM projects or public input, which was rejected as an infringement on host country sovereignty.[196]

Stanford Law Professor, Michael Wara, noted that "[b]y January 1, 2008, more than 1150 million tons (Mt) CO_2 equivalent (CO_2e) had been registered for delivery via the CDM by the end of the first compliance period."[197] He noted further that a "small number of very large projects dominate the supply of CERs from registered projects. In fact, the forty-five largest projects," which are only 5% of the total number of CDM projects, nonetheless "represent 64% of the total supply to the end of the [f]irst [c]ommitment [p]eriod."[198] The amount of projects in the CDM pipeline represents approximately 2.8% of Annex B countries' 1990 GHG emissions for each year of the first commitment period.[199]

There is one indisputable premise for carbon control: the long-term success of climate warming control will involve financing a fundamental shift of power production to renewable resources, especially in developing countries. However, the Kyoto Protocol does not explicitly reflect this premise.[200] CDMs treat carbon as a global commodity, ignoring its source or location and encouraging business to seek out and exploit the cheapest carbon-reduction technologies, regardless of whether or not they lead to replacement of the power-generating base with renewable alternatives.[201]

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[193] *Id.* These figures are converted from €8.5 billion and €200 billion respectively to U.S. dollars at an exchange rate of $1 to €0.719248, the prevailing rate on February 3, 2010, as provided by http://www.xe.com.

[194] Voigt, *supra* note 189, at 18.

[195] El-Ashry, *supra* note 60, at 5.

[196] Voigt, *supra* note 189, at 20.

[197] *See* Lessons Learned, *supra* note 25, at 35 fig.4; Michael Wara, *Measuring the Clean Development Mechanism's Performance and Potential*, 55 UCLA L. Rev. 1759, 1775 & fig.2 (2008).

[198] Wara, *supra* note 197, at 1776.

[199] *See id.*

[200] *Power Paradox*, *supra* note 56, at 525.

[201] *See* Lessons Learned, *supra* note 25, at 43–44.

In developing countries, CDMs encourage "cream-skimming" carbon reduction investments.[202] For instance, developers of CDM projects in developing nations are trapping methane and flaring it,[203] without turning it into renewable electricity in the process.[204] Even in the United States, methane is flared to garner offsets, even though such flaring is not additional, and the methane could create power resources rather than just being flared as a waste material.[205] These easy solutions to just flare methane reduce GHGs but perpetuate the community's need for electricity from other traditional sources. Flaring converts the methane into CO_2, which is a less potent GHG. However, burning methane in an engine is the ideal application because this process can produce electricity that would offset other fossil fuel-fired electric production and/or serve as a local electricity need.[206] Because of conversion factors to equate GHG reduction into CO_2es, some critics have argued that the Kyoto mechanism is overpaying for reduction of certain non-CO_2 gases.[207] Therefore, while the Kyoto Protocol CDM process encourages carbon reduction in developing countries, it does not always result in a substitution of renewable power for conventional fossil-fuel power.[208] Renewable energy projects account for 28% of CDM CERs. Methane capture and flaring projects— "mostly located at large

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[202] Jean-Charles Hourcade & Michael Grubb, *Economic Dimensions of the Kyoto Protocol*, *in* Climate Change and European Leadership: A Sustainable Role for Europe?, 173, 197 (Joyeeta Gupta & Michael Grubb eds., 2000); *Power Paradox*, *supra* note 56, at 525.

[203] Flaring burns off gas for no productive purpose. *See generally Rethinking Offsets*, Carbon Control News, Oct. 9, 2008 (LEXIS) [hereinafter *Rethinking Offsets*].

[204] *Power Paradox*, *supra* note 56, at 525. CDM projects are credited by capturing or destroying carbon gases, rather than maximizing efficiency. Because one receives 2100% greater credit from destroying methane than CO_2, many CDM projects capture rural or agricultural methane and flare it (converting it to CO_2). But in that flaring process, it is not used to produce electricity, which is otherwise locally supplied by traditional sources. Rather than invest in the lifecycle cost-effectiveness that improves electric generation technology, CDM investors often minimize capital investments by flaring methane and ignoring essentially free-at-the-margin electric generation. *See* World Bank, International Trade and Climate Change: Economic, Legal, and Institutional Perspectives 91 (2008).

[205] *See Rethinking Offsets*, *supra* note 203.

[206] *See Power Paradox*, *supra* note 56, at 525. For example, Wisconsin Energy Corporation generates enough energy from facilities that combust methane to power nearly 18,000 homes. *See* Pew Ctr. on Global Climate Change, Energy Solutions, http://www.pewclimate.org/policy_center/policy_maker_s_guide/business/business_solutions.cfm (last visited Feb. 10, 2010) (detailing renewable energy solutions by power companies).

[207] *See* Jeffrey Ball, *Kyoto's Caps on Emissions Hit Snag in Marketplace*, Wall St. J., Dec. 3, 2007, at A-1.

[208] *See* Voigt, *supra* note 189, at 18.

landfills, coal mines, and CAFOs [concentrated animal feeding operations]"—that do not produce electricity, account for 19% of CERs.[209]

The carbon offset market has misjudged regulatory risk, as well as market and host country risks, inherent in carbon offset markets. There are weak counterparts, often lower than anticipated administrative capacity, and financing risks. The risk of CDM projects is a function of the following factors:

- The level of CDM project experience in the host country where the host country's track record contributes to reducing delivery risk;
- The success of the host country base project, since subsequent rejects rely on the achievements of that base project; and
- The degree of the design and construction risk of certain projects.[210]

If carbon credits become the biggest market in the world, as expected, the quality of the credits traded becomes a crucial factor. Questions have been raised as to whether the Kyoto Executive Board and panels have the ability to correctly police the incentive to inflate CERs.[211] The typical CDM project now takes about 300 days from the comment period, which starts the validation process, to registration of the project.[212] The value of carbon aggregators has plunged, with the share prices of five public carbon market makers and CDM development companies plunging between 13 and 98% from mid-2007 to mid-2008.[213]

The majority of CDM projects, which all must be sited in (non-Annex I) developing countries, have been projects to reduce by-product emissions of trifluoromethane (HFC-23), a refrigerant.[214] An HFC-23 gas mitigation CDM project in a developing country does not shift or promote the power-generating base in either the developing host country or in the country which imports and counts the CDM CERs. While HFC-23 reduction does limit world carbon emissions, there must be a long-term fundamental shift to a renewable energy base.

To date, CERs address high global warming potential industrial gases such as HFC-23, nitrous oxide (N_2O), and methane (CH_4) emit-

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[209] Wara, *supra* note 197, at 1779.
[210] Carbon Rating Agency, *supra* note 192, at 4.
[211] Voigt, *supra* note 189, at 16.
[212] Carbon Rating Agency, *supra* note 192, at 9.
[213] *Id.* at 4 tbl.1.
[214] Ball, *supra* note 207.

ted by landfills and CAFOs.[215] Two relatively obscure industries—adipic acid and chlorodifluoromethane (HCFC-22) production—dominate CDM projects.[216]

> Adipic acid is the feedstock for the production of nylon-66 and releases abundant N_2O as a production byproduct. HCFC-22 has two major applications. It is one of two major refrigerants that were phased in to replace the CFCs under the Montreal Protocol to Protect Substances that Deplete the Ozone Layer. HCFC-22 is also the primary feedstock in the production of Dupont Teflon.[217]

The relatively small refrigerant and Teflon industries represent nearly 55% of the supply of issued CERs in the CDM to date.[218] Indeed, the industrial gas emissions that account for one-third of CDM reductions do not even occur in the developed world, not because of an absence of adipic acid or HCFC-22 manufacture, but because industries abate them voluntarily and destroy them.[219] Producers of HCFC-22 in developing countries can earn twice the amount from CDM subsidies when compared with the sales of the primary product, thus tripling revenues and profits.[220] "It appears quite likely that the sector is also gaming the system by modifying its behavior in order to generate extra credits that can then be sold to developed countries with compliance obligations."[221]

Under the CDM, a profit-maximizer goes after non-fossil-fuel gases because one can rationally earn relatively more credits given a level of investment, even though that reduction technology may be more expensive per molecule conserved. Because of the 11,700 times greater CO_2e credits earned from reducing a molecule of HFC emissions for an investment of $100 million, it generates CDM credit revenues worth $4.6 billion, an impressive return on investment.[222] Ironically, HFC emitters earned almost twice as much from these HFC by-product reduction activities than they did from selling their refrigerant gases pro-

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[215] Wara, *supra* note 197, at 1778–79.

[216] *See id.*

[217] *Id.*

[218] *Id.* at 1779.

[219] *Id.* at 1782. Prior to CDMs, the HCFC-22 manufactures vented the HFC-23 into the atmosphere. *Id.*

[220] *Id.* at 1784.

[221] Wara, *supra* note 197, at 1789.

[222] John J. Fialka, *U.S. Plots New Climate Tactic*, Wall St. J., Sept. 7, 2007, at A-8.

duced as the salable commodity in the process.[223] HFCs constitute less than 1% of GHGs, but they have received almost half of the investment in GHG mitigation.[224]

When one can reduce HFCs and create CDM offsets for less than $1/ CDM credit created, compared to renewable energy projects that can cost $10/credit created, the market is responding rationally when it favors investments in the former.[225] Minimizing the costs of producing a CER by a factor of ten or greater is economically sound within the incentives and rewards of the Kyoto scheme. Market mechanisms favor the most cost-effective private investments in CERs rather than the publicly optimal types of investments for the long-term welfare of the host country.

The problem is that HFC capture and destruction projects do nothing to shift the energy base of the world's economies to sustainable, renewable technologies.[226] The major necessary structural energy sector transformations to low-carbon technologies are not occurring. It is of note that CDM programs were originally a late minor add-on to the original Kyoto Protocol.[227] However, they have become the regulatory conduit for altering the key carbon-emitting activities of world economies.[228]

Emphasis on HFC-23 containment in the market, rather than a transition to renewable generation and sustainable development alternatives, is manifest.[229] While these HFC reductions do limit world carbon emissions, the long-term success of global warming mitigation must involve financing a fundamental shift of power production to renewable resources, especially in developing countries.[230]

The General Accounting Office (GAO) concluded that the "evidence indicates that the CDM has had a limited effect on sustainable development."[231] GAO concluded that by encouraging the lowest-cost means for a developer to reduce carbon, the CDM scheme disadvantages measures that contribute to sustainable development.[232] It also concluded that CDM projects have not been successful in promoting

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[223] *Id.*
[224] Ball, *supra* note 207.
[225] *See id.*
[226] *See Power Paradox*, *supra* note 56, at 525.
[227] Ball, *supra* note 207.
[228] *See id.*
[229] Voigt, *supra* note 189, at 19.
[230] *See id.* at 18.
[231] Lessons Learned, *supra* note 25, at 43.
[232] *Id.* at 44.

technology transfer, and that such technology transfer was most likely to occur to assist renewable power development.[233] GAO concluded that the emphasis on reduction of HFC-23 GHGs "do little to promote efficient energy use or contribute to long-term sustainable development objectives."[234] GAO determined that because of the very emphasis of CDM on low-cost GHG projects, it may not be able to encourage development of projects that promote sustainable development.[235]

With some scientists suggesting that we have less than a decade to achieve a significant world reduction in carbon emissions before the effects of global warming become irreversible, time is of the essence.[236] However, there is little prospect that renewable energy will emerge as the focus of near- or intermediate-term efforts. Permitting and constructing renewable energy projects require significant lead time. Furthermore, no reauthorization of the Kyoto Protocol is expected to take effect for at least another 3 years.

