

## UNIT 8

# POWER RESOURCES:

Pakistan, despite the enormous potential of its energy resources, remains energy deficient and has to rely heavily on imports to satisfy hardly its needs. Moreover a very large part of the rural areas does not have the electrification facilities because they are either too remote and/or too expensive to connect to the national grid.

Pakistan obtains its energy requirements from a variety of traditional and commercial sources. Share of various primary energy sources in energy supply mix remained during last few years as oil: 43.5%, gas: 41.5%, LPG: 0.3%, coal: 4.5%, hydroelectricity: 9.2%, and nuclear electricity: 1.1%.

The electric power generation included **71.9% thermal, 25.2% hydel** and 2.9% nuclear. While there is no prospect for Pakistan to reach self sufficiency in hydrocarbons, the good option is the exploitation and utilization of the huge coal reserves of **Thar** and the other renewable energy sources. Pakistan has wide spectrum of high potential renewable energy sources, conventional and as well non-conventional, which have not been adequately explored, exploited and developed. Thus, the primary energy supplies today are not enough to meet even the present demand. So, Pakistan, like other developing countries of the region, is facing a serious challenge of energy deficit. The development of the renewable energy sources can play an important role in meeting this challenge.

### **KEY POINTS:**

#### **Non renewable energy resources:**

##### **(1) Coal:**

- Coal is a very old fossil fuels
- The better types of coal have been taken several hundred million years to form
- Coal is formed by the decomposition of natural vegetation.
- There are different types of coal.
- In Pakistan bituminous to lignite types are found in limited quantity.

#### **Types of coal:**

##### **(a) Anthracite:**

- Best quality coal
- Hardest with the highest hydrocarbon content
- Burns quietly with great heat
- It is the blackest coal of all.
- It is formed in thin layers very deep underground.

### (b) Bituminous

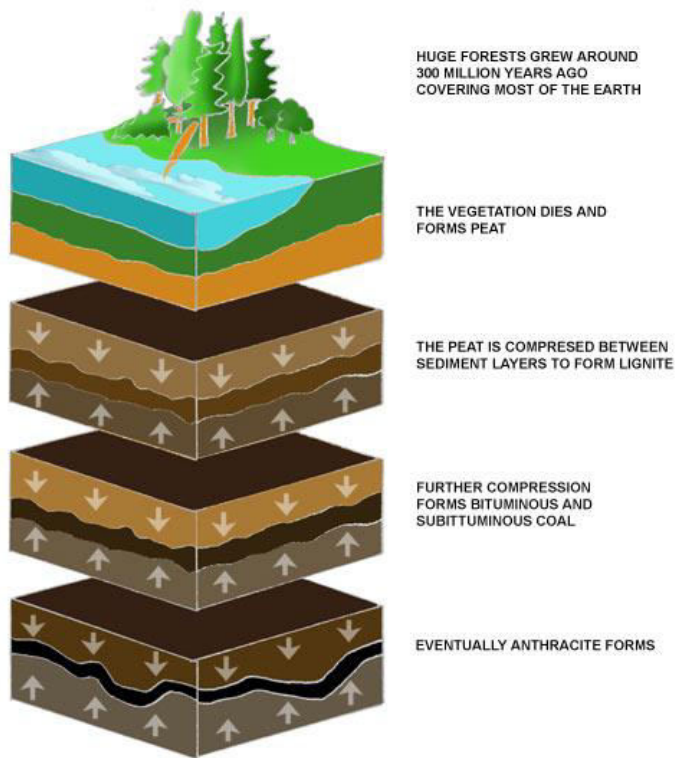
- Steam coal
- Coking coal
- A superior black, hard coal found in highly compressed seams.
- Burns with great heat.
- Its hydrocarbon content is less than that of anthracite.
- Coking coal is burnt to produce coke
- It is also used in blast furnaces for the extraction of iron from the iron ore.
- It is often formed between lignite and anthracite

### (c) Lignite

- It is found near the surface and it is easier to mine.
- It is lower quality coal with a high moisture and ash content.
- It has low heating value.

### (d) Peat

- Exclusively vegetative matter and represents the initial stage of coal formation.
- Its carbon content is slow.



