Oregon Department of Environmental Quality

OR-GREET 4.0 updates

Memo for CFP 2024 Rulemaking Workshop

Contact: Bill Peters CFP.2024@deq.oregon.gov

This document lays out the differences between the Oregon GREET 4.0 calculator and that of the California GREET 4.0 calculator as released for public comment by the California Air Resources Board in December 2023. Documentation on the changes made by California for CA-GREET from the Argonne National Laboratories GREET model can be found on their website: https://ww2.arb.ca.gov/resources/documents/lcfs-life-cycle-analysis-public-comment

The values and models being published are draft and subject to change as we continue to work on them and receive feedback throughout this rulemaking. **Please submit comments and feedback to CFP.2024@deq.oregon.gov by July 31st, 2024.**

In order to maintain a harmonized approach to assessing the carbon intensity of these fuels so that we can maintain the ability to recertify California pathways, the changes between the two models and calculators are limited to changes in the fuels as they are in Oregon (eg, the CBOB gasoline specification versus California's CARBOB) and those needed to accurately model the fuels that Oregon receives (eg, updating the crude slate for fossil liquid fuels). California is still in their rulemaking process and may make further updates to CA-GREET, which DEQ plans to review and possibly incorporate into OR-GREET prior to requesting adoption of this rulemaking by the Environmental Quality Commission.

Main OR-GREET Model Changes

Updating the Crude Slate for Oregon

DEQ has updated the carbon intensity value for upstream oil and gas production using the updated OPGEE model. The values have been adjusted from those published by California to account for the transportation distances between California refineries and Washington's refineries to Oregon's market. Given the lack of information on the crude slate from the other refineries that supply Oregon, and the fact that more than 90% of the fossil gasoline and diesel Oregon uses is from Washington, DEQ is continuing to use Washington's crude slate for this analysis as we did for OR-GREET 3.0.

The overall effect of the update is a roughly 2 gram drop in the emissions associated with crude oil. That drop is largely from better data and various model improvements in OPGEE that increased the CI of some crude oil fields and decreased others. The net effect for the Washington Crude slate is a 1.9 gram drop, largely from the lower Alaska North Slope carbon intensity value. That value dropped due to improvements in OPGEE's[1] modeling the energy and emissions associated with natural gas reinjection in that oil field which corrected overestimates in the prior version of the model.

Crude oil source	kbbls/yr	Previous CI from 2018 Rulemaking (gCO2e/MJ)	Updated CI for OR-GREET 4	Change
Alaska	73,365	15.91	9.15	-6.76

[1] A detailed methodology for the updated OPGEE model can be found here: https://ww2.arb.ca.gov/sites/default/files/classic/fuels/lcfs/crude-oil/opgee_v3.0b_methodology.pdf

Conventional Canadian	46,136	8.40	10.65	2.25
Oil Sands Canadian	22,411	23.88	23.12	-0.76
Bakken	51,465	9.73	9.84	0.11
Argentina	2,696	9.72	11.89	2.18
Brazil	1,062	5.87	7.98	2.10
Ecuador	745	9.19	12.57	3.38
Russia	162	11.36	16.04	4.68
Saudi Arabia	3,508	9.24	11.78	2.54
Unknown – excluded from average	4,857.5			
Volume-weighted Average used in OR-GREET		13.22	11.32	-1.90

Fuel Distribution for Gasoline and Diesel

Fuel transportation modes and distances for Gasoline and Diesel were updated from CA-GREET based on reported data to CFP. Based on 2021 data, 80% of the fuel imported into Oregon's bulk system was via pipeline, and 20% was by barge, with some negligible additional volume via rail. Distances were updated using the distance by land and sea from Anacortes, Washington to Linnton, Oregon. Those locations were chosen as representative for a midpoint of Washington's refineries and where the majority of where Oregon's terminal capacity is.

Oregon Grid Mix

As with previous OR-GREET models, DEQ has used data reported to the Greenhouse Gas Reporting Program to develop and add an Oregon grid mix to GREET. The resulting emissions factor for the 2021 Oregon Grid mix is 392.77 g/kWh, with the grid mix as published below added to the main OR-GREET model. In line with the Clean Fuels Program's existing practice and guidance, electricity from unspecified market sources is allocated to natural gas.

Fuel Type	**MWh**	**%**
Coal	8,000,171	14.25%
Biogas	88,964	0.16%
Distillate Fuel Oil No. 2	3,069	0.01%
Geothermal	41,960	0.07%

Hydroelectric	17,054,425	30.38%
Natural Gas	10,735,431	19.12%
Unspecified sources of electricity	11,704,049	20.85%
Solar	1,405,674	2.50%
Wind	5,075,779	9.04%
Biomass	301,940	0.54%
Nuclear	1,732,665	3.09%
Total	56,144,125	

Changes to Tier 1 and Tier 2 classification for Hydrogen

DEQ is proposing to adopt a new simplified calculator for Hydrogen in this rulemaking, which will make it a Tier 1 fuel for hydrogen production processes covered by that calculator. As we have with other fuels in the past, that will mean removing the lookup table values for hydrogen and adding temporary fuel pathway codes, which are proposed later in this memo.