E. *The Residual Preference for King Coal Alternatives*

None of the countries with the largest coal reserves—the United States, China, India, and Indonesia—has a carbon policy to regulate the release of CO_2 from the deployment of such coal reserves. None of these four counties is regulated by the Kyoto Protocol. About 40% of carbon emissions in the United States are attributed to coal-fired electricity generation.[237] The Sierra Club has made the closure of all coal-fried power plants in the United States its Beyond Coal Campaign.[238] It has been predicted that Russia's CO_2 emissions will climb dramatically by 2020 due to a 123% increase in Russia's coal consumption.[239] Over

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[233] *Id.*

[234] *Id.* at 45.

[235] *Id.* at 46.

[236] James Hansen, Dir., Nat'l Aeronautics & Space Admin. Goddard Inst. for Space Studies, Keynote Address at the Climate Change Research Conference: Is There Still Time to Avoid Disastrous Human-Made Climate Change? (Sep. 13, 2006), *available at* http://www.climatechange.ca.gov/events/2006_conference/presentations/2006-09-13/2006-09-13_HANSEN.PDF.

[237] NaturalGas.org, Natural Gas and the Environment, http://www.naturalgas.org/environment/naturalgas.asp (last visited Feb. 10, 2010).

[238] Sierra Club, Climate Recovery Partnership: Prospectus 13–17 (2009), *available at* http://www.sierraclub.org/crp/downloads/SierraClub-CRP-Prospectus.pdf. *See generally* Sierra Club, Beyond Coal, http://www.sierraclub.org/crp/campaigns/coal.aspx (last visited Feb. 10, 2010) (providing additional information on the Sierra Club's Beyond Coal campaign).

[239] Paul Carlsen, *Clean Coal 'Optimists' Win Show-of-hands Votes at EEI London*, Elec. Util. Wk, Mar. 17, 2008, at 1, 15.

the next five years, Italy is expected to more than double the percentage of coal used to generate electricity.[240] Germany, England, and other major European countries also are planning new coal plants.[241]

This is contrary to the recommendation of climate scientist James Hansen: "Building new coal-fired power plants is ill conceived . . . . We need a moratorium on coal now, with phase-out of existing plants over the next two decades."[242] However, coal remains attractive to power suppliers because of its abundance, its dispersion as an energy resource across mineral seams in many countries, and the fact that there is no coal cartel, as there is with oil producers.

However, consumption of energy is increasing exponentially as population increases and the energy intensity of (particularly developing) nations increases. China and India are building almost two new coal plants each week.[243] According to former British Prime Minister, Tony Blair, "the vast majority of new power stations in China and India will be coal-fired; not 'may be coal-fired', will be."[244]

As noted above, "China and India harbor around one-quarter of the world's coal reserves,"[245] and both nations are deploying them rapidly to fire electric power plants.[246] China's future energy use is projected to grow faster than its GDP.[247] "Over two-thirds of its energy is produced from coal."[248] China is currently installing over 1 GW of coal power generation each week, and predictions are that by the year 2030, coal-fired power in India and China will add 3000 million extra tons of CO_2 to the atmosphere every year.[249] China plans to build almost 200 additional coal plants over a few years. In 2007, China built more new

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[240] Elisabeth Rosenthal, *Europe Turns to Coal Again, Raising Alarms on Climate Change*, N.Y. Times, Apr. 23, 2008, at A1.

[241] *Id.*

[242] *Id.* (internal quotation marks omitted); *see also* James Hansen, *The Need for an International Moratorium on Coal Power*, Bull. of the Atomic Scientists, Jan. 21, 2008, http://www.thebulletin.org/web-edition/op-eds/the-need-international-moratorium-coal-power (discussing how the creation of additional coal plants pushes the global climate system closer to its tipping point).

[243] Pew Ctr. on Global Climate Change, Coal and Climate Change Facts, http://www.pewclimate.org/global-warming-basics/coalfacts.cfm [hereinafter Coal Facts] (last visited Feb. 10, 2010).

[244] Blair, *supra* note 14, at 6.

[245] *See* Int'l Energy Agency, World Energy Outlook 2006, at 129 fig.5.2 (2006) (showing coal reserves of China and India).

[246] *See* Ferrey, *supra* note 168, at 19; *supra* text accompanying notes 168–169.

[247] Nathan Borgford-Parnell, *China's Renewable Energy Law: Not Enough to Overcome China's Energy and Environmental Problems*, Sustainable Dev. L. & Pol'y, Winter 2008, at 45, 45.

[248] *Id.*

[249] Purdy, *supra* note 43, at 23.

coal-fired power plants than Britain, the seat of the coal-fired industrial revolution, built in its entire history.[250]

India, with 1.1 billion people, is the second most populous nation in the world. According to the EIA, it also contains the world's fourth largest coal reserves.[251] India maintains about 144,000 MW of generation capacity,[252] compared to over 600,000 MW in China[253] and approximately 1,000,000 MW in the United States.[254] Furthermore, 70% of India's electricity comes from coal,[255] and India has targeted 65,000 MW in new power generation capacity over the next ten years.[256]

China currently meets 70% of its electricity demand through coal plants, which are the most prolific emitters among fossil fuel plants in terms of both CO_2 and particulate matter.[257] China uses its coal resources to a greater degree than the United States uses its domestic coal resources.[258] If China used energy as the United States does, world energy consumption would double; satisfying China's oil demand would require oil production equal to 500% of Saudi Arabia's current oil production.[259] China would also have to produce 600% more coal.[260] Each year, China adds forty times more new coal capacity than new wind power.[261] It is no wonder that China now contains seven of the ten most (air) polluted cities in the world.[262]

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[250] Keith Bradsher, *China's Green Energy Gap*, N.Y. Times, Oct 24, 2007, at C1.

[251] Energy Info. Admin., U.S. Dep't of Energy, International Energy Statistics, http://tonto.eia.doe.gov/cfapps/ipdbproject/IEDIndex3.cfm (last visited Feb. 10, 2010).

[252] Energy Info. Admin., U.S. Dep't of Energy, India Energy Data (2009), http://www.eia.doe.gov/cabs/India/Electricity.html [hereinafter India Energy Data].

[253] Energy Info. Admin., U.S. Dep't of Energy, China Energy Data (2009) http://www.eia.doe.gov/cabs/China/Full.html [hereinafter China Energy Data].

[254] Energy Info. Admin., U.S. Dep't of Energy, DOE/EIA 0348, Electric Power Annual 2007, at 4 (2009).

[255] India Energy Data, *supra* note 252.

[256] Chins S. Kuo, U.S. Geological Survey, 2006 Minerals Yearbook: India 10.4 (2008).

[257] China Energy Data, *supra* note 253; Posting of Frederik Balfour to Eye on Asia, *China Has World's Fastest Growing Wind Power Capacity*, http://www.businessweek.com/globalbiz/blog/eyeonasia/archives/2009/04/china_has_world.html (Apr. 28, 2009); *see Power Paradox*, *supra* note 56, at 519.

[258] *See* William Chandler, Carnegie Endowment for Int'l Peace, Breaking the Suicide Pact: U.S.-China Cooperation on Climate Change 3 (2008).

[259] *Id.* at 2.

[260] *Id.*

[261] *Id.* at 4.

[262] Zhang Zhengming et al., Renewable Energy Development in China: The Potential and the Challenges 3 (Ctr for Res. Solutions ed., 2001), *available at* http://www.frankhaugwitz.info/doks/general/2001_China_RE_Situation_Report_full_EF.pdf.

The challenge is substantial. "The stakes, for all life on the planet, surpass those of any previous crisis."[263] "If we stay our present course, using fossil fuels to feed a growing appetite for energy-intensive life styles, we will soon leave the climate of the Holocene, the world of prior human history."[264] Does this work in a carbon-constrained age? "The single-point nature of power plants' emissions, the centralized nature of most power plant decisions in developing nations, and the exploding demand for electricity, make electricity generating-plants the logical choice for a frontal assault on GHG emissions."[265]

III. The Fatal Disconnects: Developing Nations' Forests and the Chemical Reality

> *We are recklessly burning and clearing our forests and driving more and more species into extinction. The very web of life on which we depend is being ripped and frayed.*
>
> —Al Gore[266]

A. *Forest Preservation Ineligibility Under Kyoto*

Kyoto does not cover developing countries,[267] and in some ways even fails to speak their language.[268] Developing countries harbor some of the great forests of the world: the great rain forests of South America and Indonesia are just two examples. Forests should be looked at as an opportunity to sequester carbon dioxide (CO_2) in the atmosphere, rather than the proposed controversial sequestration underground in

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[263] *Target CO_2*, *supra* note 32, at 229.

[264] *Id.* at 228.

[265] *Power Paradox*, *supra* note 56, at 520 & nn.74–75.

[266] Al Gore, Nobel Lecture (Dec. 10, 2007), *available at* http://nobelprize.org/nobel_prizes/peace/laureates/2007/gore-lecture_en.html.

[267] *See* Pierre Claude Nolin (Can.), NATO Parliamentary Assembly, *Climate Change: Thinking Beyond Kyoto*, at pt. III.B, 177 STC 07 E bis. (2007), *available at* http://www.nato-pa.int/Default.asp?SHORTCUT=1177. The argument now is that without involving countries like China or India, efforts to mitigate global warming will not bring desired results. *See id.*

[268] *See* David Fogarty, *Senior G77 Members Protest Steps to Change Kyoto Pact*, Reuters, Oct. 7, 2009, http://www.reuters.com/article/GCA-GreenBusiness/idUSTRE59623R20091007; UNFCCC, Parties and Observers, http://unfccc.int/parties_and_observers/items/2704.php (last visited Feb. 10, 2010) (listing parties and observers to Kyoto). The official languages of the United Nations are English, French, Spanish, Russian, Chinese and Arabic. Press Release, United Nations Information Service, Upgrading UN Websites in All Languages Requires Significant Investment, Under-Secretary-General Tells Information Committee, U.N. Doc. UNIS/PI/192 (Nov. 3, 1999). Some of the parties and observers to the Kyoto Protocol cannot read the document in their native language. *See id.*

mines or in the ocean.[269] The carbon market creates an opportunity to radically alter forest management and improve livelihoods in rural areas of developing countries.[270] Forest preservation is most valuable in the tropics, as forests in snowy climates can retard the reflection of warmth by snow cover.[271] Forest preservation plays a critical role in mitigating climate change.[272] Annually in the world, about 32 million acres (13 million hectares) of forest are destroyed and not replanted.[273]

The net concentration of CO_2 in the environment is a function not only of the output of CO_2, but the conversion of CO_2. Up to 20% of annual greenhouse gases (GHGs) are linked to deforestation.[274] That conversion is accomplished by the plant canopy. Leading carbon scientists have submitted that the way to reduce carbon concentrations to even 90% of current levels is to adopt "forestry practices that sequester carbon" or there will be "irreversible catastrophic effects."[275]

To illustrate the importance of forest preservation and replanting/afforestation, the United States estimates that in 2006 it had 7054 million metric tons of carbon dioxide-equivalent (CO_2e) emissions, but that carbon sinks absorbed or converted approximately 900 million metric tons of these CO_2es, reducing the total to 6170 net million metric tons of emissions.[276] The carbon stored in the existing forests of the contiguous forty-eight states equal about twenty years of industrial carbon emissions in the United States.[277]

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[269] *See generally* Sangyong Lee et al., *CO_2 Hydrate Composite for Ocean Carbon Sequestration*, 37 Env't Sci. & Tech. 3701, 3701 & nn.2–9 (discussing the potential to store CO_2 emissions in the world's oceans and other large bodies of water); U.S. Envtl. Prot. Agency, Underground Injection Control Program, http://www.epa.gov/ogwdw000/uic/index.html (last visited Feb. 3, 2010) (providing links to information of underground sequestration and the EPA's efforts to regulate such underground injection).