### **Transportation of coal from the coal mine to the end user:**

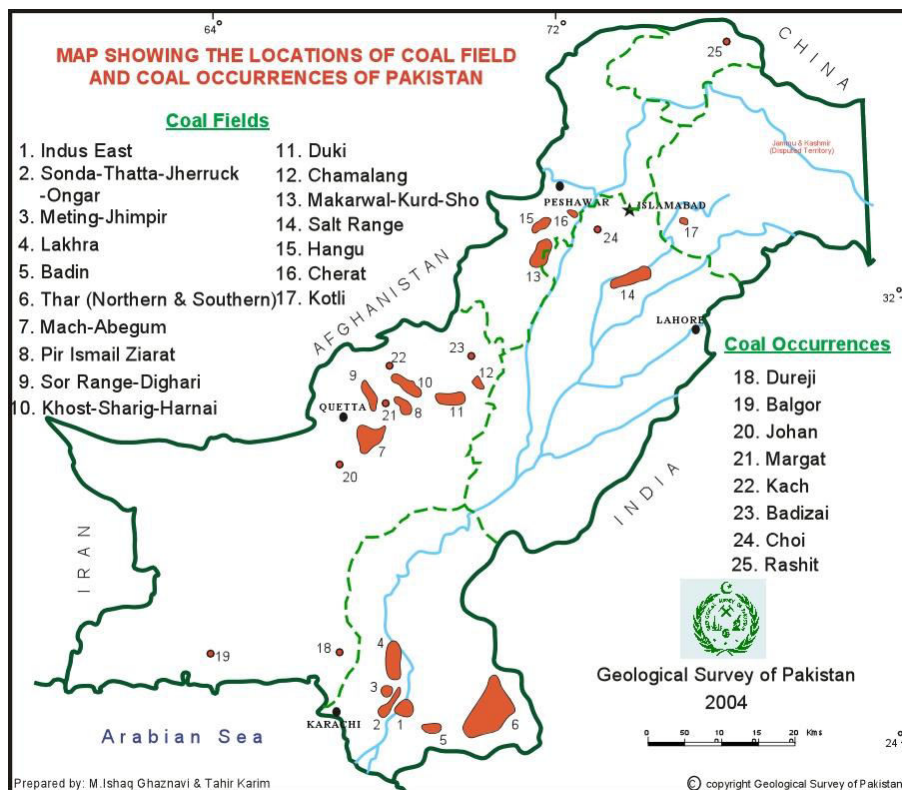
- After the extraction of coal from the coal face, it is loaded onto trolleys, which run on a track, which leads from the coalmine to the outside surface.
- In some small coalmines donkeys are used as an underground transport.
- Once the coal comes out of the mine , the qualities of coal are separated and sold to the middleman who further loads it into trucks and supplies it to the brick kilns and cement factories where it used as a fuel.
- When the coal is supplied to thermal power stations, rail transport is also used if it is economically feasible.
- Brick kilns use 83 % of Pakistan’s coal production.



### **Coal as a preferred source of power in near future:**

- Till the late 1990s coal was considered as the least popular energy fuel due to its poor quality and dangerous mining conditions.
- Recently government has been considering the use of coal in the industrial sector and for power generation due to the following factors.

- (i) New reserves of coal have been discovered in recent years. It is estimated that Pakistan has 7508 million tones of proven coal reserves in 8 major fields in lower Sindh and the salt range.
- (ii) In view of the uncertainty surrounding the price of oil and the tremendous amount of foreign exchange involved in the import of oil, the authorities have considered the option of the use of indigenous coal as an alternate source of fuel.

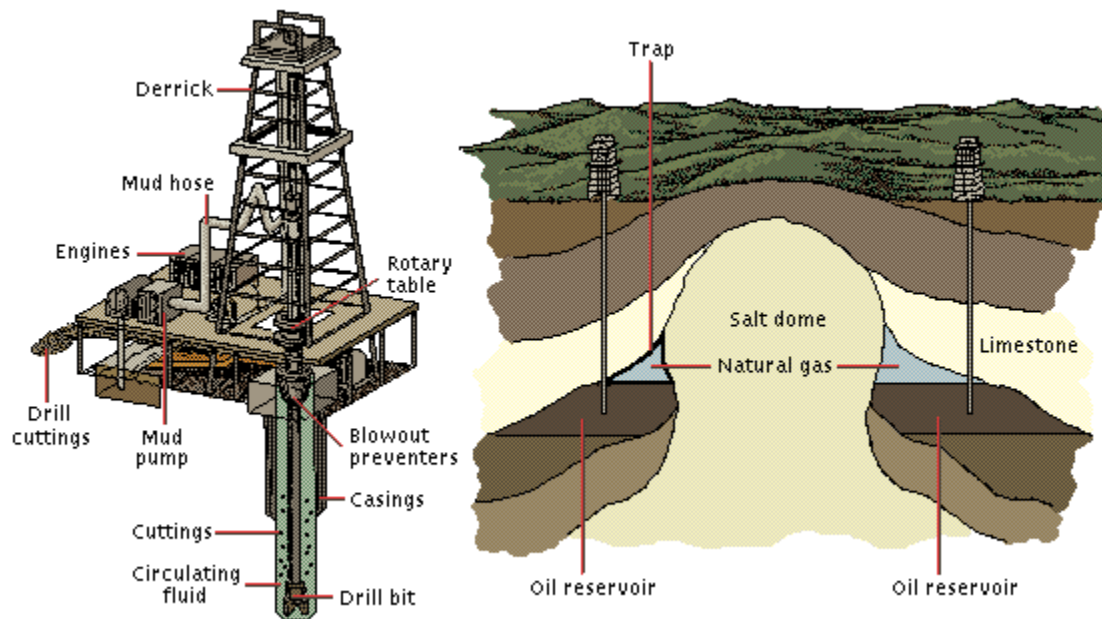
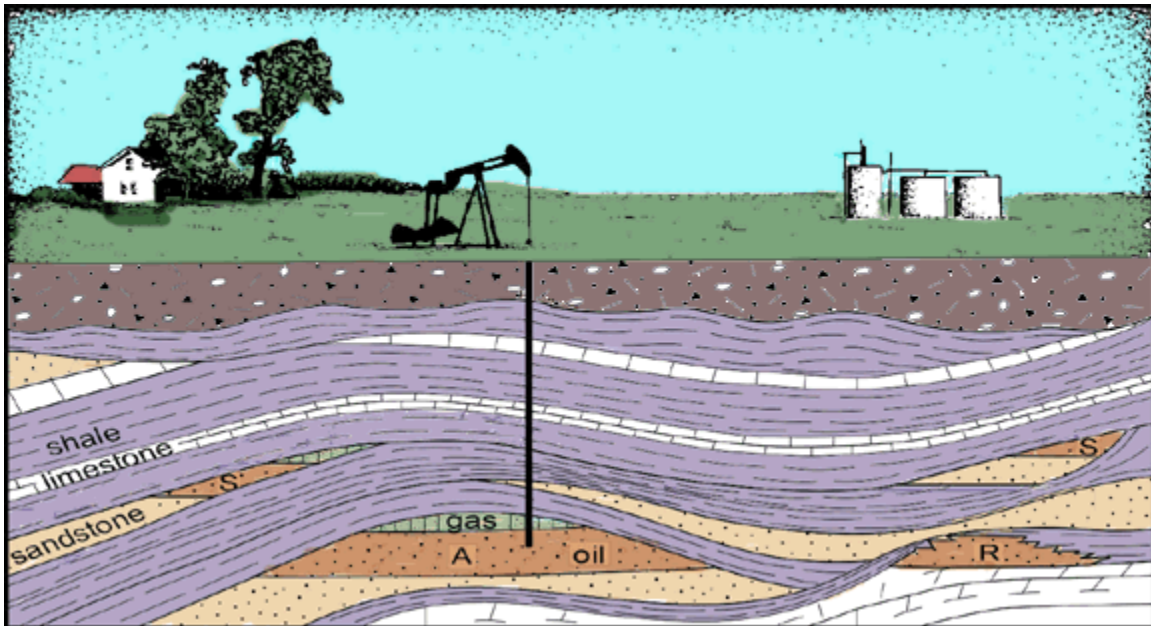


