2021 Clean Fuels Forecast

Background

Oregon Revised Statutes Chapter 468A, Section 272 authorizes the Office of Economic Analysis (OEA), with substantial assistance from the Department of Environmental Quality, to assess the availability of fossil and alternative fuels to Oregon. In particular, the forecast is to determine whether fuel supply will be sufficient to generate the necessary number of carbon reduction credits from alternative fuels (ethanol, electricity, and diesel substitutes - including biodiesel, renewable diesel, natural gas, and propane) to meet the scheduled applicable low carbon fuel standards for the compliance period. Given that the forecast "need not be limited to" these elements, OEA believes that it is important to project credit generation, and thus the reported volumes of all regulated fuels, through the compliance period in order to provide a complete picture of the program's viability in achieving mandated reductions in the carbon intensity of transportation fuels. The forecast report is required to include an assessment of banked deficits and credits at the beginning of the compliance period.

In preparing the forecast, the Office of Economic Analysis has formed a Clean Fuels Forecast Advisory Committee comprised of relevant experts and stakeholders to assist in reviewing methodological considerations and various data sources. A membership list can be found in Appendix A.

Data Sources

The forecast uses available public and program data to develop the estimates of low-carbon fuels available to Oregon and estimated consumption of fossil and alternative fuels in Oregon. The sources of this data include:

- Oregon Clean Fuels Program (CFP) Online System
- Fuel Pathway Codes (carbon intensity values) approved in Oregon and California
- Oregon Department of Transportation's (ODOT) Revenue Forecast
- Oregon DMV vehicle registration data
- Annual Energy Outlook and other resources from the US Energy Information Administration
- Trade associations (Renewable Fuels Association and the National Biodiesel Board) on their members' production capacity

Clean Fuels Program 2021 Reported Volumes Forecast

To determine the amount of deficits that will be generated in 2021, and thus the amount of credits needed for compliance, a forecast for the volumes reported to the Clean Fuels Program of all relevant fuels must be made. The following are the volume projections for each fuel type.

Gasoline Consumption

1,738 million gallons of gasoline, including ethanol, were consumed in 2019, the most recent year of data available. Growth projections exhibited in the Oregon Department of Transportation's July 2020 forecast equal -9.7 percent in 2020 followed by 9.7 percent in 2021. Due to a methodological change, growth rates are applied to the baseline levels on a quarterly basis. Thus the projected 2019-21 change in motor gasoline amounts to -0.7 percent on an annualized basis, producing a total volume of gasoline equal to

1,712 million gallons. To determine the amount of conventional gasoline represented, ethanol must be subtracted. The blend rate assumed for 2021 is 10.1 percent, roughly equal to that observed in recent years. The final forecast for conventional gasoline is 1,538.7 million gallons.

Diesel Consumption
According to CFP reported data, 789.1 million gallons of diesel, including bio- and renewable diesel, were consumed in 2019, the most recent year of data collected. Growth projections exhibited in the Oregon Department of Transportation's July 2020 forecast total 2.9 percent from 2019 to 2021. Given the same methodological consideration noted above for gasoline, the two-year growth for reported diesel amounts to 1.5 percent on an annualized basis, resulting in a projected 812.7 million gallons of total diesel. To determine the amount of conventional diesel, biodiesel and renewable diesel must be subtracted. The blend rate for these biofuels are assumed to be 9.6 percent and 7.3 percent, respectively. The final forecast for the consumption of conventional diesel in 2021 is 675.3 million gallons.

Ethanol Consumption
The amount of ethanol reported for 2019 equaled 173.7 million gallons. As described above, the amount of ethanol projected for 2021 is based on a blend rate assumption driven by historical observations and trends, as well as blend rates observed in California. The latest observation for an ethanol blend rate, for calendar year 2019, was 10.0 percent. Given adoption of some E85 blending, the assumption for 2021 is 10.1 percent. This results in a forecast for reported ethanol of 172.9 million gallons, which is 0.2 percent below the 2019 volume on an annualized basis.

Electricity Consumption
Consumption of electricity for on-road vehicles is based on a projection of the number of plug-in hybrid and battery electric vehicles in use for the compliance period. DMV vehicle registration data provides actual vehicle numbers historically, from which growth projections and variances are derived to produce the number of electric vehicles projected to be in operation for the 2021 compliance period. This equals an average of 16,086 Plug-in Hybrids and 27,811 Battery Electric vehicles. Historical volumes of electricity, including estimates for residential charging, are used to calculate average Kilowatt hours per vehicle year. For 2019, this parameter equaled 3,506 Kilowatt hours per year, which was in turn assumed for the 2021 compliance period. When converted to gasoline gallon equivalents, the forecast is 4.5 million gallons including residential charging. This is equivalent to a 25 percent increase from 2019 on an annualized basis.

