2019 Fuel Supply Forecast

Background

Oregon Revised Statutes (2017) Chapter 750, Section 163[1] authorizes the Office of Economic Analysis (OEA), with substantial assistance from the Department of Environmental Quality, to produce annually a forecast regarding deficits and credits owing to fossil and alternative fuel consumption, as well as the availability of fossil and alternative fuels in Oregon. In particular, the forecast is to determine whether fuel supply will be sufficient to generate alternative fuel (ethanol, electricity, and diesel substitutes - including biodiesel, renewable diesel, natural gas, and propane) credits 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 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 from the US Energy Information Administration
- Trade associations (Renewable Fuels Association and the National Biodiesel Board) on their members' production capacity

Methodology

The current methodology was developed by ICF Incorporated for the 2017 Clean Fuels Forecast and is based on the following components: a fuel demand component, a fuel supply component, and a carbon intensity component.

Demand Inputs

- Vehicle stocks – OEA uses Oregon DMV vehicle registration data to analyze for which vehicle types are currently registered as well as historical trends.
- Fuel consumption – OEA uses a combination of the ODOT Revenue Forecast and the EIA Annual Energy Outlook to analyze for projected and historical trends in fuel consumption.

Fuel Supply

[1] https://olis.leg.state.or.us/liz/2017R1/Downloads/MeasureDocument/HB2017/Enrolled

- Fuels and associated feedstocks - OEA reviews data regarding the supply of gasoline, diesel, ethanol, biodiesel, renewable diesel, natural gas, propane and electricity.
- Regional fuel supply – OEA primarily uses data reported to CFP to analyze the volumes and types of fuels facilities are supplying fuels to Oregon. If needed, this information can be supplemented by information from California or British Columbia to demonstrate what fuels are broadly available to the West Coast.

Carbon Intensity

- Oregon and California-approved values – OEA looks at individual carbon intensity values to facilities that have been approved by either itself or by the California Air Resources Board.

Numerous issues were raised during the development of the 2019 forecast. For the 2020 forecast cycle, the Office of Economic Analysis will form a technical advisory committee to consider modifications to the existing methodology, as well as the incorporation of additional data sources not factored into the current methodology. In addition, much of the data underlying the clean fuels forecast has only recently begun to be collected. To the degree that the passage of time will generate longitudinal time series more amenable to the econometric techniques that are the cornerstone of OEA's forecasting processes, better projections will avail themselves over time.

Deficit Generation from Fossil Fuel Consumption – Credits Needed

The amount of credits needed to comply with the 2019 clean fuel standards is based on assumptions about the consumption of fossil fuels that generate deficits.

Gasoline Consumption

1,626 million gallons of gasoline, including ethanol, were consumed in 2017, the most recent year of data collected. Growth projections exhibited in the Oregon Department of Transportation's June 2018 forecast equal -1.7 percent growth for calendar year 2018 and 0.2 percent growth for calendar year 2019. CFP data shows that gasoline is being blended with ethanol statewide at 10.3 percent of the gasoline pool. As presented in Table 1, this results in a projected 1,436 million gallons of CBOB gasoline blendstock in 2019. In comparison, AEO estimates -0.3 percent growth in 2018 and -0.5 percent growth in 2019 for the Pacific Region. Furthermore, projected deficit generation assumes a CBOB energy density of 122.5 and a carbon intensity differential of -3.6 (a projected actual value of 97.2 minus a target value of 100.8. This results in an expected deficit generation equaling 634,994 deficits.

Diesel Consumption

According to CFP reported data, 750 million gallons of diesel, including bio- and renewable diesel, were consumed in 2017, the most recent year of data collected. Growth projections from the Department of Transportation's June 2018 forecast indicate 1.4 percent growth for calendar year 2018 and1.0 percent growth for calendar year 2019. AEO estimates -1.0 percent growth in 2018 and 1.1 percent growth for 2019 for the Pacific Region. The diesel pool has a greater variance in the amount of biodiesel and renewable diesel being blended with clear diesel blendstock. Therefore, OEA and DEQ developed a low and high case of diesel consumption based on low and high scenarios for biodiesel and renewable diesel blend rates. Both cases assume an energy density of 134.5 and a carbon intensity differential of -3.6 (a projected actual value of 98.1 minus a target value of 101.7). The low fossil diesel demand case forecasts 2019 diesel consumption at 642 million gallons by assuming blending 10 percent biodiesel and 6.5 percent renewable diesel into the diesel pool, resulting in 304,536 deficits generated in 2019. The high fossil diesel

demand case forecasts 2019 diesel consumption at 705 million gallons by blending 6.9 percent biodiesel and 1.3 percent renewable diesel into the diesel pool, resulting in 334,808 deficits generated in 2019.

