Washington Department of Commerce
Clean Fuel Forecast
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BRG | ENERGY & CLIMATE

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Table of Abbreviations

Acronym	Expansion
AEO	Annual Energy Outlook
CFS	Clean Fuel Standard
CI	Carbon Intensity
DGE	Diesel Gallons Equivalent
DOE	US Department of Energy
EER	Energy Economy Ratio
EIA	US Energy Information Administration
GGE	Gallons of Gasoline Equivalent
GHG	Greenhouse Gas
HRI	Hydrogen Refueling Infrastructure
RFS	Renewable Fuel Standard
RIN	Renewable Identification Numbers
RVO	Renewable Volume Obligation

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1. Introduction/Background

In July 2021, the Washington Legislature adopted the Clean Fuel Standard ("CFS"), implemented by the Transportation Fuel-Clean Fuels Program (E3SHB 1091) in order to reduce carbon pollution from the transportation sector and help achieve the state's greenhouse gas ("GHG") emissions goals. The CFS requires a fuel supply forecast for the first compliance period, running from January 1, 2023 until December 31, 2024, to be finalized by the Washington State Department of Commerce ("Commerce") by October 1, 2022.

The fuel supply forecast must comply with the following statutory requirements:

(a) An estimate of the potential volumes of gasoline, gasoline substitutes, and gasoline alternatives, and diesel, diesel substitutes, and diesel alternatives available to Washington. In developing this estimate, Commerce must consider, but is not limited to considering:
  i. The existing and future vehicle fleet in Washington; and
  ii. Any constraints that might be preventing access to available and cost-effective low carbon fuels by Washington, such as geographic and logistical factors, and alleviating factors to the constraints;
(b) An estimate of the total banked credits and carried over deficits held by regulated parties, credit generators, and credit aggregators at the beginning of the compliance period, and an estimate of the total credits attributable to fuels described in (a) of this subsection;
(c) An estimate of the number of credits needed to meet the applicable clean fuels program requirements during the forecasted compliance period; and
(d) A comparison in the estimates of (a) and (b) of this subsection with the estimate in (c) of this subsection, for the purpose of indicating the availability of fuels and banked credits needed for compliance with the requirements of this chapter.

Furthermore, the fuel supply forecast must be developed in consultation with the Washington State Department of Ecology, the Utilities and Transportation Commission, and the Department of Agriculture, and reviewed by a Commerce-appointed review team.

Purpose of the Report

This report was prepared to provide the factual and technical basis for the Department of Commerce regarding the sufficiency of available credits in order to comply with the requirements during the first compliance period. The purpose of the report is to:

- Develop a forecast of potential volumes of gasoline, gasoline alternatives (primarily ethanol), diesel, diesel alternatives (primarily biodiesel and renewable diesel), electricity, and other gaseous fuels (natural gas, propane, and renewable natural gas) (Section 4).
- Determine the availability of fuels to meet Washington's demand (Section 4).

- Develop a forecast of generated credits attributable to the supply of the aforementioned fuels (Section 5).
- Estimate the total banked credits and deficits at the beginning of the first compliance period (Section 5).
- Estimate the necessary number of credits to meet the CFS's requirements during the compliance period (Section 5).

This report also states key assumptions and drivers of uncertainty in the calculations and analysis and potential impacts or implications of changing assumptions on key findings.

Fuels Considered

The fuels listed in Table 1 are considered in this report as the primary vehicle fuels for Washington.

Table 1: Major Vehicle Fuels and their Feedstock

Fuel	Feedstock
Gasoline	Petroleum
Diesel	Petroleum
Natural Gas	Natural gas
Electricity	Washington grid mix
Ethanol	Corn
Biodiesel	Soybean, Canola, Fats Oils and Grease
Renewable Diesel	Soybean, Canola, Fats Oils and Grease, Milling and Logging residue
Renewable Natural Gas	Landfill Gas, Wastewater Treatment Plants, Municipal Solid Waste, Dairy Operations
Propane	Natural Gas Liquids, Petroleum

Hydrogen

While hydrogen currently has limited applications in the state as a direct transportation fuel, it is eligible for participation in the standard both for regulated and opt-in vehicles. Several pilot and demonstration programs are currently in development in the state which may lead to limited utilization of low or zero-CI hydrogen as a transportation fuel during 2023 and 2024. Additionally, infrastructure investments in the state are eligible for hydrogen refueling infrastructure ("HRI") credits.

Given the uncertainty caused by technological and consumer adoption risk in bringing material quantities of low-emitting hydrogen to market in 2023 and 2024, the fuel supply forecast for the initial compliance period does not quantitatively assess the supply and demand of hydrogen as a vehicle fuel, but the forecast does include a number of hydrogen refueling infrastructure credits which are expected to be generated as Washington builds out infrastructure to support expanded long-term hydrogen

utilization. Commerce anticipates that hydrogen will likely be included as a directly modeled transportation fuel in future forecasts.

