



# Module 9

## Renewable Sources of Energy



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UP Department of Broadcast Communication  
UP National Institute for Science and Mathematics Education Development



**UP COLLEGE OF MASS COMMUNICATION**  
**DEPARTMENT OF BROADCAST COMMUNICATION**



## **DZUP EskweKalikasan: Para sa kabataan, kapaligiran, at bayan**

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## Preface

Para sa bayan, kalikasan, at kabataan? Kayang-kaya!

The project, **DZUP EskweKalikasan: Para sa kabataan, kapaligiran, at bayan** is a publicly-funded initiative of the academe, with support from the government and advocates, that aims to contribute to the initiatives to integrate climate change knowledge and concepts about the Philippine environment in formal education.

According to the Climate Change Commission, “the Philippines is one of the countries at greatest risk from present and projected climate-related hazards such as tropical cyclones, floods, landslides, and droughts” (Climate Change Commission, n.d.). These teaching modules were designed to encourage students with a comprehensive examination of the issues confronting the environment. Recognizing the curriculum visions and the objectives of inquiry-based teaching and learning that are adopted and promoted by the Philippine Basic Science Education Curriculum, these modules go beyond increasing public awareness of the environment’s significance in sustaining life on Earth to examining the effects of human actions in the protection or degradation of the environment.

Results of the early studies of Belland, Glazewski, and Richardson (2012) claim that issue-based learning is closely linked with evidence-based learning. It is thus appropriate to use scientific argumentation to implement these modules. Embedded in the modules is the provision for students’ opportunities to deeply engage in evidence-based scientific argumentation while simultaneously developing their critical thinking and communication skills. Thus, the basic components of scientific argumentation such as **claim, evidence, and justification** were strategically presented in the teaching modules. The modules, identified in the Curriculum Entry Points section, can be used in the following Senior High School Core Curriculum Subjects: Earth and Life Science or Earth Science; Understanding Culture, Society, and Politics; and Disaster Readiness and Risk Reduction.

These modules use multimodal learning to create an engaging and exciting learning environment that recognizes diverse learning styles. The concepts and issues presented in each lesson are mirrored in the podcast “*Kayang-kaya!*” to supplement classroom discussion using aural storytelling. Case studies that highlight local experiences while recognizing the various contexts that surround environmental issues, particularly climate change, are made available so the students can better grasp the environmental challenges that we are facing and be acquainted with examples of adaptation and mitigation measures that are currently being practiced.

**DZUP EskweKalikasan** aims to contribute to the wider discussion of environmental issues and the impacts of climate change and disasters in our everyday life, and to enrich conversations about sustainable living, sustainable development, and mindful consumption. These modules aim to be of utmost help for teachers to supplement their resources in their implementation of the Senior Science Education Curriculum.



## The Project

**DZUP EskweKalikasan: Para sa kabataan, kapaligiran, at bayan** is an on-air and online modular educational project about the environment for the youth. The UP Department of Broadcast Communication (CHED Center of Excellence for Broadcasting) and DZUP 1602 (the official radio station of UP Diliman) spearheaded the project with funding support from the Philippine Government under the General Appropriations Act for Fiscal Year 2019 through the initiative of the Office of Senator Loren Legarda. The UP Diliman Office of the Chancellor also provided additional funding support.

Ten modules were conceptualized and developed in collaboration with the UP National Institute for Science and Mathematics Education Development (UP NISMED).

- Module 1.** The Environment and Me
- Module 2.** The Philippine Environment
- Module 3.** Biodiversity Conservation
- Module 4.** Sustainable Living
- Module 5.** Climate Change
- Module 6.** Waste Management
- Module 7.** Management of Environmental Resources
- Module 8.** Environment and Disasters
- Module 9.** Renewable Sources of Energy
- Module 10.** The Youth, the Nation, and the Environment

Each of the teaching modules comes with a **Kayang-kaya!** podcast and an episode of **Go Teacher Go sa DZUP EskweKalikasan (GTG sa DZUP Eskwe)**.

The **Kayang-kaya!** podcast, developed and produced by the UP Department of Broadcast Communication, chronicles the adventure of three Senior High School students residing in Brgy. Luntian, as they seek to understand and uncover the issues confronting the environment.

Meanwhile, DZUP EskweKalikasan and UP NISMED's radio program Go Teacher Go, collaborated to produce **GTG sa DZUP Eskwe**, video guides for teachers in implementing the modules in their classes. **GTG sa DZUP Eskwe** also discusses tips on how to adjust the modules into different modes of learning, i.e. blended, online, remote, etc. All the teaching modules and other learning resources are available for download at [www.dzup.org/eskwekalikasan](http://www.dzup.org/eskwekalikasan).



## How to use this module

The modules promote inquiry-based teaching and learning through scientific argumentation and were designed to encourage students to appreciate Mother Nature and examine the issues confronting our environment. Each module is composed of the following sections:

### Introduction Page / Table

This page contains the general information about the teaching module and its corresponding podcast. These include the following: **module number** and **title**, **podcast topic**, main question in the podcast, **synopsis** of the podcast, and the **teaching module objectives**.

### Curriculum Entry Points

The curriculum entry points serve as guides for the educators in the appropriate use of the teaching module. This will help the educators identify the student **grade level**, **subjects**, and **subtopics** that this material can be applied to, as well as the **content standard**, **performance standard**, and **learning competencies** from the Department of Education's curriculum guide. This part also contains the **prerequisite concepts** based on students' prior knowledge from previous grade levels.

