5 Sustainable energy for the poor

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Introduction

While people in wealthy countries are obsessing about consuming too much energy, several billion poor people do not consume enough energy. Energy poverty – characterised by a lack of affordable, reliable and plentiful energy sources – affects over one-third of the world's population, mostly poor people in rural areas (where 70% of the world's poor people live).

These people depend on traditional forms of energy that are of low intensity and cause harm to both the environment and human health. There are huge opportunity costs which have not been given enough consideration in the climate change debate – particularly because these are urgent problems today rather than hypothetical long-run problems that might be caused by global warming.

But some environmental groups have argued that poor countries should not take the same developmental path as wealthy countries, because it could cause pollution. Greenpeace and The Body Shop, in a campaign for the 2002 World Summit on Sustainable Development in Johannesburg, proclaimed that 'Oil, coal and gas cannot meet the needs of the poorest, but "positive" or renewable energy can.'[1] Elsewhere, one author claims that 'Economic globalization is accelerating [global warming] by accelerating industrial activity and universalizing the carbon-intensive model of development worldwide.'[2]

Of course, these statements are simply patronising: to live more sustainably, poor people need to consume more energy and more resources. There is a direct negative causal relationship between lack of energy, the burden of poverty and environmental degradation in rural areas.

Energy and rural development are mutually dependent, and they represent one aspect of the poverty cycle that pervades most rural areas in India. Breaking this deadlock is one of the major challenges that developing countries face in developing their rural areas. It is likely that problems resulting from lack of energy will only be alleviated by investment in facilities that provide energy on a wide-scale basis. India is already full of small-scale informal sector entrepreneurs who are providing energy to the poor, because poor people are willing to pay for it.

This chapter focuses on the economic, environment and health impacts of dependence on traditional energy in India. In particular, it argues that poor people need to consume more energy to improve their lifestyle and health, to add value to their economic activities and to eliminate poverty. Though it may seem counterintuitive, increased energy consumption induces higher energy efficiency, and also leads to better environmental protection.

However, the chapter does not advocate any single type of energy as a panacea. Whether small or large, whether decentralised or grid-based, small generators, hydropower or hydrocarbons, biomass or wind – anything which is produced by the energy market should be allowed to flourish in India to solve the energy needs of the poor.

Energy scenario: global and Indian

Global

Present trends in energy consumption, and the projected future, show a steep increase in energy demand. Global primary energy demand is projected to increase on an average by 1.7% per year from 2000 to 2030, reaching an annual level of 15.3 billion tonnes of oil equivalent from the current level of 9.1 billion tonnes.[3] The outlook further states that the share of developing countries in total energy demand will increase from the current level of 30–43% while that of the developed countries will fall from 58% to 47%.[4] The share of traditional energy in industrialised countries is below 2% of the total, while reaching 46% in South Asia and 53% in sub-Saharan Africa.[5]

High-income group countries consume 51% of the total commercial energy consumed in the world and account for 80% of the income generated. Middle-income group countries consume 36% of the total energy while generating only 17% of the total wealth. Low-income

Table 3 **Trends in India's energy consumption (Petajoules)**[8]

	1970	*1980*	*1990*	*2010 (projected)*	*2020 (projected)*
Coal	1070	1444	1827	3704	6444
Petroleum	649	1212	2218	7604	15551
Natural Gas	12	33	283	742	950
Hydroelectricity	175	323	762	3124	5965
Nuclear	8	11	22	-----	-----
Fuel wood	2345	2864	3210	5722	6723
Crop residues and dung	1286	1568	1764	3101	3474
Total	5545	7455	10086	23457	39107
Total in MTOE*	132	177	246	558	930

*Metric tonnes of oil equivalent

group countries consume 13% of the total energy and generate only 3% of the total wealth.

Heavy reliance on the traditional energy has been one of the factors for slow economic growth in the developing countries and this factor has also contributed to low consumption and a low per capita output of commercial energy in the developing countries.

