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Fighting climate change:
Human solidarity in a divided world

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Access to Energy and Human Development

Amie Gaye

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Introduction

Access to modern energy services is fundamental to fulfilling basic social needs, driving economic growth and fueling human development. This is because energy services have an effect on productivity, health, education, safe water and communication services. Modern services such as electricity, natural gas, modern cooking fuel and mechanical power are necessary for improved health and education, better access to information and agricultural productivity.

There are wide variations between energy consumption of developed and developing countries, and between the rich and poor within countries, with attendant variations in human development. Furthermore, the way in which energy is generated, distributed and consumed affects the local, regional and global environment with serious implications for poor people's livelihood strategies and human development prospects[1].

This paper attempts to examine the linkages between energy services and human development in developing countries. It does so by comparing modern energy use in developed and developing countries and argues that a threshold of modern energy is required to achieve growth and improvement in human development. The paper also assesses the effect of fossil fuel use on greenhouse gas emissions and developing countries' capacity to adapt to climate change. It discusses the dual challenge of mitigating climate change and meeting the energy demands of developing countries in a sustainable way.

The paper is divided into three main sections. Section one examines inequalities in access to modern energy services and how they impact on livelihood strategies, health, education and human development in general. Section two looks at adaptation capacities of developing countries, whilst section three discusses strategies for mitigating climate change while at the same time meeting the energy demands of developing countries.

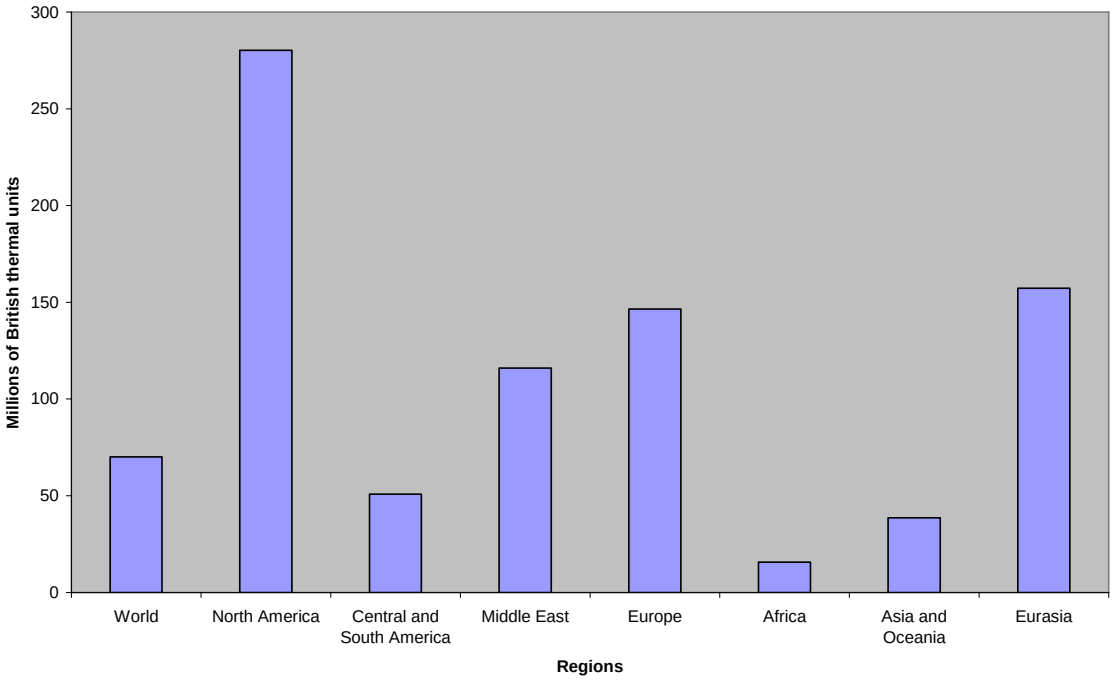
1. Inequalities in Energy Consumption

While the world's average energy consumption is estimated at 1.7 tonnes of oil equivalent (toe) per person per year in 2004, there are wide variations between industralised countries and developing countries energy consumption levels. Per capita

[1] Biomass harvesting without agro-forestry management can lead to land degradation including loss of vegetation cover. Atmospheric concentration of carbon dioxide (CO2) has been increasing as a result of energy generation, transportation, industrial and other social activities, resulting in climate change, which is one of the major challenges facing humanity this century. Annual flow of CO2 (including those emanating from land use changes) is suspected to have reached eight gigatons of carbon (GtC) in the last decade. The 2006 World Energy Outlook Report projects that if the current trends continue, CO2 emissions will increase from 26 billion tonnes in 2004 to 40 billion tones in 2030.

energy consumption in North America for example, is about 18 times that of Africa and four times the world average (see Figure 1).

Figure 1: Per capita energy consumption (in Million Btu*) for select regions, 2004



* 1 million Btu = $2.52*10^{-8}$ Million tones of oil equivalent
Source: Based on Data on World Per Capita Primary Energy Consumption for 2004, Energy Information Administration (EIA), August 2006. http://www.eia.doe.gov/pub/international/iealf/tablee.1c.xls

In the past 25 years, access to electricity and modern energy services have been extended to over one billion people around the world. Commercial energy use by developing countries has also increased at a rate higher than the OECD countries. On a per capita basis, however, this has not resulted to equitable access to modern energy services. About 2.5 billion people, mostly in developing countries, still rely on traditional biomass fuels for cooking and 1.6 billion people lack access to electricity (Modi et al, 2005) due to reasons of availability and affordability.

There are also wide variations between energy consumption levels of the rich and poor. On average, the poorest 2.5 billion people in the world use only 0.2 toe per capita annually while the billion richest people use 5 toe per capita per year, which is 25 times more. In terms of electricity consumption, the richest 20 per cent uses 75 per cent of all electricity while the poorest 20 per cent uses less than 3 per cent[2] (World Energy Council, 2000 cited in Rosario 2002).

