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THE CALIFORNIA LCFS AND ETHANOL - A Decade of Reducing Greenhouse Gas Emissions

Additional submitted attachment is included below.

The California LCFS and Ethanol:

A Decade of Reducing Greenhouse Gas Emissions

Renewable Fuels Association

May 2021

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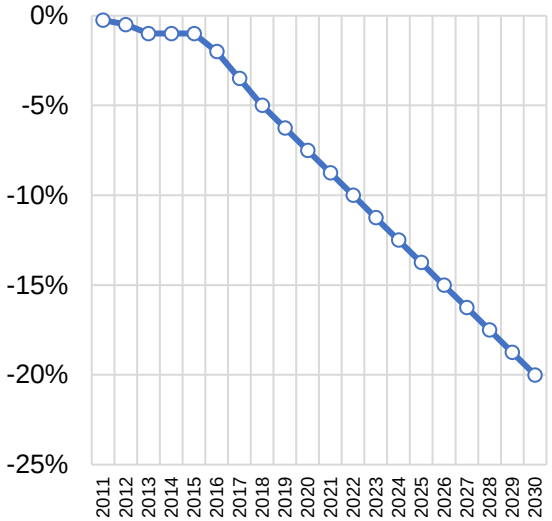
10 YEARS OF THE CALIFORNIA LCFS

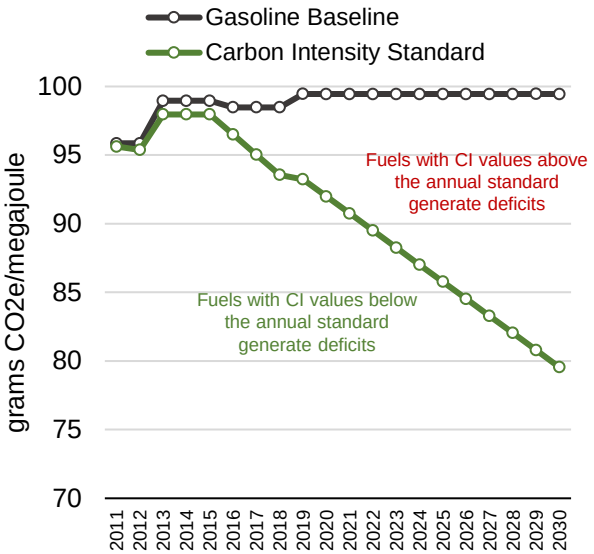
The California Global Warming Solutions Act of 2006 (Assembly Bill 32) established the first-ever Low Carbon Fuel Standard (or "LCFS"). The objective of the program was to reduce greenhouse gas emissions from the state's transportation sector, while also lessening dependence on petroleum.

The LCFS achieves GHG reductions by requiring individual fuel producers and distributors to annually reduce the average lifecycle carbon intensity ("CI") of the fuels they supply to the market. Fuels with CI values below the annual standard set by the California Air Resources Board (CARB) generate compliance credits, while fuels with CI values above the standard generate compliance deficits. Regulated parties are in compliance with the annual standards when their credits offset or exceed their deficits.

LCFS Annual Carbon Intensity Reduction Requirement (vs. 2010 Gasoline Baseline)



LCFS Carbon Intensity Requirements for Gasoline and Substitutes



Enforcement of the LCFS began in 2011 and the program was re-adopted with certain changes in 2015. In 2018, the fuel CI reduction standards were adjusted and extended. The LCFS now requires a 10% reduction by 2022 and 20% reduction by 2030.

Because the LCFS is designed to be a technology-neutral performance standard, fuel suppliers are able to adopt the compliance strategies that make the most sense for them and their customers. Some choose to reduce the CI of their fuel by blending in more low-carbon biofuels like ethanol and renewable diesel. Others choose to entirely replace petroleum fuels with lower-carbon options like renewable natural gas or electricity.

Using data recently published by the CARB, this report examines changes that have occurred in the California transportation fuels marketplace over the past 10 years in response to the LCFS. Specifically, we look at the role ethanol has played in helping fuel suppliers reduce the CI of their fuels. The report concludes with a look ahead regarding the future role for low-carbon ethanol as the LCFS enters its second decade.

