

Low Carbon Fuel Standard



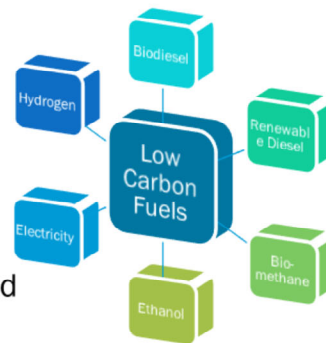
History and Background



- LCFS History
- LCFS is Part of a Portfolio of GHG Policies
- Basic LCFS Requirements
- Declining Carbon Intensity Curve

LCFS History

- Key Milestones:
 - Original adoption in 2009, amended in 2011, re-adopted in 2015, amended in 2018
- Goal: Reduce carbon intensity (CI) of transportation fuel pool by at least 20% by 2030
- Expected benefits:
 - Complement other AB 32 measures
 - Transform and diversify fuel pool
 - Reduce petroleum dependency
 - Reduce emissions of other air pollutants



In 2009 the Board approved the LCFS regulation to reduce the carbon intensity (CI) of transportation fuel used in California by at least 10 percent by 2020 from a 2010 baseline. In 2011, the Board approved amendments to clarify, streamline, and enhance certain provisions of the regulation. In 2015, the Board re-adopted the LCFS to address procedural issues, which began implementation on January 1, 2016. In 2018, the Board approved amendments to the regulation, which includes strengthening and smoothing the CI benchmarks through 2030 in-line with California's 2030 GHG target enacted through SB32.

The LCFS is one of the key AB 32 measures to reduce greenhouse gas emissions in California but also has other significant benefits. It transforms and diversifies the fuel pool in California to reduce petroleum dependency and achieves air quality benefits, which are State priorities that preceded AB 32.

LCFS is Part of a Portfolio of GHG Policies

- Transportation sector responsible for:
 - 50% GHG emissions
 - 80% NOx emissions
 - 95% PM emissions
- LCFS works with the following programs to reduce transportation GHG emissions:
 - Cap-and-Trade Program
 - Advanced Clean Cars Program
 - SB 375
- Key program to achieve Governor's petroleum reduction goal by 2030

The LCFS is designed to reduce GHG emissions in the transportation sector, which is responsible for about 50 percent of GHG emissions (including industrial sector emissions from refining and crude production), 80 percent of ozone-forming gas emissions, and over 95 percent of diesel particulate matter.

It is a key part of a comprehensive set of programs in California to reduce emissions from the transportation sector, including the Cap and Trade Program, Advanced Clean Cars Program, and SB 375.

The LCFS is also a key program to achieve the governor's goal of cutting petroleum use in half by 2030.

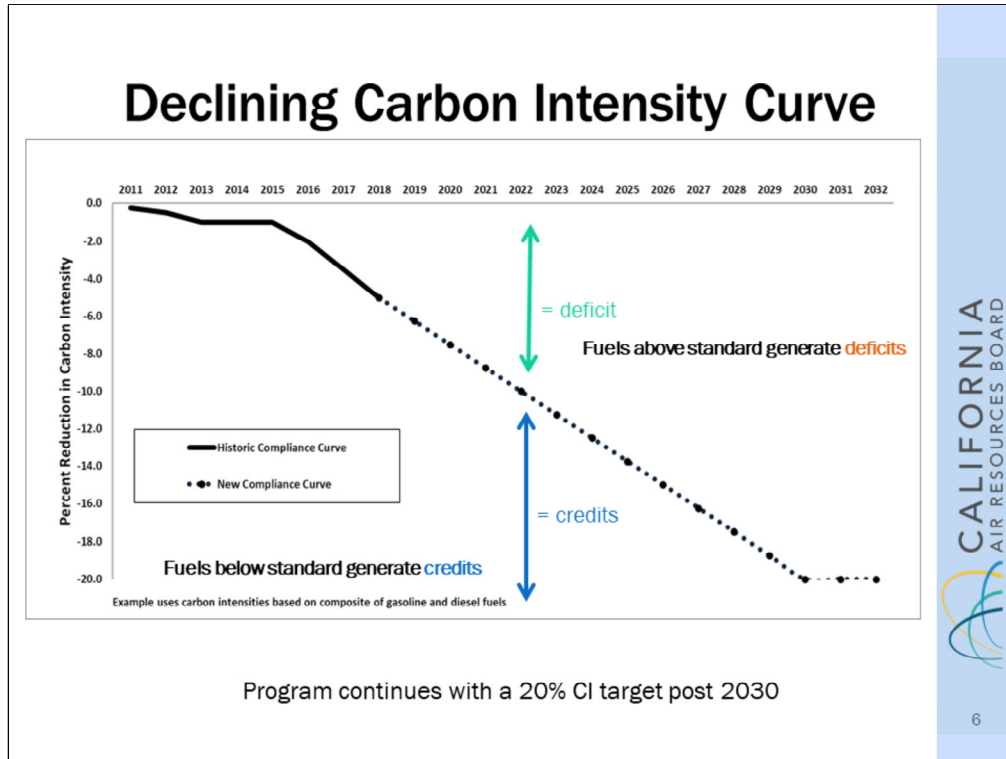
Basic LCFS Requirements

- Sets annual carbon intensity (CI) standards, or benchmarks, for gasoline, diesel, and the fuels that replace them
- CI is the measure of GHG emissions associated with producing, distributing, and consuming a fuel, which is measured in grams of carbon dioxide equivalent per megajoule (gCO₂e/MJ)
- CI based on complete life cycle analysis

The LCFS sets annual carbon intensity (CI) standards, or benchmarks, which reduce over time, for gasoline, diesel, and the fuels that replace them.

Carbon intensity is expressed in grams of carbon dioxide equivalent per megajoule of energy provided by that fuel. CI takes into account the GHG emissions associated with all of the steps of producing, transporting, and consuming a fuel—also known as a complete life cycle of that fuel.

The LCFS lets the market determine which mix of fuels will be used to reach the program targets.



Fuels and fuel blendstocks introduced into the California fuel system that have a CI higher than the benchmark generate deficits. Similarly, fuels and fuel blendstocks with CIs below the benchmark generate credits. Annual compliance is achieved when a regulated party uses credits to match its deficits.

Since the regulation was first adopted, the compliance curves have been “back-loaded” to allow time for the development of low-CI fuels and advanced vehicles (the benchmark CI reduction was frozen by court order for three years between 2013 and 2015). Due to this program design choice, there has always been the expectation that excess credits generated in the early years of the program would be available for use in more stringent future years, if needed.

Under the current LCFS regulation, the 2030 standard of a 20 percent CI decline will also be imposed for all years post-2030.

Status of the LCFS



- Status of the LCFS
- Others are joining California: Pacific Coast Collaborative

Status of the LCFS

- Low carbon fuel use is increasing, and fuel producers are taking action to decrease carbon intensity
- Established market for credit transactions with the total value exceeding \$2 billion in 2018
- The LCFS Data Dashboard contains current and historical LCFS program data
 - Volume of fuels and credits generated
 - Percent reduction in carbon intensity
 - Average credit prices and credit volumes transacted

[Click here to access the LCFS Data Dashboard web page](#)



Since the regulation went into effect, low carbon fuel use has increased. Fuel producers are also taking action to decrease the carbon intensity of their fuels.

The program has an established market for credit transactions. The total value of credit transactions exceeded \$2 billion in 2018.

