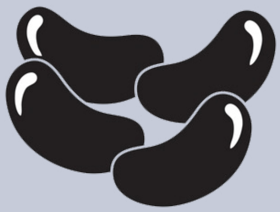


Energy Divide

Students play a competitive game to simulate consumption of energy resources and explore how energy conservation (reduction of use and waste) can help to sustain future energy supplies.

Grade Level: 5–8

Subject Areas: English Language Arts, Mathematics, Science, Social Studies

Setting: Classroom

Time:
Preparation: 30 minutes
Activity: 50 minutes

Vocabulary: Conservation, Efficiency, Finite, Nonrenewable energy resource, Renewable energy resource, Sustainability

Major Concept Areas:

- Consumption of energy resources
- Quality of life
- Management of energy resource use
- Future outlooks for the development and use of energy resources

Objectives

Students will be able to:

- explain why they might concern themselves with the needs of future energy users;
- demonstrate how conservation practices can promote the long-term availability of a resource;
- appreciate how increased population places a strain on energy resources; and
- distinguish between renewable and nonrenewable resources.

Rationale

By analyzing their response as energy consumers, students learn how consumption patterns and choice of resource affect the availability of future resources.

Materials

- Copies of ***Energy Source Illustrations*** (optional)
- Each group of students will need a container of beans, containing about 200 pieces.
- Find additional resources related to this activity on keepprogram.org > Curriculum & Resources

Background

"It's mine!"
"No! It's mine!"
"Now, kids, what have I told you about sharing?"

How many times have we heard or even participated in similar conversations? There are many things we share in life, including energy resources. When something in common is shared without consideration of other people, problems or tragedies may arise. This "Tragedy of the Commons" idea—expressed in a writing by William Forster Lloyd in 1833—was expanded by Garrett Hardin to illustrate challenges to sustaining our natural resources.

In terms of modern energy use, the "Commons" is energy resources, primarily fossil fuels such as coal, natural gas, and petroleum. The "Tragedy" is that although energy resources are developed and used for the good of society, these practices often involve inefficient use and overconsumption. These practices can lead to environmental problems and depletion of the resource. Over the past hundred years, our use of fossil fuels has increased significantly. Projections of when these fuels will run out vary from 50 to 200 years. Regardless of the depletion date used, the fact is, there is a limited amount of fossil fuels and eventually there will not be enough to meet our growing demands.

In the early 1970s, in response to increasing concern about environmental quality, government agencies such as the Department of Energy and the Department of Natural Resources launched many energy efficiency programs. There are indications that these programs have been effective. Total energy use in Wisconsin generally increased since energy tracking began in 1970. Energy use peaked in 2007 with a 53 percent increase from 1970. However, from 2007 to 2010 total energy use decreased 7 percent. These numbers do not account for the energy used to manufacture the many goods that are produced outside of the state and used here, from cars to computers. Each individual using less energy now makes more energy available for future users.

Despite these conservation efforts, there are threats to their continued success. From 1970 to 2010, energy use per person in Wisconsin increased 11 percent. Wisconsin households use 15 percent more energy than the U.S average. In 2015, Wisconsin ranked 24th lowest in the nation in per capita energy consumption. Total energy consumption per capita in the U.S. and Canada is much higher than the rest of the world. Total energy consumption per capita is 50 percent lower in Europe and 80 percent lower in China than in Wisconsin.

The increase in consumption is due to larger use of coal to generate electricity, a growing economy, increased use of air conditioning, and continued increased use of petroleum for transportation. From 1970 to 2010, the vehicle miles traveled per capita in Wisconsin increased by 85 percent. Coal, petroleum, and natural gas made up 81 percent of Wisconsin energy use in 2010. Yet because Wisconsin has no fossil fuels, these resources are imported from other states and countries.

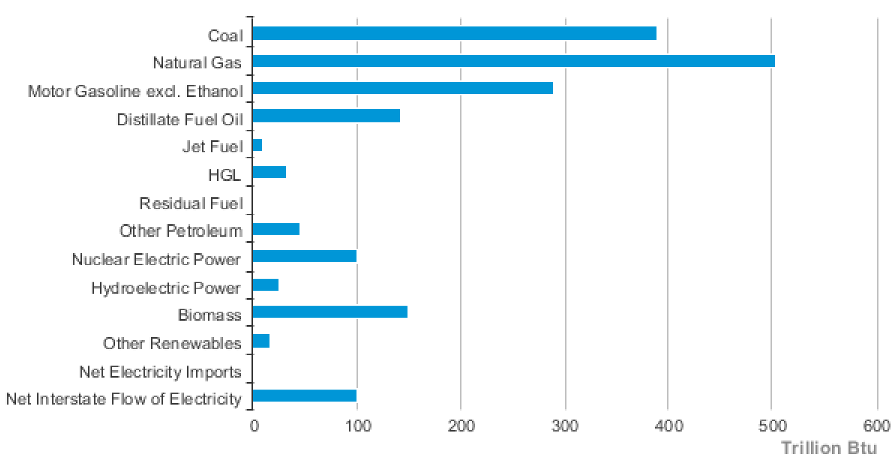
Another threat to achieving sustainable or reduced energy consumption is increasing population. In 1970, Wisconsin's population was 4,418,000. In 2016 it was 5,778,708. In the year 2040 the population is projected to be around 6,500,000, a 14% increase from 2010. Wisconsin's population growth will increase overall energy consumption and may outweigh attempts to save energy through conservation.

Since most of the energy we use in Wisconsin comes from finite resources and, despite our best efforts, the demand for these resources will continue to grow as our population increases, the need to find alternative resources is becoming more and more apparent.

Many residents and companies in Wisconsin have already begun to locate and use renewable resources as alternatives to fossil and nuclear fuels. Renewable resources are those that can be replaced relatively quickly by natural processes. Some of these resources, such as wood, can be replenished. Replenishable resources can be depleted if their rate of use exceeds their rate of replacement. Other resources, such as wind and solar, are essentially inexhaustible and will be available as long as the sun continues to shine (which it is expected to do for a few billion more years). NOTE: There are environmental impacts from using renewables as well that affect sustainability.

Wisconsin is trying to attain energy sustainability through

Wisconsin Energy Consumption Estimates, 2017



For the most recent data, go online to the U.S. Energy Information Administration Website: eia.gov/state/?sid=WI#tabs-1 the development of its renewable resources. The state legislature has established a number of energy goals, including increased energy efficiency, increased use of renewable energy, and reduction of atmospheric carbon dioxide by increasing the amount of forested land in the state. Renewable energy increased by 54 percent from 2000 to 2010 to reach 5.2 percent of total energy use in 2010. Factors contributing to this increase include Wisconsin's Renewable Portfolio Standard (RPS) which required 10 percent of all electric energy consumed in the state to be renewable energy by 2015, ethanol tax credits, state funding for renewables through Focus on Energy, and federal tax incentives.

