Energy is all around us

We use energy every day. It surrounds us in different forms, such as light, heat, and electricity. Our bodies use the energy stored in molecules of substances like carbohydrates and protein to move, breathe, grow, and think. We also use energy to do work and to play. Humans have invented thousands of machines and appliances that use energy to make our work easier, to heat our homes, and to get ourselves from place to place. Some of these machines use electricity, while others, like automobiles, use the energy stored in substances such as gasoline.

The two most common forms of energy we use are heat and electricity. Heat is the energy of moving particles in any substance. The faster the particles move, the warmer the substance is. Electricity is the energy of electrons moving along a conductor like a copper electrical wire.

Most of the machines around us use either heat or electricity to do their work. A good example is an electric clothes dryer. The dryer uses an electric motor to turn the drum that tumbles the clothes inside. The same motor also turns a fan that blows air through the clothes as they tumble. Lastly, a heating element creates large amounts of heat, which is used to dry the clothes more quickly.

A bolt of lightning is a visible example of several forms of energy: electricity, heat, light, and sound.

Photo courtesy of NOAA

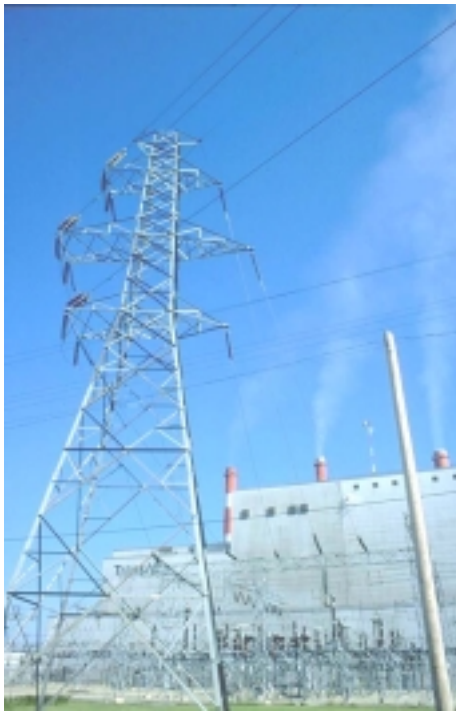
Besides heat and electricity, we use many other forms of energy every day of our lives. The list below summarizes some of the more common forms of energy and how they are generated and where they are often used.

Energy is easily converted from one form to another. This is an important and very useful property, because we rarely produce energy using the same device, or in the same form as what is needed for the task at hand. Since energy is often produced at some distance

Form of energy	What is it?	How is it generated?	Where or how is it used?
Heat	The energy of moving particles (atoms and molecules) of liquid, gas, or solid matter	• by burning fuels such as oil, natural gas, gasoline or diesel • by solar radiation coming from the sun, which warms the air, water, and ground • from nuclear energy • by the Earth's core, which can provide usable heat from ground sources (e.g., hot springs) • from electricity passing through a heating element	• heating air and water in homes and offices • melting and shaping materials such as metal and plastic • cooking • transportation (e.g., combustion engines)
Light	Radiant energy, in the form of photons	• by the sun • using fluorescent and incandescent light bulbs • from light-emitting diodes • lasers • by burning fuels such as wood (biomass) and natural gas	• illuminating working and living spaces • laser surgery • communication and advertising, such as illuminated signs • data transmission, for example on fiber-optic networks

Form of energy	What is it?	How is it generated?	Where or how is it used?
Electricity	Energy of electrons moving through a conductor	• by photovoltaic panels • by alternator or dynamo generators • from batteries • using hydrogen fuel cells • from friction (static electricity)	• turning motors • generating heat • running computers • communication systems and data transmission
Radio waves	Electro-magnetic energy	• by radio transmitters • microwave emitters	• cooking in microwave ovens • voice communication (e.g,. radio, TV, cell phones) • radar navigation
Mechanical	The force of moving objects	• falling water at hydro-electricity facilities • motors • springs and elastic bands	• automobiles, aircraft, other forms of transportation • many home appliances and tools • generating electricity
Sound	Vibrations passing through gaseous, liquid, or solid matter (such as air, water and soil)	• using speakers • by vibrating surfaces	• musical instruments • sonar navigation • communication

from its end use, we also need to transmit it from its source location to where it is needed. This is done by means of wires in the case of electricity, or pipelines or tank trucks in the case of oil or natural gas. Not all forms of energy can be easily stored or transported. For instance, light is impossible to store directly. It has to be converted to some other form, such as chemical energy first.



