



## Lesson 8: Energy Warms Maine

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### Overview

What sources of heat are available to keep Maine homes warm? In this lesson, students are introduced to Maine residents who are asking for the students' help in recommending a home heating fuel before the upcoming winter.

### Teacher Background

Energy is continually needed to heat a home. Heat naturally “escapes” from our homes as it transfers to the surrounding cooler environment. To maintain people’s comfort and safety in winter months, heat must be continually supplied. 47%-67% of energy used in homes is used for heat. Choosing how to heat one’s home is an important decision and one that is based on a number of factors. No one fuel is the perfect choice for everyone as all solutions have benefits and drawbacks.

Maine people have been burning wood to keep themselves warm for hundreds of years. Maine is the most heavily forested state in the lower 48 states making wood abundant and accessible. Another reason wood is an attractive fuel choice for Maine people is that it is an example of a renewable resource. Renewable resources are “energy sources that can be replenished in a short period of time” (Energy Information Agency). The burning of wood, however, does have drawbacks. The type of stove used as well as the type of wood burned plays a role in how clean or polluting the burning of wood is. There are a variety of wood burning stoves that are being used by Maine homeowners. Some of these stoves burn wood more efficiently than others. The burning of wood can cause high concentrations of particulate matter in the smoke that is released into the air. This can cause respiratory and heart problems to people exposed to the wood smoke. Other environmental impacts that are a concern with wood fuel are related to wood harvesting techniques.

The majority of Maine people use heating oil to heat their homes. Oil, coal, natural gas, and propane are examples of fossil fuels and are *nonrenewable* resources. Fossil fuels were formed many millions of years ago from organisms, made up of carbon molecules, that died, decomposed, and were buried long before dinosaurs even roamed the Earth. The majority of fossil fuels were formed during the Carboniferous Period (360-286 million years ago). Carboniferous gets its name from carbon, the basic element of life and

1

fossil fuels. There is a limited amount of fossil fuels, which is why these fuels are considered *nonrenewable* resources. Nonrenewable resources are “*energy sources that we are using up and cannot recreate in a short period of time*” (Energy Information Agency). To the homeowner oil, coal, propane, and natural gas may appear to be “cleaner” sources of home heating but this is not necessarily the case. The carbon released during the burning of oil, coal, propane, and natural gas was previously trapped deep underground. By burning coal, oil, propane, and natural gas the trapped carbon is released into the atmosphere as carbon dioxide. This contributes to the problem of climate change. There are other air pollutants that come from the burning of fossil fuels such as particulate matter, sulfur dioxide, and nitrogen oxides. There are also large environmental impacts from the “harvesting” of these resources.

Electricity is also used to heat Maine homes, schools, and businesses. The use of electricity for heating has declined in recent years due to the increased costs. Unlike resources such as wood, oil, natural gas, and propane, electricity is considered a “secondary” energy resource. Electricity is created using renewable energy sources like hydro and geothermal power, tidal, solar, and wind power, and nonrenewable resources such as coal, oil, propane, and natural gas. One major fossil fuel, coal, is largely responsible for much of the electricity created and used in the United States. Some of the coal that is mined for electricity was formed 65 millions of years ago during the late Cretaceous Period while dinosaurs roamed the Earth. The burning of coal contributes large amounts of pollutants to the air that are responsible for acid rain as well as climate change. Other environmental impacts from the mining of coal from deep within the earth include mountain top mining that has destroyed many acres of mountain land, polluting both land and water.

It is estimated that in 2008, over 3000 Maine homes used solar energy (passive or active solar systems) in their homes. Passive solar design technologies make use of the sun's energy for the heating and cooling of living spaces by combining the orientation of windows for maximizing solar gain and the use of building materials that store heat for long periods of time and slowly release the heat into the home. With this approach, the building materials making up the home are designed to purposefully absorb, reflect, and transmit solar radiation. A common example is a solarium built on the southeast side of a building. Also available are active solar technologies, which convert solar energy into usable heat. This process requires the use of electrical or mechanical equipment such as pumps and fans. Active solar technologies also allow the storage of energy for future heating needs. Examples of this kind of technology include air heat collectors and radiant floor

heating systems. Air heat collectors absorb solar heat in collectors and move hot air into a building. Whereas radiant floor heating systems move water through pipes installed in floors. Photovoltaics are active solar technology devices that convert the heat energy into electricity. Energy from the sun is a renewable resource. An obstacle for home owners is that some of the equipment needed to harvest, convert, and store the sun's energy into energy that can be used for heating and electricity can be expensive to install but can save money for many years to come. Since there is no combustion this is a very clean energy source.

Alternative methods of heating our homes are being examined and are becoming popular. Technologies continue to be developed and improved for existing heating systems. Methods such as geothermal heating – collecting heat in a liquid that is moved through underground piping systems or wells and is then transferred into buildings with the use of air-to-air heat exchangers utilizing heat transfers from the Earth's interior – are gaining in popularity in Maine.

With rising fuel costs and the urgency to lower the carbon dioxide impact on the planet, Maine people are working toward finding the most energy-efficient methods to heat their homes, schools, and businesses.



## Key Ideas

- Energy in fuels used to heat our homes can be traced back to the sun.
- People use resources – both renewable and nonrenewable – to maintain and improve their existence.
- Perfectly designed solutions do not exist. All solutions have trade-offs, such as safety, cost, efficiency, aesthetics, and environmental impacts. Solutions have constraints.

## Lesson Goals

Students will:

- identify different fuels used for heating Maine homes.
- describe several factors that need to be considered when selecting a fuel for heating.
- describe the benefits and challenges of using various fuels to heat Maine homes.

## Vocabulary

**resource:** naturally occurring substances that are considered valuable.

**nonrenewable resource:** a resource such as a fossil fuel that does not replenish as part of natural ecological cycles.

**renewable resource:** a resource that replenishes itself as part of natural ecological cycles.

## Preparation

- Become familiar with the types of fuels used to heat homes in Maine. Review Student Handouts 8.2: Fuel Information Sheets and determine how many fuels students will take under consideration. To make the task more manageable, consider using the Fuel Information Sheets for Wood (Biomass), Natural Gas, Heating Oil, Electricity, and Propane or the fuels commonly used in your area and are familiar to your students. Presently these five are the most commonly used fuels for heat in Maine. If students will be doing additional research on fuels, gather appropriate resources and/or preview websites if using with students.
- Review the terminology in the Fuel Information Sheets and identify terms that may be unfamiliar to or difficult for students. Renewable, nonrenewable, efficient, rural, suburban, refined, emissions, and versatile may be words that need to be pre-taught or clarified.
- Determine how groups will be organized (self-selected or assigned small groups) to carry out the research in this lesson.

## Materials

Item	Quantity
Scientist's Notebook	1 per student
Student Handouts 8.1: Consumer Profiles Student Handout 8.2: Fuel Information Sheets Student Handout 8.3: Fuel Recommendation Guidelines and Rubric Student Handout 8.4: Consumer Profile and Fuel Information Sheet Group Discussion Guide (optional)	1 per student
Access to the internet (optional)	1 per class or student

**Time Required:** 1-2 sessions

### **Connection to *Maine Learning Results: Parameters for Essential Instruction (MLR)*, and *Benchmarks for Science Literacy (BSL)***

- Identify personal choices that can either positively or negatively impact society including population, ecosystem sustainability, personal health, and environmental quality. MLR C3(6-8) b
- Identify factors that influence the development and use of science and technology. MLR C3 (6-8) c
- Different ways of obtaining, transforming, and distributing energy have different environmental consequences. Benchmarks 8C/M2
- In many instances, manufacturing and other technological activities are performed at a site close to an energy resource. Some forms of energy are transported easily, others are not. BSL 8C/M3
- Some resources are not renewable or renew very slowly. Fuels already accumulated in the earth, for instance, will become more difficult to obtain as the most readily available resources run out. How long the resources will last, however, is difficult to predict. The ultimate limit may be the prohibitive cost of obtaining them. BSL 8C/M10\*\* (SFAA)
- By burning fuels, people are releasing large amounts of carbon dioxide into the atmosphere and transforming chemical energy into thermal energy which spreads throughout the environment. BSL 8C/M11\*\*