India

In 2000, India's total energy demand stood at 1.5 million tera joules (MTJ). About 65% of that was generated by commercial sources, and the rest came from non-commercial sources such as fuel wood and agriculture wastes. Households are the major consumers with nearly 44% of total energy consumption, followed by industry at around 40%.

India's per capita energy consumption is relatively low. In 1999, per capita energy consumption in India was 12.3 million Btu, compared to 355.8 million Btu (British thermal units) per person in the United States and a world average of 63.6 million Btu per person.[6]

According to one study which analysed India's 1991 National Census: '95% of the rural population still relied primarily on biomass fuels (dung, crop residues, and wood). A small fraction uses coal, which means about 97% of rural households relied principally on

Table 4 **Sectoral and per capita use of biomass energy in India**[11]

Types of traditional energy	*Domestic sector (mt/year)*		*Industry & estabs (mt/year)*		*Total use (mt/year)*	*Per capita (GJ/year)*
	Rural	*Urban*	*Rural*	*Urban*		
Fuel wood	252	30	6	10	298	5.29
Crop residue	99	–	–	57	156	2.68
Dung cake	109	5	–	–	114	1.85

these unprocessed solid fuels. Nationwide, some 81% of all households relied on these fuels; 3% used coal and 78% used biomass.'[7]

Table 3 opposite shows clearly that traditional energy, i.e. fuel wood, crop residues and dung, has a dominant share in India's energy consumption.

Traditional energy

Traditional energy, which consists of biomass (wood, agricultural residues and dung), is a major energy source for about 2.4 billion people, mostly in developing countries, and particularly for rural people. Some forms of energy, such as LPG, have a broad market share in urban markets, but in rural areas only 1.3% of households use it for cooking.[9]

Traditional energy forms are usually burned inefficiently, with an open hearth or three-stone fire, which typically transfers only 5–15% of the fuel's energy into the cooking pot, and the excess is produced as smoke.[10] Generally traditional energy is used in poorly ventilated dwelling places, such as huts.

Due to a lack of commercial energy, traditional energy meets the energy demands of rural Indian households, accounting for nearly 90% of household energy use. It is generally used for cooking, while inefficient devices fuelled by kerosene are used for rural lighting. People in urban areas, in contrast, utilise commercial energy since it is available. Table 4 above compares the use of traditional energy in urban and rural areas of India.

Table 5 **Level of indoor pollutants by fuel type during cooking hours in the kitchen**

Types of fuel	*Total suspended particulate (mg/m3)*	*Carbon monoxide (mg/m3)*
Cattle Dung	2.75	144
Wood	1.98	156
Coal	1.10	94
Kerosene	0.46	108
LPG	0.46	14

Source: Ravindranath (2000), p. 38.

The health burden of India's traditional energy

Traditional energy forms have many adverse health effects, particularly for women and young children, who are disproportionately exposed to the by-products of biomass. According to one assessment, 'indoor exposures to the combustion products of unprocessed solid fuels have been estimated to produce the majority of (non-smoking) human exposures to particulates and probably to a range of other pollutants as well.'[12]

Women and children are most exposed to smoke because they spend the most time indoors, cooking and tending the fire. About 700 million women and children worldwide suffer as a result of this form of pollution.

According to a study by the World Health Organization, 'the public health problem of indoor air pollution is severe, accounting for nearly two million deaths and 53 million "disability adjusted life years" [DALYs] lost, which represents about 4.3% of the global total of DALYs lost in developing countries.'[13]

According to the WHO, 'Acute lower respiratory infections (ALRI) remain the single most important cause of death globally in children under 5 years and account for around 2 million deaths annually in this age group.'[14] This is estimated to be 6–7% of the global disease burden.[15] These deaths are largely caused by indoor air pollution, resulting from burning wood and dung. Likewise, indoor air pollution is a primary cause of morbidity.