Electricity is produced at large power generating stations and carried to customers over long distances by a system of overhead power lines.

Non-renewable versus renewable energy

Non-renewable Energy

Much of our energy supply comes from coal, oil, natural gas, or radioactive elements. They are considered non-renewable because once they are removed from the ground and used, they are not immediately replaced. In fact, the world's natural gas, crude oil and coal deposits took millions of years to form.

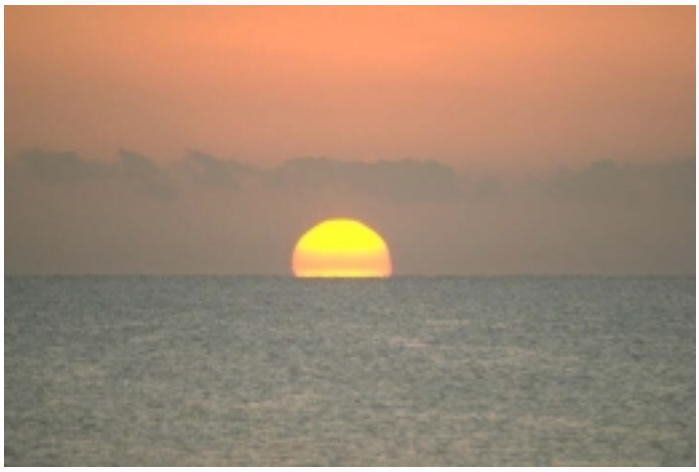
Once gas or oil is taken from the earth and used, it cannot be replaced.

Uranium, which is used for nuclear energy, has limited supply as well. Humans will have used up most of these deposits in less than 200 years. Once they are gone, non-renewable energy supplies cannot be replaced within human time scales.

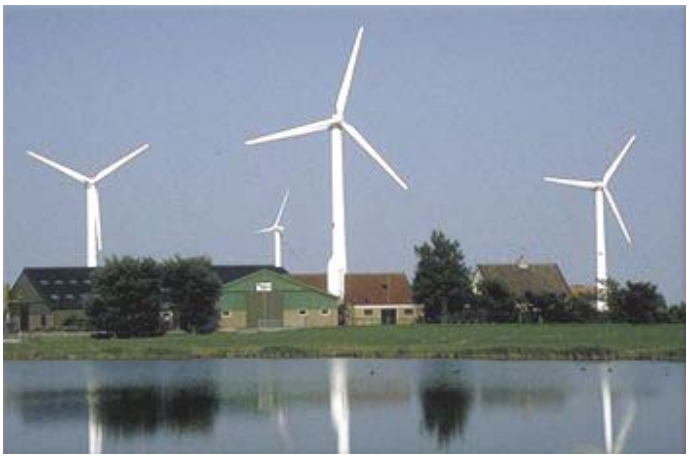
Renewable Energy

Renewable energy on the other hand quickly replaces itself and is usually available in a never-ending supply. Renewable energy comes from the natural flow of sunlight, wind, or water around the Earth. With the help of special collectors, we can capture some of this energy and put it to use in our homes and businesses. As long as sunlight, water and wind continue to flow and trees and other plants continue to grow, we have access to a ready of supply of energy.

Solar energy is being used to generate useful amounts of heat and electricity around the world.
Photo courtesy of DOE/NREL



The sun is a never-ending supply of free energy.