5



# Teaching The Lesson

## Engage

### **1** Engage students in a discussion about heat in Maine.

Review with students their current understanding about heat and use this to segue into a class discussion on the topic of heat on a much larger scale – heat use in Maine. Begin by asking students: *How does energy warm Maine? In other words, what sources of heat are available and/or are used by Maine people?*

As students respond to this question, make a class list on the board or on a piece of chart paper. During the discussion help students make the connection between various fuels and the sun. Ask students to reflect on the list and then discuss the following with students:

- *How much of the energy used in homes is used for heat?* (Almost half- anywhere from 47%-65% of the energy used in homes is used for heat.)
- *What do you think the most commonly used fuel for heat is in Maine today?* (Do not provide an answer – simply gather students' ideas. Consider asking students to suggest percentages of use for each fuel type that they suggest.)
- *What types of fuels do you think people that lived in Maine long ago (half century, century, millennium) used? Why?*
- *Do all Maine people use the same types of fuel to heat their homes? Why or why not?*

Continue the introductory exploratory conversation by asking:

- *What do you know about the types of fuels used to heat Maine homes?*
- *Where do you think these fuels come from?*
- *How do you think people decide which fuels to use?*

The purpose of this introductory discussion is to engage students in thinking about the different ways Maine people heat their homes rather than seeking out definitive answers.

6

## Explore

### 2 Introduce consumer profiles.

Arrange students in groups of 4. Provide each student with one copy of Student Handout 8.1: Consumer Profiles. Introduce the following scenario: Explain to students that the individuals described in the handout are faced with selecting a fuel to heat their homes this winter. They are new to Maine and do not know much about the fuel types available in this area. Their neighbors and the people at the town office knew that this class had been studying heat and wondered if they could help them choose. The individuals described in the handout want to make the best decision they can – deciding which fuel(s) to use to heat their homes is important!

Revisit the idea that people choose different fuels for different reasons. Discuss with students the idea that it is unlikely that one fuel will be the perfect solution for everyone, noting that individual selection is based on a number of factors, some of which they have already discussed. Ask students if there are other factors people consider when making fuel choices that haven't already been discussed.

Instruct students to “get to know” the individuals by reading the information on Student Handout 8.1. Alternately, read profiles aloud as students listen. Ask students to highlight or underline any details that they think will be important to consider when recommending a fuel for this person. Ask students to discuss at their tables some of the things they learned about the individuals, noting what they felt were the important pieces of information to keep in mind. It may be helpful for students to think about each person's needs vs. wants. Ask students to work with their group to think about fuel choice questions that they would like to ask one of the individuals described in the handouts. The purpose of the questions should be designed to aid in suggesting a fuel choice for the person described in their handout. Have students share some of their questions with the class.

**Note:** *Determine whether students will self-select the individual profile they will be focusing on or if profiles will be assigned to different groups.*

### 3 Introduce fuel information sheets.

Give each group one set of Student Handout 8.2: Fuel Information Sheets. Discuss the following with students:

- In Maine, we use different types of fuels to heat our homes. The fuel information sheets represent the most common types used in our state (as of 2008).

7

- Some fuels are readily available to consumers.
- Some fuels provide heat at a low cost; others are more expensive. Some of the fuels are renewable; others are nonrenewable. (Discuss what is meant by each of these terms, using the background teacher notes as a guide. Post these words with picture examples if possible, on the board for students to reference.)
- Some fuels affect the environment more than others.
- Some fuels are more efficient than others.

**Note:** Consider brainstorming with students what “efficient” means. Fuel efficiency is measured in complex ways. The idea here is to discuss the common usage of the word and not introduce the use of formulas to calculate efficiency.

Encourage students to divide up the fuel information sheets among their group members so that each student becomes an “expert” on one or two of the fuels. Instruct students to review the information found in their fuel handout.

**Note:** One way to adapt the activity for low and non readers is to pair students up with the fuel information sheets so that there would be two students per fuel.

There is space at the bottom of each of the information sheets for students or the teacher to add to the information about each fuel type. Students (or the teacher ahead of time) could conduct additional research about their fuel type and add it to the list on the handout. (Ex: current cost, local shortages, etc.)