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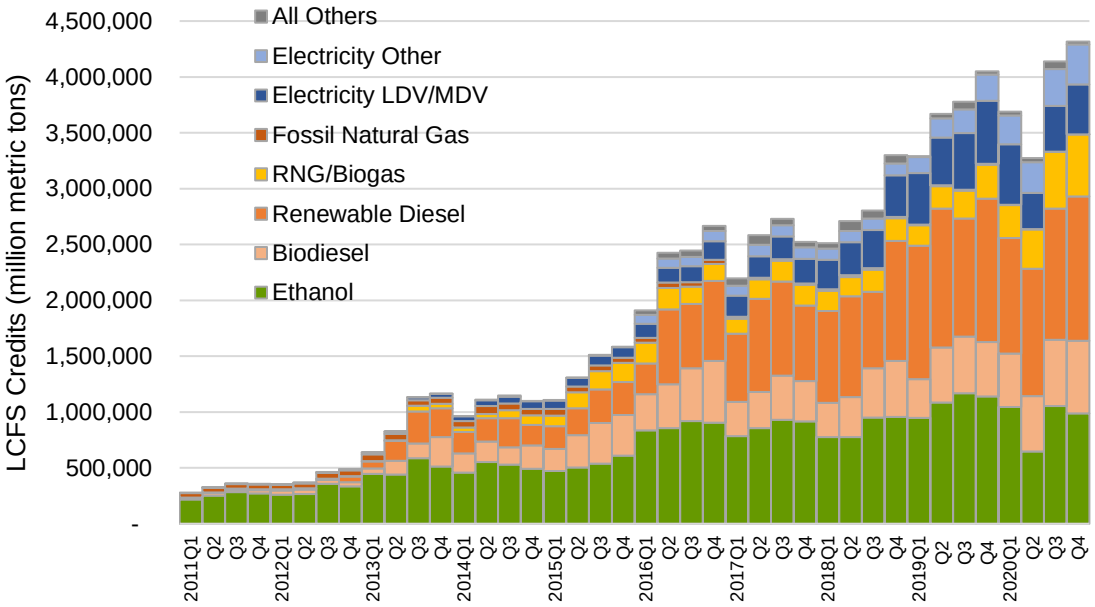
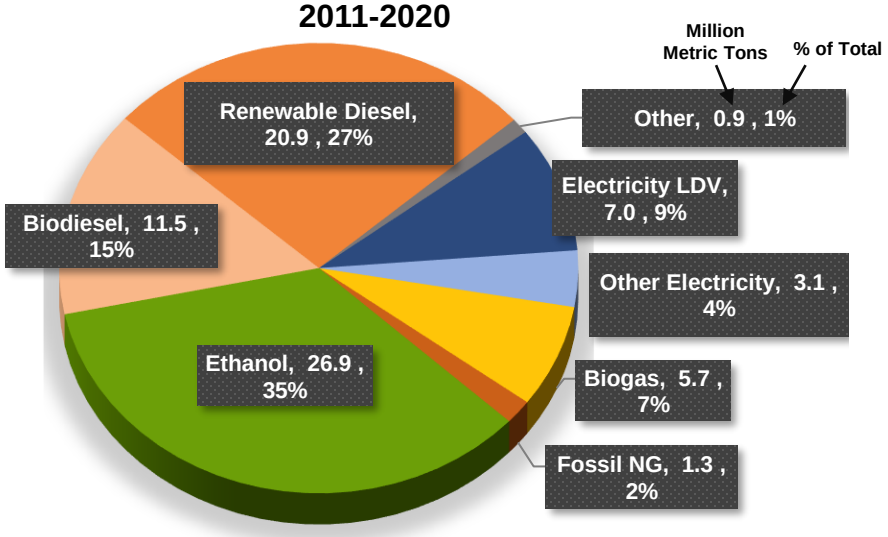
GHG Reductions Achieved by the LCFS

Since enforcement of the program began in 2011, more than **77 million** LCFS credits have been generated, with each credit representing one metric ton of GHG emissions reduction versus the annual standard. A diverse mix of low carbon fuels has been used to generate credits and reduce emissions.

California LCFS Quarterly Credit Generation by Fuel Type



California LCFS GHG Reductions by Fuel Type, 2011-2020



The use of ethanol under the LCFS has generated **26.9 million metric tons** of GHG savings (credits), or **35% of the total** since implementation began. That's more than any other low carbon fuel used in the state. All liquid biofuels combined accounted for **77% of total reductions** during the decade.

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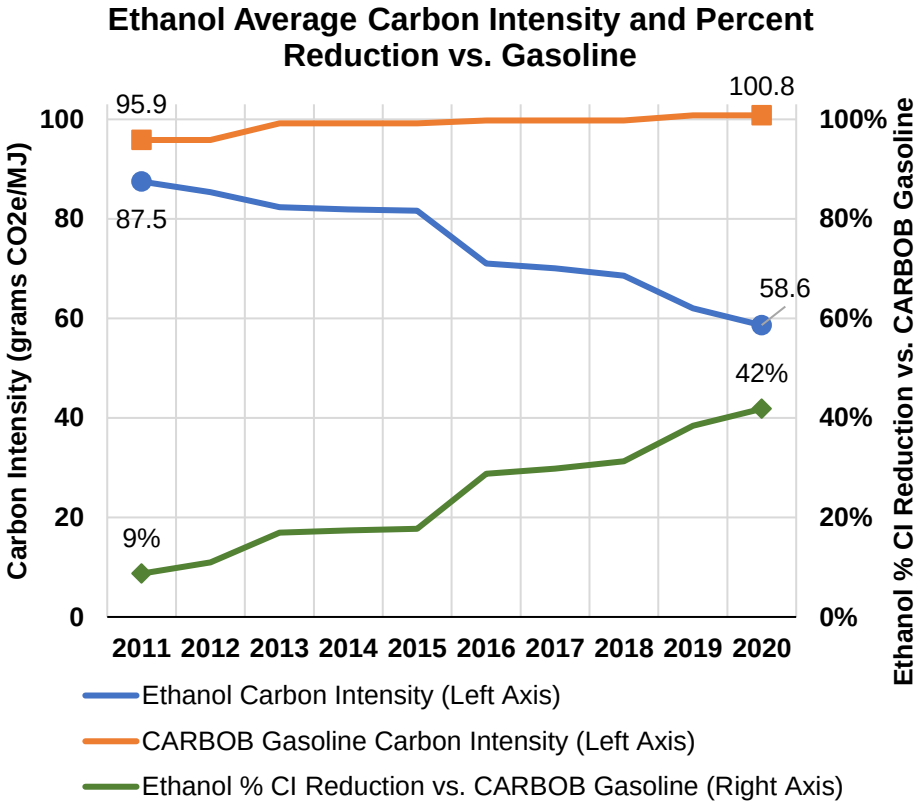
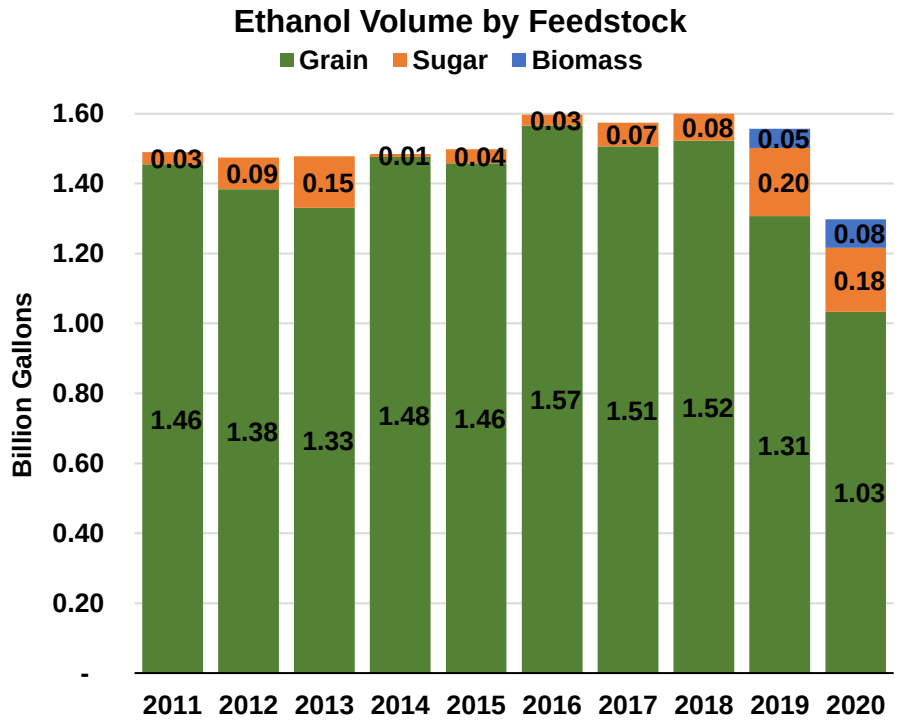
ETHANOL'S ROLE IN THE LCFS