### Teaching and Learning Process

The teaching and learning process guides the teacher in inquiry-based teaching using argumentation. This section identifies the **teaching approach**, and the **materials** that will be used to teach this module. The modules adopt the guided inquiry-based approach through argumentation as a teaching approach. It is composed of two major parts: the **lesson procedure** proper and the **assessment**. Embedded in the lesson procedure in each module is the eliciting of the three main components of argumentation: claim, evidence, and justification. They are placed differently depending on how the concepts are formed whether inductively or deductively. Assessment is used in the module in three ways: for learning (formative assessment), as learning (on-going), and of learning (summative assessment).

### Related Concepts

This part contains the science and other related concepts and their contextualized definitions depending on how they were used in the modules.

### References

This contains all the references used by the writers in writing the modules. The educators may revisit these references for additional information.

### Activity Sheets / Worksheets

Activity sheets may include **case studies** and **guide questions** to answer while listening to the podcast or for presentation purposes, and other types for individual and group activities.

### Answer Keys

The activity sheet/worksheet in each module comes with the corresponding answer key that can help the educators in assessing the student outputs.





## Teaching Module

<b>Module No. and Title</b>	Module 09. Renewable Sources of Energy
<b>Podcast Topic</b>	Non-Renewable and Renewable Sources of Energy
<b>Main Question</b>	Paano napapagana ang cellphone ng hangin at tubig?
<b>Podcast Synopsis</b>	<p>Barangay Luntian recently experienced brownouts due to simultaneous maintenance activities conducted by the power distribution utility in their community.</p> <p>In school, Kali and Naya wonder about the possibility of powering up their gadgets with the use of natural resources, such as water and wind, due to the power failures. Their quest to find out answers leads to bigger questions about the energy sector confronting the climate crisis.</p> <p><i>Nagkaroon ng sunud-sunod na brownout sa Barangay Luntian dahil sa sabay-sabay na maintenance ng mga power utility sa kanilang lugar. Hindi na sila nakaka-pagcharge, at naapektuhan na nito ang kanilang mga gawain.</i></p> <p><i>Dahil dito, pinag-usapan nina Kali at Naya sa paaralan ang posibilidad na pag-chacharge ng kanilang mga gadgets gamit ang renewable sources kagaya ng tubig at hangin. Sa kanilang pag-aaral at pagtatanong sa eksperto, magkakaroon pa sila ng mas mahahalagang katanungan tungkol sa pagharap ng energy sector sa climate crisis.</i></p>
<b>Podcast Objectives</b>	<p>After the module discussion, learners should be able to:</p> <ol style="list-style-type: none"><li>1. identify the various sources of energy in the Philippines;</li><li>2. discuss the advantages and disadvantages of non-renewable and renewable energy sources to the environment, and their contribution to climate change; and</li><li>3. examine the feasibility and status of renewable energy in the Philippines.</li></ol>
<b>Teaching Module Objectives</b>	<p>(Adapted from the DepEd curriculum guides)</p> <p>At the end of this lesson, the learners should be able to:</p> <ol style="list-style-type: none"><li>1. describe how fossil fuels are formed, and</li><li>2. cite ways to address the different environmental concerns related to the use of fossil fuels, geothermal energy, and hydroelectric energy</li></ol>

## Curriculum Entry Points

Grade Level: Grades 11/12 (Earth Science)

Content: Energy Resources

Content Standard	Performance Standard	Learning Competency
<i>The learners demonstrate an understanding of:</i>  The learners demonstrate an understanding of the various sources of energy	<i>The learners shall be able to:</i>  explore and examine the possibility of switching to renewable energy sources to help protect our environment	<i>The learners:</i>  analyze and weigh the different environmental concerns related to the use of non-renewable and renewable energy sources

## Prerequisite Concepts

1. Energy (Grade 6)
  - demonstrating how sound, heat, light, and electricity can be transformed
2. Climate (Grade 9)
  - explaining how different factors affect the climate of an area
  - describing certain climatic phenomena that occur on a global level
3. Work Power and Energy (Grade 9)
  - explaining energy transformation in various activities/events (e.g., waterfalls, archery, amusement rides)
4. Ecosystems (Grade 10)
  - suggesting ways to minimize human impact on the environment