Biodiesel Consumption
The reported volume of biodiesel in 2019 amounted to 60.1 million gallons. As described above, the amount of biodiesel projected for 2021 is based on a blend rate assumption driven by historical observations and trends, as well as blend rates observed in California. The biodiesel blend rate is expected to rise from 6.9 percent in 2019 to 9.6 percent for the 2021 compliance period, resulting in a volume projection of 78 million gallons. This represents growth of 14 percent from the 2019 actual on an annualized basis.

Renewable Diesel Consumption
The amount of renewable diesel reported in 2019 was 16.8 million gallons. Similar to biodiesel, the forecast for renewable diesel is driven by the assumption of the fraction of total diesel consumed comprised of renewable diesel. The blend rate observed for 2019 in the Clean Fuels data was 2.1 percent. Given that

California has experienced a steady increase in the renewable diesel blend rate in recent years, the assumption for 2021 in Oregon is 7.3 percent. This leads to a consumption forecast of 59.3 million gallons, a substantial 88.1 percent above the 2019 value on an annualized basis.

Natural Gas and Propane Consumption

The amount of natural gas, including renewable natural gas (biogas), reported in 2019 in diesel gallon equivalents equaled 3.6 million gallons. Annualized growth from the 2019 base year to 2021 is assumed to be 8.5 percent. This results in a forecast of 4.3 million gallons. The blend rate for renewable natural gas is expected to increase from 61.5 percent in 2019 to 75 percent in 2021.

Propane exhibits the smallest quantity of alternative fuel reported in 2019 at 2.1 million gasoline gallon equivalents. However, this was 178 percent above the 2018 reported value. Annualized growth from the 2019 base year to 2021 is assumed to be 84.4 percent, resulting in a forecast of 7.0 million gallons.

The following table presents the 2021 consumption forecast in detail. Note that the percent change figures for 2021 represent annual growth from the last available actuals in 2019.

Table 1: Summary of fossil and alternative fuel volumes

(Mil. gallons, percent)	2018	2019	2020	2021	annual %ch vs. 2019
Conventional Gasoline	1,535.8	1,562.0	1,395.0	1,538.7	-0.8%
Ethanol	172.2	173.7	156.7	172.9	-0.2%
Ethanol Blend Rate	*10.1%*	*10.0%*	*10.1%*	*10.1%*	
Blendstock	1,708.0	1,735.7	1,551.7	1,711.5	-0.7%
Fossil Diesel	716.4	712.3	690.5	675.3	-2.6%
Biodiesel	51.6	60.1	68.1	78.0	14.0%
Biodiesel Blend Rate	*6.7%*	*7.6%*	*8.6%*	*9.6%*	
Renewable Diesel	1.2	16.8	33.3	59.3	88.1%
Renew diesel Blend Rate	*0.2%*	*2.1%*	*4.2%*	*7.3%*	
Total Diesel	769.3	789.1	791.9	812.7	1.5%
Electricity (on-road)	2.2	2.9	2.9	4.5	25.4%
Electricity (off-road)	1.7	2.2	3.3	5.8	62.0%
Fossil Natural Gas	1.5	1.4	1.3	1.1	-12.6%
Biogas	1.7	2.2	2.7	3.2	19.8%
Biogas Blend Rate	*54.1%*	*61.5%*	*67.5%*	*75.0%*	
Total Natural Gas	3.2	3.6	4.0	4.3	8.5%
Propane	0.7	2.1	4.1	7.0	84.4%
On-road electricity include calculation of residential charging.					

Deficit and Credit Generation and Banked Credits

In order to estimate the number of deficits and credits associated with the consumption of each fuel type, the energy densities and carbon intensity differentials must be known. Most of the pertinent parameters are published here in administrative rule by the Department of Environmental Quality (see Tables 1, 2, and 4 starting on page 209). The following table presents these parameters for each fuel. Details regarding the estimation of carbon intensities for ethanol, biodiesel and renewable diesel can be found in Appendix B. As noted above concerning on-road electricity consumption, the average Kilowatt hours per year is assumed to be 3,506. Finally, energy economy ratios are presented for electric and natural gas engines.

Table 2: Parameter values for the 2021 forecast

	Energy Density	Carbon Intensity Target	Carbon Intensity Assumption
Gasoline	122.48	94.63	100.14
Ethanol	81.51	94.63	47.50
Diesel	134.48	95.29	100.74
Biodiesel	126.13	95.29	26.50
Renewable Diesel	129.65	95.29	27.20
Electricity	3.60	94.63	107.92
KWh/vehicle	*3506*		
EERelect	*3.40*		
EER_NG	*0.90*		
Natural Gas	134.48	95.29	79.98
Biogas	134.48	95.29	49.00
Liq. Petroleum Gas	89.63	94.63	80.88

Banked Credits

The number of credits is taken from the CFP Online System. The number of gross credits registered through the end of calendar year 2019 equaled 3.8 million, while the number of deficits recorded amounted to 3.1 million. The net credits banked equaled 732,607. OEA currently projects that another 297,394 net credits will be added to the bank in 2020. The total projected banked credits at the beginning of the 2021 compliance period is now expected to total just over one million.

Table 3: Summary of actual and projected net banked credits

Year	Deficits	Credits	Net Banked Credits
2016	-594,714	809,380	214,666
2017	-644,138	855,241	211,103
2018	-864,410	943,812	79,402
2019	-997,865	1,225,300	227,435
2020 (est.)	-1,189,059	1,486,453	297,394
Total	-4,290,186	5,320,187	1,030,001

Credit and Deficit Summary

The table below summarizes the forecast for deficit generation and credit generation. The equations for calculating the deficits and credits can be found in Appendix B.

Table 4: Summary of Deficits and Credits

Deficits	Gasoline	-1,038,387
	Diesel	-494,962
Deficit Total		**-1,533,348**
Credits	Ethanol	664,068
	Biodiesel	676,910
	Renewable Diesel	523,715
	Electricity, on-road	118,466
	Electricity, off-road	27,344
	Natural Gas	16,602
	Propane	8,613
Credit Total		**2,035,718**

2021 Net Credits/Deficits	**502,370**
2020 Estimated Ending Banked Credits	**1,030,001**
Total Net Credits/Deficits	**1,532,371**

Forecasted Fuel Supply Deferral Analysis

As shown above, the forecast does not imply such an action.

Potential Supply of Alternative Fuels

Oregon Revised Statutes Chapter 468A, Section 272 directs the Office of Economic Analysis to estimate the "potential volumes of gasoline, gasoline substitutes and gasoline alternatives and diesel, diesel fuel substitutes and diesel alternatives available to Oregon." In order to make such estimates, a number of assumptions must be made. Potential is read to mean "could be made available to Oregon under a wide range of market conditions". Currently, suppliers must be certified by the Department of Environmental Quality to deliver fuel into Oregon. In addition, they must report volumes of fuel sold in Oregon to the Clean Fuels reporting system. Thus, the capacity of facilities that were certified for the most recent compliance period (2019) is assumed to be theoretically "available" to Oregon. While facilities often report nameplate capacity when registering with DEQ, more current information is generally available through the Energy Information Administration. Where multiple values are available, the highest is assumed for the purposes of potential supply.

In addition to estimating potential supply, the Office of Economic Analysis is directed to consider "Constraints that may be preventing access to available and cost-effective low carbon fuels by Oregon, such as geographic and logistical factors, and alleviating factors to the constraints". Only biofuels that might pose a supply constraint that could ultimately limit the number of credits available to deficit holders to comply with the Clean Fuels program requirements are called out explicitly. Should supply issues arise for the more mature fuel markets such as conventional gasoline and diesel, as well as electricity, such issues would be added to the report. This is not anticipated for the foreseeable future.

Ethanol

As exhibited in Table 5, the potential supply of ethanol to Oregon as outlined above is 4.1 billion gallons. This compares to a projected reported volume for ethanol of 172.9 million gallons.

Table 5: Ethanol Supply

State	Nameplate Capacity (Mil. Gallons)	Number of Facilities
Nebraska	1,068	11
South Dakota	1,026	12
Iowa	662	7
Minnesota	530	6
Kansas	220	3
North Dakota	215	2
Colorado	100	2
Idaho	75	1
Brazil	73	2
California	60	1
Oregon	43	1
Total Oregon Suppliers	4,072	48

Data from Energy Information Administration and Clean Fuels Program.

