Advanced **Hardwood Biofuels** Northwest

Let's Talk About

POPLAR-BASED ETHANOL

Developing a cellulosic ethanol industry in the Pacific Northwest can increase energy security, build local economies, and reduce net greenhouse gas emissions and global warming potential.

CELLULOSIC ETHANOL

Ethanol, an alcohol fuel made by fermenting the sugars in plant material, is an important piece of the nation's clean fuel portfolio. Most of the ethanol produced in the U.S. is made from corn grown in the Midwest. This ethanol is distributed across the country, and even the globe, to be blended with gasoline.

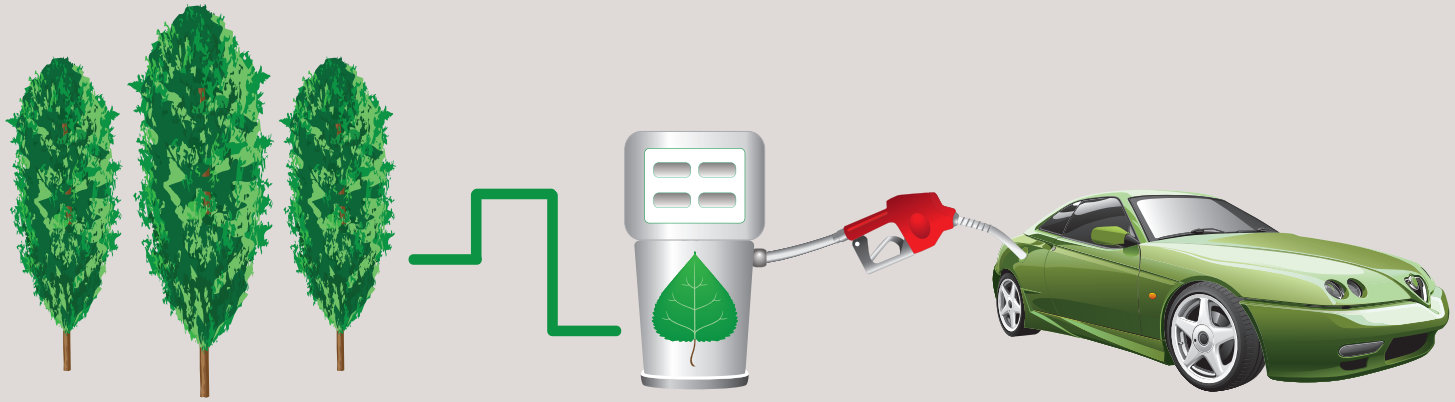
A new generation of ethanol, called cellulosic ethanol, can be made from trees, perennial grasses, and agricultural residues like corn stover or wheat straw.

Because ethanol is one of the easiest and cheapest biofuels to produce from these feedstocks, it can also serve as a stepping stone for the production of other advanced biofuels that are equivalent to petroleum-based gasoline, diesel, and jet fuel.

ETHANOL IN THE NORTHWEST

In the PNW, poplar trees are a promising feedstock for cellulosic ethanol. Poplars require relatively few inputs compared to other agricultural crops, and researchers are also working to develop methods for growing poplar on marginal lands where the trees will not compete with food crops. Poplar-based ethanol also offers reduced net greenhouse gas emissions compared to gasoline and corn ethanol because the trees require fewer energy inputs (from reduced tillage and fertilizer use) and their large root systems store carbon in the soil.

AHB's industry partner, ZeaChem, has been working to fine-tune their process to make ethanol from poplar wood chips. ZeaChem plans to expand their production to a 22.5 million gallons per year facility that will produce cellulosic ethanol from locally-sourced poplar.



Advanced Hardwood Biofuels Northwest (AHB) is a program funded by the USDA National Institute of Food and Agriculture. AHB integrates research, education, and extension to develop a poplar-based biofuel and biochemical industry in the Pacific Northwest (PNW).

CONVERTING WOOD TO ETHANOL

To make cellulosic ethanol, poplar wood chips are pre-treated with acid, steam, and enzymes to release sugars. The sugars can then be turned into ethanol in two ways.

