2023 Clean Fuels Forecast

Background

Oregon Revised Statutes (2017) Chapter 750, Section 163 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. 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 forecast assumptions, as well as methodological considerations and potential 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 projected volumes of fossil and alternative fuels in Oregon. The sources of this data include:

- Oregon Fuels Reporting System (OFRS)
- Fuel Pathway Codes (carbon intensity values) approved in Oregon and California
- Oregon Department of Transportation's (ODOT) Revenue Forecast
- Oregon Department of Transportation's Electric Vehicle Forecast
- 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 2023 Reported Volumes Forecast

To determine the number of deficits that will be generated in 2023, and thus the amount of credits needed for compliance, a forecast for the volumes reported to the Clean Fuels Program of all relevant fuels is made. The following are the volume projections for each fuel type.

Motor Gasoline

1,496.3 million gallons of gasoline, including ethanol, were reported to the program in 2021, the most recent year of data available. ODOT's forecast for gasoline consumption projects a negative 2.1 percent annualized growth from 2021 to the 2023 compliance year, resulting in a projected volume of 1,436.0 million gallons. After subtracting the projected amount of ethanol (see below), the final forecast for conventional gasoline is 1,289.5 million gallons.

Diesel
According to CFP reported data, 808.6 million gallons of diesel, including bio- and renewable diesel, were reported to the program in 2021, the most recent year of data collected. Growth projections exhibited in the Oregon Department of Transportation's April 2022 anticipate negative 2.3 percent growth annualized from 2021 to 2023. This results in a projected 771.2 million gallons of total diesel. After subtracting biodiesel and renewable diesel (see below), the final forecast for conventional diesel in 2023 is 659.4 million gallons.

Ethanol
The amount of ethanol reported for 2021 equaled 155.6 million gallons. The amount of ethanol projected for 2023 is based on a blend rate assumption driven by historical observations and trends. The latest observation for an ethanol blend rate, for calendar year 2021, was 10.4 percent. Given the passage of House Bill 3051, which allows for blends above 10 percent, the assumption for 2023 is 10.2 percent. This results in a forecast for reported ethanol of 146.5 million gallons, which is 3.0 percent below the 2021 volume on an annualized basis.

Biodiesel
The reported volume of biodiesel in 2021 amounted to 75.5 million gallons. The amount of biodiesel projected for 2022 is based on a blend rate assumption driven by historical observations and patterns. The biodiesel blend rate is expected to rise from 9.3 percent in 2021 to 11.0 percent for the 2023 compliance period, resulting in a volume projection of 84.8 million gallons. This represents growth of 6.0 percent from the 2021 actual on an annualized basis.

Renewable Diesel
The amount of renewable diesel reported in 2021 was 9.7 million gallons. Similar to biodiesel, the forecast for renewable diesel is driven by the assumption of the fraction of total diesel reported comprised of renewable diesel. The blend rate observed for 2021 in the Clean Fuels data was 1.2 percent. The blend rate is assumed to increase to 3.5 percent in 2023, leading to a forecast for reported renewable diesel of 27.0 million gallons, a 64.4 percent increase from the 2021 value on an annualized basis.

Electricity
The projection for reported 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. The forecast equals an average of 26,520 Plug-in Hybrids and 46,909 Battery Electric vehicles. Residential charging estimation assumes an 8.5 kilowatt-hour a day usage, while non-residential charging is reported directly to the program. Factoring in historical growth in the latter, the final kilowatt-hours per vehicle per year assumption in the model is 3,620. When converted to gasoline gallon equivalents, the forecast is 7.8 million gallons. This is equivalent to a 29.3 percent increase from 2021 on an annualized basis.

For electricity reported for off-road use, simple growth rates are applied to the 2021 reported volume of 5.0 million gallons. At 50 percent per year for 2022 and 2023, this results in a forecast of 11.2 million gallons for 2023.