## Teaching and Learning Process

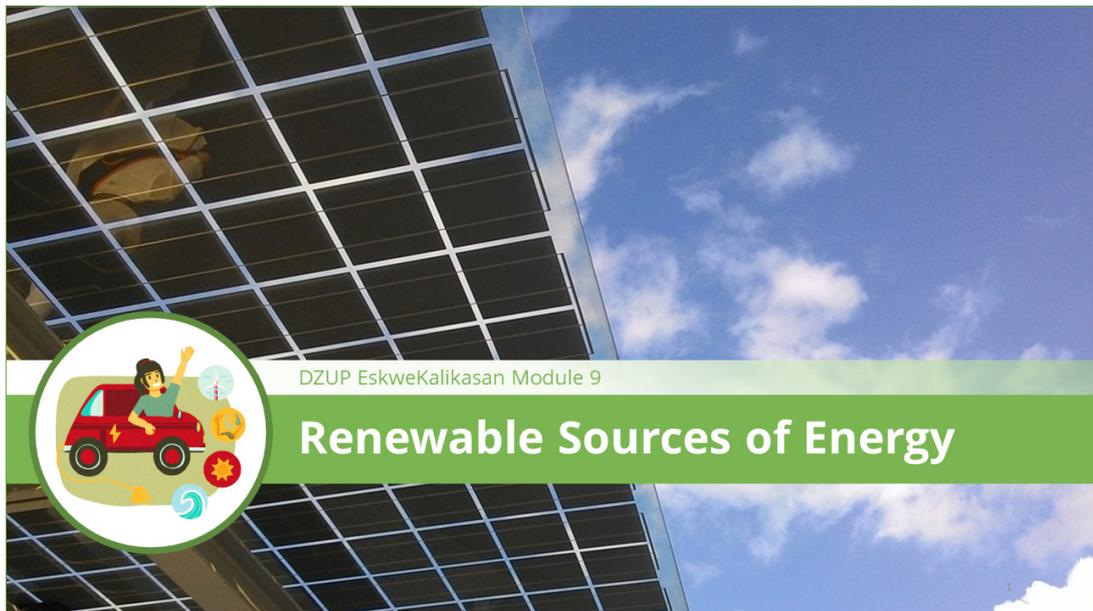
<b>Teaching Approach</b>	Inquiry-based approach through argumentation
<b>Materials</b>	<ol style="list-style-type: none"> <li>1. Podcast file</li> <li>2. Student's answer sheet</li> </ol> <i>(Please visit <a href="http://www.dzup.org/eskwekalikasan">www.dzup.org/eskwekalikasan</a> to access the podcast, PowerPoint and/or student's worksheet.)</i>

## LESSON PROCEDURE

### I. DAYS BEFORE THE LECTURE

- A. **For the assignment, provide the students with a copy of the podcast audio file and instruct them to listen from start to end.**

#### SLIDE 1



#### SLIDE 2

**DZUP ESKWEKALIKASAN PROJECT**

**DZUP EskweKalikasan: Para sa kabataan, kapaligiran, at bayan** is a publicly-funded initiative of the academe, with support from advocates and the government. It aims to raise awareness on emerging and evolving discussions about climate change, disaster risks, sustainable living and development and mindful consumption. Especially designed for senior high school teachers and students, the project has produced several teaching and learning resources such as modules, video guides, podcasts, and radio episodes that are available for free online at [dzup.org/eskwekalikasan](http://dzup.org/eskwekalikasan).

The project (whose title is a portmanteau of the Filipino words for school and nature) is spearheaded by the Department of Broadcast Communication of the University of the Philippines (UP) College of Mass Communication and DZUP 1602, in partnership with the UP National Institute for Science and Mathematics Education Development (UP NISMED) and the UP Diliman of the Office of the Chancellor. It is principally funded by the Philippine Government under the General Appropriations Act for Fiscal Year 2019 through the initiative of the Office of Senator Loren Legarda.

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### SLIDE 3



#### KAYANG-KAYA! PODCAST

**Kayang-Kaya!** is a 10-episode podcast in Filipino that follows the adventures of three senior high school students, Kali, Naya, and Alab, as they seek to understand and uncover issues confronting the environment. As an educational tool, the podcast serves to supplement classroom discussion using aural storytelling.

In **Episode 9**, titled **"Paano napapagana ang cellphone ng hangin at tubig?"**, Barangay Luntian recently experienced brownouts due to simultaneous maintenance activities conducted by the power distribution utility in their community. In school, Kali and Naya wonder about the possibility of powering up their gadgets with the use of natural resources, such as water and wind, due to the power failures. Their quest to find out answers leads to bigger questions about the energy sector confronting the climate crisis.

3 Renewable Sources of Energy

**B. Aside from listening to the podcast, instruct the students to research on various energy sources. They can use the keywords/phrases below:**

- Types of non-renewable and renewable energy sources and their uses
- Pros and cons of various energy sources

**C. On a short bond paper, have them enumerate in bullet points a summary of what they have learned from the podcast and their research.**

## II. DAY OF THE LECTURE

**A. Collect their assignments.**

**B. Introduce the topic.**

### SLIDE 4



#### Images of gadgets the youth commonly use today

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*The teacher should make the topic relatable to the students by asking the questions: "What powers up your gadgets?" followed by "Where does our electricity come from?"*

### C. Short Discussion (15 minutes)

- Through recitation, ask the students the following questions:

#### Review

- Question 1: How are energy resources utilized to generate electricity, as Sir Gerry Arances described?**

**Possible Answer/s:** According to Sir Gerry, electricity is generated from power plants that create energy using various natural sources or processes. This energy is processed and turned into electricity that we use in our homes

#### SLIDE 5

## How electricity is generated

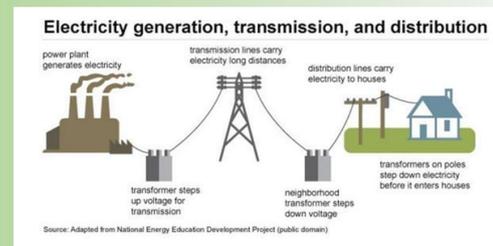
Power plants generate electricity with the use of various energy sources, such as coal, oil, and wind, among others. The energy is processed and turned into electricity, which then powers up our gadgets.

#### Non-Renewable Energy

These are sources of energy that will eventually run out and take a long time to replenish. Since it typically takes millions of years to develop, these resources are finite.

#### Renewable Energy

Often referred to as "clean energy," they come from natural sources or processes that are constantly replenished quickly and dependably.