[270] El-Ashry, *supra* note 60, at 3.

[271] *See* Ken Caldeira, *When Being Green Raises the Heat*, N. Y. Times, Jan. 16, 2007, at A21; *see also* Michael Specter, *Big Foot: In Measuring Carbon Emissions, It's Easy to Confuse Morality and Science*, New Yorker, Feb. 25, 2008, at 44, 52 (discussing the dangers of tropical deforestation).

[272] *See* Kenneth Richards et al., Pew Ctr. on Global Climate Change, Agricultural & Forestlands: U.S. Carbon Policy Strategies, at iv (2006), *available at* http://www.pewclimate.org/docUploads/Agricultural%20and%20Forestlands-U.S.%20Carbon%20Policy%20Strategies.pdf; Specter, *supra* note 271, at 52.

[273] Arthur Max, *Deal Struck on Forest in Climate Talks*, Associated Press, Dec. 10, 2008.

[274] Dean Scott & Eric Lyman, *Negotiators Finalize Measure on Forests, Fund for Adapting to Global Warming Effects*, 38 Env't Rep. (BNA) 2699 (Dec. 21, 2007).

[275] *See Target CO_2.*, *supra* note 32, at 229.

[276] U.S. Envtl. Prot. Agency, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2006 ES-6 tbl.ES-2 (2008).

[277] *See* Ann Ingerson & Wendy Loya, The Wilderness Soc'y, *Measuring Forest Carbon: Strengths and Weaknesses of Available Tools*, Sci. & Pol'y Brief, Apr. 2008, at 1, 8, *available at* http://wilderness.org/content/measuring-forest-carbon.

Deforestation accounts for 18–25% of global carbon emissions.[278] A World Bank report in 2007 found that 83% of Indonesia's annual GHG emissions and 60% of Brazil's GHG emissions come from the destruction of their forests.[279] Collectively, these emissions account for almost 10% of the world's total emissions of GHGs.[280] Deforestation destroys forests equal to the size of Portugal each year, and the resulting change in land use accounts for 18% of global GHG emissions.[281] Half of this destruction is from illegal logging that is not effectively policed.[282]

Yet, the Kyoto Protocol does not recognize this reality. Under Kyoto, offset carbon credits can be obtained for planting trees but not for preserving existing forests even though these existing forests are life's buffer against global warming.[283] A new Australian study claims that natural forests are 60% more efficient in mitigating CO_2 than replacement forests.[284] So perhaps preservation of forests, which is not eligible to create any credits under either Kyoto or the Regional Greenhouse Gas Initiative (RGGI), are more critical than afforestation of new areas, which are eligible.[285] If so, there is a significant carbon

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[278] Andrew W. Mitchell et al., Global Canopy Programme, Forests First in the Fight Against Global Climate Change 1 (2007).

[279] *See* Agus P. Sari et al., PT. PEACE, World Bank, Indonesia and Climate Change: Current Status and Policies 2 & tbl.1 (2007), *available at* http://siteresources.worldbank.org/INTINDONESIA/Resources/Environment/ClimateChange_Full_EN.pdf (summarizing GHG emissions from Indonesia and Brazil).

[280] *See* Mongabay.com, Indonesia is Third Largest Greenhouse Gas Producer Due to Deforestation, http://news.mongabay.com/2007/0326-indonesia.html (last visited Feb. 10, 2010); SciDev.net, Brazil in Top Ten for Greenhouse Gas Emissions (July 22, 2004), http://www.scidev.net/en/news/brazil-in-top-ten-for-greenhouse-gas-emissions.html; *see also* Synthesis Report, *supra* note 2, at 5 tbl.SPM.3.

[281] Global Leadership for Climate Action, Carbon Sinks, http://www.globalactionnow.org/index.php?option=com_content&task=view&id=28&Itemid=61 (last visited Feb. 10, 2010).

[282] *See* Envtl. Investigation Agency, Indonesia's Illegal Logging Crisis (Sept. 12, 2005), http://www.eia-international.org/cgi/background/background.cgi?t=template&a=24; *see also* Colin Sullivan, *Leaders from Indonesia, Brazil Join 3 U.S. States in Deforestation Accord*, N.Y. Times, Oct. 2, 2009, http://www.nytimes.com/cwire/2009/10/02/02climatewire-leaders-from-indonesia-brazil-join-3-us-stat-93701.html.

[283] *See* Michael Perry, *Untouched Forests Store 3 Times More Carbon*, Reuters, Aug. 4, 2008, http://www.reuters.com/article/latestCrisis/idUSSP255954.

[284] *Id.*; *see also Growing Forestry Offsets*, Carbon Control News, Aug. 11, 2008 (LEXIS).

[285] *See* Perry, *supra* note 283; *Growing Forestry Offsets*, *supra* note 284. Some Kyoto CDM CERs related to forestry projects are deemed temporary for a period up to sixty years, subject to verification—which occurs every five years—that burning or logging will not later release carbon from the forest. UNFCCC, Montreal, Can., Nov. 28–Dec. 10, 2005, *Report of the Conference of the Parties Serving as the Meeting of the Parties to the Kyoto Protocol*, 61, U.N. Doc. FCCC/KP/CMP/2005/8/Add.1 (Mar. 30, 2006); Seb Walhain, *Carbon Trading –*

sequestration loss once original natural forest is destroyed and replaced with new afforestation acreage.

Efforts of some developing countries to include avoiding deforestation as a CDM project was tabled in 2005 meetings, and not resolved at the Bali Kyoto meetings in late 2007.[286] Kyoto parties have tabled until 2012 conservation of forests. Consequently, the most cost-effective solution in developing countries is off the Kyoto table.

No credit of any kind is given to developing countries—or any countries for that matter—for preserving forest. Leading up to Kyoto, developed nations objected to such credit, arguing that it would be difficult to monitor and measure the amount actually preserved, as well as to ensure that preservation would endure over time.[287] There is no effective enforcement or incentive for the protection of forest cover.[288] This is something that many developing nations have in abundance—especially Brazil and Indonesia with the world's two largest rain forests—yet are not protecting. Thankfully, some modest demonstration programs on preserving forests were finally launched in 2008.[289]

For forestation projects, the integrity and credibility of offsets is one of the controversial issues.[290] Whether the forestation is "additional," monitored, and verified are issues as well. Legal additionality goes to the issue of whether the project would have happened anyway without qualifying as an offset.[291] In the RGGI scheme, only afforestation on land that has not been a forest for at least 10 years and is covered by a permanent conservation easement counts for creating an offset.[292]

Effective adaptation of forests, agriculture, and water resources will require the broad planning and regulatory capacity of a range of ministries in developing countries. Enhancements of these capabilities will require aid for international frameworks.

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the View from the Floor, *in* Climate Change: A Guide to Carbon Law and Practice, *supra* note 111, at 87, 96–97 tbl.2.

[286] Richards et al., *supra* note 272, at 13; Scott & Lyman, *supra* note 274, at 2699; *see* Dean Scott & Leora Falk, *Sensenbrenner Applauds Bali Agreement; Connaughton Defends U.S. Action at Meeting*, 38 Env't Rep. (BNA) 2700 (Dec. 21, 2007).

[287] Scott & Lyman, *supra* note 272, at 2699; *see* Scott & Falk, *supra* note 286, at 2700.

[288] Scott & Lyman, *supra* note 272, at 2699.

[289] *See id.*

[290] *Forestry CO_2 Offsets*, Carbon Control News, July 21, 2008 (LEXIS).

[291] *Id. See generally* Ferrey, *supra* note 83 (providing a more detailed discussion of additionality).

[292] RGGI Model Rule, § XX-10.5(c)(1)(i), (2)(iii) (2008).

B. *Black Carbon: A Chemical of Concern That Is Ignored by the Kyoto Protocol*

As set forth earlier, the Kyoto Protocol does not include all key warming chemicals.[293] Black carbon (BC) particulate emissions have recently been identified as the second most important climate changing agent, trapping heat as an aerosol, and changing the albedo of snow and ice.[294] "[E]missions of black carbon are the second strongest contribution to current global warming, after carbon dioxide emissions," according to Dr. V. Ramanathan and Dr. G. Carmichael.[295]

BC, also known as soot, is a significant but underappreciated GHG emission of concern. BC is an important warming chemical, particularly in the Arctic and the Himalayas, that has an especially pronounced effect on the loss of the west Antarctic ice sheets.[296] According to Dr. James Hansen and Dr. Larissa Nazarenko "Soot deposition increases surface melt on ice masses, and the meltwater spurs multiple radiative and dynamical feedback processes that accelerate ice disintegration."[297]

If Dr. Hansen and Dr. Nazarenko's assertion is true, the irony is that the two most important chemical emissions affecting warming are not covered by the Kyoto Protocol or other international global warming regulation mechanisms. The most significant global warming gas, water vapor,[298] is not covered under any global warming regulatory schemes.[299] BC is not covered in any way under the Kyoto Protocol, nor

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[293] *See supra* Part II.A (discussing the chemicals covered by Kyoto).

[294] James Hansen & Larissa Nazarenko, *Soot Climate Forcing via Snow and Ice Albedos*, 101 Proc. Nat'l Acad. Sci. 423, 423 (2004); Veerabhadran Ramanathan & Gregory R. Carmichael, *Global and Regional Climate Changes Due to Black Carbon*, 1 Nature Geoscience 221, 221 (2008).

[295] Ramanathan & Carmichael, *supra* note 294, at 221. Other scientists estimate that BC may be second only to CO_2 in its contribution to climate change. *See, e.g.*, Tami C. Bond & Haolin Sun, *Can Reducing Black Carbon Emissions Counteract Global Warming*, 39 Envtl. Sci. & Tech. 5921, 5921 (2005) ("BC is the second or third largest individual warming agent, following carbon dioxide and methane."); James Hansen, *A Brighter Future*, 52 Climatic Change 435, 435 (2002).

[296] Ramanathan & Carmichael, *supra* note 294, at 221.

