Power resources

Introduction

- All forms of energy can be changed into power
- Energy is found in nature both in renewable and non – renewable form

- **Renewable** form includes sunlight, wind energy and water energy
- **Non – renewable** includes fossil fuels and nuclear energy.

Fossil fuels

Coal

- Coal is formed by the decomposition of vegetative matter like swamp forests in a period of millions of years
- Types
- It has 4 types :-
    - Anthracite
        - Best quality coal
        - High carbon content so high heating value
        - Not available in Pakistan
    - Bituminous
        - Good quality coal
        - High carbon so high heating value
    - Lignite
        - More moisture and ash
        - Low heating value due to low carbon content
    - Peat
        - It is the first stage of formation of coal
        - Highly vegetative
        - Very low carbon content

Coal transportation

- It is transported with the help of trollies, trucks or donkeys from inside to outside of a mine
- From outside the mine, it is transported to industries with the help of either road transport e.g. by trucks or by rail transport as it is cheaper over longer distances and can carry large amount of coal

Pakistan coal fields

- Quetta coal fields
    - At Mach, Sharig, Degari, Harnai
    - Bituminous is found
        - Used in steel industry
        - Used in brick kiln industry

  Lower Sindh
    - At Jhimper, Lakhara, Sonda
    - Lignite is found
        - Used in thermal power station
- Salt range
    - At Dandot, Pidh
    - Lignite – Bituminous is found
        - Used in brick kiln industry
- Makarwal
    - At Makarwal

- Sub – Bituminous is found
    - Used in ceramic industry

Uses of coal

- In iron and steel industry to separate iron from iron ore through smelting
- Used as fuel in thermal power stations to produce steam for electricity
- Use as raw material in brick kiln, ceramic and fertilizer industry
- Used domestically and commercially for heating and cooking
- Briquetting

Coal extraction

- Coal is mined through the following methods :-
    - Shaft mining – when coal is underground
    - Adit mining – when coal is seen on a hillside
    - Open cast mining – when coal outcrops to the Earth's surface

Shaft mining

- A vertical shaft is dug into the ground
- Many shafts are also dug along coal seams
- Dynamite is used for breaking coal seams
- Pick and shovel method is used
- Coal, with the help of trollies, is brought to the main shaft and is then lifted up with the help of an elevator

Adit mining

- Horizontal shaft is dug into the ground
- There can be many shafts at different levels
- Dynamite is used to break seams
- Pick and shovel method is used
- With the help of trollies, etc. coal is brought out of the mine

Open cast mining

- Pick and shovel method is used after breaking coal seams through dynamite, etc. and is then transported by roads/rail to industries, etc.

Q: Why is coal imported?

- Low quality coal in Pakistan
- To mix with poorer quality coal
- Difficult to mine coal reserves in Pakistan due to thin seams and lack of machinery, infrastructure e.g. roads, electricity and lack of experts, etc.

Oil

- Oil is formed by the decomposition of remains of sea animals and sea vegetation in millions of years

Where it is found

- It is found in anticline
- Between two non – forest rocks with natural gas above it and water below it
- This feature is known as an oil trap because
    - Oil is trapped between two non – porous rocks which do not allow it to leak out
- It reaches the height of anticline but cannot escape

Oil drilling

- A derrick/oil rig is setup
- Well is drilled
- Rock(s) is/are broken with the help of diamond
- Water/mixture of mud is used to reduce heat
- Pipes are inserted/thrown into the wells
- Oil quickly comes out when pressure is released
- Valves are used to control the flow of oils in pipes
- The derrick is removed when oil starts flowing in pipes

Oil fields in Pakistan

- Potowar Plateau oil fields
    - Balkasar, Mayal, Dhullian, Tut, etc.
- Lower Sindh oil fields
    - Tando Adam, Mazari, Laghari, Dhabi

Oil refineries

- Karachi because :-
    - To refine imported crude oil
    - To refine crude oil from southern Sindh
    - More demand due to high population of Karachi
    - More demand due to more industries in Karachi
    - There are many thermal power stations in Karachi which use oil as fuel
- Mehmood Kot (near Multan)
    - Crude oil is transported from Karachi to Mehmood Kot through pipelines
    - High demand in Multan due to its population and industries in the suburbs of Multan
- Morgah/Attock Oil
    - Crude oil from Potowar Plateau is refined
    - High demand in Rawalpindi/Islamabad due to its population
    - High demand in further north e.g. in KPK and Gilgit Baltistan

