

▪ Landfill Gas and Biogas

Bacteria and fungi are not picky eaters. They eat dead plants and animals, causing them to rot or decay. A fungus on a rotting log is converting **cellulose** to sugars to feed itself. Although this process is slowed in a landfill, a substance called **methane** gas is still produced as the waste decays.

Regulations require landfills to collect methane gas for safety and environmental reasons. Methane gas is colorless and odorless, but it is not harmless. The gas can cause fires or explosions if it seeps into nearby homes and is ignited. Landfills can collect the methane gas, purify it, and use it as fuel to generate electricity.

Methane, the main ingredient in natural gas, is a good energy source. Most gas stoves and furnaces use methane supplied by utility companies. In 2003, East Kentucky Power Cooperative began recovering methane from three landfills. The utility now uses the gas at six landfills to generate enough electricity to power about 9,000 Kentucky homes.

Still, today a small portion of landfill gas is used to provide energy. Most is burned off at the landfill. With today's low natural gas prices, this higher-priced **biogas** is less economical to collect. Methane, however, is a more powerful greenhouse gas than carbon dioxide. It is better for the environment to burn landfill methane and change it into carbon dioxide through combustion than to release it into the atmosphere.

Methane can also be produced using energy from agricultural and human wastes. **Biogas digesters** are airtight containers or pits lined with steel or bricks. Waste put into the containers is fermented without oxygen present to produce a methane-rich gas. This gas can be used to produce electricity, or for cooking and lighting. It is a safe and clean-burning gas, producing little carbon monoxide and no smoke.

Biogas digesters are inexpensive to build and maintain. They can be built as family-sized or community-sized units. They need moderate temperatures and moisture for the fermentation process to occur. For developing countries, biogas digesters can be one of the best answers to many of their energy needs. They can help reverse the rampant deforestation caused by wood-burning, reduce air pollution, fertilize over-used fields, and produce clean, safe energy for rural communities.

Use of Biomass

Until the mid-1800s, wood gave Americans 90 percent of the energy used in the country. In 2016, biomass provided 4.89 percent of the total energy we consumed. Biomass has largely been replaced by coal, natural gas, and petroleum.

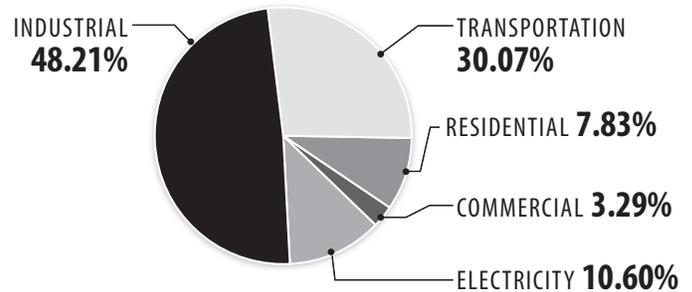
A little less than 42 percent of the biomass used today comes from burning wood and wood scraps such as saw dust. About 48 percent is from **biofuels**, principally ethanol, that are used as a gasoline additive. The rest comes from crops, garbage, and landfill gas.

Industry is the biggest user of biomass. Over 48 percent of biomass is used by industry. Electric utilities use almost 11 percent of biomass for power generation. In turn, biomass produces 1.55 percent of the electricity we use.

Transportation is the next biggest user of biomass; about 30 percent of biomass is used by the transportation sector to produce biofuels like **ethanol** and **biodiesel** (see pages 12-13).

The residential sector uses almost 8 percent of the biomass supply. The most recently reported data showed about three percent of American homes use wood as the only source of heat. Most of these homes burn wood in fireplaces and wood stoves for heat.

U.S. Biomass Consumption by Sector, 2016



Data: Energy Information Administration

Using Biomass Energy

Usually we burn wood and use its energy for heating. Burning, however, is not the only way to convert biomass energy into a usable energy source. There are four ways:

Fermentation: There are several types of processes that can produce an alcohol (ethanol) from various plants, especially corn. The two most commonly used processes involve using yeast to ferment the starch in the plant to produce ethanol. One of the newest processes involves using enzymes to break down the cellulose in the plant fibers, allowing more ethanol to be made from each plant, because all of the plant tissue is utilized, not just the starch.

Burning: We can burn biomass in waste-to-energy plants to produce steam for making electricity, or we can burn it to provide heat for industries and homes.

Bacterial Decay: Bacteria feed on dead plants and animals, producing methane. Methane is produced whenever organic material decays. Methane is the main ingredient in natural gas, the gas sold by natural gas utilities. Many landfills are recovering and using the methane gas produced by the garbage.

Conversion: Biomass can be converted into gas or liquid fuels by using chemicals or heat. In India, cow manure is converted to methane gas to produce electricity. Methane gas can also be converted to methanol, a type of alcohol made from fermenting wood. Methane and methanol each have only one carbon atom.

Biomass and the Environment

Environmentally, biomass has some advantages over fossil fuels such as coal and petroleum. Biomass contains little sulfur and nitrogen, so it does not produce the pollutants that can cause **acid rain**. Burning biomass releases carbon dioxide, but growing plants for use as biomass fuels may also help keep carbon dioxide levels balanced. Plants remove carbon dioxide—a **greenhouse gas**—from the atmosphere when they grow.