2 The United States tops the energy consumption ladder with 8.0 toe/person/year, followed by India and China with an average energy consumption of 7.3 toe per person per year each. On per capita basis, however, Canada consumes the most energy in the world. Its per capita energy consumption is 6.4 times the world average while that of the United States is 5.1 times and Western Europe's is 2.3 times the world's average (Pineau, 2006). Italy consumes the least energy among the industralised countries (3.1 toe per person per

Variations in modern energy consumption across countries partly explain the wide variations in human development, even among developing countries. United States uses about fifteen times more energy per person than does a typical developing country. While its share of the world's population is only 4.6 per cent, it accounts for 24 per cent of the world's energy consumption and over 30 per cent of GDP GDP. But the least developed countries (LDCs) with 10 per cent of the world's population account for about 1 per cent[3] of energy consumption and a mere one per cent of the world's GDP[4] (Huq, et al. 2003).

Pasternak (2000), used 1997 data for the 60 most populous countries in the world (excluding Afghanistan, North Korea and Taiwan for which the HDI is not calculated) to analyse the relationship between electricity consumption and the Human Development Index (HDI). The analysis revealed that a threshold of annual electricity consumption of 4,000 kWh per capita is required to achieve an HDI value of 0.9 or greater.

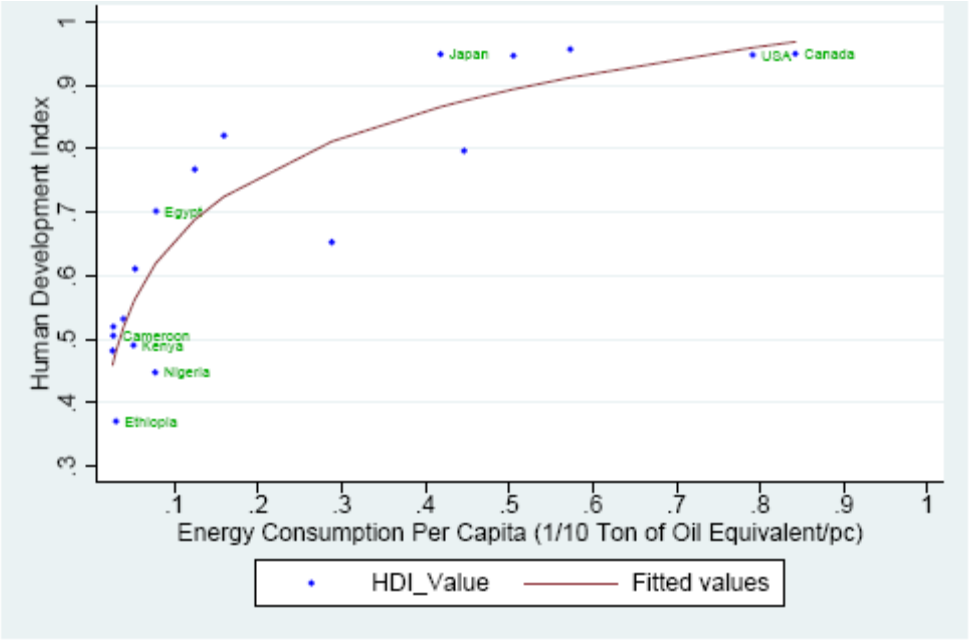
Although four countries with electricity consumption levels slightly above the threshold have HDI below 0.9 (these include South Africa where life expectancy at birth has declined by over 15 years between 1990 and 2004 due to a high HIV prevalence rate), the analysis found no country with annual consumption of electricity below the 4,000 kWh per capita threshold with an HDI of 0.9 or greater. Consumption above 4,000 kWh per capita was found not to have any significant increase in HDI value. Of the countries in the study with HDI below 0.6, 19 had annual per capita electricity consumption of less than 1,000 kWh.

For the 31 low human development countries,[5] electricity consumption per capita is below 1000 kWh. It ranges from a low 11 kWh per capita in Chad to 998 kWh per capita in Zimbabwe (HDR 2006, see also Figure 2). Against this background, strategies to mitigate climate change should not limit the ability of least developed countries to meet their basic energy needs for development but rather support access to cleaner energy sources.

year. Africa has average energy consumption of only 0.14/person/year, a ratio of 1:57, compared to the United States. Average energy consumption in Bangladesh is as low as 0.08 toe per person per year, which is a ratio of 1: 100 when compared to the United States.

[3] Base on energy consumption data from the International Energy Agency (IEA).
[4] It must be noted however that there is no automatic link between GDP growth and human development.
[5] All except for Haiti are in sub-Saharan Africa.

Figure 2: Per Capita energy consumption and HDI value, 2004



Source: Based on HDI values from HDR 2006 and Energy consumption for 2004 from IEA

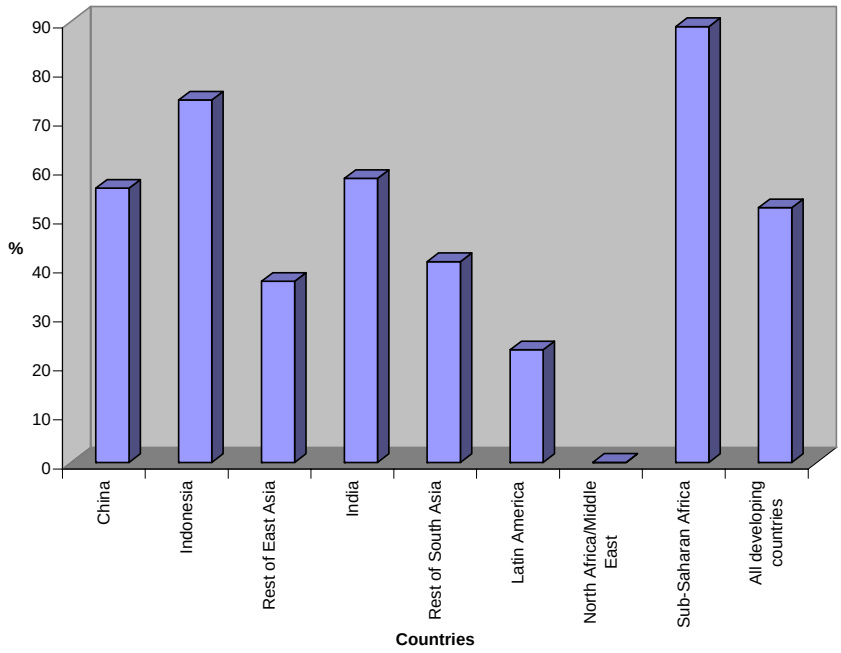
Energy Poverty

Energy poverty can be defined as the *"inability to cook with modern cooking fuels and the lack of a bare minimum of electric lighting to read or for other household and productive activities at sunset"* (UNDP 2005). By this definition, the 2.5 billion people relying on biomass for cooking and the 1.6 billion people with no access to electricity could be classified as being energy poor.