Wind energy is proving to be an economical way to make electricity. *Photo courtesy of Jim Hamm Productions*

Kinds of Renewable Energy

Solar energy

For billions of years, the sun has poured out huge amounts of energy in several forms, including light, heat, radio waves, and even x-rays. The Earth, in orbit around the sun, intercepts a very small part of the sun's immense output. On Earth, direct sunlight is available from sunrise until sunset, except during solar eclipses. Solar collectors and modules are designed to capture some of the sun's energy and change it from radiation into more usable forms such as heat or electricity. In fact, sunlight is an excellent source of heat and electricity, the two most important forms of energy we consume. Solar energy is becoming increasingly popular for remote power needs such as telecommunication towers, agricultural applications (irrigation and pasture management), in tropical countries that are not connected to an electrical grid, for heating swimming pools, and many other applications around the world.

Wind energy

Wind energy is really just another form of solar energy. Sunlight falling on oceans and continents causes air to warm and rise, which in turn generates surface winds. The wind has been used by humans for thousands of years, first to carry ships across

oceans and, later, to pump water and grind grain. More recently, wind has been harnessed as a clean, safe source of electricity.

Biomass energy

The term “biomass” refers to any form of plant or animal tissue. In the energy industry, biomass refers to wood, straw, biological waste products such as manure, and other natural materials that contain stored energy. The energy stored in biomass can be released by burning the material directly, or by feeding it to micro-organisms that use it to make biogas, a form of natural gas. Energy from biomass is still used around the world, for everything from cooking and heating to generating electricity.

Moving water

Humans have used water power to supply energy for almost as long as we’ve used wind. Archaeologists have discovered descriptions of water wheels used for grinding grain that date back to more than 3,000 years ago. Today, the energy of falling water is used mainly to drive electrical generators at hydroelectric dams. As long as snow and rainfall can fill the streams and rivers, moving water can be a renewable source of energy.

Canada generated 61% of its electricity supply from hydroelectricity in 1999, mostly from facilities with large dams. Large-scale hydro developments are common in Canada, especially in British Columbia, Manitoba, Ontario, Québec, and Newfoundland. Hydroelectric generation does not produce significant greenhouse gas emissions, but does have other major environmental impacts. The reservoirs often destroy vast areas of highly productive forest and wildlife habitat. The dams also damage freshwater ecosystems by blocking the movement of fish and other organisms. Pollution from mercury and other contaminants is a problem in many reservoirs in northern Canada. While large hydro projects are considered a source of renewable energy, they may not be sustainable in the long run because of their impact on the environment.

This hybrid biogigester in Cambodia, uses pig dung as an energy source.

Photo courtesy of Royal University of Agriculture of Cambodia

Why is renewable energy important today?

Energy Price Stability

In the last three years, we have seen large fluctuations in the cost of natural gas, oil, and electricity due to global economics, market deregulation, and political events in some parts of the world. Renewable energy is not subject to sharp price changes because it comes from sources such as sunshine, flowing water, wind, and biological waste, all of which are free. This gives people greater certainty about the cost of energy, which is good for society and the economy. By comparison, fossil fuels are limited in their supply, and their price will increase as they become scarcer.

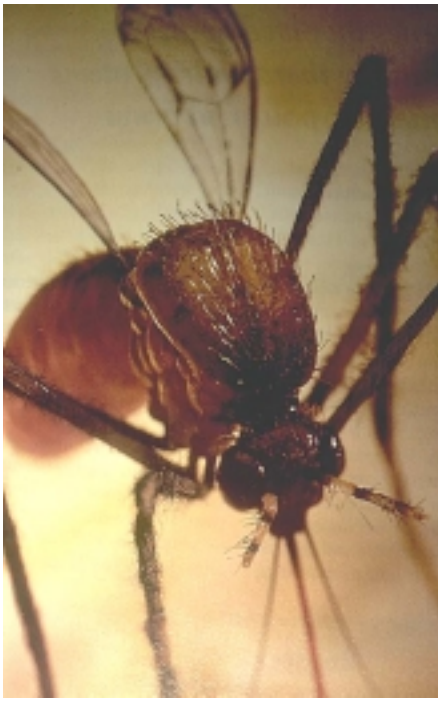
Clean Air

Air pollution is a major problem in many cities in Canada and around the world. The biggest cause of air pollution in cities is the burning of fossil fuels, including fuels used for transportation. The Canadian federal government estimates that more than 16,000 Canadians die prematurely each year from diseases caused by air pollution. Thousands more suffer from long-term sicknesses and disabilities. The great advantage of using renewable energy in place of fossil fuels is that renewable energy adds very few pollutants to the environment. Renewable energy is considered "clean" and "green."