2. Data Sources

BRG relies upon available public data to develop the estimates regarding project volumes and availability of the vehicle fuels, as well as the carbon intensity ("CI") values used in estimating the available credits necessary to comply with the CFS requirements. The sources of this data are as found in Table 2 below:

Table 2: Data Sources

Source	Description of Data Used
Federal	
U.S. Energy Information Administration ("EIA")	Annual Energy Outlook ("AEO") regional fuel consumption forecasts; State Energy Data System 1960-2020 Energy Consumption Estimates; National Fuel Production Capacities by PADD
U.S. Federal Highway Administration[1]	Washington Vehicle Miles Traveled
Government of Canada's National Gas and Oil Statistics[2]	Natural Gas Production
State and Provincial	
Washington State Legislature[3]	Washington Clean Fuels Program Legislation, for carbon intensity targets and inputs, the energy efficiency ratio, and energy density
Washington State Department of Transportation[4]	Fuel tax revenue and gallons of fuel consumption forecasts; Electric Vehicle Population Data
Washington State Department of Licensing[5]	Number of registered vehicles in Washington State by class and weight. Number of registered electric vehicles

[1] U.S. Federal Highway Administration, Highway Statistics Series, Table VM-2 and VM-4, https://www.fhwa.dot.gov/policyinformation/statistics/2019/vm2.cfm, https://www.fhwa.dot.gov/policyinformation/statistics/2019/vm4.cfm

[2] British Columbia, Natural Gas and Oil Statistics, https://www2.gov.bc.ca/gov/content/industry/natural-gas-oil/statistics

[3] Washington Clean Fuels Program, https://app.leg.wa.gov/RCW/default.aspx?cite=70A.535.025, https://app.leg.wa.gov/RCW/default.aspx?cite=70A.535

[4] Washington Electric Vehicle Population Data, https://data.wa.gov/Transportation/Electric-Vehicle-Population-Data/f6w7-q2d2

[5] Vehicle Registration Transactions Data, https://data.wa.gov/Transportation/Vehicle-Registration-Transactions-by-Department-of/brw6-jymh/data; Inputs regarding fuel economy, average VMT, vehicle electric range, and electricity usage are from Washington Electric Vehicle Population Data, https://data.wa.gov/Transportation/Electric-Vehicle-Population-Data/f6w7-q2d2

Washington Office of Financial Management[6]	2022 Transportation Revenue Forecast, containing Forecasts for Motor Fuel Consumption and Vehicle Stock Mix
California Air Resources Board[7]	Carbon intensity assumptions and targets, and alternative fuel volumes and blend rates
Oregon Department of Environmental Quality[8]	Carbon intensity assumptions and targets, and alternative fuel volumes and blend rates
Government of Alberta, Canada's Economic Dashboard[9]	Natural Gas Production
Other	
Energy Vision (partnered with Argonne National Laboratory)[10]	Operating Renewable Natural Gas Projects Production Capacities

[6] June 2022 Transportation Revenue Forecasts, https://ofm.wa.gov/budget/budget-related-information/transportation-revenue-information;
[7] BRG's analysis on blend rates relies upon California blend rates from https://ww2.arb.ca.gov/resources/documents/lcfs-data-dashboard
[8] BRG's analysis on blend rates relies upon Oregon blend rates from https://www.oregon.gov/deq/ghgp/cfp/Pages/Fuel-Supply-Forecast.aspx
[9] Alberta, Economic Dashboard, https://economicdashboard.alberta.ca/NaturalGasProduction
[10] Energy Vision RNG Project Database, https://energy-vision.org/rng-project-database/

3. Methodology and Assumptions/Constraints

BRG employs several methodologies to forecast Washington's future demand as described below. To ensure the accuracy of the forecast, each fuel requires a different approach, accounting for a variety of assumptions.

Gasoline & Diesel

BRG uses the State of Washington's consumption forecasts for blended gasoline and diesel as a basis for its forecast. BRG estimates the blend rates of alternative fuels based upon historical trends in Washington and other markets. BRG then subtracts the volumes of alternative fuels from Washington's gasoline and diesel forecasts to determine the volume of clear gasoline and diesel demand in the state.[11]

Ethanol, Biodiesel, and Renewable Diesel

BRG estimates the blend rate of each alternative fuel based upon analysis of Washington historical blending rates, incremental ability to blend in response to the CFS, historical increases in blending due to CFS policy enactment in Oregon and California, Washington's ability to access fuels, and technical blending limits. Using these blend rates, along with the State's consumption forecasts for gasoline and diesel BRG projects Washington's consumption of these fuels.

Natural Gas, Renewable Natural Gas, and Propane

BRG utilizes State of Washington data on the number of CNG vehicles registered and the average annual consumption per vehicle for its forecast. Renewable natural gas consumption is assumed to follow the same trends observed in Oregon following the implementation of the Oregon CFS. To forecast propane consumption, BRG relies upon Washington's average allocation of propane consumption calculated using data from the U.S. EIA AEO Pacific Consumption Forecast.