For India, indoor air pollution constitutes '4–6% of the Indian national burden of disease, [which places] indoor air pollution as a major risk factor in the country.'[16] For women and children – 44% of the population – 'it is equivalent to 6.3–9.2% of the burden [of disease]', about two-thirds of the country's disease burden.[17]

Biomass smoke contains many thousands of potentially harmful substances. Of these, the most damaging are particulates – carbon monoxide, nitrous oxides, sulphur oxides, formaldehyde, and polycyclic organic matter, which includes carcinogens such as benzo[a]pyrene. Small particles of diameter less than 10 microns (PM10), and in particular those less than 2.5 microns (PM2.5), penetrate deep into the lungs and have the greatest effect on health.[18]

Frequent exposure to particulate matter and these chemical compounds is associated with chronic bronchitis, respiratory infections and diseases, congestive heart failure and early onset of *cor pulmonale*.[19] It is also associated with tuberculosis, adverse pregnancy outcomes, chronic obstructive lung disease and several types of cancer.

Studies have revealed that women in Indian rural areas were exposed to total suspended particulates of about 7000 microgrammes per cubic metre in each cooking period, whereas the annual standard for outdoor air is 140 microgrammes per cubic metre. The exposure to benzo[a]pyrene was equivalent to smoking ten packets of cigarettes per day. Their exposure to toxic tiny particulates during a cooking cycle is 33 times greater than that of standard ambient air pollution.[20]

Exposure to smoke during pregnancy and infancy, either through tobacco or particulate matter from biomass smoke, may therefore increase the risk of chronic obstructive pulmonary disease. One consistent finding in patients exposed to biomass is substantial carbon deposits in the lung tissue (anthracosis).[21] The adverse effects of indoor air pollution as a whole have an even worse impact on the lives of women and children, as illustrated by Table 6 on page 104.

Acute massive exposure to wood smoke can be rapidly lethal. Besides asphyxia and carbon monoxide intoxication, severe damage to the respiratory epithelium with airway and pulmonary oedema can result.[22] Another common problem found among people exposed to smoke for long periods of time is minor irritation of the eyes, which can lead to conjunctivitis.

Table 6 **Estimated annual premature deaths from indoor air pollution in India**

Category	*Causes*	*No. of deaths annually*
I.	Acute respiratory infections (age less than 5 years)	
	Chronic obstructive pulmonary disease	310,000–470,000
II.	Blindness (women; no death) and perinatal effects	
	Tuberculosis (women)	50,000–130,000
III.	Cardiovascular disease (women); asthma	50,000–190,000
	Grand total:	410,000–790,000*

*Total annual deaths in India for women and children under 5 in these disease categories in the early 1990s.
Source: Parikh, J. *et al.* (1999), *Economic and Political Weekly*, vol. XXXIV, no. 9, Feb–March 1999.

Economic and social cost of traditional energy

Though the direct cost of traditional energy is negligible, since it is not traded in the market, the economic and social cost of burning biomass fuels is immense. Mostly these costs come in the form of opportunity costs which are not easily quantified by economic statistics – poor health, lost time and human effort expended.

Women and young children spend hours each day in the drudgery of collecting firewood or collecting, drying, and storing manure for use in cooking, heat or light. Making dung cakes can take up to two hours a day, depending on how much dung a woman has access to and the amount of cooking fuel required.[23] Because children are involved in acquiring energy, this means they spend less time, or no time, in school. Most homes in rural villages are not connected to an electrical grid and remain dark at night, so productive evening activities, either economic or leisure, are not enjoyed.

The time that rural women spend collecting wood and performing other household tasks (which are also largely based on manual labour) leaves little time for productive employment, education and community involvement. Male household members often move to cities and towns for economic opportunities, which leads to increased numbers of female-headed households, and additional time and labour burdens for women and children in rural areas.

If women had to spend less time acquiring energy, they would probably use the time they save to care for their families, to engage in other economic activities, and to help themselves develop. This would contribute positively towards the development of rural communities.

