RENEWABLE ENERGY TECHNOLOGIES

Unit 1: ENERGY SCENARIO

Module : 1

Indian energy scenario in various sectors – domestic ,industrial, commercial, agriculture, transportation and others.

INTRODUCTION

Any physical activity in this world, whether carried out by human beings or by nature, is cause due to flow of energy in one form or the other. The word 'energy' itself is derived from the Greekword 'en-ergon', which means 'in-work' or 'work content'. The work output depends on the energy input.

Energy is one of the major inputs for the economic development of any country. In the case of thedeveloping countries, the energy sector assumes a critical importance in view of the ever-increasing energy needs requiring huge investments to meet them.

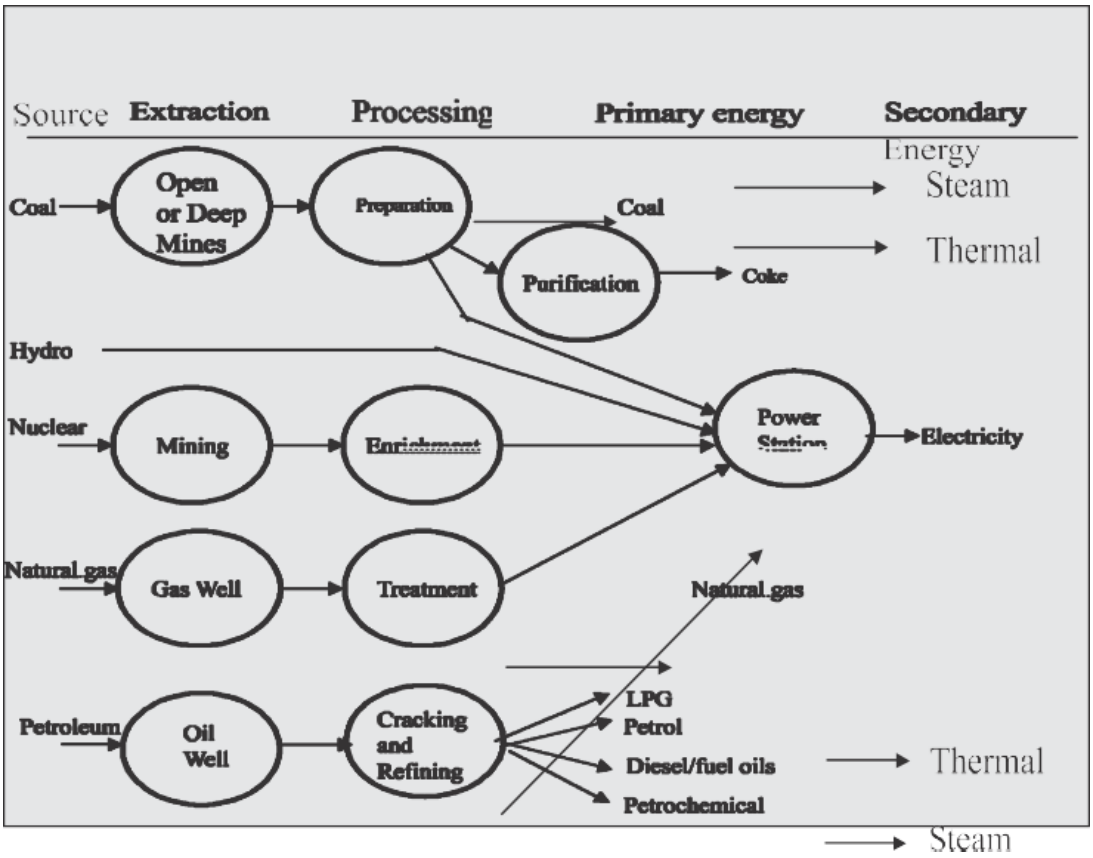
Energy can be classified into several types based on the following criteria:

- Primary and Secondary energy
- Commercial and Non commercial energy
- Renewable and Non-Renewable energy
- Conventional and Non-conventional energy

Primary and Secondary Energy:

Primary energy sources are those that are either found or stored in nature. Common primary energy sources are coal, oil, natural gas, and biomass

(such as wood). Other primary energy sources available include nuclear energy from radioactive substances, thermal energy stored in earth's interior, and potential energy due to earth's gravity. The major primary and secondary energy sources are shown in Figure.