[297] Hansen & Nazarenko, *supra* note 294, at 427–28 ("The soot effect on snow albedo may be responsible for a quarter of observed global warming.").

[298] Tapio Schneider et al., *Water Vapor and the Dynamics of Climate Changes*, 47 Rev. of Geophysics (forthcoming 2010), *available at* http://www.gps.caltech.edu/~tapio/papers/revgeophys09.pdf.

[299] Kyoto Protocol, *supra* note 77, Annex A. Nitrogen trifluoride, an industrially manufactured synthetic gas that is used to make plasma screens and flat panel televisions, is yet another highly potent warming gas that is not regulated by any international carbon restriction laws even though it may trail only after sulfur hexafluoride in potency. Michael J. Prather & Juno Hsu, *NF3, the Greenhouse Gas Missing from Kyoto*, 35 Geophysical Res. Letters L12810, L12810 (2008).

did it appear on the 2007 Kyoto Protocol Bali agenda for future reforms.[300]

However, the omission of BC is of particular significance: regulation of BC, "particularly from fossil fuels, is very likely to be the fastest method of slowing global warming" in the immediate future.[301] According to Dr. Mark Jacobson, Professor of Civil and Environmental Engineering at Stanford University, major cuts in soot emissions could slow the effects of climate change for ten to twenty years, giving policymakers more time to address CO_2 emissions.[302] This is an extension of global warming tools that policymakers will require given the lack of progress on global warming during the decade immediately following the adoption of Kyoto.[303] Dr. Jacobson states that BC from fossil fuel and biofuel soot "may contribute to about 16% of gross global warming . . . but its control in isolation could reduce 40% of net global warming" minus cooling from all negative radiative forcings (for example, sulfates).[304] What makes this complex to factor into the GHG equation is that reducing aerosols that are not BC could actually increase global temperatures by up to 2.4°C.[305]

Of the BC emissions total, about 20% of BC is emitted from burning biofuels, 40% from fossil fuels, and 40% from open biomass burning.[306] Ramanathan and Carmichael estimate that "[p]roviding alternative energy-efficient and smoke-free cookers and introducing transferring technology for reducing soot emissions from coal combustion in small industries could have major impacts on the radiative forcing due to soot."[307] Simultaneously, reducing BC emissions could save up to 3 million lives a year that otherwise would be lost to air pollution.[308]

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[300] *See generally* Mark Z. Jacobson, *Control of Fossil-Fuel Particulate Black Carbon and Organic Matter, Possibly the Most Effective Method of Slowing Global Warming*, 107 J. of Geophysical Res. 16-1 (2002) (discussing Kyoto's failure to regulate BC and the potential benefits of doing so).

[301] *EPA Carbon Black and Global Warming: Hearing Before the H. Comm. on Oversight & Government Reform*, 110th Cong. 12 (2007) (prepared statement of Mark Z. Jacobson, Professor of Civil and Environmental Engineering, Stanford University), *available at* http://oversight.house.gov/images/stories/documents/20071127165326.pdf [hereinafter Jacobson Testimony].

[302] *Id.* at 12–13; Ramanathan & Carmichael, *supra* note 294, at 226 (noting that controlling BC emissions "offers an opportunity to mitigate the effects of global warming trends in the short term").

[303] *See supra* Part II.

[304] Jacobson Testimony, *supra* note 301, at 12–13.

[305] Ramanathan & Carmichael, *supra* note 294, at 226.

[306] *Id.* at 221.

[307] *Id.* at 226.

[308] *See* Jacobson, *supra* note 300, at 16–19.

Today, unlike the policy focus on CO_2, the overwhelming majority of BC emissions is from developing countries[309] and is expected to increase.[310] The largest sources of ambient BC emissions are in Asia, Latin America, and Africa.[311] China and India alone account for 25–35% of total global BC emissions,[312] with emissions from China doubling from 2000 to 2006.[313] The BC concentration hotspots include "the Indo-Gangetic plains in South Asia; eastern China; most of Southeast Asia including Indonesia; regions of Africa between sub-Sahara and South Africa; Mexico and Central America; and most of Brazil and Peru in South America."[314] As a whole, these regions of the world are home to 3 billion people, representing half the world's population.[315]

In contrast to the developing world, "developed nations have reduced their black carbon emissions from fossil fuel sources by a factor of 5 or more since the 1950s."[316] Attention on the power generation sector in Asia would be one of the most cost-effective ways to reduce BC emissions of.[317] But here, tools addressing BC emissions are not contained in Kyoto. Developing countries have not made this transition, and will not do so quickly without mechanisms in the international legal protocols.[318]

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[309] *See EPA Carbon Black and Global Warming: Hearing Before the H. Comm. on Oversight & Government Reform*, 110th Cong. 34 fig.1 (2007) (prepared statement of Tami Bond, Assistant Professor of Civil Engineering, University of Illinois at Urbana-Champaign), *available at* http://oversight.house.gov/images/stories/documents/20071127165326.pdf (illustrating greater emissions of BC in areas like East Asia, South America, and western Africa).

[310] *See* Jacobson Testimony, *supra* note 301, at 19–20 & tbl.6.

[311] Tami Bond, Summary of Presentation at Air Pollution as a Climate Forcing: A Workshop: Summary C. Aerosols (James E. Hansen ed., Apr. 29-May 3, 2002), *available at* http://www.giss.nasa.gov/meetings/pollution2002.

[312] Ramanathan & Carmichael, *supra* note 294, at 226.

[313] *Id.*

[314] *Id.* at 221.

[315] *Id.*

[316] *EPA Carbon Black and Global Warming: Hearing Before the H. Comm. on Oversight & Government Reform*, 110th Cong. 4 (2007) (prepared statement of V. Ramanthan, Victor Alderson Professor of Applied Ocean Sciences & Distinguished Professor of Climate and Atmospheric Sciences, University of California-San Diego), *available at* http://oversight.house.gov/images/stories/documents/20071018110734.pdf.

[317] *See* Marcel De Armas & Maria Vanko, *Mitigating Black Carbon as a Mechanism to Protect the Arctic and Prevent Abrupt Climate Change*, Sustainable Dev. L. & Pol'y, Spring 2008, at 41, 42.

[318] *Id.*

IV. The Essential New International Role

A. *The Point in Time*

Since greenhouse gases (GHGs) emitted anywhere migrate and result in the warming of the entire Earth,[319] their impacts are not limited to local environments but are global in scope.[320] This is contrary to many conventional pollutants that are regulated because their emissions have a significant impact on the ambient air quality of the immediately surrounding environment.[321] The critical role for developing nations as they quickly increase electrification for their populations is their potential to develop renewable resources and to shift their resource bases as they rapidly expand their electricity generation capacity and electrify over the next decade and beyond.[322]

Unlike fossil fuels, renewable resources are widely disseminated across the globe. While many nations—particularly developing nations—do not have significant fossil fuel reserves do not have significant reserves of oil, coal, or natural gas, every nation has significant renewable energy in some form: hydropower, sunlight, wind, agricultural biomass waste, wood, ocean wave power, etc.[323] But unless Kyoto, or similar international mechanisms, promotes these technologies, developing nations will not deploy these options, which are often more expensive to implement.[324] They will instead opt to burn coal and other fossil fuels.

This technology choice is critical in developing nations. The world stands at a crossroad in time because in the next decade there will be a massive investment in electrification of developing nations.[325] During the next decade, developing nations will choose whether to deploy

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[319] *See* Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act, 74 Fed. Reg. 66,496, 66,537 n.36 (Dec. 15, 2009) (to be codified at 7 C.F.R. ch. 1) (defining well mixed gases as "gases [that] are sufficiently long-lived in the atmosphere such that, once emitted, concentrations of each gas become well mixed throughout the entire global atmosphere").

[320] *See* Richard L. Revesz, *Federalism and Interstate Environmental Externalities* 144 U. Pa. L. Rev. 2341, 2349–53 (1996); Terence Chea, *A Borderless Byproduct of Growth*, L.A. Times, July 30, 2006, at B9, *available at* http://articles.latimes.com/2006/jul/30/news/adme-pollute30.

[321] *See generally* Steven Ferrey, Environmental Law: Examples and Explanations (5th ed. 2010) (discussing environmental law in the United States that targets local air pollution by imposing state and local ambient air quality standards).

[322] *See* Energy Info. Admin., U.S. Dep't of Energy, DOE/EIA-0484, International Energy Outlook 2004, at 1 fig.3 (2004).

[323] *See* Ferrey, *supra* note 74, § 2:11.

[324] *See supra* Part II.D.

[325] *See supra* Part I.B.

conventional fossil-fuel fired or sustainable renewable options to generate electricity. Once installed, those facilities will remain in place and contribute—or not so contribute—to global warming for about forty years or more. Choices in energy technology made now certainly will be the signature of our carbon footprint during the crucial period of the next half century, during which global warming may pass the point of no return.[326]

B. *The Critical International Agency Role*

1. The Role of International Multilateral Agencies

The World Bank Group is a specialized agency of the United Nations and is a conglomeration of multiple entities,[327] including:

- International Bank for Reconstruction and Development (IBRD),
- International Development Agency (IDA),
- International Finance Corporation (IFC),
- Multilateral Investment Guarantee Agency (MIGA),
- Prototype Carbon Fund (PCF).[328]

Each World Bank agency specializes in the financing of different aspects of projects based primarily on the type of financing provided. The World Bank Group is funded primarily through borrowings on the international capital markets and is one of the largest sources of financing for energy sector projects in developing countries.[329] The cumulative lending of the first four World Bank entities is about $500 billion, with current annual lending of about $23 billion.[330]

As of June 2007, IBRD has provided approximately $433 billion in cumulative lending.[331] In 2007, IBRD provided a total of $12.8 billion

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[326] *See* McKibben, *supra* note 34 (quoting NASA's James Hansen on the necessity of a radical carbon transformation by 2015).

[327] *See* World Bank, About Us: Members, http://go.worldbank.org/Y33OQYNE90 (last visited Feb. 10, 2010).

[328] World Bank, Prototype Carbon Fund, http://wbcarbonfinance.org/Router.cfm?Page=PCF (last visited Feb. 10, 2010).

[329] World Bank, The World Bank Guarantee: Catalyst for Private Capital Flows 1 (1997) [hereinafter World Bank Guarantee Catalyst].

[330] Uwe Fritsche & Felix Matthes, Changing Course: A Contribution to a Global Energy Strategy 41 tbl.3 (2003).

[331] The World Bank, IBRD and IDA Cumulative Lending by Country, as of June 30, 2007 (2007), http://go.worldbank.org/0IMBYAQBZ0.

in financing to 112 different projects.[332] Of this, IBRD, in conjunction with IDA, spent more than $1.7 billion on energy infrastructure and service development.[333] Moreover, the World Bank spent $2.7 billion funding legal and policy reforms.[334] IBRD and IDA energy and mining sectors investments in South Asia and East Asia are shown in Table 2.

