

*36th International Electric Vehicle Symposium and Exhibition (EVS36)
Sacramento, California, USA, June 11-14, 2023*

Clean Fuel Standard Program Participation: Importance in Driving the Commercial Electrification Revolution

Todd Trauman

e-Mission Control, 801 K St, Sacramento, CA 95814

todd@e-missioncontrol.com

Executive Summary

Since originally introduced in 2015, the electrification provisions in the California Low Carbon Fuel Standard (LCFS) have had an outsized influence on both on- and off-road electrification of transportation vehicles and equipment relative to the myriad of publicly-funded incentives and grants available in that time. As other nearby states and provinces are following suit in implementing their own Low Carbon Fuel Standard Programs (LCFSPs), such as Oregon, Washington, British Columbia, and Canada nationally, several regulatory bodies are expecting to see the lion's share of credit generation be attributable to electricity-base consumption by the end of this decade. For example, the Oregon Department of Environmental Quality (DEQ) is projecting that the overall share of electricity-based credit generation to be as much as 80% by 2035[1]. This white paper provides an overview and history of Low Carbon Fuel Standard Programs and their goals, implementation, and impact as it relates to the electrification transportation sector.

5 Keywords: Clean fuel standards, compliance carbon markets, carbon intensity, carbon markets, electric vehicle incentives.

1. Introduction

The global transportation sector is undergoing a major transformation as countries and their sub-jurisdictions look for ways to reduce greenhouse gas (GHG) emissions, improve air quality, and mitigate climate change. According to the United States Environmental Protection Agency (EPA), transportation accounted for 29% of total U.S. GHG emissions in 2019, making it the largest contributor to emissions in the country [2]. One of the most promising strategies to achieve these goals is the electrification of transportation vehicles and equipment. In recent years, Low Carbon Fuel Standard Programs (LCFSPs) have emerged as an effective policy tool to accelerate the transition away from fossil fuel-powered internal combustion engines and promote the adoption of electric vehicles (EVs) and other low-carbon alternatives.

Originating in California in 2015, the electrification provisions within the California Low Carbon Fuel Standard (LCFS) have had a significant impact on the electrification of both on- and off-road transportation vehicles and equipment [3]. To-date, the California Air Resources Board (CARB) has reported that the LCFS has prevented over 50 million metric tons of carbon dioxide equivalent (CO₂e) emissions since its inception [4]. Despite being less widely known and utilized compared to other publicly-funded incentives and grants, the LCFS has been instrumental in driving the growth of the clean transportation sector in the state. With neighboring states and provinces, such as Oregon, Washington, British Columbia, and Canada, nationally, following California's lead in implementing their own LCFSPs, this policy approach is increasingly seen as a key instrument for promoting clean fuels, especially electricity as a fuel, in the transportation sector.

In this white paper, we provide an in-depth look at the origins, goals, implementation, and impact of Low Carbon Fuel Standard Programs, focusing on the California Low Carbon Fuel Standard (LCFS), Oregon Clean Fuels Program (CFP), Washington Clean Fuel Standard (CFS), British Columbia Low Carbon Fuel Standard (BC-LCFS), and the national Canada Clean Fuels Regulation. By examining the history of these programs, we aim to shed light on their significance in promoting the electrification of the transportation sector and charting a sustainable path towards a low-carbon future.

LCFSPs aim to achieve several interrelated goals, including improving air quality, reducing petroleum dependence, and fostering investment in new clean fuel technologies. The California LCFS, for instance, has set a target to reduce the carbon intensity (CI) of transportation fuels by 20% by 2030 compared to a 2010 baseline [5], and is likely to be adjusted to a 30% or 35% 2030 goal in the current rulemaking procedures[6]. By setting progressively stringent standards for the CI of transportation fuels, LCFSPs create a market-based mechanism that incentivizes the development and deployment of low-carbon alternatives, such as electricity, hydrogen, and advanced biofuels.

The implementation of LCFSPs has had a tangible impact on the electrification of the transportation sector, as evidenced by the growing number of electric vehicles on the road and the expansion of charging infrastructure in participating neighboring jurisdictions. In California, for instance, the number of registered electric vehicles increased from around 30,000 in 2012 to over 1 million by 2021, with the state aiming to have 5 million zero-emission vehicles (ZEVs) on the road by 2030 [7]. Furthermore, these programs have spurred innovation in clean fuel technologies and facilitated public-private partnerships aimed at accelerating the transition to a low-carbon transportation system, including supporting entirely new business models, such as Fleet-as-a-Service, Charging-as-a-Service, Carbon-as-a-Service, and more, in addition to the billions of dollars invested in EVSE, OEM, fleet-targeted business software, and other technology companies leveraging the LCFS in some manner to be successful. By supporting research and development, workforce training, and other initiatives, LCFSPs contribute to the creation of a vibrant clean transportation ecosystem that is well-positioned to meet the challenges of the 21st century.