Primary energy sources are costly converted in industrial utilities into secondary energy sources;

for example coal, oil or gas converted into steam and electricity. Primary energy can also be used directly. Some energy sources have non energy uses, for example coal or natural gas can be used as a feedstock in fertilizer plants.

Commercial Energy and Non Commercial Energy

Commercial Energy

The energy sources that are available in the market for a definite price are known as commercial energy. By far the most important forms of commercial energy are electricity, coal and refined petroleum products. Commercial energy forms the basis of industrial, agricultural, transport and commercial development in the modern world. In the industrialized countries, commercialized fuels are predominant source not only for economic production, but also for many household tasks of general population.

Examples: Electricity, lignite, coal, oil, natural gas etc.

Non-Commercial Energy

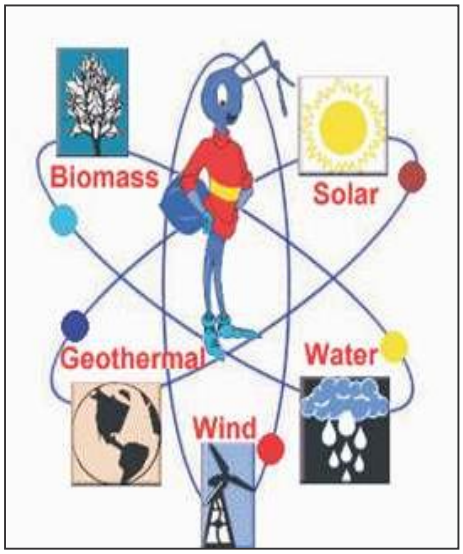
The energy sources that are not available in the commercial market for a price are classified as non-commercial energy. Non-commercial energy sources include fuels such as firewood, cattle dung and agricultural wastes, which are traditionally gathered, and not bought at a price used especially in rural households. These are also called traditional fuels. Non-commercial energy is often ignored in energy accounting.

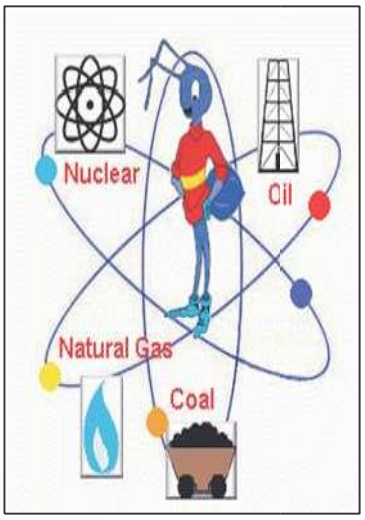
Example: Firewood, agro waste in rural areas; solar energy for water heating, electricity generation, for drying grain, fish and fruits; animal power for transport, threshing, lifting water for irrigation, crushing sugarcane; wind energy for lifting water and electricity generation.

Renewable and Non-Renewable Energy

Renewable energy is energy obtained from sources that are essentially in exhaustible. Examples of renewable resources include wind power, solar power, geo thermal energy, tidal power and hydro electric power. The most important feature of renewable energy is that it can be harnessed without the release of harmful pollutants.

Non-renewable energy is the conventional fossil fuels such as coal, oil and gas, which are likely to deplete with time.





Non-Renewable

Conventional and Non-conventional energy resources:

Conventional Energy

Conventional energy resources which are being traditionally used for many decades and were in common use around oil crisis of 1973 are called conventional energy resources, e.g., fossil fuel, nuclear and hydro resources.

Non-conventional energy

Non-conventional energy resources which are considered for large – scale use after oil crisis of 1973, are called non-conventional energy sources, e.g., solar, wind, biomass, etc.

Energy Consumption and Standard Of Living:

The energy consumption of a nation can be broadly divided into the following areas or sectors depending on energy-related activities. These can be further subdivided into sub sectors:

- Domestic sector (houses and offices including commercial buildings)
- Transportation sector
- Agriculture sector
- Industry sector

Consumption of a large amount of energy in a country indicates increased activities in these sectors. This may imply better comforts at home due to use of various appliances, better transport facilities and more agricultural and industrial production. All of this amount to a better quality of life. Therefore, the per capita energy consumption of a country is an index of the standard of living or prosperity (i.e. income) of the people of the country.