Simplified Calculators

Generally, changes to the simplified calculators have been limited to those that are clearly different for the fuel coming to Oregon, including:

- Differences in indirect land-use change (ILUC)
- Differences in fuel distribution emissions
- Updating the compression emissions factor for RNG
- Updates to fuel CIs or energy densities from CARBOB to CBOB, and the updated fuel CI for ULSD
- Use of Oregon electricity mix as an option
- Adding the EMFACT N2O emissions to the biodiesel and HEFA renewable diesel calculators

The simplified calculators are based on those California published in December[2], and DEQ plans to review and likely incorporate fixes and updates to those calculators prior to public notice and after the public comment period closes for this rulemaking. Otherwise the calculators are remaining the same to preserve the harmonization between the CA-GREET and OR-GREET models, which allows for the streamlined recertification and verification process for fuel producers. As discussed during the last RAC meeting, the updated Nitrous Oxide (N2O) tailpipe emission factor for diesel engines is being included for fossil diesel, biodiesel, and renewable diesel, as the in-use testing incorporated into EMFACT was not specific to given diesel fuels or blends.

Updates to the CI standards

As with prior updates to OR-GREET, DEQ has updated the baseline carbon intensity values it uses to set the CI standards. We are not updating the percentage targets with this rulemaking, simply applying the new CI values against the existing percentages to recalculate the CI standards for 2026 through 2035. DEQ is

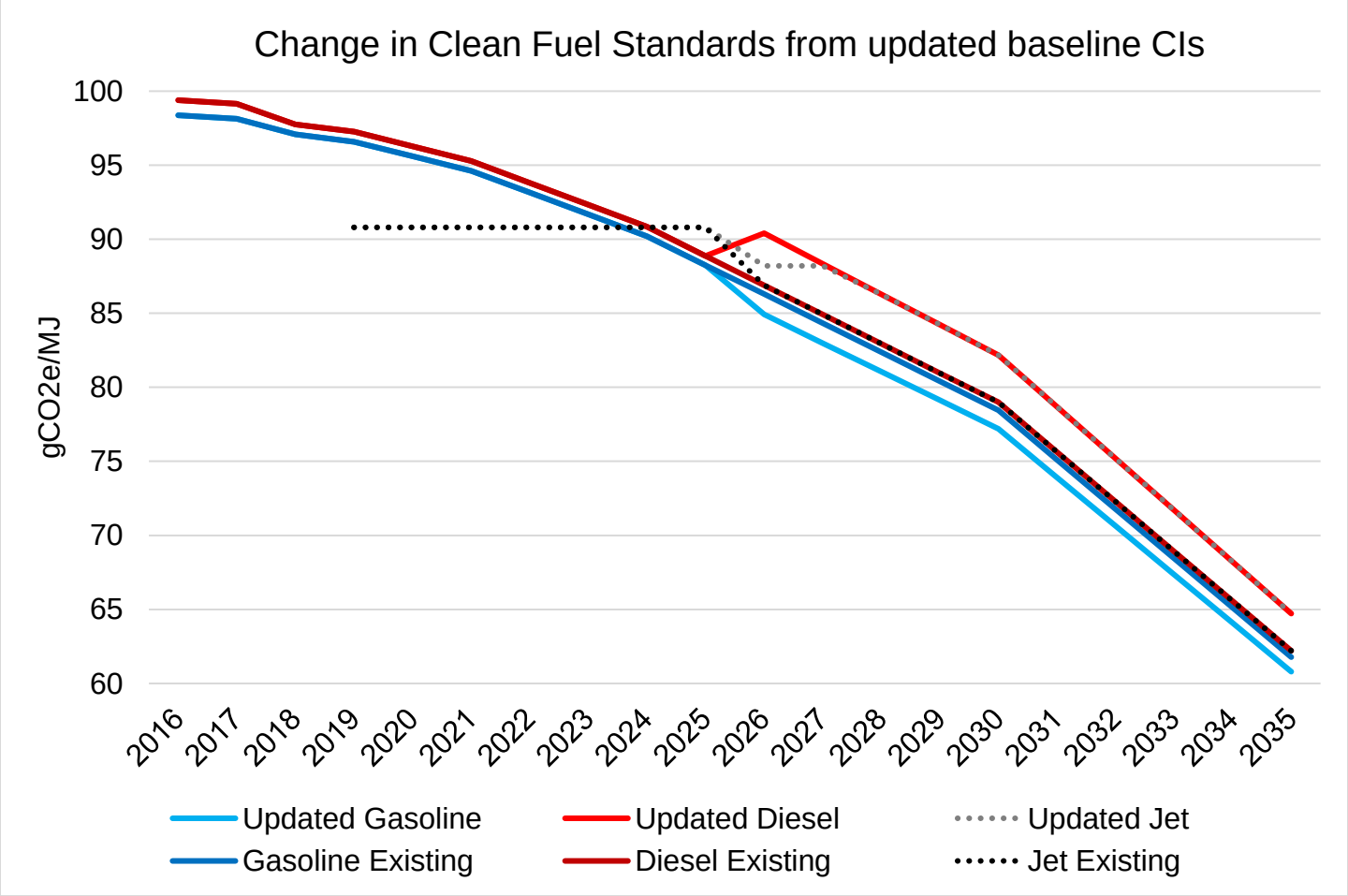
[2] https://ww2.arb.ca.gov/resources/documents/lcfs-life-cycle-analysis-public-comment