Table 2: World Bank Lending to Energy & Mining Sectors in East Asia/Pacific and South Asia from 1994 to 2003 (in millions of dollars)

Location	2002	2003	2004	2005	2006	2007
East Asia	314.5	254.3	67.2	359.1	425.2	118.5
South Asia	504.8	150.6	130.8	83.6	483.0	243.7

World Bank, The World Bank Annual Report 2007, at 35 tbl.2.2, 39 tbl.2.3 (2007).

IDA was created by the World Bank in 1960, and it currently has 169 member countries.[335] IDA is supported by governmental contributions and provides interest-free credits and grants to countries with the lowest levels of per capita income.[336] In fiscal year 2009, IDA commitments totaled $14 billion, 18% of which was provided on grant terms.[337] "Since its inception, IDA credits and grants have totaled []$207 billion, averaging []$12 billion a year in recent years and directing the largest share, about 50 percent, to Africa."[338]

MIGA was created in 1988 as a member of the World Bank Group to promote foreign direct investment into emerging economies to support economic growth, reduce poverty,[339] and improve people's lives.[340] MIGA began operations in 1988 as an independent branch of the World Bank Group and has supported various projects in twenty-seven African countries.[341] MIGA instruments provide equity financing, usu-

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[332] World Bank, The World Bank Annual Report 2007, at 10, 59 (2007), *available at* http://siteresources.worldbank.org/EXTANNREP2K7/Resources/English.pdf [hereinafter World Bank Annual Report 2007].

[333] *See id.* at 55 tbl.3.1 (this figure represents the spending by both IBRD and IDA).

[334] *Id.*

[335] The World Bank Int'l Dev. Ass'n, What is IDA?, http://go.worldbank.org/ZRAOR8IWW0 (last visited Feb. 10, 2010).

[336] *Id.*

[337] *Id.*

[338] *Id.*

[339] For the fiscal year ending June 30, 2007, MIGA issued $1.4 billion in investment guarantees (insurance) for twenty-nine projects in developing countries. World Bank Group Multilateral Inv. Guarantee Agency [MIGA], 2007 Annual Report 2 tbl.1 (2007) [hereinafter MIGA 2007 Annual Report].

[340] *See* MIGA, About MIGA, http://www.miga.org/about/index_sv.cfm?stid=1736 (last visited Feb. 10, 2010).

[341] MIGA 2007 Annual Report, *supra* note 339, at 11.

ally in the form of political risk insurance, to insure against noncommercial risks in developing countries.[342] MIGA instruments can provide up to twenty-year coverage for certain risks,[343] including currency transfer restrictions, war and civil disturbance, expropriation, and breach of contract by the host government.[344] MIGA is willing to cover a variety of investments, including shareholder loans, loan guarantees by equity holders, and commercial bank loans.[345] In 2007, MIGA provided $1.4 billion in new guarantees.[346]

The IFC was founded in 1956 with the purpose of financing private sector projects and providing advisory services.[347] IFC currently is comprised of 182 member countries.[348] The IFC is legally and financially independent of the rest of the World Bank; however, it coordinates its activities with other Bank institutions. About 30% of its budget goes to the energy sector, with oil and gas projects commanding a significant portion of these expenditures.[349] As of 2008, the IFC is committed to scaling up its activities in renewable energy[350] and energy efficiency investments.[351] IFC has a unit within its infrastructure department that focuses on investments in renewable energy projects and other GHG-friendly technologies, and it is examining several pos-

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[342] *See* MIGA, Guarantees Overview, http://www.miga.org/guarantees/index_sv.cfm?stid=1509 (last visited Feb. 10, 2010) [hereinafter MIGA Guarantees Overview].

[343] MIGA, Terms and Conditions, http://www.miga.org/guarantees/index_sv.cfm?stid=1550 (last visited Feb. 10, 2010). "Since its inception in 1988, MIGA has issued 952 guarantees for projects in 100 developing countries, totaling $20.9 billion in coverage. 29.2 percent of MIGA's gross outstanding portfolio is in IDA-eligible (world's poorest) countries. MIGA's gross exposure stands at $7.3 billion." MIGA, Guarantees Projects, http://www.miga.org/guarantees/index_sv.cfm?stid=1546 (last visited Feb. 10, 2010).

[344] *See* MIGA Guarantees Overview, *supra* note 342.

[345] MIGA, Investment Guarantee Guide 4 (2006), *available at* http://www.miga.org/documents/IGG06+pa.pdf.

[346] World Bank Annual Report 2007, *supra* note 332, at 64.

[347] World Bank Int'l Fin. Corp. [IFC], About IFC, http://www.ifc.org/about (last visited Feb. 10, 2010).

[348] IFC, About IFC: Member Countries, http://www.ifc.org/ifcext/about.nsf/Content/Member_Countries (last visited Feb. 10, 2010).

[349] Fritsche & Matthes, *supra* note 330, at 43–44, 44 tbl.5.

[350] "The IFC has since revised its methodology so that it now identifies renewable energy and energy efficiency investments in commitments it has made in other sectors, such as agriculture, water supply, industry, and transport, and in corporate loans to financial intermediaries." IFC, Catalyzing Private Investment for a Low-Carbon Economy: World Bank Group Progress on Renewable Energy and Energy Efficiency in Fiscal 2007, at 49 (2007), *available at* http://siteresources.worldbank.org/INTENERGY/Resources/renewableenergy12407SCREEN.pdf.

[351] IFC, FY09–11 Business Plan and Budget 16 (2008).

sible wind power projects.[352] Private parties use IFC financing to gain access to new sources of funding. Sources of project financing provided by the IFC include long-term loans, equity investments, subordinated loans, guarantees, standby financing, and risk management.[353]

In 1999, shortly after the creation of the Kyoto Protocol, international agreement created the Prototype Carbon Fund ("PCF" or the "Fund").[354] PCF is a partnership of public and private stakeholders that share a vision of GHG reduction.[355] Participating governments include Finland, Canada, the Netherlands,[356] Norway, and Sweden.[357] Private participants include international financing institutions and international energy corporations.[358]

The purpose of the PCF is to help finance[359] and monitor programs[360] designed to reduce GHG emissions[361] and generate emissions

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[352] *See* IFC, Infrastructure: Power, http://www.ifc.org/ifcext/infrastructure.nsf/Content/Power (last visited Feb. 10, 2010).

[353] *See* IFC, The IFC Difference: 2001 Annual Report 22 (2001), *available at* http://www.ifc.org/ifcext/annualreport.nsf/AttachmentsByTitle/AR2001_English_Vol1/$FILE/AR2001_English_Vol1.pdf.

[354] Carbon Finance Unit, World Bank, Prototype Carbon Fund, http://go.worldbank.org/734QNOM2F0 [hereinafter World Bank PCF] (last visited Feb. 10, 2010).

[355] *See* Carbon Finance Unit, World Bank, About Prototype Carbon Fund, http://wb carbonfinance.org/Router.cfm?Page=PCF&FID=9707&ItemID=9707&ft=About (last visited Feb. 10, 2010).

[356] On May 7, 2002, the World Bank and the government of the Netherlands signed an agreement which established The Netherlands Clean Development Facility. *See generally* Carbon Finance Unit, World Bank, The Netherlands CDM Facility, http://wbcarbonfinance.org/Router.cfm?Page=NCDMF&FID=9711&ItemID=9711&ft=About (last visited Feb. 10, 2010).

[357] Carbon Finance Unit, World Bank, Annual Report 2008: Carbon Finance for Sustainable Development 23 (2008), *available at* http://wbcarbonfinance.org/docs/2008_Annual_Report_CF08_Final_printed_Low_Res_04-29-09.pdf.

[358] *Id.*

[359] Bank Info. Ctr. et al., How the World Bank's Energy Framework Sells the Climate and Poor People Short: A Civil Society Response to the World Bank's Investment Framework for Clean Energy and Development 12 (2006), *available at* http://www.bicusa.org/proxy/Document.9515.aspx. The Bank has become the largest public broker of carbon purchases, with up to $1 billion in its carbon credit portfolio. *Id.* The World Bank makes between 5–10% in commissions on all the carbon credits it purchases for the fund it administers, which has the potential to amount to a $100 million profit. *See id.*

[360] *See* Carbon Finance Unit, World Bank, Annex I, Document 6A, Prototype Carbon Fund 1, http://www.ambiente.gov.ec/WEB/Cambio%20Clim%E1tico%20en%20Ecuador/UCC/Anexo1/PCF%20(Anexo%201,%20Documento%206a).pdf (last visited Feb. 10, 2010). "A major emphasis will be directed at development of projects in the area of renewable energy technology such as, but not limited to, geothermal, wind, solar and small-scale hydro energy projects." *Id.* at 3.

[361] *See id.* at 1.

reduction credits,[362] which can be registered[363] pursuant to article 12 of Kyoto.[364] PCF creates a market in carbon credits that have traded at about $3–4/ton of CO_2 equivalents.[365] Most PCF funds have gone to Latin America, with only 7% to Central Asia, 2% to East Asia, 7% to South Asia, and 18% to Africa.[366]

PCF has approximately $247 million in active pipeline projects.[367] The Fund provides technical assistance[368] for countries developing

> For many decades, the World Bank's energy lending has focused on centralized, large-scale, grid-based thermal and hydropower projects and on the privatization of public power utilities. This report shows that in spite of many promises to "green" its energy lending over the past 15 years, the World Bank's energy sector portfolio still fails to reap the double dividend of renewable energy technologies that would fight both poverty and climate change. The Bank continues to invest $2 to $3 billion a year in greenhouse gas-producing energy projects, which fuel climate change and fail to help the world's poor. Financing for renewable energy projects makes up less than 5 percent of the Bank's overall energy financing [as of] fiscal year 2005.

BANK INFO. CTR. ET AL., *supra* note 359, at 12.

[362] *See* Press Release, World Bank, Prototype Carbon Fund Shows that Kyoto Protocol Works, (Nov. 2, 2001), *available at* http://go.worldbank.org/5DSI1BEWV0 ("One of the objectives of the $145 million Fund . . . is to demonstrate how [GHG] emissions reductions generated by CDM and JI projects can contribute to sustainable development and lower the cost of compliance with the Kyoto Protocol.").

[363] *See* Kyoto Protocol, *supra* note 77, art. 12. The Carbon Fund for Europe (CFE) "is designed to help European countries meet their commitments to the Kyoto Protocol and the European Union's Emissions Trading Scheme." Carbon Finance Unit, World Bank, Carbon Fund for Europe, http://go.worldbank.org/BAP5Z2LYQ0 (last visited Feb. 10, 2010). The CFE is a trust fund established by the World Bank in cooperation with the European Investment Bank (EIB). *Id.* "The Fund will purchase greenhouse gas emission reductions through the Kyoto Protocol's CDM and JI from climate-friendly investment projects from either bank's portfolio as well as from self-standing projects." *Id.*

[364] Kyoto Protocol, *supra* note 77, art. 12.

[365] *See generally* Point Carbon, Carbon, http://www.pointcarbon.com/productsandservices/carbon/ (last visited Feb. 10, 2010) (providing up to the minute pricing information related to carbon trades).

