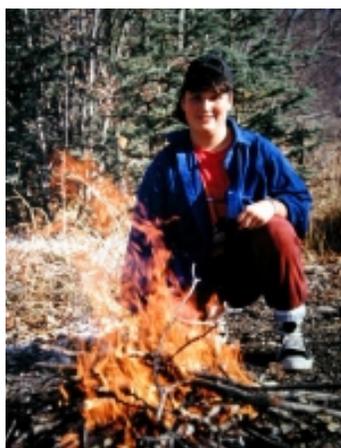


## What is Bioenergy?

**B**ioenergy is energy stored in materials made with the help of living things. An everyday example of bioenergy is wood heat. Wood is produced by growing trees, and contains highly flammable substances. Wood heat is probably humanity's oldest energy source. Other sources of bioenergy include alcohol and biogas. Alcohol is a flammable liquid made by certain yeasts, and biogas is



Wood is a source of renewable energy.

a flammable gas similar to natural gas, made by bacteria.

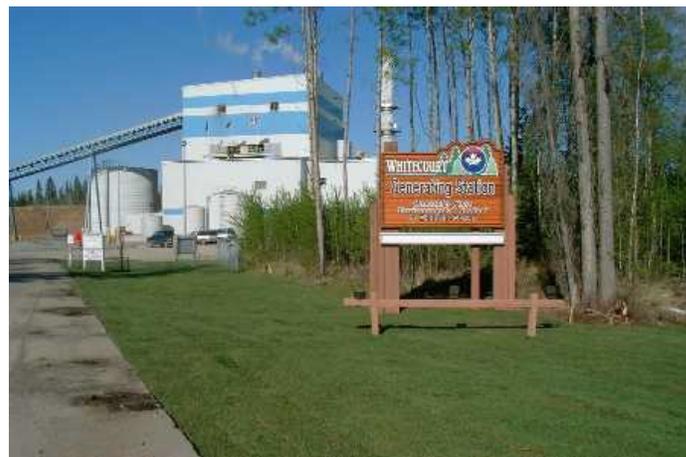
The difference between getting fuel from living things such as trees and getting it from something like coal or oil is that bioenergy is renewable. Although fossil fuels were formed by organisms that lived eons ago, it takes so long to replace fossil fuels

(millions of years) that for practical purposes, they are considered non-renewable. Peat (a brown or black material found in bogs) is another resource that is not easily replaced, taking hundreds of thousands of years to renew itself. To be considered renewable, the resources must be replaceable within our lifespan. For example, the wood used in your campfire replaces itself as the forest grows. Coal on the other hand can be taken from the earth only once, and cannot be replaced. If a forest is managed properly, it will provide wood forever. It is the same with other forms of bioenergy, including biogas and alcohols.

### Fibre Fuel

Most green plants have large amounts of a stiff material called cellulose. Cellulose is one of the main ingredients in wood, and is extracted for use in papermaking. Green plants manufacture cellulose

from sugars, which they make during photosynthesis. Because cellulose is made from sugar, it contains a lot of stored chemical energy, energy that originally came from the sun. This chemical energy can be released as heat when wood is burned.



This generating station in Canada burns biomass fuel from nearby sawmills to produce energy.

*Photo courtesy of EPCOR*

Wood has been used as a fuel far longer than any fossil fuel. In some countries, wood is still the main fuel for heating and cooking. In places where wood is scarce, other forms of plant fibre are burned. Grass, peat, and even cow manure can be used as a fuel, but these materials make very smoky fires!

As long as these materials are allowed to grow back as soon as they are used, they are considered a source of renewable energy. However, if too much wood is harvested too rapidly or in a way that damages the soil or other parts of the ecosystem, severe environmental problems can result.

### Ethanol and Methanol

Ethanol and methanol are alcohols and are highly flammable. They can be made from plant sugars or plant fibres. Alcohol is produced by feeding plant materials into large heated tanks called digesters. Inside the tanks, chemicals or yeasts are added to change the plant materials into alcohol. The alcohol is extracted, purified, and prepared for use as a fuel.



Both ethanol and methanol make excellent fuels for cars and trucks. In fact, ethanol is used in the engines of Formula 1 racing cars. It burns very cleanly, and delivers more power than gasoline. Many service stations now sell fuels that contain a blend of gasoline and an alcohol, usually ethanol.



Ethanol and methanol can be made from plant materials such as corn, at refineries like this one.

*Photo courtesy of DOE/NREL*

Methanol and ethanol



This bus uses ethanol instead of gasoline as a fuel.

*Photo courtesy of DOE/NREL*

can be deadly poisons, especially in the amounts used to make transportation fuels. Methanol is especially toxic. Even small amounts breathed in as fumes or accidentally swallowed can cause blindness, severe liver damage, and death.

## Biogas

Most mammals-humans included-produce a flammable gas called “biogas” as they digest their food. Bacteria living in their digestive systems produce methane as they break down cellulose present in the food. Biogas is also produced in bogs and wetlands where large amounts of rotting vegetation may

accumulate. Biogas consists mostly of a gas called methane, which is the same as “natural gas”, commonly burned in our furnaces and barbecues. Biogas can be used instead of natural gas for heating and cooking.

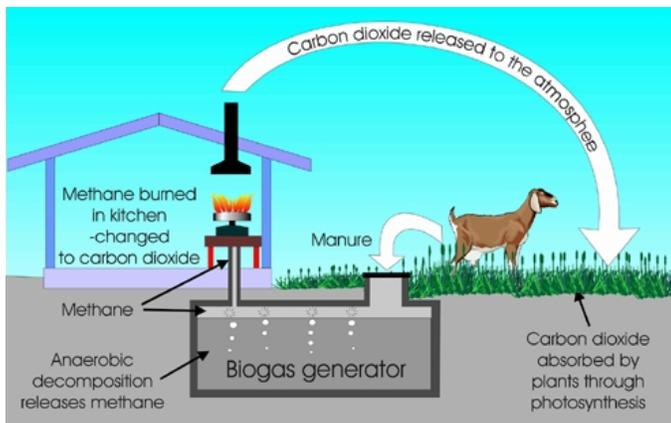


Two common sources of biogas. *Dave Mussell*

Humans have learned to duplicate this process in large tanks called biogas generators. To start the process, shredded plant materials and animal wastes are mixed with water in the biogas generator. Many kinds of naturally occurring bacteria arrive with the shredded plant material. The tank is then sealed so no air can get in. Within days, a special kind of bacteria in the tank will begin to produce biogas. These bacteria are known as “methanogenic”, because they produce methane, the main ingredient in biogas. The biogas forms bubbles in the mixture, and collects at the top of the tank. It is piped to a large balloon-like bag where it is stored until needed.

Eventually, the production of biogas in the generator starts to slow down. The mixture of water and manure is replaced with a fresh supply to start the process again. The old material is unable to produce

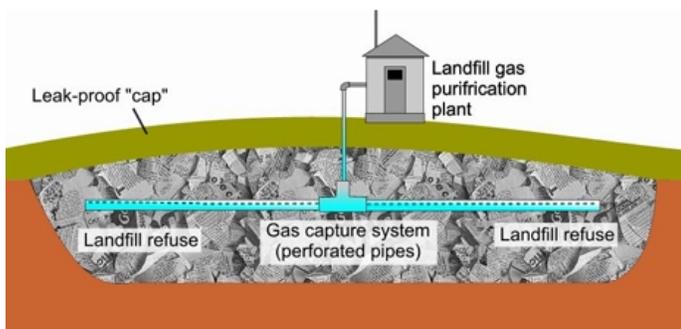




Biogas can be made using plant and animal wastes.

any more biogas, but still contains large amounts of plant material and other organic matter. It is dried to form a rich black soil, and is spread on fields as a fertilizer.

Another source of biogas is landfills. At the landfill site, large mounds of garbage are buried under the surface. Bacteria break some of the garbage down and can produce large amounts of biogas. This is sometimes collected and burned to heat buildings near the landfill. Biogas can contain traces of hydrogen sulphide (H<sub>2</sub>S) gas, particularly in the case of landfill gas. Care must be taken to deal safely with this gas because H<sub>2</sub>S can be fatal in small amounts.



Biogas can be captured from landfill waste.

## Questions

1. Why is wood considered a form of renewable energy?
2. What are two kinds of bioenergy that can be used as fuels for cars and trucks?
3. Can you think of two environmental problems created by burning wood for heating and cooking?
4. What is the main ingredient in biogas?
5. Methane from landfills is often allowed to escape directly to the atmosphere. Can you think of two reasons why this is bad?

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## Notes:

