

# Converting Fuels to Obtain Energy

When we use energy we often convert it or change it from one form to another. The energy in fossil fuels or other sources of energy is not always in the form we need. The purpose of energy conversion is to change energy resources into more usable forms.

Fuel is matter-containing energy stored in chemical form. Food, wood, and coal are all examples of fuels. Energy is packed into the chemical structure of the fuel, and we release it when we convert or change that chemical structure.

For example, food contains Calories, units of energy content. We eat food, and our bodies convert it, releasing energy in the forms of motion and heat. It is actually the energy from our food that allows us to move, and that which keeps our bodies at their normal temperature.

A similar process takes place when we burn other fuels. The chemical energy stored in them is released when they are changed or broken down by some conversion device. For example, we use a conversion device (gasoline engine, diesel engine) to change chemical energy into thermal and mechanical energy, to make a motor vehicle move.

What other energy conversion devices can be used to change energy from one form to another? What forms of energy result from these changes (conversions)? Is energy lost in making these conversions?

## Objectives

At the completion of this activity, you should be able to

- Identify several fuels
- Describe several uses for the energy obtained from fuels
- Identify devices that convert energy in fuel to some other form of energy, and
- Recognize that some energy is wasted in every fuel conversion process

## Skills and Knowledge You Need

Average reading and writing skills

Simple subtraction skills

Ability to find information in dictionaries, encyclopedias, and other references (library skills)

## Words You'll Learn

chemical energy

combustion

conversion

conversion efficiency

conversion loss

fuel

fuel cell

mechanical energy

nuclear energy

nuclear fuel

electrical energy  
electric generating plant  
energy  
energy conversion device  
fossil fuels  
fossil fuel powered electric generating plant

nuclear powered electric generating  
plant  
photosynthesis  
solar cell  
solar energy  
thermal energy

## Materials

copies of Worksheets A, B, and C  
reference books

## Procedure

1. Your teacher will introduce you to the ideas and terms on Worksheet A.
2. Look at Worksheet B. Use a dictionary, encyclopedia, and other energy reference materials to find the information necessary to complete the worksheet.
3. Look at Worksheet C. Using the reference materials, fill in the blank spaces on the chart.
4. With a partner or in a small group, list other energy conversion devices you can think of at the bottom of Worksheet C. See if you can find the required information about each of these devices to fill in the spaces on the worksheet.
5. Compare worksheets with your partners, and share information. Then see if you can answer the questions below.

## Questions

1. Is a "conversion device" the same as a machine? Why or why not?
2. Are you an energy conversion device? Where do you get your energy? What do you convert it to?
3. Does a conversion device transform all the energy in a fuel to another form of energy, or does it waste some? If some energy is lost, in what form(s) is it lost?
4. Which energy conversion device (from Worksheet C) is most efficient? Which energy conversion device is least efficient?
5. Which energy conversion devices do you yourself use? Which devices do other people operate to do things for you?
6. Are there other fuels that could be added to Worksheet B? Are there substances that are not used as fuels now that may be used as fuels in the future?
7. What conversion devices can you imagine for the future, that might use fuel more efficiently?

## Looking Back

Human beings depend on fuels. We use many kinds of energy conversion devices to get the energy from fuels and transform it into useful work.

There are two problems with using fuels. First, the supplies of some fuels are limited. If we use them up, they are gone for good. Oil, coal, and natural gas are like that, and are called nonrenewable for that reason.

The second problem with using fuels is that when we convert them to obtain usable forms of energy we always waste some of the fuel. No conversion device is 100% efficient, not even the human body. Some of the energy in fuels is not converted and remains in chemical form, and some energy is given off as waste heat. This is a problem of efficiency.

As an energy consumer, you should know when you are using nonrenewable fuels. You should also be aware of the efficiency of the conversion devices you use.

## Going Further

Figure out how to improve the efficiencies of some of the conversion devices listed on Worksheet C.

Use the library to investigate environmental effects of each conversion device listed on Worksheet C.

## Worksheet A

# A Glossary of Energy Terms

### General

energy - the ability to do work or make things move. Energy exists in a variety of forms (electrical, mechanical, gravitational, light, nuclear, chemical, heat or thermal) and can be converted from one to another. Common units for measuring energy are calories, joules, Btu, and kilowatt-hours.

### Forms of Energy

chemical energy - the energy released when substances combine or break down and form new substances.

electrical energy - energy in the form of a flow of electrons that can be produced by chemical activity in a battery, by friction, or by generators. Electrical energy can be transformed to other forms of energy such as light, heat, mechanical, or sound.

mechanical energy - energy due to the motion of an object. Example: the energy of the moving parts of an automobile engine.

nuclear energy - energy from radioactive decay or from fission or fusion reactions. In a controlled situation it can be used to produce electricity.

thermal energy - heat energy; the energy of moving particles within a solid, liquid, or gas.

### Sources of Energy

fossil fuels - coal, oil, and natural gas; this term applies to any fuels formed from the fossil remains of organic materials (plants and animals) that have been buried for millions of years.

solar energy - the radiation emitted by the sun. The earth receives this energy mostly in the forms of heat and light.

nuclear fuel - material containing atoms whose nuclei split or undergo fission, producing heat energy.

