2020 Clean Fuels Forecast

Background

Oregon Revised Statutes (2017) Chapter 750, Section 163[1] authorizes the Office of Economic Analysis (OEA), in coordination with the Department of Environmental Quality, to assess 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 credits (on ethanol, electricity, and diesel substitutes - including biodiesel, renewable diesel, natural gas, and propane) to meet the scheduled low carbon fuel standards for the compliance period. The forecast report is required to include an assessment of total deficits and banked 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 2020 Consumption Forecast

To determine the amount of deficits that will be generated in 2020, and thus the amount of credits needed for compliance, a forecast for consumption of all relevant fuels must be made. The following are the volume projections for each fuel type.

Gasoline Consumption

1,708 million gallons of gasoline, including ethanol, were consumed in 2018, the most recent year of data collected. Growth projections exhibited in the Oregon Department of Transportation's December 2018 forecast equal an annualized 0.8 percent from 2018 to 2020. There were two factors considered in making adjustments to these initial growth parameters: ODOT observed gasoline consumption coming in lower than projected through the first two quarters of 2019. Secondly, the mandated decreases in the carbon intensity targets for fossil fuels incentivize reporting parties to record supplies of fuel in the earliest year

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

possible to minimize the deficits generated. For the first factor, growth was adjusted down to 0.4 percentage points. Given that the reduction in the carbon intensity target is the same in percentage terms for 2020 and 2021, ultimately no adjustment was made for potential pull forward in reporting. The final annualized growth in motor gasoline from the 2018 base year through 2020 is 0.4 percent annually, resulting in a projected 1,720.4 million gallons for the total gasoline pool. To determine the amount of conventional gasoline represented, ethanol must be subtracted. The blend rate assumed for 2020 is 10.1 percent, equal to that observed for 2018. The final forecast for conventional gasoline is 1,546.3 million gallons.

Diesel Consumption

According to CFP reported data, 771.2 million gallons of diesel, including bio- and renewable diesel, were consumed in 2018, the most recent year of data collected. Growth projections exhibited in the Oregon Department of Transportation's December 2018 forecast equal an annualized 1.4 percent from 2018 to 2020. The same add-factor considerations noted under the gasoline section were made for diesel as well, particularly the fact that diesel consumption fell far below projections through the first two quarters of 2019. The final annualized growth in total diesel from the 2018 base year through 2020 is -0.6 percent, resulting in a projected 762.5 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 6.9 percent and 3.5 percent, respectively. The final forecast for the consumption of conventional diesel in 2020 is 683.2 million gallons.

Ethanol Consumption

The amount of ethanol reported for 2018 equaled 172.2 million gallons. As described above, the amount of ethanol projected for 2020 is based on a blend rate assumption driven by historical observations and trends, as well as blend rates observed in California. Given that the last actual blend rate observation, (for the 2018 compliance year), was 10.1 percent and that most gasoline consumed in Oregon is E10, the assumption for 2020 was maintained at 10.1 percent. This results in a forecast for ethanol consumption of 174.1 million gallons, which is 0.5 percent above the 2018 volume on an annualized basis. As with the fossil fuels, no adjustment was made for behavioral factors associated with the phasing in of the carbon intensity reductions given that the incentive would be similar on either end of the compliance period. This is true for the remaining alternative fuel forecasts, as well.

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 2020 compliance period. This equaled an average of 13,050 Plug-in Hybrids and 19,772 Battery Electric vehicles. Historical volumes of electricity, including estimates for residential charging, are used to calculate average Kilowatt hours per vehicle year. For 2018, this parameter equaled 3,621 Kilowatt hours per year, which was in turn assumed for the 2020 compliance period. When converted to gasoline gallon equivalents, the forecast is 3.5 million gallons including residential charging. This is equivalent to a 25 percent increase from 2018 on an annualized basis.