Natural Gas and Liquified Petroleum Gas

The amount of natural gas, including renewable natural gas (biogas), reported in 2021 in diesel gallon equivalents equaled 3.5 million gallons. Annualized growth from the 2021 base year to 2023 is assumed to be 11.0 percent. This results in a forecast of 4.4 million gallons. The blend rate for renewable natural gas is expected to increase from 90.8 percent in 2021 to 95.0 percent in 2023.

Liquefied Petroleum Gas exhibits the smallest quantity of alternative fuel reported in 2021 at 2.4 million gasoline gallon equivalents. Annualized growth from the 2021 base year to 2023 is assumed to be 46.2 percent, resulting in a forecast of 5.2 million gallons.

The following table presents the 2023 reported volumes forecast in detail. Note that the percent change figures for 2023 represent annual growth from the last available actuals in 2021.

Table 1: Summary of fossil and alternative fuel volumes

(Mil. gallons, percent)	2020	2021	2022F	2023F	annual %ch vs. 2021
Conventional Gasoline	1,265.4	1,341.1	1,297.6	1,287.8	-2.0%
Ethanol	141.8	153.1	147.4	146.3	-2.2%
Ethanol Blend Rate	*10.07%*	*10.24%*	*10.20%*	*10.20%*	
Blendstock	1,407.2	1,494.2	1,445.0	1,434.1	-2.0%
Fossil Diesel	661.8	723.3	682.4	657.9	-4.6%
Biodiesel	68.4	73.5	77.5	84.6	7.3%
Biodiesel Blend Rate	*9.2%*	*9.1%*	*10.0%*	*11.0%*	
Renewable Diesel	17.4	9.7	15.5	26.9	66.3%
Renew diesel Blend Rate	*2.3%*	*1.2%*	*2.0%*	*3.5%*	
Total Diesel	747.6	806.6	775.5	769.4	-2.3%
Electricity (on-road)	3.7	4.7	5.9	7.8	29.3%
Electricity (off-road)	3.2	5.0	7.5	11.2	50.0%
Fossil Natural Gas	0.4	0.3	0.3	0.2	-18.3%
Biogas	2.9	3.2	3.6	4.1	13.6%
Biogas Blend Rate	*88.7%*	*90.8%*	*92.5%*	*95.0%*	
Total Natural Gas	3.3	3.5	3.9	4.4	11.0%
Liquified Petroleum Gas	1.5	2.4	3.6	5.2	46.2%
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 reporting 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, 4, 6 and 7 in the PDF document referenced halfway down the page). The following table presents these parameters for each fuel. The highlighted carbon intensities for ethanol, biodiesel, renewable diesel, electricity and renewable natural gas are not set in rule and were discussed in detail by the advisory committee. Finally, energy economy ratios are presented for electric and natural gas engines.

Table 2: Parameter values for the 2023 forecast

	Energy Density	Carbon Intensity Target	Carbon Intensity Assumption
Gasoline	122.48	91.68	100.14
Ethanol	81.51	91.68	50.00
Diesel	134.48	92.32	100.74
Biodiesel	126.13	92.32	39.00
Renewable Diesel	129.65	92.32	34.00
Electricity	3.60	91.68	0.00
KWh/vehicle	*3620*		
EERelect	*3.40*		
EER_NG	*0.90*		
Natural Gas	134.48	92.32	79.98
Biogas	134.48	92.32	0.00
Liq. Petroleum Gas	89.63	91.68	35.00

Banked Credits

The number of credits and deficits is taken from the OFRS. The number of gross credits registered through the end of calendar year 2021 equaled 6.5 million, while the number of deficits amounted to 5.8 million. The net credits banked equaled 751,794. OEA currently projects that a negative 146,722 net credits will be subtracted from the bank during the 2022 compliance year. The total projected banked credits at the beginning of the 2023 compliance period is now expected to total 605,072.