The average carbon intensity of ethanol used in California has fallen substantially since 2011, as ethanol producers adopted new technologies and CARB improved its modeling. In 2020, the average CI value for ethanol was **58.6 g/MJ,** compared to 100.8 g/MJ for gasoline—a **42% GHG reduction**. That compares to CARB's estimate of a 9% average GHG reduction for ethanol in 2011.





The volume of ethanol consumed annually under the LCFS has remained **relatively stable** over the past decade, except for the COVID-related downturn in 2020. Over the past decade, grain starch was the feedstock for **93%** of the ethanol consumed, while sugar comprised **6%** and biomass accounted for **1%**. Notably, the volume of biomass-derived ethanol has increased in recent years, accounting for **6%** of total ethanol volume in 2020.

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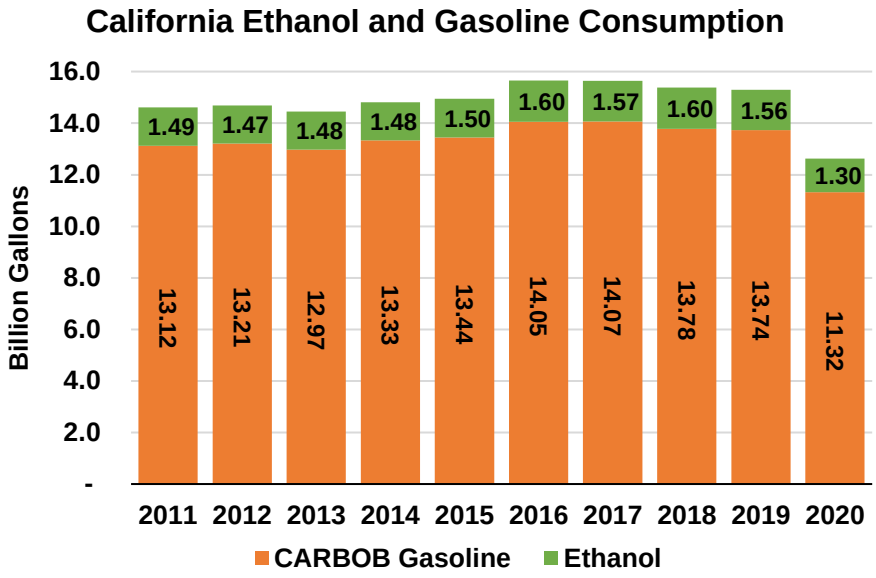
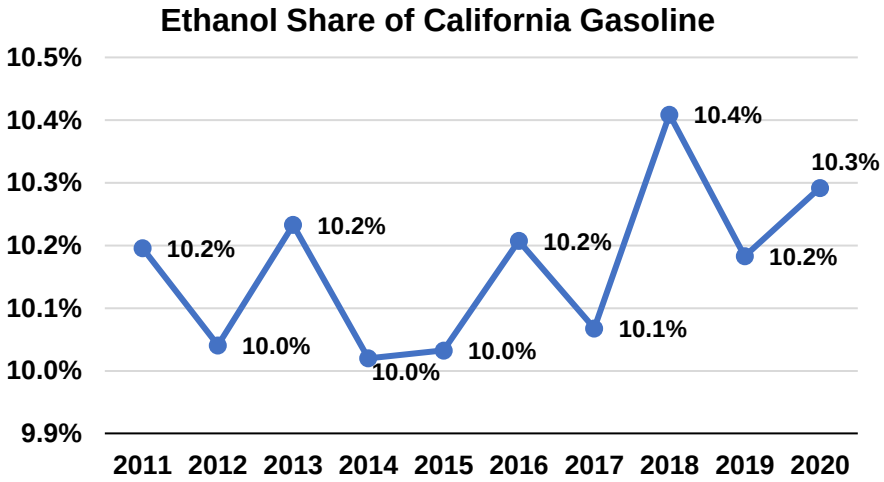
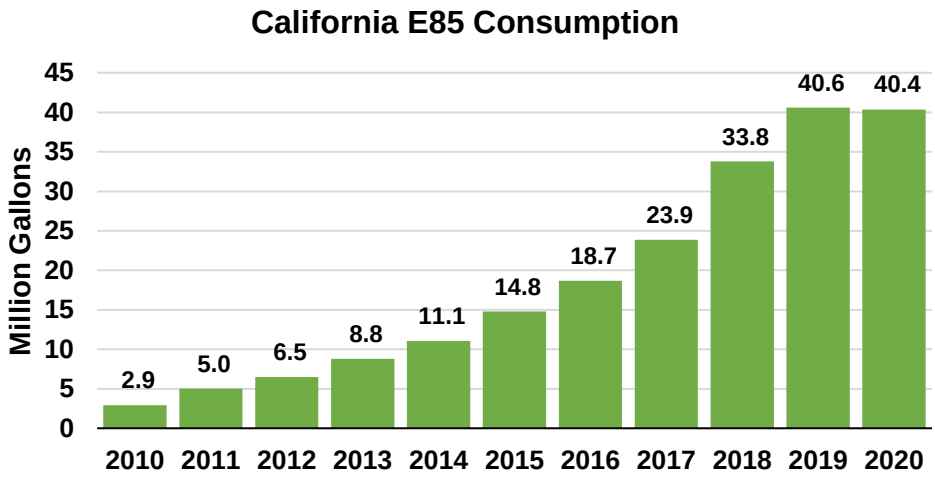
ETHANOL'S ROLE IN THE LCFS