Looking ahead, the potential for continued growth in the low-carbon fuel supply, especially electricity, is immense. As more jurisdictions adopt LCFSPs and existing programs become more ambitious, the demand for clean transportation solutions is expected to increase, creating a virtuous cycle of innovation and investment in the sector. A study by the International Council on Clean Transportation (ICCT) estimated that the U.S. could see up to 40 million electric vehicles on the road by 2050 under a scenario with strong policy support, such as LCFSPs and other incentives [8].

As the urgency to address climate change intensifies, LCFSPs offer a proven, market-based approach to drive the transformation of the transportation sector towards a more sustainable and low-carbon future. By understanding the history, goals, and impact of these programs, stakeholders can harness their potential to accelerate the electrification of transportation and create a cleaner, healthier, and more resilient world.

2. History of Clean Fuel Programs

2.1 California Low Carbon Fuel Standard

The AB 32 Scoping Plan includes the Low Carbon Fuel Standard (LCFS) as one of nine early action initiatives to decrease California's greenhouse gas (GHG) emissions responsible for climate change. The LCFS plays a crucial role in California's comprehensive approach to reducing GHG emissions and other air pollutants by enhancing vehicle technology, decreasing fuel consumption, and expanding transportation mobility options. The standard aims to lower the carbon intensity of California's transportation fuel pool while offering a growing array of low-carbon and renewable alternatives to reduce petroleum reliance and achieve air quality improvements.

The Board approved the LCFS regulation in 2009, with implementation starting on January 1, 2011. The California Air Resources Board (CARB) approved amendments to the LCFS in December 2011, which took effect on January 1, 2013. In September 2015, the Board re-adopted the LCFS, addressing procedural deficiencies in the original regulation's adoption, and it became effective on January 1, 2016. In 2018, the Board approved further amendments to strengthen and streamline carbon intensity benchmarks through 2030, aligning with California's 2030 GHG emission reduction target set by SB 32. These amendments also introduced new credit opportunities to encourage zero-emission vehicle adoption, alternative jet fuel, carbon capture and sequestration, and advanced technologies for deep decarbonization in the transportation sector.

The LCFS encourages the use and production of cleaner low-carbon transportation fuels in California, thus reducing GHG emissions and decreasing the transportation sector's reliance on petroleum. The LCFS standards are based on the "carbon intensity" (CI) of gasoline, diesel fuel, and their substitutes. The program considers each fuel's "life cycle" greenhouse gas emissions, including CO₂, CH₄, N₂O, and other GHG contributors. The life cycle assessment evaluates the GHG emissions linked to the production, transportation, and use of a specific fuel. This assessment includes direct emissions related to producing, transporting, and using fuels, as well as significant indirect effects on GHG emissions, such as land use changes for some biofuels. Carbon intensity scores for each fuel are compared to a declining CI benchmark for each year. Low carbon fuels that fall below the benchmark generate credits, while those above it generate deficits. Credits and deficits are measured in metric tons of GHG emissions. Transportation fuel providers must ensure that their supplied fuel mix in California meets the LCFS carbon intensity standards for each annual compliance period. A deficit generator can meet its compliance obligation by earning or acquiring credits equal to or greater than its incurred deficits.

Other jurisdictions, including California, Oregon, Washington, and British Columbia, have joined the Pacific Coast Collaborative, a regional agreement to coordinate policies aimed at reducing GHG emissions and promoting clean energy. CARB regularly collaborates with these jurisdictions to build an integrated West Coast market for low-carbon fuels, creating stronger market demand, increased investor confidence in low-carbon alternative fuels, and synergistic implementation and enforcement programs. CARB continues to engage with representatives from Canada and Brazil as they continue to refine their clean fuels programs.

The electrification provisions within the LCFS have had a substantial impact on the adoption of on-road electric vehicles and off-road equipment, including the development of charging infrastructure. By allowing opt-in parties (i.e. electric vehicle fleets) to generate and trade credits for utilizing low-carbon fuels, the LCFS provides financial incentives for investments in electrification across various segments of the transportation sector. This market-driven approach has not only led to an increase in electrification adoption for on-road vehicles, such as passenger cars and commercial trucks, but has also encouraged the electrification of off-road equipment, including cargo-handling equipment, refer units, vessel shore power, forklifts, and more. Separately, utilities within the state have been heavily-incentivized financially through the mechanics of the LCFS to bring down consumer costs of EV deployments, through off-the-stick incentives, reduced utility rates for EV-related electricity consumption, and discounted EVSE purchases. As a result, the LCFS electrification provisions have contributed to the broader transition towards a low-carbon transportation system and a more sustainable future in the state of California.

