



Wood Pathway: Biofuels

Similar to bioenergy, biofuels are considered a viable alternative to fossil fuels and natural gas under California's Low-Carbon Fuel Standard (LCFS). The transportation sector is considered the highest carbon emitting sector in the state and transitioning our fossil fuel dependent homes and vehicles into renewable natural gas is regarded as a climate priority. Biofuels operate under the same conversion process as bioenergy but stops before the fuel is used to generate power. Facilities inject the converted fuel from the conversion process into pre-existing pipelines and provide a cleaner fuel replacement to natural gas and fossil fuels while avoiding the costs of rebuilding new infrastructure. Biofuels is a highly promising industry which is recognized by public agencies like California Energy Commission and the Air Resources Board for its potential to offset transportation-based carbon emissions.



Technical Overview

Unlike other renewable energy sources, biomass can be converted directly into liquid fuels, called "biofuels," to help meet transportation fuel needs. The two most common types of biofuels in use today are ethanol and biodiesel, both of which represent the first generation of biofuel technology.

High-temperature deconstruction makes use of extreme heat and pressure to break down solid biomass into liquid or gaseous intermediates. There are two primary routes used in this pathway:

- Pyrolysis
- Gasification

During pyrolysis, biomass is heated rapidly at high temperatures (500°C–700°C) in an oxygen-free environment. The heat breaks down biomass into pyrolysis vapor, gas, and char. Once the char is removed, the vapors are cooled and condensed into a liquid "bio-crude" oil.

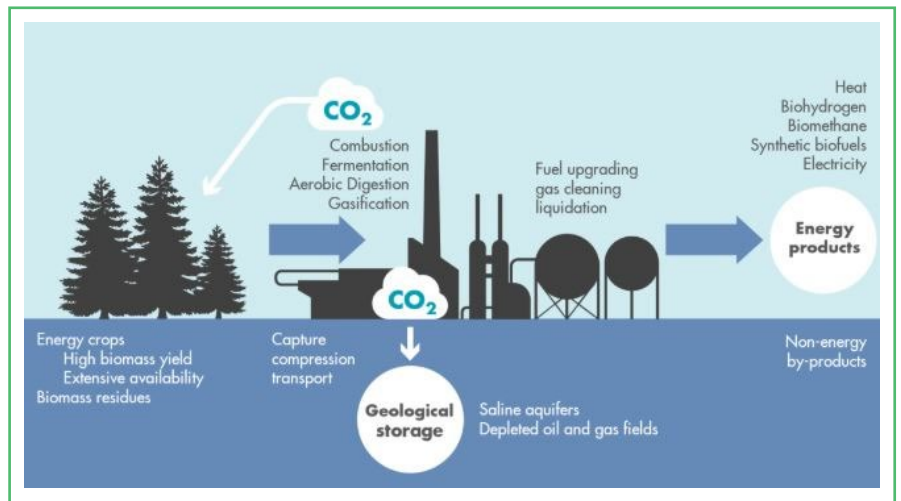
Gasification follows a slightly similar process; however, biomass is exposed to a higher temperature range (>700°C) with some oxygen present to produce synthesis gas (or syngas)—a mixture that consists mostly of carbon monoxide and hydrogen. Once syngas is produced, the facility has the option to produce electricity, fuels or hydrogen depending on their business model and tech design.

The Promise of Carbon Capture and Storage

Carbon Capture and Storage (CCS) is a technological solution that is growing in recognition for its ability to capture, transport and deposit carbon underground where it will not re-enter the atmosphere. With leading figures on climate and atmospheric science stating the need to implement negative carbon emission projects to mitigate the worst of climate change, CCS is one solution to absorb the hard-to-decarbonize industry sectors like cement or steelmaking.

Bioenergy with CCS (also known as BECCS) is the combination of use bioenergy with CCS to create a truly carbon negative supply chain instead of attempting to CCS with fossil-fuel emitting sources. The Lawrence Livermore National Laboratory (LLNL) came out with a report in 2020 that states how California can remove 84 million tons of carbon emissions per year through BECCS technology.

Moreover, California can achieve this with a cost of less 0.4% of the State's current gross domestic product. California's geologic bedrock and access to climate-smart capital investments makes BECCS a highly promising opportunity for the right entrepreneur.



The Promise of Hydrogen Conversion

Hydrogen conversion from gasification has been touted by academic institutions like the Lawrence Livermore National Laboratory and a growing cadre of European industry as a carbon negative solution to handle excess wood waste from sustainable forest operations. The US Department of Energy believes biomass gasification to hydrogen could be deployed in the near-term timeline with positive impacts for the social and environmental community.

There are two ways Hydrogen can be produced from Biomass: electricity and through biogas. Both secondary energy sources would need additional conversion systems in order to split the hydrogen molecules from water, thus creating pure hydrogen. Also known as "green hydrogen", applications of hydrogen are wide ranging across many sectors. Notably, hydrogen fuel cells are being deployed across the state to convert hard-to-decarbonize sectors like heavy duty trucking into a carbon solution.