Firewood, dung and charcoal dominate household energy consumption in many developing countries. The lack of access to modern energy services is more acute in Sub-Saharan Africa where 89 per cent of the population still relies on biomass energy compared to 0.05 in North Africa and the Middle East (see Figure 3).

Africa's energy situation is paradoxical in that the continent desperately needs energy for economic growth and poverty reduction, yet it is a net exporter of commercial energy. The continent is home to about seven per cent of the world's commercial energy yet it accounts for only three per cent of global commercial energy consumption (Practical Action, 2005)

Figure 3: Percentage of population using biomass for cooking and heating in developing countries

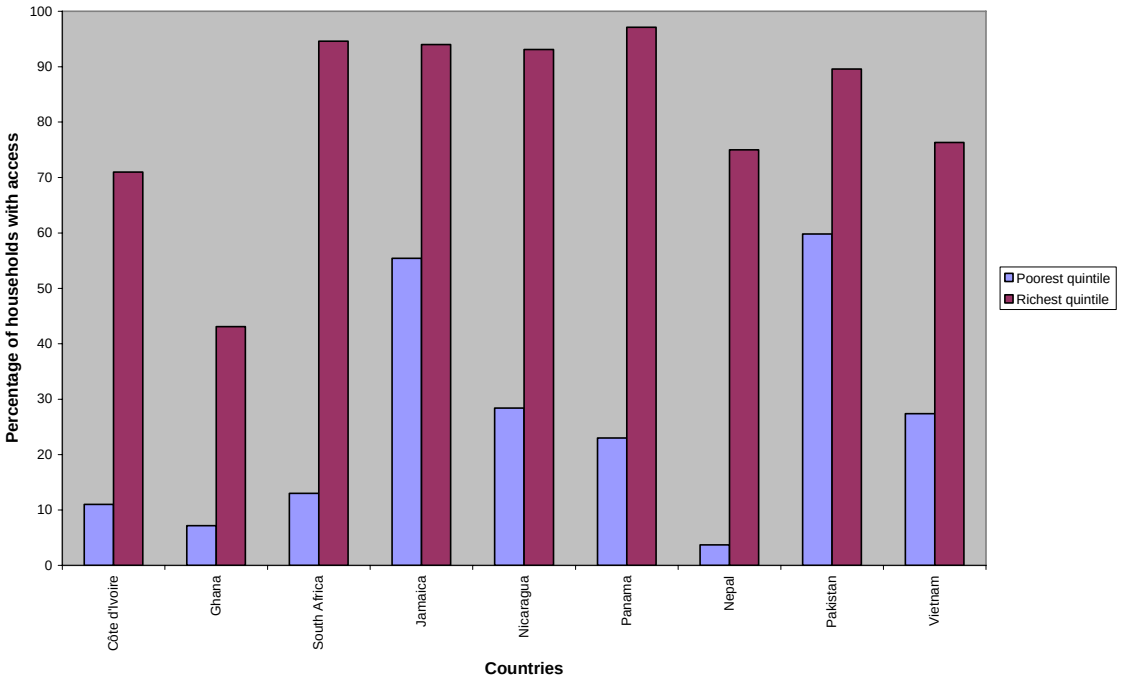


Source: Based on data from Modi et al. (2005)

Factors contributing to low access to modern energy services in developing countries include but are not limited to low income levels among un-served populations, unequal distribution of modern energy services, lack of financial resources to build the necessary infrastructure, weak institutional and legal frameworks and a lack of political commitment to scale up services.

A case in point is in India where average annual consumption of commercial energy per person is between 400kgoe (kilograms of oil equivalent) and 500kgoe but the poor cannot afford or may not have access to the basic minimum of 50kgoe, reflecting income inequality and limited availability of services. In Brazil poor household in the north and northeast of the country still rely on biomass. The gaps between rich and poor in electricity access and consumption in many countries are often huge (see Figure 4).

Figure 4: Disparities between rich and poor in electricity use



Source: Based on data from Dominique Lallement, 2001

1.2 Economic and Social Cost of Using Traditional Energy

Poor people pay a high price in health, labour, time and cash for the energy they use. Moreover, they spend a much greater proportion of their income on energy than wealthy people. A survey in Burkina Faso for example found that the poor devote 5.6 per cent and 1.3 per cent of their income to firewood and kerosene respectively. In Guatemala and Nepal, wood expenditure for households in the poorest quintile accounts for 10-15 per cent of total household expenditure (Heltberg 2003). This is not only because the incomes of poor people are much smaller but also because the type of fuel and stoves they use are less efficient.

1.2.1 Health cost

In most cultures, staple foods are subjected to lengthy cooking. Cooking takes at least 30-45 minutes and can last for two to three hours in some African cultures. Burning of solid biomass in inefficient stoves and/or in unventilated spaces produces pollutants, such as carbon monoxide, resulting in indoor air pollution.

Epidemiological studies show a strong connection between indoor air pollution (IAP) and acute respiratory infections (ARI) in children and chronic obstructive pulmonary diseases in adults. ARI is said to be the principal cause of absenteeism in school in many developing countries, accounting for more than one-third of school time in Uganda. In rural Uganda, children under the age of five are reported to suffer 1-3 episodes of ARI annually, each episode lasting for 7-9 days (Uganda's HDR, 2005).

