Analysis of the Implications of Canada's Proposed Clean Fuel Standard for Canadian Biofuels and Biofuel Feedstocks

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Report Revisions

The original version of this report was released on December 30, 2021. This original report contained a few errors which merited correction but did not significantly affect the results. The first error is that the Appendix tables entitled, "Biofuel Feedstocks Used for Canadian Domestic Consumption…" incorrectly reported fuel use in million liters for corn and wheat feedstocks instead of ethanol feedstock use in 1000 metric tons. This error was a table error only and did not affect the results.

The second error impacted the results and allowed renewable hydrocarbon fuels to appear to be produced from soybean oil which was incorrect. The model sourced all of its feedstocks from canola oil but assigned part of the fuel volume generated to soybean oil. Correcting this in order to align fuel volumes produced with canola oil, generated higher carbon credits produced (since the canola oil pathway has a lower carbon intensity score than soybean oil) reducing the overall volume of canola oil use slightly. The scenarios with a 20% reduction in carbon intensity were most affected since the production of renewable hydrocarbon fuels is the largest in those scenarios. The largest impact was in the NZ-G20 LCIF scenario that resulted in canola oil use for renewable diesel production by 2030/31 to be 2.882 million metric tons instead of 2.905 million metric tons reported in the December 30 report, a change of -0.8%. Renewable hydrocarbon fuel consumption is -0.7% lower in the revised estimates.

Introduction

This report is an update of the 2020 analysis including some of the recent changes in the proposed Clean Fuel Standard (CFS) policy as well as several scenarios looking at a more ambitious 2030 target for carbon emission reduction. Canada's proposed CFS is a system that sets a target for reduction in liquid transportation fuel carbon intensity and allows renewable fuels produced from different feedstock pathways, each with unique carbon intensities, to compete with other clean technologies to meet the required reductions.

The revisions in this year's analysis reflect changes in the fuels included in the compliance debit generation, as well as changes in the level of compliance credits generated from non-biofuel sources. Many of the Canadian provinces already have either low carbon policies or minimal blend rates for biofuels and these existing policies serve as a floor for biofuel demand. In the four scenarios presented here, only two of the CFS scenarios lift biofuel demand (called 'low carbon intensity fuels' or LCIF in the CFS) above the floor set by the provincial policies based on the assumptions regarding credits supplied by compliance categories 1 and 3, and from cross-stream low carbon intensity gaseous fuel credits.

Environment and Climate Change Canada (ECCC) released a revised E3MC model in May 2019. WAEES followed the carbon calculations laid out in this model to build an endogenous model of the Canadian CFS within the larger WAEES global agricultural and biofuels modeling system. In order to project feedstock demands within the simultaneous system, carbon intensity scores for each biofuel feedstock pathway were needed. WAEES used the carbon intensity scores provided by Advanced Biofuels Canada from the GHG Genius 5.0 model for pathways not explicitly reported in the E3MC model.

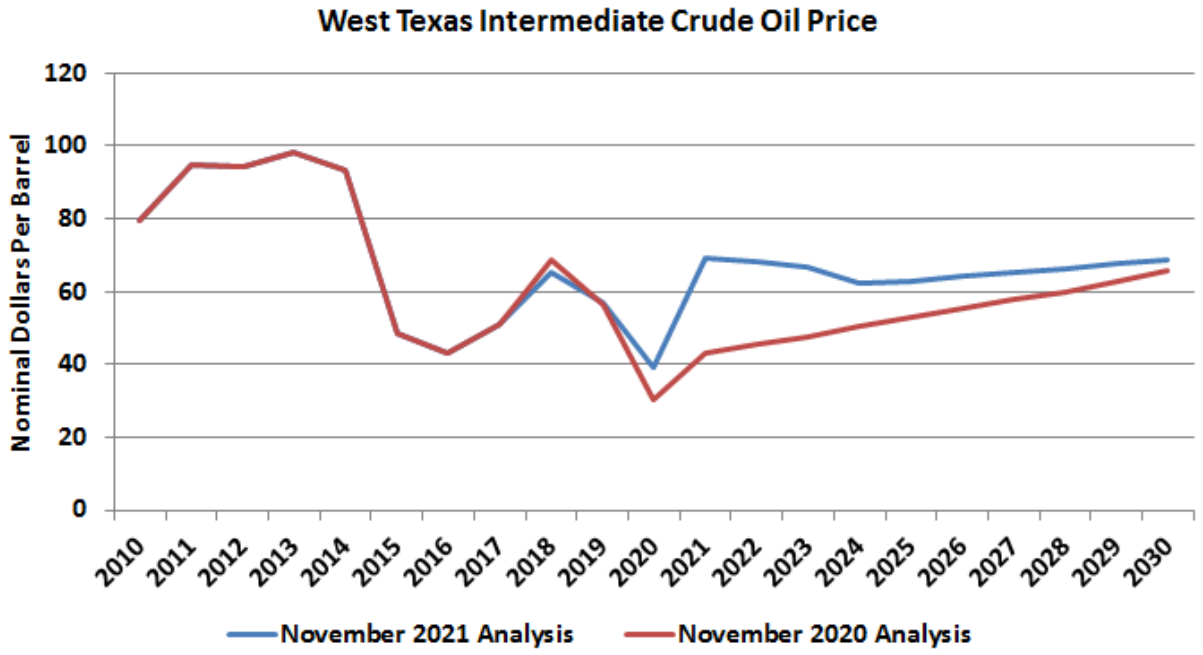
The Canadian CFS policy is part of the larger WAEES global agricultural and biofuels partial equilibrium model which encompasses 48 countries and geographic regions and over 30 agricultural commodities as well as the primary biofuels (e.g. ethanol, biodiesel, and renewable diesel) in the key global markets (see Appendix B for additional details).

Scenario Context

These scenarios were run using baseline projections generated in October/November 2021 from the WAEES global agricultural and biofuels econometric model. Global historical agricultural supply and demand data were updated to USDA's October Production, Supply, and Disposition estimates and aligned with USDA's October World Agricultural Supply and Demand Estimates. The most notable changes from the 2020 analysis are higher crude oil prices, especially over the next five years. In addition, the 2021 drought in Canada that reduced canola production by nearly 23% year over year, along with speculation regarding renewable diesel

expansion in the United States, has led to significantly higher biomass-based diesel feedstock prices.

The California Low Carbon Fuel Standard (LCFS) was included in the analysis and includes expansion in renewable diesel production in response to renewable diesel returns, including the LCFS compliance credit price. However, higher feedstock costs do rationalize how high renewable diesel production actually gets versus announced capacity expansion. The WAEES model was aligned to the high demand/high electric vehicle scenario assumptions in the California Air Resources Board 2018 illustrative compliance scenarios. WAEES also included the cap on compliance credit prices in the LCFS policy.



With the exception of Canada, international gasoline and diesel fuel demand estimates were updated to the US Department of Energy's Energy Information Administration projection in the International Energy Outlook released October 6, 2021. International biofuels historical data, excluding Canada, draws upon the reported estimates by USDA's Foreign Agricultural Service. Argentina's monthly historical biodiesel production, consumption, and trade data is based on Argentina's Instituto Nacional de Estadistica y Censos (indec). The EU-28 monthly trade data in biofuels is updated based on the European Commission's Market Access Database. The EU is assumed to enforce the second Renewable Energy Directive (RED 2) policy of phasing out palm oil as a biomass-based diesel feedstock by 2030 which is largely replaced by canola oil.

Renewable Diesel and Biodiesel

Renewable diesel has grown considerably in popularity over the last few years. It's attractiveness as a "drop-in" fuel with full fungibility with #2 petroleum diesel, (including the same cold flow properties), has stimulated interest in expanding renewable diesel production capacity. Publicly available data on the margins for renewable diesel production versus biodiesel are scarce and often involve derivations from less than transparent sources. Based on WAEES' research, there appears to be a wider margin over variable cost for renewable diesel compared to biodiesel. The wider margin is made up of:

- Generation of 1.7 RINs per gallon versus 1.5 RINs per gallon of biodiesel – value will vary with the RIN credit price
- Small difference in energy content
- Access to the California LCFS compliance credit price (some biodiesel plants are geographically too far away) – value will vary with the credit price
- Some differences in transportation costs
- Higher by-product values

Although not the focus of this analysis, it is expected that these larger margins for renewable diesel with result in new renewable diesel capacity coming online which could displace existing biodiesel production capacity if policies do not expand biofuels demand. The four scenarios presented in this analysis reflect this displacement.

Note – as many standalone and co-processing-based renewable diesel production platforms are capable of producing renewable gasoline fuels or blendstocks, renewable propane, and sustainable aviation fuels (SAFs), we have adopted the term 'Renewable Hydrocarbon Fuels' to reflect that the products may be a mix of renewable diesel, renewable gasoline, and/or SAF. In terms of model results for feedstock demands and renewable fuel production, 'renewable diesel' results may, in fact, result in renewable hydrocarbon fuel products used in the gasoline pool or aviation jet fuels.

Modeling Approach to the Canadian CFS

Development of the Canadian Clean Fuel Standard (CFS) in the WAEES model is based on the May 2019 Reduction Opportunities Model (ROM), and information released by ECCC since that time. The major difference from ECCC's ROM is that the WAEES model solves for the quantities of biofuels supplied by feedstock pathway given the credits provided in compliance categories 1 and 3 (non-biofuel credit sources) and from cross-stream (non-transportation) utilization of low carbon intensity gaseous fuels. The model solves for the "renewable fuel credit price" needed to ensure sufficient compliance credits from biofuels are generated in each compliance period.

(Note - the renewable fuel credit price is the price needed to incentivize biofuel use but the possible impact on the supply of credits from compliance categories 1 and 3 is not captured because these are exogenous assumptions in the model. In other words, the renewable fuel credit price reflects the intrinsic compliance credit price to achieve the modeled level of LCIF use (compliance category 2); it is not, therefore, a forecast of the CFS compliance credit price.)

In each feedstock pathway, the overall renewable fuel credit price is translated into the value per liter based on the carbon intensity assigned to the feedstock pathway. The value for each feedstock pathway is what incentivizes potential biomass-based fuel suppliers to produce more. Some feedstock pathways have significantly higher values from the renewable fuel credit price due to their low carbon intensity scores. However, the WAEES model also tracks the available supplies and other demands for agriculturally based feedstocks. Even though a particular feedstock pathway may have a high value from the renewable fuel credit price, how much of the feedstock that can be used depends on its supply and demand situation. The extra value from the renewable fuel credit price will be eroded as the feedstock price increases and the supply of the feedstock limits how much can be used. For example, animal fats and used cooking oils often have low carbon intensity scores but it is difficult to increase the supply of these products since they are low value by-products of other processes (i.e. tied to livestock demand for meat consumption).

The WAEES model uses econometric equations to solve for the biofuels that will be used to meet the requirements of the Canadian CFS. Each scenario has fixed assumptions regarding compliance credit use from non-biofuel pathway credit generating actions (e.g. upstream emission reduction credits, fuel switching to electric vehicles, etc.). The obligated parties are expected to meet CFS requirements, in part, by incentivizing the use of biofuels through the renewable fuel credit price. If the obligated parties cannot acquire sufficient compliance credits from all sources to meet their obligation in a period, they bid up the renewable fuel credit price until they do or they could ultimately hit the compliance credit price cap that is in the Canadian CFS policy (CAD $350/credit, plus inflation). As more biofuels are produced, the demand for biofuel feedstocks also rises, increasing feedstock prices.

The combination of fuel type and feedstock pathway form a unique pathway and carbon intensity score. The amount of carbon intensity reduction (from the fossil fuel reference) can then be calculated for each pathway and the subsequent value of that pathway given a renewable fuel credit price. Each LCIF pathway has a different compliance credit value based on its carbon intensity score. Pathways that have a higher compliance credit value per liter incentivize more biofuel production in that pathway. In order to simulate this, the model looks at the margin for each pathway which includes the biofuel price plus the carbon intensity value less the cost of the feedstock. If the renewable fuel credit price is zero then no incentive is

added to the margin equation. Both domestic and international biofuel producers see the carbon intensity value incentives.

It is important to emphasize that this is not an optimization model that solves for the least cost pathways resulting in corner solutions subject to constraints. Instead, this model emulates how each pathway responds to additional economic incentives. While the model will result in solutions that are directionally similar to an optimization model, the resulting change in the magnitude for each pathway will be different; this is because the current infrastructure is allowed to respond to the incentives it will experience, based on the carbon intensity values of its respective pathway.

Since there has been no Canadian CFS policy before, there is no historical data to help guide the exact calibration of the model. The model solves for the renewable fuel credit price by simulating how much Canadian domestic producers and international producers respond to the carbon intensity value incentive. Therefore, the level of the renewable fuel credit price depends on the responsiveness of supply equations for each pathway. The more responsive the pathway is in increasing production, the lower the renewable fuel credit price. International supply and demand conditions for feedstocks and biofuels can influence their availability and prices in Canada and ultimately the level of the renewable fuel credit price.

Another important difference from the Reduction Opportunities Model is that the overall level of electric vehicle use has a direct impact on the amount of energy demanded from gasoline and diesel vehicles. As the quantity of energy supplied by electric vehicles rises, the quantity of energy that needs to be supplied for gasoline and diesel vehicles directly declines. For the scenarios considered in this analysis, different levels of compliance credits were generated by zero emission vehicles (ZEV) across the scenarios. (Note – in the CFS, compliance category 3 includes fuel switching from gasoline and diesel to lower emission platforms: electric vehicles (EVs), hydrogen fuel cell vehicles, and renewable natural gas used in compressed natural gas and liquified natural gas transport. Given the projected increase in EV adoption, WAEES modeling of the CFS used EVs as the proxy for all compliance category 3 credit generation.) Using the EV credit generation assumptions, WAEES calculated the reduction in gasoline and diesel fuels needed. Using the EV credit equation for the energy effectiveness ratios (EERs) provided by ECCC, we can back into the reduction in terajoules of energy needed. Using the energy density of gasoline and diesel, we can derive the reduction in liquid fuels as a result of EV adoption.

Finally, compliance credit stocks are assumed to be modestly responsive to renewable fuel credit prices in this model which does allow credit pools to be drawn down to low levels, but not depleted beyond a credit bank of 5 million credits in any period. The level of credit bank is merely a guess, but to provide a buffer and allow flexibility in securing credits it should be

above zero. This has the effect of keeping compliance credit prices higher because credit pool stocks are not fully utilized to meet CFS compliance requirements.

Scenario Implementation

To explain how the scenarios were implemented, it may be helpful to identify the categories of compliance credits that are assumptions (exogenous) and those that are determined through solution of the model (endogenous). The simple description is that those credits that are not generated by biofuels are exogenous to the model and all biofuels credits are endogenous.

The exception to the above is compliance fund mechanism credits; the compliance fund allows obligated parties to purchase credits at a pre-determined ceiling price. Credits used from the compliance fund are endogenously determined by the model. These credits occur if the renewable fuel credit price is bid up above the compliance fund price ceiling set in the CFS policy. It is assumed that an obligated party would choose the lower cost option of purchasing credits via the compliance fund versus paying to create credits whose costs are in excess of the compliance fund credit price. The remaining credits required to meet the obligation are supplied through the compliance fund up to the 10 percent limit based on the obligated party's total debits.

CFS compliance credits fall into roughly three categories:

Compliance Category 1 (CC1)

- Carbon Capture and Storage
- Upstream Improvements
- Reductions in Refineries
- Incremental Methane Reductions – Conventional Oil

Compliance Category 2 (CC2)

- Ethanol
- Biodiesel
- Renewable Hydrocarbon Fuels
- Pyrolysis Oil (Biocrude)
- Sustainable Aviation Fuel

Compliance Category 3 and Other (CC3)

- Fossil fuels displaced by Propane and Renewable Propane
- Fossil fuels displaced by Natural Gas or Renewable Natural Gas or Hydrogen
- Fossil fuels displaced by Electric Vehicles

- Fossil fuels displaced by Hydrogen Fuel Cell Vehicles
- Cross Stream Credits
- Emerging Tech Credits

Based on the scenario assumptions set in the model regarding CC1, CC3, and cross-stream gaseous credit utilization, the model solves for the renewable fuel credit price needed to incentivize enough supply of biofuels to meet the remaining credits needed to comply with the CFS.

The projection of Canadian demand for transportation energy as measured in terajoules is the same across all scenarios. However, there are shifts between electric and liquid fuel vehicles depending on the assumed credit generation delivered by electric vehicles.

Scenario Definitions

Four scenarios were evaluated to determine the impact of alternative assumptions on biofuel and feedstock demands. These scenarios were formulated based on the assumptions made regarding the CC1 and CC3 categories as well as the overall carbon emission target.

As detailed in the table below, the four scenarios shared some common assumptions including:

- the same overall transportation energy demand
- the same minimum biofuel blend rates based on provincial policies
- cross stream trading credits were assumed to be the maximum 10% of fossil fuel debits
- sustainable aviation fuel volumes that grow from 0 to 5% of aviation turbo fuel by 2030
- pyrolysis oil volumes that grow from 1% of heavy fuel oil in 2022 to 15% of heavy fuel oil by 2030
- minimum credits in the compliance credit bank were set at 5 mmt CO2e
- in 2022, credits were allowed to be accumulated over half the year while compliance debits generated by fossil fuels were only accumulated over December

Common Assumptions Across All CFS Scenarios

	Units	2022	2023	2024	2025	2026	2027	2028	2029	2030
Fossil Fuel & Biofuel Demand										
Gasoline & Ethanol	petajoules	1,335	1,328	1,321	1,315	1,308	1,301	1,294	1,288	1,281
Diesel & Biomass Based Diesel	petajoules	1,059	1,078	1,097	1,116	1,135	1,154	1,173	1,192	1,211
Effective Minimum Biofuel Blend Rates										
(based on Provincial policies)										
Ethanol	percent	7.8%	8.9%	8.9%	9.6%	9.6%	9.7%	10.9%	10.9%	12.2%
Biomass-Based Diesel	percent	3.4%	3.6%	3.7%	4.1%	4.3%	4.4%	4.6%	4.7%	5.5%
Compliance Category 3 and Other Assumptions										
Cross Stream Trading Credits (% of Fossil Fuel Debits)	percent	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%
Sustainable Aviation Fuel Volume (% of aviation turbo fuel)	percent	0.0%	0.3%	0.7%	1.0%	1.8%	2.6%	3.4%	4.2%	5.0%
Pyrolysis Oil (% of heavy fuel oil)	percent	1.0%	2.8%	4.5%	6.3%	8.0%	9.8%	11.5%	13.3%	15.0%
Minimum credits in compliance credit bank	mmt CO2e	5	5	5	5	5	5	5	5	5

The table below provides a summary of the assumption changes across the four scenarios over the 2022 to 2030 period. All scenarios beginning with the NZ-GR (net-zero guardrail) prefix include a provision that restricts CC1 credit use to maximum of 25% of the total credits required in a compliance period. The cutoff at 25% is in proportion to the lifecycle emissions emitted from fossil fuel extraction and refining while the remaining 75% of the compliance obligation is met with actions that address the combustion emissions (CC2 and CC3 credits). Also behind the guardrail are: other credit flexibilities such as cross-stream credits and credits purchased through the compliance fund mechanism. The use of these flexibilities further constrains the use of CC1 credits in a compliance period. It should be noted that liquid fuels produced by way of co-processing are not behind the guardrail in the modelling and are assumed to be represented in the modelled biofuel figures.

The obligated fossil fuel carbon intensity reduction was the same in the Baseline and NZ-GR 13% scenario. Overall, the total assumed CC1 and CC3 credits were larger in the Baseline, totaling 21.1 mmt CO2e versus 17.5 mmt CO2e in the NZ-GR 13% scenario by 2030. In 2030, for the Baseline, only 6.6 mmt CO2e credits are needed from biofuels, well below the provincial biofuel policy requirements. Under the NZ-GR 13% scenario, 10.1 mmt CO2e credits are needed from biofuels, which is very close to the provincial biofuel policy demand requirements.

The NZ-GR 20% ZEV and NZ-GR 20% LCIF scenarios have a higher obligated fossil fuel carbon intensity reduction than the first two scenarios which increases the compliance credits required. Although the CC1 and cross-stream compliance credits are also increased, the CC2 (biofuel) and CC3 (ZEV) compliance credits needed are significantly higher since the guardrail constrains utilization of the CC1/cross-stream credits to no greater than 25% in a compliance period. By 2030, the NZ-GR 20% ZEV scenario requires 12.1 m CC2 credits and the NZ-GR 20% LCIF scenario requires 15.1 m CC2 credits. Since these requirements are well above the

provincial biofuel policy requirements, the CFS policy drives biofuel consumption in these scenarios.

In each scenario, the overall liquid fuel consumption is adjusted for the assumptions regarding electric vehicles. The resulting liquid fuel demands are modestly different across the scenarios after making this adjustment, but the overarching assumption regarding the energy requirement for transportation remains the same.