Source:  
Electricity explained, How electricity is delivered to consumers [Online image]. (n.d.). etia.  
<https://www.eia.gov/energyexplained/electricity/delivery-to-consumers.php>  
Here's how electricity gets to your house. (n.d.). Alliant Energy Kids.  
<https://www.alliantenergykids.com/AllAboutEnergy/HowElectricityIsMade>  
Non-Renewable Energy. (n.d.). Solar Schools. <https://www.solarschools.net/knowledge-bank/non-renewable-energy>  
Renewable Energy. (n.d.). Solar Schools. <https://www.solarschools.net/knowledge-bank/renewable-energy>  
Shinn, L. (2018, June 15). Renewable Energy: The Clean Facts. NORC. <https://www.norc.umd.edu/renewable-energy-clean-facts/>

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- Question 2: What are some types of renewable and non-renewable energy sources mentioned in the podcast?**

#### Possible Answer/s:

For non-renewable energy sources: fossil fuels such as coal, oil/petroleum,\* natural gas

- \* For clarification: Petroleum covers both naturally occurring unprocessed crude oil and petroleum products that are made up of refined crude oil and natural gases. Both terms are used interchangeably (Student Energy, n.d.).

## SLIDE 6

### Types of Non-renewable Energy Sources

#### Fossil fuels

- **Coal** – It comes from the remains of plants that died hundreds of millions of years ago. It has the highest level of carbon of all fossil fuels.
- **Oil** – Also known as petroleum, it can be extracted and refined to make products such as gasoline, diesel, and jet fuel.
- **Natural Gas** – It is formed from the remains of tiny sea plants and animals that died millions of years ago. It is mainly composed of methane.

Source: Non-Renewable Energy, (n.d.). Solar Schools. <https://www.solarschools.net/knowledge-bank/non-renewable-energy>

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For renewable energy sources: sunlight/solar, wind, water/hydropower\*

\* For clarification: Hydropower refers to the conversion of energy from moving water into electricity. Hydropower produces so-called hydroelectricity, which is also called hydroelectric power (Student Energy, n.d.).

## SLIDE 7

### Types of Renewable Energy Sources

- **Wind Energy** – Wind turbines generate electricity for residential and commercial purposes. Large blades on wind turbines harness wind energy.
- **Solar Energy** – It comes from the sun. It's the primary source of energy for all living things on Earth and can also be converted into electricity through solar cells.
- **Hydropower** – It comes from the force of moving water. Hydropower plants use dams to capture water energy and convert it into electricity.

Source: Renewable Energy, (n.d.). Solar Schools. <https://www.solarschools.net/knowledge-bank/renewable-energy>

7 Renewable Sources of Energy

- **Question 3: Based on your research, what are the other types of renewable and non-renewable sources of energy not mentioned in the podcast?**

**Possible Answer/s:**

- a. Other types of non-renewable energy source:
  - Nuclear fuel, such as uranium  
Uranium is a naturally occurring element found within the Earth's core. Its extraction is done through mining. When it reaches critical mass, uranium begins to break down and release energy which heats the water it is immersed in.

**SLIDE 8**

**Other Types of Non-renewable Energy Sources**

**Nuclear fuel, such as uranium**

Uranium is a naturally occurring element found within the earth's core. Its extraction is through mining. When it reaches critical mass, uranium begins to break down and release energy, which heats the water it is immersed in.

Source: Non-renewable energy. (n.d.). National Geographic. <https://www.nationalgeographic.org/encyclopedia/non-renewable-energy/>

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- b. Other types of renewable energy source, according to Just Energy (2018):
  - Geothermal Heat  
Geothermal is the heat trapped beneath the Earth's crust. It is captured and produced using steam that comes from the heated water pumping below the surface.
  - Ocean/ Wave energy  
It can be thermal or mechanical. The former relies on warm water surface temperature, while the latter uses the ebbs and flows of the tides to generate energy.
  - Hydrogen  
It is used for both fuel and electricity when separated from other elements.

- **Biomass**  
It is any organic matter that comes from recently living plants and other organisms. It includes wood, crops, seaweed and animal waste.

For additional resources about renewable energy, please check out the following:

- **Bioenergy.** IRENA International Renewable Energy Agency. (n.d.). <https://www.irena.org/bioenergy>.
- **Hydrogen: A renewable energy perspective.** IRENA International Renewable Energy Agency. (n.d.). <https://irena.org/publications/2019/Sep/Hydrogen-A-renewable-energy-perspective#:~:text=Hydrogen%20has%20emerged%20as%20an,to%20ensure%20a%20sustainable%20future.&text=Important%20synergies%20exist%20between%20hydrogen,can%20add%20demand%2Dside%20flexibility>.
- **Overview of Renewable Energy.** IRENA. (n.d.). <https://www.irena.org/-/media/Files/IRENA/Agency/Data-Statistics/2-Overview-of-renewable-energy.pdf?la=en&hash=6B78D45E6E3D67409D05F7FAB38D638A4F9ACB55>.

## SLIDE 9

### Other Types of Renewable Energy Sources

**Geothermal heat:** Geothermal is the heat trapped beneath the earth's crust. It is captured and produced using steam that comes from the heated water pumping below the surface.

**Ocean/Wave energy:** It can be thermal or mechanical. The former relies on warm water surface temperature, while the latter uses the ebbs and flows of the tides to generate energy.

**Hydrogen:** It is used for both fuel and electricity when separated from other elements.

**Biomass:** It is any organic matter that comes from recently living plants and organisms. It includes wood, crops, seaweed, and animal waste.