Table 1: Fossil Fuel Consumption and Deficits

Fuel	2019 Projected Consumption		Energy Density/ (Carbon Intensity Differential)	Deficits	
Gas Blendstock (CBOB)	1,436 million gallons (Ethanol blend = 10.3%)		122.48/(100.8-97.2)	634,994	
Diesel Blendstock	705 mil. gallons BR = 8.2%	642 mil. gallons BR = 16.5%	134.48/(101.7-98.1)	334,808	304,536

Credit Generation from Gasoline Substitutes and Alternatives

Credits can be generated by supplying transportation fuels that are lower in carbon intensity than the higher carbon fuels they replace. For gasoline, the most likely substitutes and alternatives are ethanol and electricity.

Ethanol Consumption

In order to estimate the number of credits that may be generated from the ethanol available to Oregon, the volume and carbon intensities must be estimated. 164 million gallons of ethanol are estimated to be consumed in 2019, based on the gasoline consumption forecast discussed above and a blend rate assumption of 10.3 percent.

For carbon intensities, OEA reviewed facilities that have Oregon-approved carbon intensity values, and focused on four of which are mostly like to deliver their ethanol to Oregon. They have a combined production capacity of 342 million gallons of ethanol, well in excess of the 164 million gallons needed, and are:

Table 2: Ethanol Producers and Capacity

Facility	Location	Production Capacity	Carbon Intensity
Pacific Ethanol Columbia	Boardman, OR	40 mil. gallons	53.81 gCO2e/MJ
Guardian Energy Janesville	Janesville, MN	110 mil. gallons	62.40 gCO2e/MJ
Guardian Energy Hankinson	Hankinson, ND	132 mil. gallons	60.11 gCO2e/MJ
Pacific Ethanol Magic Valley	Burley, ID	60 mil. gallons	54.00 gCO2e/MJ
Totals/Average		342 mil. gallons	61.6 gCO2e/MJ

CFP data shows that the average ethanol carbon intensity exhibited in 2017 was 62.7 gCO2e/MJ, which is the basis for the low credit scenario. The high credit scenario is based on the observed 61.6 carbon intensity for the supply that is assumed available to Oregon (see Table 2). The resulting ethanol credits projected for 2019 range from 490,763 and 560,412.

Electricity Consumption

In order to estimate the number of credits that may be generated from electricity used in light-duty vehicles, three factors must be considered: 1) the number of electric vehicles registered in Oregon, 2) the average amount of electricity consumed per vehicle, and 3) the carbon intensity of electricity.

Oregon DMV vehicle registration data shows that about 10,107 battery electric vehicles (BEVs) and 7,786 plug-in hybrid electric vehicles (PEVs) were registered in Oregon in June 2018. OEA projects that those numbers will rise to 11,366 BEVs and 9,050 PEVs by the end of 2018. Further, growth rates assumed for 2019 are based on historical quarterly year-over-year growth rates and variance in growth over time to produce 95 percent confidence interval of 22.5 percent (low) to 33.6 percent (high). The resulting projections put the number of electric vehicles in use in 2019 at between approximately 23,105 and 25,207.

Using assumptions that electricity consumption per vehicle is 10 kWh/day (or roughly 30 miles per day) and that the average electric vehicle is driven 347 days per year, the average electricity consumption per vehicle is 3,470 kWh of charging per year. The statewide electric mix carbon intensity is 120.27 gCO2e/MJ, although when adjusted to reflect the energy efficiency ratio of 3.4 the intensity comparable to gasoline is 35.4 gCO2e/MJ. This results in between 60,632 and 66,150 credits projected for 2019. Also, note that some charging of electric vehicles will occur in places where the carbon intensity electricity is less than the statewide mix, but this was not factored into the forecast.

Credit Generation from Diesel Substitutes and Alternatives

Credits can be generated by supplying transportation fuels that are lower in carbon intensity than the higher carbon fuels they replace. For diesel, the most likely substitutes and alternatives are biodiesel, renewable diesel, natural gas, propane and electricity.

Biodiesel Consumption

In order to estimate the number of credits that may be generated from the biodiesels available to Oregon, the volume and carbon intensities must be estimated. For biodiesel, the blend rate varies between 6.9 percent and 10 percent, as shown above in the diesel consumption discussion. The committee discussed these assumptions and noted that blend rates could range as high as 20 percent in 2019. OEA chose to go with the historical range, resulting in a range of 52 – 75 million gallons of biodiesel demand.