## **(2) MINERAL OIL (petroleum)**

- Most important fossil fuel today
- Also known as "black gold".
- It occurs in porous spaces of sedimentary rocks and is derived mainly from the decomposition of marine animal and vegetation matter over several million years.
- It can be found many hundreds of meters underground or under the sea bed.
- It mainly occurs in dome shaped anticlines between two layers of non porous rocks.
- The oil is trapped in the anticline with gas above and water below.

## Oil prospecting and Drilling:

- Wells are drilled to pump this liquid fuel out of the ground.
- Once the drilling site has been selected, a derrick or drilling rig is set up.
- The derrick is a large steel structure that holds the drilling pipes and other equipment.





### **Oil refining:**

- Crude oil cannot be used in its raw state.
- It has to be processed and refined into useful products such as petrol; for cars, aero planes, heating oil, kerosene, diesel oil for truck and buses.
- It is cheaper to import crude oil and refine it locally for domestic and industrial use than to import refined products.
- Crude oil production accounted for 36.15 % and import oil accounted for 63.85 %.
- Refined oil production is 33.58 % whereas import of refined oil accounted 64.42%.
- A substantial proportion of Pakistan's import bill is spent on petroleum products which is a great burden on Pakistan's foreign exchange reserves.

### **Oil refineries:**

- Pak-Arab Refinery Ltd.
- National Refinery Ltd.
- Byco Petroleum Pakistan Ltd. (Byco)
- Pakistan Refinery Ltd. (PRL)
- Enar Petroleum Refining Facility (Enar),
- Indus Oil Refinery Ltd

- Attock Oil refinery

### **Uses of oil:**

- Uses of by – products (wax, plastics, synthetic rubber, detergents, pharmaceutical products, furnace oil)
- Source of power (thermal electricity, for heating)
- As a lubricant for machine
- As an indispensable motor fuel (petrol, diesel, air crafts, cars, buses, rail engines)

### **Transportation of imported and local petroleum;**

#### **(i) transport at sea:**

- Pakistan's imported petroleum is transported by sea from oil producing countries (Saudi Arabia, UAE) through oil tankers.
- At keamari port or port Qasim, the oil tanker is berthed at the designated oil pier.
- The pier is a platform with an oil handling system.
- Through the pier the ship is connected to the oil handling system.
- The oil products are pumped from the oil tanker, ship to the oil marketing companies/refineries' storage tanks at keamari and korangi.

#### **(ii) Transport on land:**

On land oil is transported in 3 ways.

