Advanced Biofuels 101

AHB ENERGY LITERACY INFOSHEET #2

Advanced Biofuel Basics

Advanced biofuels are renewable fuels that are considered "advanced" because of the type of plant material or feedstock that is used to make them. All biofuels are made from plants or other recently living matter. Conventional biofuels, including ethanol and biodiesel use food crops as a feedstock, while advanced biofuels are derived specifically from non-food crops or waste products taken from farms and forests. There are many forms of advanced biofuels including cellulosic ethanol, renewable natural gas, and drop-in biofuels. All of these fuels have the potential to replace the petroleum-based fuels that we currently use.

The Road to Advanced Biofuels

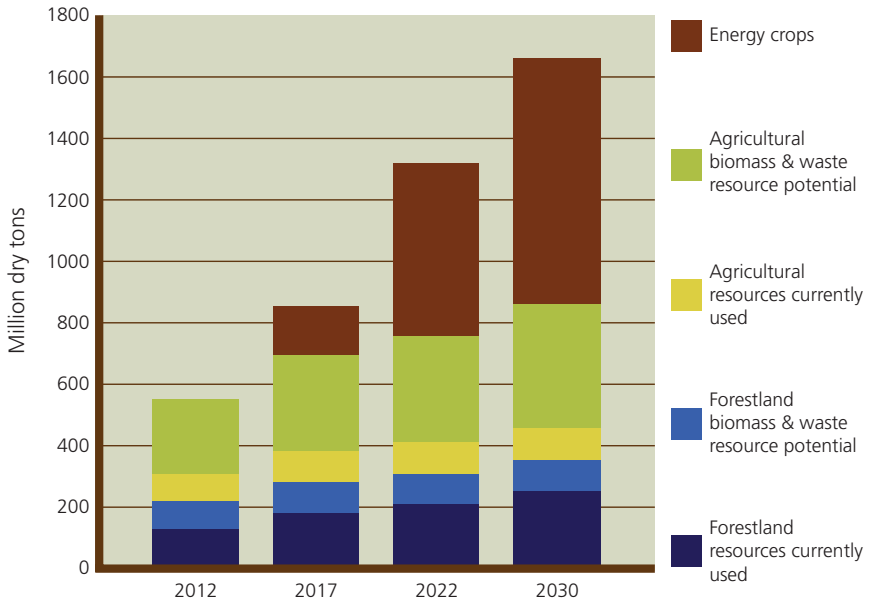
Drivers:

- Lower greenhouse gas emissions
- Stronger rural economies
- Increased energy security
- Locally produced fuels

Restraints:

- Not cost competitive with fossil fuels
- Most still in research and development stages

Growth of Advanced Biofuel Feedstocks



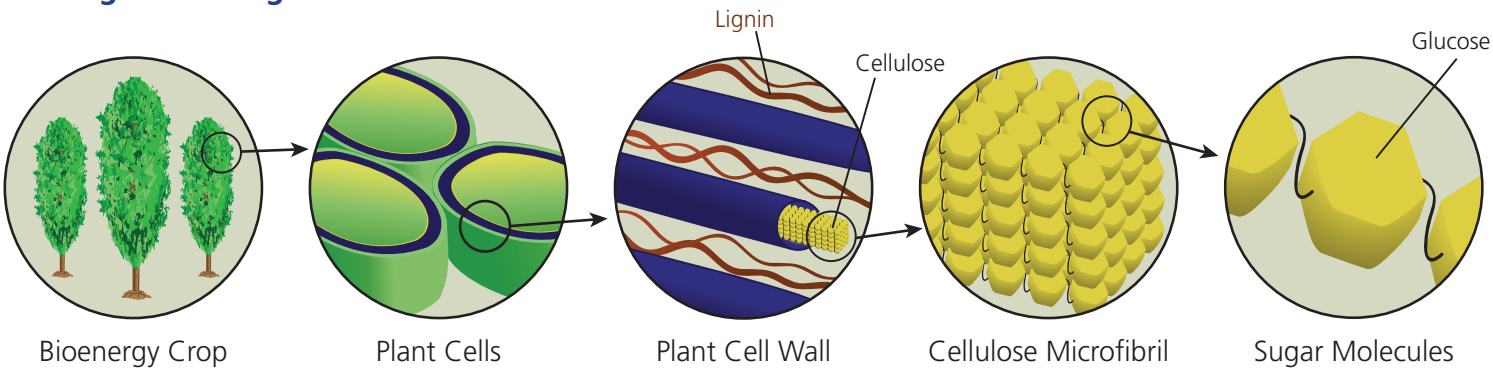
By 2030, dedicated energy crops are projected to become the largest feedstock source for advanced biofuels.

