Oregon Clean Fuels Program

Program Review

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State of Oregon
DEQ Department of Environmental Quality

This report was prepared by:

Oregon Department of Environmental Quality
Oregon Clean Fuels Program
700 NE Multnomah Street
Suite 600
Portland, OR 97232
OregonCleanFuels@deq.oregon.gov

Contact:
Colin McConnaha
Manager, Office of Greenhouse Gas Programs
(971) 239-2804
colin.mcconnaha@deq.oregon.gov

Cory-Ann Wind
Oregon Clean Fuels Program Manager
(503) 869-1326
cory.ann.wind@deq.oregon.gov

Principle Authors:
Cory-Ann Wind
Bill Peters
Stephanie Summers
Kiara Winans

State of Oregon
DEQ Department of Environmental Quality

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Executive Summary

The Clean Fuels Program is one of Oregon's most successful statewide policies for addressing the state's contribution to global climate change. This program has made significant strides in reducing greenhouse gas emissions from Oregon's transportation fuels and is on track to achieve the goal of a 10% reduction by 2025. The program's success and progress thus far can be summarized in three distinct outcomes that are happening since the outset of the program in 2016:

- Companies producing biofuels are making those fuels more cleanly and delivering them in greater volumes to Oregon
- The transition to biofuels and electricity are reducing tailpipe pollution and improving public health of Oregonians
- The transition away from fossil fuels has spurred innovation and investments without impacting the price at the pump

The way these changes have transpired could not have been perfectly foreseen when the Oregon Legislature charged DEQ with adopting a low carbon fuel standard. The Legislature knew that climate change needed to be addressed and adopted an ambitious program to tackle greenhouse gas reductions in Oregon's largest sector: transportation. At the same time, the legislature included considerable flexibility in its direction to DEQ to design a program driven by market-based considerations that allows for natural adaptation to price changes, availability of alternative fuels, and emerging technologies.

Some of the key benefits include:

Cleaner fuels: The ethanol and biodiesel Oregon uses have gotten cleaner, and more of it is being blended into gasoline and diesel, displacing the fossil portion of fuel. Renewable forms of diesel, natural gas, propane, and electricity have emerged as commercially viable and cost-effective replacements of their fossil versions. Electric vehicle adoption has seen rapid growth and is well on its way of becoming a mainstay of passenger vehicles and commercial trucks. These fuels have played an important role in reducing almost 6 million tons of emissions so far and displacing over 1 billion gallons of fossil fuels.

Improving the health of Oregonians: The transition to low-carbon fuels also improves local air quality and public health. This is especially important for Oregon's historically overburdened communities that are located near major transportation corridors, multimodal facilities, and distribution hubs. Low-carbon fuels also reduce carbon monoxide, sulfur dioxide, nitrogen oxides, and particulate matter compared to fossil fuels. Reducing these pollutants have saved Oregonians millions of dollars in avoided health costs.

Spurring innovation and investment: The program has fostered a $100-million-a-year-plus market where investments are being made to increase the production of lower-carbon fuels, spark new innovations in technology, and invest in infrastructure to deliver these fuels across the state. The program's credit prices have remained steady, signaling to fuel producers and suppliers here and beyond that they should continue to invest in Oregon. These investments have allowed the transition from fossil products to cleaner fuels to happen without any significant rise in retail or wholesale fuel prices when compared to our neighboring states. In fact, the program brings down the cost of low-carbon fuels and creates the financial incentive to decarbonize the transportation sector as no other program can do.

These successes suggest the Clean Fuels Program can and should do more, both to further reduce greenhouse gas emissions and provide a wide array of benefits to the state. To that end, DEQ has embarked on a rulemaking process to expand the program and establish more ambitious long-term goals for the program and the energy our transportation sector relies on.

Background

The 2009 Oregon Legislature adopted HB 2186 which authorized the Environmental Quality Commission to adopt rules to reduce lifecycle emissions of greenhouse gases from Oregon's transportation fuels. The Department of Environmental Quality embarked on a 13-month advisory committee process to design Oregon's low carbon fuel standards, otherwise known as the Clean Fuels Program. The EQC adopted these recommendations into administrative rules in phases, starting with recordkeeping requirements in December 2012 and then in January 2015 to establish and put into force the clean fuel standards.

Even with the rulemaking, the program could not be fully implemented at that time since HB 2186 included a sunset date of Dec. 31, 2015. That sunset date was removed in 2015 when the Legislature adopted SB 324. It further authorized the EQC to adopt rules for managing and containing the costs of compliance with the program. The EQC adopted the legislative mandates in December 2015 and additional rule revisions in April 2016 and August 2016 to improve the program.

The 2017 Legislature adopted HB 2017 that specified additional provisions to manage and contain the costs of compliance with the program and required this program review. The EQC adopted those legislative mandates in November 2017 and additional rule revisions in 2018 and 2020 to improve the program.

In March 2020, Governor Kate Brown issued Executive Order 20-04 which directed the EQC and DEQ to:

- Amend the low carbon fuel standards, and the schedule to phase in the implementation of those standards, with the goal of reducing the average amount of greenhouse gas emissions per unit of fuel energy by 20% below 2015 levels by 2030, and 25% below 2015 levels by 2035.
- Advance methods accelerating the generation and aggregation of clean fuels credits by utilities that can advance the transportation electrification goals set forth in SB 1044.

The EQC adopted rules to implement the second executive order directive in March 2021. DEQ began a rulemaking process in December 2021 to develop proposed revisions to the program rules to extend beyond 2025 and beyond the 10% standard. DEQ plans to recommend those rule revisions to the EQC in Fall 2022.

Scope of the Program Review

Section 170 of HB 2017 requires the following:

(1) The Department of Environmental Quality shall, no later than February 1, 2022, complete a review of the clean fuels program and submit a report on the department's review to the interim committees of the Legislative Assembly related to environment and natural resources in the manner provided by ORS 192.245.

(2) The review required by this section must consider all program compliance data available and must include, but need not be limited to, a review of the following:

(a) The progress of this state, through implementation of sections 159 to 167 of this 2017 Act and rules adopted pursuant to sections 159 to 167 of this 2017 Act, toward achieving the goal of reducing the average amount of greenhouse gas emissions per unit of fuel energy of the fuels by 10% below 2010 levels by the year 2025.

(b) The environmental, economic, health and other benefits realized through the implementation of sections 159 to 167 of this 2017 Act and rules adopted pursuant to sections 159 to 167 of this 2017 Act, including but not limited to the economic benefits of supplying low-carbon fuels or electric vehicle charging and related infrastructure.

(c) The projected availability of low-carbon fuels and credits through the year 2025, using the methodology described in section 163 (2) of this 2017 Act.

(d) Additional mechanisms that may be necessary to manage and contain the costs of compliance with the low carbon fuel standards.

(e) Whether adjustments to the low carbon fuel standards or the clean fuels program are necessary, including for purposes of achieving regional harmonization and consistency with the strategy described in ORS 184.617 (1)(j).

(f) The effects of the maximum price for credits in the credit clearance market, as provided for in section 166 of this 2017 Act, on implementation of sections 159 to 167 of this 2017 Act.

(g) Adjustments that could serve to strengthen and enhance the low carbon fuel standards or the clean fuels program in terms of increased emissions reductions or other net benefits attributable to the standards or program.

This program review responds to all of these requirements. These responses are not in that particular order but are woven throughout the report.

Clean Fuels Program 101

The policy goal of the program is to reduce the carbon intensity of Oregon's transportation fuels. Beginning in 2016, DEQ established annual average carbon intensity reduction standards that extend through 2025. The standards decline each year until a 10% reduction is achieved as shown in Figure 1.

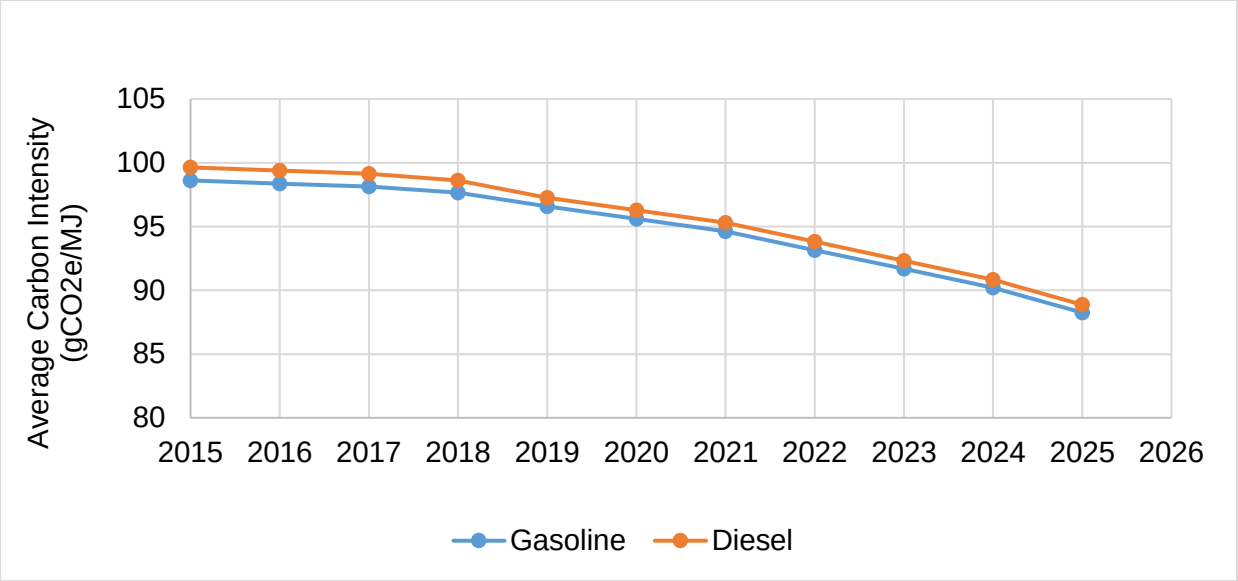


Figure 1. Annual clean fuel standards for gasoline and diesel for 2015–2025

Carbon intensity is the measure of lifecycle greenhouse gas emissions from transportation fuels. The lifecycle measured by the program encompasses emissions from the extraction, refining or production, transportation to a dispensing facility, and combustion of the fuel. The lower the fuel's carbon intensity is, the lower its total emissions are and a greater reduction in emissions is realized relative to the fossil gasoline or diesel they displace.

Fuels that are lower than the annual standard generate credits, while fuels that are higher than the annual standard generate deficits. Credits and deficits are measured in metric tons of greenhouse gas emissions. At the end of each calendar year, a fuel provider must retire enough credits to offset the number of deficits they generated in order to be in compliance with the standards. Credits can be sold to regulated entities who need them to comply which in turn creates revenue for the businesses that provide the low-carbon fuels that generate credits. The credits encourage fuel suppliers to source and supply the lowest carbon fuels to customers in Oregon.