Biodiesel

Table 6 presents the potential supply of biodiesel to Oregon, equaling just over one billion gallons in capacity for certified facilities in 2019. This compares to a projected demand for biodiesel in 2020 of 78 million gallons.

Table 6: Biodiesel Supply

Locality	Nameplate Capacity (Mil. Gallons)	Number of Facilities
Missouri	271	6
Iowa	144	3
Washington	112	2
Oregon	112	2
Canada	92	4
Nebraska	63	1
Arkansas	60	1
Asia	55	3
Minnesota	46	1
Oklahoma	35	1
Texas	15	1
Total Oregon Suppliers	1,003	25
Data from Energy Information Administration and Clean Fuels Program.		

Renewable Diesel

As presented below, the potential supply of renewable diesel to Oregon equals 517 million gallons. This compares to a projected demand for renewable diesel in 2020 of 59.3 million gallons.

Table 7: Renewable Diesel Supply

Locality	Nameplate Capacity (Mil. Gallons)	Number of Facilities
Singapore	291	1
Wyoming	109	1
Louisiana	75	1
Washington	42	1
Total Oregon Suppliers	517	4
Data from the Clean Fuels Program		

Renewable Natural Gas

The amount of renewable natural gas potentially available to Oregon amounts to 25.7 billion gasoline gallon equivalents. This compares to a projected volume for this biofuel of 4.3 million gallon equivalents. The committee discussed the fact that a number of applications to supply additional renewable natural gas to Oregon are in the process of being evaluated. Given the modest volumes of natural gas currently used in

transportation, incorporating these potential supplies would not alter the conclusion that there are no current constraints on the availability of natural gas in Oregon.

Table 8: Renewable Natural Gas

Locality	Nameplate Capacity (Mil. Gallons)	Number of Facilities
Kentucky	9.3	1
Tennessee	8.6	1
Ohio	7.8	1
Total Oregon Suppliers	25.7	3
Data from the Clean Fuels Program		

Forecast Risks

A risk is defined as a deviation from one or more assumptions that would alter the conclusion outlined in the previous sections. There are a number of potential risks to this 2021 Clean Fuels Forecast, both positive and negative and they are:

(a) The most fundamental risk to the forecast amounts to potential deviations from the assumptions highlighted in each fuel type discussion. In particular, blend rates and carbon intensities for biofuels could be subject to significant error. In addition, this forecast contrasts with prior forecasts in that it assumes that the incentives inherent in the value of the credits generated by supplying alternative fuels will drive the carbon intensities of these fuels downward. Failure to realize these declines would result in fewer credits than currently anticipated.

(b) This forecast represents a "current law" representation of the compliance period in question. OEA's methodology does not take potential future state policy actions into account.

(c) There is a discrepancy between the diesel consumption numbers reported to the Clean Fuels Program data and the taxable gallons tabulated by ODOT. Explicitly, more gallons of diesel are reported to the former that the latter. This forecast applies projected growth of taxable diesel, at least initially, to the base year 2019 reported volumes of diesel in the CFP. To the degree that taxable gallons per ODOT is not a perfect proxy for reported gallons in the CFP, actual reporting of diesel to the Clean Fuels program, and thereby the number of deficits generated could deviate from this forecast.

(d) The ethanol availability presented above is not comprehensive and does not include other potential sources, such as sugarcane ethanol imported from Brazil. Given that potential supply characterized in table 5 greatly exceeds projected demand, this is not an immediate threat to the forecast. However, it may need to be addressed as consumption increases or as carbon intensity targets are lowered.

(e) Alternative fuels used in forklifts, aviation , and certain other uses such as transport refrigeration units were recently added to the Clean Fuels Program but have not been included in the 2021 forecast These uses would generate credits in the program, constituting an upside risk to the forecast.

Accessibility

Documents can be provided upon request in an alternate format for individuals with disabilities or in a language other than English for people with limited English skills. To request a document in another format or language, call Michael Kennedy in the Office of Economic Analysis at (503) 378-5732 or email him at michael.kennedy@oregon.gov

