Clean Fuels Forecast Methodology – 2020 Forecast

This document outlines the methodology used to construct the Clean Fuels forecast for the 2020 administration year. 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 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 (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. The forecast is to be published no later than 90 days prior to the onset of the compliance period.

The document adheres to the following outline:

A. Data Sources
B. Consumption forecasts
    a. Gasoline and diesel
    b. Alternative fuels
C. Supply forecasts
D. Estimation of Deficits and Credits
    a. Fossil Fuels
    b. Alternative Fuels

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[2]
- Fuel Pathway Codes (carbon intensity values) approved in Oregon and California
- Oregon Department of Transportation's (ODOT) Revenue Model
- Oregon DMV vehicle registration data
- US Energy Information Administration, including the Annual Energy Outlook and biofuel facility data.
- The US Environmental Protection Agency
- Trade associations (Renewable Fuels Association and the National Biodiesel Board) on their members' production capacity

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

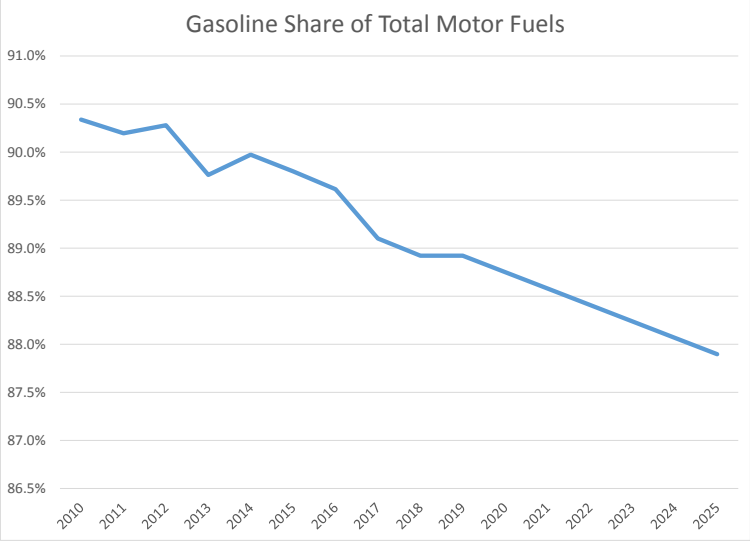
[2] https://www.oregon.gov/deq/aq/programs/Pages/Clean-Fuels-Data.aspx

B. Consumption forecasts

Gasoline and diesel

Per the methodology developed by ICF, gasoline consumption for the compliance period is based on growth factors applied to the most recent actual year of gasoline consumption available in the Clean Fuels Program database. For the 2020 forecast, the base year was 2018. Growth factors for the two year period between the actual observation and the forecast for the compliance period begin with the taxable gasoline forecast from the ODOT revenue model. Add factors are applied for a variety of factors, including tracking for actual gasoline consumption since the ODOT forecast was released and behavioral factors owing to incentives inherent in the Clean Fuels standards. Specifically, declines in the target carbon intensities for gasoline and diesel could cause suppliers to report volumes of fuel in the earliest available year to minimize deficits or maximize credits. To produce a pure gasoline (CBOB) estimate, ethanol is backed out.

ODOT reports motor gasoline and diesel subject to the gas tax separately, but projects total motor fuel growth, including both gasoline and diesel, only. In order to derive growth estimates for gasoline and diesel separately, the historical share of motor fuels comprised of gasoline is trended out to split the motor fuels forecast into its component parts. The following chart presents this split:



Similar to gasoline, diesel consumption for the compliance period is based on growth factors applied to the most recent actual per the CFP database, in the case of the 2020 forecast this being calendar year 2018.. The growth factors are again derived from ODOT's December revenue forecast as described above. Again, add-factors for interim diesel consumption and behavioral factors are incorporated into the final forecast. In order to produce a pure fossil-based diesel consumption estimate, bio- and renewable diesel are backed out.

