

FACT SHEET

Wood to Fuel for California's Transportation Sector using Autothermal Pyrolysis

THE ISSUE

California's goal to reduce greenhouse gas emissions by 40% will require new low-carbon fuel alternatives. Converting sustainably sourced local biomass to bio-oil, which can then be upgraded to renewable fuels, offers the potential to meet the State's energy goals. However, more cost-effective, innovative technologies are needed to make this option a viable solution.

The state's forest residues are one such biomass resource that can be harvested to address California's energy goals. Approximately 2 million bone-dry tons of mill residues are generated in California each year. The ability to convert these residues to fuel would provide an alternative revenue stream for the forestry sector, improving the profitability of California lumber mills and creating local jobs.

Supporting California Energy Goals

- Reduce greenhouse gas emissions.
- Expand the supply of alternative fuels.
- Improve the capacity of California's forests to remove CO₂ from the atmosphere.

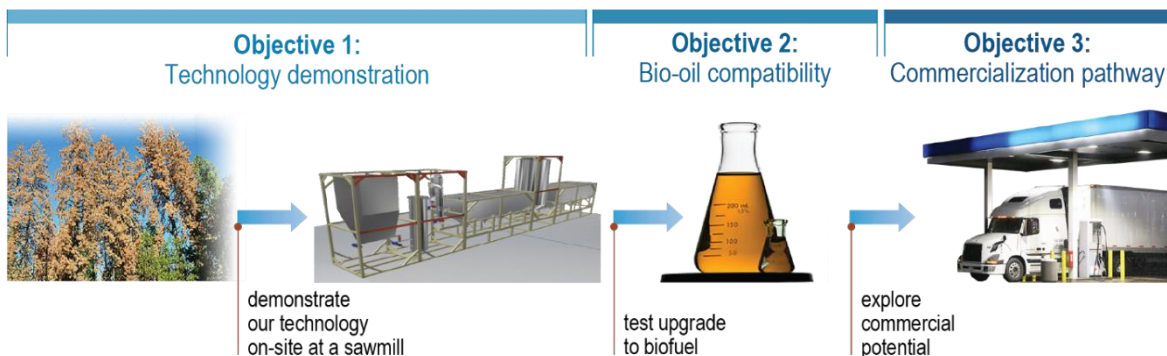
PROJECT DESCRIPTION

This project supports California energy, climate, and economic goals by harnessing forest residues to produce very low-carbon, drop-in renewable fuels. It's based on a new process, known as **autothermal process intensified (AT-PI) pyrolysis**. AT-PI pyrolysis was developed at Iowa State University (ISU) and has already proven to be successful in converting corn residues to bio-oil. If successful, this technology could support production of up to 378 million gallons gasoline equivalent of renewable fuel per year from California forest residues. Key steps to moving the technology forward toward commercialization include:

Demonstrate the Technology at Scale for Wood Waste. The team will adapt AT-PI pyrolysis for use with wood waste, and scale the technology from a 1 ton-per-day pilot to a 50-ton-per-day commercial system. A complete engineering package will be developed, modules will be manufactured, and installed at a Sierra Pacific Industries demonstration site. Over the course of the demonstration, we aim to produce at least 50,000 gallons of bio-oil.

Ensure Bio-Oil Compatibility. Intermediate bio-oil products will be upgraded to commercially viable transportation fuels, such as gasoline and diesel, using established refining processes.

Establish the Commercialization Pathway. The market potential in California for AT-PI pyrolysis technology will be evaluated, including the availability of raw materials, market needs, cost-effectiveness, and use of byproducts. Partnerships for investigating the market potential in California and a roadmap to commercialization will be forged.



Lawrence Livermore National Laboratory (LLNL) will partner with engineers at ISU, who have already demonstrated the ability to produce bio-oil from agricultural residues through AT-PI pyrolysis. ISU's pilot plant separated the bio-oil output into a range of valuable intermediate products that can be converted into renewable fuels, ethanol and methane. LLNL will partner with ISU to adapt the technology for use with wood waste.

To scale-up and manufacture the system, experts from Easy Energy Systems (EES) will use a modular approach that will enable systems to be easily scaled to meet the needs of future users. Sierra Pacific Industries (SPI) will host the technology demonstration at a sawmill in Northern California, enabling the team to evaluate results and chart a pathway to commercialization.



ISU's pilot pyrolysis system, used to convert agricultural residues to bio-oil.

Pathway to Commercialization

- Create refiner and fuel supplier confidence in the technology by demonstrating its ability to provide a consistent supply of high-quality intermediate fuel.
- Optimize the process to balance cost of lowering fuel CI and generating LCFS credit.
- Obtain support from feedstock suppliers based on the economic benefit of converting wood-to-fuel.

ANTICIPATED BENEFITS FOR CALIFORNIA

On-site conversion of wood waste to bio-fuel is a novel way to improve management of California's forests, while supporting California's energy and climate goals. AT-PI pyrolysis offers the potential to expand the supply of low-carbon fuels by hundreds of millions of gallons per year, using sustainably harvested forest residues. Once commercialized, it will:

- Reduce greenhouse gas emissions by increasing the availability of drop-in, low-carbon, renewable fuel for the transportation sector.
- Offer mill operators incentives to clear forest residue without the need to transport wood waste out of forests.
- Provide an economic boost for California's forestry sector and create new jobs in rural counties, as they convert local wood waste into bio-oil.
- Clear forest residue without burning wood waste and causing air pollution.

PROJECT SPECIFICS

Funder: California Energy Commission (GFO-16-901)

Contractor: Lawrence Livermore National Laboratory

Partners: Iowa State University, Easy Energy Systems, Sierra Pacific Industries

Proposed Award: \$5.7 million (\$1.7 million of additional match funding)

Term: January 2018 to December 2020

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