2.2 Oregon Clean Fuels Program

Oregon has taken a significant stride in addressing climate change and air pollution from its leading emission source. The Oregon Environmental Quality Commission (EQC) recently adopted an expanded Clean Fuels Program, making it the most robust standard in the country by more than tripling the existing requirements.

The new EQC-approved regulations extend the Clean Fuels Program to reduce transportation fuels' carbon intensity by 20% below 2015 levels by 2030 and 37% below 2015 levels by 2035. These ambitious carbon intensity reduction targets are crucial for achieving near-term emission reductions and mitigating co-pollutants in the transportation sector.

First introduced by the Department of Environmental Quality (DEQ) in 2016, the Clean Fuels Program has successfully reduced nearly 7.3 million tons of greenhouse gas emissions in just six years. Similar to California's structure, the program's success stems from its comprehensive "well-to-wheels" approach to assessing vehicle pollution emissions. The program evaluates the climate impact of fuel extraction, processing, transportation, and final usage, assigning a "carbon intensity" score to each fuel type and mandating reductions in carbon intensity over time.

Again, similar to California, entities that generate or use fuels cleaner than the limit earn credits, while those with higher carbon intensity fuels incur deficits. For instance, an Oregon-based company converting waste grease into biodiesel or a transit agency investing in electric buses would generate credits, while an oil company from Nebraska supplying traditional gasoline or diesel in Oregon would create deficits.

The program has resulted in cleaner fuels, improved health outcomes, and a thriving economy. In its first six years, Oregonians consumed 1 billion fewer gallons of fossil fuels, enhanced local air quality and public health, saved millions of dollars in avoided health costs, and generated \$100 million annually in the clean fuels market. This has led to increased production of affordable low-carbon fuels, technological innovation, and electric vehicle infrastructure. Moreover, the Clean Fuels Program has bolstered energy security and protected Oregonians from volatile oil and gas prices.

In response to Governor Brown's directive to extend and expand the program's carbon intensity targets for greater climate pollution reductions by 2035, DEQ initiated a nearly year-long rulemaking process. The Oregon Environmental Council (OEC) participated in the advisory committee informing the Clean Fuels Program expansion. The EQC-adopted regulations meet the ambitious goals demanded by science, extending carbon intensity reduction targets to 20% below 2015 levels by 2030 and 37% below 2015 levels by 2035. The expanded Clean Fuels Program will generate jobs in the clean fuels sector, improve public health by reducing harmful co-pollutants, and invest in local communities and economies.

As the program enters its next phase, OEC will continue advocating for maximizing clean air, climate, and health benefits, pushing for carbon intensity reduction targets to be achieved through electrification wherever possible. Additionally, OEC will ensure the program focuses on equitable economic outcomes by encouraging credit-generating utilities to fund affordable and accessible public charging infrastructure in underserved areas, such as low-income, BIPOC, and rural communities.

2.3 Washington Clean Fuel Standard

As of January 1, 2023, Washington State has implemented its Clean Fuel Standard (CFS), making it the third state to introduce a market-based transportation emissions program, following California in 2011 and Oregon in 2016. The objective of Washington's program is to progressively reduce the carbon intensity (CI) score of transportation fuels by 20% (based on 2017 levels) by 2034. Washington state's CFS is administered by the Department of Ecology (ECY) and aims to curb carbon pollution from the transportation sector by eliminating 4.3 million metric tons of carbon by 2038. Washington has a statewide commitment to reducing greenhouse gas (GHG) emissions by 95% by 2050. In 2019, transportation was the largest source of emissions in Washington, accounting for 39% of the state's total GHG emissions. The CFS

program aims to address these emissions, reducing statewide GHG emissions by 4.3 million metric tons (MMT) per year by 2034, which is equivalent to permanently removing over 900,000 cars from the road.

Washington's new Clean Fuel Standard will work similarly to the Oregon and California clean fuel programs. The CFS will grant credits to fleets of vehicles and equipment that utilize clean fuels like electricity in their operations. These credits are traded on an open market where regulated entities who are producers or importers of high carbon intensity (CI) fuels such as petroleum are mandated to purchase the credits. This gives companies of all sizes as well as state and local agencies a new revenue stream. Participating companies can use this revenue to reinvest in electrification, upgrade their operations, fund new sustainability projects and more, just for charging their electric vehicles or equipment.