A study in The Gambia found that girls aged under-five carried by their mothers while cooking have a six times higher risk of lung cancer than if their parents smoked and they were not exposed to indoor air pollution from cooking (WIN News, 1998). Chimneys are impractical in most rural homes because the roofs are thatched with grass. According to statistics, IAP is responsible for about 1.8 million deaths per year. This is double the amount of malaria related deaths. In India, it is estimated that there are 500,000 premature deaths each year in women and children aged under-5 as a result of solid fuel use (Holdren et al, 2000). Lower respiratory infections in children are known to end up as pneumonia, which is responsible for 19 per cent of deaths in children under five worldwide. A recent study projects that in the next 25 years, 10 million women and children in sub-Saharan Africa will die prematurely from the smoke produced by the cooking stoves, if the trend in current energy use continues (William, 2005).

Research has also shown that carbon monoxide, one of the compounds in wood smoke, reduces a pregnant woman's placental blood flow, making it more likely for her to bear an underweight baby (Ezzati, 2006). It is also estimated that by 2050 smoke from wood fires will release at least seven billion tonnes of greenhouse gases into the environment each year if current rates continue (ibid).

In China, the main sources of outdoor air pollution are power generation, energy use in industries, small scale heating and cooking, road transport and construction. About two-thirds of China's energy is from coal. Coal exposes humans to benzopyrene.[6] An investigation in 26 cities between 1976 and 1981 found a positive correlation between concentration of benzopyrene, and death from cancer (China's HDR 2000). Over half of the Chinese people and a fifth of the urban population rely on coal for household energy. Cooking with tinted coal has the potential to expose people to arsenic, fluorine, lead and mercury. Incidence of asthma among children in Chinese cities is said to be rising due to increased air pollution – an estimated three-fold increase in 2000 compared to ten years ago.

1.2.2 Energy and Gender

There is a differentiated impact of access to energy services for women and men but gender and energy concerns hardly enter macro-level policies. In most of the developing world, food processing, and water and firewood collection are traditionally female gender roles and take much of women's and girls' time and energy.

Labour intensity of fire wood collection depends on many factors. Availability of wood, for example, influences traveling distance and time women spend collecting it. Household size and the amount of load a woman is able to carry at a time are all important determining factors. The season of the year also influences the amount of wood to be collected. Especially in May and June when wood has to be stocked for the winter, women and their children sometimes have to gather firewood twice a day, each trip

[6] Benzopyrene is a product of incomplete combustion at temperatures between 300 and 600°C. It is found in coal tar, in automobile exhaust fumes, especially from diesel engines, tobacco smoke, and in charbroiled food.

taking up to two hours. Some rural women are reported to carry up to 20 kilograms of firewood traveling an average distance of five kilometers (Practical Action, 2005) Sometimes this is done with a baby strapped on the woman's back. In Tanzania, the amount of time females use collecting water and firewood is estimated to be 250 hours and 700 hours per person per year respectively. In rural India, an average of 37 hours is spent per person on wood collection per month (Modi et al. 2005).

The effect of fuelwood use on women's health, future potential and safety can be quite severe. Transporting heavy loads of firewood on foot makes them vulnerable to back injuries. Sometimes girls have to forgo their education to fetch wood for the family, trapping them in inter-generational poverty. A study in Malawi found that literacy levels were lower in fuelwood stressed southern and central regions compared to the northern region where fuelwood is more easily available. The study further found a strong association between the time children spends on resource collection and a reduced likelihood of school attendance, especially among girls (Nankhni and Findes, 2003).

The time spent by women doing drudgery domestic chores such as pounding, and collecting firewood and water reduces the amount of time they can devote to income generating activities. Productivity of income generating activities is also facilitated by access to improved energy for heating and lighting. Access to modern energy services can therefore improve the lives of women by improving their health condition, reducing their time poverty, and improving the productivity of their income generating activities.

Women and girls are also exposed to the risk of sexual assault during the course of firewood collection. Refugee women and girls in particular, are highly vulnerable to sexual violence because of the daily need to leave their camps in search of firewood. In natural resources stressed Darfur, for example, refugee women and girls trek hours in search of fuelwood. To avoid walking long distances under the sun, many leave at dawn, either alone or in small groups, to lessen having to compete for the scarce resource. In August 2006 the International Rescue Committee (IRC) reported 200 assault cases during such searches in a five week period from a single camp. Given the stigma associated with rape, it is highly likely that the number of cases is grossly under-reported.

1.2.3 Energy and HIV/AIDS

In 2005, it was estimated that over 65 million people around the world were living with HIV. Developing countries, especially Sub-Saharan Africa, has a disproportionate share of infected persons. Increased HIV/AIDS related mortality, prolonged illness and increasing need to care for the sick, have resulted in labour shortage and increased vulnerability of affected households to hunger and poverty. Access to modern energy services can substitute for labour required for food processing and firewood and water collection. Access to electricity can also increase coverage of HIV/AIDS education campaigns using radio and television.

Lack of access to energy services leads to a vicious circle of poverty, poor health, low productivity and household food insecurity. Yet energy concerns are not adequately

addressed in many poverty reduction strategies. A review of 54 PRSPs by UNDP revealed that energy priorities in PRSPs are geared towards electrification, with emphasis on expanding supply rather than accessibility, affordability and choice of energy services for poor and rural people. Technological options also tend to favour large-scale hydro-power and fossil fuel power plants, with no or little attention to energy needs of women with respect to cooking and agro-processing.

Access to energy services is particularly important in meeting MDGs eradicating extreme poverty, achieving universal primary education, promoting gender equality and women's empowerment, reducing child mortality, improving maternal health and ensuring environmental sustainability. Under the current energy scenario, it is unlikely that energy-poor developing countries will achieve these MDGs.