Electricity

Using data on Battery-Electric Vehicles ("BEV") and Plug-in Hybrid Electric Vehicles ("PHEV") registrations in Washington as well as vehicle performance data from the U.S. Department of Energy ("DOE"), BRG calculates the average electricity use per vehicle on an annual basis. BRG then applies this average to the state's projected stock of BEVs and PHEVs to forecast future electricity use by these vehicles.

[11] Clear gasoline and clear diesel refer to gasoline and diesel, respectively, derived from fossil rather than biological sources.

Major Policy Assumptions Relied Upon

BRG recognizes that during the period of this analysis there are active CFS programs in place in California, Oregon, British Columbia, and federally in Canada which will influence both the demand for alternative fuels and help underpin investment in technology and supply to bring more fuels to market.

Demand for these alternative fuels due to competition from neighboring states impacts the expected average CIs available for Washington as well as projected blending rates for alternative fuels in the fuel demand forecasts. These policies do not directly impact the amount of these fuels shown to be economically deliverable into the state in Section 4, but will affect the price that these fuels will receive in the marketplace.

These program's targets are in Table 3 below:

Table 3: Regional/State CFS Program CI Targets

Region/State	2024 CI % Reduction (per unit of fuel)
California's Low Carbon Fuel Standard Program	-12.5% (based on 2010 levels)[12]
Oregon's Clean Fuels Program	-8.0% (based on 2015 levels)[13]
British Columbia's Clean Fuel Standard Program	-13.5% (based on 2010 levels)[14]
Canada's Federal Clean Fuel Standard Program	-9% (based on 2016 levels)[15]

Additionally, BRG recognizes that the US Federal Renewable Fuel Standard ("RFS") will be in place for the duration of the forecasted period.[16] The RFS requires a specific volume of renewable fuel to replace or reduce the amount of petroleum-based transportation fuel. Under the RFS, refiners or importers of gasoline or diesel fuel are required to meet an annual Renewable Volume Obligation ("RVO") by blending renewable fuels into transportation fuel, generating credits ("Renewable Identification Numbers, or RINS"), or by purchasing excess credits from fuel blending entities. While targets during the initial CFS compliance period are still uncertain as of the time of this report, the policy has historically and can be expected to continue to support the availability of renewable fuels derived from biomass-based sources during the initial compliance period in Washington and nationally.

[12] https://ww2.arb.ca.gov/resources/documents/lcfs-data-dashboard
[13] https://www.oregon.gov/deq/ghgp/Documents/CFP-ProgramReview.pdf
[14] https://www2.gov.bc.ca/gov/content/industry/electricity-alternative-energy/transportation-energies/renewable-low-carbon-fuels/requirements#:~:text=The%20regulation%20will%20require%20fuel,1.09%25%20annually%20starting%20in%202020.
[15] https://www.canada.ca/en/environment-climate-change/services/managing-pollution/energy-production/fuel-regulations/clean-fuel-regulations/about.html
[16] https://www.epa.gov/renewable-fuel-standard-program

Finally, BRG acknowledges the passage of the US Federal Inflation Reduction Act, which will have several implications for the availability of clean fuels to support the standard. The legislation's impacts on the CFS will likely be more substantial in later compliance years than in the initial compliance period, when infrastructure investment decisions and technological advancements spurred by the legislation will likely increase available quantities of alternative fuels, increase the stock of electric and other alternative fuel vehicles, and improve the CI of a variety of fuels in the state. Nevertheless, the legislation will have several implications for the cost and compliance pathways of the CFS during the initial compliance period, including reducing the cost of biodiesel and renewable diesel through an extension of the Blender's Tax Credit and reducing the cost of Washington consumers adopting electric vehicles.

Constraints and Limitations

BRG's analysis recognizes several constraints that inhibit the extent to which we could forecast certain fuel volumes. These constraints are described in Table 4 below:

Table 4: Forecasted Constraints

Constraint	Description
Renewable Fuel Feedstock	Many of the lowest-CI fuels currently produced in other markets with CFS policies have limited feedstock availability. These include biodiesel and renewable diesel derived from waste fats, oils, and greases and renewable natural gas derived from dairy digesters. This feedstock availability will lead to some necessary switching to higher CI feedstocks, like vegetable oils for biodiesel and renewable diesel and landfill gas for RNG.
Competition of fuel demand	Washington is not the only consumer of the fuel volumes commercially available to it in this forecast. This report recognizes that Washington will have to compete with other state and regional provincial demand for the limited renewable fuels required to meet the CFS. The analysis does not forecast fuel availability based on other state or region's demands, but on the production capabilities and capacities of the region and greater U.S., with assumptions of sources differing depending on the fuel. Nevertheless, competition with other CFS programs will increase costs for alternative fuels relative to if Washington was the only jurisdiction with a CFS policy.
Existing out of state contracts for renewable fuels	This analysis recognizes that some volumes of renewable fuels are produced under contract with a designated consumer for these fuels. Due to the lack of transparency regarding contract specifics on the volume of renewable fuels are contracted, this analysis assumes that if a fuel is produced, it is available to be sold on the open market, but some fuels will be initially unavailable to Washington consumers due to existing contracts. Washington's historical lack of a CFS program limits the availability of legacy fuel supply contracts and may slow the process of securing larger volumes of renewable fuels during the initial compliance period.