Oregon's Climate Strategy

Approximately 40% of the state's greenhouse gas emissions come from the transportation sector. To decarbonize this sector, the state must invest in programs and policies that require cleaner fuels, cleaner vehicles, and fewer vehicle miles traveled.

The Clean Fuels Program is Oregon's primary strategy to reduce greenhouse gas emissions from transportation fuels and requires increasing reductions in the average carbon intensity over time. The policy is fuel-neutral and technology-agnostic, which provides maximum flexibility for entities to comply and encourages the transition to low-, zero-, and even negative-carbon options. Reductions can be derived through using lower carbon biofuels or switching to alternative fuels such as electricity, renewable natural gas, renewable propane, or renewable hydrogen.

The program complements other signature DEQ programs that reduce greenhouse gas emissions from the transportation sector: (1) the Zero Emission Vehicle programs for light-, medium-, and heavy-duty vehicles that require an increasing percentage of cars and trucks delivered for sale to Oregon to be battery-electric or fuel cell vehicles; and (2) the Climate Protection Program that sets statewide enforceable limits on greenhouse gas emissions from fossil fuels, including gasoline, diesel, and natural gas. The Clean Fuels Program provides valuable incentives that will help regulated entities meet those requirements, making compliance easier and more cost-effective.

Other key parts of Oregon's climate work are being led by the Oregon Public Utility Commission to implement HB 2021 by requiring 100% clean energy; the Oregon Department of Transportation in planning for EV charging infrastructure; and the Oregon Department of Land Conservation and Development in requiring land use and transportation plans to reduce vehicle miles traveled and allow Oregonians to be less reliant on automobiles. Each of those agencies' programs complement the Clean Fuels Program, and vice-versa. For example, 100% clean electricity will significantly improve how this energy source helps achieve the standards of the Clean Fuels Program, which also provides incentives and funding for low- and no-carbon electricity to be used in electric vehicles.

Reducing Greenhouse Gases

The Clean Fuels Program reduces greenhouse gas emissions by providing incentives to further develop and commercialize low-carbon fuels. This is done by requiring the average carbon intensity of Oregon's transportation fuels to decline over time.

Fuel suppliers are required to report quarterly to DEQ the amount and types of transportation fuels they produce in-state or import into the state. This data is used to calculate the amount of emissions relative to the clean fuel standard for that year, which is how the reductions can be attributed to the program.

A deficit represents a metric ton of emissions that are above the standard and a credit represents a metric ton of emissions that are below the standard. Any excess of credits above the number of deficits can be banked and used for future compliance. Figure 2 shows there have been more credits generated in the program than deficits and there is a growing bank of credits.

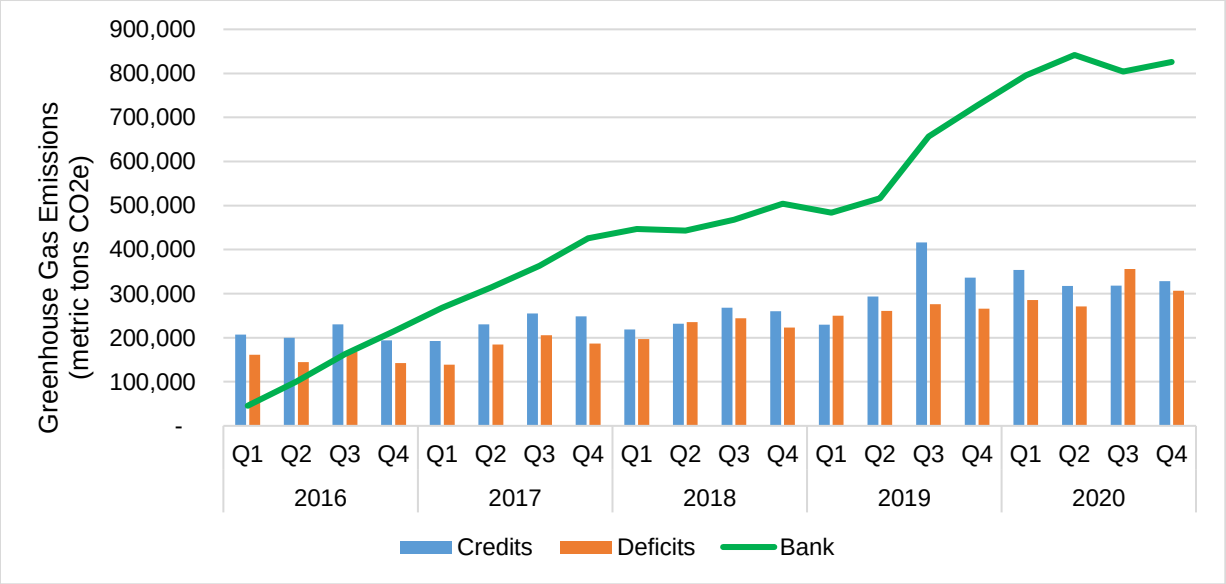


Figure 2. Summary of CFP deficit and credit generation between 2016–2020

From the beginning of the program in 2016 through 2020, approximately 5.3 million metric tons of greenhouse gas emissions (Figure 3) have been reduced because of the program.

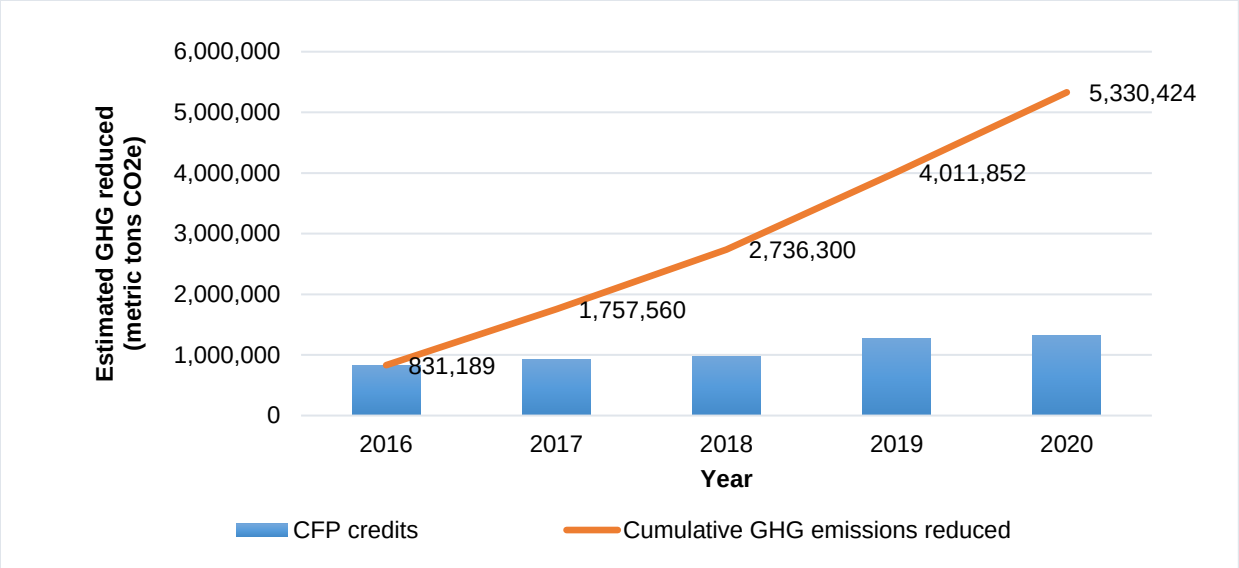


Figure 3. Estimated greenhouse gas reductions between 2016–2020

Many different fuels are responsible for reducing the overall carbon intensity of Oregon's transportation fuels. The carbon intensity of fuels that substitute for gasoline and diesel have decreased since the beginning of the program. Table 1 shows the average of carbon intensities that were approved for use in that reporting per year.

Table 1. Average carbon intensity of approved pathways by fuel type, 2016 - 2021

Year	2016	2017	2018	2019	2020	2021
Fuel type	**Straight Average Per Year**					
Biodiesel	33.34[a]	34.08[a]	35.31[a]	34.80[a]	35.52[a]	34.60[a]
Ethanol	62.45[a]	61.51[a]	58.85[a]	57.57[a]	57.12[a]	51.70[a]
Renewable Diesel	n.a.	33.60	31.94	32.11	34.53	33.57
Renewable Propane	n.a.	n.a.	39.26[b]	39.26[b]	55.00[b]	32.21
Renewable Natural Gas	34.32[a]	33.30[a]	34.65[a]	34.89[a]	33.39[a]	35.69[a]

- Unless indicated otherwise, all values are based on facility-level carbon intensity values certified and used for reporting fuel volumes under the CFP.
- n.a. indicates no fuel pathway and CI values were applicable under the CFP in that year.
- [a]Values include temporary and facility-level fuel pathway CI values
- [b]Temporary fuel pathway CI values available only

For the liquid biofuels, reductions in carbon intensity are accomplished by biorefineries becoming more efficient, by producing more co-products, or through switching from crop-based to waste-based feedstocks. Figure 4 shows the volume-weighted carbon intensity of biofuels as reported by the registered parties.

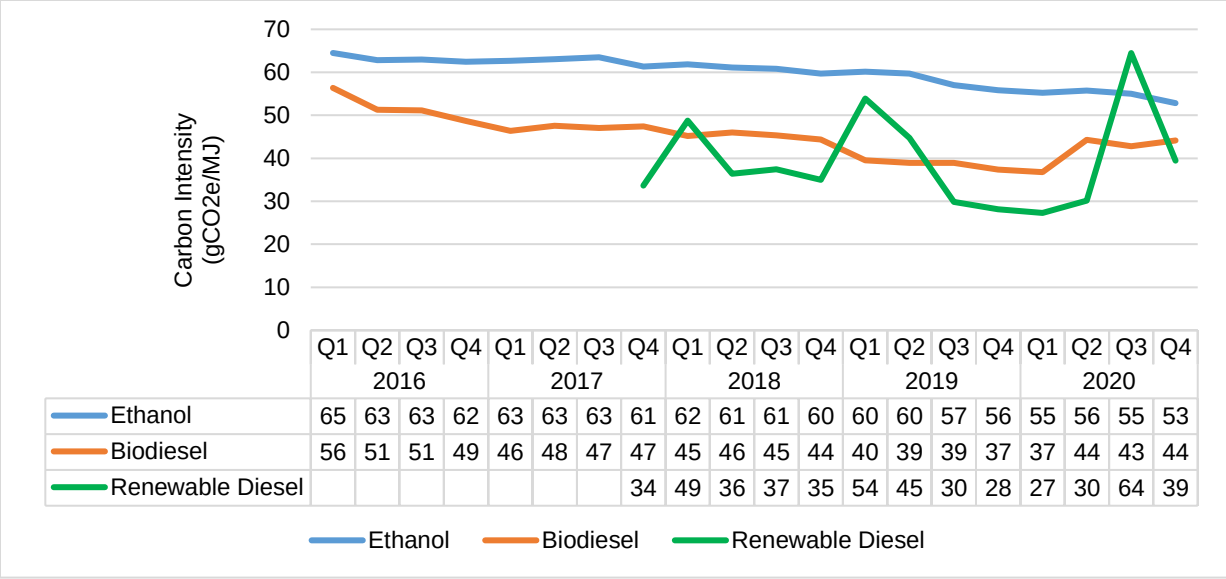


Figure 4. Average carbon intensity of liquid biofuels between 2016–2020

Other Benefits

In addition to the greenhouse gas reductions already described, the Clean Fuels Program has brought many other benefits to Oregon; some that were anticipated and others that were pleasant surprises. The following sections elaborate on several of these points and how Oregonians have benefitted from them.