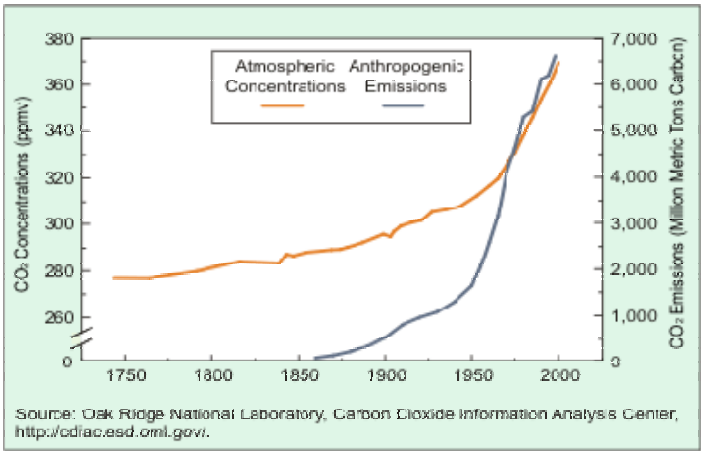
The 2006 World Energy Outlook Report estimates that it will costs US$8 billion (including capital and fuel) a year up to 2015 for the 2.5 billion people currently using biomass for cooking to switch to liquid petroleum gas. This is equivalent to around 0.005 per cent of the world GDP in 2006. This is not impossible for the world to achieve, considering the aggregate subsidies on fossil fuels in industrialised countries is estimated to be US$200 billion per year (Gelbspan, 2004).

2. Climate Change Impact, Adaptation and Energy Challenge

Beginning with the industrial revolution in the 1850s and acceleration thereafter, the human consumption of fossil fuels has raised carbon dioxide (CO_2) levels from a concentration of approximately 280 parts per million (ppm) to more than 370 ppm today. These increases are projected to reach more than 560 ppm before the end of the 21st century. Along with rising methane levels, these changes are anticipated to cause an increase of 1.4–5.6 °C between 1990 and 2100.

Figure 5: Trends in Atmospheric Concentrations and Anthropogenic

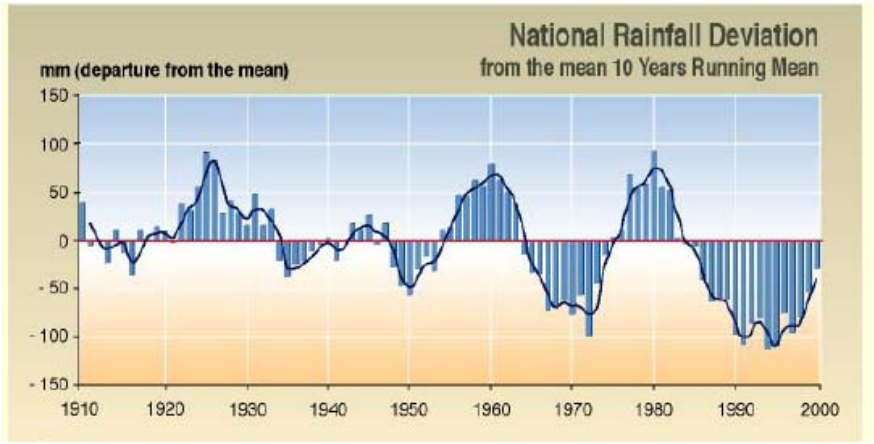
Emissions of Carbon Dioxide



The impact of climate change is already evidenced through rising sea levels due mainly to the thermal expansion of oceans. Rainfall variations, and increased frequency and severity of natural disasters, such as floods and droughts, are also disrupting agricultural activities with serious human development implications, especially for agrarian economies. Changes in precipitation can result in loss or variability in hydro-electricity potential, variations in runoff and impacts on biomass production, creating tensions between population sub-groups. Failure of rainfall and resulting water scarcity has been partly blamed for the violent clashes in Darfur. However, as noted by Sachs, 'when violence erupts in water-starved regions such as Darfur in Sudan, political leaders tend to view the problems in narrow political terms' (Sachs, 2005).

In Zimbabwe, a country where 80 per cent of the 10 million people rely on firewood for cooking, wood is said to be running out. The 1992 drought that hit the country is recorded to be the worst in the century. Rainfall in many parts of the country has been reduced to less than a quarter of that in normal years (see Figure 6).

Figure 6: National rainfall deviation



Sources: http://weather.utande.co.zw/climate/climatechnage.htm.

The Sahel region has also not fully recovered from drought that occurred in the 1970s, which killed over 250,000 people and 3.5 million cattle (Dispatch # 31). This has increased the region's vulnerability to hunger and poverty. Rainfall in the region has been reduced by 30 per cent and contributed to loss of productive tree species which require moist conditions, leaving less productive thorny species adapted to arid conditions. In Mali, 6.5 million tonnes of wood was consumed in 2000 alone, an equivalent of 1.5kg/person/day. This has a tendency to increase the pace of deforestation and aggravate the already vulnerable livelihood systems of poor people.

Increased frequency and severity of floods are other disasters that the poor have to grapple with. In 2004, severe flooding in Bangladesh caused by excessive rains killed over 600 people and displaced over 20 million.

While developing countries are disproportionately affected by climatic related disasters, in many instances they have limited capacity to adapt. The limited capacity to adapt stems from a lack of the necessary institutional framework, financial resources, and technical know-how to develop and implement effective adaptation strategies. For example, there is a lack of technical capacity and financial resources needed to make a shift to cleaner energy sources. In this regard, there is a need for a global framework that supports strategies and interventions in developing countries aimed at improving access to clean modern energy services as an engine for development, as well as to reduce vulnerability to negative effects of climate change.

As noted earlier, access to modern energy services can improve well-being and reduce poor people's vulnerability to further impoverishment. In Bhoksing, one of the most remote villages of the Parvat district in Nepal, access to electricity according to the villagers, has turned the village into 'heaven'. Villagers feel that their livelihood strategies have become more reliable and rewarding (see Box 1).

Box 1: Rural Energy made the village like heaven

Bhoksing VDC is one of the most remote and backward villages of Parvat district but with the generation of electricity, the village have been one of the exemplary villages of Nepal. All the 227 households of the village are illuminated by electricity. The village, which was once very backward, has now turned to be one of the most beautiful and attractive places due to the electricity, which has opened up many opportunities. With the support of REDP, a total of 21 kW of electricity has been generated from Chharchhare Khola (9 kW), Chhahare Khola (6 kW) and 6 kW from two peltric sets which benefits 221 households of the village. There are 17 solar home systems and 2 toilet attached biogas plant with REDP's support. Almost all the households have improved cook stoves in the village. A total of 1,468 population is directly benefited from these rural energy systems. The District Council of Parvat has declared Bhoksing as "Urja Gaun" (Energy Village) in 2000 for its achievements. The community members have made Rs. 224,456 (US $3,206) from weekly savings and made investment of Rs. 560,030 in various income generation activities including bee keeping, vegetable and poultry farming.