### Energy Conversion (Transformation)

conversion - the changing of a substance or the energy in it from one form to another

photosynthesis - the process by which green plants use solar energy to convert simple substances into complex ones which contain chemical energy. Carbon dioxide and water are combined, in the presence of sunlight and chlorophyll, into carbohydrates such as sugars, starches, and cellulose.

combustion - the process of burning a fuel to release heat energy

fuel - any substance that can be burned to produce heat. (With nuclear energy, a substance that undergoes fission in a chain reaction to produce heat.)

conversion loss - the amount of energy lost in the changing of one form of energy to another form. Much of this energy loss is in the form of waste heat.

energy conversion device - a machine or object that changes one form of energy to another form.

conversion efficiency - the percentage of usable energy that is left after an energy conversion.

$$\text{EFFICIENCY} = (\text{Energy output} / \text{Energy input}) \times 100$$

## **Energy Conversion Devices**

fuel cell - a device that changes the energy in fossil fuels to electricity.

fossil fuel powered electric generating plant - a building in which electricity is produced by burning fossil fuels to make steam which powers the generator.

nuclear powered electric generating plant - a building in which electricity is produced by using the heat given off by nuclear fuel in a controlled chain reaction to make steam which powers the generator.

solar cell - a device that changes sunlight to electricity

## Worksheet B Using Fuel Energy

**Directions:** Find information about the following fuels, and complete this chart.

Energy is often stored in chemical form. Here are two common forms of chemical energy.

	Definition	Example	Use	How Converted for Use
carbohydrates				
hydrocarbons				

Matter that has energy stored in it in chemical form is called fuel. Some common fuels are:

	Definition	Example	Use	How Converted for Use
food				
wood				
oil				
natural gas				
coal				

## Worksheet C Converting Fuel Energy

**Directions:** Find information about the following energy conversion devices and complete the chart.

Energy Conversion Device	Fuel Used	Average Conversion Efficiency	Conversion Loss	Forms of Energy Produced in the Conversion Processes
fuel cell	hydrocarbon, hydrogen, etc.	60%	40%	chemical -> electrical
gas furnace		80%		
oil furnace		80%		
wood stove		60%		
fireplace		14%		
diesel engine		38%		
gasoline engine		25%		
fossil fuel powered electric generating plant		40%		
nuclear fuel powered electric generating plant		30%		
solar cell		10%		

## Teacher Information

# Converting Fuels to Obtain Energy

### Suggested Grade Level and Discipline

Grades 7-9  
Science  
Technology  
Social Studies

### Skill Objectives

Using references to learn about various fuels  
Using references to obtain information about energy conversion devices

### Major Understandings

Fuel is energy stored in chemical form.  
Various devices are used to transform the energy in fuels into work.  
No energy conversion device is 100% efficient.  
Different devices have different efficiencies.  
The energy that is wasted in a conversion is usually in the form of heat.

### Background

Each American has over fifty "workers" performing energy conversion tasks every day, yet most Americans do not realize the energy required to feed these technological helpers. The more complex the society the greater its energy use per individual by these motors, engines, pumps, heaters etc.

Electricity, a commonly used form of energy, is produced by turbines and generators, which are conversion devices. These devices are powered by various sources of energy, such as fossil fuels, hydropower, wind, nuclear, etc. The electricity produced is eventually converted or changed into other end use forms of energy such as heat, light, mechanical energy, and others.

The efficiency of conversion devices is important in obtaining the best change in energy form with the least amount of undesirable "loss" in the form of heat or waste fuel. It is important to use the most efficient and effective conversion technology to do the job and thus conserve our nonrenewable energy supplies.

### Advance Planning

The instructor should do both the fuel worksheet (B) and the conversion device worksheet (C) to anticipate any possible problems in terms of reference materials.

Collect information on such energy conversion devices as automobiles, motorcycles, mopeds, school buses, etc. Ask students to research and build files on energy conversion devices.

Assemble dictionaries, pictures, and diagrams of energy conversion devices.

Reserve the library.

### **Suggested Time Allotment**

One period for introductory discussion and Worksheet A.

Two to three periods for researching the fuel terms and energy conversion devices found on Worksheets B and C.

Two periods for completing Worksheets B and C and discussing questions.

### **Suggested Approach**

Using Worksheet A, introduce the concepts of energy forms; energy use and conversion; energy sources and end uses; renewable and nonrenewable energy sources; energy conversion devices; and efficiency.

The Energy Transparency/Ditto Masters from the Energy Education Project's "Energy Options" packet may be useful. See Masters A-1, A-14, A-16, A-17, A-20, A-21, and A-22.

Show samples of various fuels.

Allow students to work as partners in doing their research and completing their worksheets.

### **Precautions**

This activity requires research, quality source material, and careful thinking. Be sure to plan for all of the above.

### **Points For Discussion**

Wise consumer use of energy means conserving fossil fuel and improving efficiency. Select an activity that uses energy and discuss the following: Is this activity really required? Can it be accomplished more efficiently? What options are there for accomplishing it? What is the total cost, including annual maintenance costs, for the different options?

Research, discuss and show examples of conversion loss. If energy cannot be created, where does it come from? If not destroyed, why are we running out of some forms?

## Typical Results

Results on the worksheets will reflect the quantity and quality of research each student cared to perform, as well as the adequacy of the reference materials.

Stress accuracy and depth of research and thought.

## Evaluation

Give a quiz on the glossary of energy terms.

Evaluate completeness and accuracy of worksheet answers.

Evaluated written answers to questions.

## Modifications

Add other conversion devices to the chart. Examples: solar collector, wind powered electric generator, solar power tower, hydropowered electric generator.

Contrast renewable and nonrenewable forms of energy on a chart which lists the end uses (such as heat, light, mechanical energy, etc.) of those forms.

Research one type of conversion in great detail, such as the conversion of electricity to heat.

Build friction loss devices. Examples: model cars for testing on inclined planes, model boats or airplanes.

## References

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