

Appendix H
Low Carbon Fuel Standard (LCFS) Program and
Examples

Note: This document was first released on August, 17, 2016 under the title “How Earned Low Carbon Fuel Standard (LCFS) Credits Change from Year to Year.” Staff has revised the ICT program name in this appendix. This appendix contains minor changes from the original posting. The LCFS regulation is currently in the process of amendment. The examples discussed here are based on the current LCFS regulation. The original discussion draft is available at: <https://www.arb.ca.gov/msprog/bus/lcfs.pdf>.

This summary explains how transit agencies can benefit from using cleaner fuels in their fleets and the amount of LCFS credits generated may change from year to year. Transit Agency revenues from LCFS credit sales are included in the total cost of ownership analysis for the Innovative Clean Transit regulation.

The LCFS is a regulation designed to reduce carbon intensity (CI) associated with the lifecycle of transportation fuels used in California. A transit agency using a lower CI fuel may participate in the LCFS program and generate credits¹ in many ways, including operating battery electric buses, fuel cell electric buses, or fixed guideway systems², dispensing fossil compressed natural gas (CNG), or providing hydrogen as a transportation fuel.³ Transit agencies do not generate LCFS credits when dispensing renewable natural gas or renewable diesel. However, transit agencies often receive credits or credit value from renewable natural gas providers. The credits can be sold to LCFS’ regulated parties to reduce operating costs for transit fleets.

The amount of LCFS credits that can be generated varies by fuel type, fuel pathway and annual carbon intensity benchmarks. The amount of credits that can be generated for a given fuel pathway is determined by how much its CI is below the benchmark CI for the year. The LCFS program is currently proposing a rule amendment. The proposed amendment targets a 20 percent reduction in fuel CI from a 2010 baseline by 2030.⁴ As the target gets stringent and benchmark CIs declines over time, the amount of credits that can be generated for a fuel at a given CI will also decline. It is expected that, as alternative fuel production continues to expand and innovations occur, these CIs will improve over time resulting in higher credit generation potential.

A credit value calculator⁵ is available to determine how many credits can be earned each year from 2016 to 2020. The calculator uses input variables (including calendar year, Energy

¹ California Air Resources Board (CARB) (2016). Low Carbon Fuel Standard Regulatory Guidance 16-07 LCFS for Transit Agencies. May 2016. Available: www.arb.ca.gov/fuels/lcfs/guidance/regguidance_16-07.pdf.

² Fixed Guideway System means a system of public transit electric vehicles that can operate only on its own guideway (directly operated, or DO) constructed specifically for that purpose, such as light rail, heavy rail, cable car, street car, and trolley bus.

³ The current LCFS rule amendment proposal will remove fossil CNG as an opt-in fuel starting 2019.

⁴ California Air Resources Board (CARB) (2018). Public Hearing to Consider Proposed Amendments to the Low Carbon Fuel Standard Regulation and to the Regulation on Commercialization of Alternative Diesel Fuels - Staff Report: Initial Statement of Reasons. March 6, 2018. Available: <https://www.arb.ca.gov/regact/2018/lcfs18/isor.pdf>.

⁵ California Air Resources Board (2017). The LCFS Credit Price Calculator. April 20, 2017. Available: www.arb.ca.gov/fuels/lcfs/dashboard/creditpricecalculator.xlsx.

Economy Ratio (EER)⁶ for the vehicle type, CI of the fuel used, and credit price) to determine the potential revenue generated by a given fuel pathway in a compliance year. Table 1 provides examples of the CI of various fuel pathways to show how the credit number would change as the regulation becomes more stringent and the CI benchmark declines. For illustration purpose, this example assumes the credit price remains constant at \$100/MTCO_{2e} and the CIs of fuel pathways do not change over time. The actual credit price will fluctuate with market conditions and improvements in CIs may occur over time.

Transit agencies operating zero-emission buses can benefit from continued declining CIs from the increasing renewable attributes in electricity and hydrogen. The CI of grid electricity is expected to decline because the Renewable Portfolio Standard requires 33 percent renewable generation in California by 2020 and 50 percent by 2030. The estimated credit revenue for electricity in 2020 would be greater than \$0.10/kWh at \$100/MTCO_{2e}. Senate Bill 1505 requires that all hydrogen dispensed as a transportation fuel at State-funded stations must be made from 33 percent renewable energy.