2.4 British Columbia Low Carbon Fuel Standard

The BC-LCFS was established in 2008 and implemented in 2013 with the goal of reducing the carbon intensity (CI) of fuels used in the province. The BC-LCFS functions in much the same way as the three active U.S. programs. The BC-LCFS is designed to decrease the carbon intensity of British Columbia's transportation fuel pool by 30% relative to 2010 by 2030 levels and provide an increasing range of low-carbon and renewable alternatives, which reduce petroleum dependency and achieve air quality benefits.

British Columbia's low carbon fuel supply is expected to grow significantly over the next 20 years as electric vehicle use increases. The electricity that displaces gasoline and diesel in transportation vehicles is considered an incentivized Part 3 fuel under the Greenhouse Gas Reduction (Renewable and Low Carbon Fuel Requirements) Act. Part 3 fuels are subject to the reporting requirements under the Act. This generates revenue for low carbon transportation fuel suppliers and supports investment in clean fuels and vehicles.

The BC-LCFS program serves as an important tool to achieve the province's overall carbon reduction goals for the transportation sector, and encourages low-carbon investment and innovation.

2.5 Canadian Clean Fuel Regulations

The Canadian Clean Fuel Regulations (CFR) is a national clean fuel program scheduled to go into full effect July 1, 2023. The goal of Canada's CFR is to reduce the carbon intensity of the fuel used in Canada, specifically a 15% reduction in average carbon intensity from 2016 emissions by 2030. The CFR is similar to programs that have been implemented in the United States and British Columbia, however, Canada shows leadership as the first country in the world to adopt a clean fuel program at the national level.

The CFR aims to achieve carbon reduction goals by setting performance standards for clean fuels and encouraging the use of lower-carbon fuels, such as electricity. The Canadian CFR is administered by the Ministry of Environment and Climate Change and will be implemented and enforced by the Canadian Environmental Protection Agency (CEPA).

2.6 Active Clean Fuel Program Summary Tables

Table 1: Clean Fuel Programs in the USA

Location	California	Oregon	Washington
Program Name	Low Carbon Fuel Standard (LCFS)	Clean Fuels Program (CFP)	Clean Fuel Standard (CFS)
Agency Administering Program	California Air Resources Board (CARB)	Department of Environmental Quality (DEQ)	Department of Ecology
Year Program Started	January 1, 2011	January 1, 2016	January 1, 2023
Emission Goals	20% reduction in average carbon intensity from 1990 emissions by 2030	10% reduction in average carbon intensity from 2015 levels by 2025, 20% by 2030 and 37 percent by 2035	20% reduction in average carbon intensity from 2017 emissions by 2034
In Regulatory Amendment Cycle?	Yes	No	No
2021-22 Credit Volume	~25,279,000 MT	~10,353,06 MT	N/A
# of Reporting Entities	555	233	TBD
2021-22 Average Credit Value	~\$187	~\$125	TBD
Electricity General Credit Ownership	Varies	Varies	Varies
Participation Fees	No	No	Yes, 80% toward deficit creators. 20% toward credit generators.
Crediting Cadence	Quarterly	Quarterly	Quarterly
State or Local CI's	State Grid Only	State Grid or Local Utility	State Grid or Local Utility

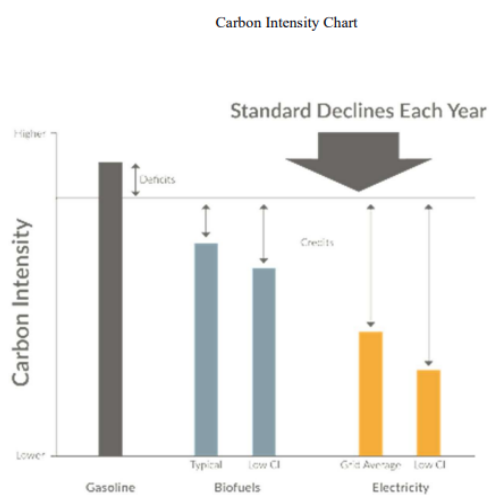
Table 2: Clean Fuel Programs in Canada

Location	British Columbia	Canada
Program Name	Low Carbon Fuel Standard (BC-LCFS)	Clean Fuel Regulations
Agency Administering Program	Ministry of Energy Mines and Low Carbon Innovation	Minister of the Environment
Year Program Started	May 1, 2008	July 1, 2023
Emission Goals	20% reduction in average carbon intensity from 2010 emissions by 2032	16% reduction in average carbon intensity from 2016 emissions by 2030
In Regulatory Amendment Cycle?	Yes	No
2021-22 Credit Volume	~551,906 MT	N/A
# of Reporting Entities	50	TBD
2021-22 Average Credit Value	~\$445.46	TBD
Electricity General Credit Ownership	Final Fuel Supplier / The Company on the Utility Bill	Charging-Site Host or Charging-Network Operator
Participation Fees	No	No
Crediting Cadence	Annually	TBD
Book & Claim for RECs	No	No
State or Local CI's	Province Grid	

3 Summary of Clean Fuel Program Mechanics and Function

States with active clean fuel programs have government agencies overseeing these regulations and who set the CI for their program. Low carbon fuels below the benchmark generate credits, while fuels above the CI benchmark generate deficits. Credits and deficits are denominated in metric tons of GHG emissions and are transacted on a private market. Credit generation is relative to the quantity of electricity supplied to the vehicles, vessels, or equipment.