Infrastructure Build-Out for Electric, Natural Gas, and Hydrogen Vehicles	While the state's existing electric infrastructure is sufficient to accommodate some increase in electric vehicles, infrastructure will limit the potential for rapid adoption of electric vehicles until electric charging infrastructure is expanded. Similarly, the state currently has limited fueling infrastructure for natural gas or hydrogen vehicles, which will need to be built out for these fuels to capture significant market share during the CFS compliance period. These infrastructure limitations are considered in the growth projections for alternative fuel demand in Washington, and credits generated by infrastructure investments supporting both electricity and hydrogen vehicles are included in the forecast.
Trans-Cascades transportation	Historically, the Cascades have increased costs of shipping fuels across Washington from west to east or east to west. As a result, the state's consumers east of the Cascades have historically relied largely on liquid transportation fuels refined in Montana, Utah, and other states east of Washington, while consumers west of the Cascades have relied more on the Washington's coastal refineries. These transportation bottlenecks will likely continue to create some bifurcation in fuel availability and prices in the state but are not expected to fundamentally impact the availability to source fuels in either region.

4. Clean Fuel Standard 2023/2024 Volume Forecast

Overview and Summary of Volumes Forecast

To calculate the number of credits and deficits that would be generated in the initial compliance period, and thus number of credits necessary for compliance and the final bank balances for the forecast period, BRG has produced a fuel volume forecast for the relevant fuels covered by the CFS.

Table 5 provides a summary of the fossil and alternative fuel volumes forecasts, including the historical volumes in 2021-2022, and each fuel forecasts respective compound annual growth rates ("CAGR") and blend rates. Each of these forecasts will be discussed in greater detail below.

Table 5: Volumes Forecast Summary

Fuel Type	2021	2022	2023	2024	CAGR % vs 2021
Fossil Gasoline (MM gallons)	2,251	2,400	2,454	2,493	3%
Ethanol (MM gallons)	243	259	265	269	3%
Ethanol Blend Rate (%)	10%	10%	10%	10%	-
Total Gasoline (MM gallons)	2,494	2,659	2,719	2,762	3%
Fossil Diesel (MM gallons)	708	758	713	699	-0.4%
Biodiesel (MM gallons)	18	19	40	48	38%
Biodiesel Blend Rate (%)	3%	3%	5%	6%	-

Renewable Diesel (MM gallons)	0	0	29	44	-
Renewable Diesel Blend Rate (%)	0%	0%	4%	6%	-
Total Diesel (MM gallons)	726	777	782	791	3%
Electricity (GWh)	131	163	213	267	27%
Natural Gas (MM DGE)	0.1	0.1	0.0	0.0	-50%
Renewable Natural Gas (MM DGE)	0.0	0.0	0.1	0.1	-
Renewable Natural Gas Blend Rate (%)	0%	0%	79%	88%	-
Total Natural Gas (MM DGE)	0.1	0.1	0.1	0.1	-
Propane (MM gallons)	2.0	2.3	2.5	2.6	9%

Individual Fuels Volumes Forecasts

Gasoline and Gasoline Alternatives

BRG forecasts Washington's demand for gasoline will increase to 2,493 million gallons annually by 2024. Likewise, ethanol is expected to increase to 269 million gallons by 2024.

Table 6: Gasoline and Alternatives Volume Demand Forecast[17]

Fuel Type	2021	2022	2023	2024	CAGR %
Fossil Gasoline (MM gallons)	2,251	2,400	2,454	2,493	3%
Ethanol (MM gallons)	243	259	265	269	3%
Ethanol Blend Rate (%)	10%	10%	10%	10%	-
Blended Gasoline (MM gallons)	2,494	2,659	2,719	2,762	3%

Regarding fuel supply availability, the analysis considers 2022 gasoline and ethanol production capacity to be able to meet Washington's anticipated demand, (see Table 7 and Table 8 below).

Gasoline: Washington has the production capacity for 4,601 MM gal/year, making it the fifth-largest refining state in the United States and a net exporter of refined products like gasoline and diesel. This alone is more than enough to meet Washington's anticipated 2,493 MM gal/year gasoline demand (though for economic and logistic reasons the state does import some gasoline from its neighbors). However, supplemental supply could be imported from other U.S. regions, with total U.S. production at 127,060 MM gal/year.

[17] BRG's blended forecast relies upon Washington DOL's fuel consumption forecast for 2022, as well as a calculated blend rate based on Oregon and California and other market trends.