[366] FRITSCHE & MATTHES, *supra* note 330, at 60. It has funded wind, waste management, bagasse, biomass, energy efficiency, geothermal, small hydro, and photovoltaic technologies. *Id.*

[367] CARBON FINANCE UNIT, WORLD BANK, PCF PERFORMANCE 2003: PCF PORTFOLIO DEVELOPMENT 2 (2003), *available at* http://wbcarbonfinance.org/docs/PCF_AR033.html.

[368] *See* CARBON FINANCE UNIT, *supra* note 357, at 9.

> As a prototype fund, the PCF has a vastly diverse portfolio in terms of technology distribution. Renewable energy projects—including wind, hydro, geothermal, bagasse and biomass—dominate the portfolio, representing 37% of the value of the PCF's emission reduction purchases. The portfolio also includes emission reduction purchases from projects involved in HFC-23 destruction, coalmine methane, energy efficiency, waste management and land-use, land-use change and forestry . . . .

emissions trading programs pursuant to the Kyoto Protocol,[369] trebling its amount of technical training assistance in carbon financing.[370] The Fund will be extinguished once private sector markets develop.[371] "As a pilot activity, the PCF does not endeavor to compete in the emission reductions market; it is restricted to []$150 million and is scheduled to terminate in 2012."[372] For PCF, one means of reducing carbon emissions is paying for verified reductions in carbon emissions.[373] Payments are made specifically to projects that have executed emissions reductions contracts with PCF. As with all international financing transactions, PCF engages in risk management to ensure actual reductions and constant payment streams.[374]

The divisions of the World Bank cannot manufacture investments. All investments must be approved by and accepted by local state authorities in the host country.[375] The World Bank is not itself a governing body over nations, but rather a financial aid conduit for projects allowed by member developing nations. Currently, the World Bank is undergoing a shift in funding priorities with the emergence of world concern about global warming.[376] Nor is the World Bank designated as the primary or the only means of financing CDM projects. The World Bank has been responsible for about one-quarter of the approved protocols for CDM project development, so while a significant participant, these areas are not exclusively its province.[377] The World Bank Group

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Id. at 25.

[369] *See id.* at 9, 25–26.

[370] *See* World Bank PCF, *supra* note 354.

[371] *See id.*

[372] *Id.*

[373] Charlotte Streck, *New Partnerships in Global Environmental Policy: The Clean Development Mechanism*, 13 J. Env't & Dev. 295, 314 (2004).

> The PCF provides financial resources for projects that are intended to generate GHG emission reductions in return for the right to have transferred to PCF contributors, or so-called participants in the PCF, a pro rata share of the emission reductions, verified and certified in accordance with the Emission Reductions Purchase Agreement with the respective project sponsor.

Id.

[374] *See* World Bank, Annual Report 2007, *supra* note 332, at 22–23.

[375] *See* UNFCCC, About Clean Development Mechanism, http://cdm.unfccc.int/about/index.html (last visited Feb. 10. 2010).

[376] *See* World Bank, Annual Report 2007, *supra* note 332, at 19.

[377] *See generally* World Bank, The Role of the World Bank Group in Carbon Finance: A Role for Further Engagement (2006) (discussing the World Bank's efforts to respond to the global warming crisis).

has funded more than $6.3 billion in renewable energy projects since 1990.[378]

Nonetheless, the position of the World Bank as the primary international public sector lender is important. Its practices influence the lending of regional development banks around the world, national export banks in major developed countries, and private banks, which all underwrite and support infrastructure development.[379] More than 80% of project financing in developing countries is provided by private banks which have adopted the Equator Principles[380] for lending, and which look for guidance to the World Bank.[381] What the World Bank does and supports is a critical key starting point.

2. International Agency Criticism

The efforts of international agencies regarding carbon reduction have come under recent criticism. House Financial Services Chairman, Barney Frank, voiced concern about the World Bank's fitness to administer a clean technology fund.[382] Environmental group Friends of the Earth (FOE) criticized the World Bank as devoting only 6% of its total funds to new renewable technologies (including small hydro but excluding conventional, larger hydro) in 2006.[383] FOE is concerned that these funds will be used to fund more large, centralized fossil fueled-fired power plants rather than "transform energy systems and . . . effectively provide clean energy to the 1.6 billion people in the world who lack access to energy."[384]

A 2008 critique by the Institute for Policy Studies (the "Institute's 2008 Report") criticized the World Bank carbon finance efforts as

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[378] Anil Cabraal, Lead Energy Specialist, Energy & Water Dep't, The World Bank, Presentation at Deutsche Gesellschaft für Technische Zusammenarbeit, Towards a Renewable Energy Future: A World Bank Plan for Action 6 (Oct. 20, 2004).

[379] *See* Daphne Wysham, *Carbon Rush at World Bank*, Asia Times (Hong Kong), Feb. 26, 2005, http://www.atimes.com/atimes/Global_Economy/GB26Dj03.html.

[380] *See generally* The Equator Principles, The "Equator Principles," http://www.equator-principles.com/principles.shtml (last visited Feb. 10, 2010) (providing background on the equator principles, which are a financial industry benchmark for determining, assessing and managing social & environmental risk in project financing).

[381] *Id.*

[382] *Obama Funds Bush Initiative for World Bank 'Clean' Energy Projects*, Carbon Control News, May 11, 2009 (LEXIS).

[383] Oilchange Int'l & Friends of the Earth, The World Bank's Climate Investment Funds: Still Fueling Global Warming 1 (2008), *available at* http://www.foe.org/pdf/CIF_Factsheet.pdf.

[384] *Id.*

"dangerously counter-productive."[385] The Institute charged the World Bank with making business-as-usual look environmentally friendly.[386] The report alleged that by the end of 2007, less than 10% of the Bank's carbon offset money went toward renewable energy projects of ten megawatts (MW) or less.[387] Therefore, the critics' concern is partly on wanting smaller projects funded, as well as including more renewable projects in the mix.

Some of this expenditure pattern reflects the very structure of the Kyoto cap-and-trade system. Kyoto does not fundamentally change capital expenditures on power generation, either in the thirty-five Annex I nations which are covered by carbon caps, nor in the other 165 nations of the world that are not covered by Kyoto's cap.[388] There is no specific provision for the power generation sector.[389] Kyoto does not specifically address the need to shift to greater reliance on non-fossil-fuel sources of power generation.[390] Rather, it attempts to set national carbon allowances for larger monitored sources in about thirty-five voluntarily participating developed countries and allows additional credits to be generated for, or sold to, these sources by offsetting carbon through various additional voluntary CDM projects in developing nations.[391]

The Institute's 2008 Report criticizes the CDM as resulting in enormous potential profits for investors in CDM projects, and resulting in little renewable energy investment.[392] The report charges that the adopted CDM carbon trading mechanism was a variation on Brazil's original proposal, as thereafter modified by the United States delegation, where the United States eventually did not adopt the Kyoto Protocol.[393] This power generation capital stock significantly determines the long-term concentrations of atmospheric carbon.[394]

The Institute's 2008 Report also claims that the World Bank, acting pursuant to Kyoto, will use money supplied by donor countries in the

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[385] *See* Janet Redman, Sustainable Energy & Econ. Network, Inst. for Policy Studies, World Bank: Climate Profiteer 24–25 (2008).

[386] *See id.* at 7.

[387] *Id.* at 24–25.

[388] *See* Kyoto Protocol, *supra* note 77, art. 2 (describing objectives of the agreement).

[389] *See id.*

[390] *See id.* arts. 2 & 10 (referring to sustainable development but not specifically pushing for shift to renewable power generation).

[391] *See id.* art. 12.

[392] *See* Redman, *supra* note 385, at 14–15.

[393] *Id.*; *see* Parts I–II.

[394] Redman, *supra* note 385, at 3.

Northern Hemisphere to fund ecologically destructive industries in the Southern Hemisphere.[395] This flow of cash is from developed nations to developing nations, either through Kyoto, World Bank, private, or other mechanisms. Ultimately, only thirty-five Kyoto Annex I countries, among 200 countries in the world, are affected by, or finance, CDM projects in developing countries.[396] The report claims that this mechanism has little transparency in funding carbon credits, while other international funds actually finance carbon "debits" associated with $1.5 billion in multilateral loans that the report identifies as for fossil-fuel-fired "destructive" investments between 2005 and 2007.[397]

CDM projects to date have focused on increasing the number of CERs created for investors, rather than focusing on renewable energy projects and sustainable alternatives in developing countries.[398] This creates an incentive for both host CDM countries and CDM investors to inflate the number of CERs created.[399] Questions have been raised as to whether the Kyoto Executive Board and panels are able to correctly police the incentive to inflate CERs.[400] Moreover, the impact of CDM projects has not been to promote appropriate renewable investments in developing countries, but rather has only served to create additional credits for Annex I countries.[401]

There is no mandatory environmental or sustainability assessment in Kyoto projects or public input, which was rejected as an infringement on host country sovereignty.[402] The lack of massive renewable energy investments to date needed to shift the basis of power generation is documented.[403] The bulk of the CDM carbon credits in developing countries is emanating not from renewable projects, but from reduction of certain high-carbon chemical gases in countries like China.[404]

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[395] *See id.* at 4.

[396] *See* UNFCCC, Parties & Observers, http://unfccc.int/parties_and_observers/items/2704.php (last visited Feb. 10, 2010).

[397] Redman, *supra* note 385, at 3–4. The report cites the Tata Group 800 MW coal-fired project in Mundra, India, approved for $450 million in financing by the IFC, an affiliate of the World Bank, in 2008. *Id.* at 16–17. It also cites the investment of the project in importing Indonesian coal, rather than local Indian coal, to fuel this facility. *Id.* The World Bank elected not to implement 2004 recommendations that by 2008, it exit support of traditional coal-fired extraction. *See id.*

[398] Voigt, *supra* note 189, at 15.

[399] *Id.*

[400] *Id.* at 16.

[401] *See id.* at 18.

[402] *Id.* at 20.

[403] *See* Voigt, *supra* note 189, at 15.

[404] *See id.* This includes reductions of HFC-23 and other gases that are by-products of the manufacture of other potential GHGs. *Id.*

World Bank data shows that more than two-thirds of its carbon reduction achievements have involved HFC-23.[405] However, when adding expenditures of the PCF and other multilateral financing mechanisms, critics still charge that only 10–15% of total investments have been in renewable energy, and international agency renewable energy investments are designed to achieve only about 5% of total GHG reductions, with a funding emphasis instead on nitrous oxide and HFC reduction[406] from chemical plants in developing countries.[407]

The multilateral international agencies point to progress in addressing global warming. According to a 2007 report from the United Nations Environment Programme, investment capital flowing into renewable energy worldwide climbed from $80 billion in 2005 to $100 billion in 2006.[408] Of contrasting note, the International Bank for Reconstruction and Development, the part of the World Bank dealing directly with developing country governments, itself has principally funded direct renewable energy projects rather than HFC-23 or coal mine methane projects.[409]

There are over 1000 CDM projects,[410] with twice that many in the project development pipeline.[411] The existing projects have generated 117 million issued CERs, with an estimated 2.6 billion CERs to be generated by 2012.[412] This would represent almost 10% of monitored emissions, which is a significant offset component relative to actual emissions. Each CER generated in a developing country increases the GHG emissions allowed in the Annex I country by the eventual owner of the CERs.[413]

According to former British Prime Minister Tony Blair, "[t]he UNFCCC [the U.N. Kyoto Protocol mechanism] is charged with making the global deal" on carbon reduction and it must occur "under its

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[405] REDMAN, *supra* note 385, at 22–23.