Oil transportation

Through pipelines

- Advantages
    - Continuous supply
    - Fast

    - Large amount
    - Cheap after pipeline's construction
- Disadvantages
    - Leakage
    - Only to main centers
    - Only one product
    - Expensive to build

Through rail tanker

- Advantages
    - Can reach such areas where pipes cannot
    - More than one product
    - Suitable for small users
- Disadvantages
    - Small amounts
    - Slow
    - Accidents

Through road tankers

- Advantages
    - Can reach remote areas where pipelines cannot
    - More than one product
    - Suitable for small users
- Disadvantages
    - Small amount
    - Slow
    - Accidents
    - Theft
    - Leakage
    - Heavy on roads

Uses of oil

- Fuel for vehicles
- Lubricant for machinery
- Power for: Thermal power stations and for heating
- By products are used for: Wax, detergent, synthetic rubber, plastics, furnace oil, paraffin

Q: Explain the uses of oil in farming and manufacturing

- Farming
    - As fuel in agricultural machinery e.g. tractors
    - As fuel for tube wells
    - As lubricant for machinery
    - As raw material in chemical fertilizers and pesticides industry
    - Tarmac for better roads so easy to bring inputs to farms and agricultural output to markets
    - As fuel in transport for agricultural products
- Manufacturing
    - In machinery as fuel

- Lubricant in machinery
- Tarmac for better roads for easy transportation of materials/goods
- For heating
- For fuel in thermal power stations for electricity which is then used in manufacturing industries
- As raw material in chemical industry e.g. fertilizer and pesticide industry

Natural gas

Areas

- Sui – Balochistan
- Mari – Sindh
- Mayal – Punjab
- Khairpur
- Dhullian
- Uah
- Pirkoh

Transportation

Through pipelines

- Advantages
  - Continuous
  - Fast
  - Large amount
  - Cheap after construction of pipelines
- Disadvantages
  - Leakage
  - Only to main centers
  - Expensive to build

Through cylinders

- Advantages
  - Can reach remote areas
  - Suitable for small users
  - Portable
- Disadvantages
  - Slow
  - Interrupted supply
  - Small amount
  - Expensive
  - Accidents, etc.

Natural gas uses

- Domestic and commercial uses e.g. cooking and heating
- As raw material in fertilizer, cement and chemical industry
- Alternative fuel for vehicles

- As fuel in thermal power stations

Q: Why is natural gas used for domestic purposes?

- Easily available in main cities of Pakistan through pipelines
- Can be transported to remote areas through cylinders
- Cheaper than coal
- Convenient as firewood is difficult to collect
- Cleaner than coal

Q: Explain the importance of natural gas as fuel in Pakistan.

- Alternative fuel for vehicles
- As fuel in thermal power stations
- Cheaper than coal/oil
- Cleaner than coal/oil
- Easy transportation than coal
- Reduces dependencies on imported fuel like fuel and oil
- Other fuels are insufficient in Pakistan

Q: Why is natural gas (a cheap fuel) easy to use?

- Produced in Pakistan
- Large reserves in Pakistan
- Lightweight
- Easily available in pipelines
- Portable in cylinders

Nuclear energy

- In nuclear energy, heat is produced through nuclear fission through breaking of atoms
- It is used for production of steam in boilers for electricity

Advantages

- Large output
- Reliable
- Small input of raw material/efficient
- Long lasting fuel
- Fossil fuels running out/reduce burden on other fuels
- Less pollution/environmentally friendly
- There will be less need for load shedding

Disadvantages

- Expensive to buy fuel
- Expensive to build
- Lack of technology/skills/difficulties of maintenance
- Dangerous/risks of radioactivity
- Unpopular/local opposition
- Disposal of waste is a problem

Thermal power stations

- Electricity is produced with the help of fossil fuels (natural gas, oil, coal)
- Fossil fuels are used to produce steam in boilers which rotates turbines
    - Which then turns shaft quickly into a generator
    - Within a magnetic field, so electricity is produced

Hydroelectric power

- At HEP stations, electricity is produced with the help of water

How is electricity produced?