Biodiesel Consumption

The reported volume of biodiesel in 2018 amounted to 51.7 million gallons. As described above, the amount of biodiesel projected for 2020 is based on a blend rate assumption driven by historical observations and trends, as well as blend rates observed in California. The highest observation in the Clean Fuels program data was 6.9 percent in 2017. This value was assumed for the 2020 forecast, resulting in a consumption projection of 52.6 million gallons. This represents growth of 0.9 percent from the 2018 actual on an annualized basis.

Renewable Diesel Consumption

The amount of renewable diesel reported in 2018 was 1.2 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 2018 in the Clean Fuels data was 0.2 percent. In California, similarly small blend rates quickly escalated to 3.0 percent and beyond. Such an adoption schedule is assumed for Oregon, resulting in a blend rate projection for renewable diesel in 2020 of 3.5 percent. This leads to a consumption forecast of 26.7 million gallons, a substantial 369.8 percent above the 2018 value on an annualized basis.

Natural Gas and Propane Consumption

The amount of natural gas, including renewable natural gas (biogas), reported in 2018 in diesel gallon equivalents equaled 3.2 million gallons. This represented 14.7 percent growth from the prior year. Annualized growth from the 2018 base year to 2020 is assumed to be 6.9 percent, equal to the Energy Information Administration's outlook for the Pacific region. This results in a forecast of 3.6 million gallons, which is 6.9 percent annually above the 2018 level.

Propane exhibits the smallest quantity of alternative fuel reported in 2018 at 0.7 million gasoline gallon equivalents. However, this was 477.1 percent above the 2017 reported value. Annualized growth from the 2018 base year to 2020 is assumed to be 213.9 percent, resulting in a forecast of 7.3 million gallons.

The following table presents the 2020 consumption forecast in detail. Note that the percent change figures for 2020 represent annual growth from the last available actuals in 2018. To the extent that 2018 actuals were not known at the time the 2019 forecast was released, this explains the significant variance in changes related to the 2019 forecast. Presenting annualized changes from 2018 is thus more informative.

Table 1: Summary of fossil and alternative fuel consumption

(Mil. gallons, percent)	2018 Actual	2019 Forecast*	% change	2020 Forecast	annual %change vs 2018
Conventional Gasoline	1,535.4	1,437.0	-6.4%	1,546.3	0.4%
Ethanol	172.2	165.0	-4.2%	174.1	0.5%
Ethanol Blend Rate	10.1%	10.3%		10.1%	
Blendstock	1,707.6	1,602.0	-6.2%	1,720.4	0.4%
Fossil Diesel	718.2	705.0	-1.9%	683.2	-2.5%
Biodiesel	51.7	57.5	11.1%	52.6	0.9%
Biodiesel Blend Rate	6.7%	7.3%		6.9%	
Renewable Diesel	1.2	29.9	2370.6%	26.7	369.8%
Renew diesel Blend Rate	0.2%	3.8%		3.5%	
Total Diesel	771.2	792.3	2.7%	762.5	-0.6%
Electricity (on-road)	2.2	2.7	23.0%	3.5	25.0%
Electricity (off-road)	1.7	N/A		N/A	
Fossil Natural Gas	1.5	1.2	-17.8%	1.1	-13.6%
Biogas	1.7	2.8	62.9%	2.5	21.6%
Biogas Blend Rate	54.1%	70.0%		70.0%	
Total Natural Gas	3.2	4.0	25.8%	3.6	6.9%
Propane	0.7	1.3	72.2%	7.3	213.9%
*Forecast equals average of range published for 2019 forecast.					
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. Also included are the two parameters associated with electricity consumed by passenger vehicles. The carbon intensity assumption is adjusted for the energy economy ratio (EER). The actual carbon intensity of electricity is 109.3.