Ethanol

As with fossil fuels, the base-year consumption for ethanol comes from CFP data. A blend rate is estimated based on historical averages and trends, as well as on data from California's Low Carbon Fuel Program, and applied to the total gasoline consumption value.

Biodiesel and renewable diesel

Both diesel biofuel forecasts are derived from blend rate assumptions based on historical CFP data, as well as observed rates from California's more tenured Low Carbon Fuel Program. Add factors are applied, in particular to account for behavioral shifts associated with the incentives inherent in the Clean Fuels Program standards.

On-road electricity

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 compliance period. Historical volumes of electricity, including estimates for residential charging, are used to calculate average Kilowatt hours per vehicle year.

Natural Gas and Propane

Consumption of natural gas and propane are based on data reported to the Clean Fuels Program, as well as DMV registration data for such vehicles. In addition, national data on mileage of such vehicles and fuel economy are employed to estimate and project utilization of natural gas and propane for on-road transportation

C. Fuel Supply estimation

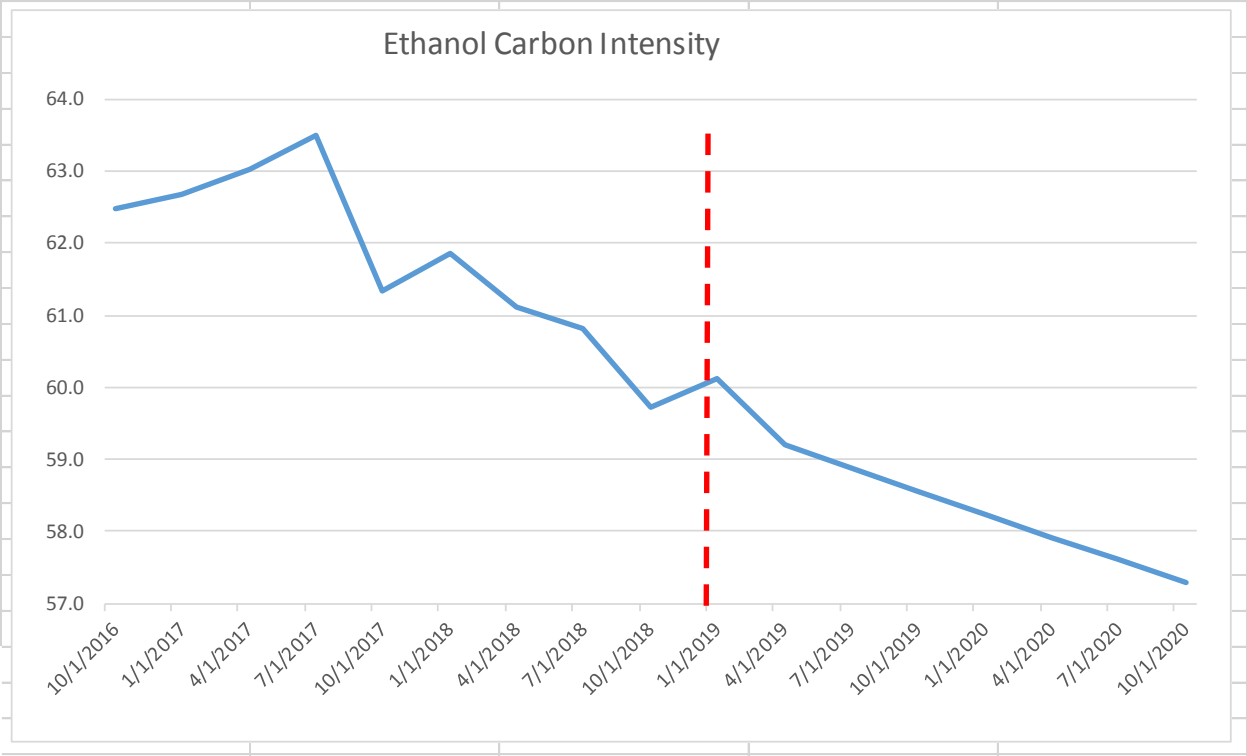
Oregon Revised Statutes (2017) Chapter 750, Section 163[3] directs the Office of Economic Analysis to estimate the "potential volumes of gasoline, gasoline substitutes and gasoline alternatives and diesel, diesel fuel substitutes and diesel alternatives available to Oregon." In order to make such estimates, 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. 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. 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.