Total ethanol consumption fluctuated from a low of 1.47 billion gallons (2012) to a high of 1.60 bg (2018), excluding the COVID-related volume of just 1.30 bg in 2020. Meanwhile, CARBOB gasoline use has ranged from 13 to 14 bg annually.

Ethanol has accounted for 10.0-10.4% of annual finished gasoline consumption over the past decade. The ethanol "blend rate" reached a record quarterly high of 11.1% in Q3 of 2020.





Use of E85 flex fuel (fuel containing up to 85% ethanol) has surged under the LCFS. Even with COVID-related market disruptions, E85 use in 2020 was down less than 1% from 2019's record level.

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WHAT'S NEXT FOR ETHANOL AND THE CALIFORNIA LCFS?

As the California LCFS begins its second decade, ethanol remains poised to contribute even more substantial GHG reductions under the program. As demonstrated during the first 10 years of the LCFS, the value of CI credits allows ethanol producers to re-invest in technologies and processes that will further reduce the CI of the fuels they are producing.

With the right market signals and incentives—and a commitment to further open the California market to low-carbon ethanol—the following new and emerging biorefinery technologies could make corn ethanol **carbon neutral**—or even **carbon negative**—in the next five to 10 years.

- Carbon capture and sequestration
- Conversion of cellulosic kernel fiber
- Substituting biogas for fossil natural gas for thermal energy needs
- Substituting renewable electricity for fossil electricity

Policy and Regulatory Needs

Ethanol producers will be reluctant to make the investments necessary to lower carbon intensity if the California ethanol market remains constrained. The following policy and regulatory actions would help open the market and encourage ethanol producers continue to invest in technologies to lower the carbon intensity of their fuels. In turn, these actions would ensure that low-carbon ethanol can continue to contribute greater GHG reductions and help the state of California achieve its goals to combat climate change.

- **Approval to sell E15** (gasoline containing 15% ethanol) for use in all 2001 and newer light-duty vehicles.
- State policies to encourage or require continued production and sale of **flex fuel vehicles** (FFVs) that can use E85 flex fuels.
- **Incorporation of soil carbon sequestration** benefits and other carbon-efficient farming practices into CA-GREET lifecycle model.
- **Updates to land use change** (LUC) analysis to ensure ILUC factors align with the Oregon Clean Fuels Program and Argonne National Laboratory GREET model.

The Road Ahead

California's trailblazing LCFS provides an example to other states—and the nation—of how to make substantial progress combatting climate change in the near term. Still, while the program's accomplishments to date are impressive, it is not quite at the halfway mark toward the 20% CI reduction target for 2030. Ethanol can continue helping California and the U.S. meet ambitious decarbonization goals, given the potential for ultra-low-carbon and even zero-carbon corn ethanol to be available over the next decade.

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