

**Grade Six: Energy**  
**Lesson 6.9: Renewable and Nonrenewable Resources**

**Lesson Concept** Renewable energy sources can be replaced in a lifetime and nonrenewable energy sources cannot be replaced in a lifetime.

**Link** In the previous lesson with photo voltaic cells student were introduced to the concept of renewable and nonrenewable sources to power a motor. In this lesson, students will learn about additional renewable and nonrenewable energy sources and discuss benefits and drawbacks.

**Time** 110 minutes (Two class periods)

**Materials** **Per Group (groups of 2-4)**  
9x12 white construction paper for posters  
Marking pen

**Individual**

Renewable/Nonrenewable Energy Usage Chart  
H1a-d Renewable/Nonrenewable Reading  
H2 Assessment Chart  
H3 a Assessment Pictures  
H3 b Assessment Answer Key  
H4 Optional Internet Scavenger Hunt

**Advance preparation**

1. Duplicate **H1a-d(Renewable/Nonrenewable Reading)**, **H2(Assessment Chart)**, **H3a(Assessment Pictures)**, and **H4 (Optional Internet Scavenger Hunt)**.
2. Cut white construction paper into 9x12 pieces.
3. Gather marking pens.

**Procedure:**

**Engage**                    ***(10 minutes) Energy used every day is frequently non-renewable.***

1. Ask students to Think-Pair-Share the energy source they have used the most today. Chart responses.
2. Display the Renewable/Nonrenewable energy usage chart with document camera.
3. Ask students to identify if the primary energy source they utilized is renewable or nonrenewable.

**Explore/Explain**    ***(50 minutes) Energy sources can be identified as renewable or non-renewable.***

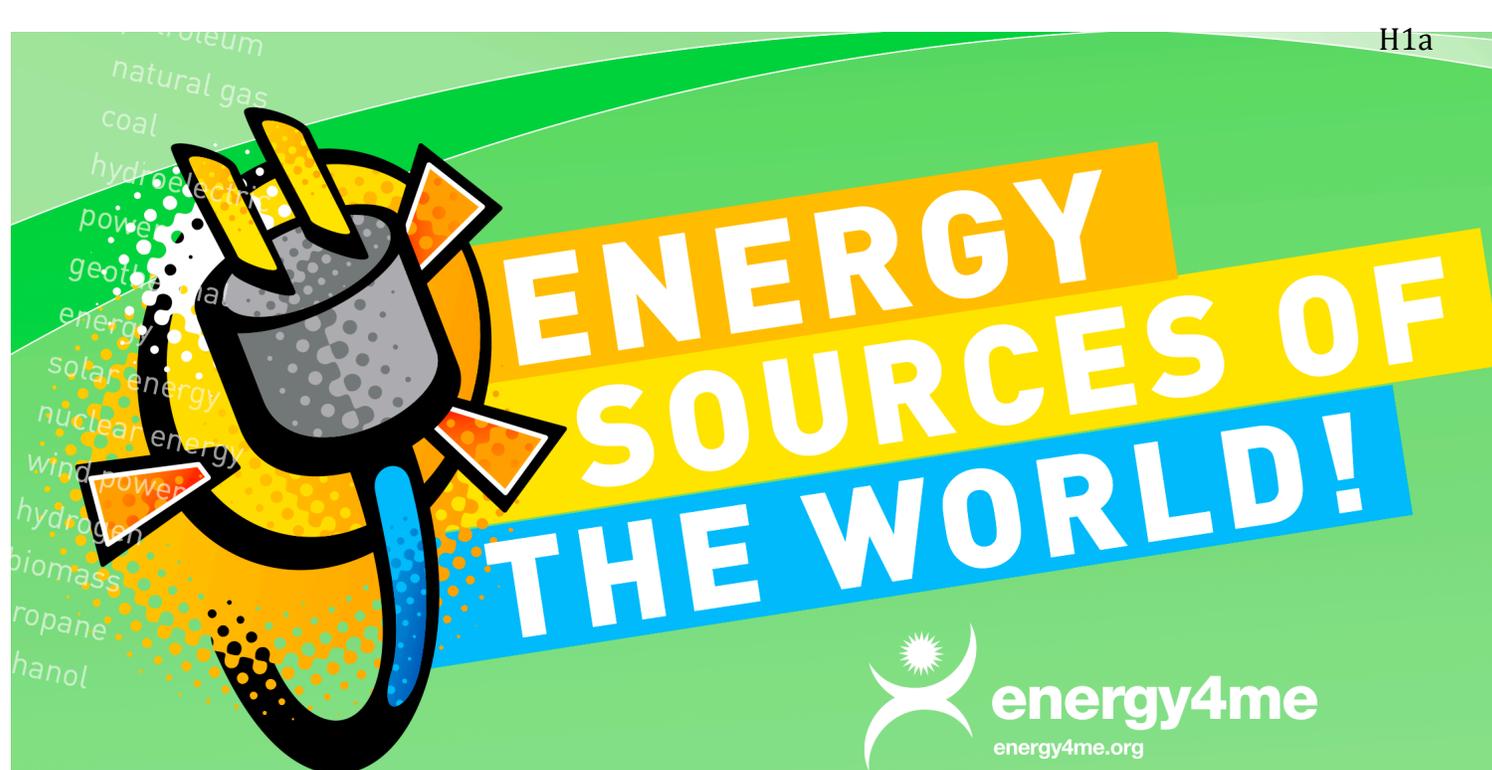
4. Divide students into twelve groups (groups of 2 or 3 students).
5. Assign each group a section of the **H1a-d(Renewable/Nonrenewable Reading)**.
6. Distribute a poster paper and marking pen to each group.
7. Ask student groups to title, summarize, and illustrate their assigned energy source on their puzzle piece AND indicate whether it is renewable or nonrenewable.
8. Ask student groups to share their findings with the whole class.