- (a) by pipeline
- (b) by road tanker
- (c) by rail tanker

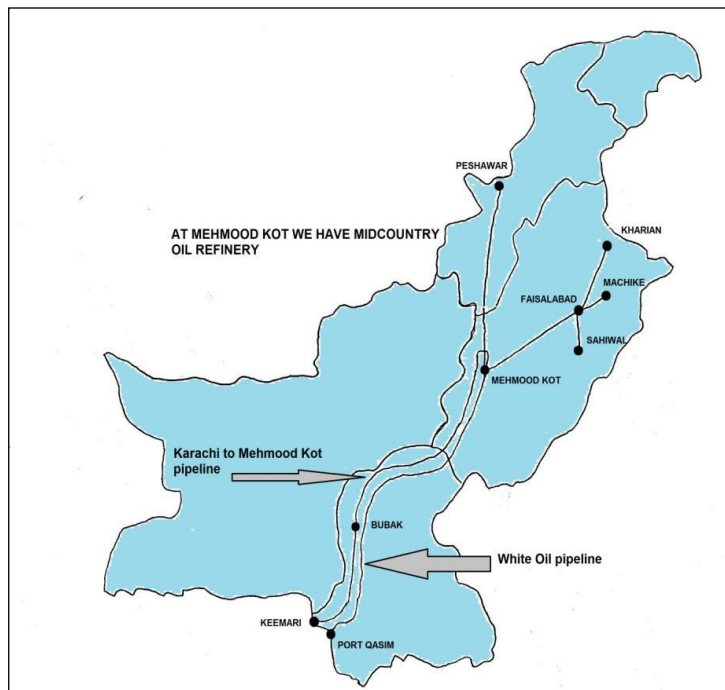
- Transportation by road and rail tankers is relatively costly, time consuming and inefficient as compared to transmission by pipelines.
- Movement of these products by roads is not only dangerous for traffic but because of their weight, it can also cause extreme degradation to the existing road surface and be a danger to human lives.
- Pipeline transportation is the most efficient, convenient and cheapest mode of transportation besides being far more environmentally friendly.



### **PARCO's project for the transportation of oil:**

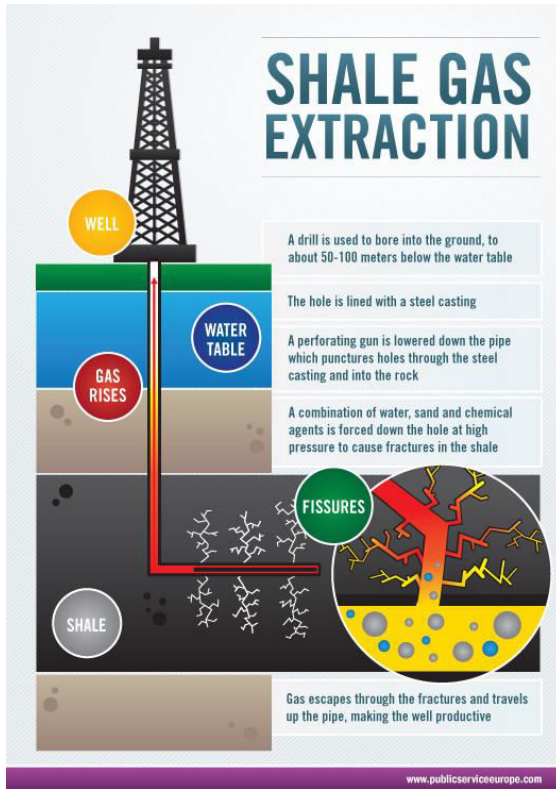
- In 2002 PARCO launched a white oil pipeline project (WOPP) which will carry refined oil from Karachi to the north.
- After conversions of PARCO's existing pipeline network for crude oil transportation, the white oil pipeline will be used for the transport of refined petroleum products to the central and northern regions of Pakistan.
- These areas account for almost 60 % of the total petroleum consumption in the country.
- Bin Qasim Port will be the initial point of the white Oil Pipeline project.
- The new underground pipeline costing \$480 million will also carry refined oil from the Pakistan oil refinery at port Qasim to Mahmood Kot in district Muzaffargarh covering a distance of 817 KM.
- The demand for petroleum products is rising at a rate of 10 % per annum.





### **(3) NATURAL GAS:**

- NG found in oil bearing rocks above the oil.
- These rocks have millions of tiny holes
- Above these rocks there is a layer of non- porous rocks that trap the gas underground and stop it from leaking out to the surface.
- Natural gas is made up of many gases especially methane, ethane, propane and butanes.
- Natural gas was discovered in 1952 at Sui, Baluchistan by Pakistan petroleum limited (PPL).
- This gas field is considered to be one of the largest in the world.
- When natural gas is cooled to a very low temperature it turns into a liquid.
- This liquid is called liquefied petroleum gas of LPG.
- It can be moved from place to place in special cylinders.
- In mountainous areas where there is no gas pipelines many people use LPG for heating and cooking.