- Water of reservoirs passes through the dam very quickly
- It goes into a narrow intake pipe which rotates turbines
    - Which then turn shaft quickly into a generator
    - Within a magnetic field provoking electricity to be produced

How is it transmitted?

- From transformers of HEP stations, electricity goes on to transmission lines/natural grid
    - Which are either underground or overhead
- Then onto local supply Friday voltage adjusted
- After the adjustment, is then transmitted to domestic and commercial consumers

Physical conditions for construction of dam

- Wet climate/high rainfall for more water
- Cool climate for low evaporation
- Deep and narrow valleys for easy construction of dams
- Steep sides for easy construction of dams
- Large catchment area for more water
- Impervious rocks to reduce seepage
- Hard rock for firm foundation of dams
- Areas of glaciers so that more water is available after melting of snow

Main HEP stations (dams) and their locations

- Tarbela on River Indus
- Mangla on River Jhelum
- Warsak on River Kabul

Q: Why are renewable resources important to Pakistan?

- Fossil fuels are expensive
- Fossil fuels are running out
- Many fossil fuels like oil are imported
- The price of oil in international market is constantly increasing
- Nuclear energy is dangerous and its wastes are difficult to dispose of
- Renewable resources are pollution free
- Renewable resources are cheaper

National grid

- It is a network of long transmission lines and transformers to transport electricity to domestic and commercial consumers
- Within different areas of the country through road centers

Problems

- Long transmission lines are difficult to install/construct
- Difficult and expensive to maintain
- Line losses due to friction

Q: Why is there shortage of electricity in Pakistan?

- Many power stations are not working to their full capacity due to :-
    - Old machinery
    - Poor maintenance
- Silt in reservoirs reduces their capacity and so less electricity is produced at HEP stations
- Silt damages dam machinery
- Less rainfall in winter so reduces water in reservoirs of HEP stations
- High demand for electricity due to
    - Growing population
    - Industrialization
    - Improved standard of living
    - Rural electrification

Rural electrification

- To improve standard of living of rural population
- Better use of modern methods of agriculture e.g. tube wells
- To reduce rural – urban migration
- To improve and expand cottage and small scale industries
- Better access to IT

Q: What has been done for rural electrification?

- Extension of national grid
- More thermal power stations
- More HEP schemes
- Some villages have been provided with electricity through biogas and solar energy
- Private and foreign investment
- Work of WAPDA
- Government programs e.g. Village Aid Program
- The government has decided to provide electricity to those areas which will bare 33% of total installation cost

Q: Why is it difficult to provide electricity to all areas of Pakistan?

- Pakistan is a large country
- Many remote areas
    - Which are cut off by mountains and deserts

- Many areas are away from the reserves of fossil fuels
- Many rivers are not suitable for HEP production
- Lack of capital
- Expensive to provide electricity to low populated areas
- Long transmission lines are difficult to construct and maintain
- Long transmission lines leads to line losses due to friction
- Theft

Solar energy

- It is the energy produced with the help of sunlight

Advantages

- 250 – 350 sunny days in a year
- Continuous sunny days (very rare continuous rainy, cloudy days)
- Pollution free
- Cheap
- Suitable for rural electrification and small users

Disadvantages

- Expensive to install
- Not suitable for large users
- Lack of technology
- Lack of experts
- Lack of government attention

Biogas

- Fermentation of cow dung produces methane gas which is used for production of electricity

Advantages

- Cheaper
- Efficient disposal of waste
- Suitable for rural electrification/small users

Disadvantages

- Air pollution as it is a green house gas
- Not suitable for large users
- Can lead to shortage of natural fertilizers
    - The import of chemical fertilizers increases

Wind energy

Advantages

- Available due to flat areas of Indus Plain

    - Due to mountains
    - Windy on coastal areas
- Pollution free
- Cheap after installation

Disadvantages

- Lack of experts
- Lack of government attention
- Expensive to install

Q: What is load shedding?

- They are the ‘planned’ power cuts