proposing that the updated standards and lookup table values for fossil fuels will all take effect in 2026 so that they can take effect at the same time as the agency rolls over existing producer-specific CI values to the recalculated OR-GREET 4.0 values.

This table presents the updated baseline CIs for the Gasoline, Diesel, and Alternative Jet Fuel standards:

Baseline description	Updated baseline CI (gCO2e/MJ)	Current baseline CI
Gasoline standard – based on the CI of E10 gasoline using Conventional Blendstock for Oxygenate blending (98.12 gCO2e/MJ) and 2015 Midwest corn ethanol (69.89 gCO2e/MJ)	96.50	98.06
Diesel standard – based on the CI of B5 diesel using Ultra-Low Sulfur Diesel (104.92gCO2e/MJ) and 2015 Midwest soybean biodiesel (58.28gCO2e/MJ)	102.73	98.74
Alternative Jet Fuel Standard – based on the CI of fossil jet fuel (88.21 gCO2e/MJ)	88.21	90.97

The Gasoline standard is used for fuels that replace or are used predominantly as a substitute for gasoline, the Diesel standard is used for fuels that replace or are used predominantly as a substitute for diesel, and the Alternative Jet Fuel standard is used for Alternative Jet Fuel. The Alternative Jet Fuel Standard is set at the CI of fossil jet fuel until the diesel standard is lower than that CI, and it is then set the same as the Diesel standard.



And this table contains the values for the updated standards, with the new values shaded in green and the pre-2025 values included for reference:

	Gasoline	Diesel	Alternative Jet Fuel
2016	98.37	99.39	
2017	98.13	99.14	
2018	97.08	97.76	
2019	96.59	97.26	90.8
2020	95.61	96.27	90.8
2021	94.63	95.29	90.8
2022	93.15	93.81	90.8
2023	91.68	92.32	90.8
2024	90.21	90.84	90.8
2025	88.25	88.87	90.80
2026	84.92	90.40	88.21
2027	82.99	88.34	88.21
2028	81.06	86.29	86.29
2029	79.13	84.24	84.24
2030	77.20	82.18	82.18
2031	73.92	78.69	78.69
2032	70.64	75.20	75.20
2033	67.36	71.70	71.70
2034	64.08	68.21	68.21
2035+	60.80	64.72	64.72

Updates to Lookup Table values

In line with the updates to the GREET model, the following values will be updated in the Lookup table:

Fuel Name	FPC	Description	OR-GREET4 Draft CI (gCO2e/MJ)	Existing CI
Gasoline	ORGAS001	Conventional gasoline - based on a weighted average of gasoline supplied to Oregon	98.12	100.14
E10 Gasoline	ORGAS002	Blended Gasoline (E10) - 90% conventional gasoline and 10% corn ethanol based on Midwest average. For use in reporting imports where the specific ethanol in the blend is not known by the importer and for subsequent transactions of that same fuel.	96.50	98.06
Diesel	ORULSD001	Ultra-low sulfur diesel, based on a weighted average of diesel fuel supplied to Oregon	104.92	101.74
B5 Diesel	ORULSD002	Blended ULSD (B5) - based on 95% ULSD and 5% soybean biodiesel. For use in reporting imports where the specific biodiesel in the blend is not known by the importer and for subsequent transactions of the same fuel.	102.73	98.74
B20 Diesel	ORULSD003	Blended ULSD (B20) - based on 80% clear ULSD and 20% soybean biodiesel. For use in reporting imports where the specific biodiesel in the blend is not known by the importer and for subsequent transactions of the same fuel.	96.06	92.68
Compressed Natural Gas	ORCNG001	North American Natural Gas delivered via pipeline; compressed in Oregon	81.89	79.98
Liquified Petroleum Gases (Propane)	ORLPG001	Fossil liquefied petroleum gas	81.69	80.88

Because the fossil LNG pathway is practically unused, DEQ is proposing to create a temporary fuel pathway code for it and allow for anyone planning to import it to apply for Tier 1 pathway.