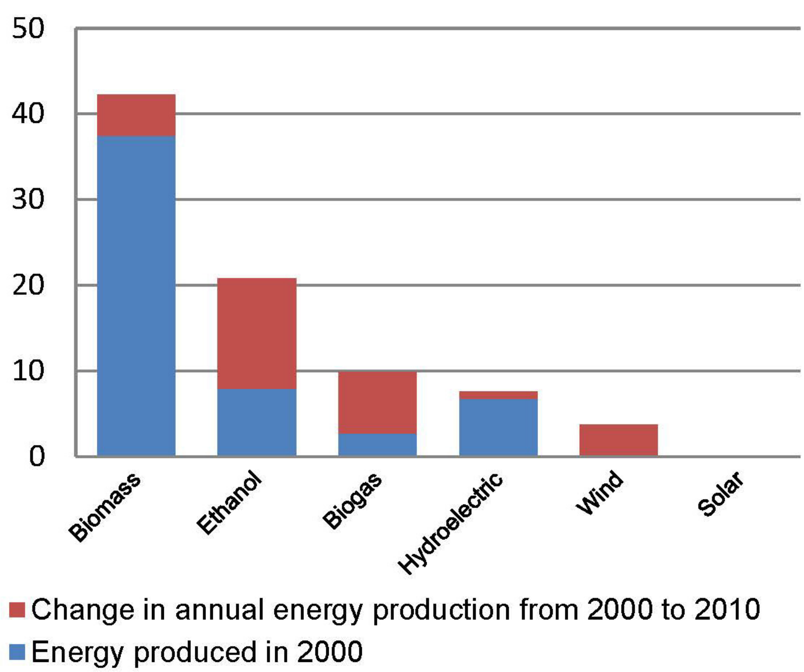
The primary renewable resource used in Wisconsin is wood. It is burned for space heating in homes and to provide energy to run industrial machinery. Other renewable resources used in Wisconsin include hydroelectric power produced from dammed rivers, biogas energy from landfills and wastewater treatment plants that have installed collection and conversion equipment, fuel derived from municipal solid waste, ethanol fuel derived from corn, active solar and wind systems. The state of Wisconsin offers incentives to help people improve energy efficiency,and convert to solar and renewable power. Solar power increased in Wisconsin in 2013 by 17%.

The amount of energy we obtain from renewables is projected to increase, but by how much varies. The chart on this page illustrates the change in annual renewable energy production from 2000 to 2010.

Both conservation practices and investments in renewable resources can help Wisconsin promote sustainable energy generation and use, and thereby avoid the tragedies of overconsuming and wasting our common energy. Modern technologies and advances have afforded most Wisconsin citizens with lifestyles our grandparents would only have dreamed of. We, in turn, need to consider how our consumptive practices will affect future energy users. Each of us should consider using energy today with the needs of tomorrow's energy users in mind.

Change in Wisconsin Annual Renewable Energy Production 2000-2010

in Trillions of BTUs (Note: 2010 solar production was 0.04.)



Source: uwsp.edu/cnr-ap/clue/Documents/megatrends/WisconsinLandUseMegatrendsEnergyIIFINAL.pdf

Procedure

Orientation

Have students list ways they use energy during a typical day. Remind them that products they use also require energy during the manufacturing process. Ask students if they have ever had problems getting enough energy to meet their needs (like running out of gasoline in a car or boat, needing wood for a fire). If any of them have experienced a power outage, have them share their feelings. Point out that, although there have been shortages, most power outages are caused by storms or technical problems.

Have students list different sources of energy. Write their responses on the board or post copies of the ***Energy Source Illustrations***. If necessary, review the different resources and what is involved in developing them for various end uses (for example, coal is mined and transported to a power plant where it is burned to generate electricity).

Steps

1. Divide the class into groups of five or six students each. Tell them they are going to be participating in an activity called "Energy Divide." Scatter a container of beans on a table or a designated spot on the floor in front of each group. NOTE: An alternative is to have one group come to the front of the class and demonstrate the game to the rest of the class.

2. Tell the class the basic rules (see ***Ground Rules for the Energy Divide***). Begin the first round, and call time after 5 seconds. Wait a few seconds and begin the second round, and so forth. Continue with all four rounds even if they run out of beans. When the last round is over, instruct the groups to return the beans.

3. Discuss the results of the game. For example, what does it mean if they ran out of beans? Request explanations for why Energy Units were used up or left over. If some Energy Units were left over, are there enough units for 20 or 40 more years of energy use?