The LCFS Data Dashboard web page was created to display the current and historical LCFS program data. Some of the information found in the Data Dashboard are the following:

- Volume of fuels and credits generated under the LCFS
- Compliance curve and the percent reduction in carbon intensity to date
- Credit volumes transacted and the average credit prices per month under the LCFS.

To see the Data Dashboard, please see

<http://www.arb.ca.gov/fuels/lcfs/dashboard/dashboard.htm>.

Others are Joining California: Pacific Coast Collaborative



- Pacific Coast Collaborative (PCC) is a regional agreement between California, Oregon, Washington, and British Columbia
- Strategically align policies to reduce GHGs and promote clean energy
- CA, OR, and BC: LCFS programs in place
- Regional low-carbon fuels market in the future with Washington considering a program
- Other regions including Canada and Brazil are taking notice of PCC's success and developing LCFS-like performance standards for transportation fuels

Other jurisdictions are joining California, which is evident in the Pacific Coast Collaborative, a regional agreement between California, Oregon, Washington, and British Columbia to strategically align policies to reduce greenhouse gases and promote clean energy.

One of the provisions of this Collaborative explicitly addresses Low Carbon Fuel Standard programs. California, Oregon, and British Columbia have existing LCFS programs in place and the Washington legislature is considering a program.

Staff has been routinely working with these jurisdictions, providing assistance where we can. Over time, these LCFS programs will build an integrated West Coast market for low-carbon fuels that will create greater market pull, increased confidence for investors of low carbon alternative fuels, and synergistic implementation and enforcement programs.

Other regions including Canada and Brazil are also noticing California's success and developing LCFS-like performance standards for transportation fuels.

Components of the LCFS



- Overview of Credit Generation Opportunities
- Overview of Entities
- Exemptions to the LCFS
- Benchmarks for Gasoline, Diesel, Jet Fuel and their Substitutes
- Life Cycle Analysis
- Demonstrating Compliance and Reporting
- Third Party Verification
- Price Cap Provides Consumer Protection
- Project-based Credit Opportunities
- Carbon Capture and Sequestration
- LCFS Electricity and Hydrogen Provisions

Overview of Credit Generation Opportunities

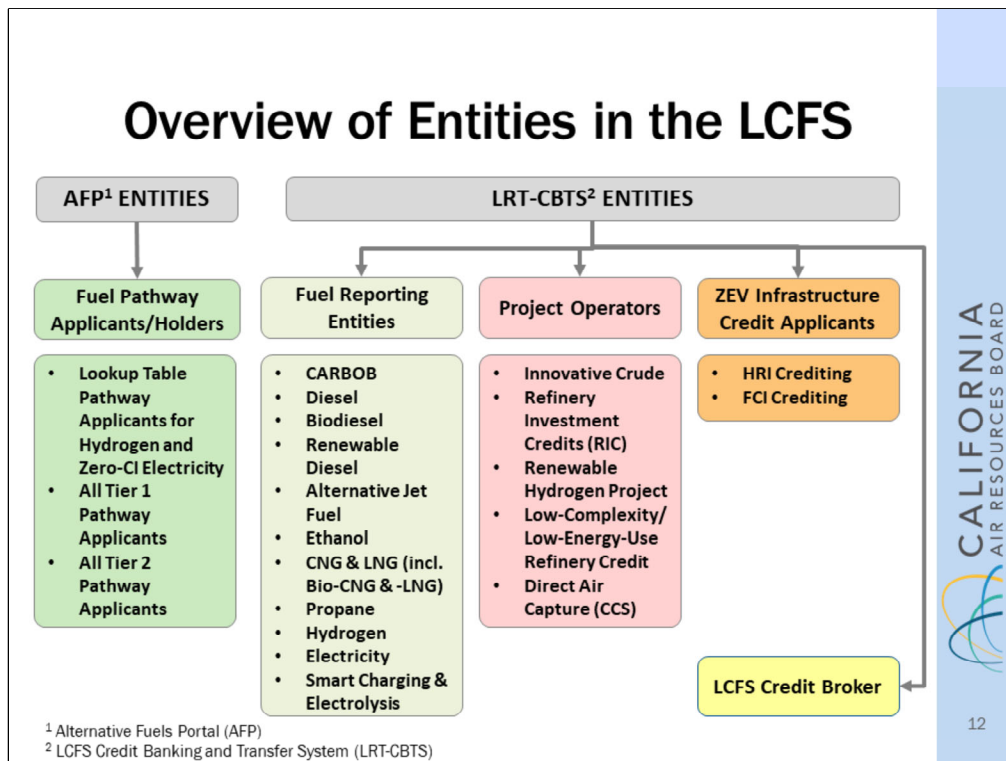
- **Fuel Pathway-based Crediting**
 - Providers of low carbon fuels used in California transportation generate credits by obtaining a certified CI and reporting transaction quantities quarterly
 - Verification occurs post-credit generation
 - Credits are calculated relative to the annual CI benchmarks
- **Project-based Crediting**
 - Projects include emission-reducing actions at refineries and crude oil production and transportation facilities, and carbon capture and sequestration using direct air capture
 - Project operators generate credits by determining the GHG emission reductions (in metric tons)
 - Verification occurs before credits are issued
 - Credits are equal to life cycle GHG reductions (in metric tons)
- **Zero Emission Vehicle Infrastructure (Capacity-based) Crediting**
 - Hydrogen refueling and direct current (DC) fast charging infrastructure
 - Credits are determined on the basis of the capacity of the station to provide fuel when fully-utilized, less the quantity of fuel that is dispensed and credited through fuel pathways

There are three ways to generate credits in the LCFS: fuel pathways, projects, and capacity-based crediting.

Under fuel pathway-based crediting, all transportation fuels need a carbon intensity score to participate in the LCFS, and the fuel type dictates which process is used to determine that CI. Providers of low carbon fuels used in California transportation generate credits by obtaining a certified CI and reporting transaction quantities on a quarterly basis. Credits are calculated relative to the annual CI benchmark and will undergo verification post credit generation.

Under project-based crediting, projects include actions to reduce GHG emissions in the petroleum supply chain, and also CCS using Direct Air Capture. Crediting for projects is based on life cycle emission reductions, and credits are issued after the reported reductions are verified.

Finally, the 2018 amendments added a new crediting mechanism to the LCFS which is designed to support the deployment of zero emission vehicle infrastructure. Crediting for ZEV infrastructure is based on the capacity of the hydrogen station or EV fast charging site minus the actual fuel dispensed.



The Alternative Fuels Portal (AFP) and the LCFS Credit Banking and Transfer System (LRT-CBTS) are two of the modules that make up the LCFS database management system. Not depicted here is the Verification module, which will provide access to participant data for LCFS-accredited Verification Bodies.

The AFP facilitates the application process to obtain a certified CI score. Applicants for Tier 1 and Tier 2 pathways, which rely on site-specific data, use this portal to submit their CI calculator and supplemental information.

All Lookup Table CI values were historically obtained through the LRT-CBTS. Beginning in 2019, all applicants for Hydrogen Lookup Table pathways will apply through the AFP, along with applicants for the Zero-CI Electricity Lookup Table pathway. Entities seeking any other Lookup Table pathway, including CARBOB, ULSD, California Average Grid Electricity, CNG, LPG, and Smart Charging or Smart Electrolysis, do not need to register in the AFP and will continue to use the LRT-CBTS.

The LRT-CBTS is designed specifically to facilitate reporting and credit banking and transfers. Beginning in 2019 it will also be able to process project-based crediting and ZEV infrastructure crediting applications.