Updates to Substitute Fuel Pathways Codes Table

The following updates to the Substitute Fuel Pathway Code table are also needed because of the updated CIs for fossil Gasoline and Diesel:

Fuel Name	FPC	Description	OR-GREET4 Draft CI (gCO2e/MJ)	Existing CI
E10 Gasoline	ORGAS0116	Substitute CI for E10 Gasoline. This pathway may only be used to report transactions that are sales or purchases without obligation, exports, loss of inventory, not for transportation use, and exempt fuel use.	94.12	96.00
B5 Diesel	ORULSD01165	Substitute CI for B5 Diesel. This pathway may only be used to report transactions that are sales or purchases without obligation, exports, loss of inventory, not for transportation use, and exempt fuel use.	101.64	96.71
B20 Diesel	ORULSD011620	Substitute CI for B20 Diesel. This pathway may only be used to report transactions that are sales or purchases without obligation, exports, loss of inventory, not for transportation use, and exempt fuel use.	87.84	84.45

Updates to the Temporary Fuel Pathway Codes Table

DEQ is proposing to make the following changes and additions to the Temporary Fuel Pathway Code table with the following proposed descriptions and values:

Fuel	Feedstock	Process and Process Energy	Proposed CI (gCO2e/MJ)	Existing CI
Hydrogen (compressed or liquified)	Natural gas and biomethane other than biomethane derived from dairy and swine manure	Steam methane reformation using grid electricity/solar and wind electricity, and natural gas with gaseous hydrogen transport distance of less than 500 miles or liquid hydrogen transport distance of less than 2,000 miles	195	N/A
Hydrogen (compressed or liquified)	Biomethane from dairy and swine manure	Steam methane reformation using grid electricity/solar and wind electricity and biomethane with gaseous hydrogen transport distance of less than 500 miles or liquid hydrogen transport distance of less than 2,000 miles	40	N/A
Hydrogen (compressed or liquified)	Biomethane other than from dairy and swine manure	Steam methane reformation using grid electricity/solar and wind electricity and biomethane with	175	N/A

		gaseous hydrogen transport distance of less than 500 miles or liquid hydrogen transport distance of less than 2,000 miles		
Hydrogen (compressed or liquified)	Electrolysis of water using zero or negative CI electricity	Electrolysis with gaseous hydrogen transport distance of less than 500 miles or liquid hydrogen transport distance of less than 2,000 miles	55	N/A
Liquified Natural Gas (LNG)	Liquefaction of fossil natural gas	Grid electricity and natural gas	95	N/A
Liquified to Compressed Natural Gas (L-CNG)	Liquefaction of fossil natural gas that is then decompressed to Compressed Natural Gas	Grid electricity and natural gas	100	N/A
Alternative Jet Fuel	Fats/Oils/Grease residues	Grid electricity, natural gas, and/or renewables	55	50
Alternative Jet Fuel	Feedstock derived from plant oils (excluding palm oil and palm derivatives, as the sole feedstock or blended with any other feedstock)	Grid electricity, natural gas, and/or renewables	75	70
Alternative Jet Fuel	Distiller's Corn Oil	Grid electricity, natural gas, and/or renewables	65	N/A
Alternative Jet Fuel	Any Other Feedstock	Grid electricity, natural gas, and/or renewables	Until 2027, the updated value for ULSD, in and after 2027, the updated Alternative Jet Fuel Baseline CI value	Current value for ULSD
Renewable Naphtha and Renewable Gasoline Blendstock	Fats/Oils/Grease residues	Grid electricity, natural gas, and/or renewables	50	45
Renewable Naphtha and Renewable	Feedstock derived from plant oils (excluding palm oil	Grid electricity, natural gas, and/or renewables	70	65

Gasoline Blendstock	and palm derivatives, as the sole feedstock or blended with any other feedstock)			
Renewable Naphtha and Renewable Gasoline Blendstock	Distiller's Corn Oil	Grid electricity, natural gas, and/or renewables	60	N/A
Renewable Naphtha and Renewable Gasoline Blendstock	Any Other Feedstock	Grid electricity, natural gas, and/or renewables	Updated value for CBOB	Current value for CBOB
Biomethane CNG	Landfill Gas or Municipal Wastewater Sludge	Grid electricity/solar and wind electricity, natural gas, and/or parasitic load	65	70
Biomethane LNG	Landfill Gas or Municipal Wastewater Sludge	Grid electricity/solar and wind electricity, natural gas, and/or parasitic load	80	85
Biomethane L-CNG	Landfill Gas or Municipal Wastewater Sludge	Grid electricity/solar and wind electricity, natural gas, and/or parasitic load	85	90

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