Source: Black, A. (2018, November). 7 Types of Renewable Energy: The Future of Energy. Just energy. <https://www.justenergy.com/blog/7-types-of-renewable-energy-the-future-of-energy/>

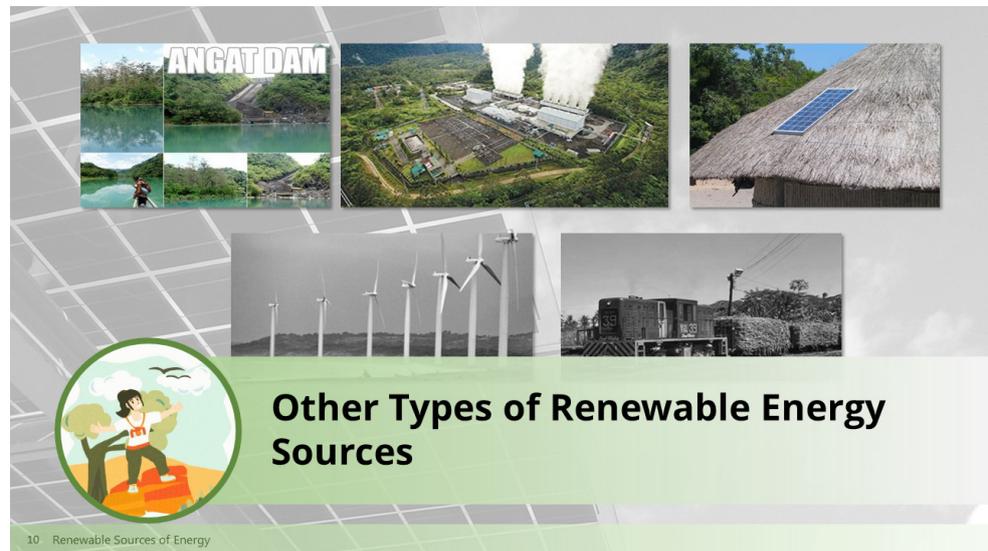
## Philippine Context/Energy Use

- **Question 4: Which of these energy sources are currently used here in the Philippines?**

### Possible Answer/s:

The Philippines uses hydroelectric power, geothermal power, solar power, wind energy, and biomass energy.

SLIDE 10



- **Question 5: Based on the chart, what percentage of the energy that we use to generate electricity comes from non-renewable sources? What percentage comes from renewable sources?**

SLIDE 11

**How much of this type of energy do we use?**

**Fact:** “Coal continuously dominated the power mix in 2019 by increasing its share from 52.1% in 2018 to 54.6%.”

Source:  
2019 Power Situation Report. (n.d.). Department of Energy.  
[https://www.doe.gov.ph/sites/default/files/pdf/electric\\_power/2019-power-situation-report.pdf](https://www.doe.gov.ph/sites/default/files/pdf/electric_power/2019-power-situation-report.pdf)

Year	Total Gross Generation (GWh)
2018	99,765
2019	106,041

**Possible Answer/s:**

In the Philippines, about 70% of non-renewable energy is used.

Based on a 2019 report by the Department of Energy, the distribution per energy source is as follows:

- Coal – 54.6%
- Natural Gas – 21.1%
- Oil-based – 3.5%

## SLIDE 12

### Trivia (Did you know?)

Fossil fuels are typically found in specific parts of the world, making them more plentiful in some nations than others.

As a result, it makes the country reliant on fossil-rich countries. The Philippines imports 75 percent of its coal, mostly from Indonesia and Australia. (Insert map of Indonesia and Australia)

This is according to the Philippines-based Institute for Climate and Sustainable Cities (ICSC).

Sources:  
Renewable Energy: The Clean Facts. (n.d.). NRDC. <https://www.nrdc.org/stories/renewable-energy-clean-facts>  
Torralba, A. (2018, May 18). Coal-reliant Philippines struggle to power up clean energy. Reuters. <https://www.reuters.com/article/us-philippines-coal-renewables/coal-reliant-philippines-struggles-to-power-up-clean-energy-idUSKCN1J1DL>

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According to the Department of Science and Technology as of 2018, the percentage of renewable energy use in the Philippines is about 25 percent.

The percentage distribution per energy source is as follows:

1. Geothermal – 44.3%
2. Hydropower – 41.5%
3. Solar – 5.2%
4. Wind – 4.7%
5. Biomass – 4.4%

## SLIDE 13

### Renewable Energy Use in the Philippines

As of 2018, **the percentage of renewable energy use in the Philippines is about 25 percent.**

Based on a data released by the Department of Energy in 2018, the distribution per energy source is as follows.

Source:  
PES-STRAED. (2018, August 20). HOW RELIANT IS THE PHILIPPINES ON RENEWABLE ENERGY? Department of Science and Technology. <http://dst.gov.ph/knowledge-resources/news/36-infographics/infographics-2018/1487-how-reliant-is-the-philippines-on-renewable-energy.html>

<b>Geothermal</b>	<b>44.3%</b>
<b>Hydropower</b>	<b>41.5%</b>
<b>Solar</b>	<b>5.2%</b>
<b>Wind</b>	<b>4.7%</b>
<b>Biomass</b>	<b>4.4%</b>

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The percentage distribution of energy per region is as follows:

- Luzon – 50%
- Visayas – 30%
- Mindanao – 20%

**SLIDE 14**

### Renewable Energy Use in the Philippines

The distribution of energy per region is as follows.