[406] *Id.* at 26 (regarding the HFC-23 factory investment). The CDM Governing Board has restricted future eligible investments in HFC-23 factories built before 2004, but has not restricted investments in newer plants. *Id.* at 27.

[407] *Id.* at 24–25.

[408] Press Release, United Nations Environment Programme, Investors Flock to Renewable Energy and Efficiency Technologies (June 20, 2007), *available at* http://new.unep.org/Documents.Multilingual/Default.asp?DocumentID=512&ArticleID=5616&l=en.

[409] Bretton Woods Project, The World Bank and Energy (July 2, 2007), http://www.brettonwoodsproject.org/art-554244.

[410] U.N. News Centre, *UN-Backed Programme for Clean Energy Projects Passes 1000 Milestone*, U.N. DAILY NEWS, Apr. 14, 2008, at 10.

[411] Voigt, *supra* note 189, at 15.

[412] *Id.*

[413] *Id.*

authority."[414] World Bank CER acquisition activities have grown from the original PCF, created in 1999, to now ten additional carbon funds with a capitalization exceeding $2 billion.[415] These can provide up-front financing for CDM carbon reduction projects, and importantly, can reduce or mitigate regulatory uncertainty and risk of eventual U.N. credit certification, credit delivery, and political risk.[416] Since Kyoto, CDM CER offsets must be created in developing countries, and there is sovereign risk and commercial risk associated with these intangible items.[417] This is mitigated by the fact that this is overseen by U.N. designated authorities in each nation that hosts a CDM project.

3. Capital Flows and Necessary Power Infrastructure Changes

Much of this debate and criticism involves a difference in basic philosophy of how to control—and who should control—world capital flows. Ultimately, the reports criticize the Bank for wresting control of new investment mechanisms away from the countries where the CDM, or other investments will be made, and exercising certain controls with the financing.[418] However, developing nations and their industries are not regulated by existing Kyoto carbon controls; developed nations and their businesses are. The critics' reports charge that CDM projects financed with World Bank money have been slow.[419] The World Bank recently suggested forming a new expanded $5–10 billion clean technology fund, as well as a $500 million climate change adaptation fund.[420] This would dramatically elevate the scope of the financing for carbon programs. The G8 nations in mid-2008 pledged to provide $10 billion annually for a fund supporting clean energy technology deployment in developing nations.[421]

Forest protection at the international level has also been subject to criticism. Much of the current debate on forest protection focuses on who controls the money: the developed country fund donors, intermediary international funding agencies, or the indigenous people who

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[414] Blair, *supra* note 14, at 5.

[415] Christopher Carr & Flavia Rosembuj, *Structuring and Financing Projects*, *in* Climate Change: A Guide to Carbon Law and Practice, *supra* note 111, at 39, 40.

[416] *See id.* at 42–43.

[417] *See* Ferrey, *supra* note 74, § 3:10 (discussing sovereign and commercial risks in developing countries).

[418] Redman, *supra* note 385, at 5.

[419] *Id.* at 3, 22.

[420] *Id.* at 3, 38.

[421] Steven Cook & Toshio Aritake, *Leaders of Major Economies Fail to Agree on Greenhouse Gas Emissions Targets*, 39 Env't Rep. (BNA), 1380, 1381 (July 11, 2008).

reside in the areas where either forest is desired to be protected or carbon emissions capped.[422] Some criticize the World Bank's substantial efforts to fund forest preservation as benefiting private interests that preserve forests more than they preserve locally affected communities.[423] There were protests in late 2007 by developing countries and their citizens against the establishment of the World Bank-funded Forest Carbon Participation Project.[424] So while this is about carbon, it is also about control over decisions about world resources and projects.

Between 1990 and 2000, world foreign direct investment in all sectors of developing countries rose from $200 billion to $1.162 trillion.[425] The needs of countries outside the Organization of Economic Cooperation and Development will require an investment of some $2 trillion to install approximately 1900 gigawatts of new electric-generating capacity by 2025.[426]

Since 1997, when private investment in the power sector of developing countries peaked at $50 billion, private investment in power sectors of developing countries has fallen dramatically. In 2002, private investment was only $7 billion.[427] Similarly, over the last two decades, the World Bank Group's financial commitments to developing country energy sectors have significantly declined. Between 1990 and 1994, World Bank Group energy sector financing accounted for approximately 25% of the Bank's overall commitments. By 2001, however, the annual commitment percentage had fallen to less than 10% of overall financing.[428]

The decline in international financing is attributable to several factors. A majority of electric-sector investment during the early 1990s went to countries with favorable investment profiles (particularly Chi-

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[422] John Vidal, *U.N.'s Forest Protection Scheme at Risk from Organized Crime*, GUARDIAN (Manchester, U.K.), Oct. 6, 2009, at 22, *available at* http://www.guardian.co.uk/environment/2009/oct/05/un-forest-protection.

[423] *See* Chad Dobson, *Put the Brakes on the Bank: Carbon Finance in Indonesia*, HUFFINGTON POST, July 30, 2009, http://www.huffingtonpost.com/chad-dobson/put-the-brakes-on-the-ban_b_247882.html.

[424] Press Release, Global Justice Ecology Project, Groups Protest World Bank (Dec. 11, 2007), *available at* http://www.globaljusticeecology.org/pressroom.php?ID=175.

[425] U. N. DEV. PROGRAMME [UNDP], WORLD ENERGY ASSESSMENT: OVERVIEW 2004 UPDATE 39 (2004) [hereinafter 2004 WORLD ENERGY ASSESSMENT].

[426] FRITSCHE & MATTHES, *supra* note 330, at 30.

[427] ENERGY & MINING SECTOR BD., WORLD BANK GROUP, OPERATIONAL GUIDANCE FOR WORLD BANK GROUP STAFF: PUBLIC AND PRIVATE SECTOR ROLES IN THE SUPPLY OF ELECTRICITY SERVICES 2 (2004).

[428] Jamal Saghir, *Foreword* to ENERGY & MINING SECTOR BD., WORLD BANK GROUP, WORLD BANK GROUP'S ENERGY PROGRAM: POVERTY ALLEVIATION, SUSTAINABILITY, AND SELECTIVITY 2 (2001).

na, Brazil, independent power programs in East Asia, and the privatizations of state-owned utilities in Latin America),[429] where host governments had embraced market-based sector reform. However, some countries had difficulty sustaining the market reforms necessary for power sector commercial viability, making investors more cautious in financing transactions.[430] Investors were particularly discouraged by numerous instances where host governments failed to honor power purchase agreements (PPAs) or carry out promised market reforms. For example, in Indonesia the government defaulted on sovereign guarantees on two projects, resulting in a loss of $575 million to the project sponsors.[431] Ultimately, despite a ruling in its favor by the United Nations Commission on International Trade Law, the project sponsors recovered nothing from the Indonesian government.[432] The sponsors ultimately recovered $290 million under its U.S. political risk insurance policy, which American taxpayers ultimately paid for.[433]

During the 1990s, the World Bank Group decided that the private sector was the solution for energy investments. It made a structural readjustment of its lending policies, reducing the Bank's lending support for public sector energy projects from approximately 25% to less than 10%.[434] Other development banks followed suit.[435]

The April 2008 Bangkok talks—following up the December 2007 Bali round of talks—concluded that a post-2012 international carbon scheme should look much like the pre-2012 Kyoto regime, including trading of allowances and the creation of additional credits or offsets through the JI and CDM mechanisms.[436] This is not as much a statement of success of such programs to date, as a statement of hoped-for continuation of existing international carbon reduction methods.[437]

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[429] Ranjit Lamech & Kazim Saeed, World Bank Group, What International Investors Look for When Investing in Developing Countries: Results from a Survey of International Investors in the Power Sector 3 (2003); 2004 World Energy Assessment, *supra* note 425, at 39.

[430] *See* Energy & Mining Sector Bd., *supra* note 427, at 2.

[431] Ferrey & Cabraal, *supra* note 158, at 203.

[432] *Id.*

[433] *Id.*

[434] *See* Energy & Mining Sector Bd., *supra* note 428, at 2.

[435] This reduced funding and project guarantees have been traditionally available to public utilities. Moreover, the Bank's shift forced countries seeking to attract foreign investment to engage in market-based sector reforms. *See* Navroz K. Dubash, *The Changing Global Context for Electricity Reform*, *in* Power Politics: Equity and Environment in Electricity Reform 11, 17 (World Res. Inst. ed., 2002).

[436] Eric J. Lyman, *"Progress" of Bangkok Talks Shows Much Still to Be Done for 2009 Global Agreement*, 39 Env't Rep. (BNA) 704 (Apr. 11, 2008).

[437] *See id.*

The 2009 Copenhagen Conference showed more dissent than consensus on any future controls.[438] Indeed, the Kyoto Protocol does not show significant signs of being a technical success within the necessary time frames given the immense tasks at hand.[439]

Effective adaptation of forests, agriculture, and water resources will require the broad planning and regulatory capacity of a range of ministries in developing countries.[440] Enhancements of these capabilities will require aid for viable international frameworks.[441] Public finance is necessary to build human and institutional capacity in developing countries for carbon mitigation and adaptation.[442]

The key is formulating and implementing a workable and very prompt policy response in developing nations. Richard Bradley, division head at the International Energy Agency, Paris, at the Bali Kyoto conference concluded that "[f]ossil fuel will dominate the energy supply for the foreseeable future. Investors need an international cost-effective framework if energy climate change objectives are to be met."[443] "It is not yet possible to discern a human influence on the emissions pathway. Policy effort is insufficient."[444] Public finance and a workable renewable program template are necessary to build human and institutional capacity in developing countries for carbon mitigation and adaptation.[445] Fortunately, there is such a template—although not widely advertised—of how to accomplish a shift to renewable resources in developing countries.[446]

V. A Template for International Success: What Works in Developing Nations in Renewable Energy

Fortunately, there is an alternative course towards a win-win situation regarding global warming and renewable energy in developing nations. There is evidence of success in developing nations deploying renewable power.[447] Between 1993 and 2005, five nations in Asia were

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[438] *See* Lyman, *supra* note 180, at 110.

[439] *See* Lyman, *supra* note 436, at 704; *supra* Part I.

[440] El-Ashry, *supra* note 60, at 4.

[441] *See id.*

[442] *See id.* at 5.

[443] Richard A. Bradley, Head, Energy Efficiency & Env't Div., Int'l Energy Agency, Time is NOT on our Side: Climate Change Mitigation as an Investment Challenge (Dec. 13, 2007), *available at* http://www.iea.org/textbase/speech/2007/Bradley_IPCC_Bali_Side-Event2.pdf.

[444] *Id.*

[445] *See* El-Ashry, *supra* note 60, at 5.

[446] *See infra* Part V; *see also Power Paradox*, *supra* note 56, at 526–38.