Indian Energy Scenario

Coal dominates the energy mix in India, contributing to 55% of the total primary energy pro- duction. Over the years, there has been a marked increase in the share of natural gas in prima- ry energy production from 10% in 1994 to 13% in 1999. There has been a decline in the share of oil in primary energy production from 20% to 17% during the same period.

Energy Supply Coal Supply

India has huge coal reserves, at least 84,396 million tones of proven recoverable reserves (at the end of 2003). These amounts to almost 8.6% of the world reserves and it may last for about 230 years at the current Reserve to Production (R/P) ratio.

In contrast, the world's proven coal reserves are expected to last only for 192 years at the current R/P ratio.

Reserves/Production (R/P) ratio-

If the reserves remaining at the end of the year are divided by the production in that year, the result is the length of time that the remaining reserves would last if production were to continue at that level.

India is the fourth largest producer of coal and lignite in the world. Coal production is concentrated in these states (Andhra Pradesh, Uttar Pradesh, Bihar, Madhya Pradesh, Maharashtra, Orissa, Jharkhand, and West Bengal).

Oil Supply

Oil accounts for about 36 % of India's total energy consumption. India today is one of the top ten oil-guzzling nations in the world and will soon overtake Korea as the third largest consumer of oil in Asia after China and Japan. The country's annual crude oil production is peaked at about 32 million tonne as against the current oil consumption by end of 2007 is expected to reach 136 million tonne(MT), of which domestic production will be only 34 MT. India will have to pay an oil bill of roughly $50 billion, assuming a weighted average price of $50 per barrel of crude. In 2003-04, against total export of $64 billion, oil imports accounted for $21 billion. India imports 70% of its crude needs mainly from gulf nations. The majority of India's roughly 5.4 billion barrels in oil reserves are located in the Bombay High, upper Assam, Cambay, Krishna-Godavari. In terms of sector wise petroleum product consumption, transport accounts for 42% followed by domestic and industry with 24% and 24% respectively. India spent more than Rs.1,10,000 crore on oil imports at the end of 2004.

Natural Gas Supply

Natural gas accounts for about 8.9 per cent of energy consumption in the country. The current demand for natural gas is about 96 million cubic metres per day (mcmd) as against availability of 67 mcmd. By 2007, the demand is expected to be around 200 mcmd. Natural gas reserves are estimated at 660 billion cubic meters.

Electrical Energy Supply:

The all India installed capacity of electric power generating stations under utilities was 1,12,581 MW as on 31st May 2004, consisting of 28,860 MW- hydro, 77,931 MW- thermal and 2,720 MW- nuclear and 1,869 MW- wind (Ministry of Power).

Nuclear Power Supply

Nuclear Power contributes to about 2.4 per cent of electricity generated in India. India has ten nuclear power reactors at five nuclear power stations producing electricity. More nuclear reactors have also been approved for construction.

Hydro Power Supply

India is endowed with a vast and viable hydro potential for power generation of which only 15% has been harnessed so far. The share of hydropower in the country's total generated units has steadily decreased and it presently stands at 25% as on 31st May 2004. It is assessed that exploitable potential at 60% load factor is 84,000 MW.

Final Energy Consumption

Final energy consumption is the actual energy demand at the user end. This is the difference between primary energy consumption and the losses that takes place in transport, transmission & distribution and refinement. The actual final energy consumption (past and projected) is given in the table given below,

TABLE 1.2 DEMAND FOR COMMERCIAL ENERGY FOR FINAL CONSUMPTION (BAU SCENARIO)					
Source	**Units**	**1994-95**	**2001-02**	**2006-07**	**2011-12**
Electricity	Billion Units	289.36	480.08	712.67	1067.88
Coal	Million Tonnes	76.67	109.01	134.99	173.47
Lignite	Million Tonnes	4.85	11.69	16.02	19.70
Natural Gas	Million Cubic	9880	15730	18291	20853
Oil	Million Tonnes	63.55	99.89	139.95	196.47
Source: Planning Commission *BAU:_Business As Usual*					

