

## **CHAPTER 21 ENERGY AND POWER RESOURCES**

### **Objectives**

After studying this chapter, students should be able to:

- define energy in relation to power supply.
- highlight different form of energy and their sources.
- describe the importance of Hydro Electric Power.
- list important Hydro Electric Power stations in the world.
- describe some problems associated with the production of Hydro Electric Power.

### **21.1 Definition and Types of energy and power resources**

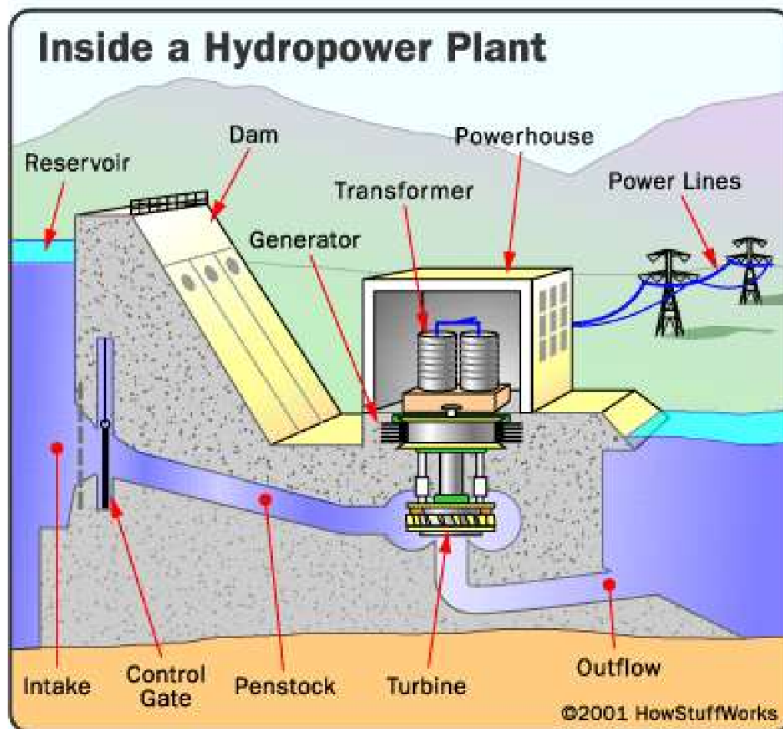
Energy concerns power supply. The world depends on a variety of energy resources for its existence. The main energy sources of the world include the following:

- A. Nuclear Energy**-This is derived from radioactive materials like uranium and plutonium.
- B. Biogas**-Derived from organic waste resources through biological processes.
- C. Coal**-A brown or black carbon that can be ignited or burned. It is mined from the ground.
- D. Geothermal Energy**-This is electricity made from naturally occurring hot water found underground. Power from this source was first produced in Africa in 1981 from lake Bogoria, Eburrru and Olkaria geothermal fields in the East African rift valley, northwest of Nairobi.

- E. Hydro-Electric Power (HEP)**-This is produced by constructing a dam across a river to store large quantity of water to form a lake.
- F. Natural Gas**-Consists of methane and ethane. Methane is a clean burning, odourless hydrocarbon.
- G. Crude Oil/Petroleum**-Vary from thick, dense, liquid to very light oils and are found underground in wells.
- H. Tidal Waves**-These are caused by gravitational forces involving the earth, sun and moon. Tidal energy comes from the ceaseless motion of ocean tides.
- I. Solar Energy**-Produced by sun. Man made photo voltaic cells converts sunlight into electricity when the sun's rays excite electrons in the cells.
- J. Wind Energy**-This is common in desert region or non-forested region. High tech windmills called *wind turbines* are built in groups of several hundreds to generate power.

## **21.2 Major Hydro-electric Projects in Africa**

Hydro electric power is generated by constructing a dam across a river to store large quantity of water to form a lake. The water falls from lakes through giant pipes into the power station below the dam. This vast quantity of water falling through pipes gives the turbines in the power station a great push that starts them spinning. The turbines in turn drive the generators which produce electricity. Hydro electric plants supply about 6 percent of the world's energy needs.



*Figure 21.1: How hydro electricity is generated*

There are several hydro electric power stations in the world. Major ones include the followings;

**i. The Kainji Dam**

It is the largest hydro electric power project in Nigeria. The dam is located south of Bussa rapids. The construction of the dam began in 1964 and was completed in 1968. The dam has the capacity to generate thousands of electricity megawatts. The dam supply power to some neighbouring countries and serves as fishing ground for local fishermen, tourist site and source of water for irrigation agriculture. Other hydro electric power stations in Nigeria include Jebba and Shiroro dams.



*Figure:12.2 Kainji Dam, Nigeria*

**ii. Volta Dam (Akosombo Dam) in Ghana**

The Volta hydro-electric power project started in 1961 and was completed in 1965. The main dam rises to about 130 metres above Volta river bed and has the capacity to generate close to 1000 megawatts of electricity.

**iii. Kariba Dam in Zimbabwe**

This was the third largest dam in Africa. It was started in 1955 and completed in 1960 on river Zambezi to generate 1,600 megawatts of electricity. The dam was jointly owned by both Zambia and Zimbabwe government. However political problems in Zimbabwe led to the revolt of a white settler called Ian Smith which led to the construction of Kafue dam at Kafue gorge by the Zambian government. Other Dams projects on Zambezi river include the Victoria falls project and Cabora project.

