

## Biofuels

**Biofuel** is a **fuel** that is usually obtained from biological raw materials, such as stalks of sugar cane or rapeseed, corn, soybeans. Cellulose and various types of organic waste can also be used.

There are **solid biofuels** (firewood, straw), **liquid biofuels** (**ethanol**, **methanol**, **biodiesel**), and **gaseous biofuels** (**biogas**, **hydrogen**).

### Solid biofuels

Firewood is the oldest **fuel**. Currently, **energy** forests which consist of fast-growing plants are grown for the production of firewood or **biomass**. Lately, the population of many countries have been reducing the consumption of petroleum **fuels** and increasing the use of firewood. This leads to deforestation.

Solid **energy sources** of biological origin (mainly manure, wood waste, peat) are briquetted, dried and burned in the fireplaces of residential buildings and **furnaces** of thermal **power plants**, producing cheap **electricity** for domestic and industrial needs. Wood waste with a minimum degree of preparation for burning (sawdust, bark, husks, straw, etc.) is pressed into fuel briquettes or pellets, which have the shape of cylindrical or spherical granules with a diameter of 8-23 mm and a length of 10-30 mm.

### Liquid biofuel

**Bioethanol** is ordinary **ethanol**, which is obtained by processing vegetable raw materials and used as **biofuel**. **Ethanol** (**ethyl alcohol**) -  $C_2H_5OH$  or  $CH_3-CH_2-OH$ , the second representative of the homologous series of monohydric alcohols, in common parlance - alcohol.

There are 2 main ways to obtain **ethanol** - microbiological (alcoholic fermentation) and synthetic (**ethylene** hydration). The result of fermentation is a solution containing no more than 15% of **ethanol**, because in more concentrated solutions, the yeast usually dies. The **ethanol** obtained thus requires purification and concentration, usually by distillation. On an industrial scale, **ethyl alcohol** is obtained from raw materials containing cellulose (wood, straw), which is pre-hydrolyzed. The resulting mixture is subjected to alcoholic fermentation.

**Ethanol** is a less "energy-saturated" source of **energy** than **gasoline**. The mileage of cars running on E85 (a mixture of 85% **ethanol** and 15% **gasoline**; the letter "E" from the English **Ethanol**), per unit volume of fuel is about 75% of the mileage of standard cars. Conventional machines cannot run on the E85, although internal combustion engines run on the E10. Only so-called "Flex-Fuel" machines work on "real" ethanol. These [cars](#) can run on regular **gasoline** or on any mixture of both.

A serious disadvantage of **bioethanol** is that when **ethanol** burns in the exhaust gases of engines, aldehydes (formaldehyde and acetaldehyde) appear, which cause no less damage to living organisms than aromatic hydrocarbons.

**Biomethanol** is a type of **liquid biofuel** based on **methyl (wood) alcohol** obtained by dry distillation of wood waste and conversion of **methane** from **biogas**. Biomass production can be carried out by cultivating phytoplankton in artificial reservoirs created on the coast. Secondary processes are **methane** fermentation of biomass and subsequent hydroxylation of **methane** to obtain **methanol**.

Despite the high octane number - more than 100, the calorific value of **methanol** is twice less than

that of **gasoline**. This, as well as the lack of volatility of pure alcohol, explains the need to mix **methanol** with **gasoline**. The standard is **biomethanol** M85 (letter "M" from the English. **Methanol**), which contains 85% of **methyl alcohol** and 15% of **gasoline**.

**Biomethanol** M85 has not become widespread due to low **energy** content and due to the exceptional corrosive activity of **methanol**, which requires the use of special materials.

In terms of **energy** production, this biosystem has significant economic advantages over other methods of converting [solar energy](#).

**Biobutanol** -C<sub>4</sub>H<sub>10</sub>O - **butyl alcohol**. Colorless liquid with a characteristic odor. Widely used in industry. **Butanol** production began in the early twentieth century. In the 1950s, due to falling oil prices, **butanol** began to be processed from **petroleum** products.

**Butanol** has no corrosive properties, can be transferred to existing infrastructure. It may, but does not have to, be mixed with traditional **fuels**. The **energy** consumption of **butanol** is close to the **energy** consumption of **gasoline**. **Butanol** can be used in **fuel** cells as well as as raw materials for hydrogen production.

The raw materials for the production of **biobutanol** can be sugar cane, beets, corn, wheat, and in the future - cellulose.

**Dimethyl ether (DME)** - C<sub>2</sub>H<sub>6</sub>O can be produced from coal, natural **gas** and **biomass**. A large amount of **dimethyl ether** is produced from pulp and paper waste. It liquefies at low pressure.

**Dimethyl ether** is an environmentally friendly fuel without sulfur content, the content of nitrogen oxides in exhaust gases is 90% lower than in **gasoline**. The use of **dimethyl ether** does not require special filters, but it is necessary to redesign the power supply systems (installation of gas cylinder equipment, correction of mixture formation) and engine ignition. Without processing it is possible to use it in the cars with LPG-engines at 30% of content in fuel.

**Biodiesel** is a **fuel** based on animal, vegetable and microbial fats, as well as their esterification products.

Vegetable or animal fats are used to produce **biodiesel**. The raw materials can be rapeseed, soybean, palm, coconut oil, or any other crude oil, as well as waste from the food industry. Technologies for the production of **biodiesel** from algae are being developed.

Second-generation **biofuel** is a **fuel** obtained by various methods of pyrolysis of biomass, or other **fuels** other than **methanol**, **ethanol**, and **biodiesel**.

Rapid pyrolysis allows you to turn biomass into a liquid that is easier and cheaper to transport, store and use. The liquid can be used to make motor **fuel** or **fuel** for power plants.

### Gaseous biofuel

**Biogas** is a product of fermentation of organic waste (biomass), which is a mixture of **methane** and carbon dioxide. Decomposition of biomass occurs under the influence of bacteria of the class of methanogens.

### Third generation biofuels

Third generation **biofuels** are **fuels** derived from algae.

In addition to growing algae in open ponds, there are technologies for growing algae in small

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bioreactors located near power plants. The waste heat of the plant is able to cover up to 77% of the heat required for growing algae. This technology does not require a hot tropical climate.

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