The Eight Indicators

►Indicator 1

Since approval of the NEP by the National Parliament, a number of policy recommendations have been implemented. First, the private sector is authorised to take part in production of electricity; exploration, production, and management of natural gas etc. As a result, a number of private companies are operating with small- to medium-scale power plants. Secondly, all the government owned new power generation units use natural gas as the base fuel and the old technologies involving coal fired and diesel based plants are being phased out. Moreover, the new installations are more efficient (combined cycle power generation units). Overall, the NEP has been very effective in terms of reduction of emissions of greenhouse gases from electricity production, although capital investments for improved technologies were much higher than that of old technologies.

In the latter half of the 1990s the demand was much higher than the peak load, especially during 6 and 10 PM. Since the time for both implementation and transfer of technology for a diesel run power plant was shorter than that for a modern natural gas based power plant, those investments resulted into a few power generation plants with petroleum based liquid fuel. One such 100 MW power plant is in the process of being converted into a natural gas based power plant in 2001. Such measures will certainly reduce the GHG emissions significantly.

Due to a number of reasons exploitation of the Barapukuria coal mine could not be started in 2000 as expected. However, it will come into operation from 2003-04 and GHG emissions from coal burning will increase significantly. The projection of GHG emissions are presented in figure-2 (ADB, 1998). Since the NEP calls for enhancing use of indigenous coal for power generation and other commercial/industrial/domestic purposes, an increase in the country's carbon emission will be a certainty in near future. But at the same time, a significant part of this indigenous coal, some 150,000 mt/annum, will be made available in the market to replace some biomass fuels. This will in turn reduce dependence on biomass fuels, reduce overall GHG emissions by achieving higher energy efficiency due to fuel switching (from biomass to coal) and thereby create conditions for biomass being recycled to enrich topsoil. The latter aspect will be extremely important for the long term sustainability of crop agriculture of the country (ADB, 1998).

In 1990-91 the per capita energy sector emission was 32.79 kg of C, an insignificant amount with respect to the then global per capita emission of 1130 kgC. In 1995-96 the value increased to 49.09 kg of C. The vector for energy sector emission, therefore, becomes 1.71, indicating high global energy sustainability.

▸Indicator 2

Bangladesh's indigenous fuels are, on an average, very clean in terms of contents of sulphur and nitrogen. Natural gas known to be a high grade fuel. It is thus expected that in terms of common energy-related pollution Bangladesh would not fare badly. The major source of pollutants are impurities laden imported liquid fuel and coal. In 1990-91 about half of the imported liquid fuel was refined in the only oil refinery of the country, the rest being imported directly as finished products. But the scenario has been changed somewhat by the year 1995-96 when about two-thirds of the imported liquid fuels came as finished product. Since the main subscriber of liquid fuel is the transport sector, non-point sources are the major polluters for Bangladesh. It is no wonder that the air quality of the capital city Dhaka is one of the worst amongst the Asian cities, because majority of the vehicles concentrate in the largest city and the economic heart of the country. Tables-8 gives permissible limits of pollutant concentrations in ambient air and Table-9 gives pollutant concentration in the ambient air at some locations of Dhaka city.

Table-8: Permissible limits of pollutant concentrations in ambient air

Pollutants	WHO Standard			8-Hr for commercial & mixed use zones		
	μ gm^{-3}			μ gm^{-3}		
	1-hr	8-hr	24-hr	Bangladesh	India	China
CO	30,000	10,000	--	5,000	5,000	4,000
Sox	350	--	105	100	120	150
Nox	400	--	150	100	120	100
SMP	--	--	150	400	500	500

Source: Alam et al., 2000.

But the other polluting fuel, coal, is being used in brick manufacturing industries all over the country, the highest concentration again is found around the capital city, which has been growing at 6~8% per annum during the 1990s. In 1996 the SO_2 concentration was recorded at 279μgm^{-3} in one of the busiest crossroads of Dhaka.