- Have students identify the problems caused by not having enough energy. Refer students to the discussion during the **Orientation**. Point out that for the most part, people in Wisconsin have the energy they need for anything they want to do. Tell students that "Energy Divide" simulated that future users may not have enough energy if current energy use practices continue. Elicit students' opinions about why they think they should or should not be concerned about future energy users.
- Ask students about things they share with other people (a bathroom, television, pizza). Have students describe arguments or problems that may arise over sharing a common item and discuss how they resolve such issues.
- Challenge students to compare their sharing experiences to "Energy Divide." Briefly provide students with information about the "Tragedy of the Commons," helping them to identify the tragedy and the commons. Discuss why it is better to share than to hoard resources. Explain that sharing in this simulation is even more difficult because the resource—the Energy Units—represent nonrenewable energy resources. These are resources that are no longer available after one use.

4. Ask students to provide suggestions on what they would do if they were to participate in the "Energy Divide" again. Have the class develop a set of recommendations that would ensure that each member of the group had enough energy to last through the four rounds. For example, they might recommend that consumers take no more than ten Energy Units in each round.

5. Have the groups play "Energy Divide" again, incorporating their suggestions to ensure that the energy will last. If the groups worked cooperatively, at the end of each round each group member should

Ground Rules for the Energy Divide

- The beans represent Energy Units.
- Each of you in this group represents a different energy consumer (this can be a large consumer, such as a country, or small one, such as an individual or a household).
- You are not allowed to talk to each other.
- The object of the game is to obtain enough energy resource units to support your basic life or business activities. You will need a handful of Energy Units every round (every 20 years). If you get more than a handful you have an energy surplus that can go towards advanced production and consumption. If you get less than a handful, you have an energy deficit that threatens your livelihood and survival.
- You will have four 5-second rounds in which to collect energy. Each round represents 20 years of energy use. You will be notified when to start and stop each round.
- When the game begins, and during each round, you may try to collect the Energy Units you need, as many as you want, or none. If you do not get any or enough Energy Units during one round, you may participate in the next round if Energy Units are still available. If not, you cannot sustain your current living standards and must step out of the game.

have enough energy and there should be some Energy Units left over. Although at the end of the fourth round there may not be enough Energy Units for many more rounds, at least this cooperative strategy is more promising. NOTE: If any students do not work cooperatively, you can insist that they do (playing the role of a law enforcement agency) or stop the game to further explore reasons people behave the way they do. You can also discuss how our society tries to promote or force cooperation (laws, regulations, incentives).

6. Inform the students that the more cooperative version of "Energy Divide"simulated energy conservation practices. Conservation involves wise use and careful management of resources (reducing waste, using only what is needed), so that current users will have enough to meet their needs while ensuring that resources will be available for future users. Ask students to share ways they avoid wasting energy. NOTE: See **Extensions** for ways to use the "Energy Divide" to illustrate challenges with population growth and to simulate renewable energy resources.

Closure

Have students review the results of the two different ways "Energy Divide" was demonstrated. They may want to devise a chart or table to record the number of Energy Units collected by all the students during the different versions. Ask them to compare the outcome of the game when they worked cooperatively to when they were unaware of each other's intentions. Review reasons why current users of energy should care about future consumers.

If students could design the parameters for a new set of rounds, what would they suggest as the best case scenario for the game? How would they adjust the number of players, the amount of energy used, and the proportion of renewable energy to make energy supplies last longer? List each suggestion students make. If time allows, have them implement the strategies in a new version of "Energy Divide."

Have students analyze whether their proposed adjustments to the activity could be applied realistically to real-life energy use policies. Challenge students to develop a plan of how energy resources should be developed and used (see **Assessment**).

Assessment

Formative

- Were students able to relate this simulation to a "Tragedy of the Commons" (problems with sharing a common resource)?
- What are the reasons students think they should or should not be concerned about future energy consumers?
- How effective were the conservation strategies suggested by the students to help conserve the amount of Energy Units each member of the group consumed?
- Can students explain why increased population challenges even the best conservation plans?
- Are students able to provide a definition for renewable and nonrenewable resources?

Summative

Have students develop a personal energy use plan for today and for 20 years from now (an alternative is to create a plan for their own or a fictional community). Both the current and 20-year plan can include ways students will conserve energy. For the 20-year plan they should envision what energy resources (renewable and nonrenewable) they would like to see used. They can also investigate ways they can begin using renewable resources more today (lighting with sunlight vs. electricity, biking or walking vs. driving a car). Have students evaluate each other's plans, identifying things they do and do not like, providing justifications for their comments.

Have students suggest how the "Energy Divide" activity could be further adjusted to allow more people to use the same amount of energy resources. For example, appliances are becoming more efficient so they need less energy; therefore, the game could be adjusted so that each member only needs three Energy Units instead of five.

Extensions

Energy Use and Population Growth

To use "Energy Divide" to illustrate population growth, have one group begin the game, but pause at the end of the second round. Ask several students to come up and join the group. Explain that these additional students also need to get enough Energy Units. When the last two rounds are completed, ask the class what adding students to the demonstration represents. Do students think the number of people in Wisconsin 40 years from now will be the same as it is today? Inform students of Wisconsin's projected population in 2040 (6,500,00) and point out that this projection is just over 20 years away.

Energy Use and Consumption
A variation of the game is to tell students to maintain growth they need to obtain equal or greater amount of Energy Units with each round. Involve the class in discussing how the game would need to be adapted to illustrate how this is happening in today's world.

Global Energy Use
A variation of this simulation is to involve the whole class in comparing world populations and consumption. Assign students to stand in different parts of the room representing different areas of the globe; the number of students in each group will roughly symbolize the population of that continent. North America has two students, South America has three, Western Europe has three, Africa has five, Australia, Russia, and Eastern Europe have two, and the rest of the class is in Asia (ideally 23 students). Have one student from each group be responsible for obtaining the resources for his or her group. Provide these students with "energy grabbers." North America's energy grabber is a large cup. Europe, Australia, and Russia each get a medium cup. South America gets a small cup, and Africa and Asia each get a spoon. The students have 30 seconds to walk back and forth to the pile of Energy Units. Discuss the results and allotments of resources, and reasons for the differences.

Energy Reserves
The "commons" also refers to where the energy resources are located. Although Wisconsin has no fossil fuels, it gets its share as part of the United States. What would happen if this were not the case? In other words, suppose Texas suddenly decided to keep all its remaining oil and natural gas reserves for itself, or suppose Wyoming, Montana, and some of the Eastern states did the same with coal. How would Wisconsin deal with this? How would we as Wisconsinites feel about that? Have students produce a play that illustrates how they would deal with this problem.

Credits

Activity adapted from O'Connor. Maura. "The Commons Dilemma" pages 27–32 in *Living Lightly on the Planet: A Global Environmental Education Curriculum Guide for Grades 10–12, Volume II*. Milwaukee, Wisc.: Schlitz Audubon Center, n.d. Used by permission. All rights reserved.

Activity adapted from Tourtillot, Leeann. "Renew-A-Bean" pages 41–43 in Conserve and Renew: An Energy Education Guide for Grades 4–6. Rohnert Park, Calif.: California Energy Extension Service, 1990. Used by permission. All rights reserved.

Portions of the background adapted from "*Wisconsin Land Use Megatrends: Energy*" Center for Land Use Education, Board of Regents of the University of Wisconsin System, d/b/a the Division of Cooperative Extension of the University of Wisconsin-Extension, 2013. Used by permission. All rights reserved.

