ENERGY – RENEWABLE AND NON-RENEWABLE SOURCES

Energy is the basis of human life. We need energy to do work. Over the past few decades, energy has been the subject of much debate. Energy is the backbone of technology and economic development. Our energy requirements have spiraled over the years following the industrial revolution. This rapid increase in our use of energy has created problems of demand and supply. The impending crisis the world over due to overuse of non-renewable energy sources for sustenance shall soon lead to a situation for all concerned to take a prudent decision to start depending on renewable energy sources for their daily needs in order to conserve our finite natural resources for generations to come.

INTRODUCTION

Energy is the basis of human life. We need energy to do work. There is hardly any activity that is not dependant on energy. Every moment of the day we are using energy in moving, studying, working, playing, etc. Energy is defined as the capacity to do work. At first, man used muscle power, then fire and animal power. Next, he learned to harness energy, convert it to useful forms and put it to various uses.

All natural processes are also driven by energy – the water cycle, the wind system, storms, lightning, growth of plants, the weathering of rocks, etc.

Over the past few decades, energy has been the subject of much debate. Energy is the backbone of technology and economic development. In addition to men, machines and money, it is now regarded as the fourth factor of production. Without energy no machine will run. Today, most machines run on electricity and they are needed to make anything and everything from bricks to buns. Hence, our energy requirements have spiraled in the years following the industrial revolution. This rapid increase in our use of energy has created problems of demand and supply. The impending crisis the world over due to overuse of non-renewable energy sources for sustenance shall soon lead to a situation for all concerned to take a prudent decision to start depending on renewable energy sources for their daily needs in order to conserve our finite natural resources for generations to come.

This exhibition aims to present an overview of the concerns about energy, its availability, usage, various alternate sources of energy, demand-supply ratio and how to conserve energy.

FROM WHERE DO WE GET ENERGY?

All energy comes from the sun. Plants absorb sunlight to make and store food. Billions of years ago, when the plants died and got compressed under sand and rock, they formed coal, oil and natural gas, which had the energy of the sun, trapped in them. These substances are called as fossil fuels and release heat when they are burnt. This heat can be used as such or converted to other forms of energy like

- Mechanical energy to drive machines eg. turbines and vehicles
- Electrical energy to run electrical equipment

Food is the fuel for the body. Coal, oil, natural gas, etc, are the commonly used fossil fuels and provide most of our energy needs.

ENERGY - DEMAND AND SUPPLY

Over the years the demand for energy has grown rapidly, due to increasing population, industrialization, urbanization, transportation and agriculture. The major demand for fuels is by the power generation, transport, industry, agriculture and domestic sectors. Today the demand is far in excess of the existing fuel reserves. There are growing concerns that at the present rate of consumption, the available energy sources may be exhausted in about 25 years. There is a continuous search for alternate energy sources to reduce the dependence on fossil fuels.

GLOBAL ENERGY SCENARIO

According to World Energy Council (1995), by 2020 more than 90m barrels of oil will be consumed a day, an increase of some 27m B/d, or the equivalent of the whole of today's OPEC production.

- Coal output will double to about 7 billion tonnes per annum.
- Annual gas demand will be more than double, to reach some 4 trillion cubic metres, almost as much as the United States of America's total current gas reserves.
- Developing countries, which today consume 30% of the world's total energy, will consume 50% by 2020 and probably 70% by 2100.

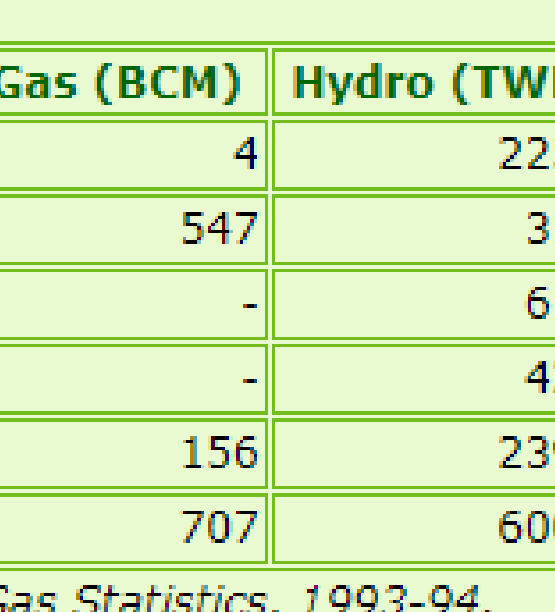
Source: Sustainable Energy Supply in Asia – Pradeep Chaturvedi, vol.II.