Table 3: Carbon Intensity Chart



3.1 Factors Affecting California Credit Price

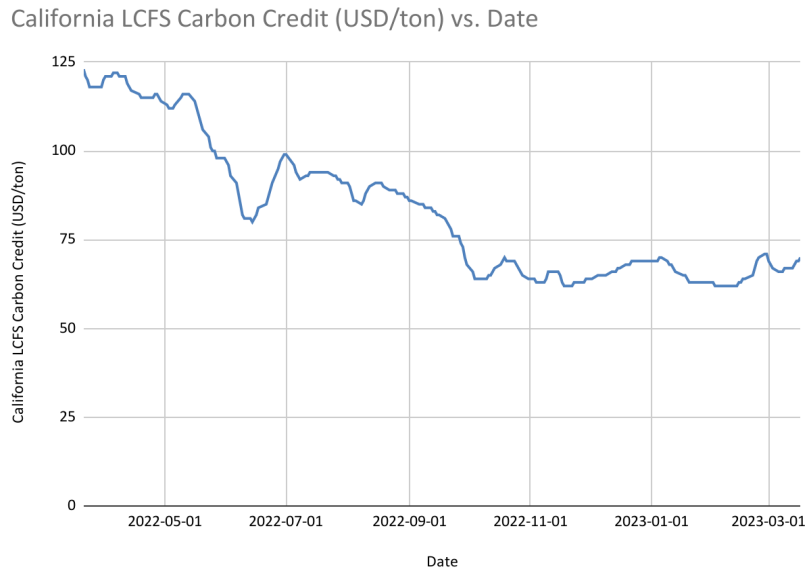
Clean fuel program credit prices fluctuate due to a variety of factors including supply and demand, government policies, economic conditions, environmental factors and technology advancements. California's Low Carbon Fuel Standard (LCFS) credit spot prices stood at \$93/ton on July 1, 2022. This is an increase from \$80 on June 14, 2022, but a dramatic drop from \$185/ton on July 1, 2021, just one year prior. In 2020, credits were trading at \$200 in 2016 dollars. While it's difficult to attribute such sharp movement to any one particular influencing factor, ramped-up production of renewable diesel and bio-CNG, and decreased demand for high-carbon fuels due to reduced travel and supply chain issues have certainly had a meaningful impact on credit price. The production volume of renewable diesel has increased to nearly one-third of all diesel supplied to the state [9] and bio-CNG has attained ultra-low carbon intensity scores which together currently account for 45% of recent credit generation.

Depressed LCFS credit prices have certainly caught the eye of state regulators, who are hearing it from all sides about the ability to shore up private financial support of clean-fuel projects if LCFS pricing is down. California regulators may try to boost credit prices by steepening and lengthening current carbon-intensity (CI) compliance targets, even those prior to 2030. This is in addition to potential caps on feedstock types (i.e. soy-based feedstocks for renewable diesel), more scrutiny on CI applications, and other ways to limit credit supply and increase demand.

Oregon credit prices have been more stable due to the lack of renewable diesel and bio-CNG in the market. However, Oregon average credit prices are lower (~\$125) than California's (~\$187) as seen in Table 1.