Table 3: Summary of actual and projected net banked credits

Year	Deficits	Credits	Net Banked Credits
2016	-594,832	809,411	214,579
2017	-644,372	855,272	210,900
2018	-864,883	943,646	78,763
2019	-1,002,020	1,220,755	218,735
2020	-1,153,904	1,260,558	106,654
2021	-1,501,919	1,424,082	-77,837
2022est.	-1,776,505	1,629,783	-146,722
Total	-7,538,435	8,143,507	605,072

Credit and Deficit Summary

The table below summarizes the forecast for deficit generation and credit generation for both the 2023 compliance year, as well as the intervening 2022 that is still a forecast in the model. The 2023 forecast calls for just over 181,000 net credits to be subtracted from the credit bank. The equations for calculating the deficits and credits can be found in Appendix B.

Table 4: Summary of Deficits and Credits

Credit / Deficit Summary			
		2022F	2023F
Deficits	Gasoline	-1,116,311	-1,334,380
	Diesel	-660,193	-744,913
Deficit Total		**-1,776,505**	**-2,079,293**
Credits	Ethanol	487,723	496,943
	Biodiesel	510,255	569,208
	Renewable Diesel	176,950	203,623
	Electricity, on-road	226,178	296,236
	Electricity, off-road	177,578	259,441
	Natural Gas	38,521	46,419
	Liquified Petroleum Gas	12,578	26,553
Credit Total		**1,629,783**	**1,898,423**
Net Credits/Deficits		**-146,722**	**-180,871**
Beginning Banked Credits		**751,794**	**605,072**
Total Net Credits/Deficits		**605,072**	**424,202**

Forecasted Fuel Supply Deferral Analysis

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

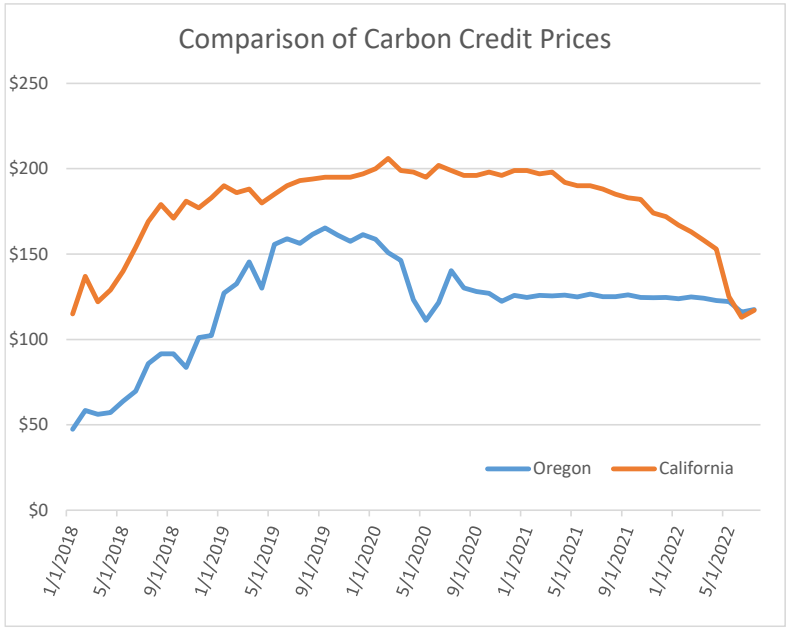
Potential Supply of Alternative Fuels

Oregon Revised Statutes (2017) Chapter 750, 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 registered by the Department of Environmental Quality to deliver fuel into Oregon. In addition, they must report volumes of fuel sold in Oregon to the OFRS. Thus, the capacity of facilities that were certified for the most recent compliance period (2022) is assumed to be theoretically "available" to Oregon.

In addition, 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 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.

