Energy Conservation and Sustainable Development

For any country, power is a critical input for economic development and for improving the quality of life. The achievement of increasing installed power capacity from 1,362 MW in 1947 to the current level of over 108,000 MW (as of April 2003) is quite impressive in absolute terms. In spite of this addition in generation capacity, the growth in demand for power has far exceeded the generation capacity augmentation, as a result of which the country is facing both energy and peaking shortages

Based on the demand projections made in the Sixteenth Electric Power Survey, over 100,000 MW additional generation capacity needs to be added by 2012 (by the end of the Eleventh Plan) to bridge the gap between demand and supply of power. This would necessitate mobilisation of nearly Rs 8,000 billion of investment in the next decade (for additional generation capacity and associated transmission and distribution system). This is a daunting challenge before the power sector.

The per capita energy consumption of primary energy in India is only 277 kg of oil equivalent. It is just 3.5 per cent of the per capita energy consumption of the US, 6.8 per cent of Japan, 37 per cent of Asia, and 18.7 percent of the world average. India's energy intensity (energy consumption per unit of GDP), however, is high compared to Japan, the US, and Asia as a whole by 3.7, 1.55 and 1.47 times respectively. This indicates inefficient use of energy with a substantial scope for energy savings.

Energy supply projects are highly capital intensive. They have long gestation period, thereby having a direct bearing on ecology and environment. Inadequate availability of energy resources affects the economic growth, and in fact, the lives of the citizens. Hence, it is imperative that energy resources are consumed rationally and economically, thereby eliminating wastages and losses to the extent possible. The goal of sustainable development, increasing concerns on environmental pollution, global climate change, and the ever-increasing gap between demand and supply has made energy conservation an integral part of our power development programme. The advent of the World Trade Organisation regime has further accentuated the need for improving energy efficiency. The country has to bring down energy intensity per unit of GDP so that goods manufactured in India remain competitive.

Energy Conservation Potential

Agriculture, industry and domestic sectors together constitute about 85-90 per cent of the total electricity consumption in different regions. The consumption in the domestic sector is predominantly for lighting, heating and refrigeration. In the commercial sector, electricity is consumed mainly for lighting and space conditioning, while motive power accounts for the single largest end-use consumption in the industrial segment. The agriculture sector is dominated by pumping loads, and to some extent by lighting. Nearly 20,000 MW equivalent of capacity creation has been estimated in India through energy conservation in electricity alone. Energy conservation potential in various sectors of the economy is shown in table-1.

Targets for Energy Savings During the Tenth Plan (2002-07)
The potential for energy savings during the Tenth Plan period based on the Sixteenth Electric Power Survey is given in table-2. Based on the energy saving potential, a pragmatic assumption of saving at least 20 per cent during the Tenth Plan would amount to about 19,000 MkWh at the consumption end. This will be equivalent to adding new capacity of about 4,000 MW assuming projected transmission and distribution losses of 20.5 per cent (as given in the 16th EPS), and average of all-India Plant Load Factor of about 68 per cent.

The estimated peak savings, however, would be of the order of 2,600 MW, assuming that agriculture load will not contribute towards any significant peak reduction, as agriculture load is generally supplied power during the off-peak hours in the country. (Source: Report of the Working Group on Power for Tenth Plan)

Constraints in Adopting Energy Conservation Measures For successful implementation of energy conservation measures, the following issues have to be sorted out:

- Establishment of necessary institutional set-up for formulation of policies, programmes and co-ordination of implementation of energy conservation activities.
- Training of managerial and operating personnel, and establishment of specialised teaching institutes.
- Devising specific strategies for creation of awareness among industrial, agricultural, commercial, and domestic consumers of energy.
- Creation of facilities for promotion of research and development of energy conservation technologies.
- Need for rational pricing of energy supply.
- Availability of adequate financial resources for institutional set up and promotion of energy conservation.
- Establishment of a regime of fiscal and financial incentives and disincentives.
- Laying down of energy efficiency standards for energy-consuming equipment and incorporating the same in the national standards.
- Mandatory display of energy consumption level on equipment labels.
- Phasing out manufacture and sales of inefficient equipment.

- Formulation of energy consumption norms for large consumers.

Though a very large number of measures have been taken in the past, they have not made any significant dent towards achieving the country's energy conservation potential. A large number of organisations have been working in the areas of energy conservation. However, in the absence of any proper institutional set-up, energy conser-vation could not be organised in an effective manner. Energy conservation is a multi-faceted activity involving both promotional and regulatory role on the part of various organisations. The promotional role includes awareness campaigns, education and training, demonstration projects, research and development, and feasibility studies. The regulatory role includes framing rules for mandatory audits for large consumers, devising norms for energy consumption under various sectors and sub-sectors, and implementing standards/provisions of fiscal and financial incentives.

