RENEWABLE ENERGY TECHNOLOGIES

Unit 1: ENERGY SCENARIO

Module : 3

Potential of various renewable energy sources, Global energy status, per capita energy consumption, Future energy plans.

Potential of various renewable energy sources:

The country has an estimated renewable energy potential of around 85,000MW from commercially exploitable sources, i.e., wind, 45,000 MW; small hydro, 15,000MW and biomass/bioenergy, 30,000 MW. In addition, India has the potential to generate 35MW per square kilometer using solar photovoltaic and solar thermal energy. There has been phenomenal progress in wind power and, with an installed capacity of over 15700 MW; India occupies the fifth position globally.

Biomass energy:

India is very rich in biomass. It has a potential of 19,500 MW (3,500 MW from biogas based cogeneration and 16,000 MW from surplus biomass). Currently, India has 537 MW commissioned and 536 MW under construction. The facts reinforce the idea of a commitment by India to develop these resources of power production. Following is a list of some States with most potential for biomass production:

- Andhra Pradesh (200 MW)
- Bihar (200 MW)
- Gujarat (200 MW)
- Karnataka (300 MW)
- Maharashtra (1,000 MW)
- Punjab (150 MW)
- Tamil Nadu (350 MW)

- Uttar Pradesh (1,000 MW)

Hydropower:

India has a huge hydro power potential, out of which around 20 % has been realized so far. New hydro projects are facing serious resistance from environmentalists. Resettlement of the displaced people with their lands becomes major issue.

The exploitable hydro-electric potential in terms of installed capacity is estimated to be about 148,700 MW out of which a capacity of 30,164 MW has been developed so far and 13,616 MW of capacity is under construction. In addition, 15,000 MW in terms of installed capacity from small, mini and micro hydro schemes have been assessed. Also, 56 sites for pumped storage schemes with an aggregate installed capacity of 94,000 MW have been identified. The government expects to harness its full potential of hydropower by 2027 with a whopping investment of 5,000 billion Rupees.

Wind Energy:

India now ranks as a "wind superpower" having a net potential of about 45000 MW only from 13 identified states. Wind resources can be exploited mainly in areas where wind power density is at least 400 W/m2 at 30 m above the ground. An annual mean wind power density greater than 200 W/m2 (watts per square meter) at 50-m height has been recorded at 211 wind monitoring stations, covering 13 states and union territories.

Solar Energy:

Solar power has so far played an almost non-existent role in the Indian energy mix. The grid-connected capacity in the country now stands at 481.48 MW, while the total solar energy potential has been estimated at 50,000 MW. Most parts of India have 300 330 sunny days in a year, which is equivalent to over 5000 trillion kWh per year. Average solar incidence stands at a robust 4 7 kWh/sqmtr/day. About 66 MW of aggregate capacity is installed for various applications comprising one million industrial PV systems 80 percent of which is solar lanterns, home/ street lighting and solar water pumps, among others India is both densely populated and has high solar insolation, providing an ideal combination for solar power in India. Much of the country does not have an electrical grid, so one of the first applications of solar power has been for water pumping; to begin replacing India's four to five

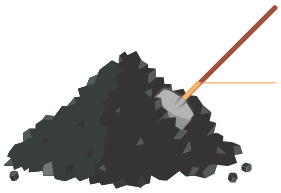
million diesel powered water pumps, each consuming about 3.5 kilowatts, and off-grid lighting.

Geothermal Energy:

Geothermal is energy generated from heat stored in the earth, or the collection of absorbed heat derived from underground. Geothermal energy is at present contributing about 10,000 MW over the world and Indias small resources can augment the above percentage. Studies carried out by the geological survey of India have observed existence of about 340 hot springs in country. These are distributed in 7 geothermal provinces. The provinces, although found along the west coast in Gujarat and Rajasthan and along a west south west- east-northeast line runningfrom the west coast to the western border of Bangladesh (known as SONATA), are most prolific in a 1500 km stretch of the Himalayas.

Global Energy Status

Coal



The proven global coal reserve was estimated to be 9,84,453 million tonnes by end of 2003. The USA had the largest share of the global reserve (25.4%) followed by Russia (15.9%), China (11.6%). India was 4th in the list with 8.6%.

Oil

The global proven oil reserve was estimated to be 1147 billion barrels by the end of 2003. Saudi Arabia had the largest share of the reserve with almost 23%. (One barrel of oil is approximately 160 liters)

Gas

The global proven gas reserve was estimated to be 176 trillion cubic metres by the end of 2003. The Russian Federation had the largest share of the reserve with almost 27%.

(*Source: BP Statistical Review of World Energy, June 2004)

Global Primary Energy Consumption

The global primary energy consumption at the end of 2003 was equivalent to 9741 million tons of oil equivalent (MTones).

