

Energy Curriculum Grades 4-6 Part 2: Renewable v. Non-renewable Energy Teacher's Guide



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This teacher' guide coincides with an interactive SMART board presentation on Renewable vs. Non-Renewable Energy Resources for 4th, 5th and 6th grade. The teacher's guide contains information to coincide with the content of the SMART board lesson, additional resources, and lesson extensions. The teacher's guide is designed to serve as a stand-alone resource, or can be used along with the SMART board presentation and/or student guide. Additional energy lessons and resources can be found at www.cceoneida.com.

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Lesson Objective	Lesson Assessment
Understand how non-renewable energy resources are made	Whole class discussion, and completion of student guide
Understand the basic concepts of six different renewable energy resources	Whole class discussion, and completion of student guide
Consider advantages and disadvantages of renewable and non-renewable energy sources	Class discussion and end of lesson activity

Lesson Content –

Students will understand:

- Concepts
 - Renewable energy
 - Non-renewable energy
 - Disadvantages and advantages
- Generalizations
 - Non-renewable energy sources take a long time to create, so the demand often exceeds the supply.
 - Renewable energy sources take a relatively short amount of time to be produced.
 - Each energy resource has both advantages and disadvantages.
- Terminology with Definitions
 - Non-renewable energy resources—sources of energy that take a long time to have been created
 - Renewable energy sources—sources of energy that take a relatively short amount of time to create.
 - Advantage—a benefit of using a specific item

- Disadvantage—a drawback of using a specific item
- Key or focus questions
 - Why are many people concerned about the continued use of non-renewable resources?
 - Why don't we use more renewable energy resources?
 - What are advantages and disadvantages of each resource?

NYS Learning Standards

Science Standards

Science within Standard 4 Physical Setting

- 4.1 b Fossil fuels contain stored solar energy and are considered nonrenewable resources. They are a major source of energy in the United States. Solar energy, wind, moving water and biomass are some examples of renewable energy resources.
- 4.1d Different forms of energy include heat, light, electrical, mechanical, sound, nuclear and chemical. Energy is transformed in many ways.
- 4.1e Energy can be considered to be either kinetic energy, which is the energy of motion, or potential energy, which depends on relative position
- 4.5b Energy can change from one form to another, although in the process some energy is always converted to heat. Some systems transform energy with less loss of heat than others.

Science within Standard 7 Living Environment

- 7.1e The environment may contain dangerous levels of substances (pollutants) that are harmful to organisms. Therefore, the good health of environments and individuals requires the monitoring of soil, air, and

water, and taking steps to keep them safe.

- 7.2d Since the Industrial Revolution, human activities have resulted in major pollution of air, water, and soil. Pollution has cumulative ecological effects such as acid rain, global warming, or ozone depletion. The survival of living things on our planet depends on the conservation and protection of Earth’s resources.

Lesson Plan

Page 3—What is Energy?

Using a Think-Pair-Share format, to brainstorm ideas about what they think energy is. Pairs can select their top idea and write it on the SMART board. Discuss these ideas before relieving the ideas on the right side of the screen.

Page 4—Energy and Your Life

Electricity is a type of energy that can occur naturally in nature—like lightning bolts. People can also make electricity. Making electricity usually requires steam. How is steam made? Water must be heated to produce steam. Fossil fuels are often used to heat water.

There are lots of energy resources that people use to heat and cool buildings. Think about your own home, or our school—what energy resources do we use?

Fuel is needed to make most of the vehicles we use today run. Most often, the fuel we put in our vehicles and equipment is made almost entirely of fossil fuels.

Page 5—

Through class discussion, brainstorm and list energy resources that we use in our daily life. Are there similarities and/or differences with some of these energy resources? Can we categorize them?

Page 6—

Today, 93% of the energy we use in the U.S. comes from non-renewable resources. Only 7% of the energy we use comes from renewable resources. Why do you think so little of our energy comes from renewable resources?