Reduction in tailpipe air pollutants and public health benefits

As part of the effort to expand Clean Fuels Program, DEQ contracted with the University of California Davis Policy Institute for Energy, Environment, and the Economy and the UC Davis Department of Civil and Environmental Engineering to study the anticipated effects on air quality from the displacement of fossil by low-carbon alternative fuels. This study examines how traditional tailpipe air pollutants such as particulate matter (also known as soot), nitrogen oxides, and ozone are affected in correlation with reductions in lifecycle greenhouse gases. These air pollutants have direct human health impacts.

As part of the effort to expand Clean Fuels Program, DEQ also contracted with the consulting firm ICF to develop scenarios to show which combination of vehicles and fuels could achieve greater reductions in average carbon intensity through 2035. Based on these scenarios and in coordination with the Oregon Department of Transportation, UC Davis generated statewide estimates of vehicle activity. Emissions were modeled using the U.S. Environmental Protection Agency's MOVES model. The emissions were then combined with existing estimates of future non-vehicles emissions from the National Emissions Inventory and used as the basis for high-resolution spatial modeling of air pollutant dispersion and chemistry. Reduced health impacts attributable to that air pollution were then estimated using EPA's BenMAP software package. The Oregon Health Authority assisted to ascertain the health outcomes based on the modeling results.

Preliminary results indicate that particulate matter is the primary driver of health risk from air quality in Oregon, with approximately 240 excess deaths per year caused by particulate matter, of which, approximately 90 were due to the pollution from vehicles. Results for the scenarios based on CFP expansion are still being processed, but the research team anticipates that achieving the 25% target in 2035 would result in approximately 12 fewer annual deaths in Oregon by reducing particulate matter pollution from vehicles. Using default values in BenMAP, there is a preliminary estimate that approximately $100 million per year is saved in avoided health costs.

At the date of this report, the UC Davis team is modeling an additional scenario with a higher target in 2035. When DEQ receives those results, the avoided health costs from reductions in the other pollutants will be added. DEQ will coordinate with OHA to ensure that Oregon-specific health outcomes and costs are incorporated into the study. Full results and a final report are expected later in Q1, 2022.

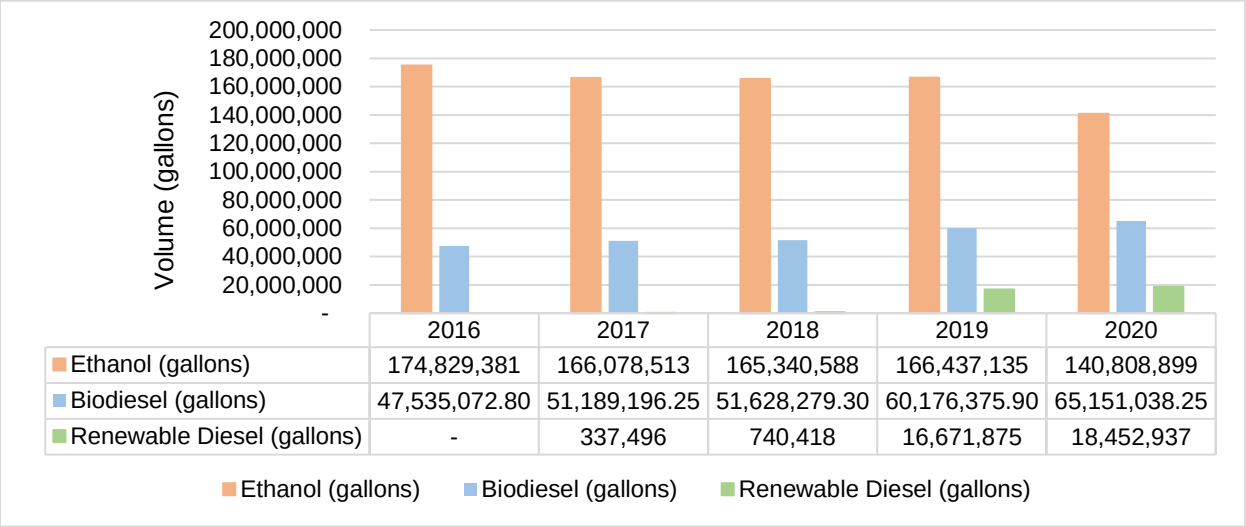
Because vehicle emissions correlate closely to vehicle activity and population, the largest impacts are in the most populous parts of the state and in communities that are located closest to highways and other transportation corridors and hubs. As such, reductions of vehicle emissions are an important strategy to

address environmental justice concerns in neighborhoods disproportionately impacted by transportation-related pollution.

Increasing the use of low-carbon fuels

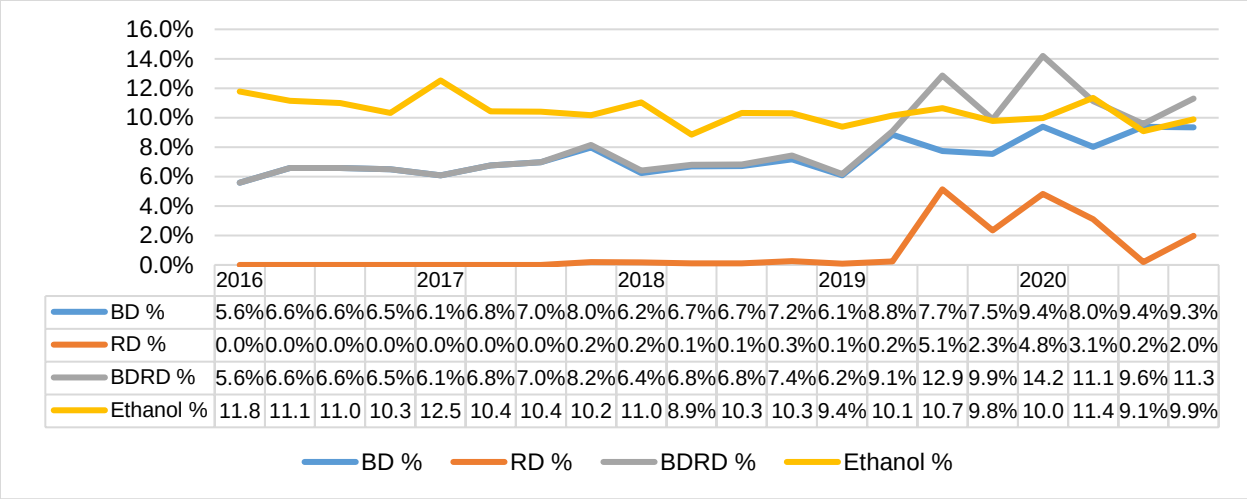
The use of low-carbon fuels has grown substantially in the state since the start of the program in 2016. This is both the direct result of program's inherent economics influencing fuel markets, and how the program supports other policies that help decarbonize the transportation sector such as the Zero Emission Vehicle regulations. Economy-wide declining caps on emissions create a clear expectation for businesses, and the decade-long increases in the annual standard allows businesses to plan and invest over time.

The program has lowered the price of low-carbon liquid fuels being delivered to the state and creates strong support for the non-liquid alternatives to gasoline and diesel. These factors have aided the adoption of higher biodiesel blends, helped draw renewable propane, renewable natural gas, and renewable diesel to Oregon, and supported light-, medium-, and heavy-duty electric vehicles and the charging infrastructure they require.



	2016	2017	2018	2019	2020
Ethanol (gallons)	174,829,381	166,078,513	165,340,588	166,437,135	140,808,899
Biodiesel (gallons)	47,535,072.80	51,189,196.25	51,628,279.30	60,176,375.90	65,151,038.25
Renewable Diesel (gallons)	-	337,496	740,418	16,671,875	18,452,937

Figure 5. Volumes of liquid biofuels between 2016–2020



	2016			2017			2018			2019			2020				
BD %	5.6%	6.6%	6.6%	6.5%	6.1%	6.8%	7.0%	8.0%	6.2%	6.7%	6.7%	7.2%	6.1%	8.8%	7.7%	7.5%	9.4%	8.0%	9.4%	9.3%
RD %	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.2%	0.1%	0.1%	0.3%	0.1%	0.2%	5.1%	2.3%	4.8%	3.1%	0.2%	2.0%
BDRD %	5.6%	6.6%	6.6%	6.5%	6.1%	6.8%	7.0%	8.2%	6.4%	6.8%	6.8%	7.4%	6.2%	9.1%	12.9	9.9%	14.2	11.1	9.6%	11.3
Ethanol %	11.8	11.1	11.0	10.3	12.5	10.4	10.4	10.2	11.0	8.9%	10.3	10.3	9.4%	10.1	10.7	9.8%	10.0	11.4	9.1%	9.9%

Figure 6. Blend rates of liquid biofuels between 2016–2020

As you can see in Figures 5 and 6, ethanol consumption has steadily declined as it remains closely tied to declining gasoline consumption, since the blend rate of 10% ethanol in gasoline was set at both a ceiling and a floor in state law. Beginning in 2022, higher blends of ethanol are likely due to legislative changes to the Oregon Renewable Fuel Standard that allow for higher blends of ethanol, allowing the favorable market conditions created by the program to take effect.

Biodiesel consumption has increased and now makes up close to 10% of the diesel fuel supplied in the state. That includes the increasing availability of higher biodiesel blends such as B10 and B20 (10% and 20% biodiesel respectively), and as pure biodiesel in the diesel trucks that have been adapted to run that fuel. This is nearly double the 5% required to be in nearly all gallons of diesel sold in the state.

Renewable diesel entered the Oregon market in late 2017 and is a fully drop-in alternative to fossil diesel. Renewable diesel now makes up approximately 2% of the fuel supplied to diesel engines in the state. This is modest relative to biodiesel, but this should increase significantly with transit agencies and other public fleets in Eugene and Portland making the switch to this fuel during 2021.