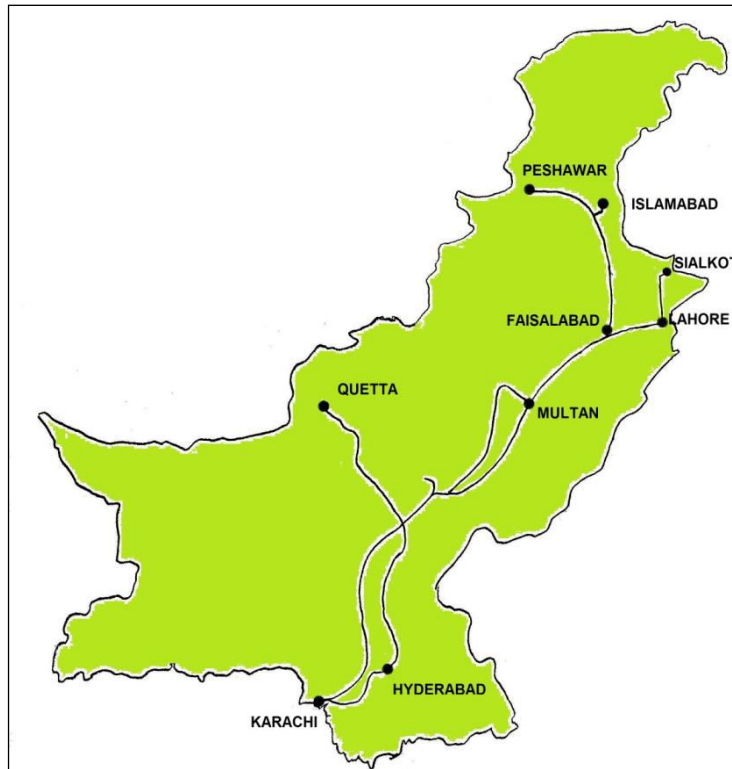


### **Organization to develop oil and gas resources:**

- (i)** Geological Survey of Pakistan (GSP) 1947
- (ii)** Oil and gas development company limited (OGDCL) 1961
- (iii)** Sui Northern Gas Pipeline Limited (SNGPL)
- (iv)** Sui Southern Gas Company Limited (SSGCL) 1963
- (v)** Pak Arab Refinery Co. Ltd.(PARCO) 1974
- (vi)** Pakistan state oil company limited (PSO) 1976
- (vii)** Hydrocarbon development institute of Pakistan 1970

### **Main gas fields:**

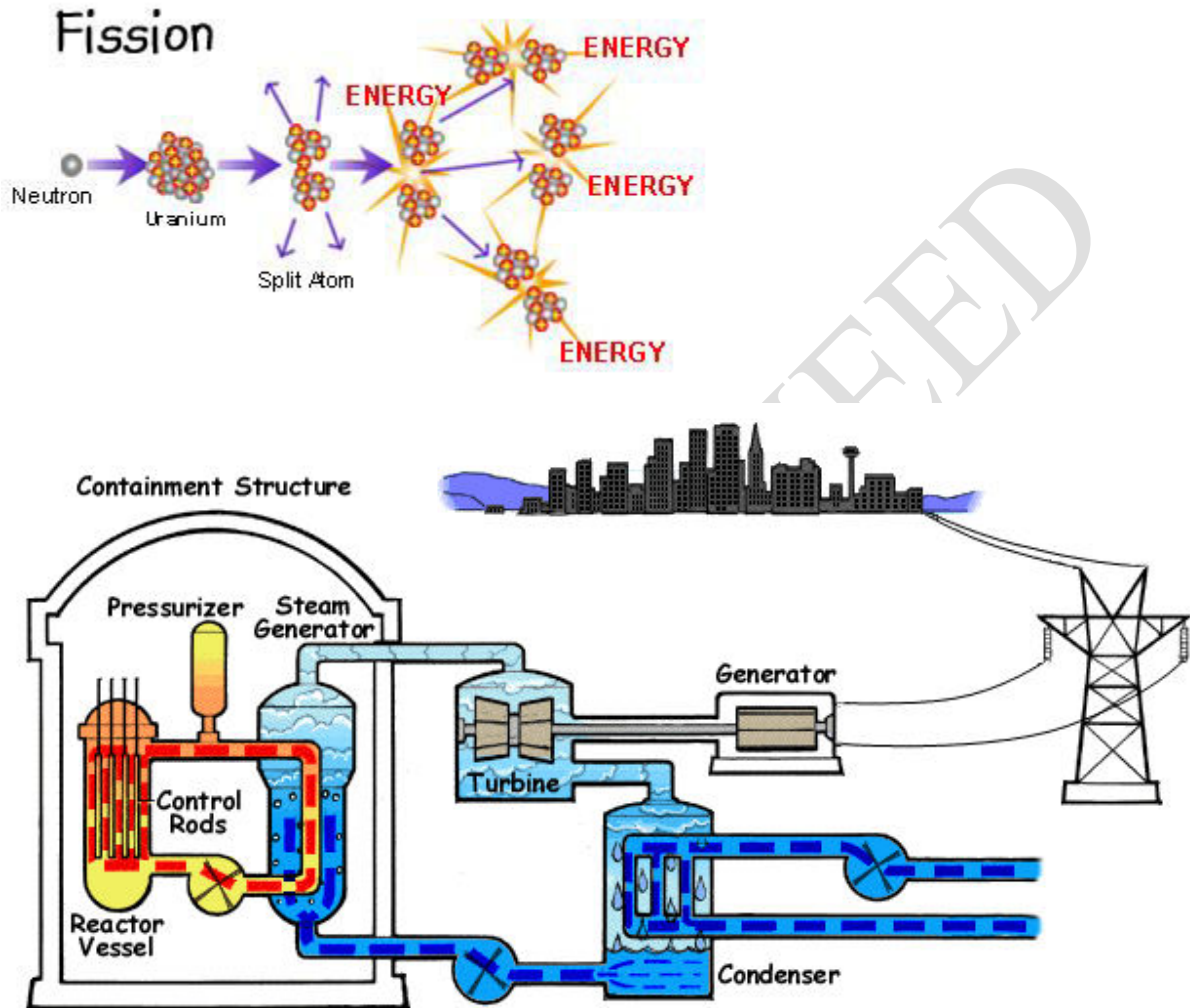
- Sui, Baluchistan
- Pirkoh, Baluchistan
- Mari, Lower Sindh
- Meyal ,potwar
- Dhurnal, Potwar.