The Government of India has taken a positive step in enacting the Energy Conservation Act, 2001, which may remove major constraints in the implementation of energy conservation programmes. The Bureau of Energy Efficiency has been created under the Act, and made responsible for taking up both promotional and regulatory functions required for successful implementation of energy conservation measures in the country.

Energy-Environment Linkage

Impact of thermal power generation

In most developing countries, substantial power requirement is met through thermal power plants. India depends largely on coal as a source of energy. Thermal power plants are also responsible for environmental pollution and greenhouse gas emissions. In the process of power generation from coal, emissions such as suspended particulate matter (SPM), carbon dioxide, sulphur dioxide and oxides of nitrogen, adversely impact the environment. Most of the Indian power grade coal has high ash content of over 40 per cent. This results in generation of gigantic volumes of ash, which, if not utilised or disposed off properly, becomes the potential source of environmental pollution.

Mitigation strategies

Strategies have to be evolved to mitigate the negative impact of thermal power plants on environment, and mitigation of greenhouse gas emissions. These can be divided into supply side and demand side options.

Supply-side management

It is imperative that most efficient technologies be adopted wherever fossil fuels are used. The need of the hour is to encourage clean coal technologies such as super and ultra super critical boilers, fluidised bed combustion, integrated gasification combined cycle plants, and use of beneficiated coal. Though these technologies are somewhat expensive, but increased cost is offset by way of higher efficiency and reduced environ-mental degradation.

Clean coal technologies: The combustion technology widely used for burning of coal for power generation is pulverized fuel combustion (PC). One of the chief limitations of standard PC cycle is low efficiency, since it relies solely on a steam cycle for electricity generation. However, the low capital cost, suitability to burn Indian coal, local availability of PC technology, makes it the preferred choice. Clean coal technologies are designed to enhance both the efficiency and environmental acceptability of coal use. There are several advanced coal technology options which increase power plant efficiencies from the 30 to 35 per cent level that are typical of existing coal plants, to the range of 40-50 per cent or above. The following clean coal technologies are in use/under development across the globe.

- Advanced pulverized coal firing (Super-critical and ultra super-critical technology);
- Atmospheric fluidized bed combustion (AFBC);
- Pressurised fluidized bed combustion (PFBC);
- Integrated gasification combined cycle technology (IGCC).

Among the above technologies, super-critical pulverized coal firing and AFBC technologies are proven and in use in many countries. The pollutants and greenhouse gas emission per kWh of electricity from these combustion technologies are lower because of the units' higher thermal efficiencies.

Renovation and modernisation of existing thermal power plants: Continuous deterioration in perfor-mance of thermal power stations was first observed during the early 1980s. Thereafter, renovation and modernisation schemes were structured and executed in order to improve the performance of existing thermal power stations. Plant load factor, which is normally taken as the index of performance of any thermal unit, was only 48.6 per cent during 1982-83. It improved to 68 per cent during 2000-01.

Coal washing/beneficiation: A number of studies have been conducted in the past to quantify the economics of using beneficiated coal in the Indian power sector. These studies have indicated the benefits of using washed coal, both in terms of operations and management, as well as project capital cost. Coal washing has achieved limited sucess in various pilot projects.

Demand-side management

The least cost option towards improving the efficiency of equipment and to mitigate environmental and global climate change is the adoption of energy conservation at the user end. There is tremendous potential for saving energy in various sectors of the economy. The Indian economy is primarily agriculture-based. Rural irrigation is mainly through millions of inefficient agricultural pumps. Improving pump set efficiency would reduce power consumption, resulting in lower demand for power. Similarly, improvement of energy consumption in the industrial sector would result in considerable power savings. There is a lot of scope for energy saving in the area of lighting sector. Still, there is extensive use of inefficient incandescent lamps. Its replacement with compact fluorescent lamps and electronic ballasts would help in reducing power consumption. Power thus saved would result in lower demand and reduced emission of pollutants and greenhouse gasses.

Conclusion

Adoption of energy conservation measures is necessary to reduce effective demand. This would not only save huge investments required in building new capacity, but would also help in abatement of greenhouse gasses and other environmental pollutants. Achieving energy conservation targets of 95,000 MkWh (as envisaged during the Tenth Plan) would avoid generation of about 25 million tonne per annum (MTPA) of greenhouse gasses, 40 MTPA of SO2 and 55 MTPA of coal ash. There is a growing awareness about the importance of energy conservation and its benefits in reducing the demand-supply gap of energy. This has led the state governments, utilities, industrial units and consumer forums to set up energy conservation and efficiency improvement cells.

Table 1: Energy saving potential (%)

Sector	**Potential**
Economy as a whole	Up to 23%
Agriculture	Up to 36%
Industry	Up to 25%
Domestic and commercial	Up to 20%
Transport	Up to 20%

Source: Planning Commission

Table 2: Energy saving potential (MkWh)

End-use type	Potential savings (MkWh)
Motors and drive system	80,000
Lighting	10,000
Energy intensive industries	5,000
Total	**95,000**

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