Four people have started poultry farming and so far, they have made a total of Rs. 38,000 (US $ 542) income. Mr. Chandra Prasad Lamichhane has been utilizing the headrace water for his water mill, which he runs during the daytime. He has been making an average income of Rs. 8,000 (US$ 115) per month from the poultry farming and water mill. People have started battery charging and video show, which makes a profit of Rs. 4,000 (US$ 57) per month. Potato chips making has also been recently started.

" The village has become like heaven as there is electricity and almost all the people have started some income generation programmes from the loan assistance of the community organization, "says Mr. Lamichhane. "Electricity has opened our eyes and our village has become an exemplary village", he adds.

Source:
http://www.undp.org.np/successstories/successstories.php?StoryID=22&showStory=1

In rural India, some communities are meeting their electricity demand through decentralised diesel generators, which are used to power irrigation pumps and television sets. These generators have allowed rural farmers to grow more crops, improved access to information in isolated communities. However, increased demand for electricity met through diesel is reported to be creating pollution problems in many Indian villages.

In Mali, access to energy services has changed the lives of villagers tremendously, especially women. The social impacts access to electricity includes but not limited to

improved service delivery – lighting of health centres, schools, refrigeration of vaccines and community services such as milling of grains and access to information and increased girls enrolment (see Box 2).

Box 2: Diesel powered Multifunctional Platforms reduce the workload of Women in Mali

Mali is one of the poorest countries in the world. Its GDP per capita in PPP terms is only US$998. It ranks 175 out of 177 countries in the Human Development Index (HDR 2006). Electricity consumption per capita is only 38 kWh per annum. Nearly three-quarters of its 12 million people live in semi-arid rural areas where poverty is most severe and electrification is virtually non-existent. The country's energy demand is mostly met by biomass, especially in rural areas. Women and girls are responsible for firewood collection, which is both labour intensive and time consuming.

In 1993, the United Nations Industrial Development Organisation (UNIDO) and the International Fund for Agricultural Development (IFAD) initiated a programme to decrease the burden of fuel collection by supplying labour-saving energy services and promoting women's empowerment by supplying multifunctional platforms to rural villages. The multifunctional platform is a 10 horsepower diesel engine with modular components that can supply motive power for time consuming and labour-intensive work such as de-husking and electricity for lighting (approximately 200-250 small bulbs), welding or pumping water. Between 1999 and 2004, 400 platforms were installed reaching about 8,000 women in villages across the country.

Although the benefits are shared by many in the villages, women's organisations own, manage and control the platforms. Capacity building and institutional support by the project, was strong in the early phases of the programme and has made it possible for project staff to reduce their presence on the ground and allow women's groups to take charge of platform operation. Relying on a network of private suppliers, technicians, and partners has also contributed immensely to the success of the programme.

In terms of funding, the women's groups cover 40-60 per cent of the initial costs while the remainder is covered by international donors and local partners. A study of 12 villages participating in the programme revealed the following impacts:

1. The platforms reduced the time required for labour-intensive tasks from many hours to minutes. The time saved is used for income generating activities leading to an average daily increase in women's income of US$0.47. This is quite significant considering that over 64 per cent of the population lives on less than US$1 a day.

2. The ratio of girls to boys in schools and the proportion of girls surviving to fifth grade have improved, as young girls are needed less to support household chores.

3. Increased time income generating activities and improved women's socio-economic status following the introduction of the platforms correlate with improvements in women's health and frequency of visits to local clinics for pre-natal care.

Source: Adapted from Modi et al. (2005)

While fossil fuel use, exploration, transportation, transformation and distribution have detrimental effects on the world's atmosphere, any strategies to deal with climate change should not limit the developing countries quest to meet their basic energy needs for development and poverty reduction. In the short term, there is a need to draw a distinction between fossil fuel use in developing and industralised countries. In the least developed countries in particular, energy consumption and greenhouse gas emissions are

low both in per capita and aggregate terms and the concern should be on the local environment. By contrast, fossil fuel use in industralised countries and emerging economies like China and India is high aggregate emissions terms and therefore significant on a global scale.

Current fossil fuel consumption level in Sub-Saharan Africa, for example, is so low that an annual increase of 10 per cent emission per capita will remain low -- at levels below 5 per cent of those in industralised countries (Modi et al. 2005). For instance, if Ethiopia's fossil fuel consumption was to increase six fold by 2015, its per capita carbon dioxide emission would still be 30 times less that of the United States (ibid). It is also estimated that, if the 2.4 billion people relying on biomass for cooking were to switch to liquefied petroleum gas (LPG), it would add less than 2 per cent to global greenhouse gas emissions from fossil fuel.

In its 2006 World Energy Report, the International Energy Agency (IEA) estimates that a switch from biomass to LPGs will increase world energy demand by a mere one per cent by 2030. In this regard, any strategies for emission cuts should be based on the principle of 'common but differentiated responsibility'. In the short term, countries with low emissions should have room to increase their emissions in order for them to develop. This will help address the sense of inequity arising from unrequited carbon debt.

In the long term, efforts at improving access to energy should focus on providing financial and technical support to help developing countries leapfrog to cleaner energy sources. Access to renewable energy resources are improving in some developing countries and support should be provided for scaling up. For example, biomass generators are making in-roads in India and Southeast Asia, solar-powered lanterns and cooking stoves are emerging in Africa, as are roof top water tanks in China.

While developing countries have contributed little to greenhouse gas emissions, they are the most vulnerable to the adverse effects of climate change due to their over-dependence on their environment. Presently, developing countries' ways of adapting to climate change include shifts in planting periods, changes in crop varieties and investment in infrastructure such as building of dykes. But more needs to be done to strengthen the adaptive capacities of developing countries to adverse effects of climate change. The industralised countries with greater responsibility for current emissions should support poor countries to improve access to cleaner energy technologies. This should not be deemed as charity but rather as compensation for damages imposed by industralised countries on the world's poorest people.