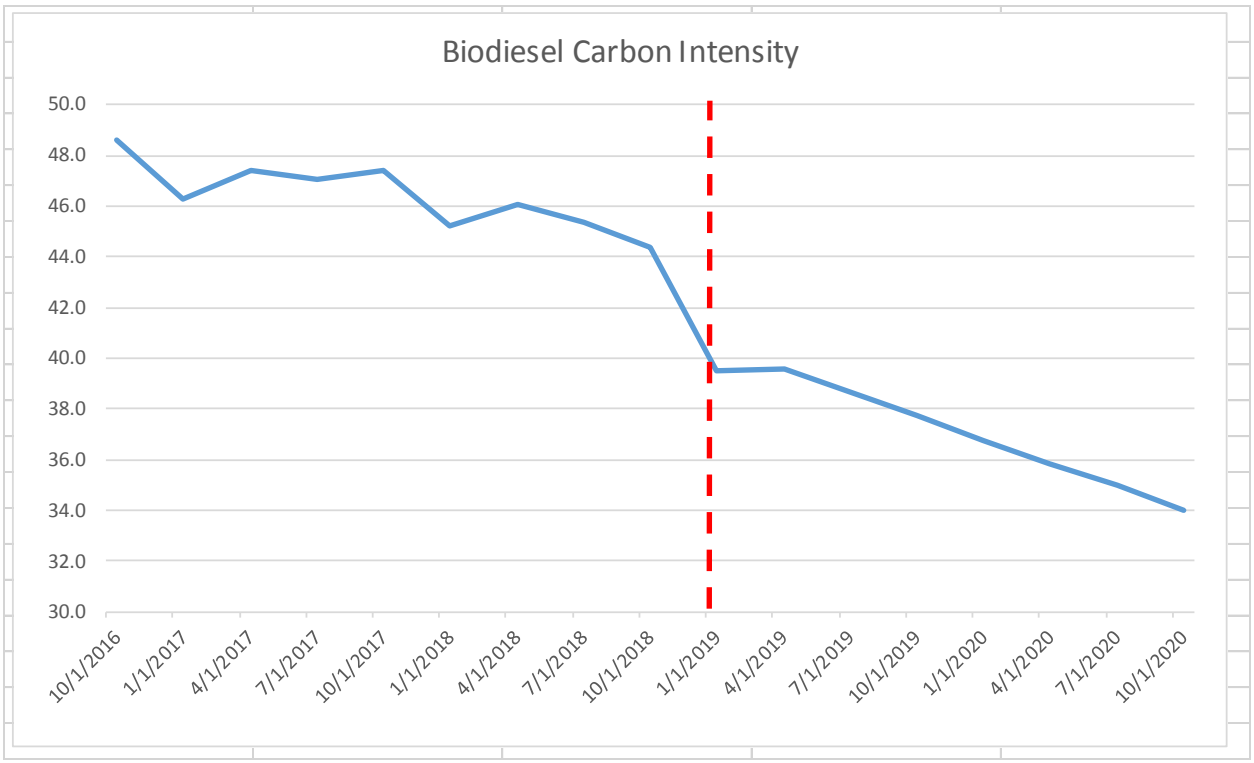
[3] https://olis.leg.state.or.us/liz/2017R1/Downloads/MeasureDocument/HB2017/Enrolled

D. Deficit and Credit calculations

Deficit and Credit forecasts are generally derived using energy densities published by the Department of Environmental Quality, as well as estimated and target carbon intensities published here (see Tables 1, 2, and 4 starting on page 209). The most recent versions of these tables are available here.