Entity requirements and responsibilities are defined by the role each entity plays. An entity may have multiple roles in the LCFS, such as an alternative liquid fuel producer may be a Fuel Pathway applicant, but because this entity also reports and generates credits, they are a fuel reporting entity as well. A hydrogen station owner who generates infrastructure credits must also be a fuel reporting entity (to report the quantity of fuel dispensed); this entity may also be a pathway holder, or another entity could have taken the responsibilities of applying for and maintaining the pathway. All fuel pathway applicants become fuel pathway holders once their CI is certified; they must annually demonstrate that the pathway remains valid.

Note that applications for carbon capture and sequestration may be approved through the:

- AFP (fuel pathway-based crediting) if the capture occurs within the process of an alternative fuel pathway, e.g., CO₂ from ethanol fermentation
- LRT (project-based crediting) if the capture is associated with crude oil production (Innovative Crude provisions) or a petroleum refinery (Refinery Investment Credit provisions), or by direct air capture (not associated with any fuel; may be credited as a stand-alone project).

To access the LRT-CBTS and AFP, please see <https://ssl.arb.ca.gov/lcfsrt/index.html?aspxerrorpath=/lcfsrt/Login.aspx>.

Exemptions to LCFS

- Alternative fuel that
 - Is not a biomass-based fuel
 - Is supplied in California by all providers of that particular fuel for transportation use at an aggregated quantity of less than 420 million MJ/year
- Conventional jet fuel or aviation gasoline
- Deficit-generating fuel used in military tactical vehicles and tactical support equipment
- Fuel used in interstate locomotives
- Fuel used in ocean-going vessels (does not apply to shore power provided to ocean-going vessels at-berth, nor to recreational and commercial harbor craft)
- Credit-generating fossil CNG or fossil propane dispensed at a fueling station with a total throughput of < 150,000 GGE/year (exempt until 2021 or 2024, respectively)
- Deficit-generating fossil propane and CNG used in school buses that were purchased prior to January 1, 2020

The LCFS regulation does not apply to an alternative fuel that is not a biomass-based fuel or is supplied in California with an aggregated quantity of less than 420 million MJ/year. Conventional jet fuel, aviation gasoline, deficit-generating fuel used in military tactical vehicles, and credit-generating fossil CNG or fossil propane dispensed at a fueling station with total throughput of 150,000 gasoline-gallons equivalent or less per year (until 2021 or 2024, respectively) are also exempt from the LCFS. The LCFS regulation also does not apply to fuels used in interstate locomotives, ocean-going vessels, and deficit-generating fossil propane and CNG used in school buses purchased prior to January 1, 2020.

Carbon Intensity Benchmarks for Gasoline and Diesel Fuel and their Substitutes

Year	Gasoline Average CI (gCO ₂ e/MJ)	Diesel Average CI (gCO ₂ e/MJ)
2019	93.23	94.17
2020	91.98	92.92
2021	90.74	91.66
2022	89.50	90.41
2023	88.25	89.15
2024	87.01	87.89
2025	85.77	86.64
2026	84.52	85.38
2027	83.28	84.13
2028	82.04	82.87
2029	80.80	81.62
2030 onwards	79.55	80.36

Credits and deficits are calculated using the carbon intensity benchmarks for gasoline and diesel fuel in each calendar year. These benchmarks equate to a 6.25 percent reduction in carbon intensity relative to 2010 in the 2019 compliance year, increasing linearly to a 20 percent reduction in 2030.

Carbon Intensity Benchmarks for Fuels Used as a Substitute for Conventional Jet Fuel

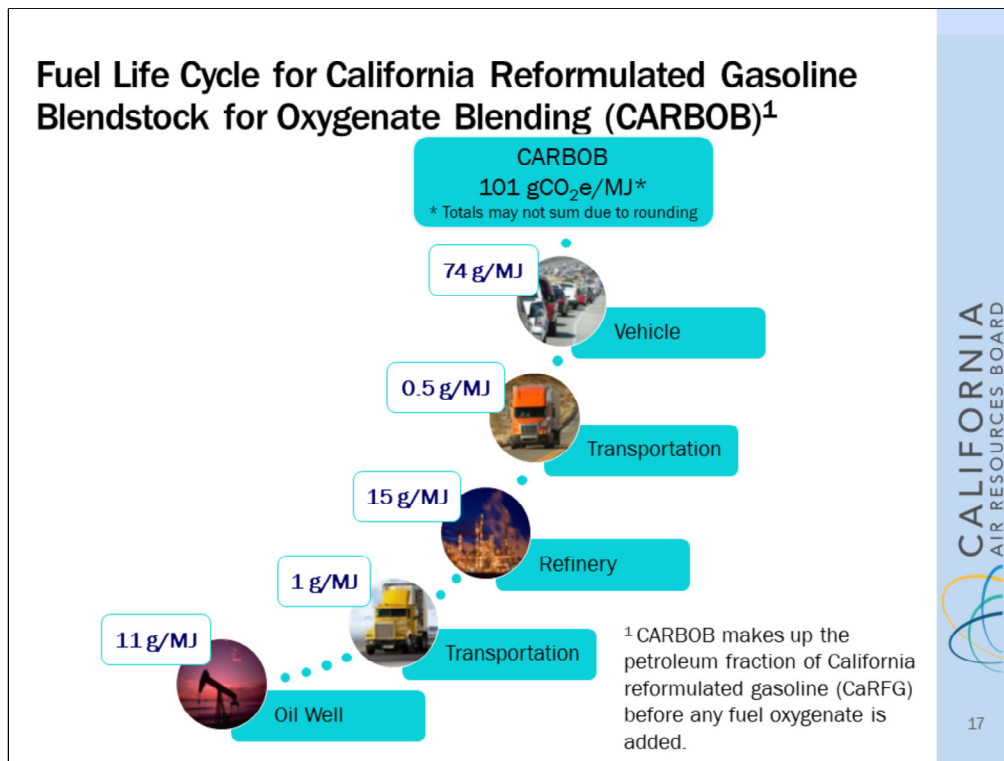
Year	Average CI (gCO ₂ e/MJ)
2019	89.37
2020	89.37
2021	89.37
2022	89.37
2023	89.15
2024	87.89
2025	86.64
2026	85.38
2027	84.13
2028	82.87
2029	81.62
2030 onwards	80.36

Since conventional jet fuel is not subject to the LCFS regulation and does not generate deficits, these carbon intensity benchmarks are used specifically to calculate credits from alternative jet fuel. The jet fuel benchmarks remain fixed at the 2010 baseline CI for conventional jet fuel, with a zero percent reduction in each year, until the benchmark for diesel substitutes declines below the CI baseline for jet fuel, in 2023. The jet fuel benchmarks then mirror the benchmarks for diesel through 2030.