For carbon intensities, OEA reviewed facilities that are mostly like to deliver biodiesel to Oregon. They have a combined production capacity of 125 million gallons of biodiesel, well in excess of the gallons needed (see Forecast Risks later in the report), and are:

Table 3: Biodiesel Suppliers and Capacity

Facility	Location	Production Capacity	Carbon Intensity
SeQuential Biodiesel	Salem, OR	15 million gallons	14.62 gCO2e/MJ
REG Grays Harbor-Canola	Grays Harbor, WA	100 million gallons	52.87 gCO2e/MJ
REG Grays Harbor-UCO	Grays Harbor, WA		18.26 gCO2e/MJ
General Biodiesel	Seattle, WA	10 million gallons	28.59 gCO2e/MJ
Totals/Average		125 million gallons	33.86 gCO2e/MJ

CFP data shows that average biodiesel carbon intensity was 47.1 gCO2e/MJ in 2017. Assuming the same CI in 2019 and incorporating the projected range of biodiesel consumption, the forecast for credits in 2019 ranges from 341,203 to 494,498.

Renewable Diesel Consumption

In order to estimate the number of credits that may be generated from renewable diesel available to Oregon, the volume and carbon intensities must be estimated. In 2016, approximately 5 million gallons of renewable diesel were supplied to Oregon based on a DEQ survey. Renewable diesel consumption volumes were first reported to the CFP for the fourth quarter 2017. Since fuel consumption exhibits a significant degree of seasonality, the first full year of data on renewable diesel consumption in Oregon will be calendar year 2018.

Table 4: Renewable Diesel Capacity

Feedstock	Potential Supply to Oregon (Low/High)	Carbon Intensity
Tallow	0 gallons/12.2 million gallons	34.48gCO2e/MJ
Soy	10 million gallons/12.2 million gallons	55.25 gCO2e/MJ
UCO	0 gallons/12.2 million gallons	20.97 gCO2e/MJ
Corn oil	0 gallons/12.2 million gallons	34.32 gCO2e/MJ
Totals/Average	10 million gallons/48.8 million gallons	36.25 gCO2e/MJ

Additionally, EIA data shows that 198.6 million gallons of renewable diesel was supplied to the West Coast in 2017 and OEA projects that between 10.0 – 48.8 million of those gallons are available to be supplied to Oregon, which would be between 1.3 - 6.5 percent of the state's diesel pool. The energy density of renewable diesel is 129.65 MJ/gallon. For carbon intensities, OEA assumed weighted average carbon intensities for available feedstocks supplied to Oregon with a range of 34.32 – 55.25 gCO2e/MJ. Those volumes and carbon intensities would result in between 55,512 – 400,545 credits generated in 2019.

Natural Gas and Propane Consumption

In order to estimate the number of credits that may be generated from natural gas used in medium and heavy-duty vehicles, OEA reviewed Oregon DMV vehicle registration data and volumes reported to CFP to date. OEA estimates that between 4 - 14 million diesel gallon equivalents of natural gas will be consumed in Oregon in 2019. Additionally, by reviewing data reported to Oregon and California, OEA estimates that 60 – 80 percent of the natural gas consumption will be in the form of renewable natural gas. The carbon intensities of renewable natural gas can vary greatly, from manure digesters, wastewater treatment plants and landfills. For the forecast, OEA assumed carbon intensity in the range of 44.0 to 53.0 gCO2e/MJ based on the assumed blend rate of biogas. Those volumes and carbon intensities would result in between 24,286 and 101,919 credits generated in 2019.

In order to estimate the number of credits that may be generated from propane used in medium and heavy-duty vehicles, DEQ reviewed Oregon DMV vehicle registration data and volumes reported to CFP to date. OEA estimates that between 0.8 - 1.3 million gasoline gallon equivalents of propane will be consumed in Oregon in 2019. The statewide carbon intensity value for propane is 83.1 gCO2e/MJ, which results in between 1,336 - 2,171 credits projected for 2019.

Electricity Consumption

For electricity used in public transit, ICF estimated credit generation from light rail, street cars, and aerial tram in their 2017 Additional Electrification memo. ICF estimated that 20,300 credits would be generated in 2018. This credit value is carried forward into 2019 as explicit data on non-road consumption of transportation electricity are just being collected by the CFP program. In addition, electricity used in public transit buses were not included in the forecast but credits will be generated in 2018 for this category. Also note that some charging of electric vehicles will occur in places where the carbon intensity electricity is less than the statewide mix, but this was not factored into the forecast.

Table 5: Alternative Fuels Consumption and Credits

Fuel Type	Consumption Forecast	Energy Density/CI Diff.	Credits Generated
Ethanol	165 mil. gallons	81.5/(97.2 – 62.7/56.4)	490,763 – 560,412
Electricity	2.4 – 2.6 mil. gallons	3.6/(97.2 - 35.4)	60,632 – 66,150
Biodiesel	52 – 75 mil. gallons	126.1/(98.1 – 47.1)	341,203 – 494,498
Renewable Diesel	10 – 49 mil. gallons	129.65/(98.1 – 39.5)	55,512 – 400,545
Natural Gas	4 – 14 mil. gallons.	78.8/(98.1 – 49.4)	3,914 – 6,849
Biogas	2.4 – 11.2 mil. gallons	134.5/(98.1 – 35.0)	20,372 – 95,070
Propane	0.8 – 1.3 mil. gallons	89.6/(97.2 – 83.1)	1,336 – 2,171

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 2017 equaled 1.76 million, while the number of deficits recorded amounted to 1.33 million. The net credits banked equaled 423,379. OEA projects that another 222,784 credits will be banked during calendar year 2018. It is important to note that credits were not generated for residential electric vehicle charging in 2016 and 2017 but will be retroactively generated as per recent changes to the regulation, these credits are not included in that bank.