Credit Creation Assumptions in 2030

		Baseline		NZ-GR 13%		NZ-GR 20% LCIF		NZ-GR 20% ZEV	
	Category	million credits	% of obligation	million credits	% of obligation	million credits	% of obligation	million credits	% of obligation
Approximate obligation (credits required)		28.2		28.2		43.4		43.4	
Process Improvement Credits	CC1	11.3	40.1%	4.2	15.0%	6.5	15.0%	6.5	15.0%
Gaseous and Solid Credits (cross-stream)	Flexibility	2.8	10.0%	2.8	10.0%	4.3	10.0%	4.3	10.0%
Compliance Fund	Flexibility	model		model		model		model	
Sub-total (all non-CC2/3 credits)	**CC1 + Flex**	**14.1**	**50.1%**	**7.1**	**25.0%**	**10.8**	**25.0%**	**10.8**	**25.0%**
ZEV credit generation LD	CC3	1.8	6.4%	1.6	5.6%	2.3	5.4%	3.5	8.1%
ZEV credit generation MD/HD	CC3	5.2	18.5%	8.9	31.5%	12.0	27.7%	14.5	33.4%
Emerging Tech credit generation	CC3	0	0%	0	0%	0	0%	0	0%
Sub-total	**CC3**	**7.0**	**24.8%**	**10.5**	**37.1%**	**14.3**	**33.1%**	**18.0**	**41.5%**
Gasoline pool	CC2	model		model		model		model	
Diesel pool	CC2	model		model		model		model	
Sub-total (balance of credits available for CC2)	**CC2**	**7.1**	**25.1%**	**10.7**	**37.9%**	**18.2**	**41.9%**	**14.5**	**33.5%**

CFS Scenario Specific Assumptions

	Units	2022	2023	2024	2025	2026	2027	2028	2029	2030
Baseline										
Obligated Fossil Fuel Carbon Intensity Reduction	tCO2e/TJ	2.4	3.6	4.8	6.0	7.2	8.4	9.6	10.8	12.0
Process Improvement Total	mmt CO2e	2.05	3.20	4.36	5.52	6.67	7.83	8.99	10.14	11.30
CCS	mmt CO2e	1.30	1.84	2.39	2.93	3.48	4.02	4.56	5.11	5.65
Other Improvements	mmt CO2e	0.00	0.18	0.35	0.53	0.71	0.88	1.06	1.24	1.41
Reductions in Refineries	mmt CO2e	0.20	0.35	0.50	0.65	0.81	0.96	1.11	1.26	1.41
Incremental Methane Reductions - Conventional Oil	mmt CO2e	0.55	0.83	1.12	1.40	1.69	1.97	2.26	2.54	2.83
EV Credit Generation	mmt CO2e	2.40	2.40	2.50	3.25	4.00	4.75	5.50	6.25	7.00
Gasoline	mmt CO2e	0.62	0.62	0.64	0.84	1.03	1.22	1.41	1.61	1.80
Diesel	mmt CO2e	1.78	1.78	1.86	2.41	2.97	3.53	4.09	4.64	5.20
Fuel Demands After Adjusting for Electric Vehicles										
Gasoline & Ethanol (Gasoline liter equivalents)	million liters	38,431	38,236	38,038	37,826	37,614	37,401	37,187	36,972	36,757
Diesel & Biomass Based Diesel (Diesel liter equivalents)	million liters	27,297	27,787	28,273	28,730	29,186	29,641	30,095	30,548	30,999
NZ-GR 13%										
Obligated Fossil Fuel Carbon Intensity Reduction	tCO2e/TJ	2.4	3.6	4.8	6.0	7.2	8.4	9.6	10.8	12.0
Process Improvement Total	mmt CO2e	2.05	2.32	2.59	2.85	3.12	3.39	3.66	3.93	4.20
CCS	mmt CO2e	1.30	1.40	1.50	1.60	1.70	1.80	1.90	2.00	2.10
Other Improvements	mmt CO2e	0.00	0.07	0.13	0.20	0.26	0.33	0.39	0.46	0.53
Reductions in Refineries	mmt CO2e	0.20	0.24	0.28	0.32	0.36	0.40	0.44	0.48	0.53
Incremental Methane Reductions - Conventional Oil	mmt CO2e	0.55	0.61	0.67	0.74	0.80	0.86	0.92	0.99	1.05
EV Credit Generation	mmt CO2e	2.40	2.40	2.50	3.83	5.17	6.50	7.83	9.17	10.50
Gasoline	mmt CO2e	0.37	0.37	0.38	0.58	0.79	0.99	1.19	1.40	1.60
Diesel	mmt CO2e	2.03	2.03	2.12	3.25	4.38	5.51	6.64	7.77	8.90
Fuel Demands After Adjusting for Electric Vehicles										
Gasoline & Ethanol (Gasoline liter equivalents)	million liters	38,452	38,257	38,061	37,848	37,635	37,421	37,207	36,992	36,776
Diesel & Biomass Based Diesel (Diesel liter equivalents)	million liters	27,283	27,773	28,258	28,680	29,101	29,520	29,936	30,350	30,762
NZ-GR 20% ZEV										
Obligated Fossil Fuel Carbon Intensity Reduction	tCO2e/TJ	2.4	4.4	6.4	8.4	10.4	12.4	14.3	16.3	18.3
Process Improvement Total	mmt CO2e	2.05	2.60	3.16	3.72	4.27	4.83	5.39	5.94	6.50
CCS	mmt CO2e	1.30	1.54	1.79	2.03	2.28	2.52	2.76	3.01	3.25
Other Improvements	mmt CO2e	0.00	0.10	0.20	0.30	0.41	0.51	0.61	0.71	0.81
Reductions in Refineries	mmt CO2e	0.20	0.28	0.35	0.43	0.51	0.58	0.66	0.74	0.81
Incremental Methane Reductions - Conventional Oil	mmt CO2e	0.55	0.68	0.82	0.95	1.09	1.22	1.36	1.49	1.63
EV Credit Generation	mmt CO2e	2.40	2.40	2.50	5.08	7.67	10.25	12.83	15.42	18.00
Gasoline	mmt CO2e	0.47	0.47	0.49	0.99	1.49	1.99	2.50	3.00	3.50
Diesel	mmt CO2e	1.93	1.93	2.01	4.09	6.18	8.26	10.34	12.42	14.50
Fuel Demands After Adjusting for Electric Vehicles										
Gasoline & Ethanol (Gasoline liter equivalents)	million liters	38,444	38,248	38,051	37,811	37,567	37,322	37,073	36,822	36,567
Diesel & Biomass Based Diesel (Diesel liter equivalents)	million liters	27,288	27,778	28,262	28,623	28,979	29,327	29,668	30,001	30,325
NZ-GR 20% LCIF										
Obligated Fossil Fuel Carbon Intensity Reduction	tCO2e/TJ	2.4	4.4	6.4	8.4	10.4	12.4	14.3	16.3	18.3
Process Improvement Total	mmt CO2e	2.05	2.60	3.16	3.72	4.27	4.83	5.39	5.94	6.50
CCS	mmt CO2e	1.30	1.54	1.79	2.03	2.28	2.52	2.76	3.01	3.25
Other Improvements	mmt CO2e	0.00	0.10	0.20	0.30	0.41	0.51	0.61	0.71	0.81
Reductions in Refineries	mmt CO2e	0.20	0.28	0.35	0.43	0.51	0.58	0.66	0.74	0.81
Incremental Methane Reductions - Conventional Oil	mmt CO2e	0.55	0.68	0.82	0.95	1.09	1.22	1.36	1.49	1.63
EV Credit Generation	mmt CO2e	2.40	2.40	2.50	4.47	6.43	8.40	10.37	12.33	14.30
Gasoline	mmt CO2e	0.39	0.39	0.40	0.72	1.03	1.35	1.67	1.98	2.30
Diesel	mmt CO2e	2.01	2.01	2.10	3.75	5.40	7.05	8.70	10.35	12.00
Fuel Demands After Adjusting for Electric Vehicles										
Gasoline & Ethanol (Gasoline liter equivalents)	million liters	38,450	38,255	38,058	37,835	37,609	37,383	37,154	36,923	36,690
Diesel & Biomass Based Diesel (Diesel liter equivalents)	million liters	27,284	27,773	28,257	28,645	29,027	29,404	29,776	30,141	30,499

Debit and Credit Generation Assumption Comparisons Across Scenarios

	2022	2023	2024	2025	2026	2027	2028	2029	2030
million metric tons									
Debits									
Baseline	0.5	8.2	11.0	13.8	16.6	19.4	22.1	25.0	27.6
NZ-GR 13%	0.5	8.2	11.0	13.7	16.5	19.4	22.1	24.9	27.5
NZ-GR 20% ZEV	0.5	10.0	14.6	19.1	23.6	28.1	32.2	36.5	40.7
NZ-GR 20% LCIF	0.5	10.0	14.6	19.1	23.6	27.7	31.8	35.8	39.9
Non Biofuel Credits									
Total									
Baseline	2.3	6.4	8.0	10.1	12.3	14.5	16.7	18.9	21.1
NZ-GR 13%	2.3	5.5	6.2	8.1	9.9	11.8	13.7	15.6	17.5
NZ-GR 20% ZEV	2.3	6.0	7.1	10.7	14.3	17.9	21.4	25.0	28.6
NZ-GR 20% LCIF	2.3	6.0	7.1	10.1	13.1	16.0	18.9	21.9	24.8
Compliance Category 1									
Baseline	1.0	3.2	4.4	5.5	6.7	7.8	9.0	10.1	11.3
NZ-GR 13%	1.0	2.3	2.6	2.9	3.1	3.4	3.7	3.9	4.2
NZ-GR 20% ZEV	1.0	2.6	3.2	3.7	4.3	4.8	5.4	5.9	6.5
NZ-GR 20% LCIF	1.0	2.6	3.2	3.7	4.3	4.8	5.4	5.9	6.5
Electric Vehicles - Gasoline									
Baseline	0.3	0.6	0.6	0.8	1.0	1.2	1.4	1.6	1.8
NZ-GR 13%	0.2	0.4	0.4	0.6	0.8	1.0	1.2	1.4	1.6
NZ-GR 20% ZEV	0.2	0.5	0.5	1.0	1.5	2.0	2.5	3.0	3.5
NZ-GR 20% LCIF	0.2	0.4	0.4	0.7	1.0	1.3	1.7	2.0	2.3
Electric Vehicles - Diesel									
Baseline	0.9	1.8	1.9	2.4	3.0	3.5	4.1	4.6	5.2
NZ-GR 13%	1.0	2.0	2.1	3.2	4.4	5.5	6.6	7.8	8.9
NZ-GR 20% ZEV	1.0	1.9	2.0	4.1	6.2	8.2	10.3	12.4	14.5
NZ-GR 20% LCIF	1.0	2.0	2.1	3.7	5.4	7.0	8.7	10.3	12.0
Cross Stream Credits									
Baseline	0.0	0.8	1.1	1.4	1.7	1.9	2.2	2.5	2.8
NZ-GR 13%	0.0	0.8	1.1	1.4	1.7	1.9	2.2	2.5	2.8
NZ-GR 20% ZEV	0.0	1.0	1.5	1.9	2.4	2.8	3.2	3.6	4.1
NZ-GR 20% LCIF	0.0	1.0	1.5	1.9	2.4	2.8	3.2	3.6	4.0
Biofuels Supplied Credits									
Baseline	1.8	1.8	3.0	3.6	4.2	4.9	5.4	6.1	6.6
NZ-GR 13%	1.8	2.7	4.8	5.7	6.6	7.5	8.4	9.3	10.1
NZ-GR 20% ZEV	1.8	4.0	7.5	8.4	9.3	10.2	10.8	11.5	12.1
NZ-GR 20% LCIF	1.8	4.0	7.5	9.0	10.5	11.7	12.8	14.0	15.1

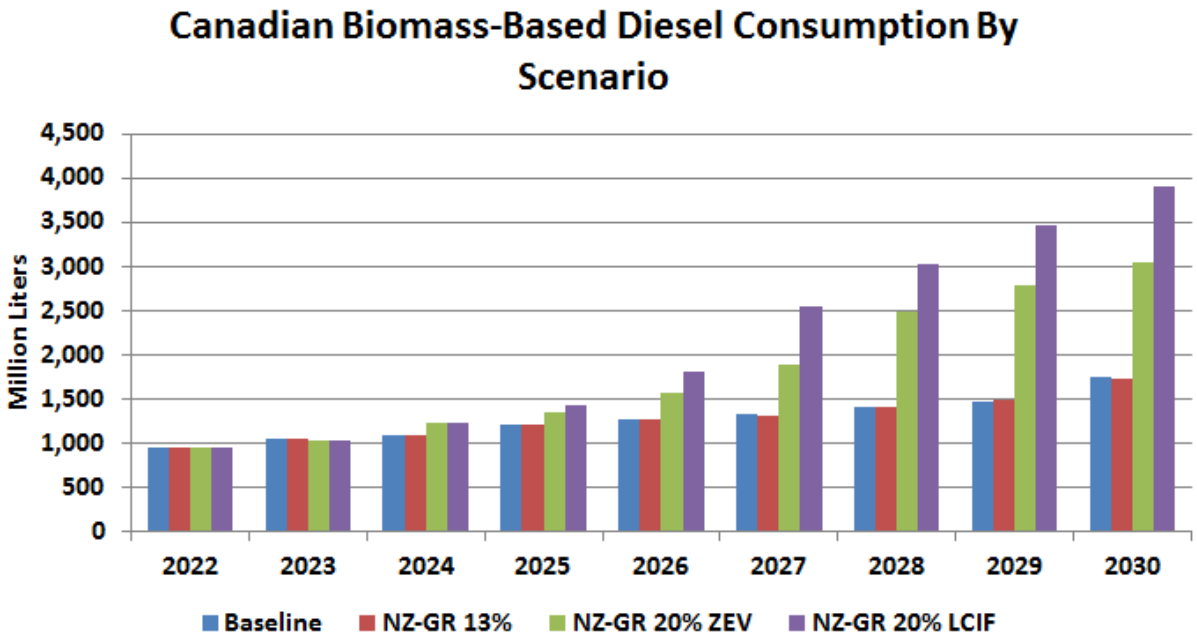
Scenario Results

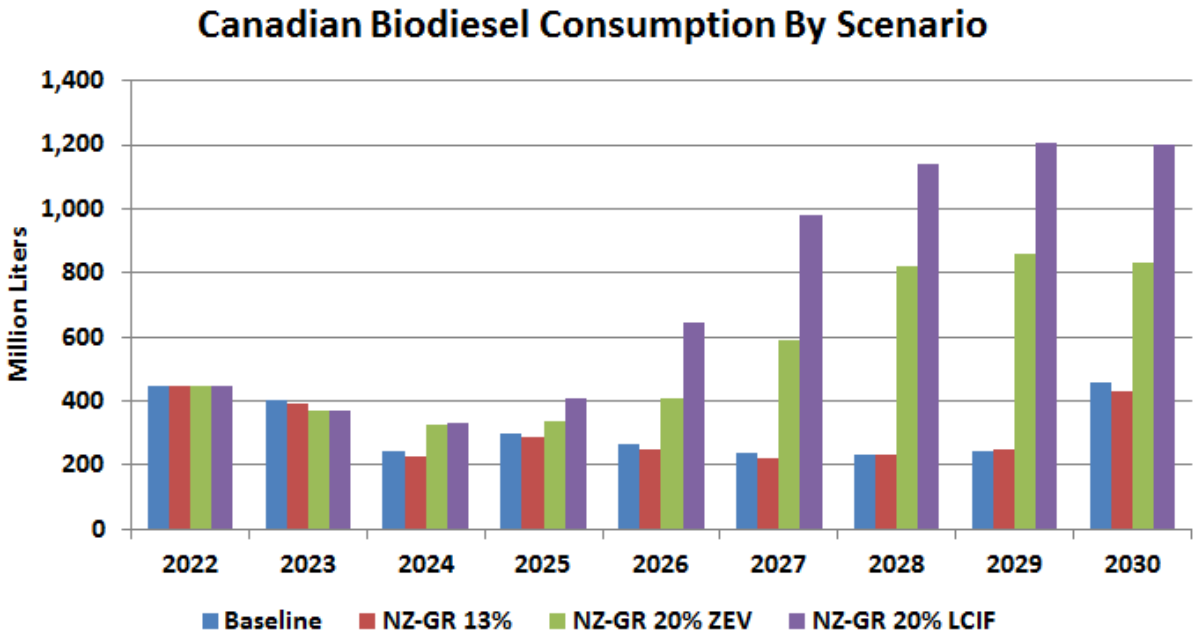
Summary tables of the scenario results are presented in Appendix B. Although the results are available for each year, the summary tables omit some years to allow the tables to conform to the page size. It should be noted that the biofuels tables are presented in a calendar year format while the grain and oilseed tables are presented in a marketing year format.

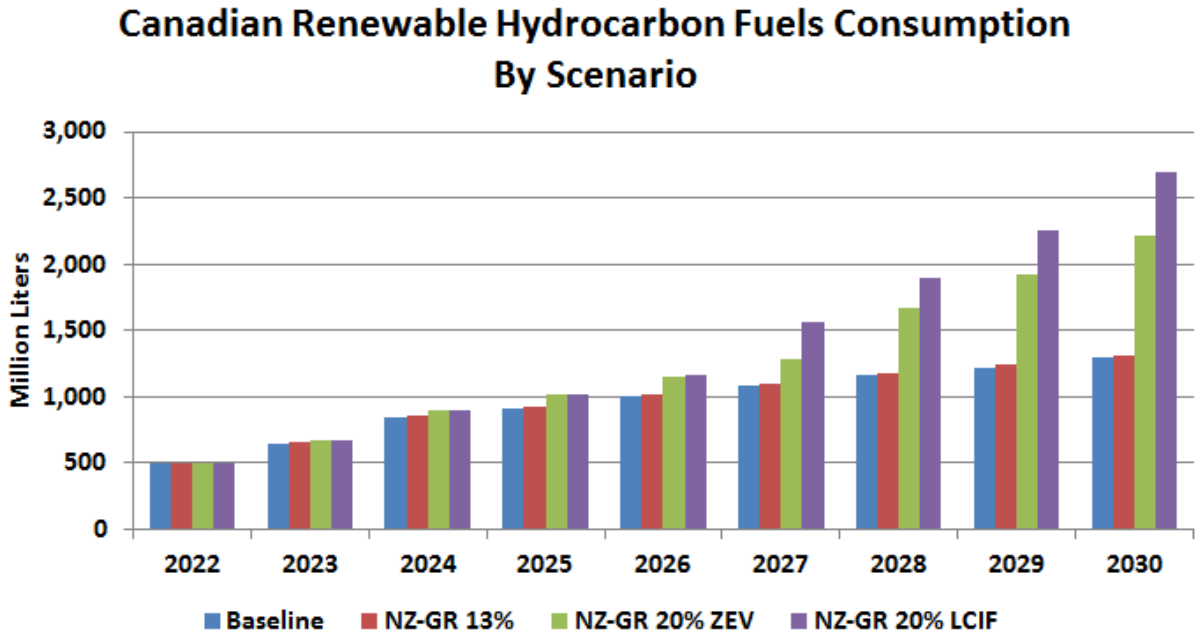
The simplest way to understand the scenario result is to consider the quantity of compliance credits supplied by non-biofuel sources. As you would expect, the larger the quantity of carbon credits supplied by non-biofuels sources, the lower the quantity of biofuels needed to reach compliance with the CFS. Since the baseline has the highest number of compliance credits supplied by non-biofuel sources, it requires the lowest quantity of biofuels to reach compliance. The NZ-GR 20% LCIF scenario has the lowest number of compliance credits supplied by non-biofuel sources in combination with higher overall carbon reduction target, and subsequently requires the highest quantity of biofuels to reach compliance.