Table 7: Gasoline Production Capacity[18]

State	Production Capacity (MM gal/year)
West Coast (PADD 5)	18,830
Washington	4,601
California	12,391
Nevada	14
Alaska	1,163
Hawaii	662
Rocky Mountains (PADD 4)	4,696
Colorado	729
Montana	1,612
Utah	1,464
Wyoming	891
Gulf Coast (PADD 3)	68,024
Midwest (PADD 2)	29,719
East Coast (PADD 1)	5,791
US Total	**127,060**

Ethanol: Washington does not produce material quantities of ethanol and imports most of its ethanol from the Midwest, with supplemental supply available from California, Oregon, and the Rocky Mountain states.

[18] Assumes 46% of a barrel of oil used for gasoline; See https://www.eia.gov/energyexplained/oil-and-petroleum-products/refining-crude-oil-inputs-and-outputs.php. Production capacity relied upon U.S. Energy Information Administration, Number and Capacity of Petroleum Refineries, accessed as of Sept. 2, 2022. https://www.eia.gov/dnav/pet/pet_pnp_cap1_dcu_nus_a.htm

Table 8: Ethanol Production Capacity[19]

State	Production Capacity (MM gal/year)
West Coast (PADD 5)	228
California	188
Oregon	40
Rocky Mountains (PADD 4)	200
Colorado	140
Idaho	60
Gulf Coast (PADD 3)	380
Midwest (PADD 2)	16,328
East Coast (PADD 1)	247
US Total	**17,383**

Diesel and Diesel Alternatives

BRG forecasts Washington's demand for fossil diesel will increase to 699 million gallons annually by 2024. Likewise, biodiesel and renewable diesel is expected to increase to 48 MM gallons and 44 MM gallons by 2024, respectively, as seen in Table 9 below:

Table 9: Diesel and Alternatives Volume Demand Forecast[20]

Fuel Type	2021	2022	2023	2024	CAGR %
Fossil Diesel (MM gallons)	708	758	713	699	-0.4%
Biodiesel (MM gallons)	18	19	40	48	38%
Biodiesel Blend Rate (%)	3%	3%	5%	6%	
Renewable Diesel (MM gallons)	0	0	29	44	
Renewable Diesel Blend Rate (%)	0%	0%	4%	6%	
Total Diesel (MM gallons)	726	777	782	791	3%

The analysis forecasts 2022 fossil-based diesel, biodiesel, and renewable diesel production capacity as being able to meet Washington's anticipated demand (see Table 10, Table 11, and Table 12 below, respectively).

[19] U.S. Energy Information Administration, U.S. Fuel Ethanol Plant Production Capacity, accessed as of Sept. 2, 2022. https://www.eia.gov/petroleum/ethanolcapacity/

[20] BRG's total diesel forecast relies upon Washington DOL's fuel consumption forecast for 2022, as well as a calculated blend rate based on Oregon and California and other market trends.

Diesel: Washington alone produces 3,187 MM gal/year, which is plenty to meet Washington's anticipated 700 MM gal/year diesel demand. Supplemental supply could be imported from other U.S. regions, with total U.S. production at 88,025 MM gal/year.

Table 10: Diesel Production Capacity[21]

State	Production Capacity (MM gal/year)
West Coast (PADD 5)	13,045
Washington	3,187
California	8,584
Nevada	10
Alaska	805
Hawaii	459
Rocky Mountains (PADD 4)	3,253
Colorado	505
Montana	1,117
Utah	1,014
Wyoming	617
Gulf Coast (PADD 3)	47,126
Midwest (PADD 2)	20,589
East Coast (PADD 1)	4,012
US Total	**88,025**

Biodiesel: Washington currently produces 107 MM gal/year, which is sufficient to meet Washington's anticipated 48 MM gal/year bio diesel demand and continue to export to neighbors. Supplemental supply could be imported from other U.S. regions, including the West Coast, Gulf Coast, and the Midwest, with total U.S. production at 2,250 MM gal/year.

[21] Assumes 32% barrel used for distillate fuel oil (diesel); See https://www.eia.gov/energyexplained/oil-and-petroleum-products/refining-crude-oil-inputs-and-outputs.php. Production capacity relied upon U.S. Energy Information Administration, Number and Capacity of Petroleum Refineries, accessed as of Sept. 2, 2022. https://www.eia.gov/dnav/pet/pet_pnp_cap1_dcu_nus_a.htm

Table 11: Biodiesel Production Capacity[22]

State	Production Capacity (MM gal/year)
West Coast (PADD 5)	193
Washington	107
Oregon	12
California	72
Arizona	2
Rocky Mountains (PADD 4)	0
Gulf Coast (PADD 3)	455
Midwest (PADD 2)	1,445
East Coast (PADD 1)	157
US Total	**2,250**

Renewable Diesel: Washington alone produces 66 MM gal/year, which is sufficient to meet Washington's anticipated 44 MM gal/year renewable diesel demand and still export to neighbors. By 2023, Washington's sole renewable diesel producer is expected to increase its production capacity to 109 MM gal/year.[23] Supplemental supply could be imported from other U.S. regions, likely from the West Coast and the Rocky Mountains, with total U.S. production at 1,794 MM gal/year.