Finally, that a particular volume of fuel will make its way to Oregon depends on the relative value of the fuel between Oregon and other states. Currently, the value of credits, which are currently unique to Oregon, California and British Columbia, add a premium to the market value of the fuel relative to other states and for the most part ensure that sufficient supply will be available to Oregon. Oregon Revised Statutes (2017) chapter 750 section 166 subsection (4) specifies a maximum credit price, indexed for inflation. At some point in the future, this constraint could theoretically pose a barrier to supply. The chart below presents the recent history of the price of credits in Oregon and California (British Columbia omitted due to frequently missing data)[1].

Chart 1: Credit Prices



[1] Information regarding credit prices is presented for informational purposes only. The reported volumes, credit/deficit and supply forecasts are not dependent on any specific credit price values.

Ethanol

As exhibited in Table 5, the potential supply of ethanol to Oregon per the methodology outlined above is 2.3 billion gallons. This compares to a projected reported volume for ethanol of 158.1 million gallons, or 6.4 percent of the potential supply, for the 2023 compliance period.

Table 5: Ethanol Supply

Ethanol Supply Available to Oregon
(Existing Suppliers in 2022)

State	Nameplate Capacity (Mil. Gallons)	Number of Facilities
South Dakota	858	12
Nebraska	565	7
Iowa	521	4
Minnesota	140	2
North Dakota	82	1
Colorado	70	2
Oregon	40	1
Total Oregon Suppliers	2,276	29

Data from Clean Fuels Program.

Biodiesel

Table 6 presents the potential supply of biodiesel to Oregon, equaling 1,003 million gallons in capacity for certified facilities in 2021. This compares to a projected volume of biodiesel in 2023 of 86.4 million gallons, or 8.5 percent of the potential supply.

Table 6: Biodiesel Supply

Biodiesel Supply Available to Oregon
(Existing Suppliers in 2022)

Locality	Nameplate Capacity (Mil. Gallons)	Number of Facilities
Iowa	260	4
Minnesota	130	1
Arkansas	124	2
Illinois	120	2
Canada	101	3
North Dakota	95	1
Washington	84	1
Missouri	42	1
Oregon	17	1
Texas	13	1
Mississippi	12	1
South Korea	5	1
Michigan	1	1
Total Oregon Suppliers	1,003	20

Data from Clean Fuels Program.

Renewable Diesel

As presented below, the potential supply of renewable diesel to Oregon equals 714 million gallons. This compares to a projected volume of renewable diesel in 2023 of 49.4 million gallons, which translates to 3.8 percent of the potential supply.

Table 7: Renewable Diesel Supply

Renewable Diesel Supply Available to Oregon
(Existing Suppliers in 2022)

Locality	Nameplate Capacity (Mil. Gallons)	Number of Facilities
North Dakota	184	1
California	180	1
Singapore	116	1
Washington	109	1
Wyoming	70	1
Louisiana	35	1
Cananda	20	1
Total Oregon Suppliers	714	7

Data from the Clean Fuels Program

Renewable Natural Gas

The amount of renewable natural gas potentially available to Oregon amounts to 84.5 billion gasoline gallon equivalents. This compares to a projected volume for this biofuel of 6.2 million gallon equivalents in 2023, or 5.2 percent of the potential supply.

Table 8: Renewable Natural Gas

Renewable Natural Gas Supply Available to Oregon
(Existing Suppliers in 2022)

Locality	Nameplate Capacity (Mil. Gallons)	Number of Facilities
Pennsylvania	34.4	2
Canada	14.0	1
New York	12.3	1
Texas	10.0	1
Kentucky	9.5	1
Louisiana	4.3	1
Wisconsin	0.0	1
Total Oregon Suppliers	84.5	8.0

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 2023 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.
(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 than the latter. This forecast applies projected growth of taxable diesel, at least initially, to the base year 2021 reported volumes of diesel in the CFP. To the degree that taxable gallons per ODOT are 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 the projected 2023 volume, 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.

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 (971) 678-5595 or email him at michael.kennedy@das.oregon.gov

Appendix A

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Appendix B

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

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

Table B.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