

# Forest Biofuels Fact Sheet

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Renewable fuels are produced from renewable resources. Forest biofuels are renewable fuels produced from byproducts of sustainable forestry. This material currently lacks sufficient value to cover the cost of its removal and transportation to facilities that can utilize it for higher end uses, such as biofuels. Examples of renewable forest biofuels include hydrogen, sustainable aviation fuel, ethanol, drop in gas/diesel, and renewable natural gas. These biofuels can replace fossil fuels (e.g., gasoline) and would contribute directly to energy independence as well as carbon mitigation goals.

The production of forest biofuels in California (CA) can play a key role in sustainable, healthy forests; reduced wildfire risk; increased carbon sequestration; improved air quality; and increased energy security in the transportation, buildings, and industry sectors.

## How are Forest Biofuels Produced?

Liquid or gaseous renewable fuels can be produced from sustainably sourced woody forest biomass using biochemical and thermochemical conversion processes such as gasification and pyrolysis.

**Biochemical conversion** of forest biomass involves the use of enzymes and microorganisms to convert fermentable sugars from wood into alcohol-based fuels such as ethanol.

**Gasification** is a well-established technology that uses heat, steam, and oxygen to convert biomass to hydrogen and other products without burning the material (no combustion).

**Pyrolysis** involves heating of biomass in the absence of oxygen to decompose woody biomass into liquid, gaseous, and solid products (no combustion).

### Carbon Capture and Storage (CCS)

CCS provides an opportunity for forest biofuels to be carbon negative. When creating forest biofuels through gasification or pyrolysis, the carbon dioxide (CO<sub>2</sub>) stored in the plant material is released as a byproduct. Using CCS, this CO<sub>2</sub> can be stored long term in locations with relevant geology.

Coupling forest biofuels with CCS is environmentally friendly and economically viable because of existing financial policy incentives for emission reductions, including the state's Low Carbon Fuels Standard and the federal 45Q tax credit, a tax credit incentivizing CO<sub>2</sub> storage or utilization.

## Current Status

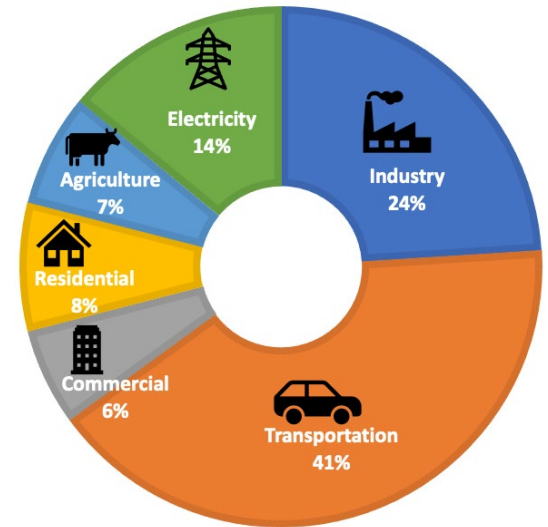
- At present there are only a few sustainably sourced forest biofuels demonstration plants in CA. Demonstration plants are used to prove commercial and technical viability.
- Despite existing policy support, advanced renewable biofuels have not yet reached commercial-scale production in the US.
- Several forest biofuels facilities are planned for CA that will utilize sustainably sourced forest biomass to produce renewable hydrogen and/or other renewable fuels. (Table 1)
- Biofuel production costs are greatly dependent on material acquisition costs.
- Forest biomass biofuel production is more expensive than both agricultural residues and municipal solid waste, largely because of transportation costs to centralized processing facilities.



## Announced Renewable Biofuels Facilities in CA

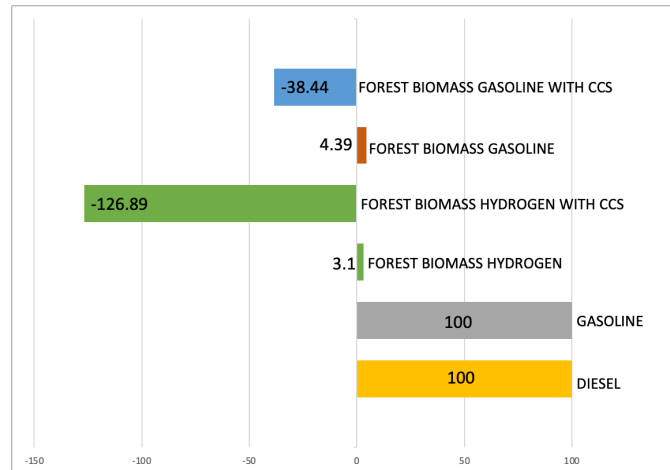
Company	Location	Fuel	Commission Date
Aemetis	Modesto	Aviation Fuel	2023
Yosemite Clean Energy	Butte	Hydrogen & Natural Gas	2024
	Tuolumne	Hydrogen & Natural Gas	2025
	Tulare	Hydrogen & Natural Gas	2026
Mote Hydrogen	Bakersfield	Hydrogen	2024
H-Cycle	Los Angeles	Hydrogen	2026
	Butte	Hydrogen	2026
	Bakersfield	Hydrogen	2026
	Contra Costa	Hydrogen	2024
Kore	Los Angeles	Hydrogen & Natural Gas	2021
	Bakersfield	Hydrogen & Natural Gas	2023
Sierra Energy	Jolon	Diesel	2017
Frontline Bioenergy	McFarland	Natural Gas	2023

## End-Use GHG Emissions in CA (2019)



## Carbon Benefits of Sustainably Sourced Forest Biofuels

- Use of forest biofuels will help CA meet greenhouse gas (GHG) emissions targets.
- Renewable biofuels burn cleaner than gasoline, resulting in fewer GHG emissions.
- CA's transportation sector is the largest contributor to GHG emissions in the state. Forest biofuels can play an integral role in the displacement of transportation sector fossil fuel use and in producing negative emissions via CCS.
- A recent study indicated that ethanol production from forest biomass had approximately 80% lower emissions than gasoline.<sup>1</sup>
- Use of forest biomass for biofuels will also help reduce wildfire risks, another major source of GHG emissions in CA.



Carbon Intensity of Fuels (gCO<sub>2</sub>e/MJ)<sup>2</sup>

## Recommended Policy Actions for a Forest Biofuels Industry in CA

- Provide technical and financial support to companies interested in establishing forest biofuels facilities in CA.
- Adopt changes in CA's Low Carbon Fuel Standard program and the federal Renewable Fuel Standard to financially incentivize forest biofuels projects in CA.
- Create a hub within the Governor's Office of Business and Economic Development to convene stakeholders and share best practices for successful project development.
- Allocate public funds for rural, community-scale forest biofuels projects to improve energy security and rural economic development.

<sup>1</sup> Therasme et al. 2022

<sup>2</sup> Gilani & Sanchez 2022; CARB