

Biofuel Production

Biofuels tap the intellectual and technological power of American agriculture with an eye toward reducing our reliance on fossil fuels. WSU has dozens of researchers working on a range of biofuels in centers on both the Pullman and Tri-Cities campuses.

Biofuel production relies on **photosynthesis**, converting water and carbon dioxide into oxygen and various forms of biomass with energy rich sugars, proteins, and fats.

The sun



Biomass



Conversion



Application



Whether you get gas at a pump or heat your house from a wood pile, all the energy you use originated at the massive nuclear fusion reactor that is our sun. Energy alternatives are variations on this theme, channeling solar energy through various forms and technologies.

Crops specifically grown for energy include **sugar beet and oilseeds**—“first-generation” biofuels because they’re readily converted to fuel. They can also compete with food production.

Second-generation biofuels target woody and grass fibers, some of which are often waste products. Some, like **manure and food waste**, are wet. Others, like **wood and straw**, are more solid and less competitive with food.

Third- and fourth-generation biofuels (algae and hydrocarbon-rich microbes) are more dedicated to energy production. They’re also more speculative, potent, and less prone to using cropland.

Oilseeds are crushed for biodiesel and refined further for specific uses such as jet fuel.

Anaerobic digestion ferments wet biomass into biogas, a mix of methane and carbon dioxide.

Solid mass can be fermented like wet biomass. Or it can be **treated thermochemically**—burned freely or burned with controlled temperature and oxygen to produce various ratios of gas, oil, and a carbon product called **biochar**.

Third- and fourth-generation fuels attempt to go more directly to a usable form of fuel. Oilseeds like **canola** and **camelina** still need several steps to become a diesel-like fuel or jet fuel. **Algae** would also require extensive processing. Work is under way to develop **microbes that exude hydrocarbons** ready for use as “drop-in” fuel.

Diesel-like transportation fuel

Heat

Electrical power

High-quality transportation fuels



The carbon dioxide produced was present in the atmosphere at the outset. With the exception of fossil fuels used in production and distribution, the fuels are **largely carbon neutral**.

Unlike solar and wind energy, biofuels also can produce **carbon-containing byproducts**—films, plastics, pharmaceuticals, textiles and more—currently being produced with petroleum.