Related KEEP Activities

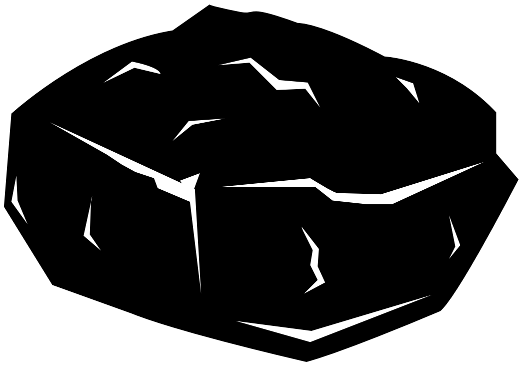
Have students use the activity "At Watt Rate?" to analyze the ways they use energy. Follow this activity by showing them ways they can conserve energy (see Action Ideas: "Energy Efficiency Measures" in the Energy Sparks section). Students can learn more about each of these resources through teaching ideas in K–5 Energy Sparks for Theme II: "Introducing Energy Resources," "Introducing Renewable and Nonrenewable Energy Resources," "Fossil Fuel Products, Sunvestigations," "Windy Wonders," and "Water Fun" and activities such as "Digging for Coal," "Get That Gasoline!" and "Harnessing Nuclear Energy." Enrich this activity with concepts found in 6–12 Energy Sparks for Theme II: "Human Population Growth and Energy Use." Use activities such as "Energy Futures" to have students envision how scenarios developed during this activity could be applied to future societies.

Energy Use and Renewable Energy
See the KEEP renewable energy education supplement Doable Renewables, activity "Renewable Candy Resources" for an alternative twist to this activity.

The Wisconsin K-12 Energy Education Program is supported through funding from

Wisconsin K-12 Energy Education Program (KEEP)
College of Natural Resources
University of Wisconsin-Stevens Point

Energy Source Illustrations

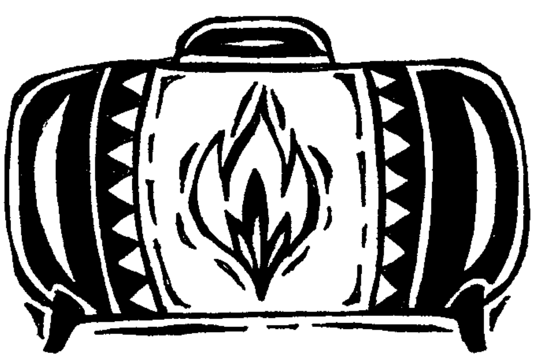


COAL

WOOD

OIL

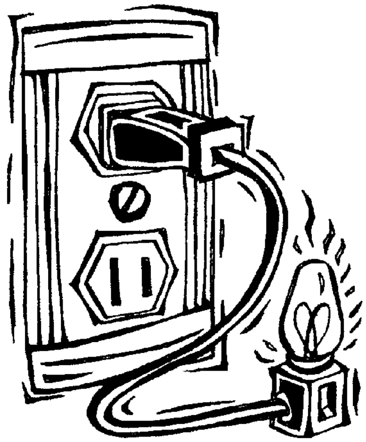
GASOLINE



PROPANE

NATURAL GAS

Energy Source Illustrations



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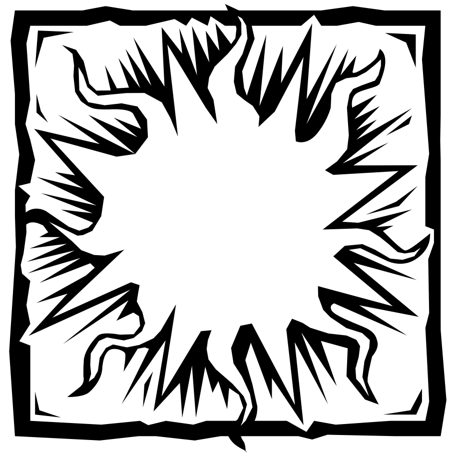