Table 12: Renewable Diesel Production Capacity[24]

State	Production Capacity (MM gal/year)
West Coast (PADD 5)	308
Washington	109
California	199
Rocky Mountains (PADD 4)	209
Gulf Coast (PADD 3)	1,082
Midwest (PADD 2)	195
East Coast (PADD 1)	0
US Total	**1,794**

[22] U.S. Energy Information Administration, U.S. Biodiesel Plant Production Capacity, accessed as of Sept. 2, 2022. https://www.eia.gov/biofuels/biodiesel/capacity/

[23] Cherry Point Refinery is expected to be operational by 2023. BP, BP investing almost $270 million to improve efficiency, reduce emissions and grow renewable diesel production at Cherry Point Refinery, https://www.bp.com/en/global/corporate/news-and-insights/press-releases/bp-investing-almost-270m-to-improve-efficiency-reduce-emissions-and-grow-renewable-diesel-production-at-cherry-point-refinery.html

[24] U.S. Energy Information Administration, U.S. Renewable Diesel Fuel and Other Biofuels Plant Production Capacity, accessed as of Sept. 2, 2022. https://www.eia.gov/biofuels/renewable/capacity/

Electricity

BRG forecasts that Washington's demand for electricity for transportation purposes will increase to 267 GWh annually by 2024, as seen in Table 13 below:

Table 13: Electricity Volume Demand Forecast[25]

Fuel Type	2021	2022	2023	2024	CAGR %
Electricity (GWh)	131	163	213	267	27%

BRG forecasts Washington's electricity generation capacity being able to meet Washington's anticipated demand in the initial compliance period (see Table 14 below).

Washington can generate 116,114 GWh of electricity, which is more than enough to meet Washington's anticipated 267 GWh of electricity demand. Supplemental supply from other WECC states provide an additional 547,725 GWh of electricity generation capacity. Electricity supply constraints on the continued growth of electric vehicles and production of credits are expected to be more closely tied to charging infrastructure and the ability to maintain low average grid CIs than the availability of electric generation.

Table 14: Electricity Production Availability to Washington[26]

State	Production Capacity (GWh)
Washington	116,114
Arizona	109,305
California	193,075
Colorado	54,115
Idaho	17,686
Nevada	40,425
Oregon	63,625
Utah	37,087
Rest of WECC	32,407
Total WECC	**663,840**

[25] BRG's electricity demand forecast relied upon Washington OFM's vehicle stock forecast, with our analysis based on inputs from Washington DOL and the US Federal Highway Administration.

[26] U.S. Energy Information Administration, Generation Tables, accessed as of Sept. 2, 2022. https://www.eia.gov/electricity/annual/html/epa_03_07.html; For the "Rest of WECC" row, we calculated the balance of WECC generation not accounted for by state in the above, https://www.eia.gov/electricity/gridmonitor/dashboard/

Natural Gas and Natural Gas Alternatives

BRG forecasts that Washington's demand for fossil natural gas for transportation purposes will decrease to less than 0.01 MM DGE by 2024. As for renewable natural gas, we forecast an increase to 0.1 MM DGE by 2024 (see Table 15 below).

Table 15: Natural Gas and Alternatives Volume Demand Forecast[27]

Fuel Type	2021	2022	2023	2024	CAGR %
Natural Gas (MM DGE)	0.1	0.1	0.0	0.0	-50%
RNG (MM DGE)	0.0	0.0	0.1	0.1	
RNG blend rate (%)	0%	0%	79%	88%	
Total Natural Gas (MM DGE)	0.1	0.1	0.1	0.1	0%

BRG forecasts that 2022 production capacity for both fossil-based natural gas and renewable natural gas will be able to meet Washington's anticipated demand (see Table 16 and Table 17 below).

Natural Gas: While Washington does not produce fossil natural gas, the Canada provinces of British Columbia and Alberta are able to produce a total of 39,783 MM DGE, with the necessary pipeline infrastructure between the provinces and Washington already in place. Supplementally, other West Coast states produce 1,227 MM DGE. Together, both sources are capable of providing plenty to meet Washington's anticipated less than 0.1 MM DGE natural gas demand.

[27] BRG's total natural gas forecast relies upon data from the Washington DOL and the US Federal Highway Administration, as well as a calculated blend rate based on Oregon and California and other market trends (see Section 0).

Table 16: Natural Gas Production Capacity[28]

State	Production Capacity (MM DGE)
West Coast (PADD 5)	1,227
Oregon	2
California	1,225
Nevada	0.1
Arizona	0.5
Rocky Mountains (PADD 4)	25,677
Colorado	14,289
Montana	273
Utah	1,737
Wyoming	9,378
Gulf Coast (PADD 3)	108,518
Midwest (PADD 2)	45,632
East Coast (PADD 1)	70,738
Alberta, CA	26,384
British Columbia, CA	13,399
US Total	**254,222**

Renewable Natural Gas: Washington alone produces 27 MM DGE of RNG from mostly landfills, livestock, and Water Treatment Facilities, which is more than enough to meet Washington's anticipated 0.1 MM DGE RNG demand and continue to export to neighboring states or use RNG for non-transportation-sector applications. Supplemental supply could be imported from other U.S. regions, with total U.S. production at 487 MM DGE.