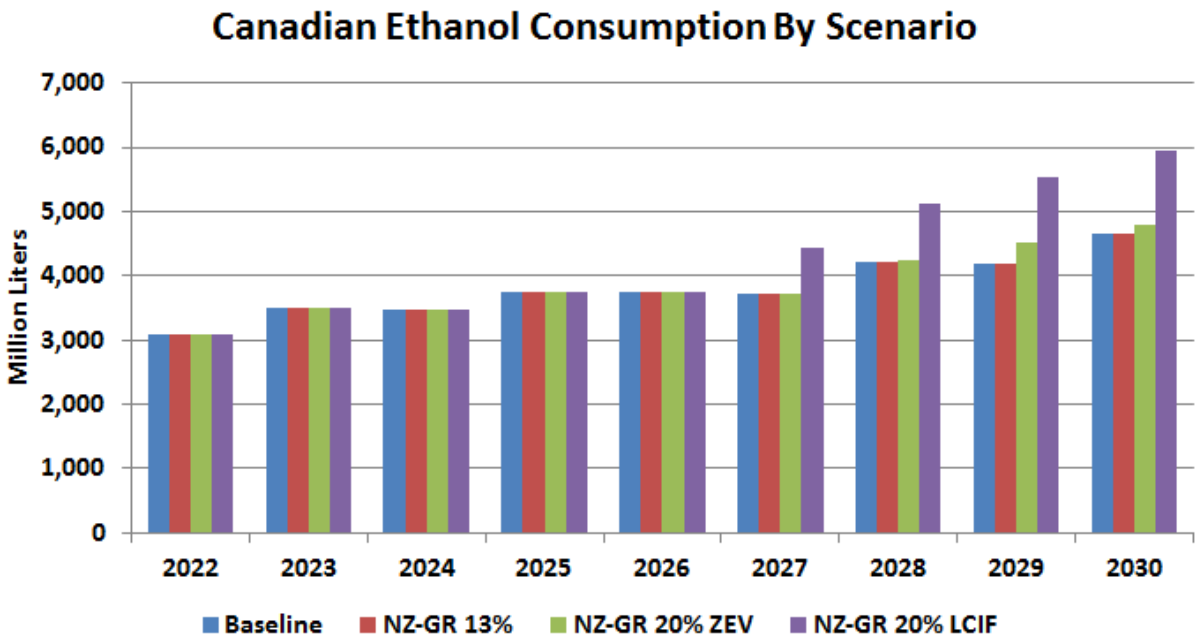
Biofuels Consumption

In the Baseline and NZ-GR 13% scenario, biofuel consumption is driven by the provincial biofuel policies. With the expansion in renewable hydrocarbon fuels production already underway in Canada, consumption of this new production displaces existing biodiesel consumption. Although overall biomass-based diesel (biodiesel plus renewable diesel) consumption increases in all scenarios, the growth in renewable hydrocarbon fuels crowds out some biodiesel consumption.









An important question is how the model sorts out how much of the CFS is met by ethanol, renewable diesel, and biodiesel. Within the model, the expected net returns for each biofuel by feedstock pathway are calculated. Each biofuel feedstock pathway generates a different amount of carbon reduction based on its carbon intensity score and subsequently produces a specific value of that carbon reduction based on the renewable fuel credit price. For example,

biodiesel produced from canola oil would get the value of the biodiesel price plus the value of carbon reduction specific to the canola oil pathway. The values of these compliance credits for each feedstock pathway in each scenario are presented in Appendix B.

In the case of the NZ-GR 20% LCIF scenario, the value of the compliance credit for biodiesel made from canola oil is $1.04 per liter by 2030. Importantly, the net returns also include the cost of the feedstocks. This means that even as gross returns increase with the value of the compliance credit, the cost of the feedstock increases as more of that feedstock is demanded offsetting some of the increase in gross returns.

The responsiveness of the supply of biodiesel, renewable diesel, and ethanol to changes in net returns is what determines how much of each biofuel is consumed. The responsiveness is determined by past responsiveness of the sector to increases in returns, differences in returns across sectors including the value of the compliance credits generated by the particular fuel pathways. In the case of renewable hydrocarbon fuels, expert judgement has been used on how responsive the industry, which doesn't currently exist in Canada, would be to expanded production incentives from the regulation based on the experience in other countries. In order to capture the lags associated with building new plants or converting existing facilities, the model includes a capacity building equation that functions off of multiple years of lagged returns. In addition, the model includes a capacity utilization which allows some flexibility in current production relative to current profitability. Production of renewable hydrocarbon fuels is determined by the product of capacity and capacity utilization. In the NZ-GR 20% LCIF scenario, ethanol consumption peaks out just above a 15 percent blend (not restricted in the model) and biomass-based diesel (biodiesel and renewable diesel) consumption peaks at a 12.1 percent blend in 2030.

Canadian imports of renewable diesel from Neste's Singapore plant are based on the additional incentives from the renewable fuel credit price specific to the feedstock pathway. Imports of renewable hydrocarbon fuels under the NZ-GR 20% LCIF scenario increase the most because the renewable fuel credit prices are the highest in that scenario. Renewable diesel imports increased by over 103 million liters in the NZ-GR 20% LCIF scenario versus the baseline. It is possible that imports of renewable diesel could be higher depending on the size of the renewable diesel expansion in the United States that is currently underway, but this will also be tied to US state and federal biofuels policy. Renewable diesel imports could be lower, should the Canadian market be more responsive to building capacity to meet the domestic and global demand.

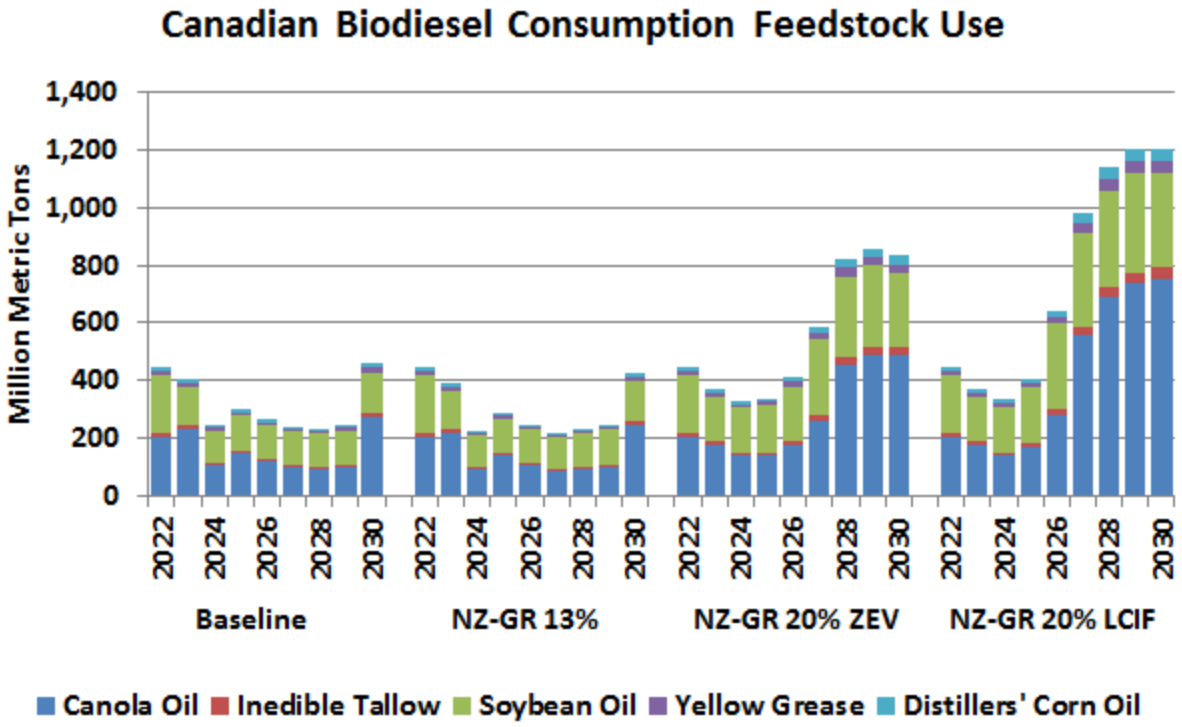
Biodiesel imports increase more significantly under the NZ-GR 20% LCIF scenario growing from 400 million liters in 2022 to 903 million liters by 2030. This production capacity could also be built in Canada, which would lower biodiesel imports.

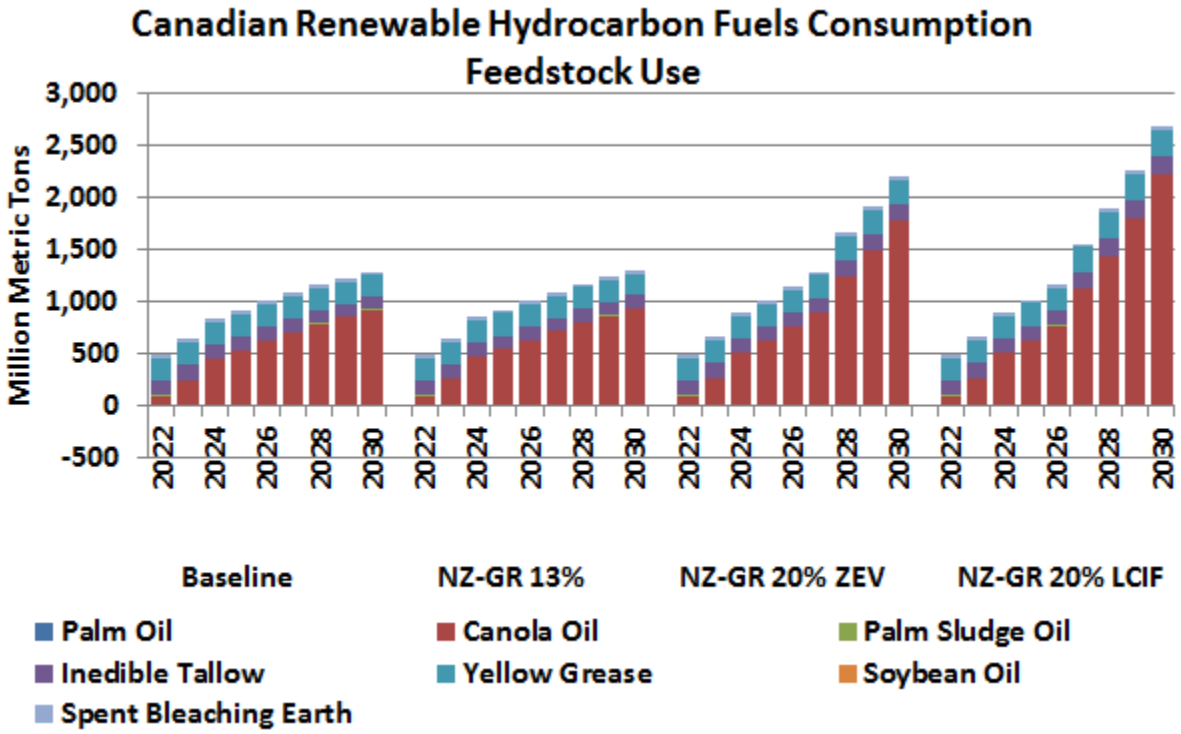
The scenarios illustrate the impact of the credit generation assumptions from non-biofuel sources and alternative obligated fossil fuel carbon intensity reduction levels. With higher credit generation assumptions from other sources, the need for credits from biofuels is reduced. The baseline and NZ-GR 13% scenarios have lower biofuel demands due to higher non-biofuel credit generation assumptions, (21.1 and 17.5, respectively). In the NZ-BR 20% LCIF scenario which includes a 20% reduction in fossil fuel carbon intensity levels, 15.1 m credits must be generated from biofuels in 2030 compared with only 6.6 mmt of credits in the Baseline in 2030.

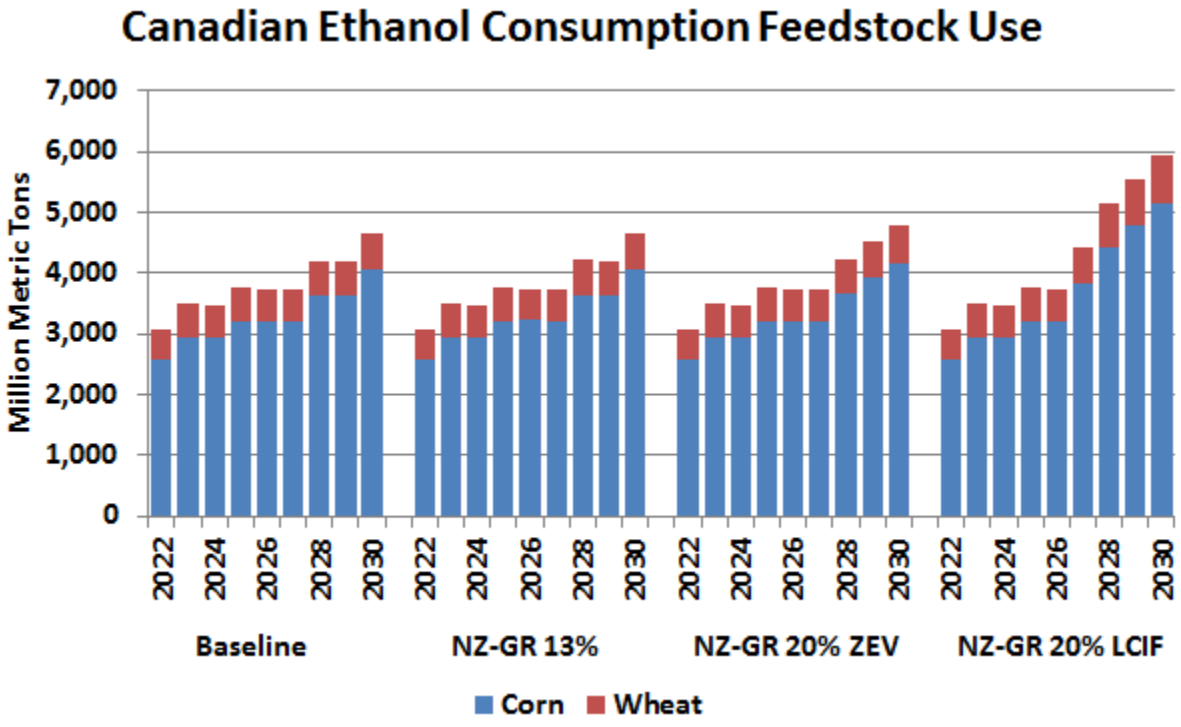
Feedstock Use

Feedstock use is determined by the expected net returns for each feedstock pathway, feedstock prices, and the available supply of feedstocks. Canola oil and soybean oil serve as the primary feedstocks due to their ample availability and comparable compliance credit values.

For biodiesel production, inedible tallow, white grease, and yellow grease have the lowest carbon intensity scores. However, there are only limited supplies of these feedstocks and we only allow them to reach about half of the available supply. Canola oil has the next lowest carbon intensity score subsequently resulting in it being the dominant source of feedstock to meet additional production. Corn and wheat remain the primary feedstocks for ethanol production.




Canadian Renewable Hydrocarbon Fuels Consumption
Feedstock Use
Million Metric Tons
3,000
2,500
2,000
1,500
1,000
500
0
-500
2022
2024
2026
2028
2030
Baseline
NZ-GR 13%
NZ-GR 20% ZEV
NZ-GR 20% LCIF
Palm Oil
Canola Oil
Palm Sludge Oil
Inedible Tallow
Yellow Grease
Soybean Oil
Spent Bleaching Earth

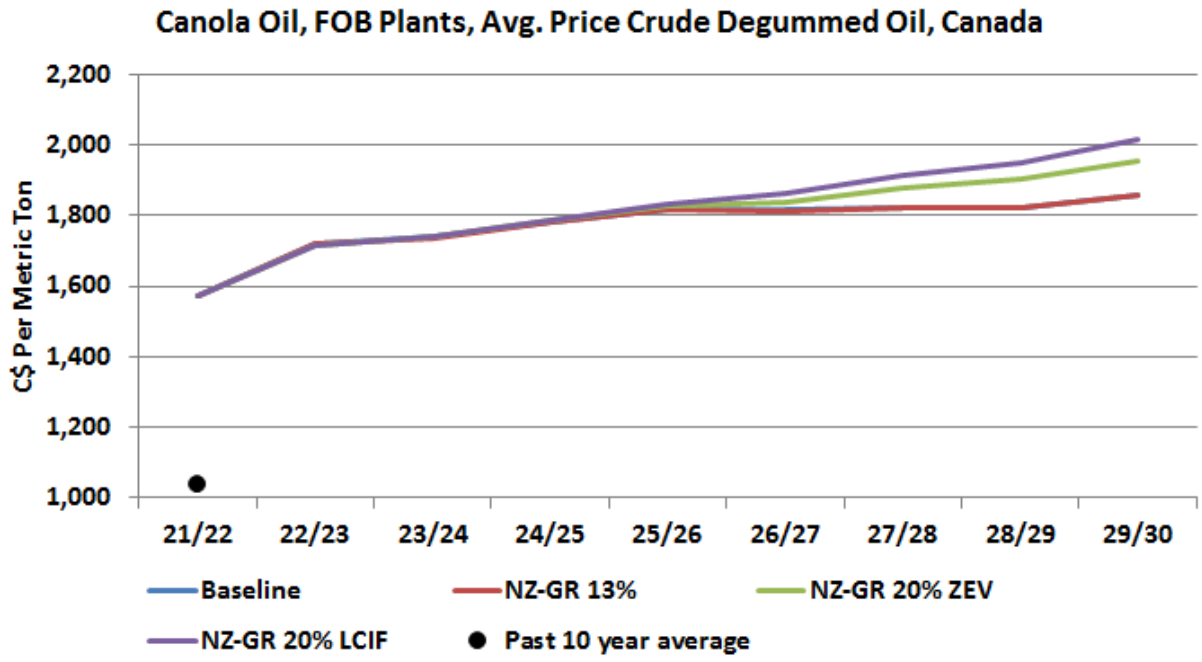

Canadian Ethanol Consumption Feedstock Use
Million Metric Tons
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2022
2024
2026
2028
2030
Baseline
NZ-GR 13%
NZ-GR 20% ZEV
NZ-GR 20% LCIF
Corn
Wheat

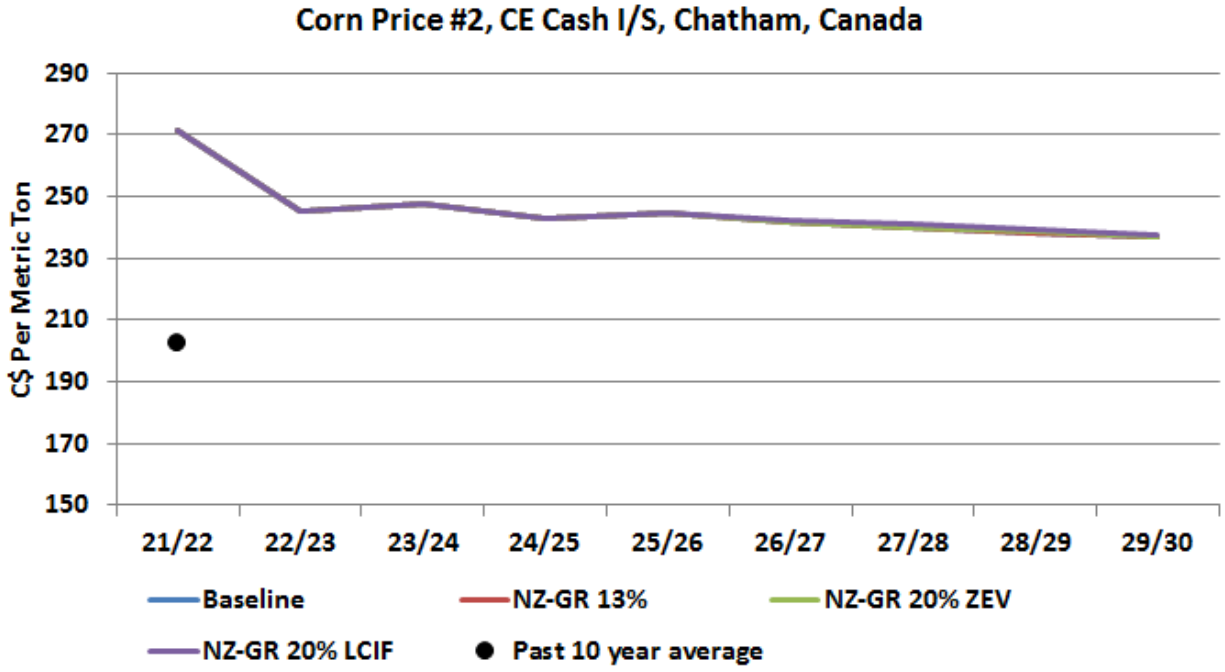
Feedstock Costs

These scenarios begin from a much higher starting point on feedstock prices versus last year's scenarios. Canola oil prices begin at almost $1,600 per metric ton, well above the ten year average of just over $1,000 per metric ton. A few of the market developments driving these higher prices include the European Union's phase out of palm oil use in biofuels, speculation and announcements around renewable diesel capacity expansion in the US, and the drought in Canada that occurred this past year significantly reducing canola production. The graphs below focus on the difference between the scenarios presented in this analysis all of which a run off the significantly higher feedstock prices in the baseline projections. Comparing across the scenarios, the NZ - GR 20% scenarios show modest impact on feedstock prices from the baseline levels. Canola oil prices are higher as more canola oil is used for the production of both biodiesel and renewable diesel. All prices in the WAEES tables are reported in nominal terms (i.e. not adjusted for inflation) although all equations include price adjusted for inflation in the WAEES econometric model.

In the NZ-GR 20% LCIF scenario with the highest biofuel demand, nominal canola oil prices increase 19 percent over the 2022 to 2030 period. In the Baseline scenario with the lowest biofuel demand, canola oil prices increase 7.8 percent over the 2022 to 2030 period. Comparing the NZ-GR 20% LCIF scenario with the Baseline, nominal canola oil prices are 10% higher by (crop year) 2030/31. This stems from the additional feedstock demand, which under the NZ-GR 20% LCIF scenario, increases canola oil use by 2.3 million metric tons over the 2022 to 2030 period of which 1.5 million metric tons is the quantity above Baseline levels.

