Wood-to-fuel for California's Transportation Sector using Autothermal Pyrolysis

Sean McCoy
Energy Analyst, E-Program

8 November 2017

LLNL-PRES-737119

This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under contract DE-AC52-07NA27344. Lawrence Livermore National Security, LLC

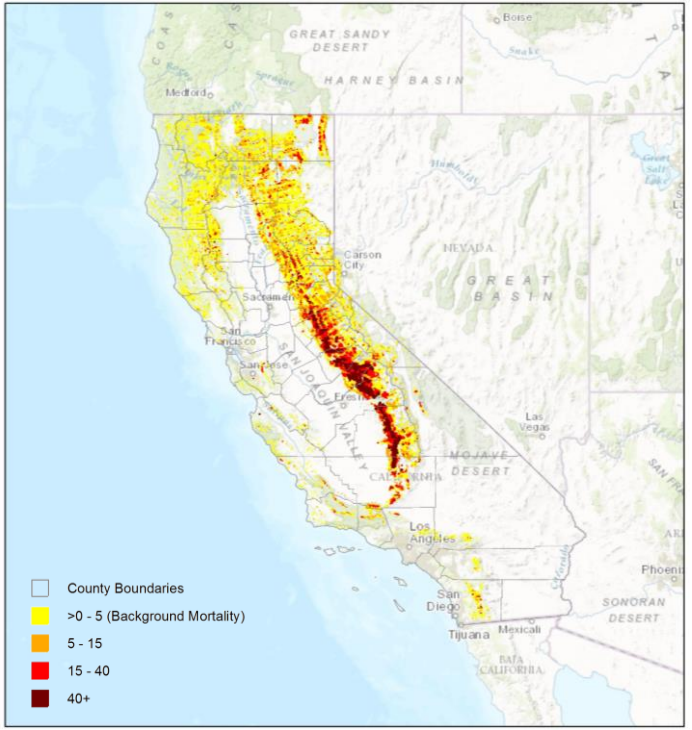
Lawrence Livermore National Laboratory

California's Policy Goals

1. Reduce the carbon intensity (CI) of transportation fuels used in California **10% from the 2010 baseline by 2020** – Low Carbon Fuel Standard (LCFS)

2. **Expand supply of "drop-in", low-carbon, renewable fuels** to support California's climate policies – Alternative and Renewable Fuel and Vehicle Technology Program (ARFVTP)

3. Improve forest management practices and **respond to the increase in tree mortality**



http://egis.fire.ca.gov/TreeMortalityViewer/

CEC Funding Opportunity: Research and Demonstration to Decarbonize Transportation Fuels

"support… **cutting-edge, pre-commercial** low-carbon fuel production processes that result in the **development of bio-oil as an intermediate fuel with wide-scale adoption potential**, and that support California's transportation sector and greenhouse gas emission reduction efforts"

- Minimum award of $3M; **maximum award of $ 5.7M**; **minimum 25% match funding required**

- Timeline:
  - Proposals due 3 April 2017
  - Notice of proposed award May 2017
  - **Funding start December 27 for 26-48 months**

LLNL's Winning Project Proposal

Objective 1:
Technology demonstration

demonstrate our technology on-site at a sawmill

Objective 2:
Bio-oil compatibility

test upgrade to biofuel

Objective 3:
Commercialization pathway

explore commercial potential

GOALS

- *Produce 50,000 gallons of bio-oil*
- *Establish baseline performance*
- *Demonstrate ability to refine bio-oil to transportation fuel*
- *Evaluate whether biofuel can meet CA standards*
- *Evaluate CA market potential*
- *Build market partnerships*
- *Develop roadmap to commercialize in CA*

Project Partners and Responsibilities

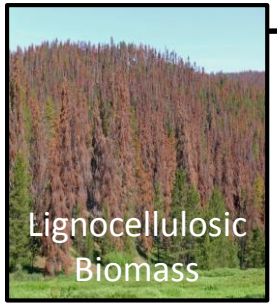
Lawrence Livermore National Laboratory (LLNL)- Prime contractor, responsible for: delivery of project tasks; mandatory and ad-hoc CEC reporting; financial controls; relationship with site; operation of pilot project; TEA\LCA deliverables.

