

Lesson 12: Energy

Lesson Objectives:

- Student will explore and describe a variety of energy resources.
- Student will understand the factors affecting the availability of renewable and nonrenewable resources.
- Student will understand how renewable and nonrenewable resources supply energy and materials for human use.
- Student will understand the relationship between energy efficiency, conservation and sustainability.
- Student will explore the environmental impact of extracting and harnessing both renewable and nonrenewable resources.

In previous lessons, we have briefly mentioned energy and that it is important to conserve energy. We need to address what we mean when we talk about energy, why it is important to conserve energy and look at ways that we can conserve energy in our everyday lives.

"First, there is the power of the Wind, constantly exerted over the globe.... Here is an almost incalculable power at our disposal, yet how trifling the use we make of it! It only serves to turn a few mills, blow a few vessels across the ocean, and a few trivial ends besides. What a poor compliment do we pay to our indefatigable and energetic servant!"

- Henry David Thoreau, "Paradise (To Be) Regained"

[1843] (<http://www.grinningplanet.com/6001/environmental-quotes.htm#energy>)

In this lesson we are going to:

- Identify various types of energy resources.
- Explain that renewable and nonrenewable resources supply energy and materials.
- Analyze factors affecting the availability of renewable and nonrenewable resources.

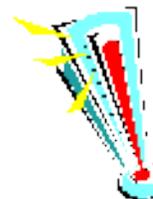


What is energy? Energy is the ability to do work and transfer heat. It comes in the form of light, heat, electricity, chemical, mechanical, and nuclear energy.

Energy is classified into two categories:

1. **Kinetic Energy** which is matter that has energy because of its mass and speed. The electromagnetic spectrum is a form of kinetic energy as wavelengths of sound, light and radiation.

Heat refers to the total kinetic energy of all moving atoms, ions, or molecules in a substance.



Temperature is a measure of the average speed of those particles.

2. Potential Energy is stored energy that has the potential to do work.

High quality energy is organized or concentrated to perform useful work.

Low-quality energy is dispersed and disorganized and has little ability to do work.

Entropy is a measure of the disorder of energy. The more disorder the less useful it is.



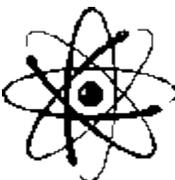


For example, the molecules in ice are more orderly and have lower entropy than steam that requires more energy to obtain a highly dispersed state.



Physical Change results in a change of shape, size, form, etc. without alteration chemically. Eggs, milk, butter and flour are just a mixture.

A **chemical change** means that chemical reactions have altered the composition of mixtures or compounds. With the addition of heat, the batter is changed into a cake.



Nuclear Change means that the nuclei of certain isotopes change into one or more different isotopes.

Radioactive Decay is a type of nuclear change where unstable isotopes are emitted as fast-moving or high-energy radiation or both.

Radioisotopes can be used to estimate the age of carbon containing matter, as tracers for pollution detection, agriculture, industry and medicine.



Energy Sources

Energy can also be divided as renewable and nonrenewable energy sources.

Renewable energy is potentially sustainable because it can last indefinitely without reducing the original supply. It can be replenished through natural processes in a manner that is quicker than depletion. It is NOT reusing or recycling energy. Renewable energy sources are:

1. Solar

The sun is ultimately the source of energy for all living things on Earth. It provides a free, one-way source of high-quality power. Using photovoltaic cells, solar radiation can be directly converted into electrical energy.

There are two types of solar power:

A. Passive Solar Heating System This method captures sunlight directly within a structure and converts it into low temperature heat for space heating. Passive solar can provide 70% of residential and 60% of commercial needs.

B. Active Solar Heating This method absorbs solar energy and fans or pumps it into a building's space heating. Currently it is too expensive for homes because of the cost of construction materials and maintenance.

2. Water

Dams control the flow of water to turn turbines and produce electricity. Currently, hydroelectric power supplies about 20% of the world's energy. Norway uses hydroelectric for 95% of its energy needs, and Canada uses it for 70% of its power.