Much of the world's energy comes from non-renewable resources, such as oil, coal, and natural gas. The bulk of the consumption of energy is centred in the industrialized nations of United States of America, Canada, Europe and Australia.

WORLD ENERGY PRODUCTION BY SOURCE

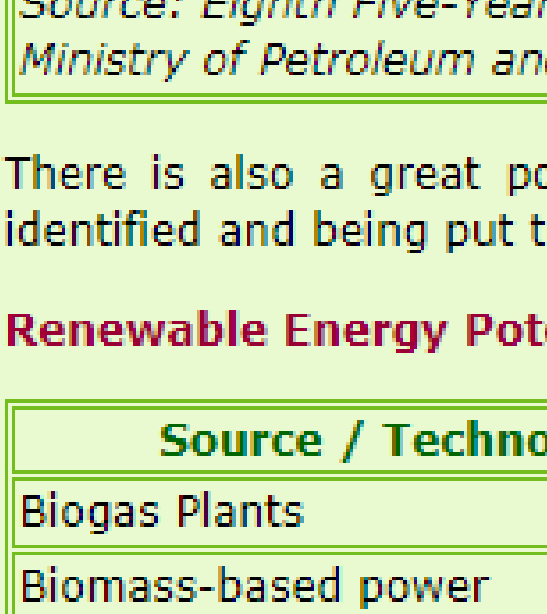
Although there is increasing interest in alternate energy sources such as solar power, almost two-thirds of the world's energy comes from oil and natural gas. Other nonrenewable resources such as coal are still heavily used in countries such as China.

Indian Energy Scenario



India is not endowed with large energy reserves keeping in mind her large geographical area, growing population and increasing energy needs. In India coal accounts for 70% of electricity generated. Oil accounts for 23% of total energy consumption in India. The oil reservoir in India is set to be around 1,500 million metric tones. Transport and household sectors consume 46.7% and 50.9% respectively on total oil consumption in India. Natural gas reservoir in India is said to be around 62.48 million metric tones.

Regional Distribution of Primary Commercial Energy Reserves



Region	Coal (BMT)	Lignite (BMT)	Crude Oil (MMT)	Natural Gas (BCM)	Hydro (TWH)
Northern	1.1	1.1	-	4	225.0
Western	47.4	0.5	609	547	31.4
Southern	12.6	24.6	-	-	61.8
Eastern	138.2	-	-	-	42.5
North-Eastern	0.8	-	156	156	239.3
Total	200.1	26.2	765	707	600.0

Source: Eighth Five-Year Plan, Planning Commission. Petroleum and Natural Gas Statistics, 1993-94, Ministry of Petroleum and Natural Gas. Geological Survey of India.

There is also a great potential to develop alternate energy sources, many of which have already been identified and being put to use in small areas.

Renewable Energy Potential in India

Source / Technology	Potential Availability	Potential exploited
Biogas Plants	12 Million	2 Million
Biomass-based power	17.000 MW	Marginal
Efficient Woodstoves	120 Million	18.5 Million
Solar Energy	5 x 10^15 Whr / Year	-
Small Hydro	10,000 MW	250 MW
Wind Energy	20,000 MW	250 MW
Ocean Thermal	50,000 MW	-
Sea Wave Power	20,000 MW	-
Tidal Power	9,000 MW	-

Source: National Paper on Energy Scenario in India, 1995, India Member Committee, World Energy Council.

NON-RENEWABLE SOURCES OFENERGY

Fossil fuels

These energy sources are finite, exhaustible and cannot be replaced quickly. Coal, petroleum and natural gas are the fossil fuels. They were formed from the remains of plants that grew in swamps millions of years ago. About 360 billion years ago, these resources took 40 billion years to form, but they are being rapidly exhausted within a few hundred years. That is why they are called non-renewable energy sources.

On combustion fossil fuels give out a large quantity of heat, which can be used to generate electricity. Fossil fuel electricity generation provides about 63 % of the world's electricity. Coal has been used as a source of heat energy since about 1000 BC. It was not until the industrial revolution, from 1800 onwards, that coal became a major source of energy. Energy from coal is the cheapest and provides a large amount of energy per unit weight.

Most of world oil is used for transportation. Experts believe that there are only 700 billion barrels of oil left in the world. Since the world uses 20 billion barrels a year, it will last another 35 years at this rate. The available natural gas will last for another 60 years. Siberia is the largest producer of natural gas. Compressed natural gas (CNG) is an alternative clean fuel for automobiles and does not emit toxic gases like carbon monoxide and benzene. Buses, Autos, and Taxis in Delhi run on CNG. The major component of the natural gas is methane.

