
UNIT 3 ENERGY RESOURCES AND CONSERVATION

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3.1 INTRODUCTION

Energy is the driving force for all kind of life on the earth. Each and every aspect of our life is affected by energy. Without energy no task is possible. We need energy to eat, walk, write, speak, etc. Similarly activities such as transportation, communication, agriculture, industrialisation, etc. need continuous supply of energy. You think of any activity and will find that everywhere energy is involved. It is for this reason that energy use is an indicator of development of any nation.

In this unit, you will learn about various sources of energy and their merits and demerits. You will also gain knowledge about the energy crisis and will learn about the measures of energy conservation.

3.0 OBJECTIVES

After reading this unit, you will be able to

- define renewable and non-renewable energy resources;
- differentiate between conventional and non conventional energy resources;
- identify the current energy problems; and
- explain the methods for energy conservation.

3.2 ENERGY RESOURCES: DEFINITION AND TYPES

Energy comes from sources on this Earth. The terms 'forms' of energy and 'types' of energy are used interchangeably. Let us understand the difference between the two. Types of energy resources pertain to the origin of that energy resource. For eg solar energy (Sun), Tidal energy (Tides), Biomass based energy (Biomass). On the other hand, potential (chemical, electrical, etc.) and kinetic (heat, sound, etc.) are different forms of energy.

There are many different sources of energy, some well-known such as coal or petroleum, others less explored, such as wind or the heat inside the Earth. Some of the energy resources are location specific and fixed. For example, presence of coal, oil, wood or gas. It is easy to estimate the occurrence and extract coal and oil but it is not the case with renewable resources such as solar or wind as they are not so obvious and are based on natural weather patterns and features of an area.

As you will go through the unit, you will come to know some more examples and types of energy resources.

Broadly speaking, energy resources are classified into three main categories:

- Renewable energy resources which can be renewed again and again.
- Potentially Renewable energy resources which if managed properly can be easily renewed.
- Non-renewable energy resources cannot be renewed once they are all used up.

3.3 RENEWABLE ENERGY RESOURCES

Renewable energy resources are those sources of energy which can be replenished and do not get depleted because of over consumption. Wind, solar, geothermal, tidal, and biomass energy are some of the renewable sources of energy. These energy resources are available for free and have been utilized since ages by human communities. For example most of the energy on Earth comes from the Sun. This energy has been traditionally used for various

purposes like drying grains, drying grains and for performing other household tasks. Traditionally, in one form or the other, the sun has provided energy for practically all living creatures. Similarly wind energy and energy from tides has also been in use since ancient times. Today when the world is confronted with pressing issue of energy crisis owing to over exploitation of non renewable energy sources, we are again looking for cleaner and efficient options of energy utilization. Solar energy, wind energy and tidal energy are some of the promising renewable energy resources.

Solar power uses the energy in sunlight directly. Moving water (in the form of waves, tides, and flowing rivers) and the wind also contain energy that can be used to spin turbines to generate electricity. Geothermal energy taps heat from inside the Earth.

Renewable energy will last as long as the Sun shines, winds blow, wave's crash and rivers flow. It is for this reason it is believed that renewable energy will never run out, is safe to use and produces little pollution because of less green house gas emission. However, renewable energy plants can be expensive to build and may not produce enough energy to meet local requirements.

The pros and cons of utilizing different renewable sources of energy are discussed below:

3.3.1 Wind Energy

Wind energy can be utilized in power turbines that generate electricity. Mostly, wind turbines are situated on agricultural or forest land and hence there is no need to clear land to place wind mills. However, wind mills pose a danger to the birds and cause noise and visual pollution. Countries like China, U.K., U.S.A and Spain obtain most of their energy requirements by utilizing wind energy.

3.3.2 Solar Energy

Sun is the ultimate source of Energy and we can use solar energy to heat water or homes and it can be converted into electricity, and for hot water heating, solar cooling, and a variety of commercial and industrial uses. With the use of photovoltaic (PV) cells, the solar energy can be converted into electricity. These cells convert sunlight directly into electricity. Like wind energy, however, solar energy is limited in availability and depends on weather conditions.

3.3.3 Geothermal Energy

Geothermal energy taps the Earth's internal heat and can be put to use for various uses like electricity production, and heating of buildings. Geothermal energy power can be trapped by installing a geothermal heat pump and these plants also do not release greenhouse gases unlike a traditional power plant.

3.3.4 Biomass Based Energy

The use of biomass for producing energy is biomass based energy. It includes several forms of biomass like food waste, agricultural waste, fuel wood, garbage, etc. This energy can be used to produce electricity, transportation fuels, or chemicals. The plant parts and other organic materials are processed to generate the electricity. Utilizing biomass for energy provides us with a renewable energy source and provides appropriate solution to waste management.

3.3.5 Hydropower

When water flows through a dam and runs a turbine, a huge amount of electricity is generated. However, not only environmental effects of big dams but issues such as displacement and rehabilitation of the people are often discussed. It is also observed that damming a river alters the aquatic and riparian ecosystems, changes the temperature and other physicochemical features of the water bodies.

3.3.6 Tidal and Wave Energy

Wave and tidal energy has been utilized to generate electricity since long. Recent advances in science and technology have improved their use in more beneficial ways. In addition to tidal energy, there's the energy of the ocean's waves, which are determined by tides as well as the winds. The sun also warms the surface of the ocean more than the ocean depths, creating a temperature difference that can be used as an energy source. All these forms of ocean energy can be used to produce electricity. Although not widely used, tidal energy is more reliable and predictable than solar or wind energy.

3.3.7 Potentially Renewable Resources

A potentially renewable resource can be replenished fairly rapidly (hours to several decades) through natural processes. Examples of such resources include forest trees, grassland grasses, wild animals, fresh lake and stream water, groundwater, fresh air, and fertile soil. A potentially renewable resource can be made sustainable by managing the use of the resource so it does not run out.

It is interesting to investigate that what limits the use of renewable energy resources inspite of the fact that they are cleaner and sustainable sources of energy Let us discuss non renewable energy resources now.

3.4 NON-RENEWABLE ENERGY RESOURCES

Non renewable energy resources are those which have been formed through several years of geological activity. Examples include coal, petroleum, and natural gas. These energy resources will ultimately decline, will be unaffordable. We currently depend on non-renewable energy resources to meet our energy demands and in doing so we extract and use them for generating electricity or use as fuels. The added disadvantage associated with the utilization of non renewable energy resources is that they release harmful gases and cause air pollution. It is for these reasons that they are also known as dirty sources of energy. As a country develops there is a shift from dirty to clean sources of energy.

Check Your Progress 1

Notes: (a) Write your answers in bout 50 words.

(b) Check your progress with possible answers given at the end of the unit.

1. Geothermal, wind, and solar are some of the energy resources which are found in abundant supply on Earth. What are the advantages of using these energy sources?

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2) What are potentially renewable sources of energy? Explain with examples.

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3.5 FOSSIL FUELS- ORIGIN AND CLASSIFICATION

Fuel is something that can be burned to produce energy in the form of heat or power. Fuels include coal, oil, natural gas, and wood. Humans have been burning wood for warmth, and to light homes and cook food, since civilization began. However, in some parts of the world, so many trees have been cut down for fuel that firewood is now scarce.

Fossil fuels are made of the fossilized remains of living things that died millions of years ago compressed at high temperature and pressure over millions of years. When electricity was first generated, it was done by burning fossil fuels. Coal, oil, and gas are the most important fossil fuels. Today, they provide most of the world’s energy.

When fossil fuels are burned in a power plant, steam is generated by boiling water. That steam drives a turbine to spin inside a large magnetic field, and this produces electricity. The main problem with doing this is that it creates a lot of pollution, including greenhouse gases like carbon dioxide, which are causing the earth’s climate to warm.

3.5.1 Coal

Coal is the organic fossil material which is solid and black in colour with varying properties and composition. It is essentially rich in amorphous carbon and contains several liquid and gaseous hydrocarbons. It is the most widespread fuel mostly used for producing electricity. On the basis of characteristics, heating value, carbon and volatile matter, coal is found in various forms viz. Anthracite (Hard coal), Bituminous (Soft coal), Lignite (Brown Coal) and Peat.

3.5.2 Natural Gas

Natural gas is mostly composed of methane. Landfills and marshes also produce methane by the methanogenic processes. Like petroleum, natural gas is processed to remove the other components and then it can be used as a fuel.

3.5.3 Petroleum

Petroleum is a toxic, flammable liquid which is found beneath the earth’s surface. It is commonly known as crude oil. It finds application in various places like pharmaceuticals, plastics, asphalt, kerosene, and synthetic rubber but mostly petroleum is used as fuel. Like natural gas, petroleum is also processed before utilizing it. Crude oil contains several types of hydrocarbons and to process the oil to serve specific function, the crude oil must be heated to a specific temperature range.

3.6 CONVENTIONAL AND NON CONVENTIONAL ENERGY SOURCES

The energy resources which have been in use since a very long time are known as conventional sources of energy. We have been using coal, oil, etc since the beginning of the civilization. Even solar energy was used since long for drying of grains and for other purposes but its commercial use has increased in the last few decades. Hence, the contemporary non-conventional sources of energy like wind, tidal, solar etc. were the conventional sources until James Watt invented the steam engine in the eighteenth century. Non conventional sources of energy include solar energy, wind energy, geothermal energy, etc. With the increase in generation of urban and domestic waste, the potential of waste to produce electricity has been in research today. The scientists are of the opinion that waste products could be used to produce energy and this can solve the problem of waste management as well as will serve to reduce energy crisis.

3.7 ALTERNATIVE SOURCES OF ENERGY

Alternate energy refers to forms of energy that are constantly replenished by the Earth. The energies are natural occurring and are tapped for conversion into other forms of energy. Alternative energy sources are those that are used in place of other non renewable energy sources. Nuclear energy, hydrogen, etc are all alternative sources of energy. Alternative energy resources are not going to run out, do not pollute as much as fossil fuels (oil, coal, natural gas), or do not generate waste products which are harmful to environment. Alternative energy is also known as clean energy, green energy and renewable energy.

3.7.1 Alternative Energy vs. Renewable Energy

Renewable energy and alternative energy are often interchangeable, but they are different from each other. Renewable energy comes from energy source which can never deplete. Electric energy that is generated from the sun (solar), the wind, the ocean (waves, currents or tides), the earth (geothermal), waste (biomass), landfill gas, or water (hydro power) is considered to be renewable energy. Renewable energy falls under the alternative energy umbrella because renewable fuel sources like wind and solar do not degrade the environment.

3.7.2 Nuclear Energy

The energy contained in the nucleus of an atom is called nuclear energy. Every object in the universe is made up of atoms and there is huge amount of energy between the bonds that join these atoms. Nuclear fission and nuclear fusion are the two processes by which this energy can be released. Sun produces energy through nuclear fusion. In nuclear fission, atoms divide and form smaller atoms, releasing energy. Nuclear power plants make use of nuclear fission to produce electricity.

In the 1930s, scientists discovered that huge amounts of energy could be produced by splitting atoms (tiny particles) of rare mineral called uranium. The technology was first used to make nuclear bombs. Later, it was used to generate electricity. Nuclear materials are radioactive and release harmful radiations that can harm living things.

Uranium and other nuclear materials are radioactive and give off radiation that can harm living things. This means that great care must be taken when they are processed and transported. Nuclear fuel is also difficult to dispose off safely once used.

3.7.3 Uranium

Uranium is a heavy, metal (U-235) which is used in fission chain reaction, thereby releasing huge amount of heat. After extraction, uranium must be processed. Most reactors utilize uranium that has been finely ground. While nuclear power offers us a clean source of energy, the cases of reactor failure and other issues pose a constraint in its large scale use.

3.7.4 Hydrogen

Hydrogen is the most abundant element on the Earth. However, it doesn't occur naturally as a gas. It's always combined with other oxygen in the form of water. Hydrogen can be burned as a fuel or can be converted into electricity.

3.7.5 Limitations of Alternative Sources of Energy

Inspite of quite good signs of hope, there are some bottle necks in the use of alternative sources. Most of the technologies involve high installation cost and require maintenance. Some of the materials that find application in designing and manufacturing of devices are not available. For eg. silicon, an essential component in solar photovoltaic is short in supply. Moreover, there is lack of human capital which affects the whole energy industry worldwide still, the benefits are driving governments, business and individual all over the world to adopt this technology.

Check Your Progress 2

Notes: (a) Write your answers in about 50 words.

(b) Check your progress with possible answers given at the end of the unit.

1) With the ongoing depletion of fossil fuels, which energy sources do you think would make the best substitutes for them?

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2) What are the pros and cons of utilizing nuclear energy?

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3.8 CURRENT ENERGY PROBLEMS AND THEIR SOLUTIONS

The country's economic growth is linked to the fortunes of the energy sector. India's per capita energy consumption currently is almost one third the global average, and trails far behind the mean figure for the developed world. Our energy consumption is largely based on coal, along with a preponderant dependence on other fossil fuels. Although per capita energy consumption has more than doubled over the past 15 years, almost 240 million people do not have access to affordable energy supply today.

Energy consumption in India has grown at a compound annual growth rate of about 6 % during the last decade. BP Energy outlook 2035 expects India to achieve the fastest energy consumption growth among all major economies, despite rapid increases in non-fossil fuel production. The total energy consumption is expected to grow by 128 % by 2035. Demand for gas is expected to expand by 155 %, followed by coal (121 %) and oil (118 %) while demand for renewable, nuclear and hydro are estimated to rise by 656 %, 334 % and 99 % respectively. Even under most modest economic growth scenario, it is expected that India's growth ambitions will lead to a 100 % increase in energy consumption, thereby requiring double the existing energy sources.

On the supply side, India is significantly dependent on coal as a primary fuel, which accounts for 58 % of the energy consumption in the country. It is estimated that we have one of the largest resource bases of coal, with the policies and gains of the last few years positioning us strongly for the future. It is expected that India will be the largest consumer of coal, equivalent to over 435 million tonnes of oil by 2035. According to current estimates with respect to oil and gas, India is home to only 0.3 % of the world's sedimentary basins. Further, we account for a mere 0.3 % of the global oil and 0.8 % of the global gas reserve. We are however, blessed with abundant natural resources in the form of sun and wind. The total wind potential in the country is estimated to be over 30 times the current installed capacity of 8 GW. Already, the government has an aggressive target of 60 GW of wind capacity and 100 GW of solar capacity by 2022.

In his book, *The Audacity of Hope*, Barack Obama states "A nation that can't control its energy resources can't control its future". Securing our energy future is thus critical for India to become a superpower in the future.

India is the world's fourth largest energy consumer. Its energy needs continue to increase, but national energy shortages and an inadequate energy infrastructure could perpetuate national energy poverty.

India's energy sector is increasingly unable to deliver a secure supply of energy amid growing demand and fuel imports due to following reasons:

- Relies on imports for meeting growing demand for oil and gas

- Electricity shortages

- Energy poverty and inequality spreads

Rapidly increasing energy demand and growing concern about economic and environmental consequences call for effective and efficient energy governance

in India. Three main objectives must be pursued to ensure equitable energy supply in India:

- i) Access to energy- When one quarter of the population lacks electricity, it becomes essential to ensure adequate and reliable supply of energy and fulfil the growing demand.
- ii) Overcoming energy poverty- Energy security in India is driven by too much dependence on imported fuels. This makes India vulnerable to greater geopolitical risks and international price volatility. Ensure overcoming energy poverty remains a top most priority
- iii) Use of clean energy- There are important environmental impacts of fossil fuel extraction as well as consumption which need special attention. Therefore to maintain steady source of energy it is essential to adopt green energy sources which do not pollute the environment and don't get depleted by overuse.

3.9 CONSERVATION OF ENERGY

We depend on energy for almost everything in our lives. We wish to make our lives comfortable, productive and enjoyable. Hence even if the outside temperature rises a little, we immediately switch on the air conditioner to keep our house cool. This is again using up of energy. Unfortunately, what we do not realize is that we have started taking things for granted and we have started wasting energy unnecessarily. Most of us forget that energy is available in abundance but it is limited and hence to maintain the quality of life, it is important that we use our energy resources wisely.

If we do not conserve energy, the energy will exhaust and we will have nothing to use. Also, energy conservation is also important when it comes to climate change. Currently, erratic climates and climatic changes are the greatest threats that we are facing today. Hence it is important to conserve energy.

Energy Conservation is unquestionably of great importance to all of us, since we rely on energy for everything we do every single day. Energy supplies are limited and, to maintain a good quality of life, we must find ways to use energy wisely. Reducing the amount of energy that we use is a good way to save money, and there are also other benefits to decreasing energy consumption. For example, a large portion of the energy we use is derived from oil. Some experts claim that we will run out of oil in just a few decades. As natural resources used to produce energy become scarce, the cost of energy will most likely increase. In this way we are not just running out of some valuable natural resource but are also destroying the environment in the process of using them. For example, toxins and pollution are released into the atmosphere during the production and consumption of energy.

Energy conservation is not about making limited resources last as long as they can, that would mean that you are doing nothing more than prolong a crisis until you finally run out of energy resources all together. Conservation is the process of reducing demand on a limited supply and enabling that supply to begin to rebuild itself. Many times the best way of doing this is to replace the energy used with an alternate.

Measures to conserve energy depend on the kind of choices we make to help us save our environment and also help our future generations. There are many things that will use less energy and by using such things you will conserve

energy in a sensible way. Instead of normal tube lights, you can choose energy efficient bulbs. Energy efficient bulbs require less energy to perform the same function that normal tube lights do.

Turning off all electronic devices when not in use is also a good way of conserving energy. Replacing or repairing leaky faucets help in saving lot of water.

Use air conditioner only when required. Instead, you can keep the doors and vents closed to keep your room. Also, you can save lot of energy by switching off the lights and using natural lighting during day time.

Embracing an energy efficient lifestyle today will help you get a better life tomorrow. So let us slow down the demand for energy and give a better future for our coming generation.

Embrace energy conservation by making small changes that will lead to a significant difference in our overall energy consumption. Your efforts combined with those of others who have chosen to make a few small changes too, will benefit your life and the lives of future generations as well as our environment.

Useful Tips for Conserving Energy

Unplug- Up to 75% of the electricity used to power home electronics is consumed while the products are turned off. Appliances like computers, TVs, cable boxes, cell phone chargers, coffee makers, etc. all continue to consume energy just by being plugged in into an outlet.

Set your thermostat at 78 degrees or higher in the summer. Use fans whenever possible instead of AC, and ventilate at night this way when practical. Using fans to supplement AC allows you to raise the thermostat temperature, using less energy. Fans cost less to use than AC.

Keep the thermostat at 70 degrees or lower in the colder months.

Turn down the thermostat at night to 65 degrees, lower when you go to bed or leave your house for more than four hours. Clean the lint filter in your dryer after every load to improve air circulation, and periodically check the dryer vent to ensure it is not blocked.

Turn lights off in unoccupied areas, including porch lights when you go to bed. Buy light bulbs that are 60 watts or less. Even better, get energy-saving compact fluorescent lights. They last much longer and you won't have to change them as often. Make sure the dish-washer and clothes-washer have full loads before running them.

Use the "air dry" setting on the dishwasher. Wash clothes in cold water when possible and rinse them in cold water.

Set your refrigerator temperature at 37 to 40 degrees and your freezer at 0-5 degrees.

Close the door quickly after you select an item.

Check air conditioner filters each month. Dirty filters block air flow, increasing your energy bills.

Check Your Progress 3

Notes: (a) Write your answers in about 50 words.

(b) Check your progress with possible answers given at the end of the unit.

1) Why it is important to conserve energy? Give some steps which must be taken to save energy in home.

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3.10 LET US SUM UP

Energy use is an indication of the development of any country. Modern day lifestyle consumes large amount of energy. The energy resources present on the planet are dwindling or creating environmental problems. The world is struggling to find ways to fight energy crisis. Hence it is of utmost importance to conserve the energy resources so that the future generations can utilize them. There is a need to explore more and more non-conventional energy sources which are less damaging and more promising.

3.11 KEY WORDS

- Energy : The capacity or power to do work.
Conservation of energy : The total energy of an isolated system remains constant irrespective of whatever internal changes may take place with energy disappearing in one form reappearing in another.
Nuclear Fission : A nuclear reaction in which a heavy nucleus splits spontaneously or on impact with another particle, with the release of energy.

3.12 REFERENCES AND SUGGESTED FURTHER READINGS

https://www.worldenergy.org/wp-content/.../09/Complete_WER_2013_Survey.pdf
www.newagepublishers.com/samplechapter/001142.pdf
Alternative Energy: Political, Economic, and Social Feasibility, Lanham, Maryland: Rowman & Littlefield, 2006. ISBN 0-7425-4909-7
Taylor Renewable and Alternative Energy Resources: A Reference Handbook 2008, Zachary Alden Smith, Katrina D.

ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 1

- 1) Your answers must include the following points:

Clean , less polluting energy source

Renewable source

Efficient utilization

- 2) Your answers must include the following points:

Can be replenished rapidly

Examples include forest trees, grasslands, etc.

Check Your Progress 2

- 1) Your answers must include the following points:

Alternative and non conventional energy sources

Less polluting and more efficient

- 2) Your answers must include the following points:

Very efficient and clean source of energy

Harmful radiations can cause problem if not handled properly.

Check Your Progress 3

- 1) Your answers must include the following points:

Energy is vital for development.

Resources are dwindling.

Non- polluting and clean energy sources are needed.