[447] *See* Ferrey & Cabraal, *supra* note 158, at 67–74.

among the first to develop small power producer (SPP) programs to promote renewable energy development in their countries.[448] These programs create important models and lessons for the rest of the world.[449]

They have achieved in just a few years a substantial contribution from new renewable small power projects to their growing national energy supplies: almost 4%of power supply in Sri Lanka, India and Thailand are from SPP renewable energy initiatives.[450] These successes in Asia are the key to what can happen in developing countries. Approximately 60% of all new power generation capacity financed in developing countries is in Asia.[451] Therefore, how and what energy resources are deployed in Asia has long-term implications for global greenhouse gas (GHG) emissions and environmental integrity. These five Asian nations each have different governmental forms, and have different predominant fuel sources in their power generation bases such as hydro, coal, gas, and oil. While some of the national electric systems have an integrated high-voltage transmission system and others have a disintegrated or island system, there are key similarities:

- All are in need of long-term increases in power generation capacity (although Thailand has had a short-term surplus)
- All have the potential to utilize small-scale renewable energy options
- Each system employs either deliberately or de facto a standardized power purchase agreement (PPA), to put the investment deal together, although it is not necessarily a neutral or consensual document in all cases.[452]

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[448] *Id.* at 67.

[449] *Id.*

[450] *Id.*; *see* Elec. Generating Auth. of Thailand, Annual Report 2003, at 84–89 (2003) (providing statistics on the Thai program); World Bank, Report No. 16063-CE, Project Appraisal Document 1–5 (1997) (providing statistics on the Sri Lanka program); *see also* Bd. of Inv. of Sri Lanka, Invest in Sri Lanka, http://www.boi.lk/2009/pdf/incentives.pdf (last visited Feb. 10, 2010) (listing incentive investment details for Sri Lanka); Gov't of India, Ministry of New and Renewable Energy, http://www.mnes.nic.in (last visited Feb. 10, 2010) (reviewing programs, tender notices, and a series of reports on the India program).

[451] R. David Gray & John Schuster, *The East Asian Financial Crisis: Fallout for Private Power Projects*, Viewpoint, Aug. 1998, at 1, 1, *available at* http://rru.worldbank.org/documents/publicpolicyjournal/146gray.pdf.

[452] Ferrey & Cabraal, *supra* note 158, at 68.

Beyond these common elements, each system has important distinctions.[453] Each of these programs is built on prior successful experiences in the United States under the Public Utility Regulatory Policies Act requirements and/or other Asian countries that preceded the Act's effort.[454] Table 3 displays key comparative elements of program design and implementation in five of the Asian programs surveyed.[455] Of the columns in Table 3, the middle column is note worthy. It shows that two of the profiled programs subsidize renewable energy SPPs.[456] "Thailand does so by providing a project-specific subsidy through a competitive solicitation process. Andhra Pradesh, a state in India, does so by providing a tariff in excess of true avoided cost for renewable energy SPPs power sales."[457]

Table 3: Comparative Program Overview

Country Program	Year begun	Maximum size (MW)	Premium for renewable energy	Primary fuel	Eligible PPA solicitation
Thailand	1992	<60 or <90	Yes, competitive bid	Gas	Controlled period
Indonesia	1993	<30 Java <15 other island grids	No	Renewable Energy	Controlled period
Sri Lanka	1998	<10	No	Hydro	Open offer
India: Andhra Pradesh	1995	<20 Prior <50	Yes, in tariff	Wind	Open offer
India: Tamil Nadu	1995	< 50	No	Wind	Open offer

Steven Ferrey, *Power Paradox: The Algorithm of Carbon and International Development,* 19 Stan. L. & Pol'y Rev. 510, 527 (2008).

Table 4 displays salient comparative elements of PPA design and contractual entitlement in the renewable energy programs in these five Asian countries.[458]

[453] *Id.* at 69.

[454] *Id.* at 69; *see also Power Paradox, supra* note 56, at 526. *See generally* Ferrey, *supra* note 74, ch. 4 (detailing the PURPA experience in the United States).

[455] *Power Paradox, supra* note 56, at 526.

[456] *Id.* at 527; *see* Ferrey & Cabraal, *supra* note 158, at 69.

[457] *Power Paradox, supra* note 56, at 527; *see* Ferrey & Cabraal, *supra* note 158, at 69.

[458] *Power Paradox, supra* note 55, at 528.

Table 4: Comparative PPA Elements					
Country program	Standard PPA?	Maximum years	Third-party sales	Self-service wheeling	Net meter–banking
Thailand	Yes	20–25 firm 5 nonfirm	No, under consideration	No, under consideration	Yes, if <1 MW
Indonesia	Yes	20 firm 5 nonfirm	No	Yes	No
Sri Lanka	Yes	15	No	No	No
India: Andhra Pradesh	Not formally, but a de facto standardized form	20	No, previously allowed	Yes, but very expensive	Yes
India: Tamil Nadu	In development	5–15	No, previously allowed	Yes	Yes
Steven Ferrey, *Power Paradox: The Algorithm of Carbon and International Development,* 19 Stan. L. & Pol'y Rev. 510, 528 (2008).					

Several important lessons for small renewable program design and policy in developing nations are revealed by analyzing these programs in detail:[459]

- "A framework for structured SPP project development is necessary. SPPs do not spring fully born[e] from the existing electric sector-environments" in developing countries.[460] "A system of law, regulation, and utility interface" that facilitates orderly SPP development must exist.[461]
- "A transparent process is required to build investor, developer, and lender confidence."[462] This is particularly true if those investors are expected to be private parties and conventionally financed.
- "The single utility buyer of power in most of the electric sectors" of developing nations can more robustly and efficiently promote renewable SPPs, either by (a) "a program for purchase of all SPP power at its full value (avoided cost) to the wholesale system," and/or (b) "the introduction of some combination of third-party retail sales, net metering energy banking, or third-party wheeling."[463]

[459] *See* Ferrey & Cabrall, *supra* note 158, at 72.
[460] *Id.*
[461] *Id.*
[462] *Id.*
[463] *Id.* at 73.

- "In many systems, additional subsidies, . . . reflect[ing the] fuel diversity and environmental advantages, are used to assist higher-cost renewable energy and smaller SPP projects."[464]
- "Bidding can be strategically employed to minimize the ultimate system cost to the buyer" of power generated from renewable power resource development.[465]

These results in Asian countries demonstrate how renewable power development can be successful in developing countries. Many of the programs were implemented prior to Kyoto impacts and are separate from the CDM Kyoto program. Adding CDM to these programs would provide even greater incentives. So there is a model for successfully beginning the shift to a renewable power base in fast-electrifying developing nations.[466]

Conclusion: Final Thoughts on International Carbon

If the world misses or ignores these renewable energy opportunities in developing nations, it misses the opportunity to successfully curtail global warming. The combustion of fossil fuels generates 98% of anthropogenic carbon dioxide (CO_2) emissions, and CO_2 comprises 83% of greenhouse gas(GHG) emissions in the United States.[467] Between 1990 and 2008, 41% of CO_2 emissions are attributable to the electric power sector.[468] The sheer amount of CO_2 emitted into the environment is enormous, and once it is released into the atmosphere, CO_2 remains there for 100 years.[469] Global CO_2 emissions are rising at the rate of approximately 10% per year.[470]

Only the shift of the power generation base to a substantial noncarbon component can offer the potential to successfully deal with world GHG emissions. Developing nations will soon dominate GHG emissions and retain this position into the indefinite future. Given this, the proposed shift in the power generation base must succeed in devel-

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[464] *Id.*

[465] Ferrey & Cabrall, *supra* note 158, at 73.

[466] *See Power Paradox, supra* note 56, at 544.

[467] Energy Info. Admin., U.S. Dep't of Energy, EIA/DOE-0573 Emission of Greenhouse Gases in the United States 1998, at 13 (1999).

[468] Energy Info. Admin., U.S. Dep't of Energy, U.S. Carbon Dioxide Emissions from Energy Sources 2008 Flash Estimate 6 (2009), *available at* http://www.eia.doe.gov/oiaf/1605/flash/pdf/flash.pdf.

[469] *See* Purdy, *supra* note 43, at 22, 23 tbl.1.

[470] *See id.* at 23 tbl.1.

oping nations for the world to have an opportunity to substantially curtail GHGs worldwide.

While a successful model exists from programs apart from international legal mechanisms and programs—funded largely by the World Bank in developing nations in Asia and elsewhere—that aim to mitigate global warming, there needs to be a sustained push to implement these successful models more broadly in developing nations. International agencies, which finance or guarantee much of the financing of power projects in developing nations, have a critical role to play in the success of such efforts. However, the Kyoto Protocol, since enacted as an international legal protocol in 1997, does not speak a language amenable to developing nations.[471] It does not include developing nations in its coverage; it does not require any shift in power generation bases either in regulated developed countries or developing countries; and it does not deal with black carbon, the significant warming chemical emitted profusely in developing nations.

The current scientific consensus forebodes that changes in the international legal scheme must be implemented by 2015 or it may be too late.[472] Waiting until after 2012, as international regulatory mechanisms are, to make any changes in the current Kyoto legal scheme could be too little, too late. Middlebury College's William McKibben has illustrated, with reference to James Hansen—one of the world's leading climate scientists, that we either implement a lasting solution within the next five to ten years, or the battle may be lost forever.[473] Three years ago Hansen stated that "[w]e have at most ten years—not ten years to decide upon action, but ten years to alter fundamentally the trajectory of global greenhouse emissions."[474] This fundamental change is nowhere on the horizon of international mechanisms as they are now embodied in the Kyoto Protocol.

Power generation projects take years to develop and implement. Changes in international law effective after 2012 would not be implemented or serviceable on a widespread basis by 2015, given how little movement in the renewable generation base there has been since the

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[471] *See supra* Part III.

[472] *See generally* World Conference on Disaster Reduction, Kobe, Hyogo, Japan, Jan. 18–22, 2005, *Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters*, U.N. Doc. A/CONF.206/6 (Mar. 16, 2005) (discussing actions to be taken before 2015, including actions designed to address the consequences of climate change).

[473] *See* William McKibben, *How Close to Catastrophe?*, N. Y. Rev. of Books, Nov. 16, 2006, at 23, 23 (quoting climatologist James Hansen to the effect that we have only until 2015 to reverse carbon emissions or face radically changing the planet).

[474] Hansen, *supra* note 51, at 12, 16.

carbon reduction process was started in 1992 and the Kyoto Protocol enacted in 1997.[475] In fact, global carbon emissions have continued to climb every year at an increasing rate of gain.[476] A more urgent international implementation schedule is required; however, that schedule will only follow after legal creation of a concerted international agency role designed to curtail current trends in increasing carbon emissions and to provide technical assistance to more than 100 developing countries.[477] So the next two years are the period in which the world will cast its carbon future, and where goes carbon, goes global warming. As the poet Robert Frost wrote, "Some say the world will end in fire; some say in ice."[478] Either, he notes, "would suffice."[479]

[475] *See supra* Parts I–II.
[476] *See supra* Part I.
[477] *See supra* Parts III–V.
[478] FROST, *supra* note 1, at 220.
[479] *Id.*