The disadvantages of burning fossil fuels is that they are environmentally damaging. Thermal power plants are by far the most damaging.

- Carbon dioxide (CO_2) and sulfur dioxide (SO_2) are produced when coal is burnt. CO_2 is a greenhouse gas that causes global warming, while SO_2 causes acid rain.
- Fly ash causes many hazardous diseases like asthma, tuberculosis, etc.
- The temperature of the environment increases
- Only 30 to 35 per cent of the energy used for heating the boiler is converted to electrical energy
- Mining of coal pollutes the surrounding air, water and land
- Oil exploration and transportation cause oil spills
- Combustion of oil emits out greenhouse gases

However fossil fuels continue to be used in large quantities as

- they have high calorific value
- they are found within small areas in large reserves
- they are now easily accessible
- they have made transportation faster and comfortable

Firewood

Global wood consumption has increased 64 percent since 1961. More than half of the 3.4 billion cubic meters of wood consumed annually is burned for fuel; the rest is used in construction and for paper and a variety of other wood products (wri.org). Every year, 16,000,000 tonnes of firewood are used as fuel in India.

The disadvantage of using these materials is that they produce a lot of smoke on burning, which is injurious to health. The forests are also being rapidly degraded.

The C.P.R. Environmental Education Centre modified the old model chulhas in order to fit the larger sized cooking pots used in the villages and rural schools and as well reduce the amount of smoke generated. The local potter and the village women's group members were simultaneously motivated and trained to construct their individual chulhas. Using these chulhas, the fuelwood consumption drops considerably by 40 % - 50% and is an economically affordable and ecologically viable model.

Nuclear energy

Nuclear power stations convert the enormous quantity of heat released by splitting an atom - nuclear fission - to generate electricity. Nuclear energy is the largest source of emission-free energy. They need only small amounts of fissionable material to produce a large amount of energy. However, disposal of the highly radioactive nuclear waste is a huge problem that affects not only us but also future generations, for thousand of years to come. About 99% of radiation in nuclear waste is given off from spent fuel rods. The largest part of nuclear waste comes from uranium mining.

Fuel used	Amount	Electricity generated
Coal	500 gms	1.5 kilowatt hours
Oil	500 gms	2.0 kilowatt hours
Uranium	500 gms	30,000 kilowatt hours

About 16% of the global electricity is produced by nuclear power. In India about 2.74 % of electricity is produced from nuclear energy.

At Chernobyl nuclear power plant at Ukraine, thousands of people died from the explosion and even more from the effects of the radiation. Radiation could cause all kinds of cancer.

RENEWABLE SOURCES OF ENERGY

The global demand for energy far surpasses its supply. The reserves of petroleum, coal and natural gas, which are the conventional sources of energy, are being eroded rapidly. Hence there is a constant search for alternate sources of energy that are renewable or will not get exhausted and will at the same time be non-polluting. There is great potential to harness the movement of water and wind. Though the initial investment for installing these renewable energy equipments are high, in the longer run, they shall prove to be an asset for life.

Renewable energy sources are

- clean sources of energy as they are emission free
- inexhaustible in supply
- used in fully automated systems

While energy generated from fossil fuels are

- highly location specific as the sources are available in some parts of the country during some months only
- can supply the needs of only a small area
- expensive as initial investment is high
- have a storage problem

WIND ENERGY

The energy of air in motion is known as wind energy. It has been used as a source of energy for thousands of years for driving sailboats, grinding grain and pumping water. Wind turbines that rotate at great speed when the wind blows over them are now used for generating electricity. In India, wind is freely available along the coastline. India has a potential to generate about 45,000 MW power from wind energy (Down to Earth, October 2003). However, wind energy systems can be generated only in areas where annual mean wind speed is 150 watts per sq. metres at 30 metres height. Gujarat and Tamilnadu are the most suitable places in India for establishing wind energy systems. There are also problems of distortion of TV signals, noise pollution, discontinuous power and a suspected interference with rainfall.

SOLAR ENERGY

The sun is the ultimate source of most other sources of energy. The heat of the sun can be trapped by using solar panels to heat water or converted to electricity by means of photovoltaic cells. India receives about 6000 billion MW of solar energy per year. If only one percent of this energy could be tapped at even 10 percent efficiency, it would be about 30 to 35 times India's present electricity generation (Gusain, 1990). For domestic purposes, investing in solar water heaters, solar panels for generating electricity, solar lamps, and the likes can go a long way in conserving our finite natural resources.

