Climate Change, Energy, and Developing Countries

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I. INTRODUCTION

Disruption of the global climate, driven by human activities, has emerged over the past few decades as a major issue of concern. It is now increasingly apparent that the impacts of a changing climate will be significant and widespread. At the same time, it is also clear that tackling the problem of rising greenhouse gas concentrations in the atmosphere will be an enormous undertaking. Given that carbon dioxide emissions from fossil-fuel combustion contribute significantly to the climate problem, many people in industrialized countries view the anticipated growth of fossil-fuel use in developing countries' energy sectors with grave concern. A few countries, the United States being a prominent example, have refused to undertake binding commitments to reduce their greenhouse gas (GHG) emissions in the absence of action by developing countries. At the same time, the growth of energy demand and use in developing countries is also seen as a significant driver of increasing stress on the global energy markets.

We believe that an analysis of the role of developing countries vis-à-vis the climate problem and the global energy situation must begin with an understanding of the role of energy in economic, social, and human development, which we briefly outline in the next section. We then discuss the current status of, and the trends in, the energy sector in developing countries and the major energy and climate-related challenges faced by these countries. We also discuss conflicts between these challenges and possible synergies between solutions to them. We end by discussing the interactions between energy and climate policies of developing and industrialized countries, and how the "global" debates on these issues are framed and viewed in industrialized countries.

II. THE IMPORTANCE OF ENERGY

Energy services underpin almost all aspects of human activity. These services provide basic needs such as cooking, heating, and lighting. They fuel a range of industrial activities, and they sustain today's transportation and communication systems. For these reasons, the energy sector plays a prominent role in the national policies of all countries.[1] Furthermore, expenditures on energy account for 7-8% of countries' gross domestic product (GDP), a significant amount indeed.[2]

For developing countries, expanding and modernizing their energy sector is particularly important since the limited availability of energy constrains human and economic development. The lack of modern energy services can prevent the realization of basic human needs like education, sanitation, health, and communication.[3] Insufficient and unreliable power can also constrain industrial production.[4] As countries become richer, energy consumption per capita rises correspondingly to satisfy increasing demand for energy services from both the industrialization process and rising living standards.[5] Thus, there is a correlation between per-capita

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1. The energy sector encompasses activities relating to the production, conversion, and use of energy. Energy production includes the extraction of primary energy forms such as coal, oil, and natural gas, or growing biomass for energy uses. Energy conversion pertains to the transformation of energy into more useful forms: this includes the refining of petroleum to yield products such as gasoline and diesel; the combustion of coal in power plants to yield electricity; the production of alcohol from biomass, etc. Energy end-use encompasses the final use of energy forms in industrial, residential, commercial, transportation and other end-uses.

2. President's Committee of Advisors on Science and Technology, *Federal Energy Research and Development for the Challenges of the 21st Century*, at 1-1 (1997).

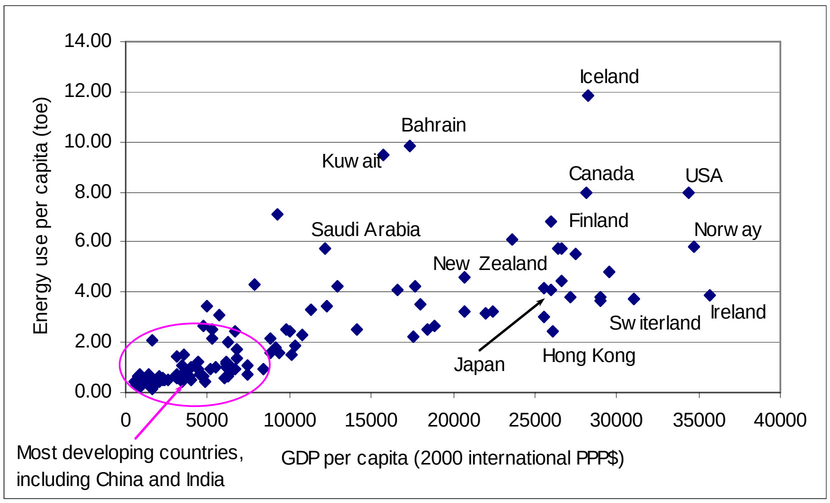
3. UNITED NATIONS DEVELOPMENT PROGRAM (UNDP) ET AL., WORLD ENERGY ASSESSMENT, OVERVIEW UPDATE 2004 33 (Jose Goldemberg & Thomas B. Johansson, eds., 2004) [hereinafter WORLD ENERGY ASSESSMENT 2004], *available at* http://www.undp.org/energy/docs/WEAOU_full.pdf.

4. *See* THE WORLD BANK GROUP, FUELING INDIA'S GROWTH & DEVELOPMENT: WORLD BANK SUPPORT FOR INDIA'S ENERGY SECTOR (July 1999), http://lnweb18.worldbank.org/sar/sa.nsf/ Attachments/InEnergy/$File/InEnrgy.pdf (indicating that in India the lack of an adequate and reliable supply of power is often cited as a critical constraint to industrial development).

5. It should be noted that energy consumption per capita does not have to be in proportion with GDP per capita. For example, among industrialized countries, Japan and European countries are less energy intensive than the United States and Canada. *See* Figure 1 (referencing energy consumption per capita versus GDP-PPP).

GDP and per-capita energy consumption (see Figure 1), as well as between the Human Development Index (as defined by the United Nations Development Programme) and per-capita energy consumption across countries (see Figure 2).[6]

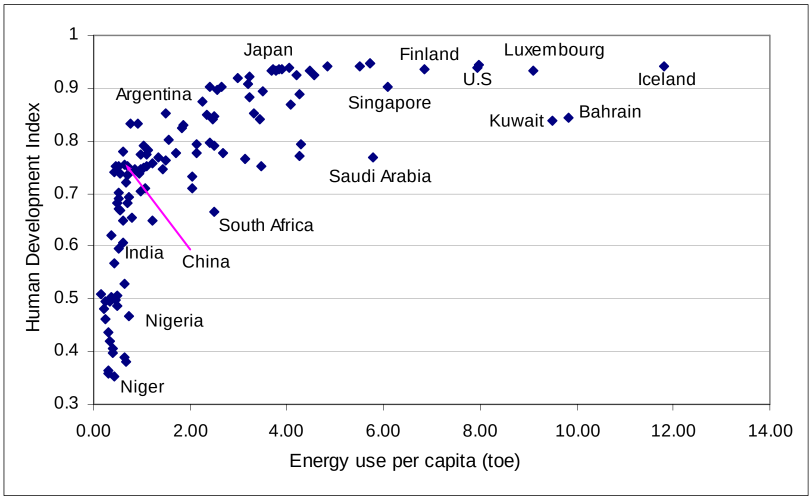
Figure 1: Energy consumption per capita vs. GDP-PPP (2002)



Source: World Bank, *World Development Indicators*.

6. WORLD ENERGY ASSESSMENT 2004, *supra* note 3, at 26-27.

Figure 2: Energy consumption per capita vs. HDI (2002)



Source: World Bank, *World Development Indicators*; United Nations Developing Program, *Human Development Report 2004*.