However, dams are expensive to build as well as maintain. They alter the environment and involve some risks of collapse.

Tidal energy facilities, like those in France and the Bay of Fundy, Nova Scotia use the flow of the tides to produce electricity. This provides only a tiny contribution to their energy needs because of the expense and limited locations.

3. Wind

Farms in California, Denmark and Germany harness the potential of wind to generate electricity. Wind farms may supply about 10% of the electricity needs in the future. India is already expanding its use of wind power. The land used for wind farms can also support agriculture, but the blades may be harmful to migrating birds.



Wind power is competitive with coal and is much easier on the land. It could become the world's cheapest ways to produce electricity.

4. Biomass

This refers to the burning of organic material such as wood, manure or plant fibers. Roughly 50% of the world's population, especially in developing countries, is using biomass for energy. However, Sweden is the world leader in biomass consumption.

It is renewable as long as trees are not harvested faster than they are planted. It is destructive to the land because deforestation promotes soil erosion and wildlife decline. Open fires waste energy.

Biomass can be converted by bacteria into gaseous and liquid fuels called Biogas. Some examples of Biogas are mixtures of methane and carbon dioxide, liquid ethanol and liquid methanol.

5. Geothermal

The process of transferring heat from underground concentrations of steam to heat space, water and sometimes produce electricity. The disadvantage is that water can be depleted if removed faster than it is renewed. About 20 countries are extracting energy from geothermal sites.

Geothermal is available everywhere if you can drill deep enough, but access is difficult and expensive. It also causes environmental degradation.

Nonrenewable energy sources are those that we are using and cannot replace once they are all used up. Most of our energy comes from nonrenewable energy sources such as oil, natural gas and coal. These are also known as fossil fuels, which contain chemical energy. As we have discussed in previous lessons, as the population continues to grow, the use of resources increases leading to concerns for sustainability.

Saudi Arabia is a leading partner of the 13 countries who make up the **Organization of Petroleum Exporting Countries (OPEC)**. They control 67% of the world's oil reserves.

By contrast, the U.S. has only 2% of the world's supply but uses 30% of the world's oil - mostly for transportation. World reserves may not last more than 80 years, and petroleum dependence increases political vulnerability.

Natural Gas is the best of the fossil fuels because it can be transported easily, has a high net energy yield, produces less air pollution than other fossil fuels, has less heat-trapping carbon dioxide, causes less environmental damage, is



easy to process, and can be burned in cogeneration power plants or used in highly efficient fuel cells.

Natural gas is a mixture of methane and heavier gaseous hydrocarbons such as ethane, propane, butane and toxic hydrogen sulfide.

Russia and Kazakhstan have 40% of the world's natural gas reserves. Most of the natural gas used in the U.S. is produced domestically.

Coal is the world's most abundant and dirtiest fossil fuel. Negative impacts include the environmental damage caused from mining, transporting, storing and burning it. However, new technology has made burning coal much cleaner than in the past. Coal provides about 25% of the world's commercial energy. Most of the reserves are located in the U.S., the former Soviet Union and China.

Nuclear plants have not been built in the U.S. or Japan since 1979. Although, France gets 80% of its power by nuclear, but it is heavily subsidized by the government.

Nuclear fission creates deadly radioactive waste products that have resulted in 45,000 contaminated sites in the U.S. It creates severe operating and economic problems. ***A major accident anywhere is a nuclear accident everywhere.***

What Are the Laws of Energy?



Law of Conservation of Energy also known as the **First Law of Thermodynamics** states that energy cannot be created or destroyed, but it can be changed in form.

This does not apply to nuclear reactions because they convert mass into energy, but the total amount of matter and energy remains constant.

So why do we need to worry about shortages of resources? Well, this answer comes from the **Second Law of Thermodynamics**. It says that when energy is changed from one form to another some of the useful energy is always degraded to lower quality energy.