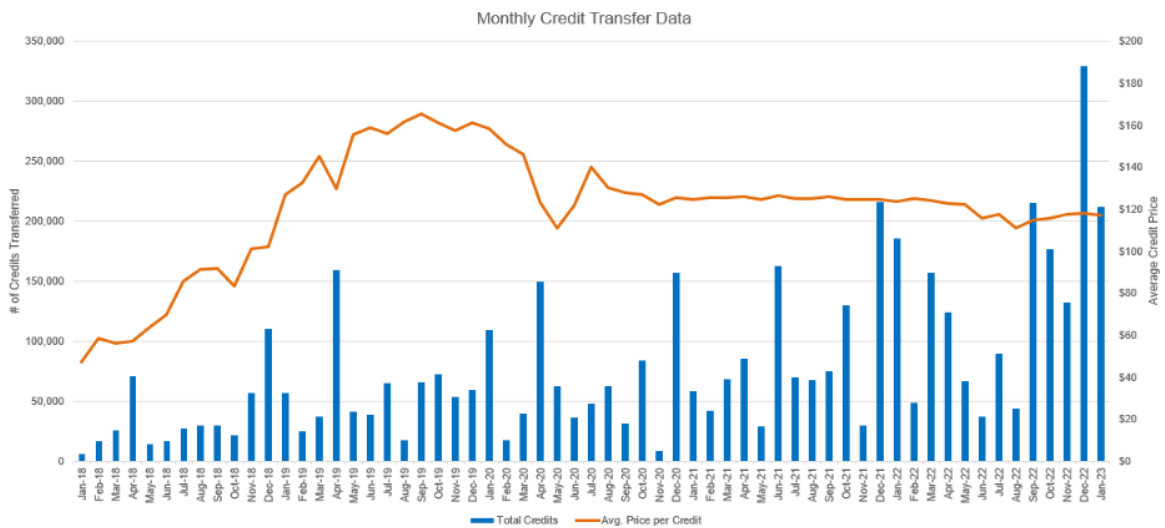
3.2 California Low Carbon Fuel Standard Credit Price

Table 4: California Low Carbon Fuel Standard Credit Price, Last 12 Months [10]



3.3 Oregon Clean Fuels program Credit Price

Table 5: Oregon Clean Fuels Program Credit Price [11]



3.4 Market Participants

Regulated Parties are petroleum fuel importers, refiners, blenders, and wholesalers who are required to reduce carbon intensity of their products to be compliant with the clean fuel program in their state or region. Biofuel refiners, electricity, natural gas suppliers and consumers can opt-in to the program to generate credits which they sell to the regulated parties.

While electrification is often associated with on-road vehicles, there are a number of technology types and equipment that can be electrified to reduce emissions and promote cleaner energy, such as electric material handling equipment, electric transportation refrigeration units (eTRUs), electric cargo handling equipment, and much more.

Many government agencies and private organizations are now embracing the idea of electrification as the future of transportation. For entities committed to the long-term future of electrified transportation, major parts of clean fuel programs are just stepping stones to a fully-electrified future. Clean fuel programs provide revenue to re-invest in electric equipment and vehicles, furthering the goals of fleets who are committed to electrification.

The implementation of clean fuel programs within electrified fleets can lead to the generation of credit revenue which can be reinvested into the fleet, thereby enabling what is commonly referred to as "snowball generation." By utilizing clean fuel program credits, these fleets can purchase new vehicles and equipment, which can be enrolled in their respective region's clean fuel program to accrue additional credits. Subsequently, these newly generated credits can be employed to acquire further equipment and vehicles that can, in turn, generate additional credits, ultimately leading to the complete electrification of the fleet.

3.5. Trends in Electricity Credit Generation

There are significant growth patterns in all sectors of electricity-based credit generation. The most prevalent credit generator growth is typically associated with residential EV-charging, of which, utilities are automatically awarded credits based on internalized calculations done by the local state agencies. As an example, growth patterns for the CA LCFS are shown below.

Table 6: Growth of California LCFS from 2011-2022 [12]

Total Electricity Reported (GGE)