Women's opportunity costs

Women in India spend up to 20% of their time every day collecting fuel wood.[24] Even at minimum wages, it has been estimated that the human effort spent to collect fuel wood is equivalent to 2% of India's gross national product.[25] At the national level it is found that the average number of hours spent on gathering biomass (including fuel wood, crop residues and dung) is about two hours per day, per household.[26]

At a minimum daily wage rate of Rs50 (US$1) for an adult labourer, this means that 7.5 man days (based on an eight-hour work day), equivalent to Rs375 (US$8), are spent every month collecting fuel wood. Annually, this loss amounts to about Rs4,500 (US$97).

Even if we concede that labourers will be unable to find full employment throughout the year, this is a huge income loss – about 25% of India's per capita income. The productivity gains caused by improved energy access could thus be immense.

Environmental costs of traditional energy

Traditional energies actually cause great devastation to the environment, especially in areas which are not owned by anyone, or are owned by government. Local people have little incentive to maintain these areas, and are likely to exploit the resources on those lands in an unsustainable manner. Combined with grazing and fodder-collection, all of these contribute heavily to deforestation, erosion and loss of biodiversity. And as we have already seen, these fuels contribute heavily to local environmental problems in the form of indoor air pollution. In urban areas especially they contribute to outdoor air pollution.

People's impact on forest and soils are also a key factor, with almost 25% of annual emissions of carbon dioxide resulting from forest clearance.[27]

Uprooting shrubs and trees leads to loosening of soil and becomes one of the primary reasons for soil erosion and loss of soil fertility. It also enhances the flow of rainwater during the rainy season that sometimes leads to flooding in downstream land. Massive deforestation in rural areas also has resulted in disruption of the socioeconomic life of tribal peoples. Excessive removal of vegetation and damage to ground vegetation during removal of fuel wood could affect plant diversity.

Currently, the right to collect fuel wood is one of the biggest sources of conflict between people in and around protected areas, and their managers. While these problems are the result of myriad causes (poorly defined property rights, corruption and aggressive government intervention), reducing the reliance of poor people on fuel wood would inevitably minimise conflicts between people and protected areas.

Environmental opportunity costs

The environmental costs of traditional energy should also be viewed in terms of alternative uses for resources currently used for energy. For instance, wood used as fuel may be more highly valued in for other uses, i.e. furniture, paper or lumber. Moreover, the time required for tree regeneration and forest succession means that wood is probably more valuable if it is not used as biomass energy.

Of course, it is illegal in India for private companies to fell timber for sale, which means that rural people cannot accurately assess the trade-offs between using timber as fuel, and using it for other purposes.

Lack of energy also relates to the amount of time that rural people devote to cultivation of agricultural crops; 77% of the required energy in agriculture is derived from animal and human energy. The remainder, 23%, of commercial energy consists of chemical fertilisers (14%), electricity (6%) and diesel (3%).[28]

It would be more efficient if cow dung currently used for cooking and heating were used primarily as a means to replace soil nutrients such as nitrogen. One estimate suggests that the annual nitrogen contribution from a cow or a buffalo with a mean yield of 5 kg/day would be 5.5 kg of nitrogen per animal every year.[29]

If biomass were to be used for major energy production, many millions of acres of vegetation and trees would need to be cleared. It is estimated that a 1MW grid-connected biomass combustion power plant operating 500 hours per year would require nearly 600 tonnes of dry wood (1.3 kg dry wood per kwh). At a productivity of 8 tonnes per hectare annually, a 1MW plant would require 800 hectares of land. India has a total land area of 328 million hectares, 45% of which is used for agriculture. A tree plantation to supply a 20,000 MW power plant would require 16 million hectares – about 5% of total land, or 12% of degraded land, in India.[30] If India were to generate all of its electricity needs from biomass, particularly firewood, then ¼ to ⅓ of land would have to be used to grow wood. Together with agriculture, there would be hardly any area left for anything else, not to mention the complete destruction of biodiversity.

Sustainability results from more energy consumption

While the idea that increasing energy consumption increases sustainability may seem counterintuitive to some, energy consumption must increase to give humanity a lighter environmental footprint.

Energy consumption gives rise to energy efficiency, because those who consume more energy have an incentive to consume it more efficiently. This creates a huge market for efficiency measures, and triggers inventions and innovations that enable us all to become more energy efficient. The larger sum of energy consumed also gives incentives to substitute towards more efficient fuels. When energy is consumed in a larger chunk, it attracts users' attention, and persuades them to use it more efficiently.

When energy consumption is high, energy production and distribution can be achieved on a larger scale to reap the advantage of economies of scale and scope. Efficiency of energy production increases, and more kilowatt-hours of energy can be produced with the same tonnage of coal or oil. Increased efficiency in energy consumption also translates into reduced carbon intensity – economies emit less carbon to produce the same output. When energy consumption increases, people switch to more efficient fuels, which are also less carbon intensive. In contrast, initiatives that focus on sequestering carbon and cutting carbon emissions are likely to have the opposite effect. The world as a whole exhibits a pattern of 'decarbonisation' in its fuel use.

Countries such as the USA and Japan, where energy consumption levels are amongst the highest, are also the greatest innovators of energy-efficient technologies. When consumption levels are high, more efficient gadgets and devices come to the market and they quickly replace old and less energy-efficient devices. Alternatively, when consumption levels are low, these devices are irrelevant.

Barriers to large-scale energy provision in India

Generally, India lacks a sufficient infrastructure to facilitate wide-scale energy provision. Because of the extent of India's poverty there is also a lack of demand for energy – but of course, this is a vicious cycle. Generally, investors are apprehensive about investing in rural energy. Lack of financial and physical infrastructure, a lack of institutions (clearly defined property rights, enforceable contracts), corruption and regulations have worked to discourage commercial investors from investing in rural energy provision in India.

The Tata Energy Research Institute found that grid-based rural electrification programmes in India are largely unaffordable and unreliable, with an estimated cost of US$12,500 to US$30,000 per village, which means US$65–US$165 per household per year, depending on the distance from the existing grid.[31] Of course, if the opportunity costs of rural people are considered (see above), these figures may not be completely out of reach even for the very poor.

Nearly 88% of India's coal is produced and marketed by Coal India Limited and its subsidiaries. A consumer who requires coal must approach the Central Marketing Organisation. Due to bureaucratic hassles and the presence of a strong mafia in the coal sector, actual delivery is always at risk.

At the behest of international institutions, aid agencies and environmental groups, India's government has subsidised the renewable energy sector, seemingly forgetting about the need to generate affordable, reliable and plentiful energy for everyone.

Renewable providers enjoy guaranteed revenue streams and government protection from market signals. Meanwhile, subsidies for renewable energy use flow directly to high- or middle-income populations: 'Government largesse to renewable energy is comprehensive, widespread, and highly attractive … A majority of wind energy projects in India have come up mainly to cash in on these tax breaks. Electric power generation is a secondary – and often neglected – priority.'[32]

Companies that invest in 'renewable' energy sources such as windmills get a 100%, one-year depreciation scheme from the Indian government, and a five-year income tax holiday. In Tamil Nadu during 1995–96, dozens of companies used this income tax break and accelerated depreciation to avoid paying any tax on income derived from other sources altogether.[33]

Thus cleaner and cheaper forms of energy, including gas, coal, hydro, oil and nuclear have been neglected. These forms of energy are far cheaper than solar and wind power in nearly all contexts. Moreover, they become cheaper as demand increases, which would happen as India's economy develops, and as companies take advantage of economies of scale.

Energy is a primary factor in industrial production. In India, State Electricity Boards (SEBs) control more than 85% of the total power generation, transmission and distribution. The SEBs are highly inefficient and because they are bankrupt, they cannot finance any addition to the installed capacity. Both peak load and energy shortages of varying degrees are prevalent in the country. This leads to perpetual scarcity, scheduled power cuts and outages.

However, India's federal and state governments have conspicuously failed to encourage an environment favourable towards private energy provision, by inhibiting development of new energy sources, over-regulating existing energy supplies, subsidising inefficient providers, providing monopoly power to certain providers, and generally by intervening in energy markets.

According to a 2002 study by the UK Department for International Development (DFID) called 'Energy for the Poor', the government of the Indian state of Andhra Pradesh was paying subsidies of US$600 million a year to the electricity board prior to power sector reform. The Indian minister for power indicated that in total SEBs lose the equivalent of US$9 billion a year.[34]

Wealthier household consumers insulate themselves from erratic electricity with diesel generators and inverters. Poorer consumers often simply do not have electricity. However, all over India poor entrepreneurs in the informal economy are getting around the problems created by the Indian state with their ingenuity and resourcefulness. Though this is very small-scale power generation, they are improving energy access for the poor – themselves – and have proven that poor people will pay for energy. This also illustrates that with formal markets,

Table 7 **India's commercial energy production and commercial energy per capita**[35]

Country	*Commercial energy production (thousand metric tons of oil equivalent) 1999*	*Commercial energy use per capita (kg of oil equivalent) 1999*
USA	1,687,886	8159
China	1,056,963	868
Bangladesh	14,474	139
India	409,788	482

consumers would likely benefit from lower prices due to economies of scale.

The poor and unreliable power supplied by SEBs also forces industries to install their own generating capacity because they cannot get enough energy to run their plants and factories.

Captive power is comparatively uneconomical and it is very cumbersome to acquire permission for setting up a captive plant. Most of the industries have to limit their production in absence of adequate power. Even India's per capita commercial energy use lags far behind other countries. It consumes about 55% of that consumed by China, and about 6% of that in the USA.

Another important factor in the lack of progress towards large-scale energy projects is opposition to hydrological power generation. Dam construction has both positive and negative consequences, but a small group of vocal opponents to dams has succeeded in stalling or abolishing proposals for new dams in India. Political tensions about water and power distribution, especially between states, have also contributed to India's lack of hydro-generating power.

Lastly, there are intrinsic regulations and cultural biases (which often become political) that ultimately affect access to energy. According to the DFID study:

> In many countries, the lack of legal status of poor people is a barrier to them having access to adequate energy services, even if

> they can afford to pay for them. For example, migrants that move to shanty towns are often not allowed to be connected to the grid as they are not legally registered. Governments may be reluctant to recognise shanty towns as legal dwellings since they are then obliged to provide them with water and other infrastructure services ... In China, rural households that move to urban areas do not have 'urban status' and are therefore not allowed to be connected to power supplies.[36]

The UN's Clean Development Mechanism

In 1997, the Kyoto Protocol established the Clean Development Mechanism (CDM), which enables Annex I countries (developed countries and economies in transition) of the United Nations Framework Convention on Climate Change to flexibly meet their greenhouse gas reduction targets at a lower cost through projects in poor countries. The CDM is based on two complementary goals – to reduce the consumption of GHGs by reducing emissions, and to help poor countries with technology transfer:

> The purpose of the clean development mechanism shall be to assist Parties not included in Annex I in achieving sustainable development and in contributing to the ultimate objective of the Convention, and to assist Parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments under Article 3.[37]

The CDM intends to allow wealthy countries to reach their agreed emissions reductions with a degree of flexibility, through voluntary partnering with poor countries.

> Article 12 of the Kyoto Protocol identifies three specific goals for the CDM: (1) to assist in the achievement of sustainable development, (2) to contribute to the attainment of the environmental goals of the Framework Convention, and (3) to assist Annex B parties in complying with their emissions reduction commitments.[38]

But the CDM's critics, including environmental organisations such as

WWF, suggest that it will do nothing to actually decrease carbon emissions:

> By intention, the CDM is not designed to reduce global greenhouse gas emissions. CDM projects that reduce emissions in the host countries will generate emissions credits that enable the investor countries to increase their domestic emissions, exceeding their Annex B emissions targets. Thus, at best, if the CDM operates as intended, it will be carbon-neutral on a global scale. However, in practice, to the extent that the CDM generates unwarranted free-rider credits, it will cause a net increase in global carbon emissions.[39]

As it is currently designed, the CDM is likely to be yet another UN-inspired bureaucracy which helps a few businesses and elite politicians at everyone else's expense. Projects under its auspices will be subjected to an endless number of criteria before approval, and it favours only large projects.

Because the CDM requires that potential projects fulfil so many criteria, it seems likely that the only projects it will attract are 1) those which would not be viable without government subsidies, or 2) those which have the best lobbying ability. However, it is unlikely that the UN will have the capacity to assess the opportunity cost of these projects against other economic activities which would take place in the absence of this 'crowding out' effect.

The CDM suffers from a broad problem which plagues many United Nations initiatives, which is that it is outcome-oriented rather than process-oriented. The broad outcome is to meet targets for reductions in greenhouse gas emissions – even though it is unclear that these targets are desirable, or will be helpful in combating global warming. Although it is intended to grant some amount of flexibility to the process, simply reaching an arbitrary target does not mean that we are progressing towards a broad goal of eliminating poverty and sustaining development.

This needless focus on targets and outcomes means that the CDM starts from the incorrect assumption that people are consuming too much energy. To that end, it proposes to restrict the availability and supply of energy, favours certain energy sources at the exclusion of others, and favours the development of certain new technologies.

Its preference for large scale projects means that the CDM neglects the most urgent human and environmental problem of poverty. For instance, if India were to reduce its energy consumption, this would only make poverty worse. One model estimates that over a period of 35 years, a 30% annual reduction in carbon emissions would lead to a decrease in GDP by 4%, and would increase the number of poor people by 17.5% in the thirtieth year.[40]

India urgently needs to reduce and eliminate poverty, not aggravate it by eliminating energy options. Eliminating poverty will only be possible by increasing the consumption of energy, especially for poor people. This would result in a virtuous cycle of development – cleaner, more efficient energies would lead to less degradation and more efficient use of resources. Ultimately, this would lead to conservation and efficiency in the energy sector. Wealthy countries have illustrated that this path of development works, and poor countries should not be discouraged from following it as well.

Technology transfer

Many commentators have praised the 'technology transfer' element of the CDM, suggesting that this is a superior way to assist development in poor countries.

Of course, new ideas and technologies are exchanged regardless of whether the UN intervenes in the transfer – this is an inherent part of the business cycle and of human adaptation. This dynamic process occurs especially when people can openly trade with each other, and when governments step back from dictating the process and outcomes of trade and investment.

Public and consumer demand also motivates technology transfer. In most developing countries today, consumers are widely adopting mobile phones instead of relying on arcane state-run telephone systems which barely work. The same will occur with clean energy technology, especially if governments concede that they cannot provide such services as well as the private sector.

Of course, the CDM may simply be yet another form of corporate welfare for businesses in wealthy countries to provide their technologies to poor countries. This could cause many negative effects, including undermining local incentives and initiatives to innovate and invest in new technologies that will satisfy the needs of local consumers. By subsidising certain technologies over others, the CDM may also 'crowd out' alternative sources of private sector investment in the energy sector, negating development and investment initiatives which would have otherwise taken place.

Of course, private sector businesses and entrepreneurs do not need subsidies to provide energy and technology to consumers. If governments and international agencies step out of the way, businesses – both local, national and international – will achieve this in a manner which satisfies consumers' needs and desires far better than governments, who have an extremely poor track record in this area.

Conclusion

Reliance on traditional energy has many disadvantages and is responsible for enormous human suffering, loss of life, reduced economic productivity, and environmental problems. Rural people have few other options, though, because governments in poor countries have conspicuously failed to facilitate broad access to energy.

For India's poor rural people, efficient, reliable energy remains a dream rather than a reality. Sadly, they will probably continue to suffer because of an unnecessary focus on reducing the amount of energy consumed in the world, to prevent the hypothetical, long-run risk of climate change. The real risk today is that billions of people in the world will not have the same opportunities to grow and develop as the First World did.

The immediate need of poor people in India and other poor countries is to consume more energy, in any form. Likewise, poor countries need plentiful, affordable, reliable and accessible energy of any kind – whether gas, nuclear, coal, oil, wind or solar, whether grid-based, locally generated or stand-alone – to fuel economic growth and improved quality of life for their people. More energy consumption will lead to more energy efficiency, which will lead to environmental benefits and sustainable energy consumption.

In developing countries, economic development usually means higher energy consumption, and more energy consumption temporarily means more air pollution. But in the long run, ever-wealthier developing countries will be able to improve their energy efficiency and thus also improve their air quality. In addition, pollution levels in the developing countries will not necessarily reach levels found earlier in rich countries during their development period. In the present era of globalisation, developing countries can gain access to modern technology quite easily. So the developing countries can achieve a high level of economic as well as environmental development in a much shorter period than did developed countries.

A truly 'clean' path of development would involve little government, and instead would rely on the initiative and ingenuity of people to solve energy needs. All over India, people in the informal economy are using their own ingenuity to achieve access to energy, and poor people are willing to pay for it.

The DFID study cited earlier correctly proposes that: 'Few people who have the interests of poor people at heart would advocate the maintenance of many of the current energy systems that are badly managed, deeply corrupt and suck in vast amounts of public money to underwrite huge and recurring losses.'[41]

Since India's government and most other poor countries have so clearly failed to improve access to energy for poor people, they should not be in the business of energy provision, or granting monopolies to certain providers, or enforcing burdensome regulations against those who would provide affordable energy.

Instead, governments should focus their energies towards establishing legal regimes which are transparent and uphold the rule of law, so that individuals and businesses can act on a level playing field to fulfil people's energy needs. This, in turn, would encourage adaptation to change – whether changes resulting from global warming, or any other phenomenon.

The Clean Development Mechanism, part of the Kyoto Protocol, has been promoted as a means to achieve reductions in greenhouse gas emissions while promoting technology transfer. However, because it is motivated by the wrong goal – one of limiting energy rather than broadly making energy available, affordable and clean for everyone – it is likely to hinder rather than promote sustainable development.

Addressing the lack of energy in poor rural areas should be a priority for those who care about eliminating poverty and promoting human well-being. Unless we solve the problems of poverty first, greenhouse gas mitigation strategies will not only be futile, but will heartlessly leave behind billions of people who today lead lives of drudgery and darkness.

Notes

1 See http://www.choose-positive-energy.org/html/content/facts_backgrnd.html
2 Sobhani and Retallack (2001), p. 225.
3 IEA (2002), p.14.
4 *Ibid.*, p.16
5 Goldemberg and Johansson (1995).
6 EIA (2001).
7 Smith (2000).
8 Ravindranath (2000), p. 30.
9 See 'Rural Energy in India' at http://www.incg.org.in/CountryGateway/RuralEnergy/Overview/RuralenergyinIndia.htm
10 UNDP (2000), p. 8.
11 Ravindranath and Hall (1999), p.19.
12 Smith (2000).
13 WHO (2000).
14 Bruce *et al.* (2002).
15 Smith and Mehta (2000).
16 Smith (2000).
17 This estimate uses a disability-adjusted lost life-year approach. *Ibid.*
18 Bruce, *et al.* (2002).
19 WHO (no date).
20 Narain (2003).
21 Bruce *et al.* (2002).
22 *Ibid.*
23 WHO (no date).
24 Ravindranath and Hall (1999), p. 44.
25 *Ibid.*
26 *Ibid.*, p. 52.
27 Auckland *et al.* (2002), p. 2.
28 Subudh (1993), p. 107.
29 Ravindranath and Hall (1999), p. 76.
30 Sukla (1997), p. 368.
31 TERI (2002).
32 Guru (2002.
34 DFID (2002), p. 12.
35 World Bank (2002), Sections 3.6–3.8.
36 DFID (2002), p. 18.
37 Kyoto Protocol, Article 12, Paragraph 2.
39 See 'Free-Riders and the Clean Development Mechanism', available at http://www.panda.org/downloads/climate_change/freeriders.rtf
40 Climate change and India, p. 222.
41 DFID (2002), p. 12.

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