Although more corn and wheat are used to produce ethanol for the Canadian CFS, in a global context, the increase in demand is a relatively small amount resulting in very little impact on corn prices across the scenarios.

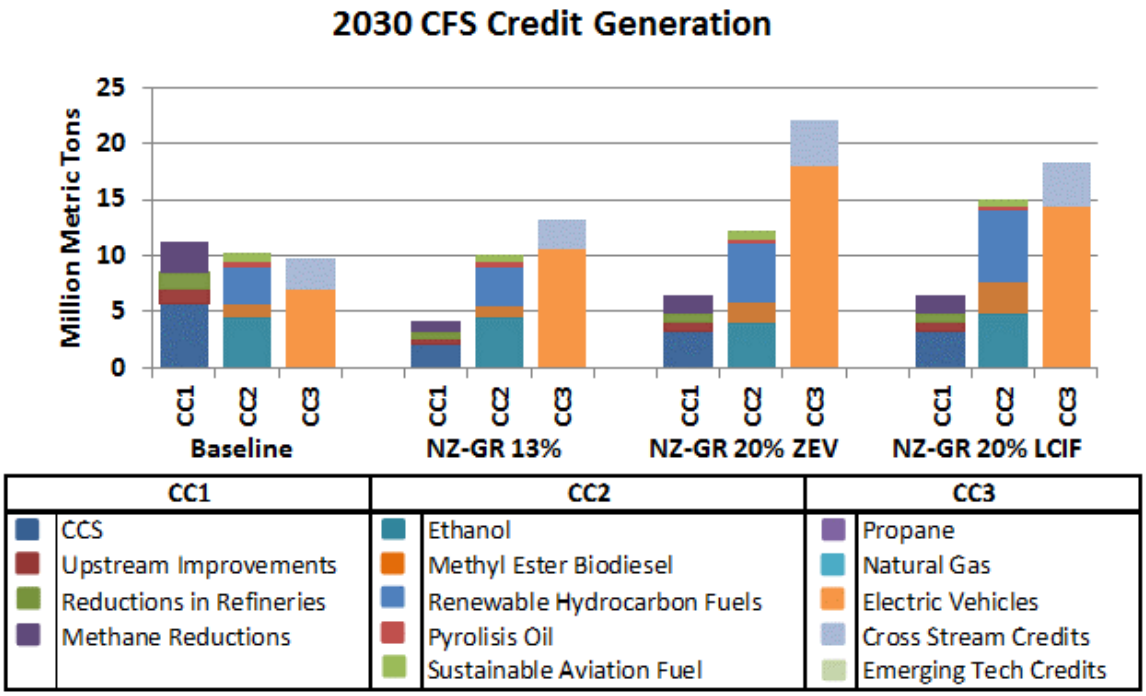


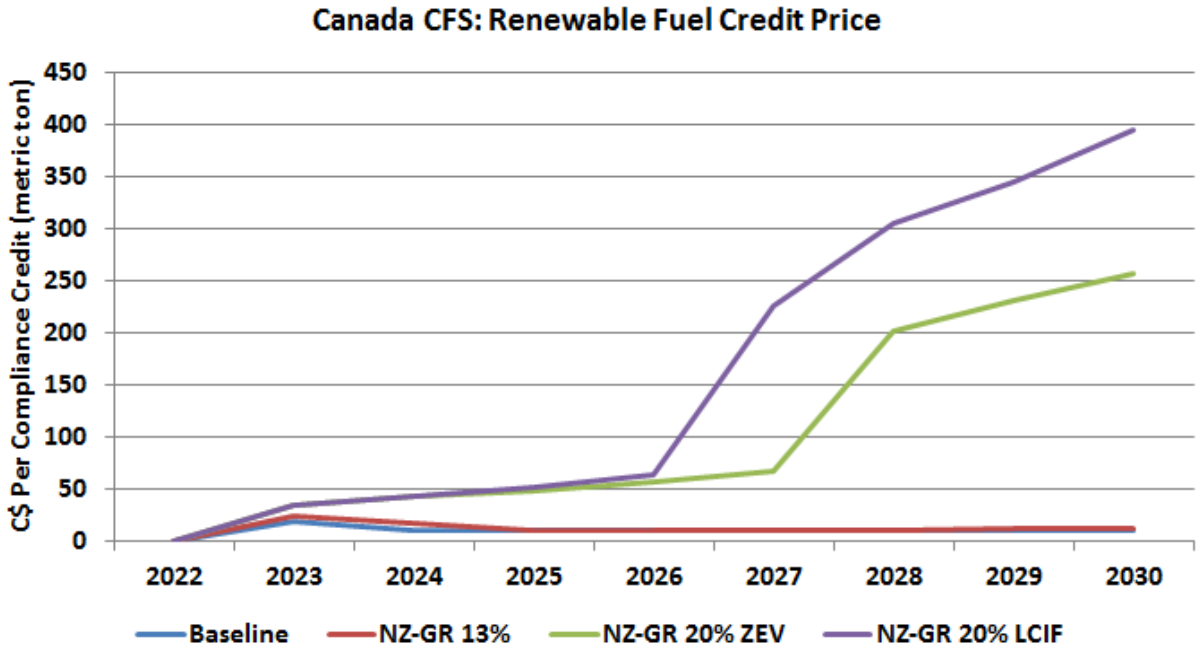


Compliance Credits

The graph below illustrates the CFS credits in 2030 generated from each compliance category for each scenario. Compliance category 2 (CC2) is primarily made up of credits from biofuels. In the Baseline scenario, the credits appear to be evenly spread across the compliance categories. However, this is deceptive in that CC2 credits generated in the baseline are actually driven by provincial policy rather than the CFS. Similarly, in the NZ-GR 13% scenario, the CC2 credits generated are driven by provincial policies, not the CFS. In the NZ-GR 20% ZEV and NZ-GR 20% LCIF scenarios, the required CC2 credits from the CFS move above the provincial policy requirements beginning in 2025.

The CFS Credit Generation graph below illustrates how the price of compliance credits change as more biofuels are needed to meet the CFS standard. As modelled, the renewable fuel credit prices are driven by the quantity of credits that need to come from biofuels. The higher the volume of biofuels required, the higher the renewable fuel credit price. Importantly, CC1 and CC3 would also likely respond to a higher credit price, but the supply curves for the sources of these other credits are unknown. In all scenarios, cross-stream gaseous credits are assumed to be utilized to the 10% maximum allowance, since these credits are likely to be produced and available pursuant to other federal and provincial climate policies.





Summary & Conclusions

The analysis evaluates the impact of introducing the Clean Fuel Standard as a national policy in Canada directed at reducing carbon emissions. The analysis is focused on the biofuels sector and provides results for alternative scenarios regarding the assumed level of compliance credits from other sources.

The analysis evaluated four scenarios with alternative assumptions regarding compliance credits generated from non-biofuel sources. The Baseline and NZ-GR 13% scenarios utilized the current proposed CFS program goals of reducing fossil fuel carbon intensity by 13 percent by 2030 and the NZ-GR 20% ZEV and NZ-GR 20% LCIF scenarios evaluated a stronger goal of reducing fossil fuel carbon intensity by 20 percent by 2030. All the NZ-GR scenarios impose a 25% limit on non-fossil clean fuel credit use in each compliance period (i.e. credits other than CC2, CC3, and co-processed fuels). With the assumed credit contributions from CC1 and CC3 categories, both the Baseline and NZ-GR 13% scenarios resolve using the provincial blend requirements because the CC2 credits required by the CFS were below provincial blend regulatory requirements.

Under the NZ-GR 20% ZEV and the NZ-GR 20% LCIF scenarios, the CC2 biofuel requirements are higher than the provincial blend requirements and result in growth in domestic production of ethanol, biodiesel, and renewable hydrocarbon fuels. Biomass-based diesel consumption (biodiesel and renewable diesel) expands by significantly more over the projection period than ethanol consumption. This reflects the lower carbon intensity scores assigned to biodiesel and

renewable diesel feedstock pathways which results in carbon credit values that are more than double the ethanol pathways. Due to limited supplies of inedible tallow, yellow grease, and white grease, much of the feedstock demand increases fall to canola oil which is in surplus supply in Canada. In the NZ-GR 20% LCIF scenario with the highest biofuel demand, canola oil prices increase 19 percent over the 2022 to 2030 period. In the Baseline scenario with the lowest biofuel demand, canola oil prices increase 7.8 percent over the 2022 to 2030 period reflecting ongoing strong global vegetable oil demand. Feedstock prices for ethanol increase very slightly because the demand increase is not significant in a global context.

The table below captures the impact on Canadian biofuel production and imports. As more compliance credits are filled by biofuels, the production and imports expand to meet the CFS requirements.

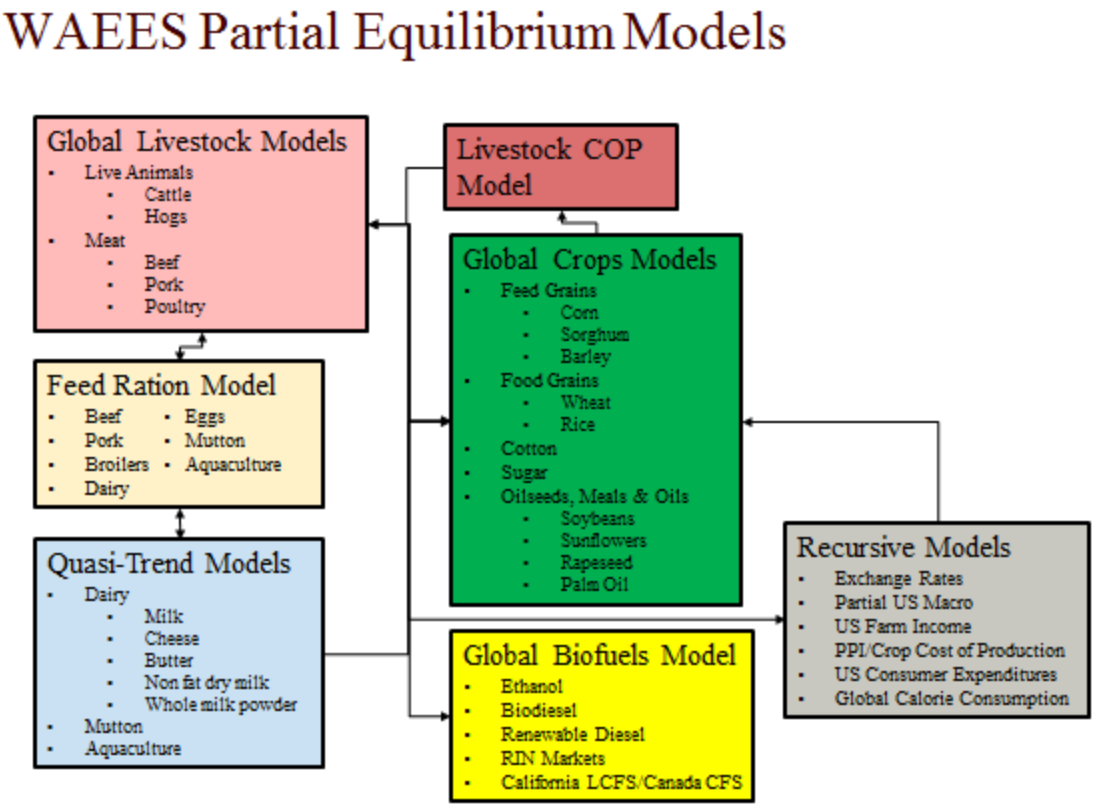
The analysis results are dependent on the global context in terms of the supply, demand, and prices of biofuels and feedstocks and the policy assumptions for other countries. International supply and demand conditions for feedstocks and biofuels can influence their availability and prices in Canada and ultimately the level of the renewable fuel credit price.

Biofuel Impacts by Scenario

	Scenarios			
	Baseline	NZ-GR 13%	NZ-GR 20% ZEV	NZ-GR 20% LCIF
	million metric tons in the year 2030			
Non-Biofuel Compliance Credits	21.1	17.5	28.6	24.8
	growth from 2022 to 2030 in million liters			
Biodiesel				
Domestic Production	189	156	236	374
% change	55%	46%	69%	109%
Imports	-23	-33	271	504
% change	-6%	-9%	68%	126%
Renewable Hydrocarbon Fuels				
Domestic Production	828	843	1,682	2,130
Imports	-29	-29	36	73
% change	-7%	-7%	9%	18%
Ethanol				
Domestic Production	1,757	1,756	1,592	2,596
% change	92%	92%	83%	135%
Imports	-172	-171	111	264
% change	-14%	-14%	9%	22%
	volumetric percent blend rates in the year 2030			
Ethanol Blend Rate	12.2%	12.2%	12.6%	15.4%
Biomass Based Diesel Blend Rate	5.4%	5.4%	9.5%	12.1%
Biodiesel Blend Rate	1.4%	1.3%	2.6%	3.7%
Renewable Diesel Blend Rate	4.0%	4.0%	6.9%	8.4%

Appendix A – Overview of the WAEES Global Agricultural and Biofuels Econometric Model

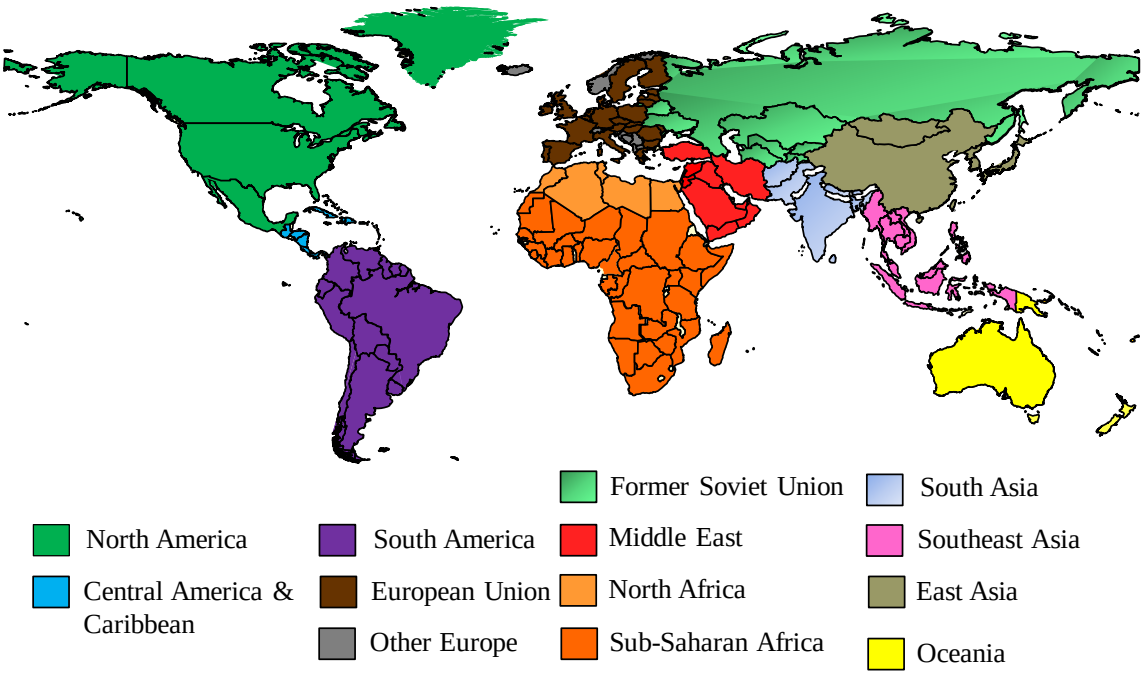
The WAEES partial equilibrium modeling system is made up of a set of global econometric models emulating the behavior of the global agricultural sector. The partial equilibrium models can be broken down into crops, livestock and biofuels components encompassing feed grains, food grains, cotton, sugar, oilseeds, beef, pork, poultry, ethanol, biodiesel, and renewable diesel.



The WAEES models cover 48 countries/regions with an additional 12 regional aggregates including the world total. WAEES follows USDA's reported data coverage which may mean that a zero is reported for a particular commodity which USDA does not cover or has discontinued covering. USDA currently covers at least 90 percent of global production; therefore, the countries which are omitted represent a small portion of total global production. Specifically the WAEES model includes Canada, Mexico, the United States, Caribbean and Central America, Argentina, Brazil, Bolivia, Chile, Colombia, Paraguay, Uruguay, Other South America, the

European Union 28, Other Europe, Kazakhstan, Russia, Ukraine, Uzbekistan, Other Former Soviet Union, Iran, Saudi Arabia, Turkey, Other Middle East, China, Japan, South Korea, Taiwan, Other East Asia, Bangladesh, India, Pakistan, Other South Asia, Indonesia, Malaysia, Myanmar, Philippines, Thailand, Vietnam, Other Southeast Asia, Australia, Other Oceania, Egypt, Morocco, Other North Africa, Kenya, Nigeria, South Africa, and Other Sub-Saharan Africa. WAEES also reports projections on crop area, yield, and production for each of the EU-28 countries.

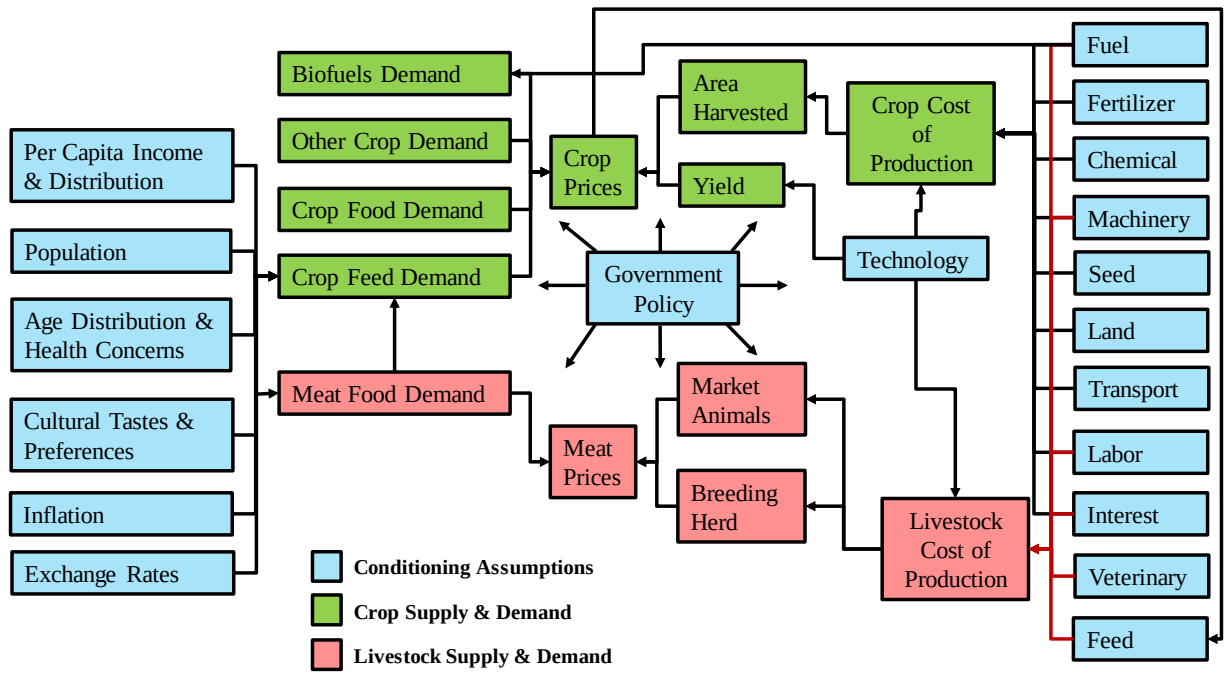
WAEES Regions follow the USDA Regions



Partial Equilibrium Models

Each partial equilibrium module is broken down into commodities with a system of structural equations capturing the supply and demand components for each of them. The drivers of these equations are theoretically derived based upon the behavioral postulates from economic theory of profit maximization by the market participants and utility maximization by consumers subject to various domestic and international trade policies. The diagram below illustrates the inter-linkages of the crops and livestock model. In the diagram, the blue boxes represent the key drivers (conditioning assumptions) of the agricultural sector including income, population, culture, inflation, exchange rates, domestic and trade policy, technology and input costs. The

