

Governing Sustainability in Biomass Supply Chains - California's Experience
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California Biomass Historical Context. Biomass energy conversion has been a contributor to California's electricity mix since 1978, reached a supply peak by the mid-1990s, but has declined in energy consumed (GWH) in recent years. In 2018, California renewable electricity surpassed 34 percent of total electricity consumption and state law requires achieving 60% renewable electricity by 2030. However, woody biomass electricity contributions will decline because production costs that often exceed 20 cents/kilowatt hour cannot compete with solar and wind at 4 cents/kilowatt hour that prevail in Renewable Portfolio Standard (RPS) auctions.

Unfortunately, a large part of the woody biomass feedstock - agricultural waste (orchard prunings, nut shells, and fruit pits) and forest residue has begun to accumulate with no pathway for economic recovery. Accumulated forest residue and a 2018 increase of 49 million dead trees are significant factors, combined with multi-year drought conditions, inconsistent forest management practices, and population growth into forested areas resulted in the 2018 doubling of California's burned acreage from wildfires compared to the previous year.

Transportation Sector Trends. California is unique in that the transportation sector represents 50 percent of the state's 2018 carbon inventory of 430 million tons of carbon dioxide equivalent emissions. Consequently, government effort to reduce greenhouse gas emissions is focused on 60 government interventions to reduce carbon in the transportation sector.

The Low Carbon Fuel Standard (LCFS) is the predominant state government interventions administered by the California Air Resources Board (CARB) as a regulation requiring obligated parties to reduce the carbon intensity (CI) of petroleum fuels sold and consumed in California by enforcing an annually declining aggregate CI reduction. The LCFS requires a 7.5 percent CI reduction below 2010 levels by 2020 and twenty percent by 2030. Obligated parties are petroleum refineries and marketers who produce gasoline and diesel refined products for sale in California or hold title to petroleum fuel sold in the state.

The LCFS implementation began in 2011, configured as a deficit/credit system in which fuels above the benchmark generate deficits and low carbon fuels below the benchmark generate credits. Fuels with carbon intensities lower than gasoline and diesel and produced or sold in the California market, hold monetary value in the form of credits measured in \$/metric ton of CO₂ equivalent (CO₂E) reduced. The credits are bought and sold in commodity markets and the credit price is capped at \$200/metric ton of CO₂E indexed for inflation – there is no floor price restriction. Liquid biofuels (imported corn ethanol, renewable diesel, biodiesel) and biomethane produced from waste residue represent over 80 percent of the low carbon fuel compliance options and are imported mainly from outside California but delivered into the state for consumption.

Carbon Intensity Lifecycle Analysis. The LCFS is a performance standard based on “well-to-wheels” lifecycle analysis, using a public domain (Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation – GREET 3.0) model as the analytical tool. Carbon intensity is

measured in units of grams of CO₂E/megajoule, in which gasoline and diesel fuels are targets – both were roughly 100 g Co₂E/MJ in the first year, 2011, but the benchmarks are incrementally more stringent each year on a prescribed schedule reflecting the progress to reduce carbon intensity.

The GREET model includes factors related to energy use, greenhouse gas and criteria pollutant emissions, and vehicle efficiency for not only refined petroleum products, but all of the lower carbon intensity options, such as liquid biofuels, biomethane, electricity used in electric vehicles, hydrogen used in hydrogen fuel cell vehicles and a host of other alternative fuels. The carbon intensity results for each pathway are defined by pathway evaluations certified by the CARB. In some instances, indirect land use impacts are included in pathway options, such as purpose-grown crops to produce biofuel feedstocks that reflect greenhouse gas emission impacts of soil disturbance from an increase in cropland. Obligated parties and low carbon fuel producers must register with CARB to maintain their eligibility to participate in the LCFS.

Compliance Action and Credit Market. The obligated parties can take action to reduce carbon intensity and meet compliance benchmarks by improving the energy efficiency of petroleum refineries, modifying their crude oil supply “slate”, displacing petroleum products with their own low carbon fuels, or buying credits generated by low carbon fuel producers when their fuels are bought and blended with petroleum fuels. The CARB maintains compliance records and reports the progress on a quarterly basis. This involves an ongoing “truing up” and audit process to verify compliance. Low carbon fuel producers generate credits and can trade or bank them for future purchases. In some instances, the credits are redeemed by the fuel producer to offset the cost of fuel production and revenue may or may not be shared with the fuel distributor or actual customer. LCFS credits generated by renewable electricity (or statewide average electricity mix or marginal mix) used to charge electric vehicles are held by utilities. In most instances, LCFS credits for electric transportation are configured as revenue to pay rebates for electric vehicle charging system costs, offer free electricity to electric vehicle owners, or pool the funds to cover system-wide electric utility expenses to establish data networking enhancing vehicle grid integration options.

Program Evolution and Interaction with Other Government Initiatives. The LCFS has progressed each year with a more stringent compliance level, although it experienced a two-year freeze (2013-2015) at one percent compliance triggered by a state court action directing CARB to correct procedural errors in adopting the regulation. The LCFS also survived other legal challenges in state and federal courts. The LCFS works in concert with other renewable fuel and greenhouse gas emission policies and programs. Renewable Identification Number (RIN) credits generated by fuel production under the federal Renewable Fuel Standard are complementary and additive to LCFS credits. The California zero emission vehicle mandate and utility rate-based investments in electric transportation infrastructure also benefit from LCFS credits. State government grant programs accelerate market growth of eligible projects contributing to creation of low carbon fuel credits. LCFS expanded credit eligibility to reduce carbon intensity of petroleum based aviation fuels and allow capacity based crediting for zero emission vehicle infrastructure. The California LCFS has stimulated similar low carbon fuel performance standards in Oregon and British Columbia, Canada and the state of Washington has a pending proposal under consideration by its legislature.