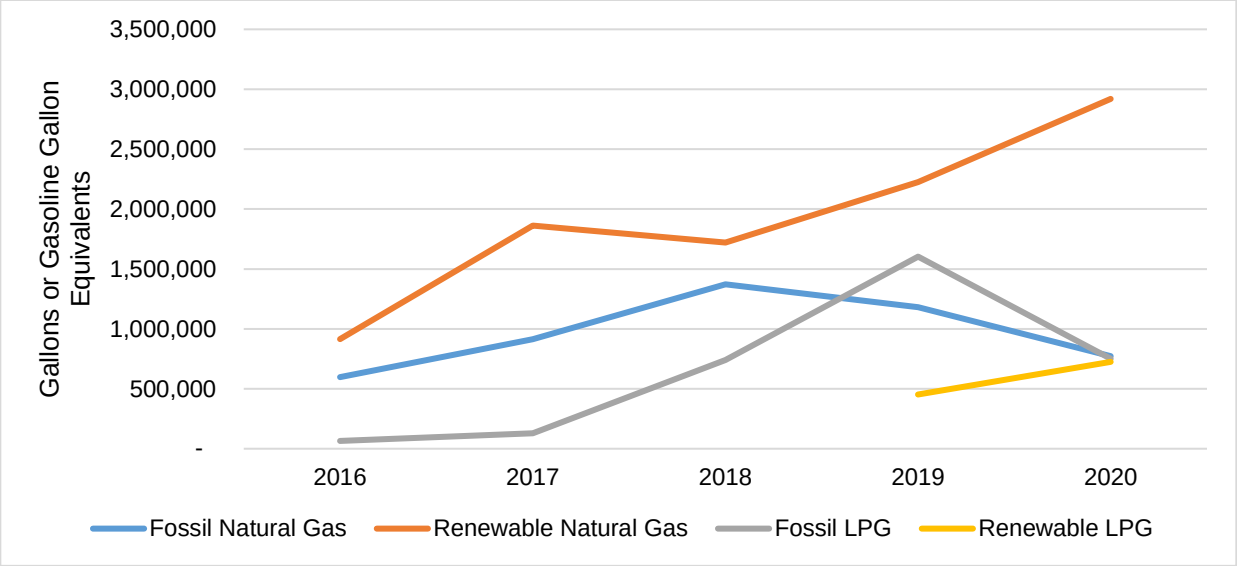
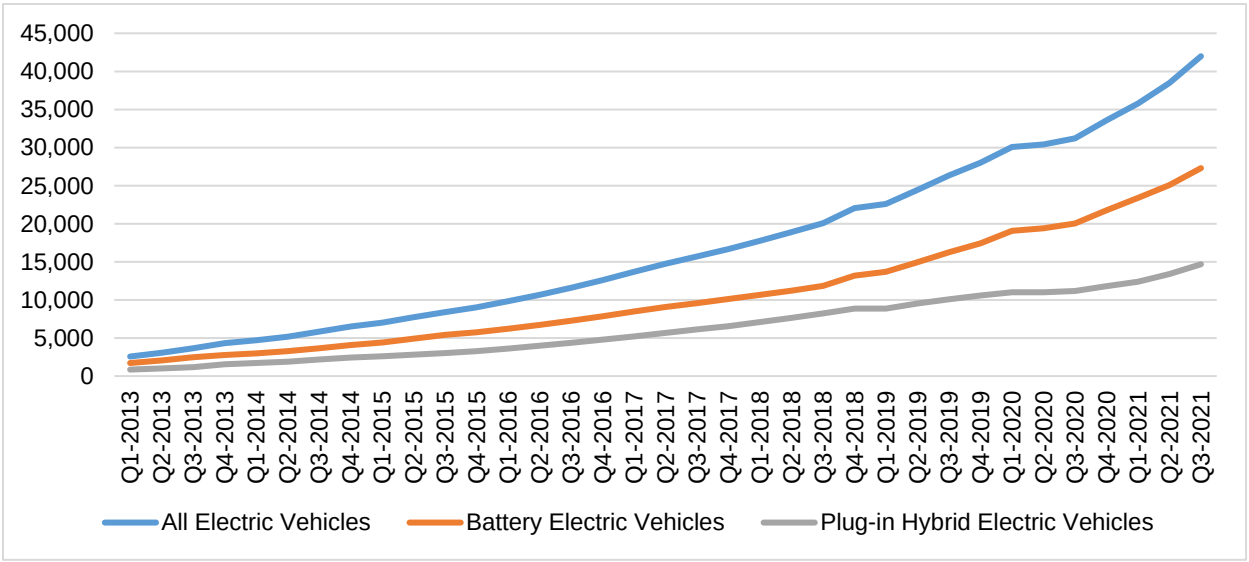


Figure 7. Volumes of natural gas and propane between 2016–2020

Natural gas is a lower-carbon fuel with the fossil version reducing approximately 20% of greenhouse gas emissions from gasoline and diesel and the renewable versions reducing in excess of 50% of greenhouse gas emissions. Renewable natural gas used as a transportation fuel entered the Oregon market in 2016 and has shown a steady increase in use due to the value of the credits. Propane is a lower-carbon fuel with the fossil version reducing approximately 20% of greenhouse gas emissions from gasoline and diesel and the renewable version reducing approximately 50% of greenhouse gas emissions. Renewable propane used as a transportation fuel entered the Oregon market in the second half of 2019 and has also shown steady increase in use. Figure 7 above shows the transition from fossil to renewable forms of natural gas and propane.



Source: Oregon DMV

Figure 8. Electric vehicles registered in Oregon between 2013–2021

Figure 8 shows the steep adoption rate of electric vehicles in Oregon. This is due to the adoption of zero emission vehicle regulations, the emergence of a state rebate applied to the purchase or lease of an EV, and the rapidly increasing availability of models by vehicle manufacturers.

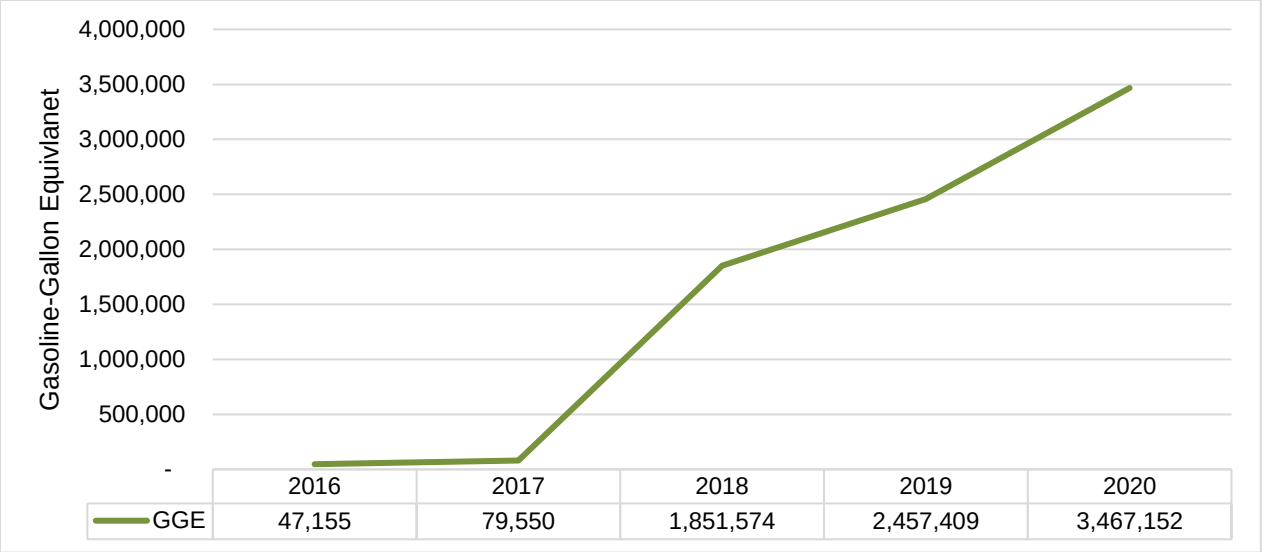


Figure 9. Volume of electricity charged between 2016–2020

Figure 9 shows the amount of electricity directly reported to the program by charger owners and operators. Not shown here is the amount of electricity that is estimated from electric vehicles that charge at home. Electricity used as a transportation fuel has grown rapidly as the number of electric vehicles has grown and that steep growth will continue in the future as required by ZEV regulations.

Hydrogen is the newest entrant to the Oregon transportation fuel market, with it just beginning use in 2021. Currently, there is no dedicated on-road fueling infrastructure in Oregon and the hydrogen is being trucked from production facilities in California. Because ZEV regulations cover both battery-electric and hydrogen fuel cell technologies, hydrogen use should increase as the number of medium- and heavy-duty zero-emission vehicles grows.

Lowering the price of low-carbon fuels

The program lowers the price of low-carbon fuels to Oregonians because these fuels generate credits which can then be sold to offset or lower the underlying commodity price. The value of the credits for a given amount of fuel is related to the carbon intensity of the fuel and the credit price in the market. The following table shows how a credit price of $125, which is the current average credit price, translates for a sampling of low-carbon fuels:

Table 2. Value of the credits in 2021 @ $125 credit price

Fuel	Value of CFP Credits in 2021
Corn ethanol	$0.39 per gallon
Used cooking oil biodiesel	$1.16 per gallon
Soy biodiesel	$0.61 per gallon
Renewable diesel	$0.79 per gallon
Electricity in a light-duty vehicle	$0.08 per kWh
Electricity in a heavy-duty vehicle	$0.15 per kWh
Landfill renewable natural gas	$0.45 per therm
Dairy renewable natural gas	$4.41 per therm
Renewable propane	$0.58 per gallon

Depending on the fuel, the value of the credits can be realized by different parties based on the program's regulations. For liquid fuels such as ethanol, biodiesel, or renewable diesel, the fuel producer or the importer of the fuel generates the credits and can choose to pass them along when it is sold in-state. The value of the credits for these fuels enables them to be cost-competitive with fossil gasoline and diesel even though their feedstocks and production processes may be more expensive.

For example, in recent months renewable diesel has sold to fleets in Oregon for 3 to 9 cents per gallon over B5 Diesel in Oregon. In contrast, renewable diesel in Washington, where there is not an operating clean fuels program, sells for a significantly higher price - approximately $1 - $1.50 per gallon higher than fossil diesel. Another example is that B20 is now commonly sold for less than B5 in Oregon. For fuels like dairy renewable natural gas, the value of the credits exceeds the cost of the fuel itself, so fleets such as the Cherriots transit agency for Salem are being paid to use the fuel.

CFP credits support electric vehicle chargers and lowers the cost of operation for fleets to switch to electric vehicles. Electricity credits generated in 2021 are on pace to be worth over $23 million at current credit prices. That amount will increase as more electric vehicles are deployed in the state.

More infrastructure for low-carbon fuels

Prior to the start of the program, the only information about alternative fuel infrastructure came from the U.S. Department of Energy's Alternative Fuel Data Center. There was a limited number of compressed natural gas and propane dispensers and they were almost exclusively for use by private fleets and not accessible by the public. The lack of fueling infrastructure was a major barrier to conversion to an alternative fuel.

Since implementing the program, the number of registered fuel supply equipment has increased. Most prominently, the number of electric vehicle chargers has quadrupled over the past four years. Table 3 shows the number of dispensers or chargers that are registered in the program which allows them to generate the credits for the fuel they supply.

Table 3. Number of registered fuel supply equipment between 2018–2021

	Registered Fuel Supply Equipment		
	CNG dispensers	LPG dispensers	EV chargers
2018	15	n/a	713
2019	22	n/a	1,347
2020	27	n/a	2,139
2021	29	45	2,863

Accelerating the adoption of new vehicle technologies

The program complements grant and rebate opportunities by providing on-going funding to offset the higher up-front costs for purchasing those vehicles, which is the primary barrier to adoption of alternative-fueled vehicles. The market incentives that the program creates increases the availability and accessibility of the alternative fuels they use which speeds up the transition to new alternative-fueled vehicles into Oregon's fleet. The sale of CFP credits generated by these alternative fuels can also be a valuable revenue stream that funds future fleet conversion.

This is especially apparent as the state rapidly transitions to zero emission technologies. Last year, the EQC approved updates that accentuate the role of the program to incentivize electricity used as a transportation fuel. As SB 1044 established aggressive goals for electric vehicle adoption, the credits generated from the program have become an increasingly important factor in creating the business case to convert to electric technology. The program established new provisions that: (1) speed up the process of new types of electric vehicles to generate credits in the program; (2) promote the use of renewable electricity to fuel electric vehicles; and (3) provide an advancement of credits to the beginning of a fleet electrification project, rather than throughout the duration of a project, in order to lower the initial costs associated with converting the fleet. The combined effect of these provisions allows the program to provide an even more prominent role in electrifying Oregon's fleet.

The program complements DEQ's regulatory programs - Light-Duty Zero Emissions Vehicle program and the Advanced Clean Trucks program - and DEQ's financial incentive programs – the Oregon Clean Vehicle Rebate program, the Charge Ahead Rebate program, and the Diesel Emissions Mitigation grant programs – which ensures that fleets have incentives to purchase the vehicles that are required to be sold into Oregon.

Collaboration with the Oregon Public Utility Commission and electric utilities

One unexpected benefit that has emerged since the beginning of the program is a much stronger partnership between DEQ and the Oregon Public Utility Commission as transportation electrification has risen as a powerful climate strategy. Their expertise in the electricity market has been invaluable to DEQ staff and on the flip side, our expertise in vehicle technology has helped them grow into their new role in transportation policy. Additionally, their oversight of ratepayer funds affords DEQ an additional set of eyes on the investments that Oregon's investor-owned utilities are making to increase the adoption of electric vehicles.

Under the Clean Fuels Program, electric utilities can opt in to generate credits from their residential customers who own electric vehicles and charge at home. On April 18, 2017, the commission opened an investigation into electric utilities' participation in the program as credit generators, how their participation would be structured, and how revenues from their participation might be allocated consistent with the public interest. On July 12, 2017, the commission found that utility participation in the program as credit generators to be in the public interest and required Portland General Electric and PacifiCorp to register with DEQ to generate and aggregate CFP credits.

The commission then adopted monetization principles for CFP credits and how the utilities would participate in the market. It also established six principles for utility participation in the program and created a process for public review. The program design principles are:

- Support the goal of electrifying Oregon's transportation sectors.
- Provide majority of benefits to residential customers.
- Provide benefits to traditionally underserved communities.
- Design programs to be independent from ratepayer support.
- Develop programs collaboratively and transparently.
- Maximize use of funds to implement the program.

Residential credits generated in 2016 and 2017 were allocated to utilities in 2018 and were monetized to fund programs in 2019. This allocation of credits occurred annually through 2020 and became semi-annual in 2021 following that year's rulemaking. As electric vehicle adoption increases, so does the amount of credits allocated to utilities and their budgets for their EV programs.

For Portland General Electric, their CFP-funded EV programs have increased from $4.5 million to over $7 million in 2022. Most of that revenue funds their Drive Change Fund and Electric School Bus Fund, updates to public charging infrastructure, and innovative programs such as pilots to test vehicle-to-grid technologies and right-of-way charging. Over three dozen community-based organizations and five school districts have benefitted so far from the grant opportunities.

PacifiCorp's CFP-funded EV programs increased from $1.5 million to about $2.5 million in 2022. Most of that revenue funds their Electric Mobility Grant and provides valuable matching dollars to customers who are applying for federal grants.

In addition, both utilities partnered to fund several statewide education and outreach campaigns including (1) the Oregoin' Electric web page and media campaign to educate Oregonians about the benefits of electric vehicles; and (2) the Future of Oregon Transportation design challenge for middle-schoolers with the Construct Foundation.

Twenty-six public utility districts, electric cooperatives, and municipalities also generate CFP credits on behalf of their customers that own electric vehicles. Many of these utilities are located in rural parts of the state and have made significant investments in installing electric vehicle chargers that are available to the public. Many are free to use. Revenue from the sale of their CFP credits also funds rebates on chargers, purchase of fleet electric vehicles, and hosting local "ride-and-drives" to give customers their first experience of driving an electric vehicle.

Macroeconomic impacts

In 2010, DEQ contracted with Jack Faucett Associates to conduct a macroeconomic analysis of an Oregon low carbon fuel standards program. The primary conclusion was that since Oregon has no in-state refining of transportation fuels, any policy that decreased the state's dependence on imported transportation fuels would result in a positive economic impact for the state. Additionally, the analysis concluded that lower carbon fuels would be cheaper than the fossil fuels they displaced so there would also be a net benefit to fuel consumers. Lastly, the analysis concluded that the cheapest way to comply with the regulation would be through the conversion to natural gas and electricity and that the investment in that infrastructure would lead to local job growth. DEQ has not conducted a subsequent analysis, but data shows that many of the conclusions of the initial analysis have proven accurate as shown throughout this program review.

Clean Fuels Program Credit Market

Credits in the Clean Fuels Program are generated when fuels are distributed or used that reduce a ton of carbon dioxide equivalent greenhouse gas emissions against the program's standards. Credits can be traded between parties in the program such that overcompliance on the part of one entity can be used to make up for undercompliance by another. The trading of credits is a flexibility mechanism that makes compliance easier and cheaper for regulated parties. More importantly, it creates a clear price signal that low-carbon fuels should be made in or brought to Oregon.

That price signal is critical to the program's success in transforming the transportation fuels market and creating strong incentives to deploy alternative fueling infrastructure such as electric vehicle chargers or compressed natural gas dispensers, and then supply them with low-carbon electricity or renewable natural gas. Renewable natural gas now makes up over 70% of the fuel supplied to natural gas vehicles in Oregon, and there has been significant uptake in the renewable electricity provisions that were adopted in a rulemaking in 2021.

The growth of the CFP market can be showed through the number of parties that are registered in the program which is the mechanism by which a business can generate credits. The growth in participation indicates that the market is robust and that the market is attracting low-carbon fuel investors.

Table 4. Number of parties registered in the CFP

	2016	2017	2018	2019	2020	2021
# of Registered Parties	92	110	140	165	184	219

The value of the Clean Fuels Program market

One way to estimate the value of the market is from the perspective of the regulated parties who are required to comply with the regulation. This entails multiplying the number of deficits generated in a given year with the average credit price in that year. Figure 10 shows how the value of the deficits has increased in the past five years.

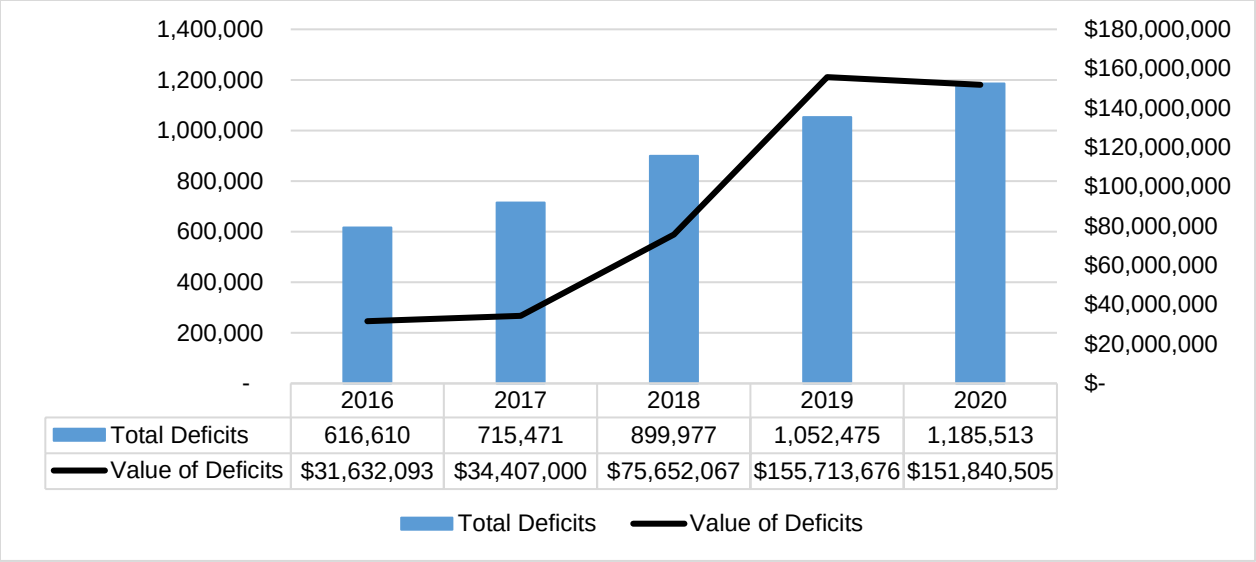


Figure 10. The value of deficits generated between 2016-2020

Another way to estimate the value of the market is from the perspective of the providers of the low-carbon fuels. This entails multiplying the number of credits transacted in a given year with the average credit price in that year. Figure 11 shows how the value of the credits has increased in the past five years.