ENERGY FROM THE OCEAN

Tidal energy

Tides or the rise and fall of ocean level are a source of energy. The difference in height between the high tide and low tide is large and can be used to turn the turbines. The first tidal energy plant was set up on River Rance in France. In India investigations on the use of tidal power have been carried out in the National Institute of Oceanography, Goa, the Gulf of Kutch and the Gulf of Cambay on the west coast and the Sunderbans on the east coast.

Wave energy

Waves keep the ocean water in continuous motion. The vertical rise and fall of the successive waves can be used to produce energy.

Ocean thermal gradient energy

The heat contained in the ocean water heated by the sun can be converted into electricity by utilizing the difference in temperature between the surface and lower levels.

GEOTHERMAL ENERGY

The earth has very hot materials below the crust, which heat up the underground water to produce steam. The hot steam and water gush out in many places as springs and geysers. Such regions are known as geothermal regions. The steam and hot water are used to run turbines and generate electricity. Geothermal heat energy is used to heat houses and offices in the Puga valley in Ladakh region.

HYDROELECTRIC ENERGY

The force and speed of running water can be used to turn turbine generators to produce electricity. Hydroelectric power is the world's second largest source of electricity. It supplies about 16% of India's commercial energy and 28% of its electricity. It is however heavily dependant on rains. The dams constructed for harvesting hydroelectric energy often flood good farmland and forests and leads to displacement of people. They also result in the spread of waterborne diseases.

BIOMASS

Organic waste material or dead parts of living things, e.g. crop residue, sewage and plant wastes such as dead leaves and wood are known as biomass. Wet biomass like animal dung can be converted to gaseous fuel called biogas. Dry wastes like leaves, wood, paper, fruits and vegetables, peel, etc., can be burnt to produce steam which will generate electricity. In India, 5,000,000 tonnes of animal dung cakes are burnt as fuel every year.

ENERGY AND THE LAW

The National Energy Policy 1980 was framed to ensure adequate energy supplies and protect the environment from adverse impact of unregulated utilization of energy resources.

It focuses on

- Intensification of exploration of oil and gas to increase indigenous production
- Management of demand for soil and other forms of energy
- Energy conservation and management, with a view to increasing energy productivity
- Development and exploitation of new renewable sources of energy to meet the energy needs of rural areas
- Intensification of research and development activities in the field of new and renewable sources of energy

National Energy Conservation Act 2001

The Energy Conservation Act 2001 is a statutory measure to regulate the energy efficiency and conservation due to an increase in the demand for electricity and fossil fuels and an increasing dependence on commercial energy. The Act tries to promote energy efficiency in the commercial sector, which is the largest user of energy. This would reduce the pressure on already existing resources and would be beneficial to the environment, as there will be a drastic reduction in greenhouse gas emissions.

Other laws

- The Coal Mines (Conservation and Development) Act, 1974
- Electricity (Supply) Act, 1948
- The Indian Electricity Act, 1910
- The Mines Act, 1952
- The Mines and Minerals (Regulation and Development) Act, 1957
- Motor Vehicles Act, 1939
- The Oil industries (Development) Act, 1974
- The Oil fields (Regulation and Development) Act, 1948
- The Oil and Natural Gas Commission Act, 1959

CONSERVE ENERGY

Avoid careless habits like leaving the lights and fans on when no one is around, keeping the car or scooter engine on while talking, running pumps and motors overtime, etc. - these contribute to wastage of energy.

Reduce your energy needs and consumption by installing energy saving devices like fluorescent bulbs, rechargeable batteries, timers, pressure cookers, etc., and practicing energy saving habits.

Reuse and recycle used paper, metal containers, glass bottles, plastic and other material to save energy consumed in making new items.

Install smokeless chulhas in rural households that depend on firewood for cooking in order to conserve our forest wealth.

Do not waste items like food, clothes, tins, boxes, paper, drinking water, etc., - these consume energy in their production.

Streamline procedural requirements for establishment of new capacities for production, generation, distribution, and consumption of all forms of energy.

CONCLUSION

The demand for energy is increasing day by day. The ever increasing use of modern means of transport systems, changing lifestyles and mechanization of labour have led to a sudden and very large spurt in the energy requirements. There are several choices available in selecting an alternate source, but, the cost factor is high and each is suitable only in a particular area. Since the renewable sources of energy have inbuilt constraints of use, almost 90% of the energy requirements have to for now be met from the finite sources available on this planet. With the impending energy crisis facing mankind, saving 'every bit of energy' is of great importance. This saved energy can then be put to some useful 'use' in future. We must remember 'energy saved is energy produced'. We have to practice sustainable consumption.