Life Cycle Analysis

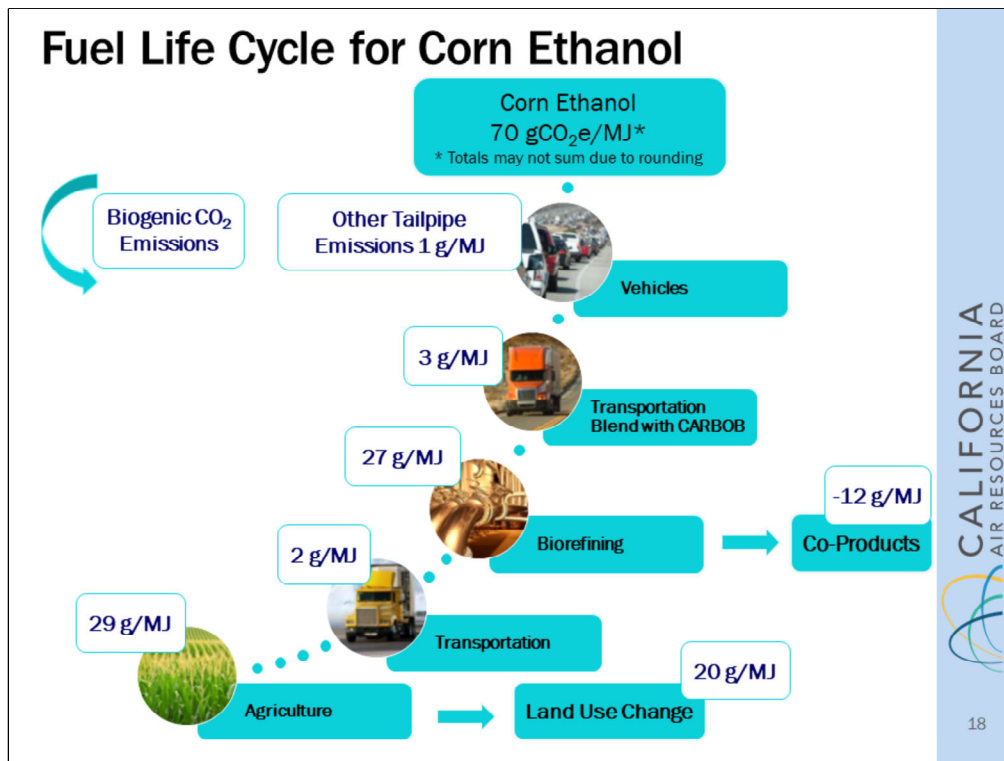
- CI includes the “direct” effects of producing and using the fuel, as well as “indirect” effects that are primarily associated with crop-based biofuels
- CI is calculated using the following tools
 - **California Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (CA-GREET):** Direct carbon intensity of fuel production and use
 - **Oil Production Greenhouse Gas Emissions Estimator (OPGEE):** Direct carbon intensity of crude production and transport to the refinery
 - **Global Trade Analysis Project (GTAP):** Indirect land use change
 - **Agro-Ecological Zone Emissions Factor (AEZ-EF):** Matches land conversions estimated by the GTAP model with corresponding carbon releases from soil and biomass

The CI includes the “direct” effects of producing and using the fuel, as well as “indirect” effects that are primarily associated with crop-based biofuels. Two models are used to calculate the direct effects, which are the California Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (CA-GREET) and Oil Production Greenhouse gas Emissions Estimator (OPGEE) models. To calculate the indirect effects, the Global Trade Analysis Project (GTAP) model was updated and the Agro-Ecological Zone Emissions Factor (AEZ-EF) model was created to supplement GTAP’s estimates of greenhouse gas emissions from various types of land conversions.



This is an illustration of the life cycle assessment of California Reformulated Gasoline Blendstock for Oxygenate Blending (CARBOB). CARBOB makes up the petroleum fraction of California reformulated gasoline (CaRFG) before any fuel oxygenate is added; CARFG is essentially 90 percent CARBOB blended with 10 percent ethanol by volume.

CARBOB CI is based on the 2010 average crude oil supplied to California refineries and average California refinery efficiencies. Crude oil is evaluated using the OPGEE model; the crude supplied to California refineries in 2010 was found to have an average CI of 11.78 gCO₂e/MJ, with some crudes ranging from as low as 4 to as high as 30 gCO₂e/MJ. Production of CARBOB at all California refineries adds 14.8 g/MJ to the fuel cycle CI. About 75 percent of the GHG emissions from the life cycle of CARBOB occur during combustion in vehicles (tailpipe emissions).



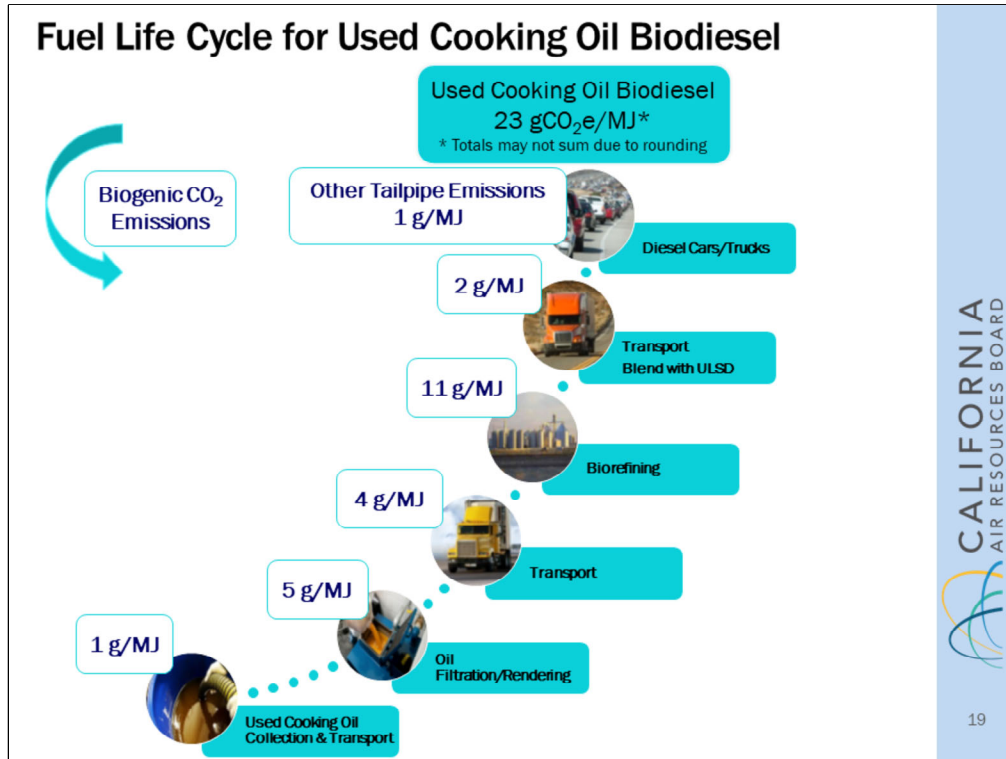
This is an illustration of the life cycle assessment of corn ethanol. Emissions associated with agriculture contribute 29 gCO₂e/MJ; of that, 11 g result from the production of fertilizer and soil amendments, and the soil emissions resulting from synthetic and organic additions contribute an additional 14 g/MJ, and on-farm emissions from energy use in tractors during activities such as planting, cultivation and harvest, make up the remainder.

Emissions from production at the ethanol facilities vary widely depending on their process fuels, their efficiencies, and any processing of co-products, such as drying distiller's grains and solubles (DGS). Please note that this slide contains numerical values for illustrative purposes only.

DGS is the remnants of the corn after fermentation and is sold and used as livestock feed. A credit of -12 g/MJ is assessed for the production of DGS at a typical rate of 5.31 dry pounds per gallon of ethanol; this credit reflects market displacement of corn and other feed ingredients from LCFS application

Contributing substantially to the impacts associated with corn (and other crops) used to produce biofuels is the phenomenon called land use change, or LUC. LUC occurs when higher ethanol demand increases the demand for corn, raising its market price. Someone, somewhere, reacting to this price signal, will convert land to corn production, either directly or through a series of daisy-chain events, which will result in carbon emissions from that land. The estimated amount of land conversion and associated GHG emissions are determined using the GTAP and AEZ-EF models and are added to the CI of corn ethanol. All crop-based feedstocks have LUC values.