[28] BRG analysis for Natural Gas production relies upon U.S. Energy Information Administration, Natural Gas Plant Field Production, accessed as of Sept. 2, 2022. https://www.eia.gov/state/rankings/?sid=MI#series/47. We rely upon the Government of Canada and the Government of Alberta, CA's economic natural gas production statistics, cited in Section 0.

Table 17: Renewable Natural Gas Production Capacity[29]

State	Production Capacity (MM DGE)
West Coast (PADD 5)	91
Washington	27
Oregon	12
California	37
Arizona	15
Rocky Mountains (PADD 4)	14
Idaho	4
Montana	1
Utah	8
Gulf Coast (PADD 3)	173
Midwest (PADD 2)	160
East Coast (PADD 1)	49
US Total	**487**

Propane

BRG forecasts that Washington's demand for propane for transportation purposes will decrease to 2.6 MM gal/year by 2024 (see Table 18 below).

Table 18: Propane Volumes Demand Forecast[30]

Fuel Type	2021	2022	2023	2024	CAGR %
Propane (MM gal/year)	2.0	2.3	2.5	2.6	9%

[29] BRG calculations relied upon the summation by state of the facilities' capacities listed in the Energy Vision Renewable Natural Gas Project Database, https://energy-vision.org/rng-project-database/. This represents a conservative estimate, as there are facilities listed without publicly available

[30] Using Washington's historical consumption, BRG has allocated the projected propane consumption using the U.S. EIA AEO 2022 Pacific Consumption Forecast, https://www.eia.gov/outlooks/aeo/data/browser/#/?id=2-AEO2022&region=1-9&cases=ref2022&start=2020&end=2050&f=A&linechart=ref2022-d011222a.3-2-AEO2022.1-9&map=ref2022-d011222a.4-2-AEO2022.1-9&sourcekey=0https://www.eia.gov/outlooks/aeo/data/browser/#/?id=2-AEO2022&region=1-9&cases=ref2022&start=2020&end=2050&f=A&linechart=ref2022-d011222a.3-2-AEO2022.1-9&map=ref2022-d011222a.4-2-AEO2022.1-9&sourcekey=0. Due to an identified data limitation BRG relied upon the average allocation to Washington from 2014 through 2019, U.S. Energy Information Administration, Table CT7, Transportation Sector Energy Consumption Estimates, 1960-2020, Washington; https://www.eia.gov/state/seds/data.php?incfile=/state/seds/sep_use/tra/use_tra_WA.html&sid=WA

BRG forecasts 2022 propane production capacity as being more than sufficient able to meet Washington's anticipated demand.

The West Coast states produce a total 617 MM gal/year of propane, which is plenty to meet Washington's anticipated 2.6 MM gal/year propane demand. As well, Washington has 5 crude oil refineries, of which propane is a major byproduct.[31] Supply could be imported from other U.S. regions, with total US productions at 30,998 MM gal/year Supplemental.

Table 19: Propane Production Availability to Washington[32]

State	Production Capacity (MM gal/year)
West Coast (PADD 5)	617
Rocky Mountains (PADD 4)	2,973
Gulf Coast (PADD 3)	17,037
Midwest (PADD 2)	6,695
East Coast (PADD 1)	3,676
US Total	**30,998**

[31] U.S. Energy Information Administration, Number and Capacity of Petroleum Refineries, accessed as of Sept. 2, 2022. https://www.eia.gov/dnav/pet/pet_pnp_cap1_dcu_nus_a.htm

[32] Propane production for the 5 PADDS is a summation of propane production from natural gas fields, as well as refinery production.

5. Deficit and Credit Generation and Banked Credits

Overview

To estimate the credits and deficits generated from the forecasted fuel consumption, BRG utilized the projected consumption of each fuel, then multiplied by the differential between the fuel's CI factors and the CI targets set by the Department of Ecology.

Carbon Intensity and Assumptions

This analysis uses CI values stated in the Clean Fuels Standard legislation WAC 173-424-900.[33] For the CI Inputs of Ethanol, Biodiesel, Renewable Diesel, and Renewable Natural Gas, the Washington CFS legislation does not provide updated CI Inputs. Therefore, BRG has sourced these CI inputs from the latest Washington-GREET model.