Adapted from the U.S. Billion-Ton Update (Perlack et al. 2011)

Common Advanced Biofuels for Transportation Uses Being Developed

	Fuel Replaced	Advantages	Commercial Status
Cellulosic Ethanol	Corn ethanol in gasoline blends	A sustainable and locally produced alternative to the corn-grain ethanol that is currently available.	Early Commercial – The first commercial-scale plants are coming into production that use corn stover (corn cob and stalks) as the primary feedstock.
"Drop-in" Biofuels	Gasoline, Diesel, and Jet fuel	Chemically equivalent to petroleum-derived gasoline, diesel, or jet fuel. "Drop in" biofuels are compatible with existing petroleum distribution systems and engines.	Research & Development – With government support, universities and industry are working to make sustainable and cost effective supply systems for drop-in biofuels.
Renewable Natural Gas	Natural gas	The decomposition of organic matter releases methane (biogas), which is processed into renewable natural gas (RNG). RNG can fuel natural gas powered vehicles as well as other energy applications.	Commercial production – Routinely captured from landfills, livestock operations, and wastewater treatment facilities and used for energy production.

Getting to the Sugar



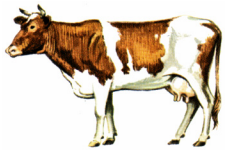
Advanced biofuels are made from the sugars found in the cell walls of plants.

Cellulosic Feedstocks

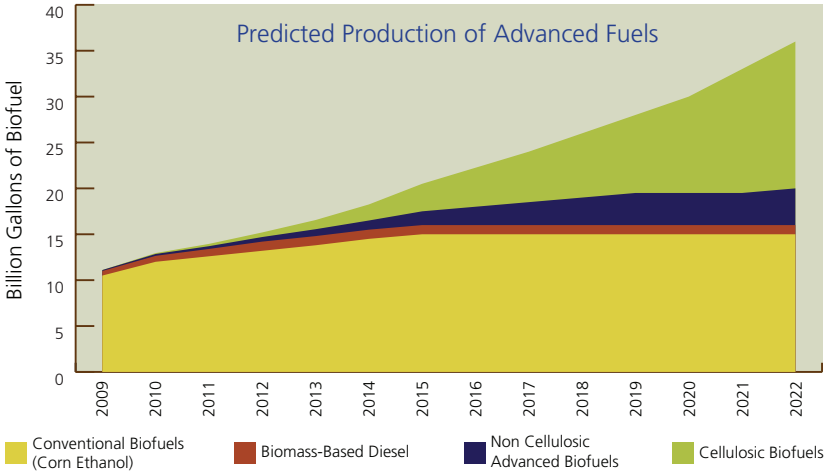
Advanced biofuels are made from cellulose, which is composed of sugar polymers (long chains of sugar molecules) found in the cell walls of plants. Cellulose, along with lignin, provides structural support and defenses to the cell. In the conversion process to advanced biofuels, the tough lignin fibers that make plants rigid are broken down to expose the cellulose sugar polymers.

Once exposed, the long cellulosic sugar chains are broken down into individual sugar molecules (glucose) that can be fermented by yeast or bacteria and further processed to the desired advanced biofuel or biochemical.

Did you know?



The United States could produce an estimated 2 million tons of renewable natural gas (RNG) from animal manure each year; enough to displace 12% of the natural gas consumed in the transportation sector.



Source: EPA

Renewable Fuel Standard

The Renewable Fuel Standard is federal policy mandating renewable fuel production in the United States. It requires that 36 billion gallons of renewable fuel be produced by 2022. Of that, 21 billion gallons must be advanced biofuels that reduce net greenhouse gas emissions by at least 50% compared to petroleum-based fuels. The Renewable Fuel Standard is important because it provides long-term policy support to industries investing in advanced biofuels.

Going Forward

- There are three cellulosic ethanol facilities currently operating in the United States with more scheduled to open in the next few years.
- The U.S. Navy and Air Force are testing and using advanced biofuels with the goal of meeting a 50% reduction in fossil fuel use by 2020.
- Commercial airlines have demonstrated the use of advanced biofuels on cross-country flights.
- A 2011 study found that the United States could produce enough feedstock for biofuels to displace 30% of our current national petroleum consumption by 2030.

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USDA United States Department of Agriculture National Institute of Food and Agriculture