It takes energy to produce energy. Net energy yield is the amount of usable energy remaining after the production cost is subtracted. The higher the ratio between input cost and output cost, the greater the net energy yield.



For example, if it cost \$8 to produce one unit of energy, but that yields \$10 worth of high quality energy, the net energy yield is a ratio of $10/8 = 1.2$ net yield.

Efficiency is the percentage of total energy input that does the useful work. It also means that less energy is required to perform the same function.

Energy-efficient lighting and appliances may cost more to purchase but will save more money in lower energy costs.



The most inefficient and expensive way to heat is with electricity, and yet that is the most common way in the U.S.

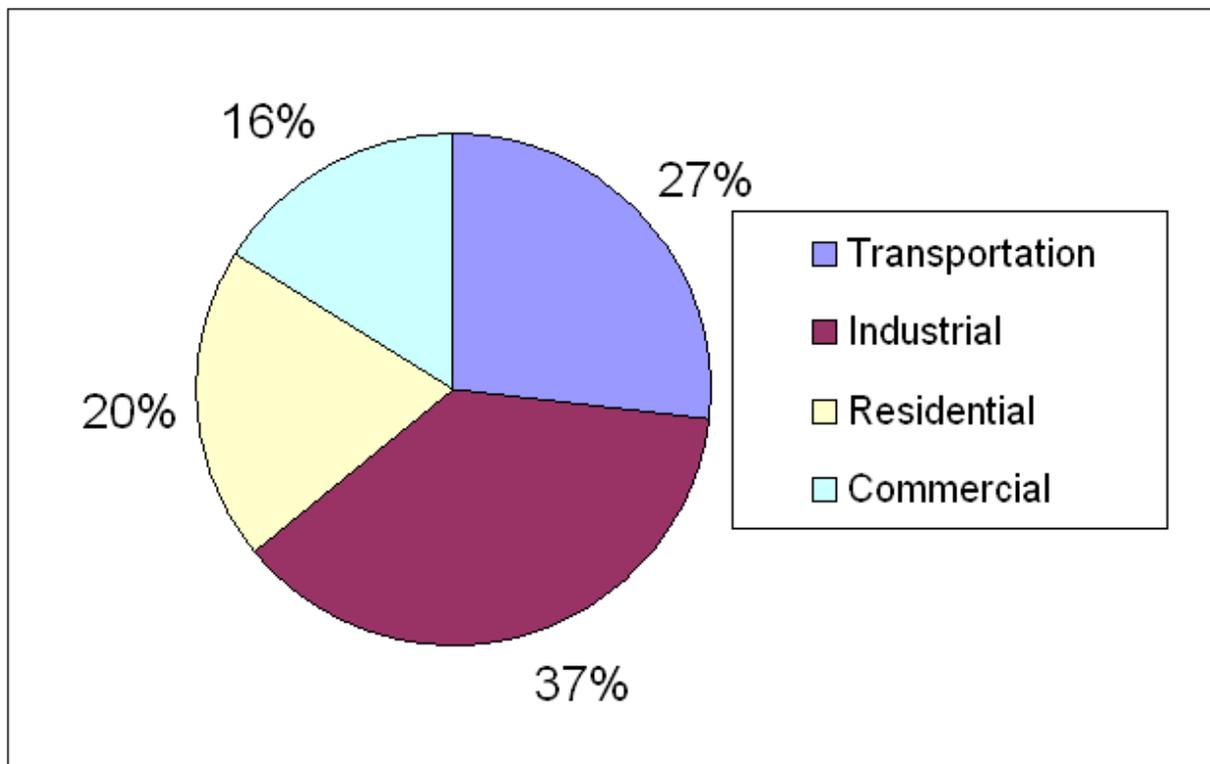
In the United States alone, we consume one fourth of the world's energy resources. The U.S. Department of Energy divides energy usage into the following categories:

37% Industrial

27% Transportation

20% Residential

16% Commercial



There are two basic principles of sustainability that apply to energy:

1. Use renewable energy
2. Recycle nutrients and other resources efficiently and return the resources in good conditions so that they can be reused.

The idea is not to convert a renewable resource, such as water, into such a polluted state that it becomes useless. Remember, that efficiency and conservation are two very important key elements in energy sustainability.

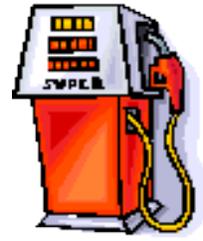


Other Ways to Save Energy (and Money)



1. Cogeneration uses two useful forms of energy from the same fuel source.
2. Negawatt revolution reduces the demand on utilities by giving customers rebates for buying efficient lights and appliances.
3. Provide low interest loans to industry and individuals for repairing and upgrading equipment.

4. The most important way to save energy is to increase the fuel efficiency of motor vehicles.



5. Super-insulated buildings, such as straw-bale houses, save energy and money.

6. Look for energy efficient ways to heat houses and water, plug heat and AC leaks and use thermal pane windows.

Remember the 3R's...

We use energy everyday, however, we need to learn how to make wiser choices about how we use energy. These simple steps can help to save energy, resources, money and the environment.

Reduce - purchase fewer goods.

Reuse - buy things that you can use over and over.

Recycle - take the time to recycle as many products as you can.

DID YOU KNOW?

If you recycle one glass bottle, it saves enough energy to light a light bulb for four hours.

We throw enough wood and paper away that could be used to heat 50 million homes for the next twenty years.

Recycling aluminum cans consumes 90% less energy than it takes to make new aluminum cans.

(<http://www.planetpals.com/fastfacts.html>)



Grading Rubric:

Your grade will be calculated by the sum of the points earned for each question. Points are earned according to the chart below.

To get a 10: A total score of 10 on your first submission or within your first revisions.

To get a 9: A total score of 9 or more after your first revision.

To get an 8: A total score of 8 or more after your first revision.

To get a 7: A total score of 7 or more after your first revision.

To get a 6: A total score of 6 or more after your first revision.

To get a 5: Any score lower than a 6 on the third revision. Lesson requirements have **not** been met. Plagiarism - purposeful or mistaken, will lower your final grade for the course (So, be very careful when posting your work!)

Short Answer (Total of 10 Points)	Answer is accurate, and complete. No facts are omitted, or in error. All required points and topics are addressed. There are no grammatical or spelling errors. 1 point each	Required points, and topics are addressed. Answer contains 1 factual error, and/or omissions. May have 1 grammatical or spelling error. .5 point each	More than 1 factual errors, and/or omissions. More than 1 grammatical or spelling error. 0 points each
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Assignment:

Do not submit text that you have copied from sources, including websites. All of your work should be in your own words. Using copied text would be considered plagiarism. For more information, review our page on [Plagiarism and Citation](#)

You are to answer the following questions in your own words. Please post the questions with your answers in the text box below to submit



your work. Remember to use complete sentences, use proper grammar, and don't forget to proofread and spell check your work before submitting it. This may require additional internet research, so be sure to cite your sources.

1. Based on the energy usage categories, provide examples of energy sources for each of these categories.
2. Explain how renewable and non-renewable sources supply energy. Provide specific examples.
3. What are some examples of ways to make your house more energy efficient?
4. Discuss solar energy as an energy source and its benefits.
5. Discuss the use of renewable energy sources and why they cause less pollution.
6. Identify and briefly discuss five examples of how you can conserve energy.
7. What are some alternative sources of energy? Explain how they can be used.
8. Many energy conservation programs have been developed. Do some research to learn more about existing programs. Select one that interests you and write about what you learned.
9. Visit the U.S. Department of Energy - Energy Efficiency and Renewable Energy's website <http://www.eere.energy.gov/>. Read about one of their programs and write about what you learned.
10. In your opinion, what is the most important thing that you can do to conserve energy? Support your answer.

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