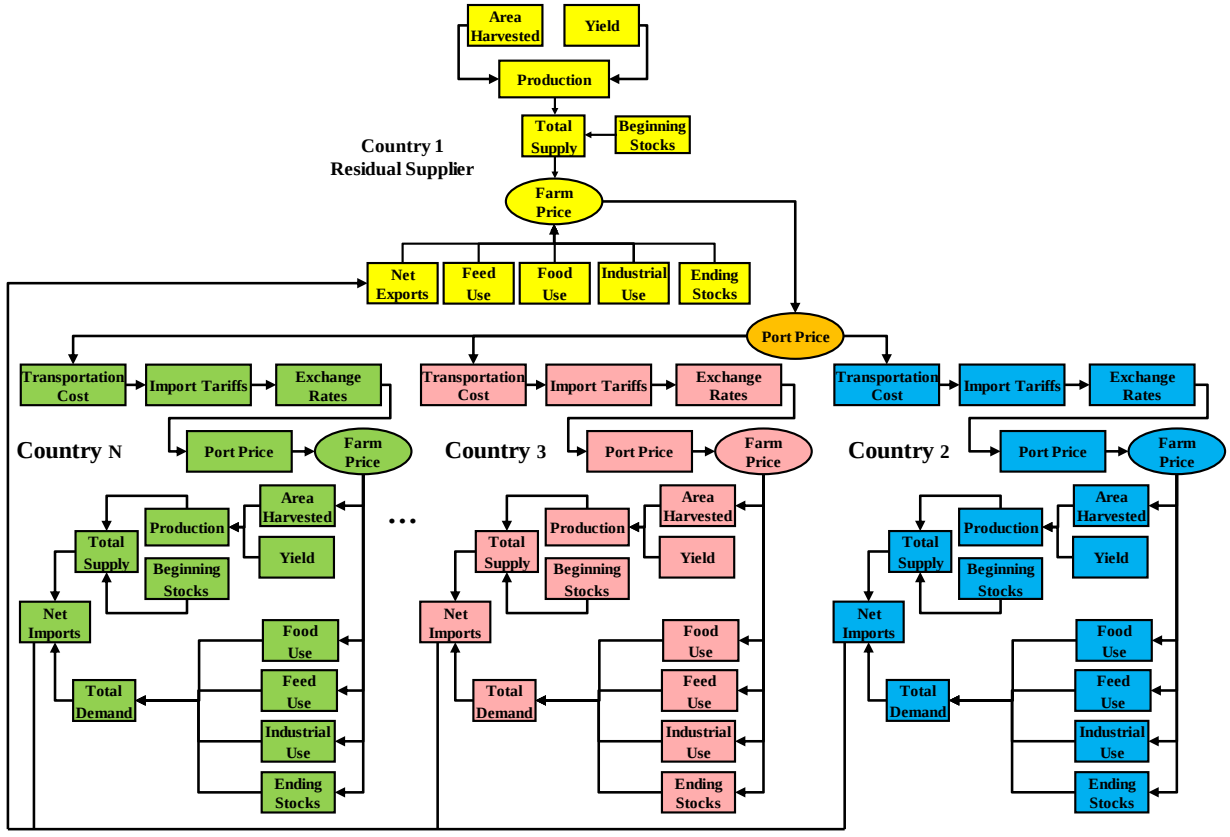
green boxes are an aggregate approximation of the crops sector. As relevant, each box represents an equation for each commodity covered. For example, there are specific feed demand equations for corn, sorghum, barley, soybean meal, sunflower meal, etc. The pink boxes are an aggregate approximation (within the diagram) of the detailed livestock sector model encompassing beef, pork and broilers. The diagram illustrates how income, population, and other factors drive food demand for crops and meats. Crude oil prices (and policies) drive the demand for biofuels. As demand increases, crop prices increase providing an incentive for production expansion. Technology growth (based on historical yield improvement trends) drives yield expansion providing much of the needed production. Crop area may also grow to meet demand needs although in developed countries this often amounts to tradeoffs among crops and fallow land. Ultimately supply and demand are balanced via commodity prices. If demand is stronger than supply, commodity prices increase until demand growth is slowed and supply growth is increases enough for supply and demand to balance.



The WAEES partial equilibrium models solve iteratively to find equilibrium by balancing global supply and demand. This occurs at the individual country level for each commodity. Most countries are at least somewhat open to trade albeit with tariffs. The trade diagram below

illustrates conceptually how global supply and demands are balanced within a "global" price equilibrium solution. Typically, a large exporting country is chosen as the residual supplier for the world. The choice of this country does not affect the solution. The commodity price in the residual supplying country is solved for by assuming an initial level of exports. This price is then transferred to other countries through trade barriers, transportation costs, and exchange rates. Based on a given price level, each country determines how much it is willing to supply or demand at that price and subsequently how much it wants to import or export. While not depicted in the diagram below, occasionally a country has tariffs high enough that no trade will occur or only a fixed amount of trade will occur at the lower tariff level. Note that in those countries internal prices may not reflect the world level of prices because supply and demand must be balanced from domestic sources. After the supply and demand in each country is determined and the implied trade position, these trade positions are summed to find the new level of exports for the residual supplying country replacing the initial assumption. The process then repeats itself until prices adjust to balance global supply and demand. For example, if the sum of trade across all other countries is lower than the initial starting assumption for the residual supplying country, the price level in the residual supplying country will fall to balance supply and demand. This lower price level will then get transferred to all other countries affecting their supply and demand and ultimately net trade positions and of course replace the exports again in the residual supplying country. This process continues until global supply and demand balance.

WAEES Structural Partial Equilibrium Models

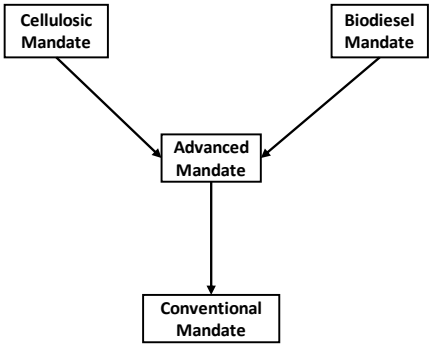


An Example of the US Partial Equilibrium Model for the Biofuels Sector

Within the WAEES model, the US ethanol, biodiesel and renewable diesel sectors are set up as partial equilibrium models with supply and demand equations and an endogenous ethanol, biodiesel and renewable diesel price. The structure of the model has its roots in the ethanol specifications documented by John Kruse, Patrick Westhoff, Seth Meyer, and Wyatt Thompson in a 2007 journal article in AgBioForum entitled, "Economic impacts of not extending biofuel subsidies." With the second Renewable Fuel Standard, these original specifications have been updated to reflect the hierarchical system of mandates. The biofuels mandates require compliance with each specific mandate type including biodiesel, cellulosic, advanced and the overall renewable fuel mandate. The rationale for different mandates in the legislation was to encourage biofuel producers to move towards feedstocks that provided the greatest level of greenhouse gas (GHG) reductions compared with conventional petroleum. The term "advanced biofuels" was used to describe biofuels that reduced GHG emissions by at least 50 percent compared with a 20 percent reduction requirement for conventional feedstocks. Cellulosic derived biofuels must reduce GHG emissions by 60 percent. Compliance with the mandates by the obligated parties is enforced by the EPA through as system of Renewal

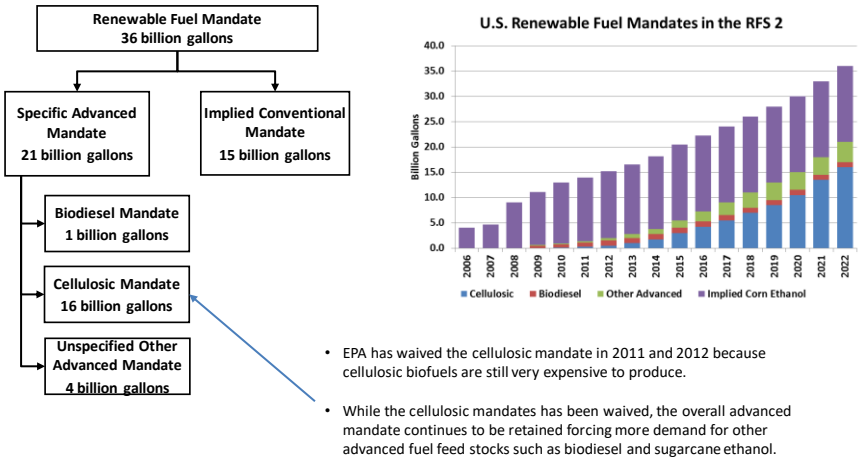
Identification Numbers (RINS) assigned to each type of biofuel produced. Obligated parties must demonstrate that they have met their assigned obligations through the number of RINS they have for each type of fuel. Theoretically there could be a specific RIN value for each type of mandate – cellulosic, biodiesel, advanced, and conventional, if each mandate was binding. Mandates are binding when the market is forced by policy to produce more than what normal economic conditions would suggest.

Hierarchical RINS Modeling



- Theoretically there can be 4 different RIN prices specific to each mandate if all the mandates are binding.
- Mandates are binding when the market is forced by policy to produce more than what normal economic conditions would suggest.
- Given the hierarchy of the mandates, it must be the case that RIN values for biodiesel are greater than or equal to advanced RIN values and advanced RIN values must be greater than or equal to conventional RINS. This is because biodiesel RINS can be used as advanced RINS and advanced RINS can be used as conventional RINS. (This process is referred to as demotion.)
- Biodiesel RINS can have the same value as advanced RINS if the biodiesel mandate is less binding than the advanced mandate.

US Biofuels Mandates in 2022



A diagram of the US biofuels models is presented below. The US biofuels sector is made up of ethanol, biodiesel, and renewable diesel. Although there are many state mandates, the diagram illustrates the national Renewable Fuel Standard (RFS) and the California Low Carbon Fuel Standard (LCFS). The RFS is enforced through the supply and demand of RINs with RIN values reflected in the plant or wholesale prices of the various biofuels. RIN values increase if more biofuel production needs to be incentivized to meet the annual volume obligations set by the Environmental Protection Agency. Simultaneously, the California LCFS requires specific reductions in carbon emissions from transportation fuel use. The program works through a system of carbon debits and credits. Fossil fuels generate debits which must be offset by credits which are generated by a variety of sources including biofuels. For biofuels, carbon credits are calculated based on the carbon intensity of each feedstock pathway. Biofuel producers are incentivized by the carbon price which creates a different incentive for each feedstock pathway based on the carbon intensity of that pathway. The LCFS allows other non-biofuel renewable fuel sources such as electric cars to generate carbon credits. The WAEES models include specific assumptions about the other sources of carbon credit generation based on the California Air Resources Board's Illustrative Compliance Scenarios model released in 2018.

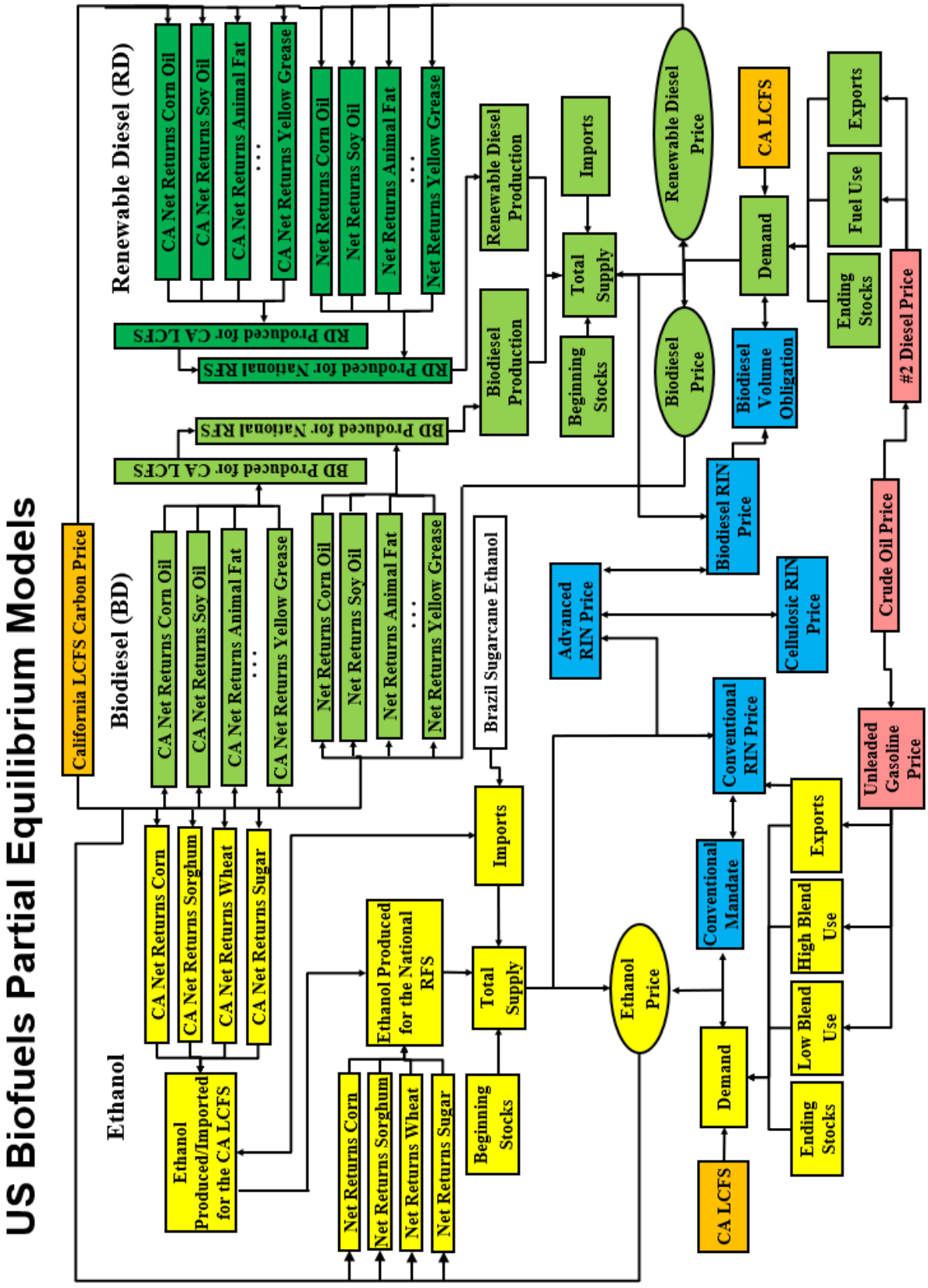
Although neither of these policies are detailed in the diagram below, the influence of the RFS and California LCFS can be seen in the diagram. Each of the biofuels includes the incentive (net returns) provided by each feedstock pathway for biofuels produced for California use or biofuels produced to meet the national RFS. Biofuels produced for the California LCFS get the

extra boost of the LCFS carbon price translated into a per gallon value based on the carbon intensity of the feedstock pathway. Biofuels produced for the national RFS but not used for the California LCFS do not realize the incentives from the LCFS carbon price. Since there are stronger incentives in the California LCFS, feedstocks compete to fill the California LCFS requirements first. Biofuels produced for the California LCFS also count towards the volume obligation requirements under the RFS.

RIN values are the primary method to incentivize biofuel production outside the California system. There is an interaction between RIN values and the California LCFS Carbon price in the model. The presence of the LCFS carbon price tends to reduce RIN values because it creates incentives to expand biofuels supply. If the LCFS carbon price weakens, RIN values tend to increase to the extent needed for the national RFS compliance. The LCFS carbon price is influence by the carbon debits created by fossil fuel use as well as credits generation by non-biofuel and biofuel sources. For example, stronger adoption of electric cars results if fewer carbon credits demanded from biofuels and lower LCFS carbon prices.

Biodiesel and renewable diesel are separated on the supply side because they each experience different incentives based on the biodiesel and renewable diesel price as well as the feedstock pathway. In both cases the LCFS carbon price provides an extra return to biofuel producers (producing for the California LCFS) specific to the carbon intensity of the feedstock pathway. However, renewable diesel also enjoys an addition price premium due to its full fungibility with petroleum. Generally, this results in stronger incentives to expand renewable diesel production than biodiesel production. Each feedstock pathway then has an associated supply curve captured by the model driven by the net returns of the pathway. Note that feedstock prices will increase as more feedstock are demanded reducing the profitability of the affected pathway. The supply and demand of each biofuel feedstock as well as substitution across feedstocks determine the feedstock price.

The total supply of each biofuel is determined by the underlying supply curves for each feedstock pathway. The demand for ethanol, biodiesel, and renewable diesel is determined by the RFS and LCFS credits required from biofuels. Higher blend ethanol uses also compete on price and fuel economy. Large adoption of higher ethanol blends is generally not incentivized under the current national RFS policy, but the CA LFCS does provide enough incentive that is likely that E15 blends can be attained in California. Based on the U.S. Department of Energy, Energy Information Administration projections of falling motor gasoline consumption, the 15-billion-gallon volume obligation for conventional biofuels would seem to push ethanol through the 10 percent blend wall. However, this will depend on the extent to which renewable diesel production growth is incentivized by the LCFS possibly resulting in Diesel RINs being used to fill the convention RIN volume obligation.


US Biofuels Partial Equilibrium Models
California LCFS Carbon Price
Ethanol
Biodiesel (BD)
Renewable Diesel (RD)
CA Net Returns Corn
CA Net Returns Sorghum
CA Net Returns Wheat
CA Net Returns Sugar
Ethanol Produced/Imported for the CA LCFS
Net Returns Corn
Net Returns Sorghum
Net Returns Wheat
Net Returns Sugar
Ethanol Produced for the National RFS
Beginning Stocks
Imports
Total Supply
Ethanol Price
Brazil Sugarcane Ethanol
CA Net Returns Corn Oil
CA Net Returns Soy Oil
CA Net Returns Animal Fat
CA Net Returns Yellow Grease
Net Returns Corn Oil
Net Returns Soy Oil
Net Returns Animal Fat
Net Returns Yellow Grease
BD Produced for CA LCFS
BD Produced for National RFS
RD Produced for CA LCFS
RD Produced for National RFS
Biodiesel Production
Renewable Diesel Production
Beginning Stocks
Imports
Total Supply
Biodiesel Price
Renewable Diesel Price
Biodiesel RIN Price
Advanced RIN Price
Cellulosic RIN Price
Conventional RIN Price
Conventional Mandate
Biodiesel Volume Obligation
CA LCFS
Demand
Exports
Fuel Use
Ending Stocks
High Blend Use
Low Blend Use
Crude Oil Price
#2 Diesel Price
Unleaded Gasoline Price

Appendix B – Scenario Summary Tables

Results for the Baseline

Canada Biomass Based Diesel Supply and Demand: Baseline

Calendar Year	Units	2022	2023	2024	2025	2026	2028	2030
Diesel Fuel Use and Biofuels Policy								
Diesel Transportation Use (excluding biofuels)	Million Liters	26,466	26,860	27,309	27,648	28,055	28,844	29,435
Biodiesel Supply & Use								
Beginning Stocks	Million Liters	0	0	0	0	0	0	0
Production	Million Liters	341	475	320	372	338	307	530
Imports	Million Liters	364	353	346	345	344	342	341
Total Supply	Million Liters	706	827	666	717	682	648	871
Domestic Use	Million Liters	450	403	245	298	264	233	460
Exports	Million Liters	256	424	421	419	418	415	412
Ending Stocks	Million Liters	0	0	0	0	0	0	0
Total Demand	Million Liters	706	827	666	717	682	648	871
Renewable Hydrocarbon Fuels Supply & Use								
Beginning Stocks	Million Liters	0	0	0	0	0	0	0
Production	Million Liters	93	246	450	532	620	788	922
Imports	Million Liters	397	396	387	383	381	375	368
Total Supply	Million Liters	491	642	837	916	1,002	1,163	1,290
Domestic Use	Million Liters	491	642	837	916	1,002	1,163	1,290
Exports	Million Liters	0	0	0	0	0	0	0
Ending Stocks	Million Liters	0	0	0	0	0	0	0
Total Demand	Million Liters	491	642	837	916	1,002	1,163	1,290
Domestic Feedstocks								
Canola Oil (Biodiesel Plants)	1000 Metric Tons	200	315	178	223	190	154	343
Canola Oil (Renewable Hydrocarbon Fuels Plants)	1000 Metric Tons	86	226	413	488	569	723	846
Inedible Tallow	1000 Metric Tons	10	11	8	8	9	10	13
Soybean Oil	1000 Metric Tons	76	78	76	77	78	80	84
Yellow Grease	1000 Metric Tons	12	12	12	12	12	12	12
Distillers Corn Oil	1000 Metric Tons	11	13	14	16	17	21	26
Domestic Feedstock Yield								
Canola Oil	1000 Liters/MT	1.11	1.11	1.11	1.11	1.11	1.11	1.11
Inedible Tallow	1000 Liters/MT	1.04	1.04	1.04	1.04	1.04	1.04	1.04
Soybean Oil	1000 Liters/MT	1.11	1.11	1.11	1.11	1.11	1.11	1.11
Yellow Grease	1000 Liters/MT	1.04	1.04	1.04	1.04	1.04	1.04	1.04
Distillers Corn Oil	1000 Liters/MT	1.11	1.11	1.11	1.11	1.11	1.11	1.11
Biomass-based Diesel Prices								
BC/AB Canada B99 Rack Price	CAD/Liter	1.29	1.23	1.20	1.20	1.23	1.28	1.39
Canada HDRD Wholesale Price	CAD/Liter	2.39	2.38	2.37	2.38	2.41	2.45	2.46