Table 2: Parameter values for the 2020 forecast

	Energy Density	Carbon Intensity Target	Carbon Intensity Assumption
Units	MJ/gallon	gCO2/MJ	gCO2/MJ
Gasoline	122.48	95.61	100.14
Ethanol	81.51	95.61	57.76
Diesel	134.48	96.27	100.74
Biodiesel	126.13	96.27	35.40
Reneweable Diesel	129.65	96.27	29.17
Electricity	3.6	95.61	32.15
KWh/vehicle	*3621*		
EER	*3.4*		
Natural Gas	134.48	96.27	79.98
Biogas	134.48	96.27	50.00
Liq. Petroleum Gas	89.63	95.61	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 2018 equaled 2.73 million, while the number of deficits recorded amounted to 2.23 million. The net credits banked equaled 502,608. Originally, OEA projected that another 365,348 credits will be banked during calendar year 2019. Given that another year of data are available, including actual fuel volumes (and thus blend rates for alternative fuels) for the 2018 compliance period, the 2019 estimated deficits and credits have been updated to reflect this. The total projected banked credits at the beginning of the 2020 compliance period is now expected to be 649,829.

Table 3: 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	-899,260	978,489	79,229
2019 (Proj.)	-1,015,633	1,162,854	147,221
Total	-3,247,021	3,896,850	649,829

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

Credit / Deficit Summary		
Deficits	Gasoline	-857,916
	Diesel	-410,701
Deficit Total		**-1,268,617**
Credits	Ethanol	537,140
	Biodiesel	403,946
	Renewable Diesel	232,191
	Electricity, on-road	92,317
	Electricity, off-road	25,784
	Natural Gas	17,896
	Propane	9,629
Credit Total		**1,318,903**

2020 Net Credits/Deficits	**50,286**
2019 Estimated Ending Banked Credits	**649,829**
Total Net Credits/Deficits	**700,115**

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 163[2] 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 receive credits for fuel delivered into Oregon. In addition, they must report volumes of fuel sold in Oregon to the Clean Fuels reporting system. It is assumed that selling fuel in Oregon implies established supply chains. Thus, the capacity of facilities that were certified and supplied fuel to Oregon for the most recent compliance period (2018) is assumed to be theoretically "available" to Oregon. The potential supply figures presented in the following sections correspond to the most recently available nameplate capacities for these facilities manufacturing the respective fuels. Where multiple values are available, the highest is presented.

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

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 3.8 billion gallons. This compares to a projected "demand" for ethanol previously characterized of 174.2 million gallons.

Table 5: Ethanol Supply

Ethanol Supply Available to Oregon
(Existing Suppliers in 2018)

State	Nameplate Capacity (Mil. Gallons)	Number of Facilities
South Dakota	900	11
Nebraska	817	10
Iowa	650	7
Minnesota	478	6
North Dakota	300	2
Kansas	220	3
Colorado	110	2
Idaho	75	1
California	50	1
Oregon	43	1
Total Oregon Suppliers	3,643	44

Data from Energy Information Administration and Clean Fuels Program.

Biodiesel

Table 6 presents the potential supply of biodiesel to Oregon, equaling 743 million gallons in capacity for certified facilities with established supply chains in 2018. This compares to a projected demand for biodiesel in 2020 of 52.6 million gallons. Note that the Energy Information Administration is currently updating their data collection regarding biodiesel producers to match that for ethanol. When these data become available, more current estimates of nameplate capacity will be incorporated into the analysis.

Table 6: Biodiesel Supply

Locality	Nameplate Capacity (Mil. Gallons)	Number of Facilities
Missouri	155	4
Iowa	106	2
Washington	105	2
Oregon	105	2
Nebraska	63	1
Arkansas	59	1
Korea	50	2
Oklahoma	35	1
Minnesota	30	1
Canada	22	4
Texas	15	1
Total Oregon Suppliers	743	21
Data from the Clean Fuels Program		

Renewable Diesel

As presented below, the potential supply of renewable diesel to Oregon equals 475 million gallons. This compares to a projected demand for renewable diesel in 2020 of 26.7 million gallons.