III. ENERGY SUPPLY AND SECURITY IN DEVELOPING COUNTRIES

Like the uneven development of economies around the world, energy consumption and service varies significantly across countries.[7] In 2002, the global total primary energy supply (TPES) was about 10,230 million tons of oil equivalent (mtoe).[8] Developing countries, with about three-quarters of the world's population, accounted for just over 37% of this total (about 3850 mtoe).[9] The Organization for Economic Co-operation and Development (OECD) countries, with less than a fifth of the world's population, consumed about 53% (about 5345 mtoe) (see Figure 3).[10] OECD countries on average consumed almost eight times as much energy per-capita as did developing countries in Asia[11] and Africa.[12] The starkest

7. WORLD ENERGY ASSESSMENT 2004, *supra* note 3, at 26-31.

8. International Energy Agency (IEA), ENERGY BALANCES OF NON-OECD COUNTRIES 2001-2002 (2004), at 249-251 [hereinafter ENERGY BALANCES OF NON-OECD COUNTRIES].

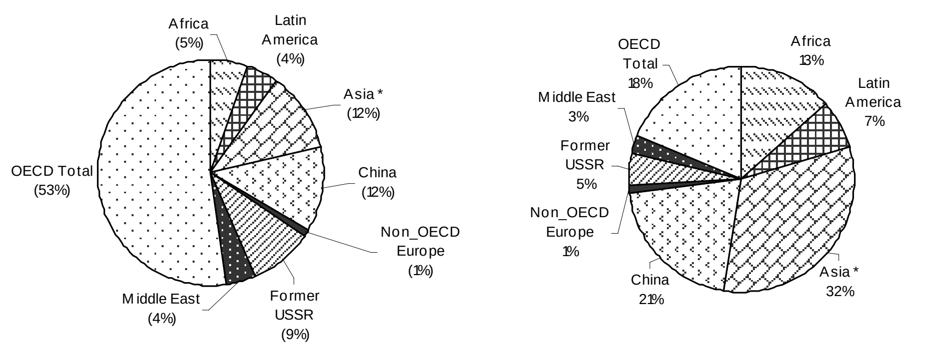
9. *Id.*

10. *Id.*

11. This article adopts the classification of regions by the International Energy Agency (IEA). Thus, developing Asia doesn't include Middle East and China. *See* International Energy Agency, http://www.iea.org (stating "An intergovernmental body committed to advancing security of energy supply, economic growth and environmental sustainability through energy policy co-operation."); *see*

contrast of energy inequity can be made by comparing energy consumption per capita of the most energy-lavish countries with that of the most energy-poor ones. For instance, in 2002, the TPES per capita of the Unites States was more than 40 times that of Bangladesh.[13]

Figure 3: World total primary energy consumption and population (in 2002, by region)



1-a World Total Primary Energy Supply by Region   1-b World Population Distribution by Region

Source: International Energy Agency, Energy Balances of Non-OECD Countries 2001-02.

While the energy consumption per capita of a country is closely linked with its level of economic development, energy use in developing countries has been growing faster than in industrialized countries.[14] In fact, developing countries increased their per-capita energy consumption by a factor of 2.1 from 1971 to 2002.[15] In terms of total primary energy consumption, China and India had an approximate three-fold increase during the same period.[16] There is little doubt that developing countries will need to further increase their total energy consumption to meet their development aspirations. The International Energy Agency (IEA) estimates

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also WORLD ENERGY ASSESSMENT 2004, *supra* note 3, at 27 (noting Asia excludes Middle East, China and OECD countries).

12. ENERGY BALANCES OF NON-OECD COUNTRIES, *supra* note 8, at 338-40.
13. *Id.*
14. WORLD ENERGY ASSESSMENT 2004, *supra* note 3, at 31.
15. ENERGY BALANCES OF NON-OECD COUNTRIES, *supra* note 8, at 338-40.
16. *Id.* at 249-51.

that the global energy demand will grow almost 60% by 2030.[17] More than two-thirds of this growth will be because of an increased demand in developing countries, especially India and China.[18] Of course, even with this enormous growth, developing countries will consume only about one-fifth as much as OECD countries on a per-capita basis.[19]

Furthermore, the types of energy resources predominantly used in a country are also associated with its development level.[20] In developing countries, about two billion people continue to rely on traditional biomass, such as agricultural residues, dung, and firewood, for cooking and heating.[21] Nearly a third of all energy consumption in developing countries is from biomass, with this fraction being close to 90% for some least-developed countries. In sub Saharan Africa, traditional biomass contributes to more than 60% of TPES on average, while in Asia, the number is 30%.[22] As income rises, people generally prefer to use more efficient and cleaner energy sources, and demand greater and diverse energy services.[23] For example, they begin using liquefied petroleum gas (LPG) and kerosene, instead of biomass, for cooking, and electricity, instead of kerosene, for lighting.[24] In wealthy countries, almost all the energy service demands are met with modern energy carriers such as gasoline, diesel, natural gas, and electricity.[25]

Developing countries' high reliance on traditional biomass, and the wide use of rudimentary technologies, leads to higher energy intensities when compared to industrialized countries.[26] For a thousand dollars of GDP output on a purchasing power parity (PPP) basis in 2002, high-income OECD countries needed 0.18 toe of energy input on average, while low- and middle-income countries needed 0.23 toe of energy input.[27] There are

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17. INTERNATIONAL ENERGY AGENCY (IEA), WORLD ENERGY OUTLOOK 31 (2004) [hereinafter, WORLD ENERGY OUTLOOK 2004].
18. *Id.*
19. *Id.* at 66.
20. *See* WORLD ENERGY ASSESSMENT 2004, *supra* note 3, at 29, figure 7 (displaying primary energy use in various regions).
21. *Id.* at 34.
22. *See* WORLD ENERGY ASSESSMENT 2004, *supra* note 3, at 29, figure 7 **,** and ENERGY BALANCES OF NON-OECD COUNTRIES, *supra* note 8, at 247, 250.
23. INTERNATIONAL ENERGY AGENCY (IEA), WORLD ENERGY OUTLOOK 2002 (2002) at 369-370, http://www.iea.org/textbase/nppdf/free/2000/weo2002.pdf [hereinafter WORLD ENERGY OUTLOOK 2002].
24. *Id.*
25. WORLD ENERGY ASSESSMENT 2004, *supra* note 3, at 29, Figure 7
26. *Id.* at 26, 30-31.
27. World Bank, *World Development Indicators* database, http://web.worldbank.org/WBSITE/ EXTERNAL/DATASTATISTICS/0,,contentMDK:20535285~menuPK:1192694~pagePK:64133150~piPK:64133175~theSitePK:239419,00.html (last visited July 21, 2006).

also significant variations within these broad country groupings: Japan's energy intensity was 0.16 toe per thousand dollars of GDP-PPP output, while the corresponding number for the United States was 0.23 toe; sub-Saharan African countries consumed 0.35 toe on average for the same amount of GDP output, while China and India consumed about 0.22 and 0.20 toe, respectively.[28] Similarly, energy conversion efficiency in developing countries is much lower than that in industrialized countries. In Africa, less than one-third of primary energy enters final consumption.[29] In Asia, the number is about 45%.[30] In comparison, OECD countries convert about two-thirds of primary energy supply into final consumption.[31]

Energy security is the ability to access adequate, affordable, reliable, and diverse energy sources required for a country's development needs.[32] Key energy security issues can be different for different countries, depending on their level of development and natural resource endowment. Most industrialized countries' current energy security concerns are focused on the availability of reasonably priced supply of oil and natural gas.[33] By contrast, energy security in developing countries has at least three dimensions. The first dimension is access to sufficient primary energy sources to generate electricity needed for industrial, commercial and residential sectors. The second is to obtain enough oil for the transportation sector. The third is to provide access to traditional fuels for the poor in the short and medium term and then to transition them to a modern energy system. The first two dimensions converge with the concerns of many industrialized countries, while the third is unique to developing countries.[34] So far not enough attention and effort have been devoted to this latter dimension.[35]

The electric power sector has seen enormous growth worldwide over the past few decades electricity generation almost tripled from 5.2 petawatt-hours (PWh, 10 watt-hours^{15}) to 16.1 PWh between 1971 and 2002.[36] In absolute terms much of the growth came from OECD countries whose

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28. *Id.*
29. This is primarily because of the conversion efficiency of biomass is very low (~15%). *See* AMULYA K.N. REDDY ET. AL., ENERGY AFTER RIO: PROSPECTS AND CHALLENGES (1997) at Ch.2 § 2.1.1.2, *available at* http://www.undp.org/energy/publications/1997/1997a.htm [hereinafter ENERGY AFTER RIO], at Ch.2 § 2.1.1.1 (noting that "more efficient energy conversion devices would confer sizeable gains in purchasing power").
30. ENERGY BALANCES OF NON-OECD COUNTRIES, *supra* note 8, at II. 250, II. 283.
31. *Id*. at 251, 284.
32. WORLD ENERGY ASSESSMENT 2004, *supra* note 3, at 42.
33. *Id.* at 43.
34. *Id.* at 34.
35. *Id.*
36. ENERGY BALANCES OF NON-OECD COUNTRIES, *supra* note 8, at 268.

energy generation rose from 3.8 to 9.8 PWh over this period.[37] However, many parts of the developing world saw greater increases in percentage terms. Asia, excluding China, increased its generation more than ten-fold, from 0.13 PWh to 1.4 PWh during this period, while China made an even bigger leap, going from 0.14 PWh to 1.7 PWh. Generation in Africa increased from 90 Terawatt-hours (TWh, 10 watt-hours^{12}) to 476 TWh over this period.[38] Globally, a number of primary energy sources like coal, nuclear, gas, water, and oil, contribute to power generation, with coal dominating at about 40% at the turn of the century.[39] In OECD countries and Africa, many of the recent additions in power generation have come from gas, while in Asia, coal power plants that were already a major source of generation capacity saw further growth.[40] In fact, in India and China, the two largest generators of power outside the OECD and Russia, coal accounted for 70% and 77% of the power generation, respectively, in 2002.[41]

In many countries, the growth of the power sector has been guided by the availability of domestic resources. In South America, for example, the abundance of water resources has led to significant hydroelectricity development, while India and China have relied heavily on coal because of its domestic availability.[42] There has also been an increase worldwide, especially in OECD countries, of gas-based power generation due to the greater availability of gas from neighboring countries like Russia and Norway, in the case of Europe, and Canada, in the case of the United States.[43] Looking ahead, the IEA estimates that fossil fuels will meet much of the global energy demand with gas and coal dominating the growth in the power generation sector. India and China together might account for about two-thirds of the increase in the world coal demand, as they continue to rely upon these domestic resources.[44]

Economic development worldwide has increased world oil demand considerably in the past few decades, and this tendency is likely to continue in the future.[45] In 1971, the global oil demand was about 1.89 billion tons,

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37. *Id.*
38. *Id.* at 266-68.
39. *Id.* at 256.
40. *Id.* at 255-56, 260-61.
41. *Id.* at 255.
42. *See, e.g.*, INTERNATIONAL ENERGY AGENCY, KEY WORLD ENERGY STATISTICS 14-15, 18-19 (2005), http://www.iea.org/dbtw-wpd/Textbase/nppdf/free/2005/key2005.pdf (providing graphical representations of Hard Coal Production and Hydroproduction).
43. WORLD ENERGY OUTLOOK 2004, *supra* note 17, at 35.
44. *Id.* at 29, 31, 34.
45. *Id.* at 35.

with OECD countries accounting for 76% (i.e., 1.43 billion tons) and non-OECD countries accounting for 24% (i.e., 460 million tons).[46] In 2004, global oil consumption reached 3.77 billion tons, with OECD countries now consuming about 60% (i.e., 2.25 billion tons) and non-OECD countries, consuming about 40% (i.e., 1.52 billion tons).[47] Therefore, even as the demand in non-OECD countries grew faster than in OECD countries, the overall consumption is still dominated by the latter group. The six-fold difference between the two groups, on a per-capita basis, is even starker. The IEA estimates that oil demand in non-OECD countries is likely to increase at an annual rate of 2.7% during the period from 2002 to 2030, while the average rate of growth in OECD countries is likely to be around 0.8%.[48] Thus, it is only by 2030 that the total oil demand in non-OECD countries would exceed that in OECD countries.[49]

However, in recent years, increased oil demand from the rapidly growing developing countries, especially China and India, has caught much of the world's attention.[50] China has been singled out for driving up world oil prices.[51] This finger-pointing is unfair given that oil demand in the United States has also grown strongly, especially in absolute terms, during the past decade, as shown in Figure 4. Furthermore, a country's share of blame for high oil prices should be proportionate to its share of the global oil consumption and imports. Despite the fact that China's oil demand has grown at a pace faster than any other major oil users, China's total oil consumption accounted for only 8% of world total consumption in 2004. In contrast, the United States consumed about 25% of all oil consumed globally. Further, China's reliance on imported crude oil, about 123 million tons in 2004 or 6.6% of global crude imports, is also much lower than the United States' reliance on imported crude oil, which is 500 million tons or

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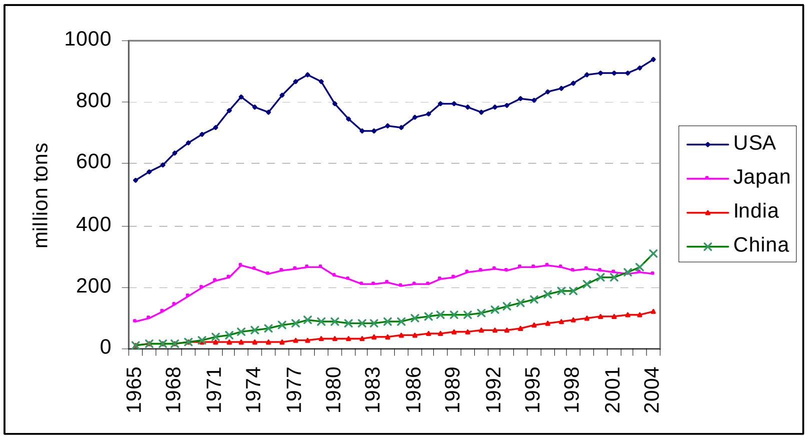
46. ENERGY BALANCES OF NON-OECD COUNTRIES, *supra* note 8, at 276.
47. BRITISH PETROLEUM (BP), STATISTICAL REVIEW OF WORLD ENERGY 10 (2005) [hereinafter BP], http://www.bp.com/liveassets/bp_internet/globalbp/globalbp_uk_english/publications/energy_reviews_2005/STAGING/local_assets/downloads/pdf/statistical_review_of_world_energy_full_report_2005.pdf.
48. WORLD ENERGY OUTLOOK 2004, *supra* note 17, at 82.
49. *Id.*
50. *See* A. Browne et al., *Asian Rivals Put Pressure on Western Giants*, WALL ST. J., Jan. 5, 2005, at A1 (stating that "energy companies in India and China want bigger slices of the global oil patch"); David Zweig & Bi Jianhi, *China's Global Hunt for Energy*, FOREIGN AFF. Sept./Oct. 2005, at 25 (indicating that "[a]n unprecedented need for resources is now driving China's foreign policy."). *See generally* Survey, *The World Economy: A Hungry Dragon*, THE ECONOMIST, Oct. 2, 2004, at 12-14 (noting China's electricity shortages).
51. *See Chinese Oil Demand*, FINANCIAL TIMES, Feb. 25, 2005, at 20 (indicating that China's exploding demand for oil drove the price of oil above $40 a barrel). *See also* Carola Hoyos, *China's Oil Demand Set to Keep Oil Prices High*, FINANCIAL TIMES, Apr. 10, 2004, at 8 (noting that springtime petroleum prices will not decrease due to China's oil demand).

27% of global imports.[52]

Figure 4: Crude oil consumption in selected countries (1965-2004)



Source: BP, Statistical Review of World Energy (2005).

Higher oil prices negatively affect all oil-importing countries, but hurt developing countries the most. They lack the resources and capabilities for developing and employing oil-efficient technologies. Moreover, these countries also have less financial and technical ability to use other alternatives to buffer against the impacts of high oil prices. An increase in the cost of oil imports, as a result of a price hike, is therefore more likely to destabilize trade balances, drive up inflation, and undermine economic growth in developing countries. IEA estimated that a ten-dollar increase of oil price per barrel from $25 to $35 would cause 0.4% GDP loss in OECD countries as a whole during the first couple of years following the price increase, but the damage to developing economies would be much more severe: 0.8% GDP loss in Asia, and 1.6% GDP loss in very poor and highly indebted countries.[53]

52. BP, *supra* note 47, at 19.
53. INTERNATIONAL ENERGY AGENCY (IEA), ANALYSIS OF THE IMPACT OF HIGH OIL PRICES ON THE GLOBAL ECONOMY 2 (2004), http://www.iea.org/textbase/papers/2004/high_oil_prices.pdf.

IV. ENERGY FOR THE POOR

It is widely believed that about two billion people worldwide, most of them living in extreme poverty, do not have access to modern energy services.[54] As discussed earlier, energy services are crucial to meeting basic human needs. Thus energy-poverty, which is the inability to access or purchase sufficient energy due to the lack of availability, choice, or the ability to pay for these services, is an important energy-related challenge for developing countries because it has health, social, environmental, and economic implications. Lack of access to modern energy also impedes poverty reduction, a key Millennium Development Goal of the United Nations.[55] Although it is difficult to show a causal relationship between energy and poverty, very low per-capita energy consumption in many developing countries correlates with a low Human Development Index.[56]

First, it is important to understand the magnitude of the problem. Nearly two out of five people in developing countries do not have access to, or the ability to purchase, modern energy such as electricity and liquid fuels, which are efficient and clean energy carriers generally used by industrialized countries and by the urban elite in developing countries.[57] Instead, the energy-poor rely primarily on traditional biofuels like firewood, crop residues, dung, and coal for cooking,[58] lighting, water heating, and heating.[59] A cross-country analysis has shown that the reliance on biomass is greater among countries with lower incomes, countries with disparate income distributions, and countries with low urban populations.[60] Despite the widespread use of biofuels in developing countries, there is very little understanding of the economics of traditional fuel use because these fuels

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54. WORLD ENERGY ASSESSMENT 2004, *supra* note 3, at 33.
55. WORLD ENERGY OUTLOOK 2002, *supra* note 23, at 365; UNITED NATIONS DEVELOPMENT PROGRAMME, ENERGIZING THE MILLENNIUM DEVELOPMENT GOALS (Aug. 2005) at 8, http://www.undp.org/energy/docs2/ENRG-MDG_Guide_all.pdf. (The U.N. Millennium Declaration commits the member countries to halve, by the year 2015, the proportion of the world's people whose income is less than one dollar a day. In 2001, about 1 billion people lived with less than a $1 per day, and close to 2.7 billion people with less than $2 per day. *See* World Bank, World Development Indicators, *supra* note 27.)
56. *See* FIGURE 2; *see also* WORLD ENERGY ASSESSMENT 2004, *supra* note 3, at 26 (noting that an HDI of 0.8 or higher requires a minimum energy consumption of about 1 ton of oil-equivalent per year per capita).
57. Most of the biofuel use occurs in rural populations, although the poor in urban areas also rely on biofuels.
58. *See* ENERGY AFTER RIO, *supra* note 29, at Ch.2 § 2.2.1.4 (noting that coal is used as a household fuel for cooking and heating primarily in rural areas of China, South Africa, and some countries in Latin America and former Soviet Union).
59. *Id.* at Ch.2 § 2.1.1.1.
60. *Id.* at Ch.2 § 2.1.1.2.

are not part of the conventional market economy.

Traditional biomass is mainly used for cooking and space heating. The inefficient burning of wood and coal in cookstoves has serious impacts on human health. The smoke from the wood burning contains many hazardous chemicals and particulates.[61] Smoke from coal use in rural households is additionally problematic because of the emission of sulfur oxides and other toxics. The indoor air quality in rural homes is very poor because of both inefficient cookstove design and poor ventilation in rural kitchens. Women and children, who have prolonged daily exposure to this smoke, suffer from acute respiratory diseases.[62] For example, a study in The Gambia found that children who were carried by their mothers on their backs while cooking were six times more likely to develop respiratory illness than other children.[63] The World Health Organization has estimated that indoor air pollution from biomass and coal use in poor households is the sixth largest health risk factor in developing countries, accounting for an estimated 1.6 million premature deaths annually.[64] Overall, indoor smoke from these solid fuels is responsible for about 38 million disability-adjusted lost years in developing countries.[65] Thus, in many ways, indoor smoke exposure is worse than outdoor urban air pollution, even though the latter issue gets more policy attention in industrialized as well as developing countries.[66] Additionally, there are other indirect impacts. Those who lack convenient energy sources and supplies suffer from poor nutrition, caused by improper cooking, and the prevalence of diarrhea and other parasite-based diseases that result from not boiling drinking water.[67]

The collection of biofuels such as wood, dung, and coal, is enormously time consuming and primarily performed by women and children. Given that the use of wood in traditional cookstoves is very inefficient (15%),[68] large quantities of wood need to be collected daily. For example, Nepali women in hilly areas spend more than an hour every day gathering wood,

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61. *Id.* at Ch.2 § 2.2.1.4.
62. *Id.*
63. World Bank, RURAL ENERGY AND DEVELOPMENT FOR TWO BILLION PEOPLE: MEETING THE CHALLENGE FOR RURAL ENERGY AND DEVELOPMENT (1997) at 5 [hereinafter WORLD BANK 1997], http://www.eldis.org/static/DOC12261.htm.
64. World Health Organization, WORLD HEALTH REPORT: REDUCING RISKS, PROMOTING HEALTHY LIFE 83 (2002) [hereinafter WHO 2002], http://www.who.int/whr/2002/en/whr02_en.pdf.
65. One disability-adjusted-lost-year represents one healthy year of life lost by an individual due to disease/adverse health condition. *Id. See* ENERGY AFTER RIO, *supra* note 29, at Ch.2 § 2.2.1.4 (noting that household use of biomass (and coal) results in greater human exposure to pollutants).
66. ENERGY AFTER RIO, *supra* note 29, at Ch.2 § 2.2.1.4.
67. *Id.*
68. *Id.* at Ch.2 § 2.1.1.1 . (The efficiency of cookstoves using firewood (traditional), kerosene, and gas are 15, 50, and 60 per cent, respectively.).

even in areas with fairly good supply; in areas where wood is scarce, they spend nearly 2.5 hours.[69] And in rural sub-Saharan Africa, many women carry 20 kilograms of fuel wood an average of five kilometers every day. Thus, they are unable to engage in productive economic activities to improve their condition.[70] Children who are condemned to spend hours collecting biomass to support their families do not have time or energy to participate in educational activities.[71] Thus, the energy-poor are trapped without access to better energy services and they continue to remain poor. As a corollary, poor households pay a larger fraction of their disposable incomes for energy than the rich ones. For example, the low-income households in Uganda spend about 15% of their income on energy, while the high-income households in the United Kingdom spend only 2% on energy on average.[72]

Energy-poverty and the use of biofuels are also intimately linked with gender disparity and inequity.[73] A majority of the 2.7 billion people living in poverty are women, with many of them spending long hours in survival activities.[74] As discussed above, women and children are the primary gatherers of fuelwood and other minor forest produce for household consumption. They also spend significantly more time and walk longer distances than men to collect firewood and water. The women in rural areas also spend long hours indoors, cooking and taking care of children,[75] therefore they bear the brunt of the health problems associated with indoor smoke. Women are also the most vulnerable to energy scarcity, environmental damages, and adverse impacts of technological changes in the energy sector.[76] Thus, the problem is not just one of energy economics or technology, but one of social justice.

Finally, continued use of traditional fuels can have adverse impacts on the environment.[77] Collection of firewood involves not just the gathering of

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69. WORLD BANK 1997, *supra* note 63, at 5.
70. ENERGY AFTER RIO, *supra* note 29, at Ch.2 § 2.1.2.
71. *Id.*
72. WORLD ENERGY OUTLOOK 2002, *supra* note 23, at 368.
73. ENERGY AFTER RIO, *supra* note 29, at Ch.2 § 2.1.2.
74. *Id.*
75. United Nations Development Program (UNDP), United Nations Department of Economic and Social Affairs, World Energy Council (WEC), WORLD ENERGY ASSESSMENT: ENERGY AND THE CHALLENGE OF SUSTAINABILITY, at 48 (2000); *see* United Nations Development Program, HUMAN DEVELOPMENT REPORT 1995, at 6 (Despite this enormous contribution to society, much of the women's work is undervalued and unrecorded, and the time they spend every day managing their households in unrecognized. About two-thirds of women's contribution to National Accounts is left out. It is estimated that women contributed to about $11 trillion of unrecorded economic activity in 1993).
76. ENERGY AFTER RIO, *supra* note 29, at Ch.2 § 2.1.2.2.
77. WORLD ENERGY OUTLOOK 2002, *supra* note 23, at 367.

small twigs and branches, but also cutting down trees, first in local areas and then later in areas farther away.[78] Such denuding of forests is exacerbated under drought conditions. In some cases, the local and regional impact of deforestation from biomass production can have significant impact on environment, although less than logging or the clearing of land for agriculture.[79] It can strongly affect communities that rely heavily on forest produce for their nutrition and livelihood. With dwindling biomass supplies, some countries are promoting the use of coal for household fuel use, which also has serious health effects and climate implications.[80] The use of crop residue and dung for fuel also eliminates an important source of manure for agriculture.[81]

Factors that determine the transition from traditional to modern energy use are availability, affordability, and cultural preferences.[82] Without modern distribution systems, households cannot access modern fuels even if they can afford them.[83] Penetration rate for LPG in many developing countries is low, partly because of the lack of distribution infrastructure. Even if rural people can afford modern fuels, many households may choose not to use them if they are more expensive than traditional biomass.[84] In many cases, biomass is often considered to be freely and readily available;[85] even when fuelwood is purchased, it is likely to be cheaper than an alternative. Also, the affordability of end-use equipment is just as important as the affordability of fuels. The initial cost of acquiring kerosene and LPG stoves or LPG cylinders may prevent some people from using such fuels.[86] Thus, efforts to bring improved energy services to the poor have to contend not only with enhancing the supply, but also setting up programs and policies that account for the relevant economic, financial, cultural, and institutional context.

Still, there have been some successful efforts to enhance improved traditional and modern energy services for poor people. On the former front, the large-scale Chinese effort to promote improved cookstoves stands out.[87] This program has now distributed about 200 million improved

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78. WORLD BANK 1997, *supra* note 63, at 20.
79. *Id.* at 22-23.
80. ENERGY AFTER RIO, *supra* note 29, at 13-14.
81. WORLD BANK 1997, *supra* note 63, at 22.
82. WORLD ENERGY OUTLOOK 2002, *supra* note 23, at 368.
83. *Id.*
84. *Id.*
85. *Id.*
86. *Id.*
87. K. R. Smith et al., *100-million Improved Cookstoves in China: How was it Done?*, WORLD DEVELOPMENT, June 1993, at 941 (1993).

stoves.[88] In a related vein, the Chinese government's success in electrifying rural areas is also impressive. This is true especially in terms of sheer scale. China brought electricity access to almost 700 million people in two decades, achieving an electrification rate of more than 98% by 2000.[89] An example of a different approach is the Intermediate Technology Development Group's (ITDG) effort to bring micro-hydro to rural areas, which has been successful in a number of countries. This is part of a larger ITDG effort to develop and commercialize energy technologies for the poor, including low-cost cooking stoves and small-scale, off-grid, sustainable energy supply technologies like small scale wind generators, affordable solar lanterns, and biogas plants.[90]

V. CLIMATE CHANGE AND DEVELOPING COUNTRIES[91]

In recent years, climate change has received significant and increasing attention for its possible impacts on humans, ecosystems, and economies, and for the scale of efforts necessary to mitigate the problem.[92] Climate change is driven by the accumulation in the Earth's atmosphere of heat trapping greenhouse gases (GHGs) resulting from anthropogenic activities.[93] Carbon dioxide (CO_2), mostly the product of fossil fuel combustion, is the single largest contributor to the problem, accounting for about 60% of the direct radiative forcing of all greenhouse gases.[94] Thus, the climate issue is intimately linked to the modern energy sector.

The most recent data indicates that CO2 levels in the atmosphere now exceed 380 parts per million by volume (ppmv), a significant rise from the

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88. V. Mishra et al., *Indoor Air Pollution: The Quiet Killer*, No. 63 ANALYSIS FROM THE EAST-WEST CENTER 6-7 (2002), http://www.eastwestcenter.org/stored/pdfs/api063.pdf.

89. WORLD ENERGY OUTLOOK 2002, *supra* note 23, at 373.

90. B. Biagini et al., Non-governmental Organization and Energy, ENCYCLOPEDIA OF ENERGY (Cutler Cleveland ed. 2002).

91. Local (outdoor) air pollution is also a major issue in developing countries but we don't focus on that in this article because of space limitations.

92. *See, e.g.*, Andrew C. Revkin, *Federal Study Finds Accord on Warming*, N. Y. TIMES, May 3, 2006, *available at* http://www.nytimes.com/2006/05/03/science/03climate.html ("Bush administration concluded yesterday that the lower atmosphere was indeed growing warmer and that there was 'clear evidence of human influences on the climate system.'"); Andrew C. Revkin, *Climate Data Hint at Irreversible Rise in Seas*, N. Y. TIMES, March 24, 2006, *available at* http://www.nytimes.com/2006/03/24/science/earth/24melt.html (noting that "the growing human influence on Earth's climate could lead to a long and irreversible rise in sea levels by eroding the planet's vast polar ice sheets"); INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC), SUMMARY FOR POLICYMAKERS: A REPORT OF WORKING GROUP I OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (2001) [hereinafter IPCC WORKING GROUP I], http://www.ipcc.ch/pub/spm22-01.pdf (review of climate change literature by an international panel of scientists).

93. IPCC WORKING GROUP I, *supra* note 92, at 5.

94. *Id.*

pre-industrial concentration of about 280 ppmv.[95] Other GHGs have also shown significant increases in atmospheric concentration.[96] Over the last century, global mean surface temperatures have risen by about 0.8 °C, with the two hottest years on record, 1998 and 2005, having come in the last decade.[97] At the same time, manifestations of a warming planet and changing climate have become more apparent. For example, reductions of snow cover and ice in the northern latitudes and changes in precipitation patterns have been observed.[98]

Scenarios developed by the International Panel on Climate Change (IPCC) indicate that global mean surface temperatures will increase anywhere between 1.4 to 5.8°C over the 21st century.[99] This will be accompanied by an estimated sea-level rise of about 0.1 to 0.9 meters, increased variances in temperature and precipitation patterns, and further reductions in snow cover and polar and sea-ice in the Northern hemisphere.[100] Simultaneously, there will likely be significant changes in extreme climate and weather events (see Table 1). There is also the potential for large-scale and possibly irreversible changes like a slowdown of the North Atlantic thermohaline current,[101] reductions in or collapse of the Greenland and West Antarctic ice sheets, and release of carbon from permafrost regions.[102]

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95. *Id.* at 6.
96. *Id.*
97. GODDARD INSTITUTE FOR SPACE STUDIES, GISS SURFACE TEMPERATURE ANALYSIS (2005), http://data.giss.nasa.gov/gistemp/2005/.
98. IPCC WORKING GROUP I, *supra* note 92, at 2-3.
99. *Id.* at 13.
100. *Id.*
101. *See* W. Broecker, *Chaotic Climate*, SCIENTIFIC AMERICAN, Nov. 1995, at 62-68 (The thermohaline circulation is a global ocean circulation driven by differences in the density of the sea water. This sea-water density is controlled by temperature (thermal) and salinity (haline). In the North Atlantic it transports warm and salty water to the North, where it sinks into the deep ocean. This colder deep water is then transported southward.).
102. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC), SUMMARY FOR POLICYMAKERS: A REPORT OF WORKING GROUP II OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (2001) [hereinafter IPCC WORKING GROUP II].

Table 1 : Some possible changes in extreme weather and climate events over 21st century and confidence in projections

Changes in extreme weather and climate events	*Confidence in projected changes (during the 21st century)*
Higher maximum temperatures and more hot days over nearly all land areas	Very likely
Higher minimum temperatures, fewer cold days and frost days over nearly all land areas	Very likely
Reduced diurnal temperature range over most land areas	Very likely
Increase of heat index over land areas	Very likely, over most areas
More intense precipitation events	Very likely, over many areas
Increased summer continental drying and associated risk of drought	Likely, over most mid-latitude continental interiors. (Lack of consistent projections in other areas.)
Increase in tropical cyclone peak wind intensities	Likely, over some areas
Increase in tropical cyclone mean and peak precipitation intensities	Likely, over some areas

Source: IPCC, Summary for Policymakers: A Report of Working Group I of the Intergovernmental Panel on Climate Change (2001).

These changes in the climate could have enormous human, ecological, and economic impacts. For example, more intense rainfall could lead to floods, landslides, and greater erosion.[103] Increased mean temperatures could change disease patterns and affect agricultural productivity. More frequent and intense coastal storms could cause enormous damage to human settlements, coastal ecosystems, and result in loss of life.[104]

A particularly important aspect of a changing climate is the geographic variability of the impacts. Northern latitudes, for example, have seen an increase in precipitation over the last century while many tropical areas, especially in Africa, have seen significant decreases.[105] Thus, different

103. *Id.*
104. *Id.*
105. *Id.*

countries (or even areas within countries) will see different kinds and magnitudes of changes. Developing countries may experience particularly problematic changes, like reduced precipitation that could lead to drought.[106] At the same time, humans and natural systems in these countries are often already weak or under stress.[107] This, combined with the lack of adaptive capacity to respond proactively to reduce the potential for impacts, or reactively to limit the damages from any specific events, results in significant vulnerability to climate change. As the IPCC states, the "impacts of climate change will fall disproportionately upon developing countries and the poor persons within all countries . . . . Populations in developing countries are generally exposed to relatively high risks of adverse impacts from climate change. In addition, poverty and other factors create conditions of low adaptive capacity in most developing countries."[108]

The U.N. Convention on Climate Change has recognized the need to stabilize "greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system."[109] Given that the emissions from the combustion of fossil fuels are a major contributor to climate change[110] and that fossil fuels account for almost 80% of the global energy supply,[111] stabilizing GHG concentrations will require a significant reorientation of energy systems, not just in industrialized countries, but also in industrializing economies.

As shown in Figure 5, there has already been a decline in the energy intensity (i.e., energy use per unit GDP) worldwide, although with significant differences among countries (as illustrated in Figure 5). While energy intensity worldwide has declined over 1.3% per year over the last three decades with the oil crises of the 1970s being a major driver of these declines,[112] the carbon factor (i.e., carbon emissions per unit energy used)

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106. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC), CLIMATE CHANGE 2001: SYNTHESIS REPORT: SUMMARY FOR POLICYMAKERS 8 (2001) [hereinafter CLIMATE CHANGE 2001: SYNTHESIS REPORT], http://www.ipcc.ch/pub/un/syreng/spm.pdf.

107. *Id.*

108. *Id.* at 12.

109. UNITED NATIONS (UN), UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE 9 (1992), *available at* http://www.unfccc.int/resource/docs/convkp/conveng.pdf.

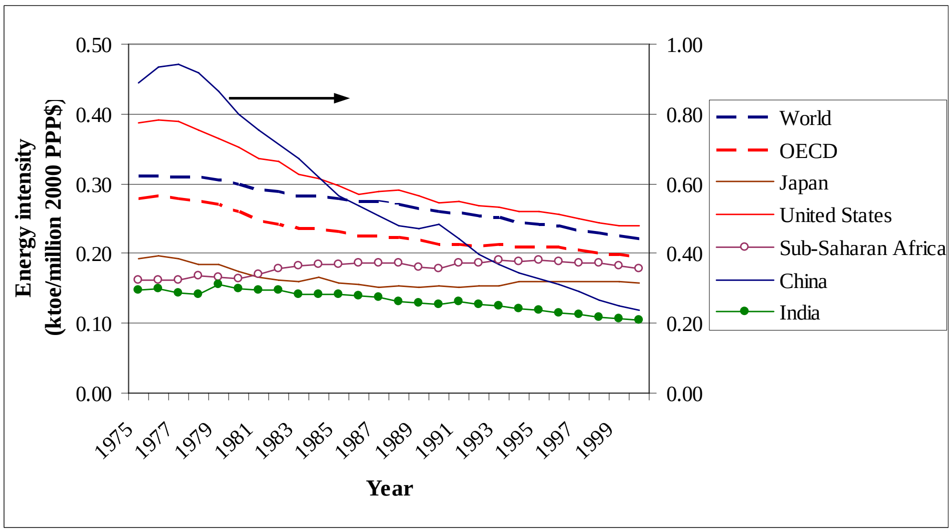
110. CLIMATE CHANGE 2001: SYNTHESIS REPORT, *supra* note 106, at 4.

111. ENERGY BALANCES OF NON-OECD COUNTRIES, *supra* note 8, at 18.

113. Changes in energy intensity in most countries can be attributed to a combination of two factors: one, structural changes in the economy (whereby a shift away from energy-intensive activities, such as manufacturing, towards the service sector reduces the energy intensity, as has been the case in most industrialized countries over the past few decades; conversely, an increase in the contribution of energy-intensive activities such as manufacturing to the GDP increases the energy intensity of the economy, as in the case of South Korea in the 1970 and 1980s), and two, changes in the efficiency of energy conversion and end-use.

has declined by only 0.4% per year over the same period (Figure 6).[113]

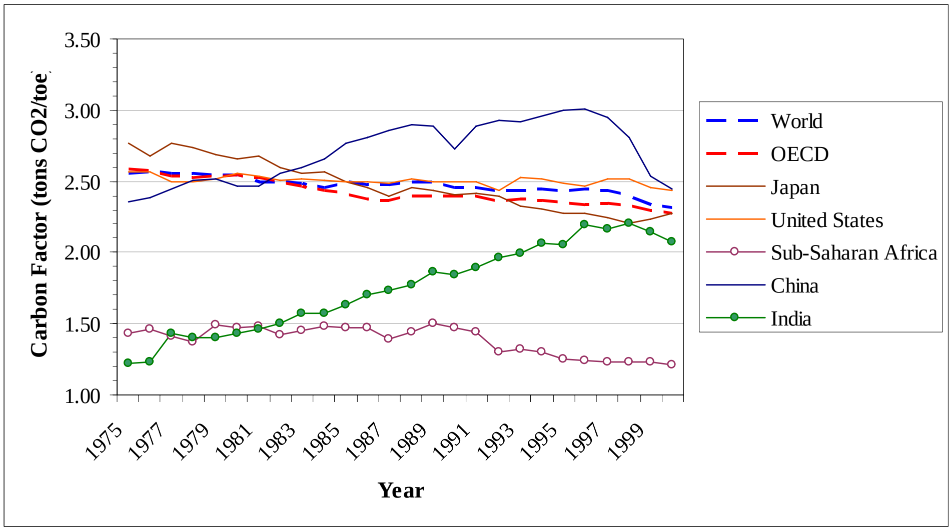
Figure 5: Energy-intensity trends for key countries/groups, 1975-2000 (Note that the curve for China, India, and Sub-Saharan Africa corresponds to y-axis on the right hand side.)



Source: World Bank, World Development Indicators.

114. In the case of India and China, an increase in the carbon factor is due to the increasing share of fossil fuels (and decreasing share of biomass) in the energy mix of these countries.

Figure 6: Carbon-factor trends for key countries/groups, 1975-2000



Source: World Bank, World Development Indicators.

Hence, the global energy system will require accelerated changes to meet the United Nations Framework Convention on Climate Change (UNFCCC) goals for stabilizing greenhouse gases. It has been estimated that even if global energy intensity of GDP declined at 2% per year over the next century, a three-fold increase in carbon-free energy supply would still be needed to stabilize CO_2 levels at 550 ppmv, a number that corresponds to a rough doubling from pre-industrial concentrations.[114]

GHG mitigation will require the implementation of a range of new technologies and practices. These include more efficient conversion and use of energy, low GHG-emitting technologies, carbon capture and storage, and improvements in land use, land-use change, and forestry practices. Many of the required technologies currently exist.[115] The appropriate use of these currently available technologies could limit the global emissions trajectory consistent with the goal of keeping atmospheric CO_2 concentration below two-times the pre-industrial levels.[116]

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115. JOHN P. HOLDREN, ASPEN INSTITUTE CONGRESSIONAL PROGRAM, U.S. CLIMATE POLICY POST-KYOTO: SCIENTIFIC UNDERPINNINGS, POLICY HISTORY, AND THE PATH AHEAD 4 (May 2003), http://stephenschneider.stanford.edu/Publications/PDF_Papers/RomeTextHoldren.pdf.

115. S. Pacala & R. Socolow, *Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies*, 305 SCIENCE 901, 968 (2004).

118. *Id.*

But the implementation of new, improved, or existing technologies with a lower climate impact is limited by economic, political, technical, institutional, financial, and behavioral barriers. The economics of GHG mitigation is clearly a dominant issue, given the substantial costs of meeting the appropriate stabilization targets.[117] A stabilization target of 550 ppmv is estimated to cost between 100 and 800 trillion dollars over the next century. To reach a tighter stabilization target of 450 ppmv, a level suggested by many as being required to avoid dangerous climate change, could cost between 350 and 1,750 trillion dollars (amounts in 1990 US$, present value discounted at 5% per annum from 1990-2100).[118]

The barriers mentioned above could be overcome by a range of actions. Research and development could be used to lower costs of low-climate impact technologies and make them more competitive with existing options. Suitable policies or incentives for the adoption of these technologies could lower costs through technological learning. In addition, financing options can help make these technologies more accessible to consumers. Likewise, institutional barriers, like technology lock-in, can be overcome by changing consumer attitudes and behaviors towards the use of efficient energy technologies.[119] All of these measures require appropriate political support.[120] However, these options generally require a number of actions and policies to be taken in concert, which is non-trivial in practice.

Also, while much attention is often paid to the implementation of new technologies and systems, modification of consumer attitudes and behavior that guide energy-use patterns has not received as much attention despite its importance. For example, GHG emissions from the transportation sector derive from vehicle technologies in use, as well as total vehicle-miles traveled. In the arena of passenger cars, whose use generally constitutes the majority of GHG emissions from transportation, technological improvements have been directed towards enhancing vehicle performance rather than fuel efficiency. At the same time, the number of vehicle-miles traveled has continued to increase, leading to continued increases in fuel consumption and GHG emissions.

For developing countries, the GHG-mitigation challenge comes at a

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117. The exact cost of mitigation depends on a specific pathway chosen to meet stabilization targets.

121. CLIMATE CHANGE 2001: SYNTHESIS REPORT, *supra* note 106, at 31.

119. W. B. Arthur, *Competing technologies, increasing returns and lock-in by historical events*, ECONOMIC JOURNAL 99, 116-31 (1989); *see* R. Perkins, *Technology "lock-in,"* INTERNET ENCYCLOPEDIA OF ECOLOGICAL ECONOMICS (2003), http://www.ecoeco.org/publica/encyc_entries/ TechLkIn.pdf (The key idea of technology lock-in is that technologies and technological systems follow specific paths that are difficult and costly to escape. Hence, they tend to persist for extended periods, i.e., locked-in to the system, even where there is competition from potentially superior substitutes.).

123. CLIMATE CHANGE 2001: SYNTHESIS REPORT, *supra* note 106, at 24.

time when there are more pressing challenges facing the energy sector. A climate-based reorientation of the energy sector would require new technologies, like clean-coal-based power generation, carbon capture and storage, and other non-GHG-emitting options. These new technologies will mostly be developed in industrialized countries, since developing countries do not have the appropriate technological capability to do so. The subsequent transfer of these technologies from industrialized countries to developing countries then has to contend with issues such as poor adaptation, higher costs, and further marginalization of indigenous technology development.

Despite these issues, there is immense pressure on developing countries to start GHG mitigation activities and even take on climate commitments. The latter issue is being pressed particularly by the United States, which has made its own climate-commitment actions contingent upon participation by developing countries. This flies in the face of the UNFCCC, signed and ratified by all industrialized countries including the United States, which requires industrialized countries to take the lead in combating climate change. At the same time, the long lifetime of CO_2 in the atmosphere means that the overwhelming responsibility for the current rise in atmospheric CO_2 concentration lies with industrialized countries whose cumulative emissions over the past century far outweigh the contribution of developing countries. While the GHG contributions of developing countries have risen over the past few decades, they still account for only about a third of the global CO_2 emissions, even though these countries account for three-quarters of the global population.

This puts developing countries in an awkward situation: they will likely suffer disproportionately from a changed climate while being only minor contributors to the problem. At the same time, there is increasing pressure upon them to undertake GHG-mitigation commitments. While it is in the interest of developing countries to work towards mitigating climate change, these countries have limited means and institutional capacity to do so. Thus, equity issues pertaining to sharing the burdens of mitigation and adaptation are pivotal to climate negotiations.

VII. CONCLUDING THOUGHTS

Energy remains a pressing problem for developing countries. Their energy sectors face a number of challenges, climate change being only one of them. Meeting these challenges simultaneously will indeed be a complex task and will require an integrated approach to energy policy where such approaches have not always been the norm. The enormous breadth of the energy sector has often led to a piecemeal approach that makes the integrative task that much more arduous.

We would like to end by drawing particular attention to two sets of themes connecting and underlying these challenges. The first pertains to the possibility of conflicts, tradeoffs, and synergies across these challenges and their solutions. And the second is the interactions between the energy and climate policies of industrialized countries and developing countries.

A. *CONFLICTS, TRADEOFFS AND SYNERGIES*

Developing countries have generally viewed the need to enhance energy supply as a high priority in their energy policies. This attention has particularly been focused on enhancing commercial energy supply, especially fossil-fuels for electric power and transportation. This inherently presents a conflict with climate change issues. Simultaneously, the substantial attention paid to power sector reforms intended to promote economic efficiency and investment-friendly context in the sector, has often precluded appropriate consideration of energy efficiency on the end-use side. These power-sector reforms have shown only mixed success in most developing countries, with the agenda often driven by aid agencies, consonant with the general worldwide shift towards market-based and private-sector led approaches. This has also resulted in scant attention being paid to broader environmental or sustainability concerns.[121]

Furthermore, the single-minded focus on the commercial energy sector frequently ignores the issue of energy for the poor. While there have been some efforts towards tackling this problem, they generally have not been commensurate with the magnitude of the challenge (China being a notable exception). In some sense, the appearance of the climate change issue has served to further marginalize energy-poverty, since domestic and international concerns have been directed towards GHG emissions growth in developing countries. This overlooks the two billion people who by

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124. World Resources Institute, *Power Politics: Equity and Environment in Electricity Reform* (N. Dubash ed., World Resources Institute 2002), *available at* http://pubs.wri.org/pubs_pdf.cfm?PubID=3159.

virtue of their involuntarily low-energy-consuming lifestyle are contributing to the goals of the climate convention. This leads to a "polluters get paid" principle, while non-polluters get ignored.[122]

Yet, there are also possibilities for approaches with synergistic positive outcomes across multiple challenges. For example, a concerted focus on improving the efficiency of energy use would help reach multiple goals at the same time. It would reduce the pressure to expand energy supply, therefore contributing to energy security. Energy efficiency would also mitigate greenhouse gas emissions per unit of energy service delivered and also decrease local air pollution. Similarly, appropriate attention to renewables could supplement the energy supply while also helping to ameliorate energy poverty through judicious choice of technologies and applications, like solar lanterns, micro-hydro, and biomass gasification. Improvements in traditional technologies such as improved cookstoves or the introduction of modern energy services to the poor can make a positive climate impact by eliminating products of incomplete combustion that are greenhouse gases.[123] These technologies will also deliver significant positive health and other benefits to users.

B. *Interactions Between Energy and Climate Policies of Industrialized Countries and Developing Countries*

There are numerous links between the energy and climate policies of industrialized and developing countries. For primary energy sources such as oil and natural gas, where demand has strained the global energy markets and caused recent price increases, the large appetite of industrialized countries far outweighs the demand in developing countries. The latter economies, however, are more sensitive to such price increases.

Climate policies of industrialized countries affect developing countries in two ways. One, GHG emissions from industrialized countries are much larger than those of developing countries. The long atmospheric lifetime of these GHGs further magnifies the responsibility of industrialized countries for climate change. But, it is the developing countries that are generally

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125. Ambuj Sagar, *A "Polluters Get Paid" Principle?*, ENVIRONMENT, Nov. 1999, at 4-5; Ambuj Sagar & T. Banuri, *In Fairness to Current Generations: Lost Voices in the Climate Debate*, 27(9) ENERGY POLICY 509, 509-514 (1999).

126. *See generally* Kirk R. Smith et al., *Greenhouse Implications of Household Stoves: An Analysis for India*, 25 ANNUAL REVIEW OF ENERGY AND THE ENVIRONMENT 741, 758-9 (2000) ("Biogas, being based on a renewable fuel and, because it is a gas, being combusted with high efficiency in simple devices, has by far the lowest GWC [global warming commitment] emitted at the stove per meal and is indicative of the advantage that upgraded fuels made from biomass have in moving toward sustainable development goals.").

more vulnerable to the manifestations of a changing climate and more likely to suffer greater human and economic impacts. Two, climate policies in industrialized countries are being increasingly linked to mitigation policies in developing countries. This puts pressure on the latter to take on commitments to reduce GHG emissions growth, which in turn has implications for their development aspirations. Furthermore, the energy and climate policies in industrialized countries have ramifications for the deployment of new and improved energy technologies in developing countries. Since developing countries generally have limited capacity to develop such energy technologies on their own, enhancement of their energy sectors is often contingent on the availability of these technologies from industrialized countries. But the development of such technologies is driven by energy and environmental policies of industrialized countries. This has perhaps the greatest implication for energy for the poor, an issue that receives only marginal attention in industrialized countries even though their technological capabilities could make an enormous contribution.[124]

The framing of the problem invariably shapes the search for the solution. Clearly, in the energy and global environment arena, the lines of influence run more strongly from industrialized to developing countries than vice-versa. This is contrary to the common portrayal in the media and by many analysts of the risks posed by the growth in energy demand and greenhouse gas emissions in developing countries. Therefore, a better understanding of the energy needs and aspirations of developing countries, viewed in a global and historical context, is imperative. Such a foundation is necessary for jointly solving the energy and environmental challenges faced by the global community of nations in the twenty-first century.

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127. In fact, despite the recognition of the urgent need to provide modern energy services and infrastructure to the poor is crucial, aid to developing countries from OECD countries have reduced to low levels – perhaps "a conscious decision to neglect the needs of people living in poverty, despite overwhelming rhetoric to the contrary."
REALITY OF AID, EARTHSCAN (2000), http://www.realityofaid.org.