**iv. Aswan High Dam on River Nile in Egypt**

This is located on the southern Egypt. It was built with the assistance of Soviet government and commissioned in 1971. It supplies power to power industries in Aswan areas and its municipalities.

### **21.3 Hydro-electric Projects in other parts of the world**

#### **v. The Tennesse (T.V.A) Scheme**

The dam is located on the Tennesse River, a tributary of the Ohio River which is also a tributary of the Mississippi River. The scheme has 33 dams.

#### **vi. The Grand Disence HEP Scheme in Switzerland**

The dam is 285 metres above river level. It is the tallest gravity dam in the world and has its power stations in Chandoline, Nendaz and Fionnay.

Others are The Rjukan Scheme in Norway, The Snowy River Scheme in Australia and River Durance Scheme in France.

### **21.4 Conditions favouring the establishment of HEP Scheme**

The following are some of the conditions that can favour the establishment of hydro electric power scheme;

- i. A steep gradient or slope in the form of waterfalls.
- ii. Constant supply of large volume of water.
- iii. Capital- Dam construction is a capital intensive project.
- iv. Large market for electric power.
- v. Presence of narrow valley suitable for building the dam.
- vi. Presence of non-porous rock beneath the river bed around area of the dam.

### **21.5 Advantages of Hydro Electric Power over other forms of Energy**

- i. It is non-polluting
- ii. It is easily transported over a long distance with the help of cables and wire.
- iii. It is cheap to run.
- iv. The lake created during its construction can be used for other economic purposes e.g fishing, transportation, and water for irrigation farming.
- v. The water on which it depends cannot be exhausted unlike coal and oil.

### **21.6 Disadvantages of Hydro Electric Power**

- i. Environmental problem such as flooding may arise as a result of dam construction.
- ii. Dam construction may lead to the migration or extinction of certain fish species.
- iii. It often results into displacement of human being and the need for resettlement.
- iv. It is capital intensive and costly compared to other forms of energy e.g solar energy.

### **21.7 Problems Associated with HEP Projects**

Some problems associated with hydro electric power projects include;

- i. Seasonal fluctuations in river water level. This problem is related to climatic factor, particularly rainfall. Whenever there is shortage of rainfall water level goes down and this may affect generation of electricity. Little could be done to solve this problem because it is natural.

- ii. Dam collapse due to natural forces or engineering lapses. Failure due to natural forces such as earthquake, earth tremor etc cannot be averted, but those related to engineering fault could be addressed by ensuring proper construction to avoid the occurrence of collapse.
- iii. High cost of maintenance of dam- Government can seek for funds from international agencies and other donor bodies who are willing to help. Particularly World Bank, IMF and many other international financial agencies would be willing to offer assistance.
- iv. High cost of resettling displaced population and designing new settlement. Usually government build new settlement and provides necessary logistics to resettle the displaced people, however, the psychological effects of displacement on the people may be difficult to address.

### **Summary**

In this chapter, you have learnt that:

- Main sources of energy in the world include: Nuclear energy, Biogas, coal, geothermal energy hydro-electric power, solar energy, petroleum , etc.
- The most cleanest form of energy is the hydro-electric generated energy.
- Important hydro-electronic projects in Africa include Kainji dam in Nigeria, Akosombo dam in Ghana, Kariba dam in Zimbabwe and Aswari High Dam on River Nile, Egypt.
- One important factor militatory against hydro-electric power supply is seasonal fluctuations in river water level.

### **Revision Questions**

1. A form of energy derived from radioactive materials is known as

A. Nuclear Energy B. Geothermal energy C. Hydro-electricity D.

Biogas

2. It is derived from the ceaseless motion of ocean tides caused by the gravitational pull of the earth, sun and moon. This describes a kind of energy known as

A. Wind energy B. Tidal energy C. National energy D. Ocean energy

3. Which areas of the world will wind energy be most suitable?

A. Tropical areas B. Desert region C. High temperate region D. none of the above

4. Kainji Dam is found in

A. Sokoto state, Nigeria B. Kebbi state, Nigeria C. Accra Ghana D. Niger state, Nigeria

5. Which of these is not one of the conditions that can favour the development of hydroelectric power scheme?

A. A steep gradient or slope B. Constant supply of large volume of water C. presence of narrow valley D. presence of semi-porous rocks beneath the river bed around the dam area

6. It is a form of energy derived from organic waste resources through biological processes. This describes

A. Biogas B. Coal C. Crude oil D. Natural gas

7. That which drives generators which produce electricity in hydro electric plant is known as

A. Turbine B. Generator driver C. Push engine D. power drive

8. Other importance of dam include the following EXCEPT

A. fishing B. Water for irrigation C. Tourism D. Navigation by large vessels

9. Aswan Dam is found in

A. Tanzania B. Ghana C. Rwanda D. Egypt



10. Which of these is not an advantage of hydro-electric power?
- A. Easy transportation    B. Cheap maintenance    C. Non-polluting
- D. None of the above

### **Essay Questions**

1. List and discuss various sources and types of energy.
2. Discuss two hydro-electric power schemes in Africa that you are familiar with.
3. Enumerate and discuss condition that can favour the establishment of hydro-electric power scheme.
4. Identify problems associated with Hydro-electric power projects and discuss ways of addressing those problems.
5. Solar energy is most available in Africa but also utilized, discuss.