

ENVIRONMENTAL SCIENCE QUARTER 4 MODULE 1

Energy Resources in the Philippines

At the end of this module, you are expected to:

1. Identify energy resources in the Philippines
2. Classify the energy resources as renewable or non-renewable
3. Give the beneficial and harmful effects of energy resources in the ecological system
4. Value the importance of energy resources in the Philippines.

ENERGY RESOURCES IN THE PHILIPPINES

- Energy is abundant and is all around us.
- The Philippines as a tropical land has the potential to produce a great deal of energy from natural resources.
- The existence of volcanoes and its geological conditions also explain why we are rich in energy resources.

- The Philippines is near the equator which makes solar energy readily available for the country.
- The **Philippines** is also located in the Pacific Ring of Fire and thus has a **high** geothermal potential.

- There are **two types of natural resources**: renewable and non-renewable.
- Renewable resources are natural resources that can be replaced or replenished in a short period of time.
- Nonrenewable resources are natural resources that cannot be replaced/replenished easily. It will take thousands or millions of years to replace it.

- Resources** are characterized as **renewable** or **nonrenewable**.
- A **renewable resource** can replenish itself at the rate it is used, while a **nonrenewable resource** has a limited supply.

- The Philippines has been generating energy from renewable sources for a long while now.
- It has only been in recent history that more and more Filipino are recognizing the benefit of renewable energies as an alternative to oil and carbon.

- A renewable resource, also known as a flow resource, is a natural resource which will replenish to replace the portion depleted by usage and consumption, either through natural reproduction or other recurring processes in a finite amount of time in a human time scale.

RENEWABLE ENERGIES FOUND IN THE PHILIPPINES

Hydroelectric Power

- Hydroelectric energy, also called hydroelectric power or hydroelectricity, is a form of energy that harnesses the power of water in motion to generate electricity.

Most hydroelectric power plants have a reservoir of water, a gate or valve to control how much water flows out of the reservoir, and an outlet or place where the water ends up after flowing downward. Water gains potential energy just before it spills over the top of a dam or flows down a hill. The potential energy is converted into kinetic energy as water flows downhill. The water can be used to turn the blades of a turbine to generate electricity, which is distributed to the power plant's customers.

- The Philippines makes use of two ways to harness water power – dam storage or poundage and run-of-river.
- Whereas poundage makes use of artificial dams in order to store water, run-of-river depends on flowing bodies of water like waterfalls.

Types of Hydroelectric Energy Plants

1.) In an impoundment facility, a dam is used to control the flow of water stored in a pool or reservoir. When more energy is needed, water is released from the dam. Once water is released, gravity takes over and the water flows downward through a turbine. As the blades of the turbine spin, they power a generator.

2.) Another type of hydroelectric energy plant is a diversion facility. This type of plant is unique because it does not use a dam. Instead, it uses a series of canals to channel flowing river water toward the generator-powering turbines.

- Hydroelectric power plants in the Philippines are found in Pangasinan, Benguet, Laguna, Isabela, Bulacan, Nueva Ecija, Ilocos Sur, Bohol, Lanao del Sur, Lanao del Norte, Bukidnon, Davao del Sur, and Misamis Oriental.

Maria Cristina Falls powers the Agus VI Hydroelectric Plant, one of the several hydroelectric plants that harness Agus River. The power plant has a 200 MW potential capacity supplied by a water flow of about 130 cubic meters per second.

Location: Iligan City, Lanao del Norte, Philippines

ADVANTAGES OF HYDROELECTRIC POWER

- 1) It makes use of available resources; no need to burn fuel.
- 2) It does not produce pollutants.
- 3) It is more reliable than wind or solar.
- 4) Electricity can be generated constantly.
- 5) Water can be stored above the dam ready to cope with peaks in demand.