#### **(4) NUCLEAR ENERGY:**

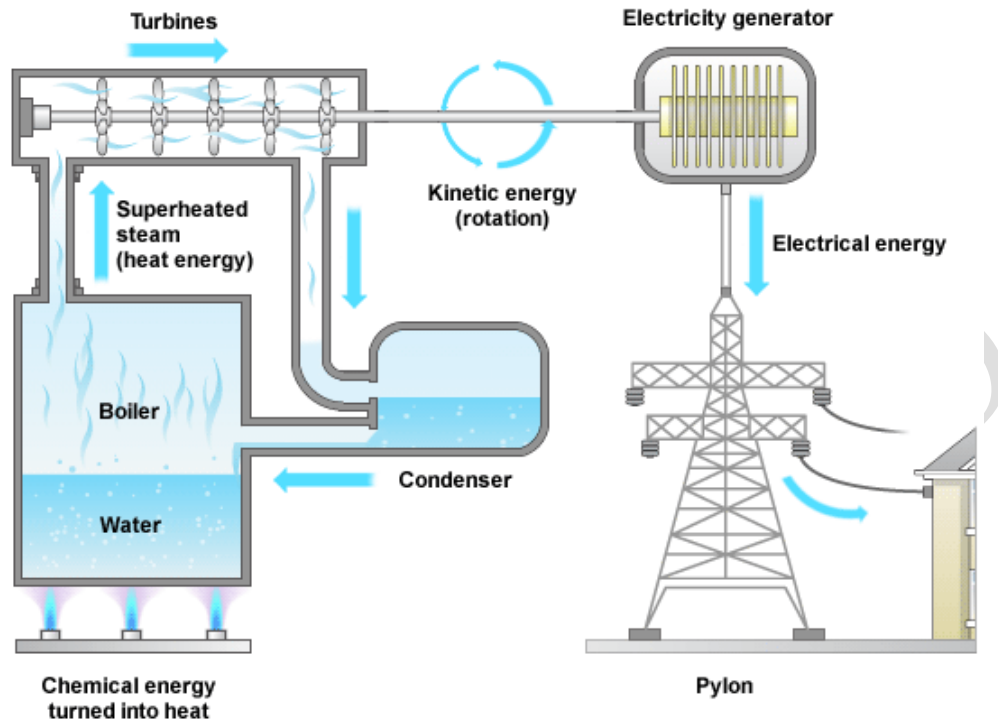
- NE is power that is released from atoms.
- It is the most powerful source of energy.
- In atomic fission , energy is released when the atoms split into their constitute parts (each has a neutron, a proton, and electron)
- In atomic fusion, energy is released when atoms are fused together.
- At present nuclear power stations are based on atomic fusion.
- Pakistan is trying to utilize nuclear energy for electricity generation like other advance countries.
- The Karachi Nuclear Power Plant was commissioned in 1971 as the first nuclear power station.
- It has an installed capacity of 137 MW.
- The second Nuclear power plant, Chashma Nuclear Power Plant was constructed under a contract between the Pakistan Atomic Energy

Commission and the China National Nuclear Corporation. The plant was commissioned in 1999.