Source: PES-STRAED. (2018, August 20). HOW RELIANT IS THE PHILIPPINES ON RENEWABLE ENERGY? Department of Science and Technology. <http://dost.gov.ph/knowledge-resources/news/56-infographics/infographics-2018/1487-how-reliant-is-the-philippines-on-renewable-energy.html>



**Luzon - 50%**

**Visayas - 30%**

**Mindanao - 20%**

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Depending on the kind, the area distribution of energy in the Philippines according to Solenergy Systems Incorporated is as follows:

- Hydroelectric power plants are located in Pangasinan, Benguet, Laguna, Isabela, Bulacan, Nueva Ecija, Ilocos Sur, Bohol, Lanao del Sur, Lanao del Norte, Bukidnon, Davao del Sur, and Misamis Oriental.
- Geothermal plants are located in Laguna, Sorsogon, Albay, Batangas, Negros Occidental, Leyte, and North Cotabato.
- Solar farms can be found in Cavite, Pampanga, Ilocos Norte, and Cagayan de Oro.
- Wind power plants are located in Ilocos Norte, Rizal, Guimaras, and Aklan.
- Biomass power plants are found in Isabela, Nueva Ecija, Rizal, Laguna, Isabela, and Metro Manila.

**SLIDE 15**

### Renewable Energy Use in the Philippines

Per area:

**Hydroelectric power plants** are located in Pangasinan, Benguet, Laguna, Isabela, Bulacan, Nueva Ecija, Ilocos Sur, Bohol, Lanao del Sur, Lanao del Norte, Bukidnon, Davao del Sur, and Misamis Oriental (Solenergy Systems Incorporated, n.d.).

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SLIDE 16

**Renewable Energy Use in the Philippines**

**Geothermal plants** are located in Laguna, Sorsogon, Albay, Batangas, Negros Occidental, Leyte, and North Cotabato (Solenergy Systems Incorporated, n.d.)

SLIDE 17

**Renewable Energy Use in the Philippines**

**Solar farms** can be found in Cavite, Pampanga, Ilocos Norte, and Cagayan de Oro (Solenergy Systems Incorporated, n.d.)

SLIDE 18

**Renewable Energy Use in the Philippines**

**Wind power plants** are located in Ilocos Norte, Rizal, Guimaras, and Aklan (Solenergy Systems Incorporated, n.d.)

SLIDE 19

**Renewable Energy Use in the Philippines**

**Biomass power plants** are found in Isabela, Nueva Ecija, Rizal, Laguna, Isabela, and Metro Manila.

Source: Renewable energy spots in the Philippines. (n.d.). SolarenergySystems Inc. <https://solenergy.com.ph/renewable-energy-spots-philippines/>

**D. Class Activity (15 minutes)**

1. Divide the class into smaller groups depending on class size. The ideal group size is five to eight members.
2. Let each group choose at least one among the non-renewable and renewable energy sources. Distribute sheets of Manila paper for each group.
3. Instruct them that they will be given 10 minutes to identify the advantages and disadvantages of the renewable and non-renewable energy sources of their choice. In the first column, they will write the energy source, the second will be the advantages, and the third will be the disadvantages similar to the table of possible answers below.
4. After 10 minutes, instruct them to post their group accomplishment on the board for presentation.

**Possible Answer/s:**

<b>Energy Source</b>	<b>Advantages</b>	<b>Disadvantages</b>
Fossil fuels, including coal, natural gas, petroleum	<ul style="list-style-type: none"> <li>• inexpensive to extract</li> <li>• easily stored, piped, and shipped anywhere in the world</li> <li>• easy to find</li> <li>• high energy release</li> <li>• proven form of energy</li> </ul>	<ul style="list-style-type: none"> <li>• pollutes the air, water, land</li> <li>• releases carbon dioxide that contributes to "greenhouse effect"</li> <li>• damages the environment through drilling and mining</li> <li>• makes the Philippines highly dependent on fuel-rich countries</li> <li>• has harmful effects on health</li> <li>• has possibility of oil spill and earthquake</li> </ul>
Nuclear fuel, such as uranium	<ul style="list-style-type: none"> <li>• Nuclear power plants do not pollute the air or emit greenhouse gases.</li> </ul>	<ul style="list-style-type: none"> <li>• difficult to harvest</li> <li>• complicated to build and run</li> <li>• produces extremely toxic radioactive waste</li> <li>• difficult and expensive disposal</li> </ul>
Solar energy	<ul style="list-style-type: none"> <li>• limitless sunlight</li> <li>• free</li> <li>• pollution-free</li> </ul>	<ul style="list-style-type: none"> <li>• space consuming for solar panels</li> <li>• lower production of energy because sunlight is limited to daytime only</li> <li>• has high initial costs for materials and installation</li> </ul>