Table 7: Renewable Diesel Supply

Locality	Nameplate Capacity (Mil. Gallons)	Number of Facilities
Singapore	291	1
Wyoming	109	1
Louisiana	75	1
Total Oregon Suppliers	475	3
Data from the Clean Fuels Program		

Renewable Natural Gas

The amount of renewable natural gas potentially available to Oregon amounts to 2.2 billion gallon equivalents. This compares to a projected demand for this biofuel of 2.5 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	1,179	1
Ohio	990	1
Total Oregon Suppliers	2,169	2
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 2020 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 2018 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 consumption of diesel and thereby the number of deficits generated could deviate from this forecast.

(d) House Bill 2017 (2017 Legislative Session) created a rebate for sales of electric vehicles in Oregon. 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, constituting an upside risk to the forecast.

(e) 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.

(f) 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 2020 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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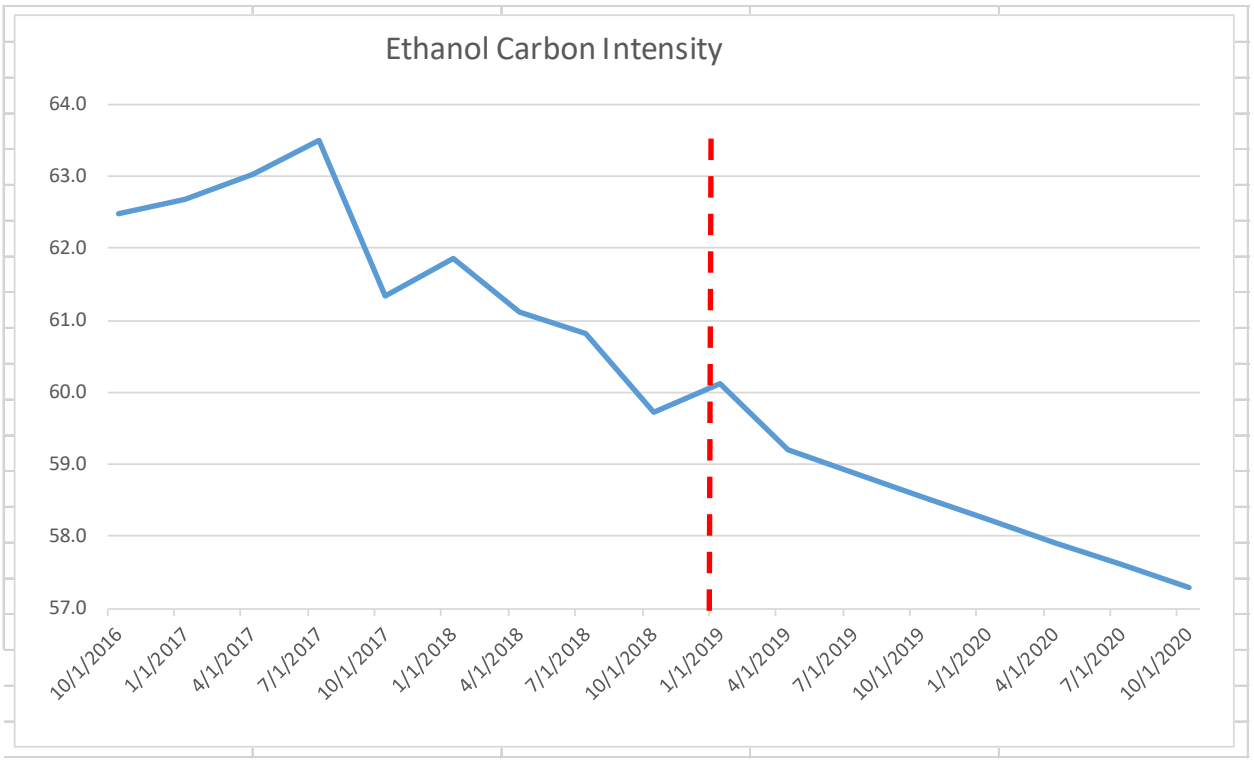
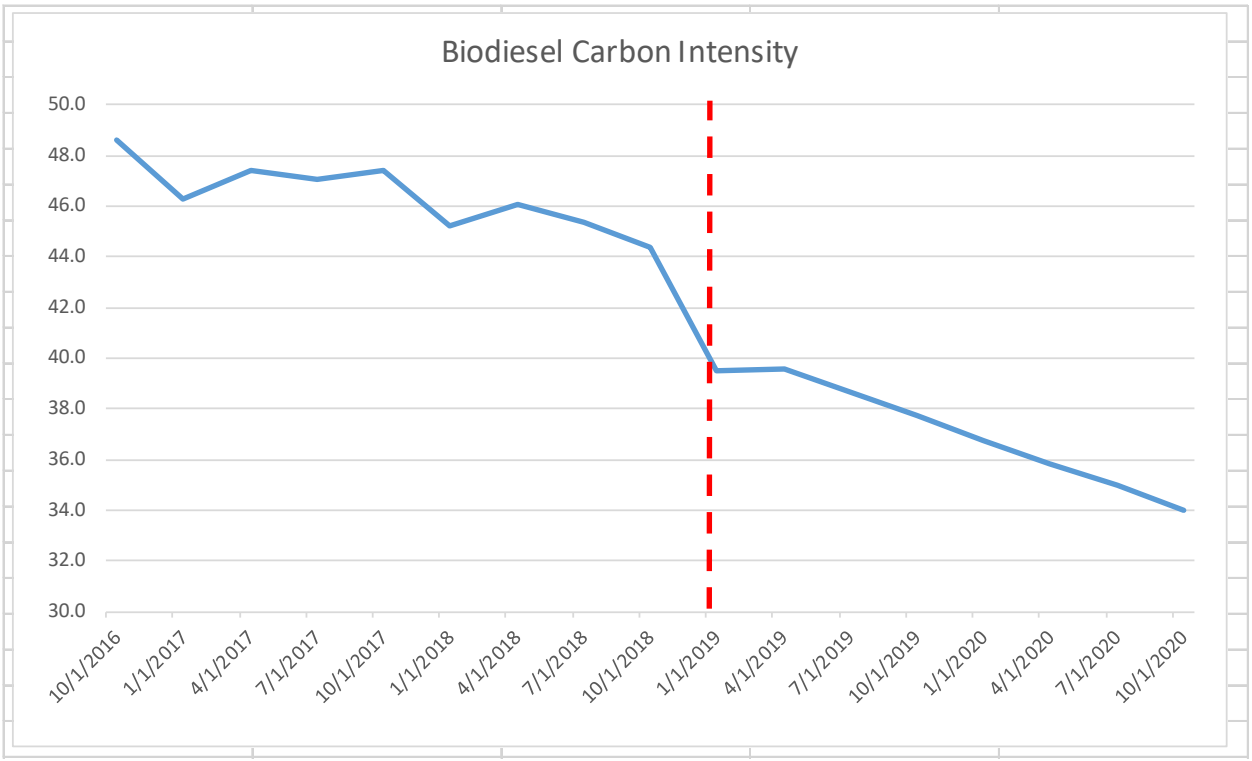
Appendix B

The estimated carbon intensities for ethanol, biodiesel and renewable diesel that are not published in rule are projected based on the historical trend in reported carbon intensities. Add factors may be employed where steeper declines are expected due to the incentives inherent in the program, as well as new information regarding potential changes in the mix of feedstocks and the composition of facilities that supply biofuels to Oregon. Currently, thirteen quarters of data are available for ethanol and biodiesel, while six quarters are available for renewable diesel. As more data become available, more advanced econometric techniques (including dynamic modeling) may be employed to provide more accurate projections. The following charts show the expected declines in all three series:




Biodiesel Carbon Intensity
50.0
48.0
46.0
44.0
42.0
40.0
38.0
36.0
34.0
32.0
30.0
10/1/2016
1/1/2017
4/1/2017
7/1/2017
10/1/2017
1/1/2018
4/1/2018
7/1/2018
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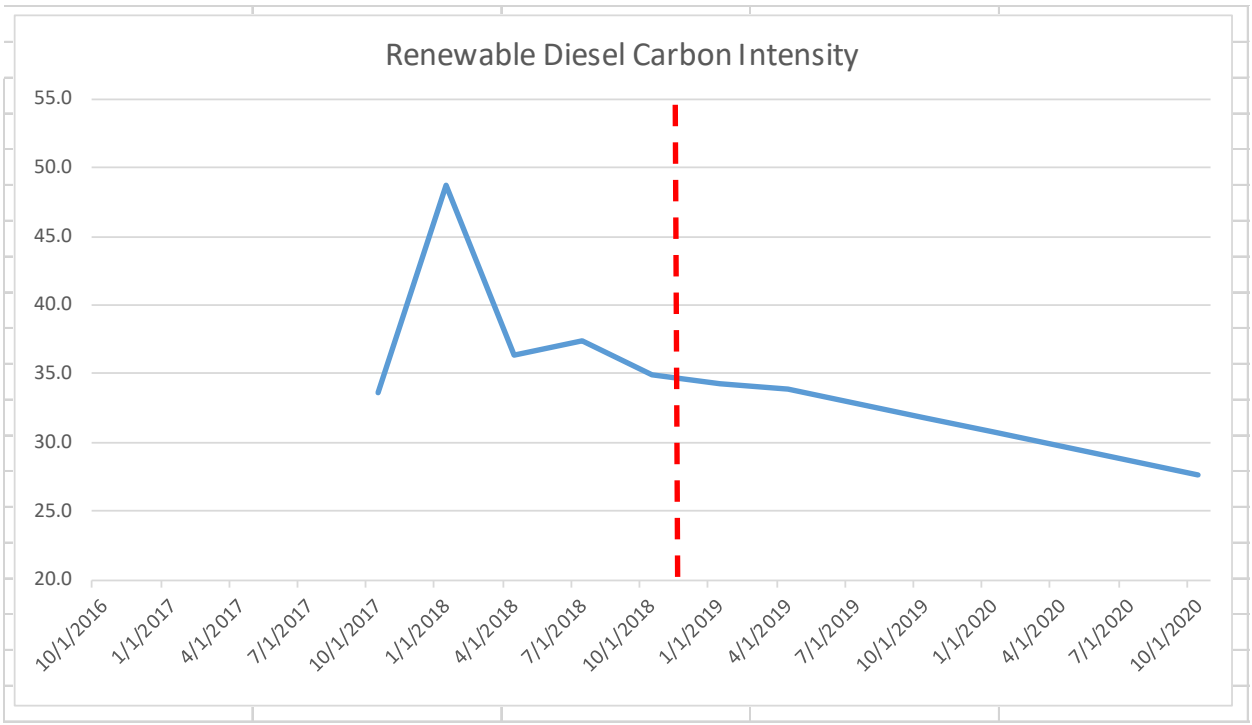
7/1/2019
10/1/2019
1/1/2020
4/1/2020
7/1/2020
10/1/2020


Renewable Diesel Carbon Intensity
55.0
50.0
45.0
40.0
35.0
30.0
25.0
20.0
10/1/2016
1/1/2017
4/1/2017
7/1/2017
10/1/2017
1/1/2018
4/1/2018
7/1/2018
10/1/2018
1/1/2019
4/1/2019
7/1/2019
10/1/2019
1/1/2020
4/1/2020
7/1/2020
10/1/2020

Appendix C

The following are the formulas resulting in the deficits and credits presented in Table 4.

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

$Credit_C = K_C * EER_E * ED_E * (CIT_G - (CIA_C/EER_E)/1{,}000{,}000$

Natural Gas

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

Propane

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