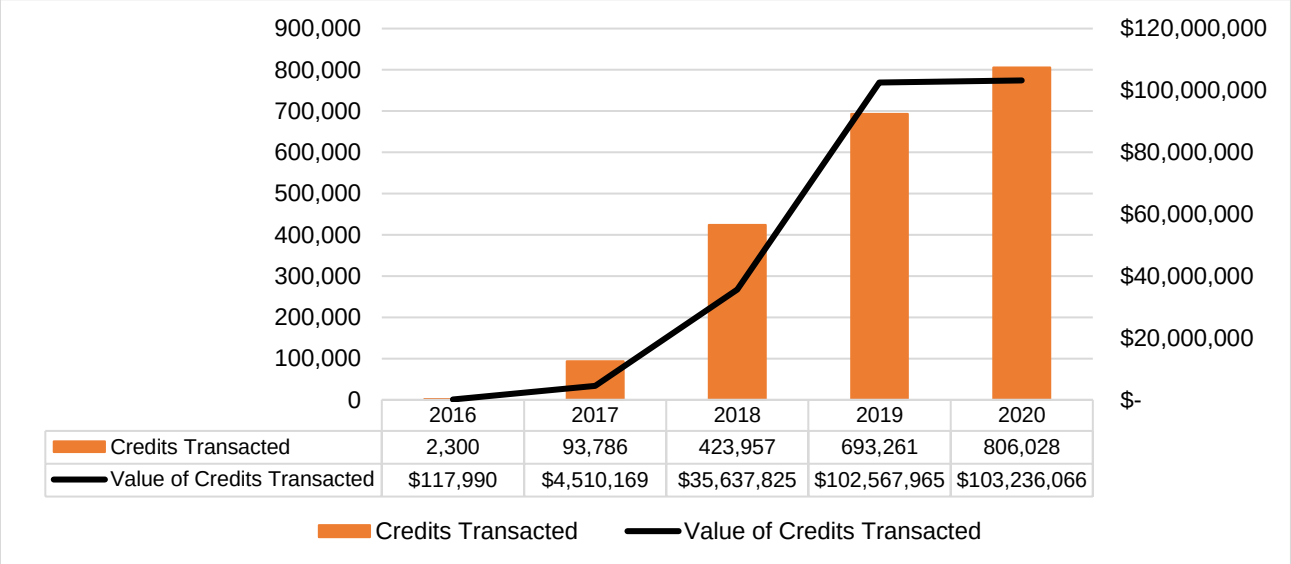


Figure 11. The value of credits transacted between 2016–2020

The value of the total number of credits shown above is lower than the total value of deficits in Figure 11 because regulated parties in the program generate a significant number of the credits from their biofuel imports and from their own investments in producing low-carbon fuels. Many of them bank or hold on to those credits for future use since the credits have no expiration date. With either approach, the increasing value of the CFP market has provided a strong signal to bring low-carbon fuels to Oregon.

Impact of credit prices on the price of fuels

CFP credits began to trade at the end of 2016, and through 2021 approximately $328 million of credits have changed hands. The credit market has traded steadily since 2017 as shown in Figure 12, and over $100 million in credits are now being transferred each year. The overall value of the market is likely to grow as the targets advance toward the program's 10% reduction target in 2025 and more credits will be required for compliance. DEQ staff regularly monitor the market to ensure that it remains competitive and to understand the effect of the program on the transportation fuels market it regulates.

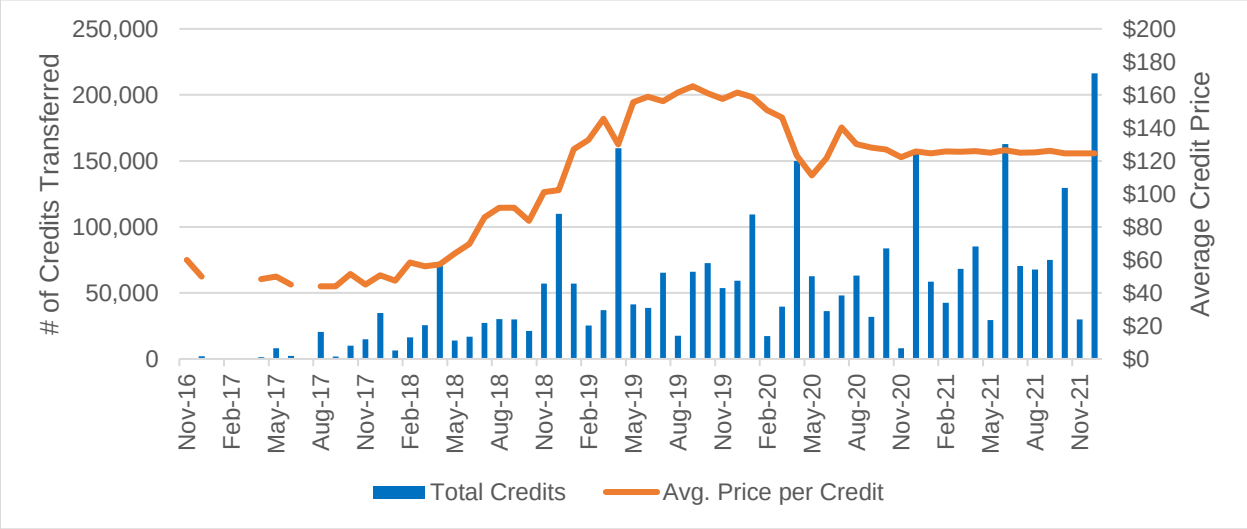


Figure 12. Monthly credit transfer data between 2016-2021

The value of the credits across the active Pacific Coast low-carbon fuel standards jurisdictions factors into business decisions in-state and out-of-state. Low-carbon fuel producers across North America and beyond are continuously evaluating ways to lower the carbon intensity of their fuels by sourcing low-carbon feedstocks, by improving the efficiency of their operations, by integrating renewable energy into their production, by increasing the production of co-products from what was previously considered waste, or by considering carbon capture and sequestration practices. This has resulted in the carbon intensity of ethanol and biodiesel used in Oregon dropping since the start of the program as shown in Figure 4.

Since the program design of all three low-carbon fuel standard programs are harmonized, the primary factor that distinguishes one from another is their credit price. Figure 13 illustrates the differences in the credit prices in the California Low Carbon Fuel Standards program and the Oregon Clean Fuels Program. California LCFS credit prices have been higher than Oregon CFP credit prices through the duration of the programs but the spread between the two has been decreasing recently, bringing the values of the programs closer.

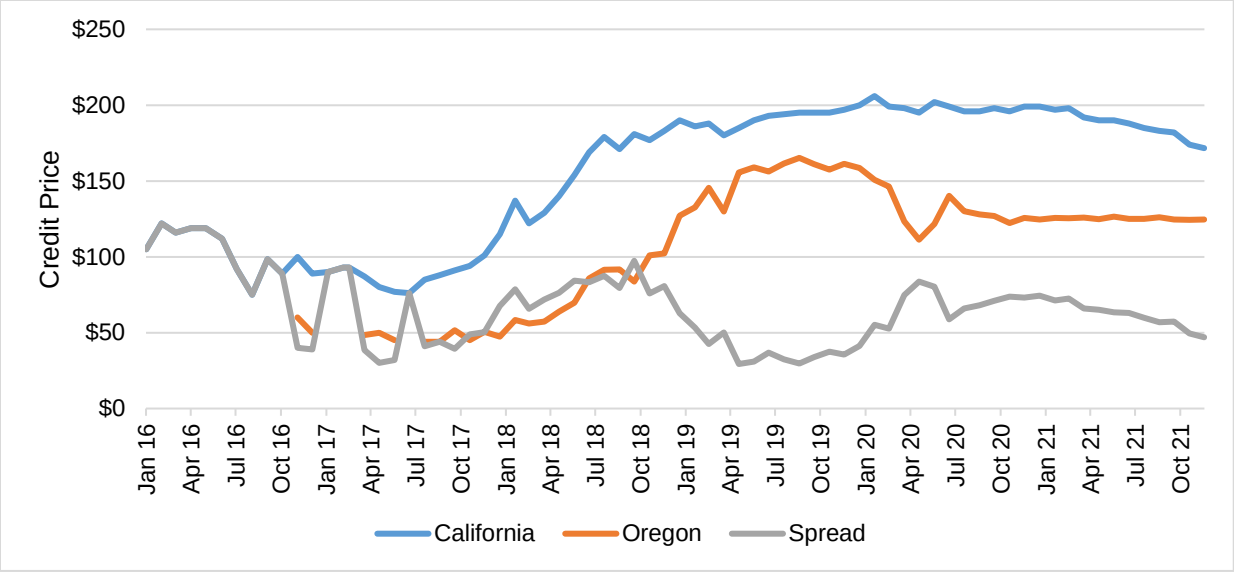


Figure 13. Credit prices in the California and Oregon markets between 2016-2021

The California and Oregon markets are not directly linked, meaning that California credits cannot be used for compliance in Oregon, or vice versa. Credit prices in each jurisdiction are set by the supply and demand for credits in each program. While they are not directly linked, the markets do exert influence on each other and create a common demand for low-carbon fuels across these two adjacent geographies.

Figure 14 is an example of how the fluctuating credit prices in both jurisdictions impact the value to a typical gallon of soy or canola oil-based biodiesel that carries a carbon intensity score of 50 gCO2e/MJ. Generally speaking, the higher price of California credits means that the biodiesel producer can get about $0.20 more per gallon in California than in Oregon which is a factor in deciding where to deliver the fuel.

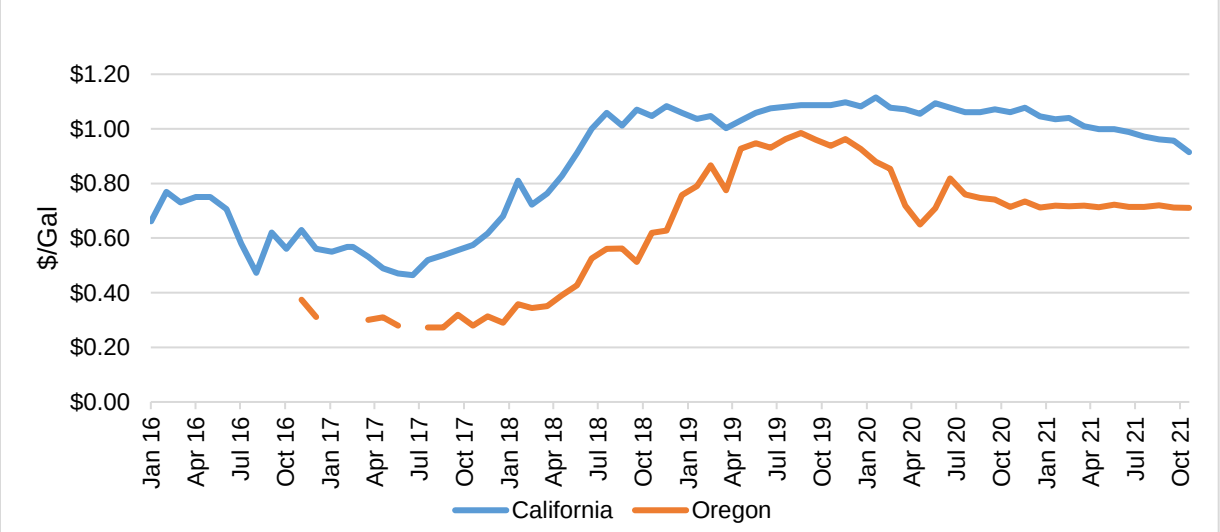


Figure 14. Credit value to biodiesel in California and Oregon between 2016-2021

Impact of more states adopting a low-carbon fuel standard

In addition to California and Oregon, Washington will begin implementing a low-carbon fuel standard in 2023. Several other states are working with their legislatures and stakeholders to add a low-carbon fuel standard to their portfolios. Additional states adopting low-carbon fuel standards will expand the market for low-carbon fuels and provide additional support for decarbonizing the transportation sector.