DISADVANTAGES OF HYDROELECTRIC POWER

1. Dams are very expensive to build.
2. Finding suitable site to build dams is difficult.
3. It can cause flooding in many areas.
4. Summer drought affect water level in dams which may not be enough to generate energy.

Geothermal Power

- Geothermal energy** is heat within the earth.
- The word **geothermal** comes from the Greek words “*geo*” (earth) and “*therme*” (heat).
- Geothermal energy** is a renewable **energy** source because heat is continuously produced inside the earth.

Geothermal energy is the heat produced deep in the Earth's core.

Geothermal energy is a clean, renewable resource that can be harnessed for use as heat and electricity.

Since 2015 the three countries with the greatest capacity for geothermal energy use have included the United States, Indonesia, and the Philippines.

- ❑ Geothermal power plants in the Philippines are found in Laguna, Sorsogon, Albay, Batangas, Negros Occidental, Leyte, and North Cotabato.
- ❑ There are two ways of extracting geothermal energy utilized in the Philippines: flash steam and the binary cycle.

FLASH-STEAM POWER PLANTS

- ❑ Flash-steam power plants use naturally occurring sources of underground hot water and steam.
- ❑ Water that is hotter than 182° C (360° F) is pumped into a low-pressure area.
- ❑ Some of the water “flashes,” or evaporates rapidly into steam, and is funneled out to power a turbine and generate electricity.
- ❑ Any remaining water can be flashed in a separate tank to extract more energy.

The islands of the Philippines also sit over a tectonically active area, the "Ring of Fire" that rims the Pacific Ocean. Government and industry in the Philippines have invested in flash-steam power plants, and today the nation is second only to the United States in its use of geothermal energy. In fact, the largest single geothermal power plant is a flash-steam facility in Malitbog, Leyte Philippines.

BINARY CYCLE POWER PLANTS

- ❑ Binary cycle power plants use a unique process to conserve water and generate heat.
- ❑ Water is heated underground to about 107°-182° C (225°-360° F).
- ❑ The hot water is contained in a pipe, which cycles above ground.
- ❑ The hot water heats a liquid organic compound that has a lower boiling point than water.
- ❑ The organic liquid creates steam, which flows through a turbine and powers a generator to create electricity.
- ❑ The only emission in this process is steam.
- ❑ The water in the pipe is recycled back to the ground, to be re-heated by the Earth and provide heat for the organic compound again.

Heat from the geothermal fluid causes the secondary fluid to flash to vapor, which then drives the turbines and subsequently, the generators. Binary cycle power plants are closed-loop systems, and virtually nothing (except water vapor) is emitted to the atmosphere.

ADVANTAGES OF GEOTHERMAL POWER

1. This energy source is more environmentally friendly than conventional fuel sources.
2. A source of renewable energy.
3. A sustainable source of energy as its always available unlike wind and solar.
4. No fuel is required.
5. Pollution levels are much lower compared to fossil fuels.

DISADVANTAGES OF GEOTHERMAL POWER

1. The largest single disadvantage of geothermal energy is that it is location specific.
2. Gases are released into the atmosphere during digging
3. Geothermal energy runs the risk of triggering earthquakes.
4. Expensive resource to tap into, with high upfront costs ranging from around \$2-\$7 million for a plant with a 1 megawatt capacity.

5. Energy fluid needs to be pumped back into the underground reservoirs faster than it is depleted. Management is required to maintain sustainability.

Solar Power

- Solar energy is used as a source of energy in the Philippines through industrial-sized photovoltaic plants within the country.
- The Philippines has recently incorporated large scale solar farms since the country is geographically situated in a very region that receives a high quantity of daylight annually.
- Major solar farms within the Philippines are found in Batangas, Cavite, Pampanga, Ilocos Norte, and Cagayan De Oro.

Solar power is usable energy generated from the sun in the form of electric or thermal energy. Solar energy is captured in a variety of ways, the most common of which is with photovoltaic solar panels that convert the sun's rays into usable electricity.

ADVANTAGES OF SOLAR ENERGY

1. Solar energy is free - no need to burn fuel.
2. It is non-polluting or does not cause pollution.
3. In tropical countries, solar power can be used to provide electricity in remote places.

DISADVANTAGES OF SOLAR ENERGY

1. It does not work at night unless the energy is saved/stored in batteries.
2. Solar cells are very expensive.
3. It can be unreliable unless you live somewhere sunny.

Wind Energy

- Like water, moving air generates energy through wind turbines that provide mechanical energy through mechanical power.
 - The turbines then power a generator to supply energy.
 - Wind energy power plants in the Philippines are found in Ilocos Norte, Rizal, Guimaras, and Aklan.
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- **Anything that moves has kinetic energy, and scientists and engineers are using the wind's kinetic energy to generate electricity.**
 - **Wind energy, or wind power, is created using a wind turbine, a device that channels the power of the wind to generate electricity.**
 - **The wind blows the blades of the turbine, which are attached to a rotor. The rotor then spins a generator to create electricity.**

Burgos Wind Farm is a wind farm in Burgos, Ilocos Norte, Philippines. It is the second wind farm built in the province of Ilocos Norte and the largest project of its kind in the Philippines. The estimated cost for the construction of the wind farm was US\$450 million.

ADVANTAGES OF WIND ENERGY

1. Like solar energy, no need to burn fuel.
2. It produces no waste or pollution.
3. Wind farms may also serve as tourist destinations.
4. The land beneath can usually still be used in farming.
5. It can generate electricity for 24 hours for as long as there is enough wind.

DISADVANTAGES OF WIND ENERGY

1. Weather dependent; wind may not always be available.
2. Building a wind farm is expensive.

3. It can kill birds if hit by the spinning blades.
4. It can affect television reception if you live nearby.
5. It causes noise pollution.
6. A large space in coastal areas are needed to accommodate windmills.

Biomass: Energy from Organic Materials

- Biomass could be a matter typically thought of as garbage.
- It includes dead trees, leftover crops, wood chips, bark, sawdust, rubbish, corn stalk, and even animal manure.
- Biomass energy is comparable to fuel in a way that it's combusted to boil water to supply steam which will drive a generator.
- **Biomass is plant or animal material used as fuel to produce electricity or heat.**
- **Examples are wood, energy crops and waste from forests, yards, or farms.**
- **Since biomass technically can be used as a fuel directly (e.g. wood logs), some people use the terms biomass and biofuel interchangeably.**
- Being an agricultural country, the Philippines made natural resources like pulp, rice husks, and coconut husks into fuel.
- Biomass power plants in the Philippines are found in Negros Occidental, Bataan, Iloilo, Bukidnon, Cagayan, Misamis Oriental, Batangas, Isabela, Nueva Ecija, Rizal, Laguna and Panay.

The **Philippines** has large and abundant supplies of **biomass** resources, including agricultural crop residues, forest residues, animal waste, agro-industrial waste, municipal solid waste and aquatic **biomass**. The most common agricultural waste are rice hull, bagasse, coconut shell husk and coconut coir.

ADVANTAGES OF BIOMASS

1. It makes sense to use waste materials when we can.
2. The fuel tends to be cheap.

DISADVANTAGES OF BIOMASS

1. Burning of waste produces green house gases.
2. Collecting the waste in sufficient quantities can be difficult.

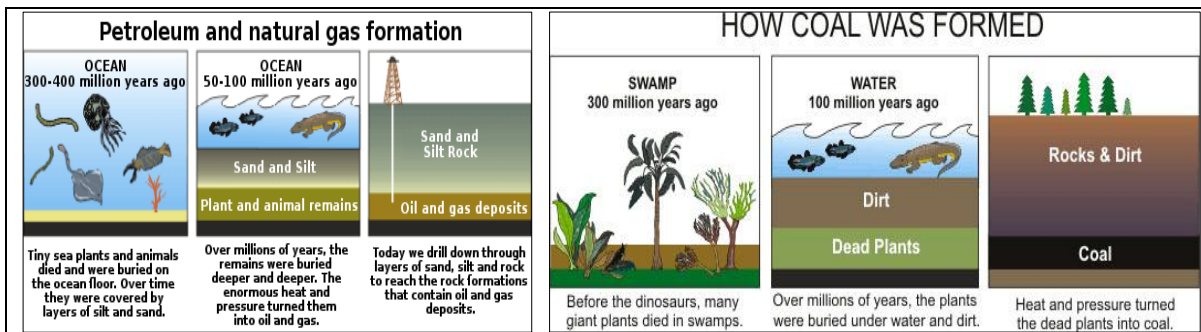
NONRENEWABLE ENERGIES FOUND IN THE PHILIPPINES

FOSSIL FUELS

- Fossil fuels are made from decomposing plants and animals.
- These fuels are found in the Earth's crust and contain carbon and hydrogen, which can be burned for energy.
- Coal, oil, and gas are the major types of fossil fuels.

A fossil fuel is a fuel formed by natural processes, such as anaerobic decomposition of buried dead organisms, containing organic molecules originating in ancient photosynthesis that release energy in combustion.

- These are organic remains of plants and animals that died million years ago.
- It is assumed that fossil fuels were buried three hundred million years past, during the Carboniferous Period.



COAL

- Coal is a black or brownish black, solid rock that can be burned.
- It contains about 40% non-combustible components, thus a source of air pollution when used as fuel.
- **Coal** is called a **fossil fuel** because it was made from plants that were once alive!
- Since **coal** comes from plants, and plants get their energy from the sun, the energy in **coal** also came from the sun.
- The **coal** we use today took millions of years to form. ... That is why **coal** is called nonrenewable.
- Coal deposits are scattered over the Philippines.
- The largest deposit is found in **Semirara Island, Antique**.
- Coal mines also are settled in Cebu, Zamboanga Sibugay, Albay, Surigao, and Negros Provinces.

CRUDE OIL OR PETROLEUM

- Crude oil or petroleum is mainly composed of hydrocarbons which were formed more than 300 million years ago.
- This thick, black oil must be changed or refined before it can be used.
- This can be done through fractional distillation.
- This method separates the crude oil into its components because of its differences in boiling points.

Crude oil is separated by fractional distillation. Crude oil is heated to vaporize the different hydrocarbons in a tank which is cool at the top and hot at the bottom. The vapors then rise and the different hydrocarbons condense at their specific boiling points, allowing them to be separated.

NATURAL GAS

- Natural Gas is mostly made up of methane (CH₄), a highly flammable gas.
- It is usually found near petroleum underground.
- It is pumped-up from the bottom and travels in pipeline and storage tanks.
- It is mixed with chemical to give it a rotten egg smell.
- This odor makes it easy to detect if there is a leak
- Natural gas or fossil gas is a non-renewable energy source, which is an odorless, colorless, flammable, and non-toxic hydrocarbon.
- The largest component is methane (CH₄).
- Natural gas is a fuel to provide power to factories or even households.
- Hydraulic fracturing is the exciting side of gas production. This way drilling starts with a generated 'micro-earthquake'. With high-pressure streams of water, sand,

and chemicals it breaks up the formation of rocks. After that, natural gas can flow up to gathering gas pipelines and wells on the surface.

- Natural gas in the Philippines are located off-shore, above the country's deep-sea oil reserves.
- The Philippines possesses 3.9 cubic feet of natural gas reserves.
- Although extraction began only in year 2000, production has been able to meet demand every year without imports.
- Even larger natural gas deposits maybe held in another offshore location.
- Our natural gas deposits are found offshore of Palawan.
- The **Malampaya Deep-Water Gas-to-Power Project** employs state-of-the-art deepwater technology to draw natural gas from deep beneath Philippine waters.
- The gas fuels natural gas-fired power stations to provide 40-45% of Luzon's power generation requirements.

The Malampaya Deepwater Gas-to-Power project utilizes state-of-the-art technology to extract natural gas and condensate from the depths of the Palawan basin. It then processes the gas in a nearby shallow water production platform and transports it across three provinces through a 504-km (313-mile) underwater pipeline. An onshore gas plant in Batangas receives the gas for further processing, before it is sent to five power-plant customers.

- The Department of Energy reports that since October 2001, the Philippines has been importing less petroleum for electricity generation, providing the country foreign-exchange savings and energy security from this clean fuel.

ADVANTAGES OF FOSSIL FUELS

1. Transport of oil and gas to power plant is easy.
2. Generated coal, a cheap source, can generate very large amount of electricity.
3. Gas-fired power stations are very efficient.

DISADVANTAGE OF FOSSIL FUELS

1. It has a limited supply and take million of years to form.
2. Burning fossil fuels causes pollution.
3. Burning produces CO₂ which contributes to green house effect.
4. It also produces sulfur dioxide which contributes to acid rain.

NUCLEAR ENERGY

- Nuclear Energy is generated using radioactive elements such as uranium and plutonium.
- The process starts when atoms are loaded into very long rods and are placed in reactors.
- Reactors splits atoms apart, generating huge amounts of energy.
- Water is pumped through the reactor to absorb the heat.
- This water is then converted to steam, which is responsible for turning turbines. This produces electricity.

In a nuclear energy plant, heat is produced from splitting atoms – a process called **nuclear fission**.

1. Nuclear reactor creates heat that is used to make steam.
2. The steam turns a turbine connected to an electromagnet, called a generator.
3. The generator produces electricity.

ADVANTAGES OF NUCLEAR ENERGY

1. It is a reliable source.
2. It is not expensive, just like coal.
3. It does not contribute to green house effect.
4. It does not produce smoke or CO₂.
5. It produces huge amount of energy from small amount of fuel.
6. It produces small components of waste.
7. It contains small amounts of radioactive material can provide energy for years.

DISADVANTAGES OF NUCLEAR ENERGY

1. Radioactive wastes are difficult to dispose and manage.
2. Though reliable, it is expensive to build and a safety hazard.
3. Waste must be sealed and buried for many thousands of years to allow radioactivity to die away.

BATAAN NUCLEAR POWER PLANT (BNPP)

- There are talks on reviving the Bataan Nuclear Power Plant (BNPP).
- Senate Bill 2729 and House Bill 4631 were passed in response to this action.
- However, a lot of demonstrations led by a group “No to BNPP Revival” and even prayer rallies have been conducted to oppose it.
- These are some reasons why they oppose it:
 1. It is obsolete and so, it is unsafe to operate.
 2. It is located within a volcano, Mt. Natib, with recorded seismic activity.
 3. It does not ensure cheaper electricity bill.

The Bataan Nuclear Power Plant (BNPP) is an interesting case study of nuclear energy. Completed back in 1980s and costing \$2.2 billion, the BNPP currently stands in Morong, Bataan, atop Napot Point that overlooks the West Philippine Sea.

However, it never achieved its goal of generating 623 MW of electricity. The BNPP is currently the only nuclear power plant in the Philippines and more interestingly, was still the only nuclear plant in the Association of Southeast Asian Nations (ASEAN) as of 2014.

Nuclear energy first came to the forefront of Philippine politics back in the 1950s when the U.S. gave the Philippines a nuclear fission reactor. The government then formally established a nuclear program in 1958 under the Philippine Atomic Energy Commission (PAEC). The BNPP was then proposed in the 1960s and approved under the Marcos regime (1965 - 1986) in July of 1973. The final contract was given to Westinghouse Electric. The project was completed in 1984.