Table 1 lists a few common fuel pathways for transit agencies and how the LCFS credit value changes from 2016 to 2020 under the current regulation. The CI scores shown here are representative examples of each fuel type and are held constant for illustration purpose. In reality, the CIs vary with individual pathways and are likely to change as alternative fuel production continues to improve.

Table 1. LCFS credit revenue for selected fuels in 2016 and in 2020^a at credit price \$100/MT

	Representative Carbon Intensity ^b (CI) (gCO _{2e} /MJ)	EER for transit buses	LCFS Credit Revenue in 2016	LCFS Credit Revenue in 2020
Fossil diesel	102	1		
Renewable diesel	50	1	\$0.67/DGE	\$0.56/DGE
Fossil CNG	78	0.9	\$0.16/DGE	\$0.06/DGE
Renewable CNG	25	0.9	\$0.87/DGE	\$0.77/DGE
Electricity (Grid)	105	4.2	\$0.11/kWh	\$0.10/kWh
Electricity (Solar)	0	4.2	\$0.15/kWh	\$0.14/kWh
33% Renewable Hydrogen ^c	88	1.9	\$1.22/kg	\$1.03/kg
100% Renewable Hydrogen ^d	0	1.9	\$2.28/kg	\$2.09/kg

a: The revenues shown for 2020 using existing CIs.

b: Certified CI values can be found at <http://www.arb.ca.gov/regact/2015/lcfs2015/lcfsfinalregorder.pdf> (Table 6 on p. 66) and at <http://www.arb.ca.gov/fuels/lcfs/fuelpathways/pathwaytable.htm>

c: Hydrogen made by reforming a mixture of natural gas with 33% biomethane.

d: A certified pathway for hydrogen produced by electrolysis using solar PV power.

⁶ EER means the dimensionless value that represents the efficiency of a fuel as used in a powertrain as compared to a reference fuel. EERs are often a comparison of miles per gasoline gallon equivalent (mpge) between two fuels. EERs for fixed guideway systems are based on MJ/number of passenger-miles.

The current proposed LCFS rule amendment includes three major components that would affect transit agencies:

- (1) transit agencies that use fossil CNG as a transportation fuel will need to participate in the LCFS program on a mandatory basis starting in 2019 as fossil CNG will no longer be an opt-in fuel;
- (2) increase the BEB energy economy ratio by 20 percent;
- (3) further reduce the carbon intensity for the transportation fuels through 2030; and
- (4) clarify how hydrogen station operators can receive credits.

If approved, these amendments would provide more credits for BEBs and allow transit agencies to claim the credits for dispensing hydrogen directly.

Reference List H

The following documents are the technical, theoretical, or empirical studies, reports, or similar documents relied upon in proposing these regulatory amendments, identified as required by Government Code, section 11346.2, subdivision (b)(3). Additionally, each appendix references the documents upon which it relies, as required by Government Code, section 11346.2, subdivision (b)(3).

Note: Each “Explanatory Footnote” is a footnote containing explanatory discussion rather than referencing specific documents relied upon.

1. California Air Resources Board (CARB) (2016). Low Carbon Fuel Standard Regulatory Guidance 16-07 LCFS for Transit Agencies. May 2016. Available: www.arb.ca.gov/fuels/lcfs/guidance/regguidance_16-07.pdf.
2. Explanatory Footnote.
3. Explanatory Footnote.
4. California Air Resources Board (CARB) (2018). Public Hearing to Consider Proposed Amendments to the Low Carbon Fuel Standard Regulation and to the Regulation on Commercialization of Alternative Diesel Fuels - Staff Report: Initial Statement of Reasons. March 6, 2018. Available: <https://www.arb.ca.gov/regact/2018/lcfs18/isor.pdf>.
5. California Air Resources Board (2017). The LCFS Credit Price Calculator. April 20, 2017. Available: www.arb.ca.gov/fuels/lcfs/dashboard/creditpricecalculator.xlsx.
6. Explanatory Footnote.