As with other multi-state regulations such as the Zero Emission Vehicle programs, states setting harmonized long-term requirements can better force technology development, adoption, and deployment by private industry. Over time, the additional demand from new programs will lead to additional production of low-carbon fuels and lower prices for them. As electric vehicle manufacturers ramp up production, the cost of those vehicles will likely come down. Additional states adopting the program and creating demand for those fuels and vehicles will solidify the investment case in lower-carbon fuels.

Cost Containment Mechanisms

There are several program design elements that act to minimize the costs of complying with the program. Credits can be generated early in the program and banked for future use, traded between companies, and used interchangeably to offset deficits from fossil gasoline and diesel. All of these flexibilities bring down compliance costs.

In addition, HB 2017 created a credit clearance market where credits can be acquired by regulated parties that need them at the end of a compliance period if they have not generated or purchased a sufficient number of credits to meet their compliance obligations. The maximum price -- $200 in 2018 dollars and adjusted annually for inflation -- that credits can be purchased through this credit clearance market acts as a cap for the regular credit market during the rest of the year.

As seen in Figure 12, credit prices have not approached the maximum credit prices established for the credit clearance market. As such, DEQ is not proposing to change any of the cost containment mechanisms at this time.

Cost of complying with the Clean Fuels Program

HB 2017 requires DEQ to calculate the average cost or cost-savings of the program per gallon of gasoline (E10) and diesel (B5) for the previous year using the following formula:

$$Average\ Cost = [(Carbon\ Intensity - Standard) \times (Energy\ Density)] \times \left(\frac{1\ tonne}{1{,}000{,}000\ g}\right) \times (Credit\ Price)$$

Where:

- Carbon Intensity is shown in Table 4 of OAR 340-253-8010
- Standards are shown in Table 1 or Table 2 of OAR 340-253-8010
- Energy density is calculated from values in Table 6 of OAR 340-253-8010
- Credit Price is taken from the Monthly Credit Transaction Report

Average Cost of the CFP per gallon of E10 for 2021:

$$Average\ Cost\ of\ the\ CFP\ per\ gallon\ of\ E10 =$$

$$\left[\left(98.06\ \frac{gCO2e}{MJ} - 94.63\frac{gCO2e}{MJ}\right) \times \left(118.38\ \frac{MJ}{gallon}\right)\right] \times \left(\frac{1\ tonne}{1{,}000{,}000\ g}\right) \times \left(\frac{\$125.30}{tonne}\right)$$

The Average Cost of the CFP was $0.0509 or 5.09 cents per gallon of E10 for 2021.

Average Cost of the CFP per gallon of B5 for 2021:

$$Average\ Cost\ of\ the\ CFP\ per\ gallon\ of\ B5 =$$

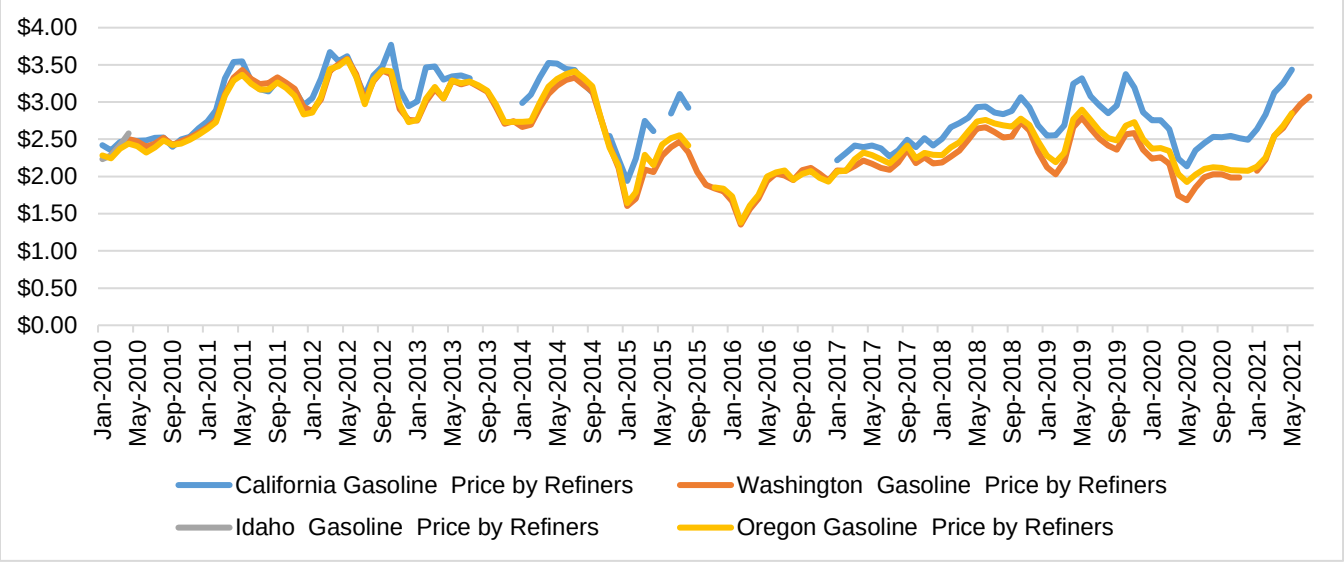
$$\left[\left(98.74\ \frac{gCO2e}{MJ} - 95.29\frac{gCO2e}{MJ}\right) \times \left(134.06\ \frac{MJ}{gallon}\right)\right] \times \left(\frac{1\ tonne}{1{,}000{,}000\ g}\right) \times \left(\frac{\$125.30}{tonne}\right)$$

The Average Cost of the CFP was $0.0580 or 5.80 cents per gallon of B5 for 2021.

This approach is conservative, meaning it likely overstates the price of the program. This is because it assumes that a regulated party will go to the market to buy all of the credits needed to comply, which is the most expensive compliance option. Many regulated parties generate credits themselves or are in long-term contracts with low-carbon fuel producers where credits are transferred along with the fuel at below-market value. The approach also does not account for the value of CFP credits being used to lower the cost of the low-carbon biofuels being blended into gasoline and diesel for use in Oregon, nor does it capture the value of the credits making other low-carbon fuels such as electricity, renewable natural gas, or renewable propane cheaper for consumers.

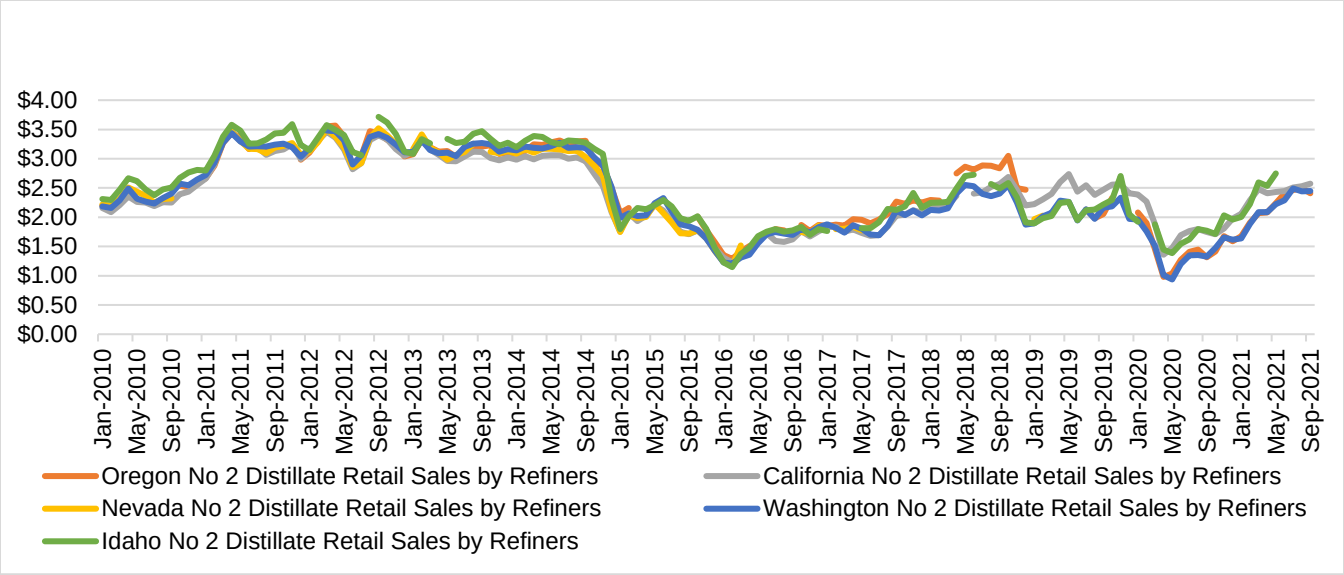
Retail prices for gasoline and diesel

While the prices for low-carbon fuels have decreased, retail prices for gasoline and diesel remain well within the range of neighboring states, including those that have not adopted a low carbon fuel standard. Oregon's fuel prices remain largely in line with where they were in relation to other states prior to the implementation of the program.