Table-9: Pollutant concentration in the ambient air at some specific locations in Dhaka city

Location	Area specification	CO	NOx	SOx	SPM
		μ gm^{-3}	μ gm^{-3}	μ gm^{-3}	μ gm^{-3}
Gulistan	Commercial	33200	500	800	1332
Jatrabari	Transport-intensive (TI) area	67000	500	1300	4667
Pantho Path	Residential TI area	85100	500	900	2666
Mohakhali	Transport-intensive (TI) area	69300	500	1200	2111

Note: Modified from Alam et al., 2000.

Since the level of SO_2 emissions depend on actual sulphur concentration in each of the imported fuel types and being unknown, a rough estimate provides a range of 2700 to 5500 metric tons in 1990-91, which rose to 5350 to 10800 metric tons in 1995-96. The vector for most significant energy-related local pollutant appears to be 1.88. This is perhaps an indication of 88% higher emission of SO_2 in 1995-96 compared to 1990-91.

▶Indicator 3

Majority of the country's population live in rural areas, meting most of their energy needs (for domestic, commercial, and industrial needs) from locally available biomass fuels. At present various marketing companies under the Bangladesh Petroleum Corporation (BPC) distribute kerosene and diesel throughout the country at a uniform tariff rate set by the government. The Rural Electrification Board (REB) is responsible for providing electricity to the rural communities through Rural Electricity Associations. But the quality of power services in rural areas is very poor; there are reports of frequent voltage fluctuations, unreliable and erratic supply. Due to lack of purchasing power very small proportion of rural households use to subscribe energy services from commercial sectors.

According to the statistics provided in the pocketbooks/yearbooks of the Bangladesh Bureau of Statistics (BBS) the total number of households with access to electricity increased from 1.34 million to 1.85 million between 1990-91 and 1995-96. The vector for households with access to electricity thus appears to have decreased from 0.935 in 1990-91 to o.823 in 1995-96.

▸Indicator 4

As mentioned earlier, the government is keen on investing on modern and cleaner technologies for electricity generation, which received impetus from the NEP. But there has not been any appreciable investment in clean technologies (both renewable and cleaner) between 1990-91 and 1995-96. Since 1996-97, with donor assistance, the government of Bangladesh has taken a pilot project to offer solar-power to about 1100 families in a riverine (char) island, an area which was otherwise deprived of grid-based electricity due to its remoteness. The initial success prompted to extend the idea and provide solar-based home systems in other island areas where grid system cannot be extended economically. A total of about 2000 families are now enjoying solar-photovoltaic (PV) system based electricity services.

Again in 1995-96 the government carried out a study on possibilities of harnessing wind power, especially from the coastal areas. The wind velocity was found to be erratic and unsuitable for continuing operation of conversion into electricity through wind turbines. The reliable wind speeds at suitable heights in a number of locations were found to be less than the threshold values and future of development of wind energy has virtually been shelved thereon.

The government is now contemplating to extend the capacity of the only hydroelectricity plant located in Kaptai lake area. The uncertainty of relocation of many adversely affected families and other socio-cultural and environmental aspects make the proposal particularly unsuitable for the country, despite potentials for high financial returns.

Since no significant investment is made between 1990-91 and 1995-96 in clean energy development, the indicator of sustainable energy development could not be worked out.

▸Indicator 5

Despite the fact that the energy security of the country is maintained by biomass based traditional fuels and indigenous natural gas, the importance of the imported fuels are increasing day by day. Following the acceptance of the NEP by the Parliament in 1995 a number of multinational companies have brought foreign direct investment for exploration of natural gas fields all over the country. A number of new gas fields are discovered, especially in the southern and eastern parts of the country, and the 'best estimate' shows a tripling of 'proven and recoverable' reserve, from less than 11 TCF to 31 TCF. Since Bangladesh' government cannot utilised all the natural gas being produced by the multinational companies, the temporary ban imposed on exporting natural gas in excess to national capacity to utilise is about to be lifted. The Prime Minister suggested that the government would allow export of natural gas only when it would ascertain that it has sufficient reserve in excess to its requirement for the coming 50 years. There are indications that Bangladesh will become a net energy exporting country within the next few years.