Appendix A

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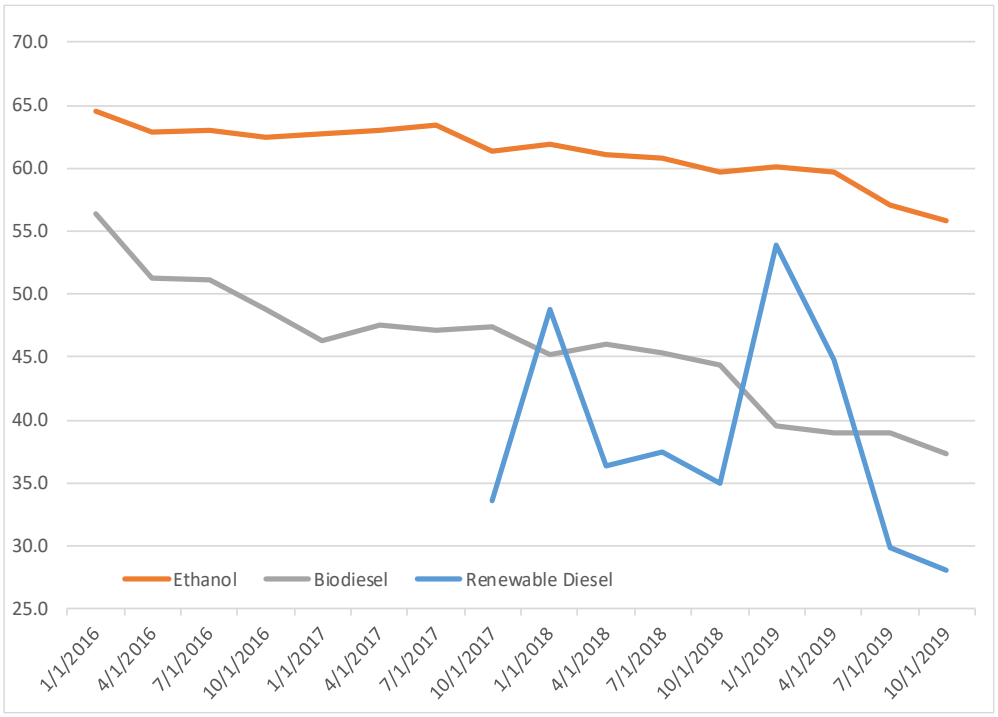
Appendix B

The estimated carbon intensities for ethanol, biodiesel and renewable diesel that are not published in rule are projected based a number of factors. The first is the historical movement in the series themselves (see Chart 1). The certified carbon intensities of facilities registered in Oregon are also reviewed to ascertain the levels that might be obtained if market forces favor lower CI facilities. Finally, realized carbon intensities in California are reviewed. Final parameters are based on all three factors, forecaster judgement and input from stakeholders.

Chart B.1: Biofuel Carbon Intensities



Appendix C

The following are the formulas resulting in the deficits and credits presented in Table 4 of the Clean Fuels Forecast.

Gasoline

$Deficit_G = CBOB * ED_G * (CIT_G - CIA_G)/1{,}000{,}000$

Diesel

$Deficit_D = V_D * ED_D * (CIT_D – CIA_D)/1{,}000{,}000$

Ethanol

$Credit_E = V_E * ED_E * (CIT_G – CIA_E)/1{,}000{,}000$

Biodiesel

$Credit_{BD} = V_{BD} * ED_{BD} * (CIT_D – CIA_{BD})/1{,}000{,}000$

Renewable Diesel

$Credit_{RD} = V_{RD} * ED_{RD} * (CIT_D – CIA_{RD})/1{,}000{,}000$

Electricity

$Credit_C = K_C * EER_C * ED_C * (CIT_G – (CIA_C/EER_C)/1{,}000{,}000$

Natural Gas

$Credit_{NG} = V_{FNG} * ED_D * EER_{NG} * (CIT_D – (CIA_{FNG}/ EER_{NG})/1{,}000{,}000 + V_{RNG} * ED_D * EER_{NG} * (CIT_D – (CIA_{RNG}/ EER_{NG})/1{,}000{,}000$

Propane

$Credit_P = V_P * ED_P * (CIT_D – CIA_P)/1{,}000{,}000$

Table C.1: Definition of Symbols

Where:	
G = Gasoline	D = Diesel
CBOB = Conventional Blendstock for Oxygenated Blending	E = Ethanol
	BD = Biodiesel
ED = Energy Density	RD = Renewable Diesel
V = Volume consumed	C = Electricity
CIT = Carbon Intensity Target	NG = Natural Gas
CIA = Carbon Intensity Actual	FNG = Fossil Natural Gas
K = Total Kilowatts (Total Electric Vehicles * Kilowatts Per Vehicle per Year)	RNG = Renewable Natural Gas
EER = Energy Economy Ratio	P = Propane