#### **(5) THERMAL ELECTRICITY:**

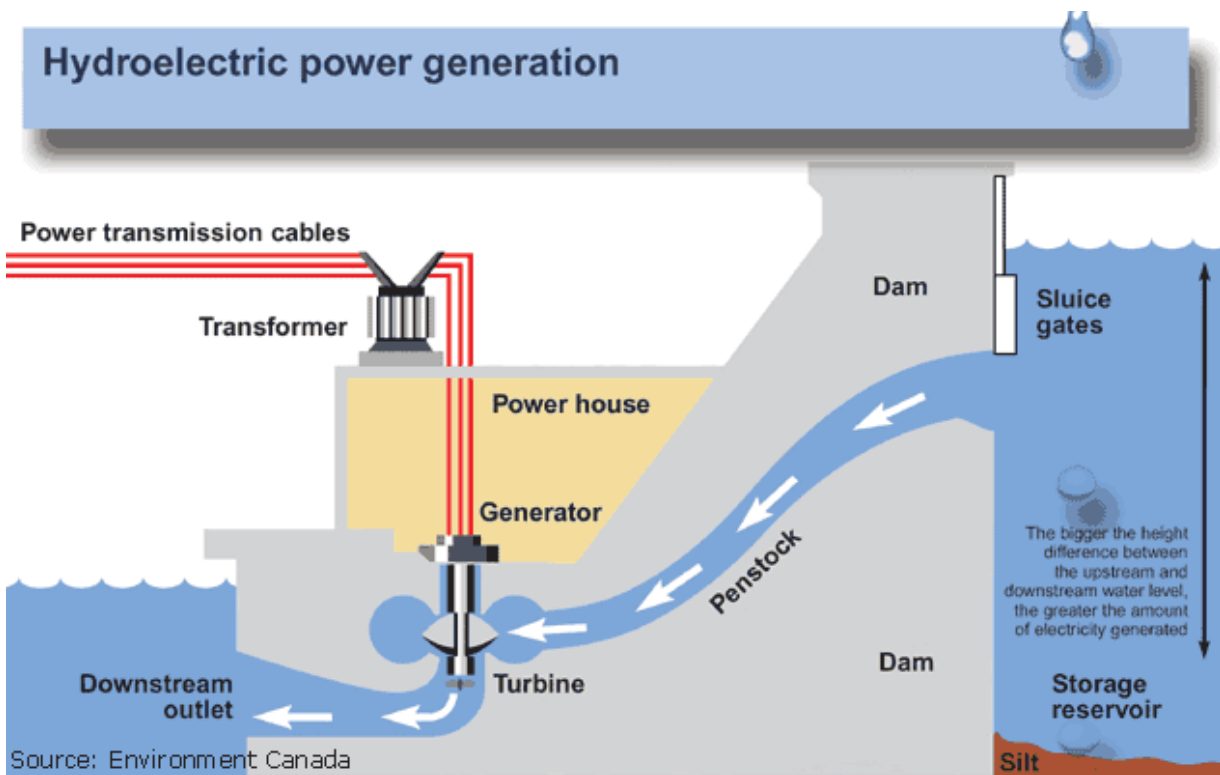
- Electricity is a flexible form of energy that can be easily converted to heat, light or sound energy.
- Electricity that is generated by non- renewable resources like coal, gas, nuclear fuel is called "thermal electricity" .
- Fossil fuels and nuclear power stations produce heat energy .this is used to turn water into steam which is then used to run turbines.



## Renewable energy resources:

### **(1)HYDRO ELETRIC POWER (HEP)**

- HEP stations use the force of flowing water to spin the hydro-turbines.
- From a hydro turbine there is a shaft going into the generator.
- Because the water has made the hydro turbine spin rapidly this shaft spins rapidly inside a magnetic field in the generator and this generates electricity.
- The electric current is regulated by the transformer and sent through the power line at the required voltage.
- HEP is best developed in the mountainous regions where precipitation is adequate and there is a steep slope or gradient.



### The locations for HEP

- Kurramgari, Warsak, Dargai, Malakand, Tarbela, Mangla, Rasul, Shadiwal, Nandipur, renalakurd, chichokimalian

### The location thermal power station:

- Daudkhel, shahdara, sahiwal, multan, quetta, guddu, sukkur, kotri, Hyderabad

### The location for nuclear power station:

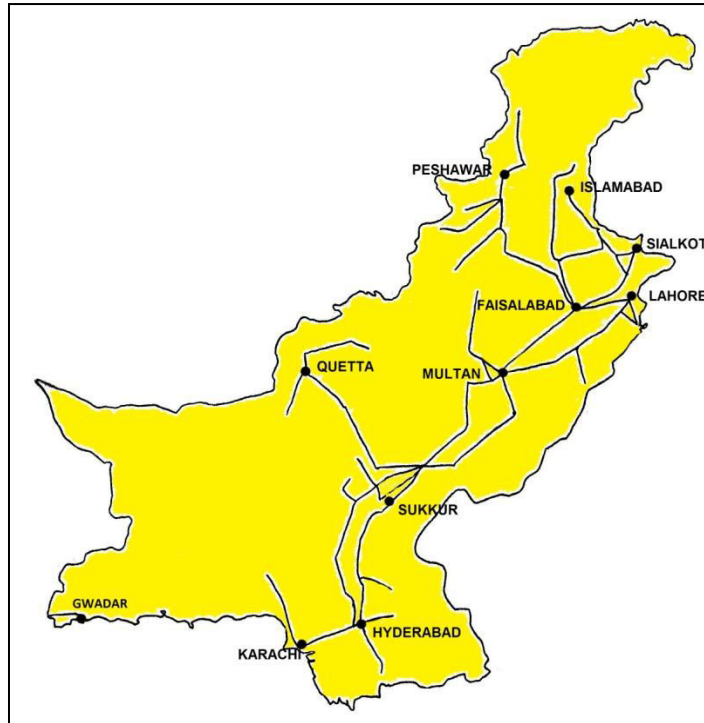
- Chasma, Karachi

### Profile of electricity generation:

- WAPDA and KESC are the main organizations involved in power generation, transmission and distribution of electricity.
- The Karachi nuclear power plant (KANUPP) a public sector organization and some independent private produces (IPP) are also involved in power generation.

