CAL POLY HUMBOLDT

Schatz Energy Research Center

Project Brief

DELIVERING CLIMATE AND AIR QUALITY BENEFITS FROM THE USE OF FOREST RESIDUES IN CALIFORNIA

Research effort funded by the California Department of Forestry and Fire Protection (CalFire)

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Background:

The State of California faces crisis conditions on its forested landscapes. The increased drought and hotter, drier, windier weather conditions brought on by climate change have created increasingly severe wildfire conditions in forests already overstocked with biomass following a century of aggressive logging and fire suppression. In light of this ongoing ecological, climate, economic, and public health emergency, and in view of the potential for sustainable forestry to deliver both climate change mitigation *and* adaptation, the state has prioritized funding for forest management with the goal of treating one million acres of forest per year in the near future. This aggressive forest management activity, on top of ongoing commercial activity in California's working forestlands, generates millions of tons per year of woody residues that are typically left or burned in the field, impacting air quality, creating wildfire hazard, and leading to further ecosystem disruption.

Developed with the support of a four-year research grant from the California Energy Commission, the California Biomass Residue Emissions Characterization (C-BREC) model offers a spatially-explicit Life Cycle Assessment framework to rigorously and transparently establish the climate and air pollution impacts of the use of these forest residues for thermoelectric power generation in California. C-BREC characterizes the variable emissions from different biomass supply chains as well as the counterfactual emissions from prescribed burn, wildfire, and decay avoided by residue mobilization. The C-BREC model provides novel approaches to this issue and builds upon prior analyses by:

- Enabling quantification and mapping of criteria pollutant emissions (CO_2, CH_4, N_2O, VOCs, NO_x, SO_2, PM_{10}, $PM_{2.5}$, and black carbon) associated with bioenergy generation
- Quantifying emissions from decay, prescribed burns, and subsequent wildfires in a spatially disaggregated fashion, which is critical to assessing the impact of bioenergy systems on a concrete, case-specific basis
- Employing a time-explicit approach to calculate the relative climate impact of the pulse of emissions related to burning residuals today compared to the time series of emissions associated with leaving them in the field

Modeling with C-BREC shows significant variation in the climate and air quality performance of biomass electricity derived from residues of forest management in California. The following are key findings related to climate impact:

- The life cycle emissions of biopower from woody residues range widely—from comparable with solar PV to comparable with natural gas.
- Using residues that would be otherwise have been burned if not mobilized for biopower generation has a lower net carbon intensity than using material that would otherwise have been left in place.

- There is significant spatial variation in the carbon intensity of feedstock sourced from across the state's forestlands, driven primarily by geographic factors, such as species and size class characteristics of the residue, as well as the climatic drivers of both decay and wildfire emissions.

This project:

The C-BREC model offers the most rigorous and transparent accounting of the life-cycle impact of forest residue-to-electricity systems to date, and its results reveal significant variation in climate and air pollution impacts across supply chains, feedstock types, and geographies in California. C-BREC enables project-level analysis, making it a useful tool in supporting California's forest products industries to deliver on the state's climate and air quality goals going forward. This project will support the expansion and application of the C-BREC platform into the following three targeted policy-relevant use cases for woody biomass:

1. California's Low Carbon Fuel Standard (LCFS) is a transportation fuel policy targeted at reducing the life-cycle carbon intensity of transport fuels used in the state. Given the high LCFS credit price and large market size, liquid transport fuels have been identified as a key market for forest residues. We will collaborate with the managers of this program at the California Air Resources Board to develop a harmonized set of C-BREC outputs quantifying avoided in-field emissions for use in assigning carbon intensity scores to liquid fuels made from woody biomass. A 2021 report from the California Board of Forestry stated that: "As a matter of first priority, CARB could adopt a forest biomass feedstock calculator which estimates the GHG emissions savings from mobilizing in-state forest residues relative to the counterfactual fate of these feedstocks."
2. California's Public Utilities Commission (PUC) manages a feed-in tariff program (BioMAT) which supports the use of woody forest residues in thermoelectric power generation in the state. The PUC department responsible for managing this program recently recommended that participants be required to use the C-BREC model to evaluate the net climate and air quality impacts of their projects to qualify for the program. We will collaborate with the BioMAT team at the PUC to update and adapt the C-BREC webtool to meet their specific programmatic needs.
3. Another potentially key market for woody forest residues is production of biochar. Its potential to provide long-term carbon sequestration in soils adds additional value to the water retention and nutrient adsorption characteristics that make biochar a valuable agricultural amendment. Intent on creating a revenue stream to support that sequestration value, the Climate Action Reserve is developing a protocol to offer rigorous carbon offsets for biochar made from forest residues. Modeling with C-BREC will support this effort in accounting for the variable climate benefit of biochar production to facilitate the creation of a sustainable biochar industry supported by robust and reliable carbon offset revenues.

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More information about the C-BREC model and related work can be found at schatzcenter.org/cbrec/ as well as our 2021 report from the California Energy Commission.