Canada Ethanol Supply and Demand: Baseline

Calendar Year	Units	2022	2023	2024	2025	2026	2028	2030
Gasoline Fuel Use and Biofuels Policy								
Gasoline Transportation Use	Million Liters	36,338	35,863	35,675	35,274	35,072	34,328	33,588
Supply & Demand								
Beginning Stocks	Million Liters	0	0	0	0	0	0	0
Production	Million Liters	1,915	2,240	2,338	2,648	2,669	3,178	3,671
Imports	Million Liters	1,196	1,281	1,171	1,138	1,101	1,059	1,023
Total Supply	Million Liters	3,110	3,521	3,509	3,787	3,770	4,237	4,695
Domestic Use	Million Liters	3,079	3,490	3,478	3,755	3,739	4,206	4,663
Exports	Million Liters	31	31	31	31	31	31	31
Ending Stocks	Million Liters	0	0	0	0	0	0	0
Total Demand	Million Liters	3,110	3,521	3,509	3,787	3,770	4,237	4,695
Feedstocks								
Corn	1000 Metric Tons	3,723	4,433	4,730	5,487	5,543	6,775	7,958
Wheat	1000 Metric Tons	921	996	930	916	910	898	898
Feedstock Yield								
Corn	1000 Liters/MT	0.42	0.42	0.42	0.42	0.42	0.42	0.42
Wheat	1000 Liters/MT	0.39	0.39	0.39	0.39	0.39	0.39	0.39
Distillers' Grains Production								
Corn	1000 Metric Tons	1,130	1,346	1,436	1,666	1,683	2,057	2,416
Wheat	1000 Metric Tons	279	302	282	278	276	273	272
Wholesale Ethanol Price (excludes CFS Credit Value)	CAD/Liter	0.69	0.68	0.67	0.66	0.67	0.67	0.68

Canada CFS Program Parameters: Baseline

Calendar Year	Units	2022	2023	2024	2025	2026	2028	2030
Program Goals								
2016 Stream Carbon Intensity	tCO2e/TJ	91.6	91.6	91.6	91.6	91.6	91.6	91.6
Credit Stream Carbon Intensity Reference	tCO2e/TJ	89.3	88.2	87.0	85.9	84.7	82.4	80.1
Obligated Fossil Fuel Carbon Intensity Reduction	tCO2e/TJ	2.4	3.6	4.8	6.0	7.2	9.6	12.0
Obligated Jet Fuel Carbon Intensity Reduction	tCO2e/TJ	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy Economy Ratios								
Hydrogen (Gasoline)	Ratio	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Hydrogen (Diesel)	Ratio	1.9	1.9	1.9	1.9	1.9	1.9	1.9
CNG (Diesel)	Ratio	0.9	0.9	0.9	0.9	0.9	0.9	0.9
EV (Gasoline)	Ratio	4.1	4.1	4.1	4.1	4.1	4.1	4.1
EV (Diesel)	Ratio	5	5	5	5	5	5	5
Energy Density of Fuels								
Gasoline	MJ/Liter	34.69	34.69	34.69	34.69	34.69	34.69	34.69
Diesel	MJ/Liter	38.65	38.65	38.65	38.65	38.65	38.65	38.65
Aviation Fuel	MJ/Liter	35.46	35.46	35.46	35.46	35.46	35.46	35.46
Ethanol	MJ/Liter	23.58	23.58	23.58	23.58	23.58	23.58	23.58
Biodiesel	MJ/Liter	35.40	35.40	35.40	35.40	35.40	35.40	35.40
Renewable Hydrocarbon Fuels (HDRD)	MJ/Liter	36.51	36.51	36.51	36.51	36.51	36.51	36.51
Sustainable Aviation Fuel	MJ/Liter	34.81	34.81	34.81	34.81	34.81	34.81	34.81
Electricity	MJ/kWh	3.60	3.60	3.60	3.60	3.60	3.60	3.60
LFO	MJ/Liter	38.80	38.80	38.80	38.80	38.80	38.80	38.80
Kerosene	MJ/Liter	37.68	37.68	37.68	37.68	37.68	37.68	37.68
Pyrolisis Oil (Biocrude)	MJ/Liter	21.35	21.35	21.35	21.35	21.35	21.35	21.35
HFO	MJ/Liter	41.10	41.10	41.10	41.10	41.10	41.10	41.10

Canada CFS Carbon Intensity Average Scores: Baseline

Calendar Year	Units	2022	2023	2024	2025	2026	2028	2030
Motor gasoline	tCO2e/TJ	91.9	91.9	91.9	91.9	91.9	91.9	91.9
Ethanol	tCO2e/TJ							
Ethanol from corn	tCO2e/TJ	44.1	43.5	43.0	42.5	41.9	40.9	39.8
Ethanol from wheat	tCO2e/TJ	38.6	38.2	37.8	37.4	37.0	36.2	35.3
Diesel fuel oil	tCO2e/TJ	97.1	97.1	97.1	97.1	97.1	97.1	97.1
Biodiesel	tCO2e/TJ							
Biodiesel from canola oil	tCO2e/TJ	9.6	9.4	9.3	9.2	9.1	8.8	8.6
Biodiesel from inedible tallow	tCO2e/TJ	-1.2	-1.3	-1.4	-1.5	-1.7	-1.9	-2.1
Biodiesel from soybean oil	tCO2e/TJ	16.8	16.6	16.5	16.3	16.1	15.8	15.5
Biodiesel from yellow grease	tCO2e/TJ	4.2	4.2	4.1	4.0	3.9	3.8	3.7
Biodiesel from distillers corn oil	tCO2e/TJ	16.7	16.5	16.3	16.1	15.9	15.4	15.0
Biodiesel from unknown	tCO2e/TJ	3.8	3.8	3.8	3.8	3.8	3.8	3.8
Renewable Hydrocarbon Fuels (HDRD) (weighted avg)	tCO2e/TJ							
Renewable Hydrocarbon Fuels from palm oil	tCO2e/TJ	71.7	71.3	71.0	70.6	70.3	69.6	68.9
Renewable Hydrocarbon Fuels from canola oil	tCO2e/TJ	9.6	9.4	9.3	9.2	9.1	8.8	8.6
Renewable Hydrocarbon Fuels from palm sludge oil	tCO2e/TJ	11.2	11.1	11.1	11.1	11.0	10.9	10.9
Renewable Hydrocarbon Fuels from tallow	tCO2e/TJ	7.2	7.1	7.0	6.9	6.9	6.7	6.5
Renewable Hydrocarbon Fuels from yellow grease	tCO2e/TJ	12.7	12.6	12.6	12.5	12.4	12.3	12.2
Renewable Hydrocarbon Fuels from soybean oil	tCO2e/TJ	30.8	30.6	30.4	30.2	30.0	29.6	29.2
Renewable Hydrocarbon Fuels from spent bleaching earth	tCO2e/TJ	18.6	18.4	18.3	18.2	18.0	17.8	17.5
Light fuel oil	tCO2e/TJ	87.0	87.0	87.0	87.0	87.0	87.0	87.0
Kerosene & stove oil	tCO2e/TJ	82.0	82.0	82.0	82.0	82.0	82.0	82.0
Heavy fuel oil	tCO2e/TJ	91.0	91.0	91.0	91.0	91.0	91.0	91.0
Pyrolisis Oil (Biocrude)	tCO2e/TJ	25.0	24.0	23.0	22.0	21.0	19.0	17.0
Aviation gasoline	tCO2e/TJ	94.0	94.0	94.0	94.0	94.0	94.0	94.0
Aviation turbo fuel	tCO2e/TJ	90.1	90.1	90.1	90.1	90.1	90.1	90.1
Sustainable Aviation Fuel	tCO2e/TJ	30.0	30.0	30.0	30.0	30.0	30.0	30.0
Propane Vehicle	tCO2e/TJ	68.0	68.0	68.0	68.0	68.0	68.0	68.0
Natural Gas Vehicle	tCO2e/TJ	62.9	62.9	62.9	62.9	62.9	62.9	62.9
EV (Gasoline)	tCO2e/TJ	21.7	21.7	21.7	21.7	21.7	21.7	21.7

Canada Fuel Consumption Volumes: Baseline

Calendar Year	Units	2022	2023	2024	2025	2026	2028	2030
Blended Gasoline (volumetric total)	million liters	39,417	39,354	39,152	39,029	38,811	38,534	38,251
Motor gasoline	million liters	36,338	35,863	35,675	35,274	35,072	34,328	33,588
Ethanol	million liters	3,079	3,490	3,478	3,755	3,739	4,206	4,663
Ethanol from corn	million liters	2,588	2,937	2,939	3,199	3,216	3,624	4,048
Ethanol from wheat	million liters	491	553	539	556	523	582	615
Blended Diesel (volumetric total)	million liters	27,359	27,853	28,337	28,802	29,260	30,175	31,104
Diesel fuel oil	million liters	26,466	26,860	27,309	27,648	28,055	28,844	29,435
Biomass Based Diesel	million liters	893	994	1,028	1,154	1,205	1,331	1,669
Biodiesel	million liters	427	383	232	282	250	221	436
Biodiesel from canola oil	million liters	195	221	99	139	112	87	261
Biodiesel from inedible tallow	million liters	13	12	7	9	8	7	14
Biodiesel from soybean oil	million liters	188	123	110	115	113	112	131
Biodiesel from yellow grease	million liters	15	13	8	10	9	8	15
Biodiesel from distillers corn oil	million liters	15	13	8	10	9	8	15
Biodiesel made from unknown	million liters	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels (HDRD)	million liters	466	611	796	872	955	1,110	1,233
Renewable Hydrocarbon Fuels made from palm oil	million liters	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels made from canola oil	million liters	89	234	428	507	591	752	882
Renewable Hydrocarbon Fuels made from palm sludge oil	million liters	3	3	3	3	3	3	3
Renewable Hydrocarbon Fuels made from tallow	million liters	130	129	125	123	122	119	115
Renewable Hydrocarbon Fuels made from yellow grease	million liters	210	209	206	205	204	202	199
Renewable Hydrocarbon Fuels made from soybean oil	million liters	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels made from spent bleaching earth	million liters	35	35	35	35	35	35	34
Blended Light Fuel Oil		2,057	2,017	1,978	1,940	1,903	1,832	1,761
Light diesel fuel oil	million liters	2,009	1,965	1,925	1,881	1,842	1,767	1,680
Biomass Based Diesel	million liters	47	52	53	59	61	65	80
Biodiesel	million liters	23	21	13	16	14	12	24
Biodiesel from canola oil	million liters	11	12	5	8	6	5	14
Biodiesel from inedible tallow	million liters	1	1	0	0	0	0	1
Biodiesel from soybean oil	million liters	10	7	6	6	6	6	7
Biodiesel from yellow grease	million liters	1	1	0	1	0	0	1
Biodiesel from distillers corn oil	million liters	1	1	0	1	0	0	1
Biodiesel from unknown	million liters	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels (HDRD)	million liters	24	31	40	43	47	53	56
Renewable Hydrocarbon Fuels made from palm oil	million liters	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels made from canola oil	million liters	5	12	22	25	29	36	40
Renewable Hydrocarbon Fuels made from palm sludge oil	million liters	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels made from tallow	million liters	7	7	6	6	6	6	5
Renewable Hydrocarbon Fuels made from yellow grease	million liters	11	11	10	10	10	10	9
Renewable Hydrocarbon Fuels made from soybean oil	million liters	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels made from spent bleaching earth	million liters	2	2	2	2	2	2	2
Blended Heavy Fuel Oil		2,453	2,488	2,520	2,550	2,580	2,653	2,735
Heavy fuel oil	million liters	2,429	2,421	2,411	2,400	2,389	2,379	2,378
Pyrolisis Oil (Biocrude)	million liters	24	67	109	150	191	274	357
Blended Jet Fuel		8,492	8,564	8,643	8,737	8,886	9,232	9,621
Aviation turbo fuel	million liters	8,492	8,536	8,586	8,650	8,729	8,929	9,162
Sustainable Aviation Fuel	million liters	0	28	57	87	157	304	458
Kerosene & stove oil	million liters	443	434	425	417	409	395	383

Canada Fuel Consumption Volumes in Terajoules: Baseline

Calendar Year	Units	2022	2023	2024	2025	2026	2028	2030
Blended Gasoline	terajoules	1,333,170	1,326,400	1,319,552	1,312,195	1,304,820	1,290,010	1,275,116
Motor Gasoline	terajoules	1,260,563	1,244,104	1,237,551	1,223,643	1,216,653	1,190,842	1,165,151
Ethanol	terajoules	72,608	82,296	82,001	88,552	88,166	99,168	109,964
Ethanol from corn	terajoules	61,034	69,263	69,301	75,433	75,835	85,448	95,462
Ethanol from wheat	terajoules	11,574	13,032	12,700	13,119	12,331	13,720	14,503
Blended Diesel	terajoules	1,055,031	1,073,981	1,092,761	1,110,422	1,128,045	1,163,171	1,198,127
Diesel fuel oil	terajoules	1,022,908	1,038,133	1,055,475	1,068,588	1,084,329	1,114,809	1,137,673
Biodiesel	terajoules	15,101	13,545	8,216	9,995	8,855	7,826	15,427
Biodiesel from canola oil	terajoules	6,913	7,824	3,508	4,929	3,976	3,088	9,247
Biodiesel from inedible tallow	terajoules	473	424	257	313	277	245	483
Biodiesel from soybean oil	terajoules	6,668	4,357	3,881	4,061	3,988	3,950	4,627
Biodiesel from yellow grease	terajoules	526	472	286	348	308	273	537
Biodiesel from distillers corn oil	terajoules	522	468	284	345	306	270	533
Biodiesel from unknown	terajoules	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels (HDRD)	terajoules	17,022	22,304	29,071	31,839	34,861	40,537	45,027
Renewable Hydrocarbon Fuels made from palm oil	terajoules	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels made from canola oil	terajoules	3,241	8,542	15,625	18,505	21,588	27,458	32,189
Renewable Hydrocarbon Fuels made from palm sludge oil	terajoules	109	109	109	109	109	109	110
Renewable Hydrocarbon Fuels made from tallow	terajoules	4,729	4,721	4,548	4,485	4,451	4,343	4,210
Renewable Hydrocarbon Fuels made from yellow grease	terajoules	7,657	7,647	7,514	7,467	7,443	7,362	7,262
Renewable Hydrocarbon Fuels made from soybean oil	terajoules	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels made from spent bleaching earth	terajoules	1,287	1,286	1,275	1,272	1,270	1,265	1,258
Blended Light Fuel Oil	terajoules	79,665	78,129	76,628	75,136	73,678	70,918	68,097
Light fuel oil	terajoules	77,964	76,242	74,702	72,995	71,477	68,561	65,198
Biodiesel	terajoules	813	739	453	554	492	434	845
Biodiesel from canola oil	terajoules	372	427	193	273	221	171	506
Biodiesel from inedible tallow	terajoules	25	23	14	17	15	14	26
Biodiesel from soybean oil	terajoules	359	238	214	225	221	219	253
Biodiesel from yellow grease	terajoules	28	26	16	19	17	15	29
Biodiesel from distillers corn oil	terajoules	28	26	16	19	17	15	29
Biodiesel from unknown	terajoules	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels (HDRD)	terajoules	889	1,147	1,474	1,587	1,709	1,923	2,055
Renewable Hydrocarbon Fuels made from palm oil	terajoules	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels made from canola oil	terajoules	169	439	792	923	1,058	1,302	1,469
Renewable Hydrocarbon Fuels made from palm sludge oil	terajoules	6	6	6	5	5	5	5
Renewable Hydrocarbon Fuels made from tallow	terajoules	247	243	231	224	218	206	192
Renewable Hydrocarbon Fuels made from yellow grease	terajoules	400	393	381	372	365	349	331
Renewable Hydrocarbon Fuels made from soybean oil	terajoules	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels made from spent bleaching earth	terajoules	67	66	65	63	62	60	57
Blended Heavy Fuel Oil	terajoules	100,343	100,936	101,410	101,841	102,250	103,625	105,364
Heavy fuel oil	terajoules	99,825	99,514	99,093	98,639	98,170	97,783	97,747
Pyrolisis Oil (Biocrude)	terajoules	519	1,422	2,317	3,203	4,080	5,842	7,617
Blended Jet Fuel	terajoules	301,135	303,675	306,443	309,743	315,009	327,185	340,846
Aviation turbo fuel	terajoules	301,135	302,684	304,450	306,732	309,540	316,617	324,899
Sustainable Aviation Fuel	terajoules	0	990	1,992	3,011	5,470	10,568	15,947
Kerosene & stove oil	terajoules	16,688	16,340	16,019	15,713	15,420	14,886	14,418
Propane Vehicle	terajoules	0	0	0	0	0	0	0
Natural Gas Vehicle	terajoules	0	0	0	0	0	0	0
Electric Vehicles (Gasoline) Assumption	terajoules	1,788	1,813	1,917	2,529	3,159	4,479	5,884
Electric Vehicles (Diesel) Assumption	terajoules	3,945	3,998	4,221	5,564	6,943	9,823	12,873

Canada Fuel Blend Rates: Baseline

Calendar Year	Units	2022	2023	2024	2025	2026	2028	2030
Ethanol in gasoline	% by Volume	7.8%	8.9%	8.9%	9.6%	9.6%	10.9%	12.2%
Biomass based diesel in diesel	% by Volume	3.3%	3.6%	3.6%	4.0%	4.1%	4.4%	5.4%
Biodiesel in diesel	% by Volume	1.6%	1.4%	0.8%	1.0%	0.9%	0.7%	1.4%
Renewable Hydrocarbon Fuels (HDRD) in diesel	% by Volume	1.7%	2.2%	2.8%	3.0%	3.3%	3.7%	4.0%
Biomass based diesel in LFO	% by Volume	2.3%	2.6%	2.7%	3.0%	3.2%	3.5%	4.6%
Biodiesel in LFO	% by Volume	1.1%	1.0%	0.6%	0.8%	0.7%	0.7%	1.4%
Renewable Hydrocarbon Fuels (HDRD) in LFO	% by Volume	1.2%	1.6%	2.0%	2.2%	2.5%	2.9%	3.2%
Pyrolisis oil (Biocrude) in HFO	% by Volume	1.0%	2.7%	4.3%	5.9%	7.4%	10.3%	13.0%
Sustainable Aviation Fuel in aviation turbo fuel	% by Volume	0.0%	0.3%	0.7%	1.0%	1.8%	3.3%	4.8%
Ethanol in gasoline	% by Energy	5.4%	6.2%	6.2%	6.7%	6.8%	7.7%	8.6%
Biomass based diesel in diesel	% by Energy	3.0%	3.3%	3.4%	3.8%	3.9%	4.2%	5.0%
Biodiesel in diesel	% by Energy	1.4%	1.3%	0.8%	0.9%	0.8%	0.7%	1.3%
Renewable Hydrocarbon Fuels (HDRD) in diesel	% by Energy	1.6%	2.1%	2.7%	2.9%	3.1%	3.5%	3.8%
Biomass based diesel in LFO	% by Energy	2.1%	2.4%	2.5%	2.8%	3.0%	3.3%	4.3%
Biodiesel in LFO	% by Energy	1.0%	0.9%	0.6%	0.7%	0.7%	0.6%	1.2%
HDRD in LFO	% by Energy	1.1%	1.5%	1.9%	2.1%	2.3%	2.7%	3.0%
Pyrolisis oil (Biocrude) in HFO	% by Energy	0.5%	1.4%	2.3%	3.1%	4.0%	5.6%	7.2%
Sustainable aviation fuel in aviation turbo fuel	% by Energy	0.0%	0.3%	0.7%	1.0%	1.7%	3.2%	4.7%