Finally, the CO₂ emitted from vehicles during biofuel combustion is considered carbon neutral, in accordance with IPCC and U.S. EPA GHG inventory guidelines, as the carbon released was uptaken from the atmosphere by the corn within a short timeframe. Additionally, ethanol is required to be denatured in order to render it unfit for human consumption. A small amount of gasoline blendstock is added, typically 2.5%v/v, for this purpose, adding 1 g/MJ to the CI of denatured ethanol.

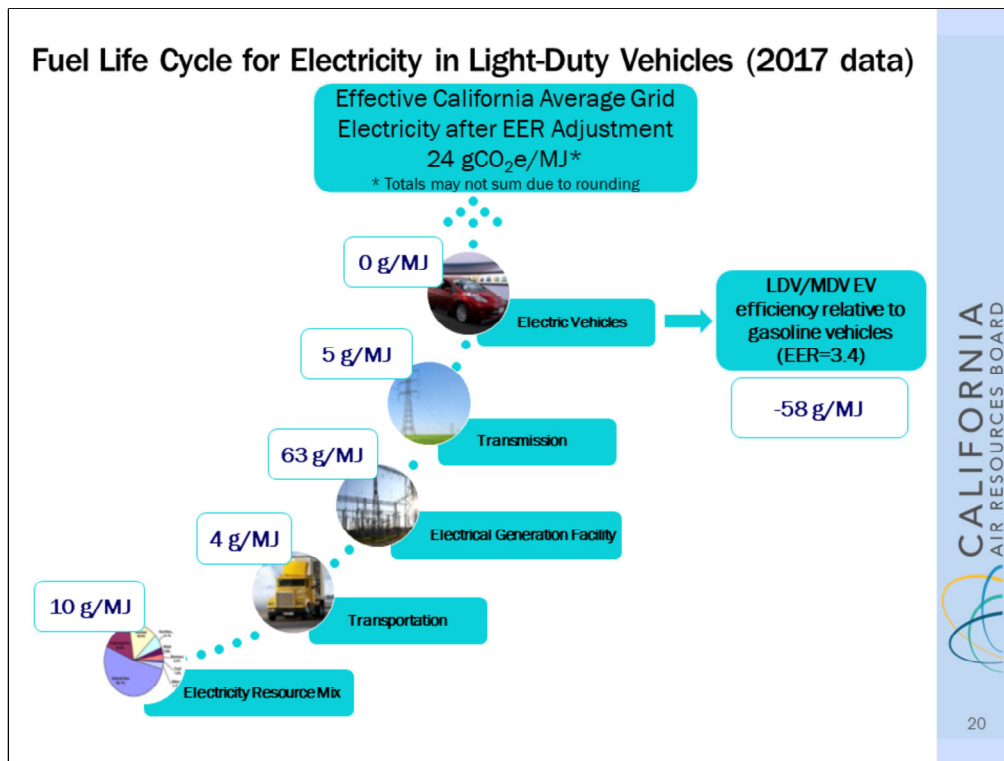


This is an illustration of the life cycle assessment of biodiesel made from used cooking oil (UCO). UCO, also known as waste grease, is collected from sites like industrial food processors and restaurants. The UCO is transported to a rendering facility where it is filtered and purified to remove any water, solids, contaminants, to reduce the level of free fatty acids (FFA) and ensure the oil has the correct properties required for fuel production.

The rendered oil is then transported to a biorefinery where it is converted to biodiesel by reacting with methanol in a chemical process called esterification. The process also yields a co-product, glycerin; an accounting method known as energy-based allocation is used to divide the total emissions from the facility between its two products. 95 percent of the production emissions are attributed to biodiesel and the remaining 5 percent to glycerin.

Please note that this slide contains numerical values for illustrative purposes only.

The CO₂ emitted from vehicles during biofuel combustion is considered carbon neutral, in accordance with IPCC and U.S. EPA GHG inventory guidelines, as the carbon released was uptaken from the atmosphere within a short timeframe by the plant that produced the oil. A small amount of emissions, less than 1 g/MJ, result from the GHGs (methane and nitrous oxide) that form during biodiesel combustion.



This is an illustration of the life cycle assessment of California's average grid electricity when it is used to charge Electric Vehicles (EV).

The carbon intensity of California electricity is calculated in CA-GREET 3.0 using the 2017 average California generation resource mix from the CEC database¹, slightly modified to match CA-GREET resource categories² in order to calculate the emissions associated with each resource.

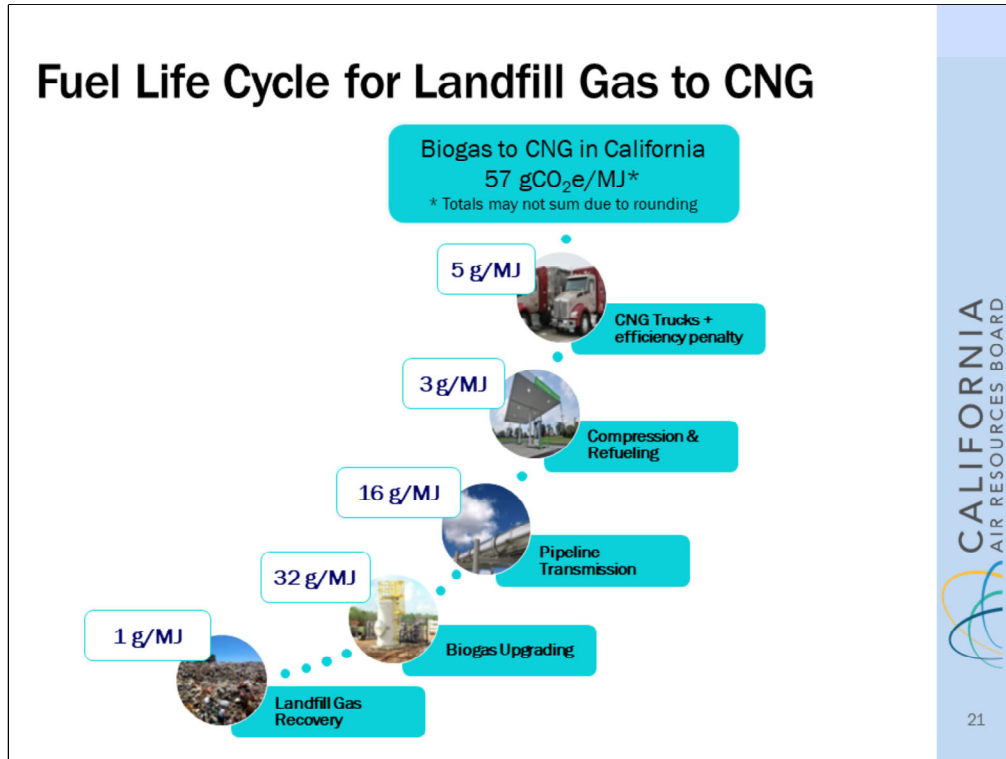
The GHG emissions for this pathway consist of the upstream emissions associated with producing and transporting each fuel to the power plant, the emissions associated with generating electricity (combustion of fossil based resources like natural gas), and transmission line losses (translated to emissions from the excess electricity that must be supplied to meet demand).

Finally, EVs in the Light-duty Vehicles (LDV) and Medium-duty Vehicles (MDV) are over three times more efficient than the internal combustion engines (ICE) they replace. The life cycle emissions from electricity generation sum up to 81.49 gCO₂/MJ of electricity, but the effective CI shown here is on the basis of the amount of gasoline that is displaced by the use of EVs. The efficiency ratio is, therefore, translated to an emission savings representing the smaller amount of energy an EV needs to travel the same distance as an ICE.