Sector Wise Energy Consumption in India

The major commercial energy consuming sectors in the country are classified as shown in the Figure. As seen from the figure, industry remains the biggest consumer of commercial energy and its share in the overall consumption is 49%. (Reference year: 1999/2000)

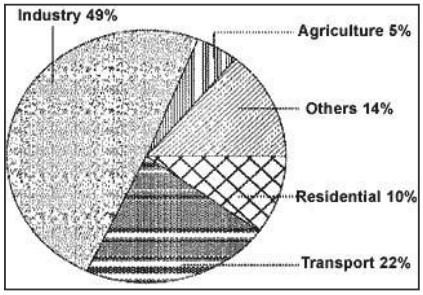


Figure
Sector Wise Energy Consumption (1999-2000)

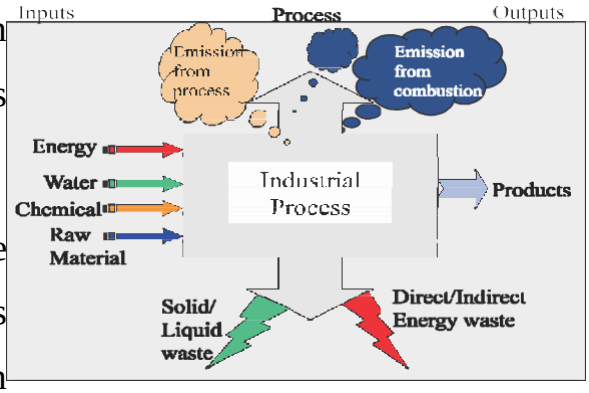
Energy and Environment

The usage of energy resources in industry leads to environmental damages by polluting the atmosphere.

Few of examples of air pollution are sulphur dioxide (SO2), nitrous oxide (NOX) and carbon

monoxide (CO) emissions from boilers and furnaces, Chlorofluro carbons (CFC)

emissions from refrigerants use, etc. In chemical and fertilizers industries, toxic gases are released. Cement plants



and power plants spew out particulate matter. Typical inputs, outputs, and emissions for a typical industrial process are shown in Figure.

Air Pollution

A variety of air pollutants have known or suspected harmful effects on human health and the environment. These air pollutants are basically the products of combustion from fossil fuel use. Air pollutants from these sources may not only create problems near to these sources but also can cause problems far away. Air pollutants can travel long distances, chemically react in the atmosphere to produce secondary pollutants such as acid rain or ozone.

Evolutionary Trends in Pollution Problems

both developed and rapidly industrializing countries, the major historic air pollution problem has typically been high levels of smoke and SO2 arising from the combustion of sulphur-containing fossil fuels such as coal for domestic and industrial purposes.

Smogs resulting from the combined effects of black smoke, sulphate / acid aerosol and fog have

been seen in European cities until few decades ago and still occur in many cities in developing world. In developed countries, this problem has significantly reduced

over recent decades as a result of changing fuel-use patterns; the increasing use of cleaner fuels such as natural gas, and the implementation of effective smoke and emission control policies.

In both developed and developing countries, the major threat to clean air is now posed by traffic emissions. Petrol- and diesel engine motor vehicles emit a wide variety of pollutants, principally carbon monoxide (CO), oxides of nitrogen (NOx), volatile organic compounds (VOCs) and particulates, which have an increasing impact on urban air quality.

In addition, photochemical reactions resulting from the action of sunlight on NO2 and VOCs from vehicles leads to the formation of ozone, a secondary long-range pollutant, which impacts in rural areas often far from the original emission site. Acid rain is another long-range pollutant influenced by vehicle NOx emissions.

Industrial and domestic pollutant sources, together with their impact on air quality, tend to be steady- state or improving over time. However, traffic pollution problems are worsening world-wide. The problem may be particularly severe in developing countries with dramatically increasing vehicle population, infrastructural limitations, poor engine/emission control technologies and limited provision for maintenance or vehicle regulation.

The principle pollutants produced by industrial, domestic and traffic sources are sulphur dioxide, nitrogen oxides, particulate matter, carbon monoxide, ozone, hydrocarbons, benzene, 1,3- butadiene, toxic organic micro pollutants, lead and heavy metals.