Canada CFS Compliance Credits and Debits: Baseline

Calendar Year	Units	2022	2023	2024	2025	2026	2028	2030
Debits								
Fossil Fuels								
Motor Gasoline	tCO2e	252,113	4,478,775	5,940,244	7,341,858	8,759,904	11,432,080	13,981,814
Diesel fuel oil	tCO2e	204,582	3,737,278	5,066,279	6,411,525	7,807,166	10,702,163	13,652,076
Light fuel oil	tCO2e	0	0	0	0	0	0	0
Heavy fuel oil	tCO2e	0	0	0	0	0	0	0
Aviation turbo fuel (Domestic Only)	tCO2e	0	0	0	0	0	0	0
Kerosene & stove oil	tCO2e	0	0	0	0	0	0	0
Total Debits	tCO2e	456,694	8,216,054	11,006,522	13,753,383	16,567,069	22,134,244	27,633,890
CFS Compliance Credits								
Compliance Category 1								
CCS	tCO2e	650,000	1,843,750	2,387,500	2,931,250	3,475,000	4,562,500	5,650,000
Upstream Improvements	tCO2e	0	176,563	353,125	529,688	706,250	1,059,375	1,412,500
Reductions in Refineries	tCO2e	100,000	351,563	503,125	654,688	806,250	1,109,375	1,412,500
Incremental Methane Reductions - Conventional Oil	tCO2e	273,373	831,528	1,116,310	1,401,092	1,685,873	2,255,437	2,825,000
Subtotal Compliance Category 1	tCO2e	1,023,373	3,203,404	4,360,060	5,516,718	6,673,373	8,986,687	11,300,000
Compliance Category 2								
Bank Renewable Fuel Regulation (RFR)	tCO2e	1,400,000	0	0	0	0	0	0
Ethanol	tCO2e	1,674,962	3,743,368	3,675,612	3,909,166	3,831,783	4,181,797	4,492,608
Ethanol from corn	tCO2e	1,381,453	3,092,129	3,050,464	3,273,244	3,243,238	3,547,503	3,843,823
Ethanol from wheat	tCO2e	293,509	651,239	625,149	635,922	588,545	634,294	648,784
Biodiesel	tCO2e	611,491	1,095,497	646,616	781,170	679,729	580,778	1,134,017
Biodiesel from canola oil	tCO2e	290,602	649,664	287,604	398,796	317,402	239,736	697,132
Biodiesel from inedible tallow	tCO2e	22,540	39,993	23,987	28,847	25,254	21,778	41,834
Biodiesel from soybean oil	tCO2e	254,801	328,677	288,808	298,030	288,559	277,557	315,194
Biodiesel from yellow grease	tCO2e	23,588	41,800	25,038	30,071	26,290	22,606	43,296
Biodiesel from distillers corn oil	tCO2e	19,961	35,363	21,178	25,428	22,225	19,101	36,561
Biodiesel from unknown	tCO2e	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels (HDRD)	tCO2e	701,500	1,820,089	2,346,405	2,535,100	2,737,585	3,093,799	3,335,117
Renewable Hydrocarbon Fuels from palm oil	tCO2e	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels from canola oil	tCO2e	136,015	707,164	1,275,650	1,489,422	1,712,632	2,115,368	2,405,701
Renewable Hydrocarbon Fuels from palm sludge oil	tCO2e	4,476	8,824	8,696	8,568	8,440	8,184	7,928
Renewable Hydrocarbon Fuels from tallow	tCO2e	204,350	402,360	382,191	371,632	363,485	344,356	323,814
Renewable Hydrocarbon Fuels from yellow grease	tCO2e	308,750	607,448	587,781	575,079	564,178	540,299	515,418
Renewable Hydrocarbon Fuels from soybean oil	tCO2e	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels from spent bleaching earth	tCO2e	47,908	94,293	92,087	90,399	88,850	85,592	82,257
Pyrolisis Oil (Biocrude)	tCO2e	16,680	91,230	148,288	204,505	259,879	370,260	480,363
Sustainable Aviation Fuel	tCO2e	0	57,610	113,595	168,185	299,170	553,548	798,405
Subtotal Compliance Category 2	tCO2e	4,404,633	6,807,793	6,930,516	7,598,126	7,808,146	8,780,181	10,240,511
Compliance Category 3								
Diesel Displaced by Propane	tCO2e	0	0	0	0	0	0	0
Diesel Displaced by Natural Gas	tCO2e	0	0	0	0	0	0	0
Gasoline Displaced by Electric Vehicles	tCO2e	308,571	617,143	642,857	835,714	1,028,571	1,414,286	1,800,000
Diesel Displaced by Electric Vehicles	tCO2e	891,429	1,782,857	1,857,143	2,414,286	2,971,429	4,085,714	5,200,000
Subtotal Compliance Category 3	tCO2e	1,200,000	2,400,000	2,500,000	3,250,000	4,000,000	5,500,000	7,000,000
External Credit Sources								
Cross Steam Credits	tCO2e	45,669	821,605	1,100,652	1,375,338	1,656,707	2,213,424	2,763,389
Compliance Fund	tCO2e	0	0	0	0	0	0	0
Emerging Tech Credit Generation	tCO2e	0	0	0	0	0	0	0
Total Credits		6,673,675	13,232,802	14,891,229	17,740,182	20,138,226	25,480,293	31,303,900
Banked for the Year	tCO2e	6,216,981	5,016,749	3,884,706	3,986,799	3,571,157	3,346,049	3,670,010
Running Net Credit Balance	tCO2e	6,216,981	11,233,730	15,118,436	19,105,235	22,676,392	29,163,608	35,739,824
Renewable Fuel Credit Price	C$/MT	0	18	10	10	10	10	10
Maximum CFS Compliance Credit Price	C$/MT	350	358	365	373	380	396	412

Value of Canada Compliance Credits By Feedstock Pathway: Baseline

	Calendar Year	Units	2022	2023	2024	2025	2026	2028	2030
Ethanol									
Ethanol from corn		C$/liter	0.00	0.02	0.01	0.01	0.01	0.01	0.01
Ethanol from wheat		C$/liter	0.00	0.02	0.01	0.01	0.01	0.01	0.01
Biodiesel									
Biodiesel from canola oil		C$/liter	0.00	0.05	0.03	0.03	0.03	0.03	0.03
Biodiesel from inedible tallow		C$/liter	0.00	0.06	0.03	0.03	0.03	0.03	0.03
Biodiesel from soybean oil		C$/liter	0.00	0.05	0.02	0.02	0.02	0.02	0.02
Biodiesel from yellow grease		C$/liter	0.00	0.05	0.03	0.03	0.03	0.03	0.03
Biodiesel from distillers corn oil		C$/liter	0.00	0.05	0.02	0.02	0.02	0.02	0.02
Renewable Hydrocarbon Fuels		C$/liter							
Renewable Hydrocarbon Fuels from palm oil		C$/liter	0.00	0.01	0.01	0.01	0.01	0.00	0.00
Renewable Hydrocarbon Fuels from canola oil		C$/liter	0.00	0.05	0.03	0.03	0.03	0.03	0.03
Renewable Hydrocarbon Fuels from palm sludge oil		C$/liter	0.00	0.05	0.03	0.03	0.03	0.03	0.03
Renewable Hydrocarbon Fuels from tallow		C$/liter	0.00	0.05	0.03	0.03	0.03	0.03	0.03
Renewable Hydrocarbon Fuels from yellow grease		C$/liter	0.00	0.05	0.03	0.03	0.03	0.03	0.03
Renewable Hydrocarbon Fuels from soybean oil		C$/liter	0.00	0.04	0.02	0.02	0.02	0.02	0.02
Renewable Hydrocarbon Fuels from spent bleaching earth		C$/liter	0.00	0.05	0.02	0.02	0.02	0.02	0.02

Biofuel Feedstocks Used for Canadian Domestic Consumption: Baseline

	Calendar Year	Units	2022	2023	2024	2025	2026	2028	2030
Ethanol Feedstocks									
Corn		1000 MT	3,723	4,433	4,730	5,487	5,543	6,775	7,958
Wheat		1000 MT	921	996	930	916	910	898	898
Biodiesel Feedstocks									
Canola Oil		1000 MT	185	209	94	132	107	83	248
Inedible Tallow		1000 MT	13	12	7	9	8	7	14
Soybean Oil		1000 MT	178	117	104	109	107	106	124
Yellow Grease		1000 MT	15	13	8	10	9	8	15
Distillers Corn Oil		1000 MT	14	13	8	9	8	7	14
Unknown		1000 MT	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels Feedstocks									
Feedstocks Used for Domestic Production									
Canola Oil		1000 MT	86	226	413	488	569	723	846
Feedstocks Used for Imports (Approximation)									
Palm Oil		1000 MT	0	0	0	0	0	0	0
Palm Sludge Oil		1000 MT	3	3	3	3	3	3	3
Inedible Tallow		1000 MT	131	131	126	124	123	120	116
Yellow Grease		1000 MT	213	212	209	207	206	204	201
Soybean Oil		1000 MT	0	0	0	0	0	0	0
Spent Bleaching Earth		1000 MT	36	36	35	35	35	35	35

Canada Canola and Canola Products Supply and Demand: Baseline

	Units	22/23	23/24	24/25	25/26	26/27	28/29	30/31
Canola								
Area Planted	1000 ha	8,571	8,354	8,444	8,545	8,562	8,613	8,687
Area Harvested	1000 ha	8,485	8,270	8,358	8,459	8,475	8,526	8,599
Yield	mt per ha	2.33	2.35	2.37	2.40	2.42	2.46	2.51
Supply								
Beginning Stocks	1000 mt	716	1,629	1,631	1,747	1,875	2,101	2,307
Production	1000 mt	19,774	19,455	19,848	20,273	20,500	21,000	21,559
Imports	1000 mt	104	104	104	104	104	104	104
Total Supply	1000 mt	20,594	21,189	21,583	22,124	22,479	23,205	23,970
Domestic Disappearance								
Crush	1000 mt	11,052	11,391	11,626	11,829	11,937	12,130	12,358
Food	1000 mt	0	0	0	0	0	0	0
Feed, Seed, Waste	1000 mt	109	107	110	112	115	122	127
Total Domestic Disappearance	1000 mt	11,161	11,498	11,735	11,941	12,052	12,252	12,485
Exports	1000 mt	7,803	8,060	8,101	8,308	8,448	8,759	9,088
Ending Stocks	1000 mt	1,629	1,631	1,747	1,875	1,979	2,194	2,397
Canola Meal								
Extraction Rate	kg/kg	0.56	0.56	0.56	0.56	0.56	0.56	0.56
Supply								
Beginning Stocks	1000 mt	54	89	94	100	106	113	119
Production	1000 mt	6,169	6,358	6,489	6,603	6,663	6,771	6,898
Imports	1000 mt	56	56	56	56	56	56	56
Total Supply	1000 mt	6,280	6,503	6,639	6,759	6,825	6,940	7,073
Domestic Disappearance								
Food	1000 mt	0	0	0	0	0	0	0
Feed & Residual	1000 mt	744	741	768	789	804	836	871
Industrial	1000 mt	0	0	0	0	0	0	0
Total Domestic Disappearance	1000 mt	744	741	768	789	804	836	871
Exports	1000 mt	5,447	5,669	5,770	5,864	5,912	5,989	6,080
Ending Stocks	1000 mt	89	94	100	106	109	115	121
Canola Oil								
Extraction Rate	kg/kg	0.44	0.44	0.44	0.44	0.44	0.44	0.44
Supply								
Beginning Stocks	1000 mt	412	488	514	523	530	551	568
Production	1000 mt	4,838	4,986	5,089	5,178	5,226	5,310	5,410
Imports	1000 mt	0	0	0	0	0	0	0
Total Supply	1000 mt	5,250	5,474	5,603	5,701	5,755	5,861	5,978
Domestic Disappearance								
Food	1000 mt	687	667	667	669	678	693	704
Feed & Residual	1000 mt	0	0	0	0	0	0	0
Industrial	1000 mt	619	720	823	889	940	1,067	1,358
Total Domestic Disappearance	1000 mt	1,305	1,388	1,490	1,558	1,617	1,760	2,062
Exports	1000 mt	3,457	3,573	3,590	3,613	3,597	3,538	3,338
Ending Stocks	1000 mt	488	514	523	530	541	563	579
Canola and Derivative Prices								
Canola Average Farm Price, Saskatchewan	CAD/mt	649	672	673	675	671	662	661
Canola Seed Average Price, Pacific Coast	CAD/mt	673	698	698	700	697	688	686
Canola Oil FOB Plants, Crude Degummed	CAD/mt	1,719	1,738	1,782	1,816	1,815	1,819	1,853
Canola Meal FOB Plant	CAD/mt	305	326	308	297	292	281	268

Canada Grains Supply and Demand: Baseline

	Units	22/23	23/24	24/25	25/26	26/27	28/29	30/31
Corn								
Area Planted	1000 ha	1,475	1,476	1,475	1,476	1,476	1,475	1,475
Area Harvested	1000 ha	1,430	1,425	1,428	1,424	1,428	1,426	1,426
Yield	mt per ha	9.98	10.09	10.21	10.32	10.44	10.67	10.90
Supply								
Beginning Stocks	1000 mt	1,981	2,080	2,118	2,177	2,204	2,285	2,358
Production	1000 mt	14,272	14,382	14,572	14,697	14,900	15,216	15,546
Imports	1000 mt	3,360	3,327	3,711	3,438	3,371	4,677	2,038
Total Supply	1000 mt	19,613	19,788	20,402	20,312	20,475	22,179	19,942
Domestic Disappearance								
Feed & Residual Use	1000 mt	10,548	10,257	10,083	9,668	9,671	9,936	9,807
Food, Seed, and Industrial Use	1000 mt	6,011	6,439	7,168	7,466	7,582	8,944	6,755
Bioethanol Use	1000 mt	4,256	4,656	5,298	5,529	5,563	6,768	4,413
Total Domestic Disappearance	1000 mt	16,559	16,696	17,251	17,134	17,253	18,880	16,562
Exports	1000 mt	974	974	974	974	974	974	974
Ending Stocks	1000 mt	2,080	2,118	2,177	2,204	2,248	2,325	2,406
Wheat								
Area Planted	1000 ha	10,147	10,142	9,960	9,888	9,832	9,681	9,544
Area Harvested	1000 ha	9,370	9,318	9,309	9,248	9,209	9,126	9,068
Yield	mt per ha	3.45	3.47	3.49	3.51	3.53	3.58	3.62
Supply								
Beginning Stocks	1000 mt	4,488	5,460	5,814	6,042	6,197	6,424	6,615
Production	1000 mt	32,289	32,317	32,492	32,484	32,549	32,657	32,849
Imports	1000 mt	700	700	700	700	700	700	700
Total Supply	1000 mt	37,477	38,478	39,006	39,226	39,446	39,781	40,164
Domestic Disappearance								
Feed & Residual Use	1000 mt	4,013	4,130	4,278	4,373	4,415	4,646	4,653
Food, Seed, and Industrial Use	1000 mt	5,169	5,187	5,164	5,169	5,177	5,190	5,197
Bioethanol Use	1000 mt	959	963	923	913	909	897	879
Total Domestic Disappearance	1000 mt	9,182	9,318	9,442	9,542	9,592	9,835	9,851
Exports	1000 mt	22,835	23,346	23,522	23,487	23,566	23,442	23,539
Ending Stocks	1000 mt	5,460	5,814	6,042	6,197	6,288	6,503	6,774
Grain Prices								
Barley, #1 Feed, Alberta	CAD/mt	372	376	388	396	401	419	433
Barley Farm Price	CAD/mt	285	288	297	303	307	321	331
Corn #2, CE Cash, Chatham	CAD/mt	245	248	243	245	242	238	232
Wheat, Western Red Spring, 12.5% Protein	CAD/mt	390	394	395	396	402	408	408
Wheat Producer Price, Ontario	CAD/mt	279	283	283	284	289	293	294

Results for NZ-Guardrail 13% Scenario

Canada Biomass Based Diesel Supply and Demand: NZ-Guardrail 13% Scenario

Calendar Year	Units	2022	2024	2026	2028	2030	2022	2024	2026	2028	2030
							(Scenario NZ-GR 13% - Baseline)				
Diesel Fuel Use and Biofuels Policy											
Diesel Transportation Use (excluding biofuels)	Million Liters	26,452	27,295	27,974	28,674	29,212	-14	-13	-81	-170	-223
Biodiesel Supply & Use											
Beginning Stocks	Million Liters	0	0	0	0	0	0	0	0	0	0
Production	Million Liters	341	300	323	306	497	0	-20	-15	0	-33
Imports	Million Liters	375	349	344	344	342	11	3	0	2	1
Total Supply	Million Liters	717	649	667	650	840	11	-17	-15	2	-32
Domestic Use	Million Liters	449	228	249	235	428	-1	-17	-15	2	-32
Exports	Million Liters	268	421	418	415	412	12	0	0	0	0
Ending Stocks	Million Liters	0	0	0	0	0	0	0	0	0	0
Total Demand	Million Liters	717	649	667	650	840	11	-17	-15	2	-32
Renewable Hydrocarbon Fuels Supply & Use											
Beginning Stocks	Million Liters	0	0	0	0	0	0	0	0	0	0
Production	Million Liters	93	462	630	798	937	0	12	10	10	15
Imports	Million Liters	397	389	381	375	368	0	2	0	0	0
Total Supply	Million Liters	491	851	1,011	1,173	1,305	0	14	10	10	15
Domestic Use	Million Liters	491	851	1,011	1,173	1,305	0	14	10	10	15
Exports	Million Liters	0	0	0	0	0	0	0	0	0	0
Ending Stocks	Million Liters	0	0	0	0	0	0	0	0	0	0
Total Demand	Million Liters	491	851	1,011	1,173	1,305	0	14	10	10	15
Domestic Feedstocks											
Canola Oil (Biodiesel Plants)	1000 Metric Tons	200	159	177	154	314	0	-19	-13	0	-29
Canola Oil (Renewable Hydrocarbon Fuels Plants)	1000 Metric Tons	86	424	578	732	859	0	11	9	10	14
Inedible Tallow	1000 Metric Tons	10	9	9	10	13	0	1	0	0	0
Soybean Oil	1000 Metric Tons	76	77	78	80	84	0	1	0	0	0
Yellow Grease	1000 Metric Tons	12	12	12	12	12	0	0	0	0	0
Distillers Corn Oil	1000 Metric Tons	11	14	17	21	26	0	0	0	0	0
Domestic Feedstock Yield											
Canola Oil	1000 Liters/MT	1.11	1.11	1.11	1.11	1.11	0.00	0.00	0.00	0.00	0.00
Inedible Tallow	1000 Liters/MT	1.04	1.04	1.04	1.04	1.04	0.00	0.00	0.00	0.00	0.00
Soybean Oil	1000 Liters/MT	1.11	1.11	1.11	1.11	1.11	0.00	0.00	0.00	0.00	0.00
Yellow Grease	1000 Liters/MT	1.04	1.04	1.04	1.04	1.04	0.00	0.00	0.00	0.00	0.00
Distillers Corn Oil	1000 Liters/MT	1.11	1.11	1.11	1.11	1.11	0.00	0.00	0.00	0.00	0.00
Biomass-based Diesel Prices											
BC/AB Canada B99 Rack Price	CAD/Liter	1.29	1.20	1.23	1.28	1.39	0.00	0.00	0.00	0.00	-0.01
Canada HDRD Wholesale Price	CAD/Liter	2.39	2.37	2.41	2.45	2.47	0.00	0.00	0.00	0.00	0.00

Canada Ethanol Supply and Demand: NZ-Guardrail 13% Scenario

Calendar Year	Units	2022	2024	2026	2028	2030	2022	2024	2026	2028	2030
							(Scenario NZ-GR 13% - Baseline)				
Gasoline Fuel Use and Biofuels Policy											
Gasoline Transportation Use	Million Liters	36,358	35,696	35,092	34,347	33,605	20	21	20	19	17
Supply & Demand											
Beginning Stocks	Million Liters	0	0	0	0	0	0	0	0	0	0
Production	Million Liters	1,916	2,335	2,666	3,180	3,672	2	-3	-3	2	1
Imports	Million Liters	1,196	1,176	1,106	1,059	1,025	0	6	5	0	1
Total Supply	Million Liters	3,112	3,511	3,772	4,239	4,697	2	2	2	2	2
Domestic Use	Million Liters	3,081	3,480	3,741	4,208	4,666	2	2	2	2	2
Exports	Million Liters	31	31	31	31	31	0	0	0	0	0
Ending Stocks	Million Liters	0	0	0	0	0	0	0	0	0	0
Total Demand	Million Liters	3,112	3,511	3,772	4,239	4,697	2	2	2	2	2
Feedstocks											
Corn	1000 Metric Tons	3,728	4,682	5,537	6,780	7,964	4	-48	-7	5	6
Wheat	1000 Metric Tons	921	972	910	898	893	0	42	0	0	-4
Feedstock Yield											
Corn	1000 Liters/MT	0.42	0.42	0.42	0.42	0.42	0.00	0.00	0.00	0.00	0.00
Wheat	1000 Liters/MT	0.39	0.39	0.39	0.39	0.39	0.00	0.00	0.00	0.00	0.00
Distillers' Grains Production											
Corn	1000 Metric Tons	1,132	1,421	1,681	2,058	2,418	1	-14	-2	2	2
Wheat	1000 Metric Tons	279	295	276	273	271	0	13	0	0	-1
Wholesale Ethanol Price (excludes CFS Credit Value)	CAD/Liter	0.69	0.67	0.67	0.67	0.68	0.00	0.00	0.00	0.00	0.00

