

# Introduction to Biomass Energy



## What is Bioenergy?

Bioenergy is energy stored in materials made with the help of living things. For example, wood, is produced by 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 a flammable gas like natural gas, made by bacteria.

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. If a forest is managed properly, it will provide wood forever. The same goes for other forms of bioenergy, including biogas and alcohols.

Coal and oil (fossil fuels) on the other hand, takes millions of years to replace and are considered non-renewable. Peat (a brown or black material found in bogs is shown below) is also non-renewable because it takes hundreds of thousands of years to form.



Photo Courtesy of Unsplash

## 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 paper making. 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

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 highly flammable alcohols. 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*

However, methanol and ethanol are poisonous in large amounts especially in transportation fuels. Methanol is highly toxic. Inhaling fumes or swallowing methanol can cause blindness, severe liver damage, and death.

## Biogas

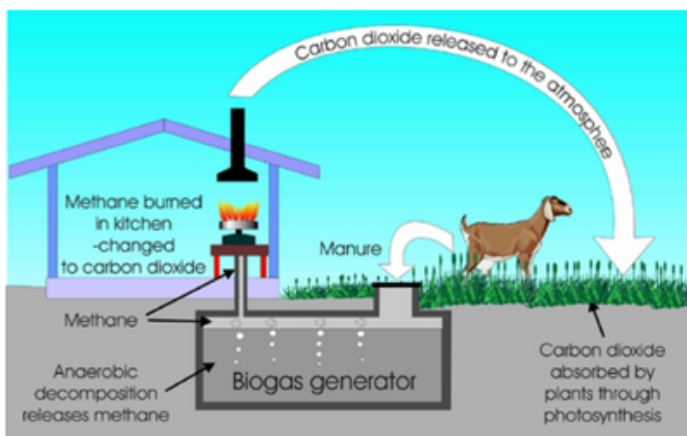
Most mammals, humans included, produce a flammable gas called “biogas” as they digest their food. Bacteria living in their digestive systems produce methane as they break down cellulose present in the food. Biogas is also produced in bogs and wet-lands where large amounts of rotting vegetation may accumulate.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

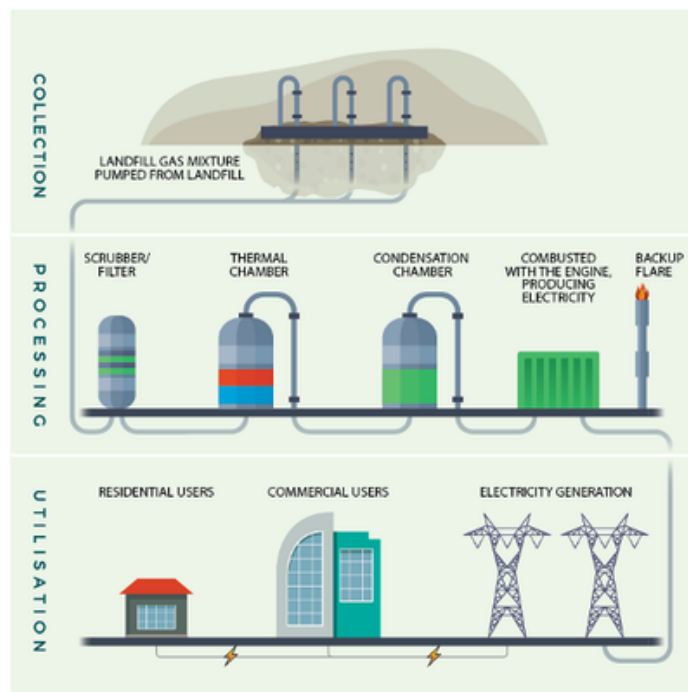
These bacteria are known as “methanogenic” because they produce methane, the main ingredient in biogas. The biogas forms bubbles in the mixture and collects at the top of the tank. It is piped to a large balloon-like bag where it is stored until needed. When the production of biogas slows down, it is replaced with a new mixture of water and manure, restarting the process. The old material, containing plant material and organic matter, is dried to form a rich black soil used as fertilizer.



Biogas can be made using plant and animal wastes.

*Photo Courtesy of Engineering Corner*

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.  
*Photo Courtesy of Government of the Australian Capital Territory*

## 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?