Under the Kyoto Protocol three funds have been set up to help developing countries cope with climate change. The first is the Adaptation Fund[7] which is expected to be funded

[7] Though initially created in 2001, the Adaptation Fund has not yet been operationalised. Furthermore, because of its future potential of attracting a relatively large amount of money (through the 2% levy on CDM projects), issues surrounding the Fund's management have become a crucial point of contention among developed and developing nations.

from a levy on CDM projects. The other two, LDC Fund[8] and the Special Climate Change Fund (SCCF)[9], are voluntary and have so far received little contribution. Total pledges to the LDC Fund and the SCCF to date is approximately US$42 million and US$38 million respectively**.** In contrast, the World Bank estimates that the global cost of total adaptation through "climate proofing" developments in developing countries range between US$10 billion and US$40 billion annually.

Improving Access to Modern Energy Services to Mitigate Climate Change

It is estimated that 16 million tonnes of carbon dioxide are emitted into the atmosphere every 24 hours worldwide. The United States is the world's largest single emitter accounting for nearly a quarter of energy related carbon emissions. However, emissions from fast developing countries such China and India are also growing. It is estimated that half of the projected increase in emissions from new power stations, mainly using, coal will be from China and India. By 2010 China will overtake the United States in emissions (IEA, 2006). This notwithstanding, China's per capita emissions would still be just 60 per cent of those of OECD in 2030.

If all emissions were to stop today, the CO_2 that has already been emitted will result in an enhanced GHG effect for the next 50 years. Meeting the energy needs of un-served populations in developing countries while at the same mitigating climate change is a major challenge and requires a number of government actions and international cooperation in promoting renewable energy, enacting proper regulations, attracting sufficient investment in clean energy development, reworking the tax structure to remove barriers to energy access, as well as effective targeting of energy subsidies with clear exit strategies.

Brazil, Chile, China, Morocco and Tunisia for instance, have managed to improve access to modern energy services for their populations, which has led to growth and improvement in people's well-being. Between 1960 and 2004, the proportion of the Brazilian population using LPG for cooking increased from 16 per cent to almost 100. Tunisia's electrification programme expanded services from 6 per cent in 1976 to 88 per cent in 2001.

China and Morocco's electrification rate reached 97 per cent and 72 per cent respectively in 2004. These expansions were made possible because of a combination of factors, among which are public sector funding that combined domestic resources with borrowing from development banks, effective cost recovery tariffs, and efficient targeted subsidies.

Senegal achieved success in cooking energy switch by removing taxes on cooking gas equipment and subsidising gas prices (see Box 6).

[8] The LDC Fund is meant to provide support to LDCs to prepare National Adaptation Programme Action (NAPA).

[9] The SCCF is to fund projects relating to adaptation, technology transfer and capacity building, energy, transport, agriculture, forestry and economic diversification.

Box 6: Senegal's experience with subsidies

In 1974, the Government of Senegal promoted the use of butane gas for cooking to address the problem of deforestation. All butane related equipment were exempted from custom duty and in 1976, gas itself was subsidized. In 1988, subsidies were increased further -- the retail price dropped by about 38 per cent and demand for gas enlarged sharply. Annual consumption rose from below 5000 tonnes to 15,000 tonnes in 1987 and more than 100,000 tonnes in 2004. By the time the subsidy on gas was partially withdrawn in 1998, 85 per cent of households had switched to cooking with gas. The subsidies, exemptions and tax reduction widened access to poor households. Although the growth of demand slowed down from about 15 per cent in 1999 to 6 per cent in 2001, the 80 per cent reduction in subsidy did not stop the demand for gas.

Source: Sokona et al., 2003

Privatisation of utility companies and removal of subsidies

Electricity generation and distribution in most developing countries, especially in Africa were for many years carried out through state-owned enterprises. During these periods, most countries experienced rapid economic growth as a result of high prices of primary exports that permitted the state to grant subsidies that kept state economic crisis in the 1980s, the Bretton Woods Institutions (the World Bank and the International Monetary Fund) prescribed privatisation of state enterprises including utility companies because it was felt that public enterprises could not deliver efficient services.

Experiences from Cameroon, Senegal and other countries, show that liberalisation and privatisation of electricity services promoted as an option for efficient delivery of electricity services have not been successful in meeting the energy needs of rural people (Jaff, 2003). This is because most multinational companies prefer large-scale energy production through an interconnected grid geared to serve the urban market. While such bulk supplies are economical for the private enterprises, they do not necessarily improve access to the millions of energy-poor rural households.

Public utility companies in many developing countries, especially in Africa, have not been effective in supplying electricity in rural areas. Private companies, however, are not likely to achieve this objective without the promotion of decentralized energy generation with some public funding. In least developed countries many people, especially in rural areas, will not have access to energy if it is delivered on commercial basis. Private electrical companies obviously must cover the cost of operations and make profits. In this regard, tariffs may not be subjected to social considerations and may therefore not take into consideration the income levels of poor households. Electricity supply in developing countries, where poverty is endemic, should be treated as a social amenity that can help lift the poor out of poverty. Therefore, public sector funding and efficient targeted subsidies with clear exit strategies are required to meet the energy needs of the 2.5 billion relying on solid biomass.

Fossil fuel subsidies are common in developed countries. In 2004, aggregate subsidies for fossil fuels in industralised countries were estimated to be US$200 billion per year (Gelbspan, 2004). The United States alone spends more than US$20 billion a year on subsidised fossil fuels. According to Pineau (2006) high income households in British Columbia, Canada receives an average of US$500 per year in subsidies and low income

households US$200 per year. This is equivalent to US$416 million a year, the bulk of which benefit rich households in British Columbia.