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
10/1/2018
1/1/2019
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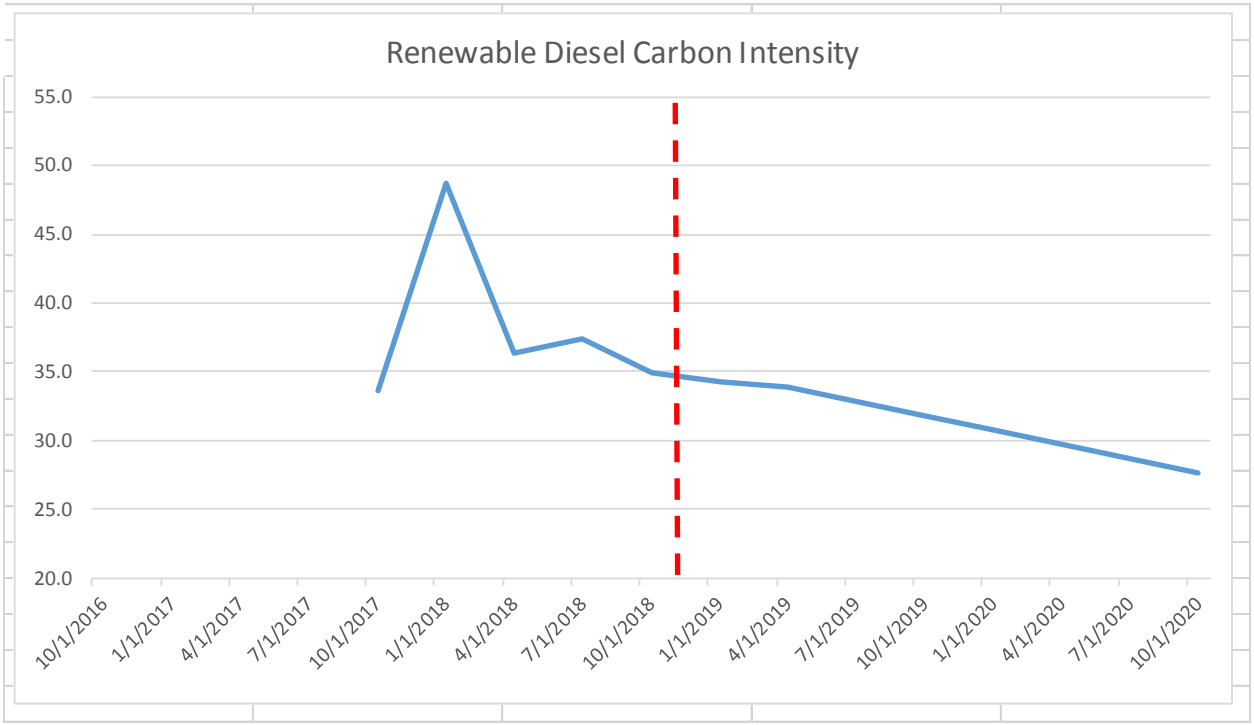
7/1/2019
10/1/2019
1/1/2020
4/1/2020
7/1/2020
10/1/2020


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

The following are the formulas resulting in the deficits and credits presented in Table 4 of the Clean Fuels Forecast 2020 that can be found on this page:
https://www.oregon.gov/das/OEA/Pages/forecastcleanfuels.aspx

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

Table 1: Definition of Symbols

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

The following table presents key parameter values factored into the 2020 forecast for deficits and credits owing to fossil and alternative fuel consumption.

Table 2: Parameter Values for 2020 Forecast

	Energy Density	Carbon Intensity Target	Carbon Intensity Assumption
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