¹ 2017 California Total System Electric Generation, California Energy Commission:

https://www.energy.ca.gov/almanac/electricity_data/total_system_power.html

² California Air Resources Board, CA-GREET 3.0 Supplemental Document and Tables of Changes, 13-AUG-2018: https://www.arb.ca.gov/fuels/lcfs/ca-greet/cagreet_supp_doc_clean.pdf



This illustration shows the stages that are analyzed while performing life cycle assessment of compressed natural gas (CNG) from landfill gas (LFG). LFG is also known as biogas as it originates from organic materials which decompose without oxygen in landfills, resulting in generation of methane. Biogas is typically 50-60% methane and the remainder is made up of CO₂ and trace gases.

Recovery of biogas is accomplished using electrical fans to draw gas up through wells inserted throughout a landfill. Most landfills are required to capture LFG and oxidize methane to CO₂ by the use of a flare or thermal oxidizer. By capturing and using this gas as a transportation fuel rather than flaring, CO₂ emissions are avoided.

Capture mechanisms are imperfect, resulting in an estimated 25 percent of LFG that escapes the flare; this emission is considered outside of the LCA system boundary, as it occurs whether a landfill is capturing gas for use as a fuel, or for flaring. This is a principle of life cycle assessment, which seeks to determine what emissions would occur in a reference or baseline scenario, and compares the project case in order to determine the net change caused by a process or product.

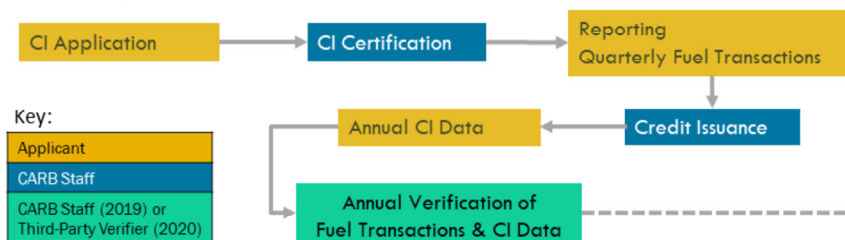
Biogas upgrading is where the majority of the emissions associated with LFG to CNG occur. The objective is to remove CO₂, water, and to scrub unwanted components such as hydrogen sulfide in order to bring the biogas to pipeline-quality and motor vehicle standards. At this stage the gas is referred to as biomethane.

Transmission via the system of natural gas pipelines that span the U.S. can also result in a significant quantity of emissions, for a conservative distance from a landfill to CA, 3,600 miles pipeline is chosen. Compressors require energy to move gas through pipelines, and methane has opportunities to escape during gas transmission; the magnitude of emissions is dependent on the distance gas travels from its source to its end use.

When pipeline gas is withdrawn at a refueling station, it is compressed to CNG before it is injected into a vehicle. The tailpipe emissions that occur during combustion of CNG in a natural gas engine for methane and nitrous oxide only; CO₂ is cancelled with the avoidance of the combustion of a flare. Please note that this slide contains numerical values for illustrative purposes only.

Fuel Pathway Based Crediting

- All transportation fuels have a certified carbon intensity (CI)
 - Lookup Table: Simplest pathways, including gasoline and diesel; CI is predetermined by CARB
 - Tier 1: For the most common low carbon fuels; use a Simplified CI Calculator to determine CI
 - Tier 2: For innovative, next generation fuel pathways, including fuel pathways with carbon capture and sequestration, use the full CA-GREET 3.0 model
- Credits are calculated based on CI of the fuel, EER of the vehicle-fuel combination, and the quantity of fuel that is transacted in each quarter



All transportation fuels need a carbon intensity score to participate in the LCFS, and the fuel type dictates which process is used to determine that CI.

Lookup Table pathways have CI scores that are predetermined by CARB using industry-wide average inputs, or conservative assumptions. Most of the fuels in the Lookup Table don't require an application, and those that do require an application have a few requirements and a very streamlined approval process.

The Tier 1 pathway application process is for the most common low carbon fuels, and applicants use a Simplified CI Calculator to determine their site-specific fuel production and transport emissions. Under Tier 1, most emissions from feedstock production are based on standard inputs, but the calculators have some flexibility to accommodate user-defined process energy inputs.

The Tier 2 application process is designed for innovative, next-generation pathways, which may use unique feedstocks or include advanced technologies like Carbon Capture and Sequestration. Tier 2 fuels include Alternative jet fuel, and any other pathway that is not eligible to use the Lookup Table or Tier 1 process. Applicants for these pathways can fully customize the California GREET model to accurately determine their site-specific CI.

The diagram shows the basic process for credit generation. Credits for fuel pathways are calculated based on the CI score that is determined in the initial pathway application, the energy economy ratio or EER for the type of vehicle the fuel is used in, and the quantity of fuel reported. Credits are issued quarterly, and pathways with site-specific CI data will typically be verified annually.

Demonstrating Compliance and Reporting

- Compliance period: January 1st through December 31st
- A Deficit Generator's annual compliance obligation is met when it has retired a number of credits from its credit account that is equal to its deficits
- Fuel transactions from each calendar quarter are reported during the next calendar quarter
 - After each deadline, no credits can be generated for an activity that took place in the prior quarter (e.g., no credits will be issued for a transaction in the 1st quarter that is reported after June 30th)
 - Transactions involving business partners must be reconciled by the "Deadline" dates shown in the following table

LCFS Reporting Schedule

Report	Period Covered	Deadline
1 st calendar quarter	January - March	June 30 th
2 nd calendar quarter	April - June	September 30 th
3 rd calendar quarter	July - September	December 31 st
4 th calendar quarter	October - December	March 31
Annual	The prior calendar year	April 30 th

For more information on the LRT-CBTS and AFP, please click [here](#) to access the Data Management System web page

A regulated entity's annual compliance obligation is met when the regulated entity demonstrates via its annual report that it possessed and has retired a number of credits from its credit account that is equal to its compliance obligation. The annual compliance period is January 1st through December 31st of each calendar year.

Fuel transactions from each calendar quarter are reported during the next calendar quarter. After each deadline, no credits can be generated for an activity that took place in the prior quarter. Transactions involving business partners must be reconciled by the "Deadline" dates shown in the LCFS Reporting Schedule table. The quarterly reporting schedule is as follows:

- June 30th: For the first calendar quarter covering January through March
- September 30th: For the second calendar quarter covering April through June
- December 31st: For the third calendar quarter covering July through September
- March 31st: For the fourth calendar quarter covering October through December

The annual compliance reports must be submitted by April 30th of each year.

For more information on the LRT-CBTS and AFP, or to submit quarterly or annual reports, please visit the Data Management System web page:

<http://www.arb.ca.gov/fuels/lcfs/reportingtool/datamanagementsystem.htm>.

LCFS Verification Program

- Ensures data reported to, and used by, CARB is accurate and conforms to the regulatory requirements
 - Consistent with the verification programs implemented under CARB's Cap-and-Trade Program
- Provides confidence and reliability in reported data for stakeholders, market participants and the public
- International best practice
 - Based on ISO 14064-3 and 14065
 - Considered a requirement for carbon pricing mechanisms internationally
- Provides a systematic, independent and documented process for evaluation of reported data against the LCFS regulatory requirements and methods for calculation

A system for third-party verification is needed to ensure accuracy of reported greenhouse gas data. The framework and principles of the LCFS verification program are consistent with the verification systems that support CARB's Cap-and-Trade program. The LCFS verification program provides confidence and reliability in reported data for stakeholders, market participants, and the public—the data have financial implications and quality assurance must meet a specified level of rigor.