Provide each student with a copy of Student Handout 8.4: Consumer Profile and Fuel Information Sheet Group Discussion Guide (optional). Students will share the information about their fuel with other group members and use the information to recommend a fuel for their individual. If there are items on the bulleted list that students do not understand, encourage them to find out more by doing additional research. The Energy Story at <http://energy-quest.ca.gov/story/chapter08.html> contains a wealth of information.

As students are discussing information in their groups, encourage them to jot down notes about the advantages and disadvantages of the different fuel choices in conjunction with the individual’s profile. Consider brainstorming and/or modeling how students might keep the information they are collecting organized. (Ex: listing pros and cons in a data chart.)

As students work, circulate among groups monitoring progress, posing questions, and supporting students as needed.

## Reflect And Discuss

### 4 Discuss recommendations.

After students have considered the consumer profiles and consulted the information about different fuel types, bring students together for a class discussion. As student groups share their recommendations ensure students support their recommendations with reasoning.

### 5 Introduce analysis task.

Explain that students will continue to work in their group to create a one-page product that clearly explains the group's recommended fuel choice for one of the individuals introduced in the student handout. Provide each student with a copy of Student Handout 8.3. For their product, students may choose to write a letter to the individual, create a graphic (ex: Venn diagram, comparison chart, etc.), or script a phone conversation that describes the recommended fuel choice as well as why the group recommends it.

Be sure to review the assignment details and scoring rubric found on the handout with students.

### 6 Reflect and bring lesson to a close.

Ask students if there are other ways people in Maine keep their homes warm that were not included as choices. As students share what they know, discuss how they think these methods are related to and/or are different from those featured in this lesson. For example, students may suggest that coal, wind, and solar power may be used to heat homes. While coal can be burned in furnaces to create heat for homes, wind and some methods of solar energy are used to generate electricity which can then be used for heat. Students may also be familiar with geothermal heating methods. Geothermal heat comes from deep within the Earth. Despite our seasonal changes in temperature, the temperature 10-30 feet below the ground remains fairly constant year round. In Maine, people typically access geothermal heat through wells. They pump the heat up from the well, concentrate it, and circulate it around their homes.

As students suggest different ways people heat their homes, help them recognize or question the “heat” connections. Consider giving students time to investigate some additional sources. The Chewonki Foundation has developed an interactive website for their poster “Pathways to a Sustainable Future” that students may find helpful in thinking about the connections between sources

9

of energy traditionally used for heat. Several types of renewable energy and their connection to heat are described: [http://www.chewonki.org/Pathways/interactive\\_poster/default.shtml](http://www.chewonki.org/Pathways/interactive_poster/default.shtml)

Ask students to find out how they heat their homes. This information will be used at the start of Lesson 9.

Bring the lesson to a close by asking students if they know what type of heat source they use in their homes. Ask students if they think the types of fuels available to Maine people will remain the same or if they think these will change and why.

## Extensions

Students may:

- visit “The Energy Story” to learn more about fossil fuels- coal, oil, and natural gas. <http://www.energyquest.ca.gov/story/chapter08.html>
- visit the Chewonki Foundation's: Pathways to a Sustainable Future Renewable Energy Poster. This interactive poster allows students to learn more about sustainable energy and includes a number of follow up activities. [http://www.chewonki.org/Pathways/interactive\\_poster/default.shtml](http://www.chewonki.org/Pathways/interactive_poster/default.shtml)
- play MEEP's Global Energy Game Balance the 3 E's: Energy, Economics and Environment, and win! (6th-adult). Downloadable gameboard and instructions available at: <http://www.maine.gov/dep/air/education/teachers.htm>
- read Energy Information Administration **Energy for Kids** Page that describes renewable and not renewable energy sources and while not specific to thermal energy includes information about energy used to heat homes. <http://www.eia.doe.gov/kids/energyfacts/>
- investigate historical weather events in Maine that students' parents, grandparents, aunts and uncles may remember. Students can interview older relatives and gather information on such weather events. Students could ask and record such questions such as, how did the weather event affect their ability to stay warm? Did they lose power? Did they have a wood burning stove and wood to burn? How did they cook and get water? Students could put together a “History Booklet” or “Hall/Wall Display Imagery” of how their relatives coped with such events.

One example of a large weather event that affected many of Maine's citizens was the Ice Storm of 1998. Many students were just babies or not yet born during what is considered to be one of Maine's most memorable ices storms in recent history. Many

people found their homes and communities without electricity for days (even weeks!) and had to rely on alternative methods to keep their homes warm. During this event, many Maine families learned the importance of having a back up heating system – one that would work in the absence of electricity. Students may find the following websites about the Ice Storm of 1998 interesting.

WMTW TV Channel 8 News Clip Ice Storm 1998 (you tube)  
<http://video.google.com/videosearch?q=ice%20storm%201998%20Maine%20news&ie=utf-8&oe=utf-8&rls=org.mozilla:en-US:official&client=firefox-a&um=1&sa=N&tab=iv#>

Kids From Maine Talk About Surviving The Ice Storm Of '98  
[http://www.fema.gov/kids/me98\\_01.htm](http://www.fema.gov/kids/me98_01.htm)

MPBN: Ice Storm Remembered.  
Audio broadcast reflecting back on experiences during 1998 Ice Storm. <http://www.mpbn.net/News/MaineNews/tabid/181/ctl/ViewItem/mid/1858/ItemId/7130/Default.aspx>

- participate in NEED's *Great Energy Debate*. Students evaluate the advantages and disadvantages of the major energy sources in an innovative debate format:  
<http://www.need.org/Guides-Grade.php>

## Connection to Maine Agencies

MEEP (Maine Energy Education Program) has a *Great Energy Debate Game (4th to 12th grade)*. What are the pros and cons of renewable versus nonrenewable resources? Do you have any preconceptions as to which energy sources is the best? In this debate, students take on the real world challenge of convincing others that one energy source is the best. A MEEP representative will come to interested schools, free of charge, to guide this activity.

MEEP also has a Coal-fired Power Plant Activity. Students learn how electricity is made in a power plant and discuss the pros and cons of using coal. They then discover alternative ways to spin a turbine to run a generator. A MEEP representative will come to interested schools, free of charge, to guide this activity. The MEEP website is <http://www.meepnews.org/classroomactivities>

For schools in Aroostook County, a Maine Public Service (MPS) representative will come to interested schools, free of charge, to guide and support concepts developed in this lesson. A description of programs is available at [www.mainepublicservice.com](http://www.mainepublicservice.com). Click on the education section of the site. To schedule a presentation contact Nancy Chandler at 207.760.2556 or [nchandler@mainepublicservice.com](mailto:nchandler@mainepublicservice.com).

## Online resources and references

Lesson adapted from NEED Project, PO Box 10101, Manassas, VA, *The Great Energy Debate Game*. <http://www.need.org/needpdf/Great%20Energy%20Debate%20Game.pdf>.

Chewonki Foundation: Pathways to a Sustainable Future Renewable Energy Poster. [http://www.chewonki.org/Pathways/interactive\\_poster/default.shtml](http://www.chewonki.org/Pathways/interactive_poster/default.shtml)

Heating fuel comparison calculator: <http://www.energymaine.com/pdf/heatfuelcomparisoncalculator.xls>

University of Maine Cooperative Extension. (Nov. 2008). Comparing Values of Various Heating Fuels. <http://www.umext.maine.edu/energy/Homeheating/comparingfuelheat.htm>

University of Maine Cooperative Extension:  
Home Heating Alternatives.  
<http://www.umext.maine.edu/energy/homeheat.htm>

StrastoSphere. (2007). *Advantages and Disadvantages of Various Fuels*. <http://chestofbooks.com/food/household/A-Manual-Of-Home-Making/Advantages-And-Disadvantages-Of-Various-Fuels.html>

Maine Solar House  
(site maintained by homeowners Bill and Debbi Lord)  
<http://www.solarhouse.com/>

Heimer Engineering:  
Heating The Heating System, Boiler, and Furnace  
[http://www.heimer.com/information/heating\\_system.html](http://www.heimer.com/information/heating_system.html)