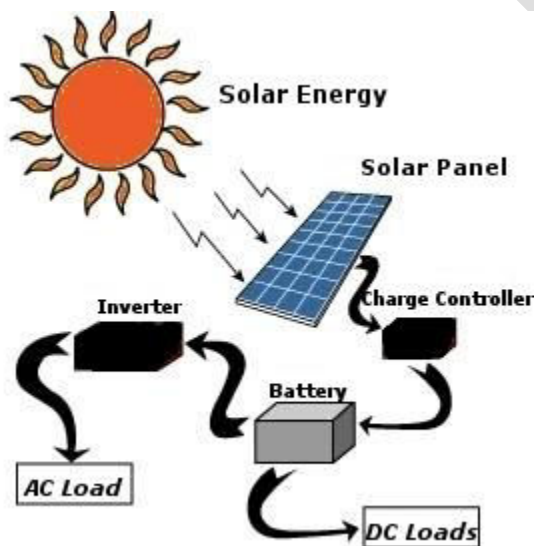
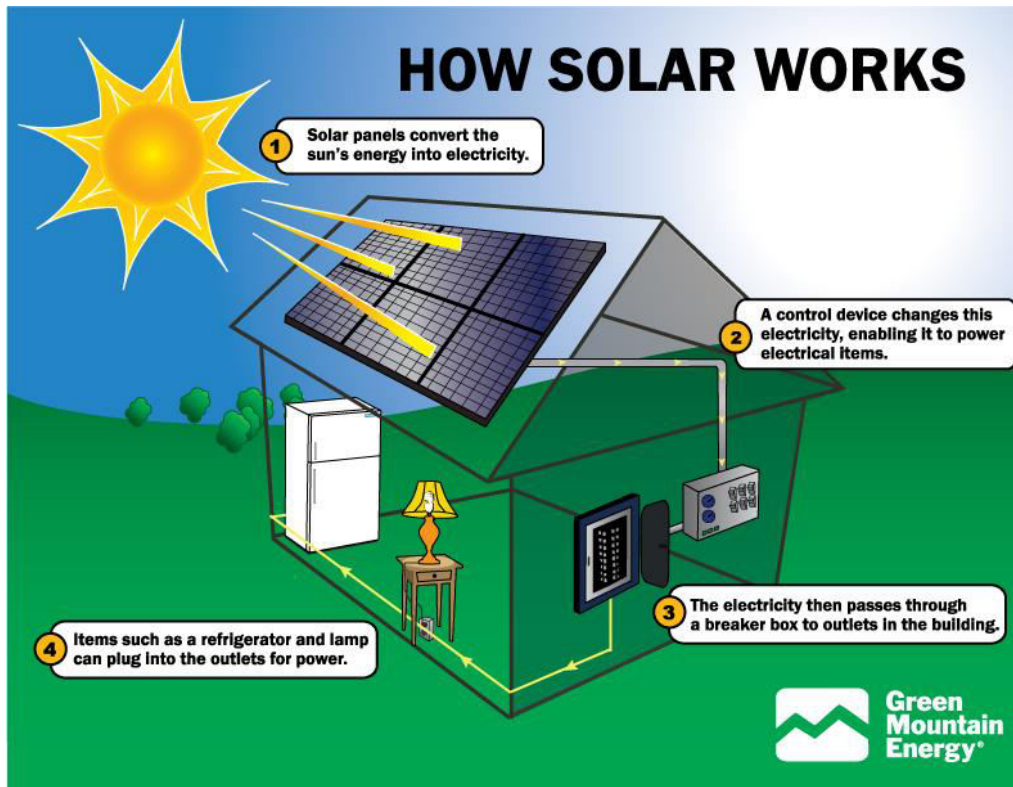
### **Installed Generation Capacity:**

- HEP produces 4,825 MW (41.72%)
- Thermal produces 6,741 MW (58.28%)



### **(2) SOLAR POWER**

- The energy of sun light, solar power is used in several ways.
- One way is to collect it in **solar cells** (photovoltaic cells).
- Solar cells can power radios and even small cars.
- **Solar furnaces** use giant mirrors to focus the sun's rays on a boilers.
- Steam from the boiler is used to make electricity.
- **Solar panels** collect heat energy from the sun.
- Pakistan has the potential for solar energy as there are 250-300 sunny days.
- Solar power is safe, pollution free, efficient and limitless.



### (3) BIO GAS:

- Bio gas is produced from animal and plant waste.
- Fermentation of cow dung gives off methane gas, which is used for cooking, heating and other purposes.



- Biogas projects are in the process of development.
- Although bio gas is a cheap source of energy, it means cow dung can no longer be used as manure.
- It this happens on a large scale it will aggravate the deficiency of a soil already lacking in organic nutrients.
- Moreover it will increase air pollution because methane is green house gas.

### Biofuels: how Bio Gas is Generated.

Floating gas holder type of plant: The diagram below shows the details of a floating gas holder type of bio gas plant.