GGE = kWh * 0.031

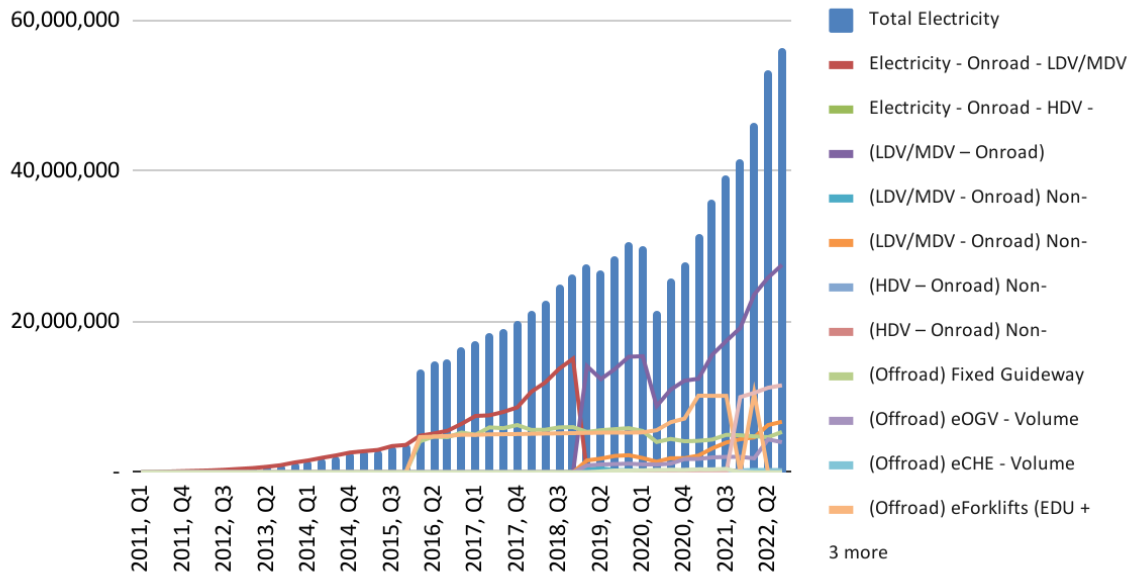
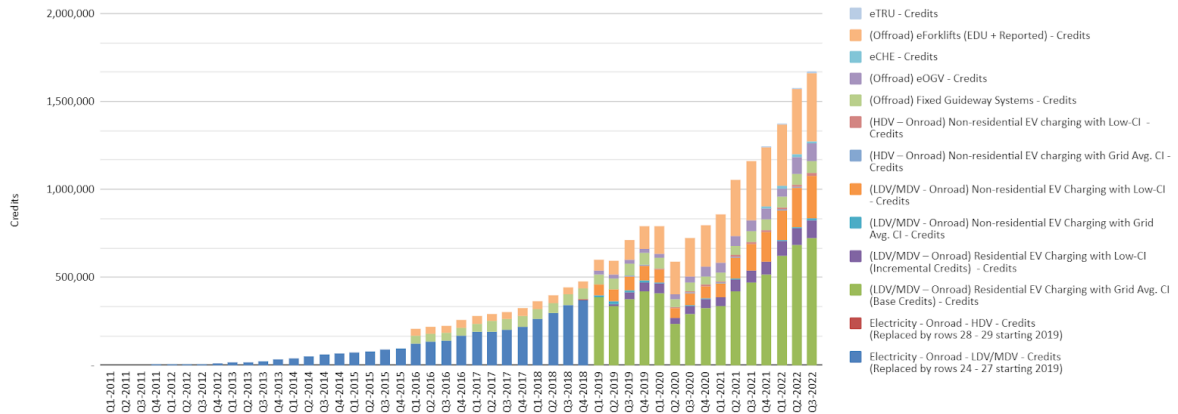


Table 7: Credit Generation by Electricity Categories 2011-2022 [12]

Credit Generation by Electricity Categories



As described above, residential EV-charging has shown the largest growth in credit generation over the last two years, followed closely by non-residential EV and non-residential EV paired with zero-emission electricity (i.e. Book-and-Claim accounting). Despite accounting for much of the dialogue in recent regulatory proceedings, the overall share of electric forklifts has not shown the same growth in credit generation as other categories. FCI and HRI pathways still only account for approximately 19% and 27%, respectively, of their current caps.

4 Case studies

Case studies of e-Mission Control partners will show that clean fuel programs are a driver of sustainability goals and revenue generated through credit incentive revenue goes to further invest in electrification.

4.1 Case study: Leading International Fresh Food Distributor

The partnership between one of the largest publicly traded wholesale distributors of health and specialty food in the United States and Canada and e-Mission Control has achieved significant sustainability milestones by reducing carbon emissions and improving air quality around the distributor's California facilities. The partnership has enabled the distributor to expand its electric fleets of forklifts and electric transport refrigeration units (eTRUs) and offset a large portion of the cost through the California Low Carbon Fuel Standard (LCFS) program.

Since 2019, the distributor has reported on 1,019 electric forklifts and 53 eTRUs, which have removed 25,215 metric tons of carbon dioxide from the atmosphere and generated over 25,000 LCFS credits. These credits amount to almost \$3M worth of additional LCFS credit revenue that can be invested in new electric material handling equipment (eMHE), eTRUs, or other sustainability projects. The distributor's commitment to sustainability is evident in its partnership with e-Mission Control and participation in the LCFS program, which have enabled it to continue to make a positive impact on the environment.

4.2 Case study: Top US Wine Producer

One of the leading wine producers in the United States has made a firm commitment towards sustainable practices, such as environmental stewardship, water conservation, and reduction of greenhouse gas emissions in their wine production process. In Q2 of 2020, this wine producer partnered with e-Mission Control to participate in the CA LCFS. The primary electric equipment used by the wine producer is forklifts, which has generated more than 2,050 credits as of February 2023, with a corresponding revenue of \$207,800.

The wine producer is an active participant in the LCFS program, which supports various sustainability initiatives, including a reduction of 25% of market-based scope 1-3 greenhouse gas emissions per gallon produced, starting from the 2015 baseline.