Page 7—Showing What You Know

Graphing is an important math skill developed in the later elementary years. Ask students to develop a graph to illustrate the types of energy the U.S. consumes. Draw the graph. Why did you choose the graph you did? Is it ok to use different graphs to represent the information?

Page 8—Non-renewable Energy Resources

Ask students to share what “non-renewable” means to them. Write responses on the SMART board. Then, reveal the definition given on the right side of the page.

Page 9—Non-renewable energy: Fossil Fuels

This page gives basic information on fossil fuels. If time allows, view the linked video

on fossil fuels from Bill Nye. The video is 5:44 minutes in length and discusses in detail petroleum oil drilling and coal mining.

Page 10—How Petroleum Oil & Natural Gas are Made

This slide illustrates the process by which petroleum oil and natural gas are made (the process is also discussed in some detail in bioenergy video).

If time allows: Also see the “Carbon Cycle” extension lesson in this guide.

Page 11—How Coal is Made

This slide illustrates the process by which coal is made (the process is also discussed in some detail in the bioenergy video).

If time allows: Also see the “Carbon Cycle” extension lesson in this guide.

Page 12—So What’s Wrong with Fossil Fuels

Reveal the information behind each of the four photos on this page. Fossil fuels are the most economical energy resource we have right now, but there are made concerns with using fossil fuels. What do you think is the most concerning reason for people to explore other energy resources? Why?

Page 13—Our Alternative is Renewable Energy

There are pros and cons to using alternative energy resources, and they can differ depending on each resource.

- Renewable energy comes from energy resources that can be easily replenished
- utilizes resources that are safer and cleaner for Earth & people
- utilizes resources that have multiple purposes
- needs more research, investment and practice to have expanded success

We are going to learn more about five types of renewable energy, and pros and cons of each one.

Page 14—Renewable Energy Source: Bioenergy

Bioenergy—a.k.a. biofuels or biomass, encompasses several energy resources that can be used to generate electricity, heat homes or fuel vehicles.

The linked video, “Biomass . . . Maybe” is approximately 3:30 minutes in length.

Pages 15-16—Bioenergy in the US

Share the information on each pull tab to learn how vegetable crops, animal waste, landfill gas, landfill waste and wood products can be used to generate energy.

Page 17—Environmental Impact of Bioenergy

Each resource has a different impact on the environment.

When burned bioenergy pollutes the air (by releasing carbon dioxide into it), but not as much as fossil fuels because as a bioenergy

crop is growing, it takes carbon dioxide from the air through photosynthesis.

The Environmental Protection Agency has imposed laws on waste-to-energy plants that limit the amount of pollution they can produce.

Some people are concerned that using vegetable crops will take away from food supplies and/or raise food prices.

Page 18—Renewable Energy

Resource: Hydropower

Briefly discuss the definition of hydropower. If time allows, view the linked video, “Hydroelectric Power, How it Works”, which is approximately 2:11 minutes in length.

Page 19—Hydropower in the US

Hydropower is responsible for about 67% of the renewable energy used in the U.S. in 2008. The U.S. map shows the states that use the most hydropower. What features do you think these states have that allow them to be successful in hydropower? If time allows, allow students to explore hydropower in these states.

Page 20—Environmental Impacts of Hydropower

Discuss the following environmental impacts:

- A dam to create a reservoir may obstruct migration of fish
- A reservoir or operation of the dam can change the natural water

temperatures, chemistry, flow characteristics, and silt loads, leading to changes in the ecology of the living environment

- Reservoirs may cover important natural areas, agricultural land, and archeological sites, and cause the relocation of people
- Greenhouse gases, carbon dioxide and methane, may also form in reservoirs and be emitted to the atmosphere

Page 21—Renewable Energy

Resource: Wind Power

Discuss the premise of wind power: Today’s wind turbines use blades to collect the wind’s kinetic energy and then convert it to electricity. The Earth’s daily wind cycle can be used to produce energy. Wind energy is most often used to make electricity. Why do you think wind energy is most often used renewable resource?

If time allows, view the short video, “How Wind turbines Generate Electricity”, which is approximately 1:30 minutes long.

Page 22—Wind Power in the U.S.

In only 2 years, the amount of wind power used in the U.S. doubled! Wind power provides electricity to 4.6 million people, or the entire state of Colorado! Why do you think wind power is so popular?

Lots of money and research have made the technology that creates electricity from wind more accessible, and there are lots of tax breaks for using wind turbines.

Page 23—The Environmental Impact of Wind Power

Discuss the following environmental impacts:

- wind power plants produce no air or water pollution because no fuel is burned to generate electricity
- negative effect on wild bird populations
- visual impact on the landscape
- other energy must be used at times when the wind isn't blowing strong enough

Page 24—Renewable Energy

Resource: Solar Power

The sun's heat and light can produce energy called solar power. In fact, in one minute, the Earth receives enough of the Sun's light to produce enough electricity for the entire world for one year!

If time allows, view the short video, "Facts about solar energy and solar power", which is approximately 1:15 in length.

Page 25—Solar Power in the U.S.

Discuss the information contained on the pull tabs. Why do you think certain areas of the U.S. have wider-reaching solar programs?

If time allows, research the cities the U.S. Department of Energy has indicated as Solar Cities.

Page 26—Environmental Impacts of Solar Power

Discuss the environmental impacts of solar power:

- solar power produces no air or water pollution and no greenhouse gases
- large solar thermal power plants can harm desert ecosystems if not properly managed.
- Birds and insects can be killed if they fly into a concentrated beam of sunlight
- Some solar thermal systems use hazardous fluids to transfer heat.
- Using water for regular cleaning of solar plant equipment may affect the ecosystem in some arid locations.

Page 27—Renewable Energy

Resource: Geothermal Power

Discuss the basic information on geothermal energy:

Geothermal energy is heat from within the Earth. It comes from volcanoes, hot springs and geysers. People can harness this heat as steam or hot water and use it to heat buildings or generate electricity.

If time allows, view the linked video, "Geothermal Energy Process", which is approximately 1:48 minutes in length.

Page 28-29—Geothermal Energy in the U.S.

Geothermal energy can be developed in two main ways:

1. Power plants can be built near large geysers, and that power can be used to supply power used to create electricity. These power plants harness steam to create electricity.

- Individual buildings can use geothermal heat pump systems to provide them with heat or cooling. This works as when a series of pipes buried in the shallow ground near the building circulate water in the pipes, which carries heat into a building in the winter and pulls heat out of the building in the summer.

The U.S. leads the world in generated geothermal power--.4% of the U.S.'s electric power comes from geothermal sources.

Geothermal resources are typically found near plate boundaries under the Earth's surface, where earthquakes and volcanoes are located. When magma comes close to the Earth's surface, it heats ground water that is trapped in rocks or water running along faults.

Why do you think most geothermal resources in the United States are found in the western U.S.?

If time allows, students can research the Pacific "Ring of Fire", a hotbed of geothermic activity because of the volcanic activity along the Pacific's rim.

Page 30—Environmental Impacts of Geothermal Energy

- Direct use and heating applications have almost no negative impact on the environment.
- Geothermal power plants do not burn fuel to generate electricity, so they release less than 1% of the

carbon dioxide emissions of a fossil fuel plant.

- Emit 97% less acid rain-causing compounds than by fossil fuel plants.
- Steam and water from a geothermal reservoirs are placed back into the Earth after being used.
- Laws protect the use of geothermal features in national parks.

Page 31—Renewable Energy—Past, Present and Future

There are many reasons why renewable energy is nowhere near as popular as non-renewable resources. Through class discussion, consider advantages and disadvantages of renewable energy. Does one outweigh the other? Why?

Page 32—Rank These Factors when Considering a Renewable Resource

In small groups, allow students to rank these factors as most important to least important to think about when considering an energy resource for further development and use. Why did each group choose the order they selected? Did different groups choose different orders? Is it ok to have differing opinions?

Page 33—The future is up to us!

People are using non-renewable energy faster than the Earth can create it. Without other energy resources that can be produced quickly and safely, we will run out of the resources we need to keep us warm, provide us with electricity and run our vehicles.

How can we support renewable energy and other ways to protect our environment? Why is it important? Discuss.

The next lesson in this unit, Environmental Stewardship, will continue on this idea.

Page 34—Sharing what you know

Students will be required to select one of the following three activities as an end-of-lesson assessment.

The activity will be graded using a rubric that can be used to assess participating in the entire unit. The rubric is included in this guide.

1. Construct a timeline highlighting the history of one renewable energy resources over the last 100 years. You will need to include at least 12 facts about the history of the energy resource. Include photos or illustrations of your resource's history as well.
2. President Obama has said that renewable energy should be a priority in the United States. Do you agree or disagree? Write President Obama a letter telling him a. If you agree or disagree and why; b. what renewable energy resource(s) you think the U.S. should focus their expansion efforts on and why. Remember, your letter should be persuasive while keeping in mind your audience. You must use facts about energy to back up your feelings!
3. Create a poster advertising support for one form of renewable energy. You must use graphics/illustrations, as well as brief text to persuade

viewers to support your energy resource. Your ad must have a title, a slogan and a paragraph of information synthesizing why someone should support the energy resource.

Lesson Extensions

➤ Local efforts

Are there efforts to use a renewable energy resource in your community, either in personal residences, individual businesses or the larger community? Have students interview those people behind the renewable energy push, or invite them to speak to your class. Whatever you decide to do, it's important to tie those local efforts into this lesson!

➤ Research renewable resources

Allow students to research information on renewable energy resources in small groups. How to do it:

1. Separate students in small, homogeneous groups.
2. Assign each group a non-fiction book on a specific renewable energy resource.
3. Allow students to research their energy resource and complete a graphic organizer while doing so (see attached graphic organizer)
4. Allow students to present the information on their graphic

organizer to the class, to share information on each renewable resource.

5. Students may complete graphic organizers for each resource during the oral presentations.

These books may be suitable:

Armentrout, P. & Armentrout, D. (2008).

Biofuels. Rourke Press.

Oor, T. (2007). Geothermal Energy. Cherry Lake Press.

Sherman, J. & Brick, S. (2004). Energy at Work: Hydroelectric Power. Coughlan Publishing.

Walker, N. (2006). Harnessing Power from the Sun. Crabtree Publishing Co.

Walker, N. (2006). Generating Wind Power. Crabtree Publishing Co.

Wheeler, J. (2008). Eye on Energy Fossil Fuels. ABDO Publishing.

➤ **The Carbon Cycle**

1. Learn about the carbon cycle and it's affect on the environment. Show short animated video about the carbon cycle. The video is located at: <http://www.youtube.com/watch?v=U3SZKJVKRxQ>
2. Or, discuss the steps of the carbon cycle. They can be accessed from Windows to the Universe http://www.windows.ucar.edu/tour/link=/earth/Water/co2_cycle.html
3. Talk about the problem with the carbon cycle. It's been happening for millions of years, and no one has really complained about it until relatively recently. Carbon dioxide traps heat in the atmosphere. Without it and other greenhouse gases, Earth would be a frozen world. But more humans and more human activity means that there is about 30% more carbon dioxide in the air today than there was about 150

years ago. Scientists believe that greenhouse gases like carbon dioxide contribute climate change.

4. Talk about climate change (information on climate change can be found at What is Climate Change? at <http://www.ecy.wa.gov/climatechange/whatis.htm>)
5. "Climate change" affects more than just a change in the weather, it refers to seasonal changes over a long period of time. These climate patterns play a fundamental role in shaping natural ecosystems, and the human economies and cultures that depend on them.
6. Climates are important because they are related to aspects of where and how people, plants and animals live, produce food, and use water.
7. People are paying attention to changes in climate that last over two years of more extreme climate change because it affects, people, animals, the environment and even the economy!

➤ **Your Carbon Footprint**

Students have used time in the computer lab to determine their carbon footprint at www.zerofootprintkids.com. This carbon footprint calculator is specific to children, and measures carbon footprint in relation to transportation, the food you eat, home and school, what you use and what you throw away.

After determining their carbon footprint, students can graph their carbon footprint on a bar graph drawn on a sheet of chart paper, and compare it with the other students in class.

History of energy resources

How energy is made from the resource

Name of energy resource

One sentence slogan about this resource

Advantages of this resource

- 1.
- 2.

Disadvantages of this resource

- 1.
- 2.

Interesting fact about this energy resource

Rubric for Lesson Assessment

	5	3	1	Comments
Study Guide	Study Guide is completed accurately and entirely	Study Guide is completed, but with some inaccuracies or blanks	Study Guide is completed with many inaccuracies or several blanks	
Class Discussion	Student often contributes to class discussion	Student sometimes contributes to class discussion	Student rarely contributes to class discussion	
End of Lesson Activity: Required elements	<p>Timeline includes:</p> <ul style="list-style-type: none"> ➤ 12 facts ➤ 6 graphics <p>Letter includes:</p> <ul style="list-style-type: none"> ➤ Stand on renewable energy with 3 back-up facts ➤ Explanation of which energy resource to support with 3 back-up facts <p>Poster advertisement</p> <ul style="list-style-type: none"> ➤ Graphic illustrating support ➤ Title ➤ Slogan ➤ Supporting explanation w/3 facts 	<p>Timeline includes:</p> <ul style="list-style-type: none"> ➤ 8-11 facts ➤ 3-5 graphics <p>Letter includes:</p> <ul style="list-style-type: none"> ➤ Stand on renewable energy with 1-2 back-up facts ➤ Explanation of which energy resource to support with 1-2 back-up facts <p>Poster advertisement is missing 1 of the following:</p> <ul style="list-style-type: none"> ➤ Graphic illustrating support ➤ Title ➤ Slogan • Supporting explanation 	<p>Timeline includes:</p> <ul style="list-style-type: none"> ➤ < 8 facts ➤ < 3 graphics <p>Letter includes:</p> <ul style="list-style-type: none"> ➤ Stand on renewable energy with no back-up facts ➤ Explanation of which energy resource to support with no back-up facts <p>Poster advertisement is missing two or more:</p> <ul style="list-style-type: none"> ➤ Graphic illustrating support ➤ Title ➤ Slogan • Supporting explanation 	

<p><i>End of Lesson Activity:</i> Accurate content</p>	<p>All activity content is correct:</p> <ul style="list-style-type: none"> • All information is accurate • Necessary graphics are accurate 	<p>Most activity content is correct, but:</p> <ul style="list-style-type: none"> • 1—2 facts are incorrect • Some graphics are inaccurate 	<ul style="list-style-type: none"> • 3 or more facts are incorrect • Most graphics are inaccurate 	
<p><i>End of Lesson Activity:</i> Grammar & Mechanics</p>	<ul style="list-style-type: none"> • There are no grammar or mechanic errors in activity 	<ul style="list-style-type: none"> • There are 1—4 grammar or mechanical errors in the activity 	<ul style="list-style-type: none"> • There are 5 or more grammar or mechanical errors in the activity 	

References & Resources

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Biomass? Maybe.

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Fossil Fuels with Bill Nye.

http://www.teachertube.com/viewVideo.php?video_id=77641

Geothermal Energy Process.

<http://www.youtube.com/watch?v=rFUQy86ZMpQ>

How Wind Turbines Generate Electricity.

http://www.youtube.com/watch?v=0Kx3qj_oRCc&feature=related

Hydroelectric power--how it works.

<http://www.youtube.com/watch?v=cEL7yc8R42k>

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<http://www.ecy.wa.gov/climatechange/whatis.htm>

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Resources for Students

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Amsel, S. (2007). *Everything Kids' Environment Book: Learn how You Can Help the Environment-By Getting Involved at School, at Home, or at Play.* Adams Media.

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Resources for Teachers

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