1. YEAST FERMENTATION

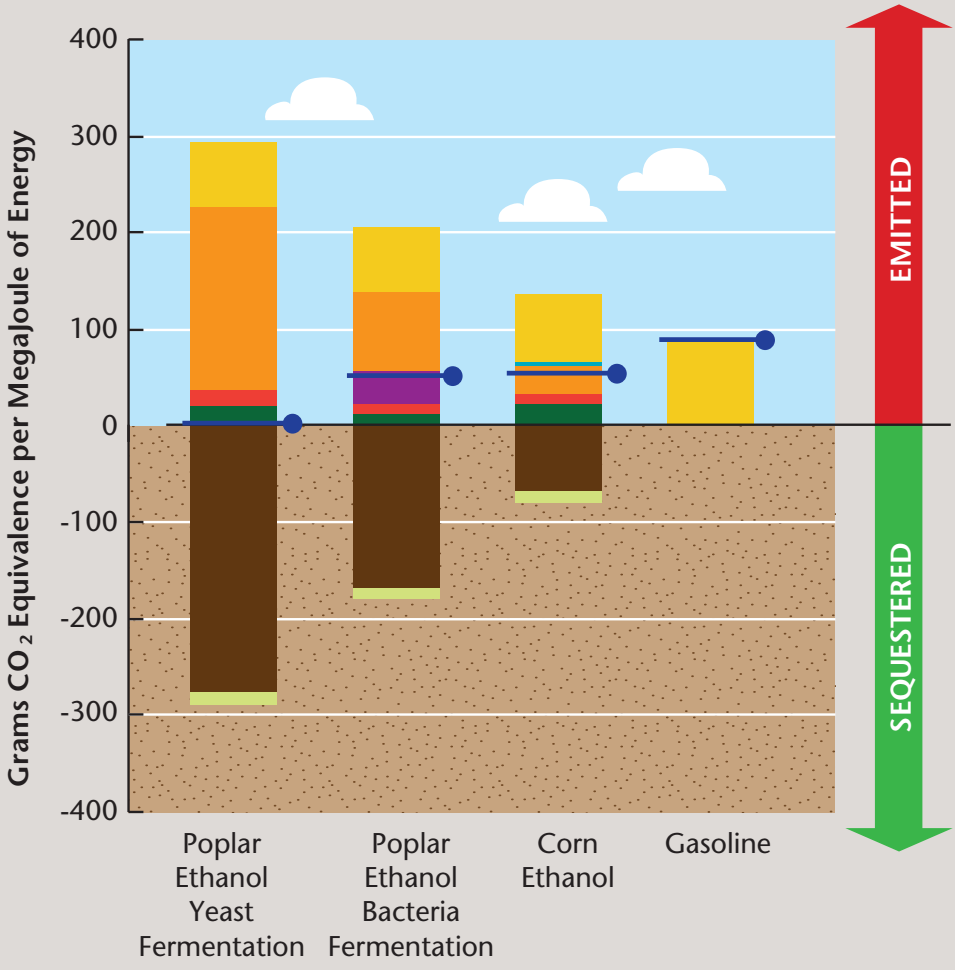
Yeast can ferment sugar directly to ethanol, which is the current method used to make corn ethanol. This process requires very little additional energy but produces lower yields compared to bacteria fermentation.

2. BACTERIA FERMENTATION

Bacteria, similar to the type found in compost piles, ferment the sugars to acetic acid. The acidic acid is then converted to an intermediate product, ethyl acetate, which is reacted with hydrogen to make ethanol. The advantage of the bacterial pathway is an increased ethanol yield; however, this process requires additional energy inputs, which could substantially affect the life cycle global warming potential of the process.

Poplar chips at ZeaChem's demonstration biorefinery in Boardman, OR.

GLOBAL WARMING POTENTIAL



When comparing the two pathways per unit of energy produced, the yeast and bacteria fermentation pathways have an estimated GWP that is 97% and 50% lower than the GWP of gasoline, respectively. However, because the bacterial pathway achieves higher yields, less total land is needed to produce a unit of ethanol. Therefore, when the GWP are compared per unit of land, the two pathways achieve similar reductions.*

- Combustion
- Miscellaneous
- Biorefinery Fuel Production
- Hydrogen Production
- Chemical Inputs
- Farming
- Carbon in Biomass
- Avoided Production
- Net Emissions

* The Global Warming Potential (GWP) is the sum of greenhouse gas emissions expressed as CO_2 equivalence.

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hardwoodbiofuels.org

USDA

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