Sierra Pacific Industries (SPI)- Subcontractor to LLNL, responsible for: provision of space, utilities, and feedstock for pilot project; may also use excess bio-oil as cogeneration fuel.

Iowa State University (ISU)- Subcontractor to LLNL, responsible for: provision of IP technology and expertise; pilot testing of feedstocks; upgrading tests for bio-oil; delivery of relevant inputs to analysis and CEC reporting.

Easy Energy Systems (EES)- Subcontractor to LLNL; design, manufacturing, and (as required) operational maintenance of demonstration unit.

ISU's Autothermal Pyrolysis Technology



Autothermal Pyrolysis

Product Recovery

Unrefined Sugars

Phenolic Oil

Unrefined Acetate

Biochar

First Generation Products	-n-Butanol -Acetone -Ethanol	Lignocol Boiler Fuel 	Methane	Soil Amendment
Potential Future Products	-Pharmaceuticals -Polymers 	-Transportation Fuels -Carbon Fibers -Bio-asphalt -Chemicals 	-Transportation Fuels -Acetic Acid -Biocement -Alcohols 	Activated Carbon

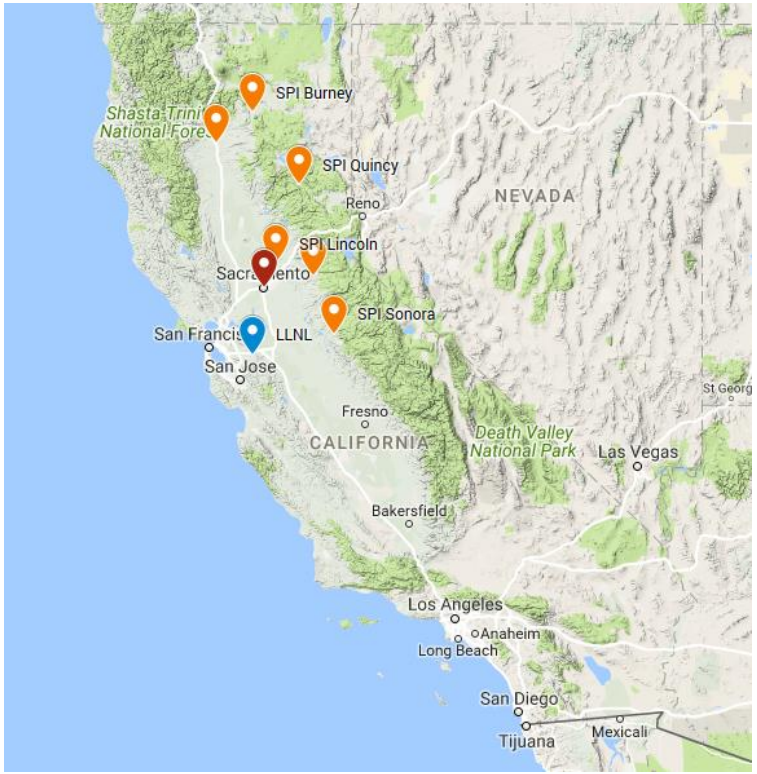
Pre-Award Activities

Site Selection: SPI has offered multiple potential sites. Site visit on 16 August; decision to proceed at Camino site.

NEPA Compliance: Working with LLNL Environmental Stewardship Planning and Monitoring to secure a categorical exclusion.

CEQA Compliance: Aim to secure letter(s) from El Dorado county indicating their willingness to work with LLNL to secure permits for the project

CEC Award: CEC staff hope to present the award to the Commission at a business meeting in December 2017



Thank-you!

Sean McCoy, Ph.D.
Energy Analyst, E-Program
mccoy24@llnl.gov

Lawrence Livermore National Laboratory