Energy Source	Advantages	Disadvantages
Wind energy	<ul style="list-style-type: none"> <li>• clean</li> <li>• pollution-free</li> <li>• unlimited</li> </ul>	<ul style="list-style-type: none"> <li>• demanding in space</li> <li>• far from cities</li> <li>• located only in rural and remote areas</li> <li>• higher costs in transporting the energy via transition lines</li> <li>• a threat to local wildlife, due to its noise and turbines</li> </ul>
Hydroelectric energy	<ul style="list-style-type: none"> <li>• pollution-free</li> <li>• reliable</li> <li>• can be both large-scale, such as dams, or small-scale on rivers and streams</li> </ul>	<ul style="list-style-type: none"> <li>• storage system needs fossil fuel to pump water</li> <li>• disrupts waterways and negatively affects animals</li> <li>• dependence on the availability of water</li> </ul>
Geothermal energy	<ul style="list-style-type: none"> <li>• leaves little footprint on land</li> <li>• can be built underground</li> <li>• reliable</li> <li>• high efficiency</li> </ul>	<ul style="list-style-type: none"> <li>• infrastructure is costly</li> <li>• land can be vulnerable to earthquakes</li> <li>• extraction still releases little greenhouse gases</li> </ul>
Ocean	<ul style="list-style-type: none"> <li>• Wave energy is predictable, and the amount of energy is easily estimated.</li> <li>• more consistent than sun and wind</li> <li>• abundant</li> </ul>	<ul style="list-style-type: none"> <li>• costly infrastructure</li> <li>• vulnerable to earthquakes</li> <li>• extraction releases little greenhouse gases</li> </ul>
Hydrogen	<ul style="list-style-type: none"> <li>• clean</li> <li>• available</li> </ul>	<ul style="list-style-type: none"> <li>• inaccessible to landlocked areas</li> <li>• high disturbance to the ocean's ecosystem; with built-in machinery</li> <li>• waves and weather consistency dependent</li> <li>• expensive machinery</li> </ul>
Biomass	<ul style="list-style-type: none"> <li>• easily available</li> <li>• versatile, as it can be converted into many different fuel sources</li> <li>• low cost</li> <li>• reduces waste</li> <li>• can be produced domestically</li> </ul>	<ul style="list-style-type: none"> <li>• expensive due to intricate processes</li> <li>• difficult to store</li> <li>• highly flammable</li> <li>• dependent on fossil fuel in separating it from other elements</li> </ul>

Instruct the students to post their answers on the board. The teacher will assess the answers and present a summary or conclusion by presenting the table below.

SLIDE 20

Advantages and Disadvantages of Non-Renewable Energy	
Advantages	Disadvantages
<ul style="list-style-type: none"><li>• consistent</li><li>• always available</li><li>• easy and inexpensive to extract and store</li><li>• high in energy release</li><li>• easily stored, piped, and shipped anywhere in the world</li></ul>	<ul style="list-style-type: none"><li>• produces greenhouse gases that contribute to climate change</li><li>• climate change resulting to extreme weather events, shifting wild population and habitats, rising seas, etc.</li><li>• mining works damage the environment</li><li>• takes a long time to replenish</li><li>• rising costs (especially that the price of fuel fluctuates)</li><li>• high dependence on fuel-rich countries</li></ul>

20 Renewable Sources of Energy

SLIDE 21

Advantages and Disadvantages of Renewable Energy	
Advantages	Disadvantages
<ul style="list-style-type: none"><li>• abundant</li><li>• accessible</li><li>• safe</li><li>• clean</li><li>• environment-friendly</li><li>• no greenhouse gases emission</li><li>• less dependence on fuel imports</li><li>• lower energy bills</li><li>• expansion of energy access in developing countries</li></ul>	<ul style="list-style-type: none"><li>• storage capabilities</li><li>• not available 24/7</li><li>• geographic limitations</li><li>• location specific (for example, wind power is only applicable in some areas)</li><li>• costly, as technology still needs development</li><li>• requires massive amount of space (i.e., wind and solar farms)</li></ul>

Sources for slides 18-19:  
Greenpeace. (n.d.). Green is Gold. <https://storage.googleapis.com/planet4-philippines-stateless/2019/05/b7d41fa1-green-is-gold-how-renewable-energy-can-save-us-money-and-generate-jobs-03.pdf>  
Shinn, L. (2018, June 15). Renewable Energy: The Clean Facts. NRDC. <https://www.nrdc.org/stories/renewable-energy-clean-facts>  
Non-renewable energy. (n.d.). National Geographic. <https://www.nationalgeographic.org/encyclopedia/non-renewable-energy/>

21 Renewable Sources of Energy

SLIDE 22



## Key Concepts

**Climate crisis is a reality.**

- Burning fossil fuels, like coal, oil, and natural gas, is harmful to the environment. They release carbon dioxide in the earth's atmosphere, contributing to the greenhouse effect.
- Greenhouse gases trap heat and make the planet warmer, which could lead to potentially catastrophic changes in the Earth's climate.

Source: Climate 101. (n.d.). The Climate Reality Project. <https://www.climate realityproject.org/climate-101>



SLIDE 23

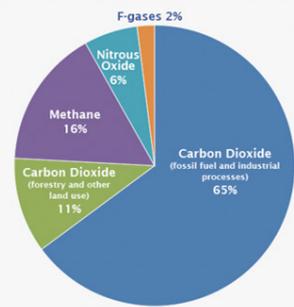


## Key Concepts

Over the past ten years, **the energy sector has remained the largest contributor to greenhouse emissions**, representing the biggest percentage of global emissions in 2013.

Source: Greenhouse Gas Emissions. (n.d.). EPA. <https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data>

Global Greenhouse Gas Emissions by Gas



5. Through recitation, answer the argumentative question below:

**Is it important for the Philippines to shift to renewable sources of energy? Can the Philippines shift to renewable energy sources? If yes, why? If no, why not?**

**SLIDE 24**

**Argumentative Question**

Is it important for the Philippines to shift to renewable sources of energy? Can the Philippines shift to renewable energy sources? If yes, why? If no, why not?

24 Renewable Sources of Energy

**SLIDE 25**

**Quotable Quote**

*"The climate crisis has already been solved. We already have the facts and solutions. All we have to do is to wake up and change."*

Greta Thunberg

25 Renewable Sources of Energy



*Note: From their answers, also introduce the concept of energy mixing. Definition and explanation can be found in Key Concepts section.*

**E. Culminating Activity/Assessment**

1. Ask the students to create an infographic identifying the learning concepts they have gained from the lesson. It may be any of the following:
  - a. Information about the two classifications of energy sources
  - b. Information about the specific type of energy source assigned to their group
  - c. Information about how fossil fuels contribute to climate change
  - d. Steps to address the harmful effects of using different sources of energy
  - e. A presentation of their claims in the previously raised argumentative statement with their pieces of evidence (e.g., data, phrases, etc.) and justifications
2. Students may present their work in their next meeting. They are also encouraged to use technology (computer, graphic design program) in creating their infographics.

**Related Concepts****FOR THE REVIEW PART****1. Electricity as the Most Common Source of Energy**

- Electricity is made at generating station that uses various energy sources, such as wind, coal, natural gas, water, etc. Power plants generate electricity that is delivered to customers through transmission and distribution power lines.

**2. Non-renewable Sources of Energy**

- Referred to as “dirty energy,” it includes fossil fuels such as oil, gas, and coal. Non-renewable sources of energy are only available in limited amounts and take a long time to replenish.
- Non-renewable energy sources are also typically found in specific parts of the world, making them more plentiful in some nations than others. By contrast, every country has access to sunshine and wind which are natural sources of energy.

**3. Renewable Sources of Energy**

- Often referred to as “clean energy,” renewable energy comes from natural sources or processes that are constantly replenished. For example, sunlight or wind keeps shining and blowing, even if their availability depends on time and weather.
- While renewable energy is often thought of as a new technology, harnessing nature’s power has long been used for heating, transportation, lighting, and more. The wind has powered boats to sail and windmills to grind grain. The sun has provided warmth during the day and helped kindle fires to last into the evening. But over the past 500 years or so, humans increasingly turned to cheaper, dirtier energy sources such as coal and fracked gas.

#### 4. **Fossil Fuels**

- Fossil fuels, which include coal, oil, and natural gas, are currently the world's primary energy source. As it is formed from organic material over the course of millions of years, fossil fuels are finite resources, and they can also harm the environment.
- Carbon is the main element of fossil fuels. Over time, prehistoric plants and animals which died and decayed turned into fossil fuels, with energy stored in them. Today, there are huge underground pockets, called reservoirs of these non-renewable energy sources all over the world.
- Burning fossil fuels is harmful for the environment. They release carbon dioxide into the Earth's atmosphere, contributing to the greenhouse effect. Greenhouse gases trap heat and make the planet warmer, which could lead to potentially catastrophic changes in the Earth's climate.

#### **FOR THE PHILIPPINE CONTEXT/ENERGY USE**

##### 5. **Coal Imports of the Philippines**

According to the article "Towards a Just Transition in the Philippines Electricity Sector, Challenges and Opportunities" (n.d.),

- Because the Philippines is poor in fossil fuel resources, it imports most of its oil and coal requirements. The DOE reported that the Philippines consumed 22 million metric tons of coal in 2015, with the power sector accounting for almost 80 percent.
- Seventy percent (70%) of the coal imports of the country come from Indonesia. According to data from the Bureau of Customs, the total coal importation reached 21 million tons in 2016, an increase of 47.8 percent from 2015.

#### **FOR THE ARGUMENTATIVE QUESTION**

##### 6. **Climate crisis is a reality.**

According to The Climate Reality Project,

- Ninety-seven percent of climate scientists agree that human activity is driving a climate crisis across the Earth.
- Carbon pollution from burning fossil fuels like coal, oil, and natural gas is changing our climate and warming our planet. The more carbon pollution in the air, the more the sun's energy gets trapped as heat. It means things keep getting hotter. In fact, the world has already gotten nearly 1°C warmer since 1880.
- Warmer temperatures have real consequences for all of us—not just for polar bears. Sea levels around the world have risen nearly 20 cm (7.8 inches) since 1901, swallowing entire islands and creeping closer to populated areas of great coastal cities. Moreover, extreme weather events like hurricanes, floods, and droughts are becoming more frequent and intense.

7. **Renewable energy potential in the Philippines: Is it really possible?**

- The country's economy continues to grow rapidly, but the country's economy predominantly is coal-powered. By reducing its dependence on imported fossil fuels, the transition to renewables would make the country energy self-reliant and economically independent.
- The Philippines has very rich natural sources of energy, considering its archipelagic nature composed of more than 7,000 islands. By reducing its dependence on imported fossil fuels, the transition to renewable energy would make the country self-reliant and economically independent. Political will is a must.

8. **Mixing Energy Sources**

According to *National Geographic*:

- There are a variety of energy sources that generate the most electricity, and these energy resources vary from place to place.
- Communities may choose a higher percentage of one energy resource because it has a lower cost in their area than another resource, or because political incentives or policies encourage or limit the use of some types of resources.
- Geography might also affect which renewable energy resources are viable and cost-effective for an area. For example, places located near a major river can take advantage of hydroelectric power, while places away from any major rivers cannot do so as easily.

9. **The Philippines should also make an effort to address the climate crisis.**

(Towards a Just Transition in the Philippines Electricity Sector, Challenges and Opportunities, n.d.):

- One of the most identified vulnerable countries to climate change is the Philippines. From 1996 to 2015, the Philippines ranked fifth among the 10 countries most affected by extreme weather events linked to global warming.
- Although the per-capita CO<sub>2</sub> emissions of the Philippines in 2014 is 1.0 metric tons which represents only one-fifth of the world average of 5.0 tons, the Philippines is always on top of the list of countries with the highest number of strong typhoons.

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