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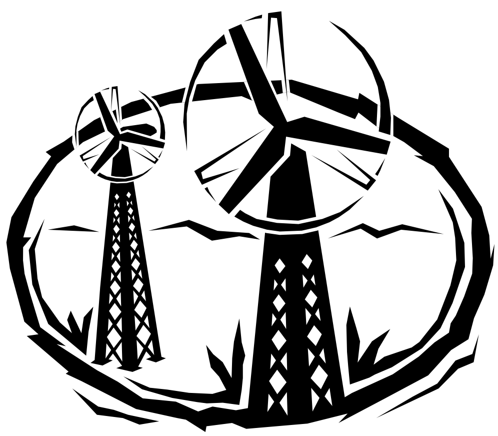
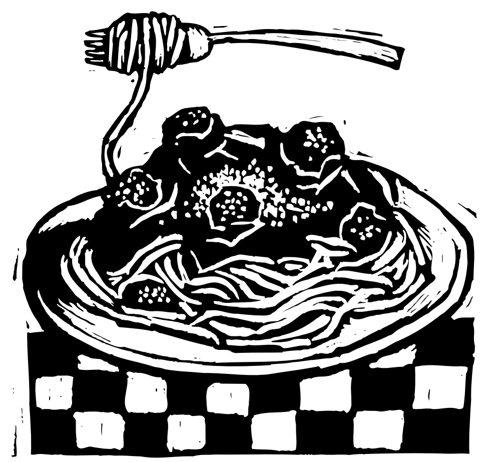


WIND

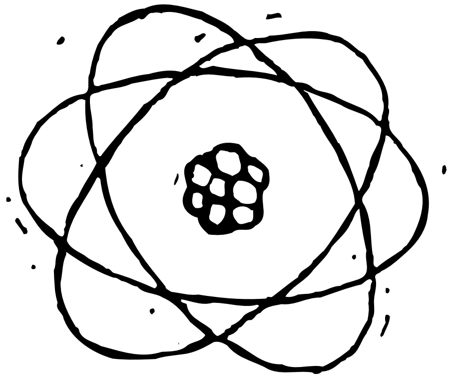


FOOD ENERGY

KEROSENE

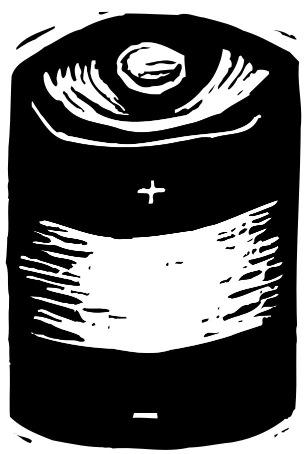
BIOMASS FUELS

Energy Source Illustrations

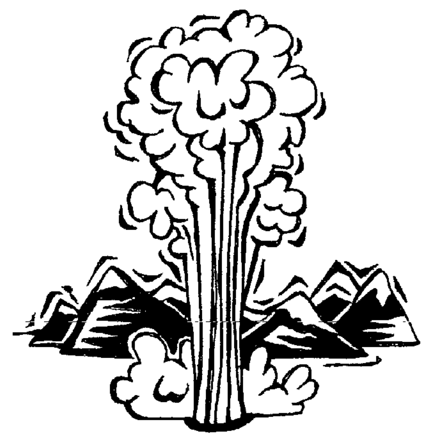


NUCLEAR ENERGY

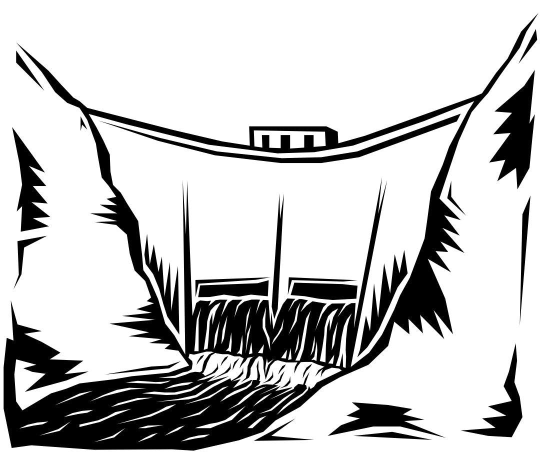
HUMAN ENERGY



BATTERY



GEOTHERMAL ENERGY



HYDROPOWER