Table 6: Summary of actual and projected net banked credits

Year	Deficits	Credits	Net Banked Credits
2016	617,071	830,714	213,643
2017	715.057	924,793	209,736
2018 (Projected)	814,395	1,037,179	222,784
Total	2,146,523	2,792,686	646,163

Data Summary

The table below summarizes the forecast for deficit generation and credit generation:

Table 7: Summary of Deficits and Credits

	Credit / Deficit Summary		
Deficits	RBOB (Gasoline)	-634,994	
	Diesel	-334,808	-304,536
		Low	**High**
Credits	Ethanol	490,763	560,412
	Biodiesel	341,203	494,498
	Renewable Diesel	55,512	400,545
	Electricity, on-road	60,632	66,150
	Electricity, off-road	20,300	20,300
	Natural Gas	24,286	101,919
	Propane	1,336	2,171
2019 Net Credits/Deficits		**24,232**	**706,464**
2018 Banked Credits/Deficits		**646,163**	**646,163**
Total Net Credits/Deficits		**670,395**	**1,352,627**
Percent of Credits Needed		**69.1%**	**144.0%**

Forecasted Fuel Supply Deferral Analysis & Determination

If OEA forecasts a shortfall in clean fuel credits greater than five percent of the credits that are estimated to be needed for compliance, then the forecasted fuel supply deferral is triggered. House Bill 2017 changed

the calculation to include projected banked credits. As shown above, neither scenario results in an expected deferral.

Forecast Risks

There are a number of potential risks to this 2019 Clean Fuels Forecast. A risk is defined as a deviation from one or more assumptions that would alter the conclusion outlined in the previous section. They are:

(a) The most fundamental risk to the forecast amounts to potential deviations from the assumptions highlighted in each fuel type discussion. Further, there is risk that the actuals used as the basis for consumption predictions in 2019 are not completely accurate to one degree or another, given that they are reported figures rather than direct counts (e.g., tax collections and prison beds). More detailed descriptions of these types of error are described below.

(b) The forecasting model developed by ICF uses historical carbon intensities with the assumption that projected carbon intensities will not increase (no backsliding). However, many members of the committee expressed concern that this was a significantly conservative assumption given that new technologies have been reducing carbon intensities over time. As the CFP data increase in historical coverage, more advanced longitudinal and statistical techniques become possible to better produce unbiased estimates of future carbon intensities.

(c) There is a significant discrepancy between the diesel consumption numbers in the Clean Fuels Program data and the number generated by ODOT's Weight Mile Tax program, with the former being higher than the latter. This forecast uses the CFP consumption numbers for 2017, but inflates them using the growth rates exhibited in the ODOT June 2018 forecast. To the degree that the actual diesel consumption for 2017 is more similar to the ODOT numbers, the net credits figures in Table 7 would skew more positive, potentially even eliminating the small likelihood of deferral. In addition, CFP data indicate a 2.9 percent decrease in diesel consumption for 2017, whereas the ODOT data result in a growth rate of 6.7 percent. If the ODOT growth forecast is higher than actually transpires, diesel deficits would be lower and the net credits would skew even higher. Bottom line, this issue is only a "risk" in the sense that net credits might deviate significantly outside the range presented in Table 7.

(d) House Bill 2017 (2017 Legislative Session) created a rebate for sales of electric vehicles in Oregon. The Oregon Supreme Court upheld that this component of the bill was constitutional. The electric vehicle forecast underlying the credit projections for electricity consumption do not explicitly account for the potential impact of this rebate. To the degree that electric vehicle sales skew higher than expected herein, net credits would be even higher than exhibited in table 7, constituting an upside risk to the forecast.

(e) The ethanol availability presented above does not include other potential sources, such as sugarcane ethanol imported from Brazil. To the degree that available ethanol in Oregon exceeds the amount indicated, the likelihood that capacity impinges on consumption is even less, thus reinforcing the credit generation from ethanol presented in Table 7. This mirrors the characterization of risk for diesel consumption in section (b).

(f) Forklifts, aviation fuels, and certain other fuel types not currently included in the Clean Fuels Program are being considered for inclusion in 2019. To the degree that this would increase deficits, the probability for deferral would be higher that exhibited in this 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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