Energy distribution between developed and developing Countries

Although 80 percent of the world's population lies in the developing countries (a four- fold population increase in the past 25 years), their energy consumption amounts to only 40 percent of the world total energy consumption.

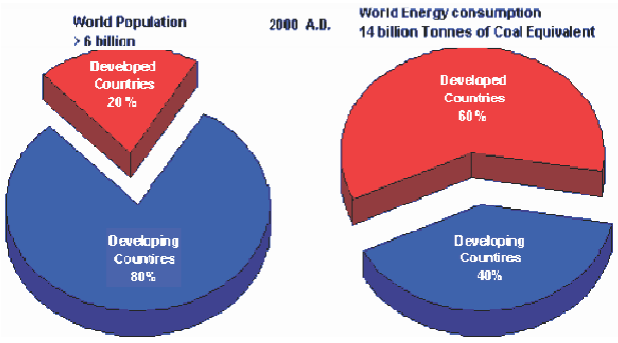


Fig. 1.4: Energy Distribution Between Developed and Developing Countries

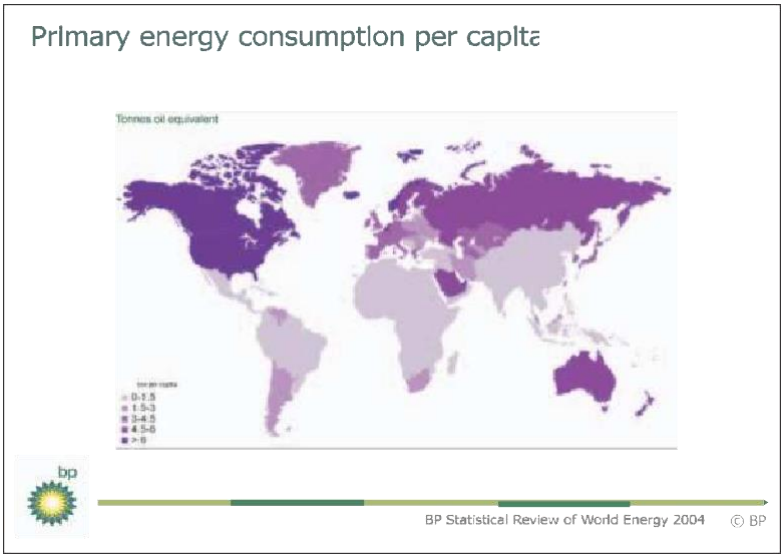
The high standards of living in the developed Countries are attributable to high energy consumption levels.

Also the rapid population growth in the developing countries has kept the per capita energy consumption low compared with that of highly industrialized developed countries. The world average energy consumption per person is equivalent to 2.2 tones of coal. In industrialized countries, people use four to five times more than the world average and nine times more than the average for the developing countries. An American uses 32 times more commercial energy than an Indian.

Per capita energy consumption:

Energy intensity is energy consumption per unit of GDP. Energy intensity indicates the development stage of the country. India's energy intensity is 3.7 times of Japan, 1.55 times of USA,

1.47 times of Asia and 1.5 times of World average.



Per Capita Energy Consumption

Future energy plans:

Energy Strategy for the Future

The energy strategy for the future could be classified into immediate, medium-term and long- term strategy. The various components of these strategies are listed below:

Immediate-term strategy

- Rationalizing the tariff structure of various energy products.
- Optimum utilization of existing assets
- Efficiency in production systems and reduction in distribution losses, including those in traditional energy sources.
- Promoting R&D, transfer and use of technologies and practices for environmentally sound energy systems, including new and renewable energy sources.

Medium-term strategy:

- Demand management through greater conservation of energy, optimum fuel mix, structural changes in the economy, an appropriate model mix in the transport sector, i.e. greater dependence on rail than on road for the movement of goods and passengers and a shift away from private modes to public modes for passenger transport; changes in design of different products to reduce the material intensity of those products, recycling, etc.

- There is need to shift to less energy-intensive modes of transport. This would include measures to improve the transport infrastructure viz. roads, better design of vehicles, use of compressed natural gas (CNG) and synthetic fuel, etc. Similarly, better urban planning would also reduce the demand for energy use in the transport sector.

- There is need to move away from non-renewable to renewable energy sources viz. solar, wind, biomass energy, etc.

Long-term strategy:

- Efficient generation of energy resources

- Efficient production of coal, oil and natural gas

- Reduction of natural gas flaring Improving energy infrastructure
- Building new refineries

- Creation of urban gas transmission and distribution network

- Maximizing efficiency of rail transport of coal production.

- Building new coal and gas fired power stations.

- Enhancing energy efficiency