4.3 Case study: Top California Food Processor

An agricultural cooperative, also known as the largest nut product producer globally, initiated its partnership with e-Mission Control in Q1 of 2020. This food manufacturer is devoted to minimizing its climate change impact through innovation and stewardship practices throughout its value chain, from the growers' farms to processing facilities. The company's fleet is significant, resulting in over 12,500 credits as of February 2023.

These credits have translated into more than \$1.2 million in revenue, which the partner has invested in on-road electric vehicles and infrastructure. By doing so, they have taken significant steps towards achieving their sustainability objectives.

5 Conclusion

In summary, clean fuel programs and their promotion of electric fleet expansion offer a promising strategy for reducing CO₂ emissions and promoting environmental sustainability. The adoption of electric vehicles and equipment is a key component of this strategy, as it can significantly reduce carbon emissions and help mitigate the effects of climate change. Additionally, incentive revenue from clean fuel programs can reduce the total cost of ownership (TCO) for businesses investing in electrification. Overall, the adoption of clean fuel programs can offer numerous benefits to both the environment and to businesses. It is critical for governments, businesses, and individuals to continue investing in and adopting clean energy technologies, such as electric vehicles, to reduce our carbon footprint and safeguard the planet for future generations.

References

- [1] Oregon.gov Oregon Department of Environmental Quality Proposed Targets CFP Expansion 2022 Rulemaking Retrieved from: <https://www.oregon.gov/deq/rulemaking/Documents/cfp2022m3Targets.pdf> Accessed 3/24/23
- [2] U.S. Environmental Protection Agency (EPA). (2021). Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2019. Retrieved from <https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks> Accessed 3/24/23
- [3] California Air Resources Board (CARB). (2021). Low Carbon Fuel Standard. Retrieved from <https://ww2.arb.ca.gov/our-work/programs/low-carbon-fuel-standard> Accessed 3/24/23
- [4] CARB. (2021). Low Carbon Fuel Standard: Program Overview and Recent Trends. Retrieved from https://ww2.arb.ca.gov/sites/default/files/2021-05/lcfs_overview.pdf Accessed 3/24/23
- [5] CARB. California Low Carbon Fuel Standard: Retrieved from <https://ww2.arb.ca.gov/resources/documents/lcfs-data-dashboard> Accessed 3/24/23
- [6] CARB <https://ww2.arb.ca.gov/our-work/programs/low-carbon-fuel-standard/lcfs-meetings-and-workshops> Accessed 3/24/23
- [7] California Department of Finance. (2021). California Vehicle Registration Statistics. Retrieved from <http://www.dof.ca.gov/Forecasting/Demographics/Estimates> Accessed 3/24/23
- [8] International Council on Clean Transportation (ICCT). (2021). Electric Vehicle Capitals of the World: What Markets Are Leading the Transition to Electric?. Retrieved from https://theicct.org/sites/default/files/publications/World-EV-capitals_ICCT-Briefing_08112017_vF.pdf Accessed 3/24/23
- [9] High Plains Journal “How big is the ‘California window’ for renewable diesel?” Retrieved from https://www.hpj.com/crops/how-big-is-the-california-window-for-renewable-diesel/article_c17e6e08-724c-11ed-b384-a754fe3c4839.html Accessed 3/24/23
- [10] Neste California Low Carbon Fuel Standard Credit price <https://www.neste.com/investors/market-data/lcfs-credit-price#eb721ce3> Accessed 3/27/23
- [11] Oregon.gov Oregon Clean Fuels Program Monthly Credit Transaction Report <https://www.oregon.gov/deq/ghgp/cfp/Pages/Monthly-Data.aspx> Accessed 3/24/23
- [12] CARB Low Carbon Fuel Standard Reporting Tool Quarterly Summaries <https://ww2.arb.ca.gov/resources/documents/low-carbon-fuel-standard-reporting-tool-quarterly-summaries> Accessed 3/24/23

Author Biography



Todd Trauman is CEO of e-Mission Control, a SaaS company that designs, manages and executes electricity consumption and clean-fuel data products and services for forward-thinking on- and off-road vehicle fleet operators. For over a decade, Todd has worked with a wide variety of fleet operators, OEM’s, and regulatory agencies at the local and federal level to advance the state of affairs of GHG reduction technologies in the transportation sector. He leverages specific experience in zero-emission technologies, alternative fuels, clean fuel program frameworks, onboard diagnostics systems, certification requirements, and much more. Todd also serves as an advisory member of Drive Clean, a group committed to a national clean fuels policy. Todd holds a B.S. in Mechanical Engineering and Minor in Technical and Creative Writing from California Polytechnic State University, San Luis Obispo.