Third-party verification is international best practice for credible greenhouse gas monitoring and reporting and considered a requirement for carbon pricing systems. The verification program is based on ISO 14064-3 and 14065. It also provides a systematic, independent, and documented process for evaluation of reported data against the LCFS regulatory requirements and methods for calculation.

Beginning in 2019, verifiers will apply for CARB accreditation and take required training and exam(s). CARB will publish on the LCFS website the list of verification bodies and verifiers accredited to perform LCFS verification services.

Entities Required to Contract for LCFS Verification

- Alternative liquid fuel producers and importers
- Alternative and fossil liquid fuel exporters if fuel previously reported¹
- All fuel pathway holders with site-specific CI data, including electricity pathways under Tier 2²
- All fuel pathways holders with biomethane book-and-claim accounting, including renewable hydrogen (SMR) for fueling hydrogen vehicles³
- Reporters of bio- and fossil propane and CNG/LNG
- Petroleum refineries
- Reporters of project-based credits

¹ Exemption threshold for specified transactions provided in section 95500(c)(2)(C)

² Lookup Table electricity and Tier 2 applications for EER-adjusted carbon intensity scores do not require

third-party verification

³ Lookup Table hydrogen fueling (excluding book-and-claim biomethane) does not require third-party verification

*Note that verification may be deferred up to two years under sections 95500(b)(2)(B) and 95500(c)(2)(B)

The entities required to contract for verification services are summarized here.

Regulated entities specified in section 95500 are required to retain the services of independent verifiers accredited by CARB, beginning with 2020 fuel pathway applications and in 2021 for LCFS data reports, and thereafter. Deferred verification statements are due in 2023 for those who are eligible.

LCFS Data Accuracy & Verification

The LCFS Regulation includes requirements for data accuracy and meter calibration.

- Reported LCFS data have financial implications and must meet specified levels of rigor
- All entities that submit LCFS data used to calculate GHG emissions and reductions must attest to its accuracy

The requirements for LCFS measurement and meter accuracy are as follows:

- Most LCFS data are based on measurements using meters relied on for financial transactions
- CARB accepts the accuracy of meters that meet the criteria for financial transactions in MRR 95103(k)(7) (referenced in section 95491.1(c)(1)(G))
- LCFS data measured using internal meters are considered accurate if they are installed, operated, and maintained according to manufacturer-recommended calibration frequency and precision requirements (section 95488.8(j))

In addition, entities are responsible for obtaining third-party validation and/or verification

- Document measurement device information in a written Monitoring Plan according to section 95491.1(c)
- Demonstrate acceptable measurement accuracy as described above for financial transaction meters and internal meters
- If data are missing, must be able to demonstrate to the verifier that reported data are accurate within +/- 5% or must obtain CARB approval of alternate monitoring method (section 95488.8(k))

The LCFS Regulation includes requirements for data accuracy and meter calibration. Reported LCFS data have financial implications and must meet the specified level of rigor. All entities that submit LCFS data used to calculate GHG emissions and reductions must attest to its accuracy. Most LCFS data are based on financial transaction meters that meet CARB's accuracy requirements: suppliers and purchasers who do not have common owners rely on the measurements for sales, meters are sealed with a valid seal from the county sealer of weights and measures or from a county certified designee, or third parties operate the meters. Meters that do not meet the criteria above, referred to as "internal meters," must be installed, operated, and maintained according to manufacturer-recommended calibration frequency and precision requirements to meet accuracy requirements for LCFS data. In addition, entities responsible for obtaining third-party verification must document measurement device information in a written Monitoring Plan according to section 95491.1(c) and demonstrate acceptable measurement accuracy. If data are missing, the regulated entity must be able to demonstrate to the verifier that reported data are accurate within +/- 5 percent or must obtain CARB approval of an alternate monitoring method pursuant to section 95488.8(k).

Price Cap Provides Consumer Protection

- Provides a route for compliance even if a credit shortfall occurs
- Strengthens incentives to invest in low-CI fuels
- Increases certainty regarding the maximum cost of compliance
- Prevents extreme market volatility
- Ensures that willing credit generators can sell available credits

If a regulated party does not retire sufficient credits to meet its compliance obligation, then a Credit Clearance Market will be initiated. Entities with credits to sell can opt to pledge credits into the market and entities needing credits must purchase their pro-rata share of these pledged credits. A price cap in the clearance market prevents extreme market volatility, thereby providing consumer protection.

Project-based Credit Opportunities

- Renewable Hydrogen Used at Refineries
 - Credit for renewable hydrogen used at a refinery to make transportation fuels
- Refinery Investment
 - Incentives GHG-reduction projects at refineries
- Innovative Crude Production Methods
 - Solar steam or heat generation
 - Solar- or wind-based electricity
 - Carbon capture and sequestration
 - Renewable natural gas or biogas energy
- Low-Complexity/Low-Energy-Use Refinery
- Carbon Capture and Sequestration by Direct Air Capture

The LCFS contains two credit opportunities for refineries, an expanded credit opportunity for crude production, and Carbon Capture and Sequestration by Direct Air Capture.

The renewable hydrogen refinery credit provision allows refineries to generate credits through the use of renewable hydrogen at the refinery to produce gasoline and diesel. Renewable hydrogen can be produced using steam methane reforming of renewable natural gas or through electrolysis using renewable electricity.

The refinery investment credit provision allows refineries to generate credits for GHG reduction projects undertaken at a refinery. These projects include use of renewable energy sources, conversion of combustion power sources to electricity, use of carbon capture and sequestration, and process improvement projects.

The innovative crude credit provision supports innovative technologies for solar steam or heat generation, solar- or wind-based electricity, renewable natural gas or biogas energy, and carbon capture and sequestration.

Carbon Capture and Sequestration (CCS)

- Projects claiming CCS credits must comply with the CCS Protocol
- Credits must be prorated based on the volumes delivered to California (except for direct air capture projects)
- Amount of net CO₂ sequestered by alternative fuel producers can be used to adjust the carbon intensities of the associated fuel pathways
- Must undergo verification

Projects claiming CCS credits must comply with the CCS Protocol. Credits must be prorated based on the volumes delivered to California, except for direct air capture projects.

The amount of net CO₂ sequestered by alternative fuel producers can be used to adjust the carbon intensities of the associated fuel pathways.

All CCS projects must undergo verification.

CCS Eligibility & Crediting

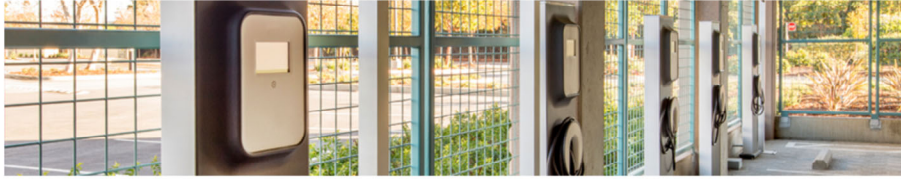
- Examples of how the CCS Protocol can be used:
 - Low carbon fuel pathway (e.g., ethanol or biogas)
 - Refinery investment (e.g., steam methane reforming)
 - Innovative crude (e.g., co-gen at oilfield)
 - Direct air capture
- General requirements for Crediting
 - Credits go to the capture facility
 - Storage facility must be a co-applicant
 - Capture and storage facilities do not need to be co-located
 - All CCS projects must receive Permanence Certification before LCFS credit generation is possible
- Recognized reservoirs
 - Saline formations
 - CO₂ enhanced oil recovery
 - Depleted oil and gas reservoirs

Examples of how the CCS Protocol can be used in the LCFS include low carbon fuel pathway, refinery investment, innovative crude, or direct air capture.