This large exhaust stack emits harmful gases into our atmosphere every day.

Protecting Global Climates

When fossil fuels are burned, they release carbon dioxide. This gas acts like an invisible blanket, trapping more of the sun's energy in the atmosphere, causing the Earth to warm up little by little. Carbon dioxide is building up in the atmosphere as more and more fossil fuels are used in homes, factories, and automobiles. If this continues, most scientists think our planet is likely to become significantly warmer, which could cause many serious problems around the world. These problems could include melting of arctic ice, increased forest fires, rising sea levels, loss of animal habitat, damage to coral reefs, the spreading of tropical diseases, expanding deserts, and more frequent and severe storms.



Climate change may cause the world-wide spread of diseases such as malaria, which is carried by mosquitoes.

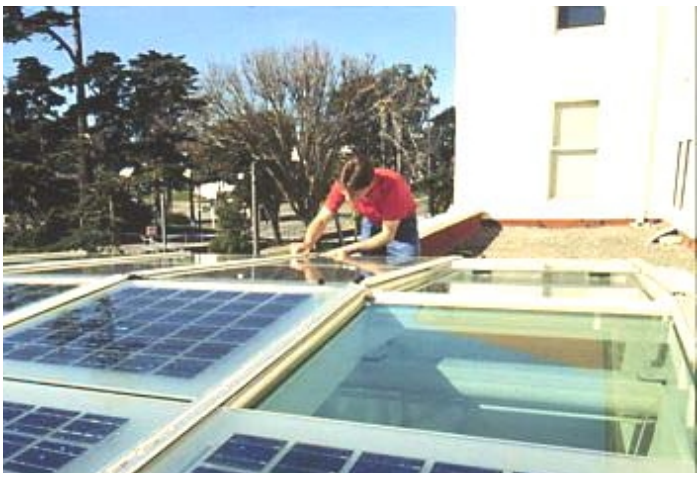
Protecting Landscapes and Watersheds

Some energy projects, particularly big coalmines, hydro dams, and oil and gas activities, can have a large impact on lands and watersheds. Damage or loss of natural lands and watersheds is likely to affect humans and animals. For example, wilderness areas could be lost for when energy resources are extracted. Hydro dams can flood large areas, while the facilities associated with oil and gas and oilsands development can affect forests and disrupt animal movements and migrations. On the other hand, solar energy can provide a continuous supply of energy, which is integrated directly into buildings so that it has very little impact on land use. Run-of-river hydro plants can be designed to allow for free flow of existing streams.

Unlimited Supplies

Renewable energy supplies will never run out. While the supplies of coal, oil, and natural gas are limited, sunshine, wind, biomass, and water power are considered almost limitless resources. Canada's coal supply is expected to last 200 years, and natural gas about 100 years. Our large, untapped supplies of wind, sun,

water, and biomass can power our society indefinitely.



Renewable energy such as this rooftop photovoltaic panel can save the owner a lot of money over time.

Photo courtesy of Australian Cooperative Research Center for Renewable Energy

Jobs and the Economy

Renewable energy can be developed in such a way that every household or neighbourhood could have its own renewable power generating equipment. This would create many new jobs for people involved in setting up and maintaining this energy supply, and in manufacturing the equipment. It is also more efficient to produce renewable energy in small amounts right where it is needed. The energy losses and equipment needed to transmit power over long distances can also be minimized in this way.

Endnotes:

i Canadian Electricity Association. *Electric Power in Canada* 1998-99.

ii Environment Canada. "Canada's response to the U.S. EPA Proposal on Transboundary Air Pollution," Government of Canada, 16 March 1998.

Questions

1. Give some examples of non-renewable energy. Describe why they are considered non-renewable.

2. Give several examples of renewable energy. Why are they considered "renewable"?

3. What are some of the advantages of renewable energy over non-renewable energy?

4. Can you describe any examples of how renewable energy is being used in your region?

Contact us at: info@greenlearning.ca

Notes: