Life Cycle Assessment for Transportation Fuels

EcoShift's Biofuels Footprint Services

Biofuel Life Cycle Analysis: Regulatory Basis

A key component of future federal Climate Change policy will be incorporation of renewable fuels into the transportation fuel mix, which currently comprises over 28% of U.S. energy consumption. Even renewable energy sources like biofuels use fossil fuel energy throughout their life cycle, so life cycle assessment is increasingly becoming an essential tool for understanding the carbon intensity of transportation fuels.

California has approved a plan to reduce the life cycle carbon intensity of transportation fuel by 10% by 2020. Carbon intensity is the total life cycle greenhouse gas emissions from the production, transport, storage, dispensing and use of a fuel. It is expressed as the amount of carbon per unit energy (technically, grams of CO2 equivalent per megajoule of fuel energy or CO2e/MJ). The purpose of the regulation is to incentivize the development of lower carbon fuel for California's transportation system. Any fuel with 10% less carbon than conventional transportation fuel can generate credits, which must be purchased by fuel producers that are non-compliant with the LCFS. We anticipate that a similar framework will be adopted at the national level.

How California's LCFS works

The LCFS requires any fuel provider in California to register with the California Air Resources Board (CARB) and determine its carbon intensity. Carbon intensity values are obtained from a "lookup table" in the LCFS regulation. CARB generated these values with a greenhouse gas emissions model called Regulated Emission and Energy consumption of Transportation Fuel (GREET) developed by Argonne National Labs. Where no values for a specific fuel are found, additional fuel pathways must be created using a similar model.

The fuel pathway describes the life cycle greenhouse gas emission along the fuel's route as it moves from "well to wheels" for fossil fuels, or from "seed or field to wheels" for biofuels. The pathway is the aggregate of various input values for the direct emission associated with each stage of the life cycle including production, transport, storage, dispensing, and use. Emissions may also result from land use or other indirect effects. Changes to land use change modifications must employ the GTAP (Global Trade Analysis Project) model.

How can PathwayShift help you accurately assess carbon intensity?

Because the CARB data are necessarily broad and general, the carbon intensity of your fuel pathway may not be accurately described. EcoShift's consultants can analyze the life cycle of your fuel to recalculate any overestimates found in the carbon intensity lookup table. Any changes to the carbon intensity values are subject to public comments and hearings, so they must be based on scientifically defensible and robust data. Ecoshift is familiar with the California modifications to the GREET model, and will assess where the published input values differ from the actual processes used to produce your fuel. We will help gather technical specifications for new equipment, develop flow diagrams representing fuel pathways, identify peer-reviewed technical papers to support your application, determine land use change impacts, and collect monitoring data for proposed equipment and processes.

Establishing Fuel Pathways

There are two means of determining the carbon intensity of a transportation fuel sold in California. Under Method 1, when registering a transportation fuel, values are selected from the carbon intensity lookup table.

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The number of feedstocks and fuel types found in the table are currently limited, and the pathways presented are worst case estimates, so a regulated party may aim to establish a more accurate value for their fuel.

There are two methods for establishing new fuel pathways. Under Method 2A, new sub-pathways—modified versions of existing pathways from the lookup table—can be added to the lookup table when a fuel provider demonstrates improvement in the carbon intensity of a particular process. Under Method 2B, an entirely new fuel pathway can be added to the lookup table. Any new fuels, feedstocks, or processes for an existing fuel can be added to the lookup table. In both 2A and 2B Methods, land use change or other indirect impacts require investigation.

Improving your existing pathway?

Since Ecoshift is familiar with the various design improvements in the acquisition and processing of fuels, and follows the ISO 14040 life cycle analysis guidelines, we can help you identify places to improve the physical pathway used to produce your biofuel. Once implemented with your fuel, we can then apply to CARB for a new pathway.

We work to achieve transitions to sustainable practices that are transparent, clearly quantified, marketable, and cost-effective. With a broadly trained team, EcoShift Consulting produces comprehensive sustainability solutions for small and large private enterprises and local governments.

EcoShift consultants are broadly trained in energy policy, engineering, carbon modeling, economics, and lifecycle assessment. Our principals are doctorate-level scientists that teach and conduct research at leading California universities, and our analysts are highly trained specialists within their respective fields.

Sample carbon intensities from the CARB lookup table

Fuel	*Pathway*	*Carbon Intensity (gCO2e/MJ)*
Gasoline	Average crude oil delivered to California refineries; average California refinery efficiency	95.86
Diesel	Average crude oil delivered to California refineries; average California refinery efficiency	94.71
Biodiesel	Waste oils	15.84
Biodiesel	Tallow conversion; low energy rendering	19.65
Ethanol Corn	California average; Dry mill, wet distillers' grains; natural gas	50.70
Ethanol Corn	Midwest; Wet Mill; 60% natural gas, 40% coal	75.10
Ethanol Sugarcane	Brazil average	27.40
Natural gas, Compressed	California via pipeline; Compressed in California	67.70
Natural gas, Compressed	Dairy Digester Biogas derived	13.45
Electricity	California average electricity mix	124.10

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