In 1990-91 the country's non-renewable energy imports amounted to about 97.5 PJ, which was increased to about 162.0 PJ in 1995-96. The metrices for the Indicator #5 therefore appear to be 0.374 for 1990-91 and 0.391 for 1995-96, suggesting that non-renewable energy trade has actually increased by less than 2% between 1990-91 and 1995-96. It is expected that this trend will be observed till, perhaps, 2001-02 and a reversal will be observed thereafter. There was no import of renewable energy both in 1990-91 and 1995-96, while the total energy consumption was 759.9 PJ and 929.4 PJ, respectively (worked out by the author, basic data are given in GOB, 1997 and GOB, 2000).

▸Indicator 6

In the past about 20% of all capital investment made by the government was for the development of energy sector. The vector value for the burden on energy investments also suggests a value of 0.20 for the year 1990-91. As discussed earlier, FDI came into play since 1995-96 through the multinational companies and private sector investment has become significant in the following years. The vector value for the year 1995-96 was estimated at 0.13, suggesting participation of private sector in energy development and management activities as recommended in the NEP.

So far, the initial trend for private sector participation was to invest in natural gas exploration. Since 2000-01, private sectors have become a significant player in natural gas production, production of liquefied petroleum gas (LPG) for small-scale commercial and cooking purposes, and production of electricity. Due to an increase in private sector participation the production of natural gas reached its NEP suggested maximum limit of 1000 MMCFD, 24% of which was supplied by the International Oil Companies (IOC). It is expected that private sector's role will increase even further in coming years.

▸Indicator 7

In terms of energy productivity, Bangladesh fared well with respect to global average. The vector value for 1995-96 was 1.30. Bangladesh consumed 27 per cent higher commercial energy with respect to the global average per dollar of its economic output in 1995-96. Considering a net increase in use of commercial energy in recent years and also the inherent management and institutional inefficiencies in actual use of energy, it is likely that the vector value might increase in the future.

▸Indicator 8

Although it is enshrined in the NEP that higher emphasis will be given on the promotion of renewable energy technologies very little has been done in the past. Two separate projects on promotion of solar photovoltaic (PV) electricity supply systems for individual households in remote rural areas have been taken between 1990 and 2000 and about 2000 households have been brought under the project with solar lights. But in both the cases the units are subsidised heavily because otherwise the initial investment costs appear to be much higher than the 'willingness to pay' of the poor customers for the energy services. The PV chips are imported and despite repeated plea to the government by the environmental advocacy groups, the government did not relax its import duties and other value added taxes and tariffs on those items. As a result the PV systems could not be promoted.

It was argued that if the government was willing to offer tax incentives in other renewable technologies such as solar-PV water pumps for irrigation, solar-PV based lanterns, water heaters etc. then renewable technologies could easily find its own place in the market (Ahmed, 2001).

The other potential GHG savings in large scale could be achieved through improvement of household and commercial cooking stoves, which generally use biomass as fuel. The household level cooking stoves are very poor in energy efficiency. An improved version of the traditional cooking stove already exists, having twice the efficiency of a traditional cooking stove, but the technology has never been transferred to the grassroots. It is believed that a significant amount of GHG could be saved by large-scale introduction of the improved cooking stove in about 21 to 23 million households. The saved biomass could be recycled in a number of possible ways which could have other environmental benefits. Despite having specific guidance in the NEP very little has been done in this regard.

It was found that the total renewable energy used in 1990-91 was about 499 PJ which subsequently increased to 515 PJ in 1995-96. The renewable energy deployment vector for 1990-91 and 1995-96 were estimated at 0.3393 and 0.4585, respectively.