These assumptions are critical to driving the overall credit generation and deficit forecast because they model the total emissions reduction from using each type of fuel. The carbon intensity inputs, carbon intensity targets, and energy densities relied upon in this analysis are shown in Table 20 below:

Table 20: Carbon Intensities used in scenario analysis, by fuel (gCO_2e/MJ)[34]

Fuel Type	CI Input for Credit Calculations (gCO2e/MJ)	Washington 2023 CI Targets (gCO2e/MJ)	Washington 2024 CI Targets (gCO2e/MJ)
Gasoline	100.37	98.36	97.86
Ethanol	73.15	-	-
Diesel	101.09	99.52	99.02
Biodiesel	55.33	-	-
Renewable Diesel	51.08	-	-
Natural Gas	77.98	-	-
Renewable Natural Gas	64.52	-	-
Propane	83.14	-	-
Electricity[35]	18.68	-	-

[33] Chapter 173-424 WAC, Clean Fuels Program Rule, Tables, https://ecology.wa.gov/DOE/files/e9/e97a5150-9ed2-4512-a4fd-6b0317f907dc.pdf

[34] Chapter 173-424 WAC, Clean Fuels Program Rule, Tables, https://ecology.wa.gov/DOE/files/e9/e97a5150-9ed2-4512-a4fd-6b0317f907dc.pdf

[35] Post EER Adjustment.

In calculating adjusted CI values for electricity, an Energy Economy Ratio ("EER") of 3.4 is used to account for the much higher fuel economy per unit of fuel of electric vehicles due to their electric motor.[36]

The energy densities relied upon in the calculations of energy consumed per fuel are shown in Table 21 below:

Table 21: Energy Densities by Fuel

Fuel Type	Energy Density
Gasoline (MJ/GGE)	122.48
Ethanol (MJ/GGE)	81.51
Diesel (MJ/DGE)	134.48
Biodiesel (MJ/DGE)	126.13
Renewable Diesel (MJ/DGE)	129.65
Natural Gas (MJ/DGE)	134.48
Renewable Natural Gas (MJ/DGE)	134.48
Propane (MJ/DGE)	89.63
Electricity (MJ/kWh	3.60

Banked Credits

BRG calculated the total banked credits and deficits carried over at the beginning of the compliance period and estimated the number of credits and deficits attributed to the fuels aforementioned. Over the first two compliance years, CI targets allow significant credit banking for future compliance periods. Credits are generated and banked by utilizing low carbon fossil fuel alternatives such as biofuels or electricity. As CI targets become more stringent in future years, this bank can be drawn down alongside greater low carbon fuel adoption to achieve compliance. A summary of the net annual bank balance for 2023 and 2024 are found in Table 22 and Table 23:

Table 22: Summary of Current and Projected Net Credit/Deficit Generation

Year	Fueling Related Deficits Generation	Fueling Related Credits Generation	Non-Fueling Capacity and Infrastructure Capacity	Net Credit Generation
2023	(754,574)	1,017,225	37,729	300,380
2024	(961,036)	1,157,564	48,052	244,579
Total	**(1,715,610)**	**2,174,789**	**85,781**	**544,959**

[36] Chapter 173-424 WAC, Clean Fuels Program Rule, Tables, https://ecology.wa.gov/DOE/files/e9/e97a5150-9ed2-4512-a4fd-6b0317f907dc.pdf

Table 23: Credit Bank Balance

Year	Beginning Bank Balance	Total Banked Credits
2023	-	300,380
2024	300,380	544,959

Credits and Deficits

BRG calculated the number of credits and deficits that would be generated by the fuels aforementioned for the years 2023 and 2024. In the first two compliance years, ethanol and diesel substitutes more than offset gasoline and diesel deficits. Although fossil fuels generate significant deficits in 2023 and 2024, the CI targets in these years allow for biofuels and electricity to generate enough credits to allow for meaningful banking. A summary of the credits and deficits generation by fuel type is in Table 24 below:

Table 24: Summary of Credits and Deficits Forecast

Fuel Type	2023 Credits/Deficits (+/-)	2024 Credits/Deficits (+/-)
Gasoline	(604,112)	(766,319)
Ethanol	544,750	542,390
Diesel	(150,462)	(194,717)
Biodiesel	223,161	264,585
Renewable Diesel	184,168	270,402
Electricity	61,011	76,060
Natural Gas	59	34
Renewable Natural Gas	360	393
Propane	3,715	3,699
Total Non-Fueling Capacity and Infrastructure Credits	37,729	48,052
Total Deficits	(754,574)	(961,036)
Total Credits	1,054,954	1,205,615
Total Net Credits/Deficits	300,380	244,579

6. Conclusion

BRG's analysis shows that Washington's fuel volume demand can be met by the available production capacity of Washington and neighboring states and regions. Furthermore, through the generation of credits from alternative fuels and infrastructure investments, BRG forecasts a significant bank balance to be built up for the years 2023 and 2024, which can be drawn upon in future compliance periods when CI targets tighten.

Forecast Risks

The analysis relies on several assumptions rooted in strong fundamental analysis which impact the viability of our inputs. This analysis strives to incorporate assumptions from well-respected federal and state sources and utilize models developed by federal agencies and national labs to limit the opportunities for bias. Nevertheless, each of these models and sources makes simplifying assumptions which may not always reflect reality.

Despite these potential limitations, BRG considers this analysis to be the best available representation of the potential fuel supply in Washington over the first compliance period.