In the United States, energy subsidies take three forms—direct payment to producers and consumers, tax expenditures, and research and development. It is estimated that the United States federal energy subsidy totaled US$6.2 billion in 1999 (EIA, 2000xiii cited in Pineau 2006). Indirect subsidies transferred by federal utilities (four Power Marketing Administration and Tennessee Valley Authority) to customers amounted to US$1.4 billion in 1998 (ibid). If energy subsidies are to be removed, they should happen in countries where energy consumption is high and efficiency gains would have the biggest impact.

Komives et al. argue that utility subsidies in developing countries should be seen as a potential part of a package of policy measures to help ensure access to utility services for poor households.

The United Nations Millennium Project estimates that it will cost approximately US$15 - US$20 per person per year to meet the basic energy needs of energy poor people. This is equivalent to US$37.5 billion to US$50 billion per year. Fossil fuel subsidies in developed countries could be invested in clean energy technologies in developing countries to help meet these costs.

One of the ways to increase access to clean energy, while at the same time mitigating global climate change is to improve access to electricity through grid-connected renewable energy systems. However, these systems require large capital investments. In sub-Saharan Africa, average solar radiation potential ranges from 5 to 7 kWh/m2/day[10] but the region accounts for only 1.3 per cent of world photovoltaic production capacity. Only 7 per cent of hydraulic energy potential is exploited due to lack of financial resources and other constraints. International partnership is required to raise the required financial and technical resources needed to expand access to clean energy.

This is where carbon financing can play a major role in mobilising the needed resources for clean development in the least developed countries. As of September 2006, total the global carbon market grew in value to an estimated US$21.5 billion. The project-based market also grew to an estimated value of US$3 billion by October 2006 (World Bank 2006) though distribution of these benefits is highly skewed.

The Clean Development Mechanism (CDM) under the Kyoto Protocol allows industralised countries (Annex 1 countries) with emission commitment to invest in emission reducing projects in developing countries (Annex 2 countries). Apart from helping Annex 1 countries to meet their emission reduction commitments, the CDM also aims to assist developing countries in achieving sustainable development. Currently, CDM projects are unevenly distributed, with least developed countries hardly benefiting. Of the 299 registered projects and another 861 at validation stage, the largest share (148 registered and 704 validations) is in Asia-Pacific regions, followed by Latin America and

[10] The rate at which solar energy reaches the earth

the Caribbean with 141 registered and 421 validations. Africa and the countries with economies in transition have 5 registered projects each and 27 and 8 respectively for projects under validations. About 72 per cent of registered CDM projects are accounted for by Brazil, Chile, China, India and Mexico indicating both intra and inter-regional imbalances.

As at October 2006, only 19 out of the total 1274 projects in the CDM pipeline for developing countries were from Sub-Saharan Africa. Côte d'Ivoire, Equatorial Guinea, Nigeria, South Africa, Tanzania and Uganda had at least one CDM project at validation stage or beyond. Four projects registered in Sub-Saharan Africa were all in South Africa.

The CDM Watch also highlights the inconsistency between the World Bank's CDM rhetoric about climate change and carbon market and the World Bank's projects in developing countries. In the ten years following the 1992 Rio Earth Summit, the World Bank is said to have invested US$22 billion in oil projects that will result in 40 billion tones of CO_2 emission over their lifetimes. During the same period, the World Bank's investment in renewable and efficiency projects amounted to only US$1 billion.

Deforestation is said to account for about 20 per cent of GHG emissions. Carbon sequestration from avoided deforestation has a potential for climate mitigation and could benefit the economies of developing countries like Sub-Saharan Africa with limited energy and industrial sectors. But this is not yet included in the CDM. This notwithstanding, Kenya, Madagascar, Niger and Uganda are finding innovative ways to sequester carbon through afforestation and reforestation projects that also have economic benefits for their communities.

Summary and conclusion

This paper has brought out critical issues relating to inequality in access to modern energy services and the implication for human development. It has also highlighted the negative impacts of climate change on poor developing countries that bear little or no responsibility for current emissions. Important links between access to modern energy services and the health and economic empowerment of women; and achievement of the MDGs have been amply demonstrated.

The paper emphasises that while developed countries are better placed to take a lead technologies and behavioural change needed to mitigate GHG emissions, the fast growing countries' emissions are significant at the global level and they should bear some responsibility for emission reduction. Besides, they are also vulnerable to adverse effects of climate change and therefore should have a vested interest to slow climate change.

It is evident from the analysis that addressing the energy needs of developing countries requires a combination of strategies and actions, including the following.

- Firstly, developing country governments should commit to expanding access to modern energy services by making it a national development priority. In West Africa, ECOWAS has articulated the highest political commitment to addressing the energy crisis and has generated debate at national levels to upscale and accelerate ongoing national efforts for integrating energy issues into poverty reduction strategies. This political commitment should be translated into national energy action plans backed by adequate financial and technical resources for implementation.

- Secondly, strategies for rural electrification should be based on decentralised power generation. Decentralisation has the potential to assist with technology transfer, increased equity in distribution and consumption, and increased participation of local people in the supply of energy services. Furthermore, small scale power generation systems are a viable alternative to centralized grid systems especially in Sub-Saharan Africa where population in rural areas is sparsely distributed.

- Thirdly, energy sector strategies should pay particular attention to differentiated energy needs of women and men. The realities of poor people should also be borne in mind in any energy reform. There should be a wide range of energy technology options to ensure that poor people can make a choice based on their income and be able to switch fuel in response to price fluctuations.

- In the least developed countries, for example, switching from biomass to cleaner energy sources might take some time. Even better-off households do not always make a complete switch from biomass to other cooking fuel. Other sources are used selectively to supplement firewood due to preference in 'smoky flavour'. Promoting efficient use of biomass through the use of improved cooking stoves and improved efficiency in converting wood into charcoal could be a short term measure for developing countries to meet their cooking energy demands. In the medium and long-term, investing in technologies to convert biomass efficiently and economically into other clean fuel should be considered.

- Developed and developing countries should also work together to develop an enabling environment and framework for equitable clean development investment that benefits least developed countries as well.

- Finally, developed countries should deliver on their commitment to allocate 0.7 per cent of GNP to ODA to help developing countries meet their developing challenges. This is in addition to supporting efforts to switch to cleaner energy sources and strengthening capacity to adapt to the negative effects of climate change.

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