Source: US Energy Information Agency (EIA)

Figure 15. Retail gasoline prices in neighboring states between 2010-2021

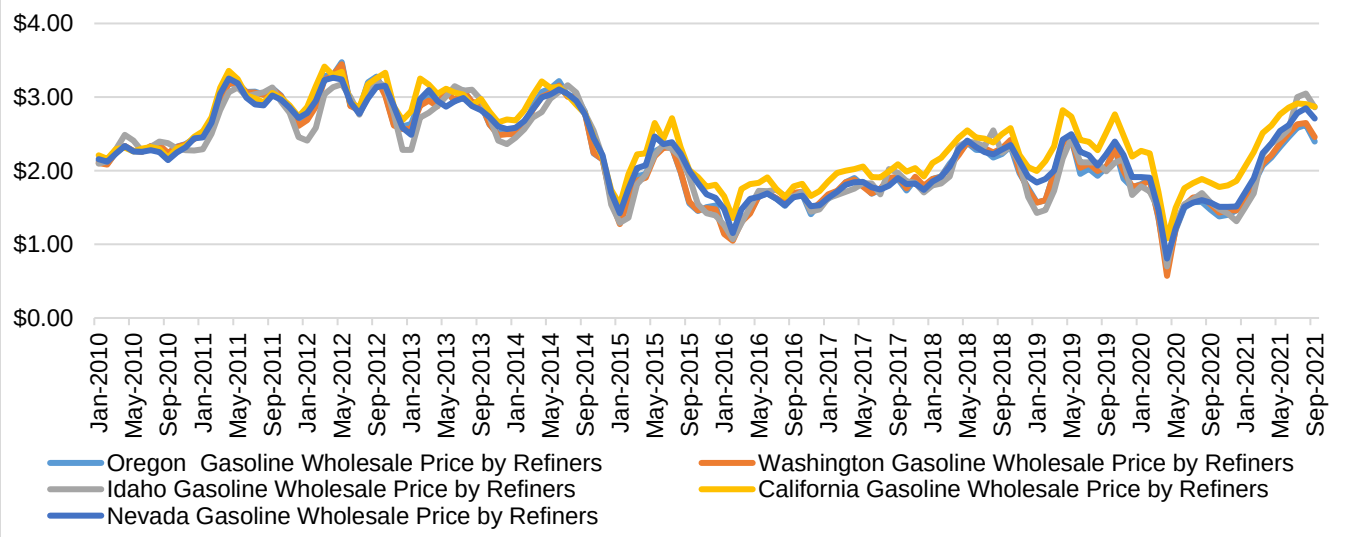


Source: US EIA

Figure 16. Retail diesel prices in neighboring states between 2010-2021

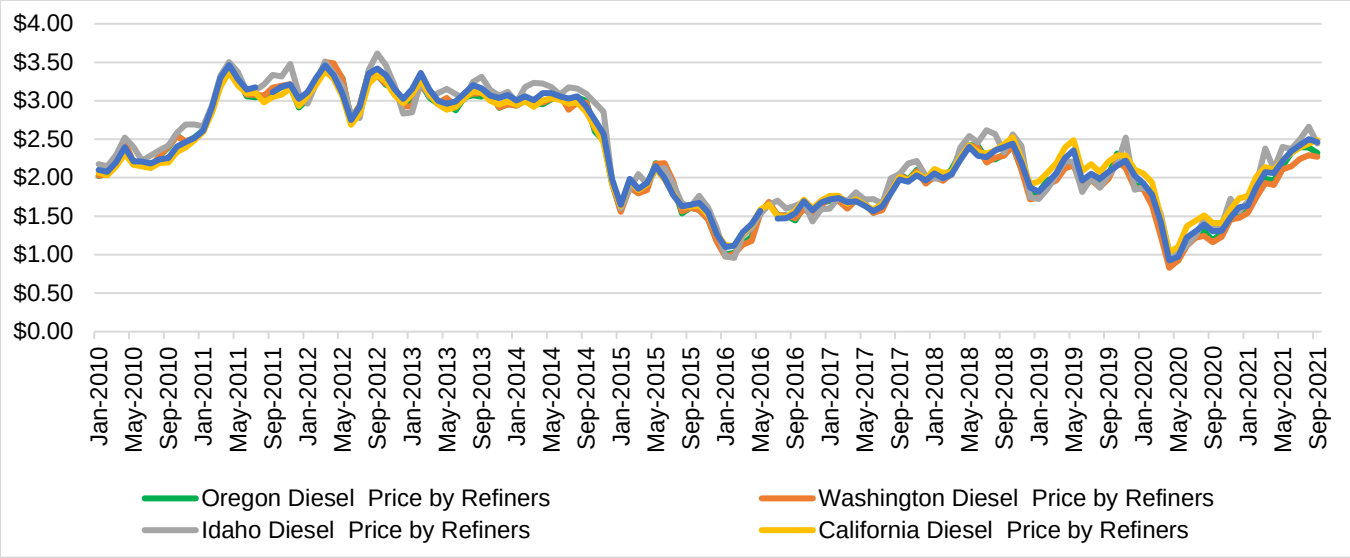
Figures 15 and 16 show that Oregon retail prices for gasoline and diesel have hewed closely to those of neighboring states. Oregon prices most closely align with Washington's, which would be expected because over 90% of the gasoline and diesel distributed in Oregon is produced at refineries in the Puget Sound area.

The Energy Information Administration has reported less statewide retail pricing in recent years as the result of fewer entities meeting EIA's reporting requirements, leading to an incomplete data set. To provide a more complete data set, Figures 17 and 18 are included to show the wholesale pricing of fossil gasoline and diesel.



Source: US EIA

Figure 17. Wholesale gasoline prices in neighboring states between 2010-2021



Source: US EIA

Figure 18. Wholesale diesel prices in neighboring states between 2010-2021

The wholesale pricing largely tells the same story as retail pricing available from EIA. Notable here is that Idaho pricing for diesel in the wholesale and retail markets has been higher than that of Oregon and often California over the past year, showing that the implementation of carbon reduction policies has not necessarily increased the cost of fuels.

Availability of Fuels through 2025

To assess the availability of lower-carbon fuels through 2025, DEQ contracted with the consulting firm ICF to consider the demand and supply of transportation fuels. ICF originally developed an approach to forecast the availability of fuels for DEQ in 2018 and updated that approach for 2025. The approach characterizes the demand of fossil fuels and the supply of low-carbon fuels and its impact on deficit and credit generation, including the bank of credits that are carried over from year to year.

ICF used data from the Oregon Department of Transportation to develop the growth rates for gasoline and diesel consumption as shown in Table 5.

Table 5. Growth rates of gasoline and diesel

Fuel	Growth Rates (compared to 2021 as reference year)			
	2022	2023	2024	2025
Gasoline	1.3%	1.0%	1.0%	0.0%
Diesel	1.9%	2.8%	3.6%	5.7%

ICF used program data to estimate ethanol, biodiesel, renewable diesel, electricity, natural gas, propane, and hydrogen consumption as shown in Table 6.

Table 6. Future consumption of transportation fuels

Fuel Volumes	Units	2022	2023	2024	2025
Gasoline	million gallons	1,374	1,353	1,336	1,306
Diesel	million gallons	756	724	662	614
Ethanol	million gallons	177	193	210	225
Biodiesel	million gallons	88	89	90	92
Renewable Diesel	million gallons	38	78	146	210
Electricity	million gge	9.30	11.75	14.90	18.98
Electricity, On-Road	million gge	7.12	9.81	13.38	18.16
Electricity, Off-Road	million gge	4.63	5.09	5.60	6.16
Natural Gas					
CNG	million dge	0.43	0.24	0.13	0.15
Bio-CNG	million dge	3.83	4.52	5.18	5.79
LNG	million dge				
Bio-LNG	million dge	0.34	0.34	0.34	0.34
Propane					
LPG	million dge	1.01	0.99	0.95	0.90
Renewable Propane	million dge	1.24	1.49	1.77	2.10
Hydrogen	million dge	0.11	0.13	0.16	0.19

ICF used program data to develop the future carbon intensities of the transportation fuels. The deficits and credits are calculated annually as shown in Table 7, including the net annual balance (i.e., the sum of credits and deficits generated in that year) and the cumulative bank of credits. The cumulative bank of

credits (or deficits) represents the sum of the annual balances from the program's inception to the year of interest. ICF estimated that there would be a net positive bank at the end of 2021 of about 740,000 credits.

Table 7. Future forecast of deficit/credit generation

Credits / Deficits	2022	2023	2024	2025
Gasoline	-1.18	-1.40	-1.63	-1.90
Diesel	-0.80	-0.91	-0.96	-1.05
Ethanol	0.61	0.68	0.75	0.81
Biodiesel	0.60	0.59	0.52	0.51
Renewable Diesel	0.27	0.53	0.87	1.20
Electricity				
Electricity, On-Road	0.22	0.30	0.41	0.55
Electricity, Off-Road	0.15	0.17	0.18	0.20
Natural Gas				
CNG	0.00	0.00	0.00	0.00
Bio-CNG	0.02	0.03	0.06	0.08
LNG	0.00	0.00	0.00	0.00
Bio-LNG	0.00	0.00	0.00	0.00
Propane				
LPG	0.00	0.00	0.00	0.00
Renewable Propane	0.01	0.01	0.01	0.02
Hydrogen	0.00	0.00	0.00	0.00
Total Deficits	**-1.98**	**-2.31**	**-2.59**	**-2.96**
Total Credits	**1.88**	**2.31**	**2.81**	**3.36**
Net Annual	**-0.10**	**-0.01**	**0.22**	**0.40**
Bank, Cumulative	**0.40**	**0.40**	**0.62**	**1.02**

This forecast shows a very slight net negative number of credits generated in 2022 and 2023, but a healthy rebound in 2024 and beyond when the electrification of light-, medium- and heavy-duty vehicles begins to generate large numbers of credits. This also shows that there are a sufficient number of credits in the bank to compensate for the shortages in the near-term and keep the program on pace to meet its 2025 standards.

What's Next for the Clean Fuels Program?

The first five years of implementing the Clean Fuels Program have included many early successes and lessons learned. Greenhouse gas emissions and traditional air pollutants have been reduced throughout Oregon as a direct consequence of the program. New types of low-carbon fuels have entered the market and their lower prices have benefitted early adopters. The transformation of Oregon's transportation fuels has begun, and the program is a key driver. The success of the program suggests that it is time to expand and extend its benefits.

In October 2020, DEQ kicked off a conversation about how Oregon's transportation fuels market could meet new ambitious targets, post-2025. DEQ hired ICF as technical experts and invited stakeholders to participate in setting the stage for the technical analysis that informed the development of program scenarios extended through 2035. DEQ uses illustrative compliance scenarios to represent possible ways to achieve carbon intensity reductions. As part of developing these scenarios, DEQ asked what combination of vehicles and fuels might exist in the future and then determined what reductions in carbon intensity would result from those assumptions.

The following are key highlights from the illustrative compliance scenarios:

- An expanded program can be achieved through a diverse fuel supply. In other words, all of the scenarios include a combination of ethanol, biodiesel, and renewable diesel from various feedstocks, electricity, renewable natural gas, and propane to achieve the carbon intensity reduction targets.
- Over-compliance prior to 2025 allows time for the increasing adoption of electric vehicles to build a healthy bank of credits that will help the program to achieve its ambitious new standards through 2035.
- Current and additional light-, medium- and heavy-duty electrification policies plus expected reductions in the carbon intensity of electricity have the potential for significant credit generation and contribution to compliance of an expanded program.
- Renewable diesel is necessary for compliance as the primary drop-in fuel to generate credits and reduce deficits with the existing diesel vehicle fleet.

In December 2021, DEQ embarked on a new rulemaking to propose changes to Clean Fuels Program regulations. The rulemaking will propose annual average carbon intensity reduction targets beyond 10% and beyond 2025, informed by the long-term illustrative compliance scenarios and feedback from stakeholders. In addition, other modifications will be considered that will support the achievement of the new standards and improve the effectiveness of the program. DEQ is scheduled to propose rules to the EQC in fall 2022.