To generate credits for CCS projects, credits go to the capture facility. The storage facility must also be a co-applicant, but capture and storage facilities do not need to be co-located. All CCS projects must receive a Permanence Certification before LCFS credit generation is possible.

Recognized reservoirs under the LCFS include saline formations, CO₂ enhanced oil recovery, and depleted oil and gas reservoirs.

LCFS Electricity and Hydrogen



Electricity Provisions

- Electric vehicles, trucks, electric transit systems (fixed guideway, buses), electric forklifts, electric cargo-handling equipment, transportation refrigeration units (TRUs), and shore power to ocean-going vessels at-berth are eligible to generate credits
 - Specific energy economy ratios (EER) are determined by CARB for each type of electric vehicle or equipment; New equipment types can apply for an EER through a Tier 2 application
- Carbon intensity of California's average grid electricity is updated annually. For reporting in 2019, the CI is 81.49 gCO₂e/MJ

[To learn more about the LCFS electricity and hydrogen provisions, click here](#)

Electric vehicles, trucks, electric transit systems (fixed guideway, buses), electric forklifts, electric cargo-handling equipment, electric transportation refrigeration units, and shore power to ocean-going vessels at-berth are eligible to generate credits.

Due to the fact that consumer preferences of electric vehicle owners has not resulted in widespread installation of separate metering in residences, CARB calculates the credits for non-metered residential charging of EVs, to maintain the quality and accuracy of the credit generations. Electrical Distribution Utilities (EDU) earn "base" credits for all residential charging using the grid average CI, and the load serving entity, auto manufacturer, or another entity may also generate "incremental" credits for supplying metered, low-CI electricity or smart charging to those residences. In the event that multiple entities claim incremental credits for a given residence, the LCFS provides the following order of priority: the Load-Serving Entity (LSE), including a Community Choice Aggregator (CCA); the automobile manufacturer who provides metered charging data through on-vehicle telematics; and any other entity who can provide the metered data has the third priority, which could include a charging service provider or an aggregator. All electricity credit generators must use credit proceeds to promote transportation electrification, and provide benefits to their EV customers and educate them about the benefits of EV transportation.

The LCFS streamlines and facilitates the credit generation and reporting for public, workplace and fleet charging. Utilities will receive those credits unless electrical vehicle service providers, site hosts or fleet owners opt in.

Renewable Electricity to ZEVs

- Add flexibility for pathways using low-CI electricity in ZEV applications
- Allow for indirect accounting for matching renewable electricity production to EV charging
- Recognize charging when lower CI resources are supplying the Grid



The combination of zero-carbon electricity and zero-emission vehicles offers significant opportunity for reductions that are not well recognized by the program to date. To address this issue, the 2018 amendments allow renewable power generated off-site to be used in EV charging and hydrogen production by electrolysis. The amendments also recognize the benefits of shifting EV charging and electrolyzer loads to periods of time when excess renewable electricity might otherwise be wasted. These amendments are intended to be a first step in promoting further expansion of zero-emission vehicle infrastructure through the LCFS, as directed by the Governor's Executive Order. They would help make these vehicles fully "zero emission" on a life cycle basis.

LCFS Electricity and Hydrogen



Hydrogen Provisions

- Entity that owns the hydrogen fueling supply equipment or the hydrogen forklift fleet is eligible to generate credits for hydrogen fueling; another entity may be designated by written agreement
- Lookup Table pathways for hydrogen produced in California (SMR or electrolysis) are available to streamline participation; no site-specific CI data is needed
 - Renewable hydrogen pathways require evidence of renewable inputs
 - Unique or innovative pathways may use a Tier 2 pathway application to determine CI
 - Smart electrolysis: reporting hourly-metered electricity provided to an electrolyzer rewards operation at times of day when marginal grid CI is lower than average
- Hydrogen is an opt-in fuel until statewide use in transportation meets a threshold of 3,500 tons per year

[To learn more about the LCFS electricity and hydrogen provisions, click here.](http://www.arb.ca.gov/fuels/lcfs/electricity/electricityh2.htm)

The LCFS also contains hydrogen provisions. The person who owns the hydrogen fueling supply equipment or the hydrogen forklift fleet is eligible to generate credits for hydrogen fueling. Lookup Table pathways for hydrogen produced in California are available to streamline participation. Hydrogen is an opt-in fuel until statewide use in transportation meets a threshold of 3,500 tons per year.

To learn more about the LCFS electricity and hydrogen provisions, please see <http://www.arb.ca.gov/fuels/lcfs/electricity/electricityh2.htm>.

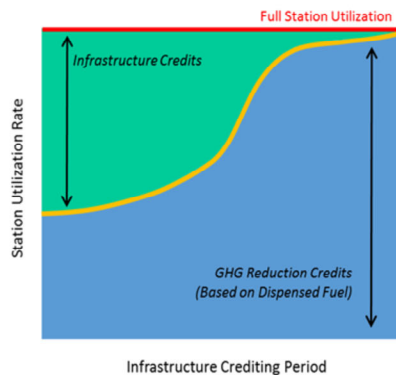
Statewide Clean Fuel Reward for Electric Vehicles



- Utilities and Automakers are developing a statewide program to provide an EV rebate at the time of sale
- Provides considerable incentive to encourage the purchase of Electric Vehicles
- Minor changes to the LCFS regulation to accommodate the rebate program:
 - Require a minimum percentage contribution from each utility
 - Specify four tiers to determine the rebate amount based on EV battery capacity

In April 2018, the Board also directed staff to explore the establishment of a statewide Clean Fuel Reward program funded by the sale of LCFS credits and given at the point of electric vehicle sale or lease. Since the April Board hearing, a coalition of Electrical Utilities and Automakers have come together to lay the groundwork for such a program. The approach required targeted changes in the LCFS to accommodate the rebate program: we have set a minimum percentage contribution from all utilities that opt in, which scales with utility size and increases over time; and we have also established battery-capacity tiers—in line with the federal rebate structure—to ensure EVs with higher battery capacity get the maximum rebate.

Zero Emission Vehicle Infrastructure



- New provision to credit hydrogen stations and direct current fast chargers based on fueling capacity minus any dispensed fuel
- Previously, credits only eligible for dispensed fuel
- Crediting unused refueling capacity encourages rapid deployment of zero emission infrastructure and eliminates “chicken-and-egg” concerns

[For more information about LCFS ZEV Infrastructure Crediting, click here.](#)

To provide additional incentives for growth of ZEVs, in the recent round of rulemaking, the program included a provision termed “infrastructure crediting” to include both hydrogen refueling stations and DC fast chargers. The concept is simple: The LCFS will credit eligible stations based on the capacity of the station to deliver fuel once the station is fully utilized. Infrastructure credits will decrease as a station/charger reaches full utilization, until it is only generating credits for its dispensed fuel. In this way, the provision is designed to be “self-sunsetting.” This provision is designed to address the “chicken & egg” problem, in which demand for zero emission vehicles is low because consumers can’t refuel them, and refueling station developers won’t build stations until more vehicles are sold.

For more information on the LCFS ZEV Infrastructure Crediting Provision, please see https://www.arb.ca.gov/fuels/lcfs/electricity/zev_infrastructure/zev_infrastructure.htm