**Extend (optional)**    ***(30 minutes) Energy sources are identified on the internet.***

9. In class or during computer lab time, students can complete **H4 (Optional Internet Scavenger Hunt)**.

**Evaluate**                    ***(20 minutes) Knowledge of renewable and nonrenewable energy sources leads to understanding advantages and disadvantages of the source.***

10. Ask students to complete the top portion of **H2 (Assessment Chart)** for the renewable/nonrenewable quiz by cutting and pasting the energy icons on **H3a (Assessment Pictures)** into the appropriate column. This is a quiz, so don't allow the students to use the reading packet.
11. On the bottom of the quiz, ask students to select a renewable and nonrenewable energy source, and describe what it is and how it works, and explain the advantages and disadvantages of the source. Students should use the reading packet to complete this portion.



**energy4me**  
energy4me.org

Presented by **Society of Petroleum Engineers**

## Did you know there are at least 12 different energy sources?

**A**lthough oil, natural gas, and coal will remain the primary energy sources for the foreseeable future, a variety of resources will be needed to meet the world's growing demand. All energy sources have benefits, as well as challenges to overcome to produce, deliver, and use them on a wide-scale and efficient basis. Costs are an important consideration. How much will the capital/set-up costs be, and what are the ongoing operating costs? Will the final product be too expensive for the average consumer? Does the energy source require storage or other additional infrastructure? Is it possible to produce it on a large scale? Also, think about how its production will impact the environment.

### RENEWABLE

**Renewable** resources can be replenished at a comparable rate to the rate of consumption. Energy sources like hydroelectric power, solar energy, and wind power are considered "perpetual resources" because they run no risk of depletion.

### NONRENEWABLE

**Nonrenewable** resources are energy sources like petroleum, propane, natural gas, coal, and nuclear energy that take millions of years to form and cannot be regenerated in a short time period.

## PETROLEUM



**PETROLEUM** is formed from animals and plants that lived millions of years ago when heat and pressure turned decayed matter into crude oil. It is a part of the fossil fuels family, found underground or under seabed floor by drilling. It is then transported to refineries and distilled into fuel or base chemical products.

### PROS

- Transportation fuel for the world
- Basis of many products, from prescription drugs to plastics
- Economical to produce, easy to transport

### CONS

- High CO<sub>2</sub> emissions
- Found in limited areas
- Supply may be exhausted before natural gas and coal resources
- Possible environmental impact from drilling and transporting



nonrenewable



**PROPANE (LIQUEFIED PETROLEUM GAS or LPG)** is produced as a byproduct from natural gas processing and crude oil refining. A part of the fossil fuels family, the components recovered during processing include ethane, propane, and butane as well as heavier hydrocarbons. Propane has been made safer by adding artificial odor, so people can easily smell the gas if it leaks. It burns hotter and more evenly than other fuels.

### PROS

- Yields 60–70% less smog-producing hydrocarbons than gasoline/diesel fuel or propane exhaust
- Nontoxic and insoluble in water
- Doesn't spill, pool, or leave a residue
- Appliances pay for themselves via energy savings more quickly

### CONS

- Uses some fossil fuels in conversion
- Highly flammable
- Costs prone to seasonal price fluctuations that complicate fuel cost budgeting
- Less energy in a gallon of propane than in a gallon of gasoline or diesel fuel

## PROPANE



nonrenewable

## NATURAL GAS



**NATURAL GAS** consists primarily of methane but includes significant quantities of ethane, butane, propane, carbon dioxide, nitrogen, helium, and hydrogen sulfide. It is a part of the fossil fuels family and found underground by drilling. It is then transported by tankers or pipelines as liquefied natural gas.

### PROS

- Widely available
- Burns more cleanly than coal or oil
- Often used in combination with other fuels to decrease pollution in electricity generation

### CONS

- Transportation costs are high; lack of infrastructure makes gas resources unavailable from some areas
- Burns cleanly, but still has emissions
- Pipelines impact ecosystems



nonrenewable



**COAL** is formed from trees and plants in vast primeval forests, when heat and pressure turned decayed matter into coal. Coal is a part of the fossil fuels family.

### PROS

- Abundant supply
- Currently inexpensive to extract
- Reliable and capable of generating large amounts of power

### CONS

- Emits major greenhouse gases/acid rain
- High environmental impact from mining and burning, although cleaner coal-burning technology is being developed
- Mining can be dangerous for miners

## COAL



nonrenewable

## NUCLEAR ENERGY



**NUCLEAR ENERGY** is generated in reactors, when nuclear fuel fission (using uranium) heats water, and the steam turns turbines to run the generators that convert energy into electricity.

### PROS

- No greenhouse gases or CO<sub>2</sub> emissions
- Very efficient at transforming energy into electricity compared to coal plants
- Uranium reserves are abundant (but costly to mine)
- Refueled yearly unlike coal plants that need trainloads of coal every day

### CONS

- Higher capital costs due to safety, emergency, containment, radioactive waste, and storage systems
- Problem of long-term storage of radioactive waste
- Heated waste water from nuclear plants harms aquatic life
- Potential nuclear proliferation issue



**SOLAR ENERGY** is generated when photovoltaic (PV) cells convert heat from the sun directly into electricity.

### PROS

- Nonpolluting
- Most abundant energy source available
- Systems last 15–30 years

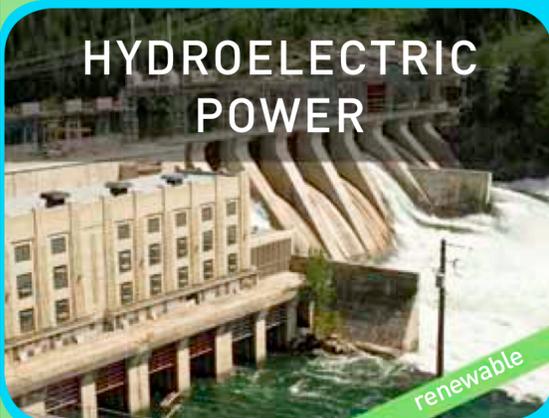
### CONS

- High initial investment
- Dependent on sunny weather
- Supplemental energy may be needed in low sunlight areas
- Requires large physical space for PV cell panels
- Limited availability of polysilicon for panels

## SOLAR ENERGY



## HYDROELECTRIC POWER



**HYDROELECTRIC POWER** is generated when flowing water turns turbines to run generators that convert energy into electricity.

### PROS

- No emissions
- Reliable
- Capable of generating large amounts of power
- Output can be regulated to meet demand

### CONS

- Environmental impacts by changing the environment
- Hydroelectric dams are expensive to build
- Dams may be affected by drought
- Potential for floods



**WIND POWER** is generated when wind turns turbines to run the generators that convert energy into electricity, which is then stored in batteries.

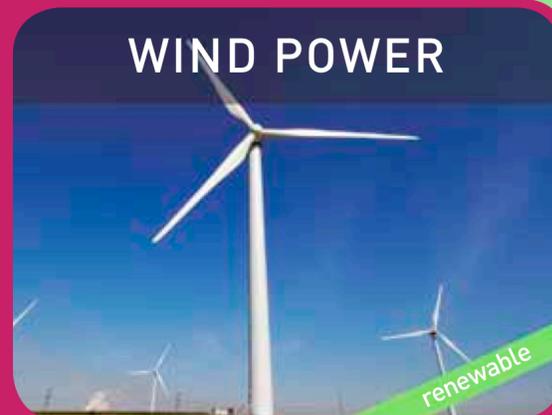
### PROS

- No emissions
- Affordable
- Little disruption of ecosystems
- Relatively high output

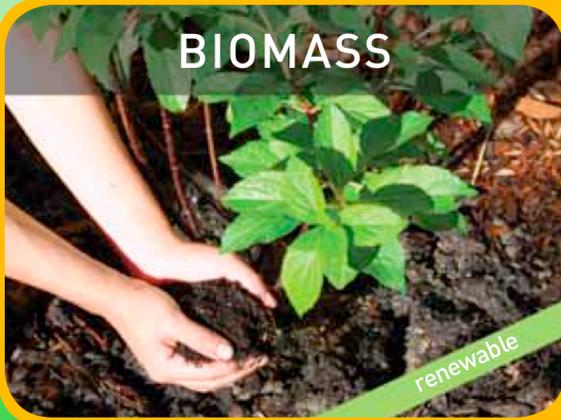
### CONS

- Output is proportional to wind speed
- Not feasible for all geographical locations
- High initial investment and ongoing maintenance costs
- Extensive land use
- Can be unsightly and noisy
- Can pose a threat to birds

## WIND POWER



## BIOMASS



**BIOMASS** is produced from vegetable oils, animal fats, recycled restaurant greases, and other byproducts of plant, agricultural, and forestry processing or industrial/human waste products. It is converted to electricity in a process similar to converting fossil fuels to heat or electricity.

### PROS

- Abundant supply
- Fewer emissions than fossil fuel sources
- Can be used in diesel engines
- Auto engines easily converted to run on biomass fuel

### CONS

- Source must be near usage to cut transportation costs
- Emits some pollution as gas/liquid waste
- Increases nitrogen oxides, an air pollutant emissions
- Uses some fossil fuels in conversion



**ETHANOL** is a subset of biomass that is manufactured from alcohols, ethers, esters, and other chemicals extracted from plant and tree residue. It can be made from corn, sugar, wheat, and barley.

### PROS

- Easily manufactured
- Fewer emissions than fossil fuel sources
- Carbon-neutral (CO<sub>2</sub> emissions offset by photosynthesis in plants)

### CONS

- Source must be near usage to cut transportation costs
- Extensive use of cropland
- Less energy in a gallon of ethanol than in a gallon of gasoline and diesel fuel
- Costs more than gasoline to produce
- Currently requires government subsidy to be affordable to consumers
- Requires engine conversion to be used as fuel

## ETHANOL



## HYDROGEN



**HYDROGEN** is found in combination with oxygen in water, but it is also present in organic matter such as living plants, petroleum, or coal. Hydrogen fuel is a byproduct of chemically-mixing hydrogen and oxygen to produce electricity, water, and heat. It is stored in a "cell" or battery.

### PROS

- Abundant supply
- Water vapor emissions only
- Excellent industrial safety record

### CONS

- More expensive to produce than fossil fuel systems
- Currently uses a large amount of fossil fuels in the hydrogen extraction process
- Storage and fuel cell technology still being developed



**GEOHERMAL ENERGY** is generated by heat in the earth's core. It is found underground by drilling steam wells (like oil drilling). There is a global debate as to whether geothermal energy is renewable or nonrenewable.

### PROS

- Produces about 1/3 the CO<sub>2</sub> that a power plant using natural gas emits
- Efficient
- Minimal environmental impact

### CONS

- Geothermal fields found in few areas around the world
- Wells could eventually be depleted
- Expensive start-up costs

## GEOHERMAL ENERGY



### RENEWABLE OR NONRENEWABLE ENERGY SOURCES

1. Cut out each of the energy sources on the attached page
2. Glue each in the appropriate column: Renewable or Nonrenewable.
3. Select one in each column by CIRCLING IT and describe what it is; how it works, and the advantages and disadvantages. You may use your reading packet now.

#### RENEWABLE ENERGY

#### NONRENEWABLE ENERGY

Describe what it is:

Describe what it is:

Describe how it works:

Describe how it works:

Advantages:

Advantages:

Disadvantages:

Disadvantages:

# Renewable or Nonrenewable?

Draw a circle around the renewable energy sources and a square around the nonrenewable energy sources.

INTERMEDIATE STUDENTS



Oil/Petroleum



Coal



Solar



Wind Power



Natural Gas



Nuclear



Biomass



Hydroelectric  
Power



Hydrogen



Geothermal



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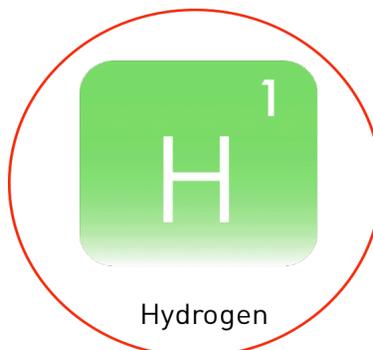
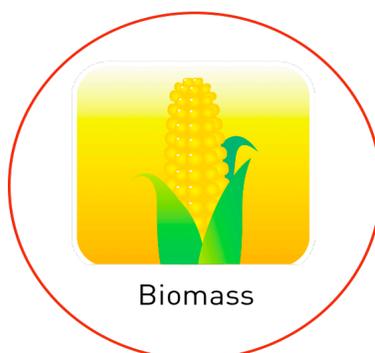
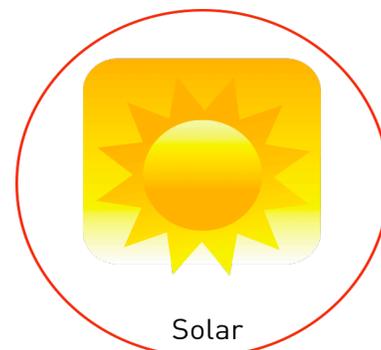
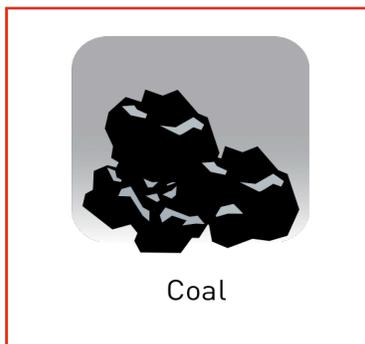
6.9 Energy in Earth Systems: Renewable-Nonrenewable Energy

\*SCIENCE MATTERS

# Renewable or Nonrenewable?

Draw a circle around the renewable energy sources and a square around the nonrenewable energy sources.

**TEACHER ANSWERS**



# Energy Internet Scavenger Hunt

Use your computer to search for the answers to these questions.

INTERMEDIATE STUDENTS

**1) What are fossil fuels?**

<http://glossary.eea.europa.eu/EEAGlossary>

**2) What are renewable energy sources?**

<http://glossary.eea.europa.eu/EEAGlossary>

**3) What percent of the world's electricity is supplied by hydro power?**

[www.worldcoal.org/assets\\_cm/files/PDF/fact\\_card07.pdf](http://www.worldcoal.org/assets_cm/files/PDF/fact_card07.pdf)

**4) What types of gases make up natural gas?**

[www.naturalgas.org/overview/background.asp](http://www.naturalgas.org/overview/background.asp)

**5) What materials are used on solar panels to allow them to produce electricity?**

[www.managenergy.net/kidscorner/en/u11/u11.html](http://www.managenergy.net/kidscorner/en/u11/u11.html)

**6) What is nuclear energy?**

<http://scienceclub.nei.org/scienceclub/nuclearworld.html>

**7) Who is considered the entrepreneur of the oil industry?**

[www.eia.doe.gov/kids/history/people/pioneers.html](http://www.eia.doe.gov/kids/history/people/pioneers.html)

**8) Do electronics use energy when they're off?**

[www.energy4me.org/use/home.htm](http://www.energy4me.org/use/home.htm)

**9) By what percentage is the use of wind power growing worldwide each year?**

[www.eere.energy.gov/consumer/your\\_home/electricity/index.cfm/mytopic=10501](http://www.eere.energy.gov/consumer/your_home/electricity/index.cfm/mytopic=10501)

**10) How did oil and natural gas form?**

[http://worldalmanacforkids.com/WAKI-Chapter.aspx?chapter\\_id=4#Energy\\_and\\_its\\_Sources](http://worldalmanacforkids.com/WAKI-Chapter.aspx?chapter_id=4#Energy_and_its_Sources)  
(In the chapter articles, click petroleum.)