Canada CFS Program Parameters: NZ-Guardrail 13% Scenario

Calendar Year	Units	2022	2024	2026	2028	2030	2022	2024	2026	2028	2030
							(Scenario NZ-GR 13% - Baseline)				
Program Goals											
2016 Stream Carbon Intensity	tCO2e/TJ	91.6	91.6	91.6	91.6	91.6	0.0	0.0	0.0	0.0	0.0
Credit Stream Carbon Intensity Reference	tCO2e/TJ	89.3	87.0	84.7	82.4	80.1	0.0	0.0	0.0	0.0	0.0
Obligated Fossil Fuel Carbon Intensity Reduction	tCO2e/TJ	2.4	4.8	7.2	9.6	12.0	0.0	0.0	0.0	0.0	0.0
Obligated Jet Fuel Carbon Intensity Reduction	tCO2e/TJ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy Economy Ratios											
Hydrogen (Gasoline)	Ratio	2.5	2.5	2.5	2.5	2.5	0	0	0	0	0
Hydrogen (Diesel)	Ratio	1.9	1.9	1.9	1.9	1.9	0	0	0	0	0
CNG (Diesel)	Ratio	0.9	0.9	0.9	0.9	0.9	0	0	0	0	0
EV (Gasoline)	Ratio	4.1	4.1	4.1	4.1	4.1	0	0	0	0	0
EV (Diesel)	Ratio	5	5	5	5	5	0	0	0	0	0
Energy Density of Fuels											
Gasoline	MJ/Liter	34.69	34.69	34.69	34.69	34.69	0.00	0.00	0.00	0.00	0.00
Diesel	MJ/Liter	38.65	38.65	38.65	38.65	38.65	0.00	0.00	0.00	0.00	0.00
Aviation Fuel	MJ/Liter	35.46	35.46	35.46	35.46	35.46	0.00	0.00	0.00	0.00	0.00
Ethanol	MJ/Liter	23.58	23.58	23.58	23.58	23.58	0.00	0.00	0.00	0.00	0.00
Biodiesel	MJ/Liter	35.40	35.40	35.40	35.40	35.40	0.00	0.00	0.00	0.00	0.00
Renewable Hydrocarbon Fuels (HDRD)	MJ/Liter	36.51	36.51	36.51	36.51	36.51	0.00	0.00	0.00	0.00	0.00
Sustainable Aviation Fuel	MJ/Liter	34.81	34.81	34.81	34.81	34.81	0.00	0.00	0.00	0.00	0.00
Electricity	MJ/kWh	3.60	3.60	3.60	3.60	3.60	0.00	0.00	0.00	0.00	0.00
LFO	MJ/Liter	38.80	38.80	38.80	38.80	38.80	0.00	0.00	0.00	0.00	0.00
Kerosene	MJ/Liter	37.68	37.68	37.68	37.68	37.68	0.00	0.00	0.00	0.00	0.00
Pyrolisis Oil (Biocrude)	MJ/Liter	21.35	21.35	21.35	21.35	21.35	0.00	0.00	0.00	0.00	0.00
HFO	MJ/Liter	41.10	41.10	41.10	41.10	41.10	0.00	0.00	0.00	0.00	0.00

Canada CFS Carbon Intensity Average Scores: NZ-Guardrail 13% Scenario

Calendar Year	Units	2022	2024	2026	2028	2030	2022	2024	2026	2028	2030
							(Scenario NZ-GR 13% - Baseline)				
Motor gasoline	tCO2e/TJ	91.9	91.9	91.9	91.9	91.9	0.0	0.0	0.0	0.0	0.0
Ethanol	tCO2e/TJ										
Ethanol from corn	tCO2e/TJ	44.1	43.0	41.9	40.9	39.8	0.0	0.0	0.0	0.0	0.0
Ethanol from wheat	tCO2e/TJ	38.6	37.8	37.0	36.2	35.3	0.0	0.0	0.0	0.0	0.0
Diesel fuel oil	tCO2e/TJ	97.1	97.1	97.1	97.1	97.1	0.0	0.0	0.0	0.0	0.0
Biodiesel	tCO2e/TJ										
Biodiesel from canola oil	tCO2e/TJ	9.6	9.3	9.1	8.8	8.6	0.0	0.0	0.0	0.0	0.0
Biodiesel from inedible tallow	tCO2e/TJ	-1.2	-1.4	-1.7	-1.9	-2.1	0.0	0.0	0.0	0.0	0.0
Biodiesel from soybean oil	tCO2e/TJ	16.8	16.5	16.1	15.8	15.5	0.0	0.0	0.0	0.0	0.0
Biodiesel from yellow grease	tCO2e/TJ	4.2	4.1	3.9	3.8	3.7	0.0	0.0	0.0	0.0	0.0
Biodiesel from distillers corn oil	tCO2e/TJ	16.7	16.3	15.9	15.4	15.0	0.0	0.0	0.0	0.0	0.0
Biodiesel from unknown	tCO2e/TJ	3.8	3.8	3.8	3.8	3.8	0.0	0.0	0.0	0.0	0.0
Renewable Hydrocarbon Fuels (HDRD) (weighted avg)	tCO2e/TJ										
Renewable Hydrocarbon Fuels from palm oil	tCO2e/TJ	71.7	71.0	70.3	69.6	68.9	0.0	0.0	0.0	0.0	0.0
Renewable Hydrocarbon Fuels from canola oil	tCO2e/TJ	9.6	9.3	9.1	8.8	8.6	0.0	0.0	0.0	0.0	0.0
Renewable Hydrocarbon Fuels from palm sludge oil	tCO2e/TJ	11.2	11.1	11.0	10.9	10.9	0.0	0.0	0.0	0.0	0.0
Renewable Hydrocarbon Fuels from tallow	tCO2e/TJ	7.2	7.0	6.9	6.7	6.5	0.0	0.0	0.0	0.0	0.0
Renewable Hydrocarbon Fuels from yellow grease	tCO2e/TJ	12.7	12.6	12.4	12.3	12.2	0.0	0.0	0.0	0.0	0.0
Renewable Hydrocarbon Fuels from soybean oil	tCO2e/TJ	30.8	30.4	30.0	29.6	29.2	0.0	0.0	0.0	0.0	0.0
Renewable Hydrocarbon Fuels from spent bleaching earth	tCO2e/TJ	18.6	18.3	18.0	17.8	17.5	0.0	0.0	0.0	0.0	0.0
Light fuel oil	tCO2e/TJ	87.0	87.0	87.0	87.0	87.0	0.0	0.0	0.0	0.0	0.0
Kerosene & stove oil	tCO2e/TJ	82.0	82.0	82.0	82.0	82.0	0.0	0.0	0.0	0.0	0.0
Heavy fuel oil	tCO2e/TJ	91.0	91.0	91.0	91.0	91.0	0.0	0.0	0.0	0.0	0.0
Pyrolisis Oil (Biocrude)	tCO2e/TJ	25.0	23.0	21.0	19.0	17.0	0.0	0.0	0.0	0.0	0.0
Aviation gasoline	tCO2e/TJ	94.0	94.0	94.0	94.0	94.0	0.0	0.0	0.0	0.0	0.0
Aviation turbo fuel	tCO2e/TJ	90.1	90.1	90.1	90.1	90.1	0.0	0.0	0.0	0.0	0.0
Sustainable aviation fuel	tCO2e/TJ	30.0	30.0	30.0	30.0	30.0	0.0	0.0	0.0	0.0	0.0
Propane Vehicle	tCO2e/TJ	68.0	68.0	68.0	68.0	68.0	0.0	0.0	0.0	0.0	0.0
Natural Gas Vehicle	tCO2e/TJ	62.9	62.9	62.9	62.9	62.9	0.0	0.0	0.0	0.0	0.0
EV (Gasoline)	tCO2e/TJ	21.7	21.7	21.7	21.7	21.7	0.0	0.0	0.0	0.0	0.0

Canada Fuel Consumption Volumes: NZ-Guardrail 13% Scenario

Calendar Year	Units	2022	2024	2026	2028	2030	2022	2024	2026	2028	2030
							(Scenario NZ-GR 13% - Baseline)				
Blended Gasoline (volumetric total)	million liters	39,439	39,175	38,833	38,555	38,271	22	23	22	21	20
Motor gasoline	million liters	36,358	35,696	35,092	34,347	33,605	20	21	20	19	17
Ethanol	million liters	3,081	3,480	3,741	4,208	4,666	2	2	2	2	2
Ethanol from corn	million liters	2,590	2,941	3,218	3,626	4,050	1	2	2	2	2
Ethanol from wheat	million liters	491	539	523	582	615	0	0	0	0	0
Blended Diesel (volumetric total)	million liters	27,344	28,321	29,174	30,017	30,866	-14	-16	-86	-158	-239
Diesel fuel oil	million liters	26,452	27,295	27,974	28,674	29,212	-14	-13	-81	-170	-223
Biomass Based Diesel	million liters	892	1,026	1,200	1,343	1,654	0	-3	-5	12	-15
Biodiesel	million liters	426	216	236	223	406	-1	-16	-14	2	-30
Biodiesel from canola oil	million liters	195	85	101	88	235	0	-14	-11	1	-26
Biodiesel from inedible tallow	million liters	13	7	7	7	13	0	-1	0	0	-1
Biodiesel from soybean oil	million liters	188	109	111	113	130	0	0	-1	1	-1
Biodiesel from yellow grease	million liters	15	8	8	8	14	0	-1	0	0	-1
Biodiesel from distillers corn oil	million liters	15	7	8	8	14	0	-1	0	0	-1
Biodiesel made from unknown	million liters	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels (HDRD)	million liters	466	810	964	1,120	1,248	0	14	9	10	15
Renewable Hydrocarbon Fuels made from palm oil	million liters	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels made from canola oil	million liters	89	440	601	762	896	0	12	9	10	14
Renewable Hydrocarbon Fuels made from palm sludge oil	million liters	3	3	3	3	3	0	0	0	0	0
Renewable Hydrocarbon Fuels made from tallow	million liters	130	126	122	119	115	0	1	0	0	0
Renewable Hydrocarbon Fuels made from yellow grease	million liters	210	207	204	202	199	0	1	0	0	0
Renewable Hydrocarbon Fuels made from soybean oil	million liters	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels made from spent bleaching earth	million liters	35	35	35	35	34	0	0	0	0	0
Blended Light Fuel Oil		2,057	1,978	1,903	1,832	1,760	0	0	0	0	0
Light diesel fuel oil	million liters	2,009	1,925	1,842	1,766	1,681	0	0	0	-1	1
Biomass Based Diesel	million liters	47	53	60	66	79	0	0	0	1	-1
Biodiesel	million liters	23	12	13	12	22	0	-1	-1	0	-2
Biodiesel from canola oil	million liters	11	5	6	5	13	0	-1	-1	0	-1
Biodiesel from inedible tallow	million liters	1	0	0	0	1	0	0	0	0	0
Biodiesel from soybean oil	million liters	10	6	6	6	7	0	0	0	0	0
Biodiesel from yellow grease	million liters	1	0	0	0	1	0	0	0	0	0
Biodiesel from distillers corn oil	million liters	1	0	0	0	1	0	0	0	0	0
Biodiesel from unknown	million liters	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels (HDRD)	million liters	24	41	47	53	57	0	1	0	0	1
Renewable Hydrocarbon Fuels made from palm oil	million liters	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels made from canola oil	million liters	5	22	29	36	41	0	1	0	0	1
Renewable Hydrocarbon Fuels made from palm sludge oil	million liters	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels made from tallow	million liters	7	6	6	6	5	0	0	0	0	0
Renewable Hydrocarbon Fuels made from yellow grease	million liters	11	10	10	10	9	0	0	0	0	0
Renewable Hydrocarbon Fuels made from soybean oil	million liters	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels made from spent bleaching earth	million liters	2	2	2	2	2	0	0	0	0	0
Blended Heavy Fuel Oil		2,453	2,520	2,580	2,653	2,735	0	0	0	0	0
Heavy fuel oil	million liters	2,429	2,411	2,389	2,379	2,378	0	0	0	0	0
Pyrolisis Oil (Biocrude)	million liters	24	109	191	274	357	0	0	0	0	0
Blended Jet Fuel		8,492	8,643	8,886	9,232	9,621	0	0	0	0	0
Aviation turbo fuel	million liters	8,492	8,586	8,729	8,929	9,162	0	0	0	0	0
Sustainable aviation fuel	million liters	0	57	157	304	458	0	0	0	0	0
Kerosene & stove oil	million liters	443	425	409	395	383	0	0	0	0	0

Canada Fuel Consumption Volumes in Terajoules: NZ-Guardrail 13% Scenario

Calendar Year	Units	2022	2024	2026	2028	2030	2022	2024	2026	2028	2030
							(Scenario NZ-GR 13% - Baseline)				
Blended Gasoline	terajoules	1,333,899	1,320,333	1,305,561	1,290,709	1,275,769	728	781	741	699	654
Motor Gasoline	terajoules	1,261,251	1,238,283	1,217,344	1,191,487	1,165,749	689	732	691	645	597
Ethanol	terajoules	72,647	82,049	88,216	99,222	110,021	40	49	50	54	56
Ethanol from corn	terajoules	61,067	69,342	75,878	85,495	95,511	33	41	43	46	49
Ethanol from wheat	terajoules	11,580	12,708	12,338	13,727	14,510	6	8	7	7	7
Blended Diesel	terajoules	1,054,475	1,092,166	1,124,755	1,157,031	1,188,968	-556	-595	-3,290	-6,140	-9,160
Diesel fuel oil	terajoules	1,022,368	1,054,954	1,081,199	1,108,239	1,129,043	-540	-521	-3,130	-6,569	-8,630
Biodiesel	terajoules	15,082	7,643	8,352	7,894	14,367	-20	-572	-503	67	-1,059
Biodiesel from canola oil	terajoules	6,906	3,008	3,576	3,111	8,330	-7	-500	-401	23	-917
Biodiesel from inedible tallow	terajoules	472	239	261	247	450	-1	-18	-16	2	-33
Biodiesel from soybean oil	terajoules	6,657	3,866	3,936	3,988	4,591	-11	-15	-52	37	-36
Biodiesel from yellow grease	terajoules	525	266	291	275	500	-1	-20	-18	2	-37
Biodiesel from distillers corn oil	terajoules	521	264	288	273	496	-1	-20	-17	2	-37
Biodiesel from unknown	terajoules	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels (HDRD)	terajoules	17,025	29,568	35,204	40,899	45,557	3	498	343	362	530
Renewable Hydrocarbon Fuels made from palm oil	terajoules	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels made from canola oil	terajoules	3,244	16,052	21,931	27,819	32,707	3	427	344	361	518
Renewable Hydrocarbon Fuels made from palm sludge oil	terajoules	109	109	109	109	110	0	0	0	0	0
Renewable Hydrocarbon Fuels made from tallow	terajoules	4,730	4,587	4,450	4,343	4,216	0	39	-1	0	6
Renewable Hydrocarbon Fuels made from yellow grease	terajoules	7,657	7,543	7,442	7,362	7,267	0	29	0	0	5
Renewable Hydrocarbon Fuels made from soybean oil	terajoules	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels made from spent bleaching earth	terajoules	1,287	1,278	1,270	1,265	1,258	0	2	0	0	0
Blended Light Fuel Oil	terajoules	79,665	76,628	73,678	70,918	68,097	0	0	0	0	0
Light fuel oil	terajoules	77,965	74,708	71,488	68,540	65,232	1	6	11	-21	34
Biodiesel	terajoules	812	421	464	438	787	-1	-32	-28	4	-58
Biodiesel from canola oil	terajoules	372	166	199	173	456	0	-28	-22	1	-50
Biodiesel from inedible tallow	terajoules	25	13	15	14	25	0	-1	-1	0	-2
Biodiesel from soybean oil	terajoules	358	213	219	221	251	-1	-1	-3	2	-2
Biodiesel from yellow grease	terajoules	28	15	16	15	27	0	-1	-1	0	-2
Biodiesel from distillers corn oil	terajoules	28	15	16	15	27	0	-1	-1	0	-2
Biodiesel from unknown	terajoules	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels (HDRD)	terajoules	889	1,499	1,726	1,940	2,079	0	25	17	17	24
Renewable Hydrocarbon Fuels made from palm oil	terajoules	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels made from canola oil	terajoules	169	814	1,075	1,319	1,493	0	22	17	17	24
Renewable Hydrocarbon Fuels made from palm sludge oil	terajoules	6	6	5	5	5	0	0	0	0	0
Renewable Hydrocarbon Fuels made from tallow	terajoules	247	232	218	206	192	0	2	0	0	0
Renewable Hydrocarbon Fuels made from yellow grease	terajoules	400	382	365	349	332	0	1	0	0	0
Renewable Hydrocarbon Fuels made from soybean oil	terajoules	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels made from spent bleaching earth	terajoules	67	65	62	60	57	0	0	0	0	0
Blended Heavy Fuel Oil	terajoules	100,343	101,410	102,250	103,625	105,364	0	0	0	0	0
Heavy fuel oil	terajoules	99,825	99,093	98,170	97,783	97,747	0	0	0	0	0
Pyrolisis Oil (Biocrude)	terajoules	519	2,317	4,080	5,842	7,617	0	0	0	0	0
Blended Jet Fuel	terajoules	301,135	306,443	315,009	327,185	340,846	0	0	0	0	0
Aviation turbo fuel	terajoules	301,135	304,450	309,540	316,617	324,899	0	0	0	0	0
Sustainable aviation fuel	terajoules	0	1,992	5,470	10,568	15,947	0	0	0	0	0
Kerosene & stove oil	terajoules	16,688	16,019	15,420	14,886	14,418	0	0	0	0	0
Propane Vehicle	terajoules	0	0	0	0	0	0	0	0	0	0
Natural Gas Vehicle	terajoules	0	0	0	0	0	0	0	0	0	0
Electric Vehicles (Gasoline) Assumption	terajoules	1,059	1,136	2,418	3,781	5,231	-728	-781	-741	-699	-654
Electric Vehicles (Diesel) Assumption	terajoules	4,501	4,817	10,233	15,963	22,032	556	595	3,290	6,140	9,160

Canada Fuel Blend Rates: NZ-Guardrail 13% Scenario

Calendar Year	Units	2022	2024	2026	2028	2030	2022	2024	2026	2028	2030
							(Scenario NZ-GR 13% - Baseline)				
Ethanol in gasoline	% by Volume	7.8%	8.9%	9.6%	10.9%	12.2%	0.0%	0.0%	0.0%	0.0%	0.0%
Biomass based diesel in diesel	% by Volume	3.3%	3.6%	4.1%	4.5%	5.4%	0.0%	0.0%	0.0%	0.1%	0.0%
Biodiesel in diesel	% by Volume	1.6%	0.8%	0.8%	0.7%	1.3%	0.0%	-0.1%	0.0%	0.0%	-0.1%
Renewable Hydrocarbon Fuels (HDRD) in diesel	% by Volume	1.7%	2.9%	3.3%	3.7%	4.0%	0.0%	0.0%	0.0%	0.1%	0.1%
Biomass based diesel in LFO	% by Volume	2.3%	2.7%	3.2%	3.6%	4.5%	0.0%	0.0%	0.0%	0.0%	-0.1%
Biodiesel in LFO	% by Volume	1.1%	0.6%	0.7%	0.7%	1.3%	0.0%	0.0%	0.0%	0.0%	-0.1%
Renewable Hydrocarbon Fuels (HDRD) in LFO	% by Volume	1.2%	2.1%	2.5%	2.9%	3.2%	0.0%	0.0%	0.0%	0.0%	0.0%
Pyrolisis oil (Biocrude) in HFO	% by Volume	1.0%	4.3%	7.4%	10.3%	13.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Sustainable aviation fuel in aviation turbo fuel	% by Volume	0.0%	0.7%	1.8%	3.3%	4.8%	0.0%	0.0%	0.0%	0.0%	0.0%
Ethanol in gasoline	% by Energy	5.4%	6.2%	6.8%	7.7%	8.6%	0.0%	0.0%	0.0%	0.0%	0.0%
Biomass based diesel in diesel	% by Energy	3.0%	3.4%	3.9%	4.2%	5.0%	0.0%	0.0%	0.0%	0.1%	0.0%
Biodiesel in diesel	% by Energy	1.4%	0.7%	0.7%	0.7%	1.2%	0.0%	-0.1%	0.0%	0.0%	-0.1%
Renewable Hydrocarbon Fuels (HDRD) in diesel	% by Energy	1.6%	2.7%	3.1%	3.5%	3.8%	0.0%	0.0%	0.0%	0.0%	0.1%
Biomass based diesel in LFO	% by Energy	2.1%	2.5%	3.0%	3.4%	4.2%	0.0%	0.0%	0.0%	0.0%	0.0%
Biodiesel in LFO	% by Energy	1.0%	0.5%	0.6%	0.6%	1.2%	0.0%	0.0%	0.0%	0.0%	-0.1%
HDRD in LFO	% by Energy	1.1%	2.0%	2.3%	2.7%	3.1%	0.0%	0.0%	0.0%	0.0%	0.0%
Pyrolisis oil (Biocrude) in HFO	% by Energy	0.5%	2.3%	4.0%	5.6%	7.2%	0.0%	0.0%	0.0%	0.0%	0.0%
Sustainable aviation fuel in aviation turbo fuel	% by Energy	0.0%	0.7%	1.7%	3.2%	4.7%	0.0%	0.0%	0.0%	0.0%	0.0%

Canada CFS Compliance Credits and Debits: NZ-Guardrail 13% Scenario

Calendar Year	Units	2022	2024	2026	2028	2030	2022	2024	2026	2028	2030
Debits							*(Scenario NZ-GR 13% - Baseline)*				
Fossil Fuels											
Motor Gasoline	tCO2e	252,250	5,943,759	8,764,879	11,438,273	13,988,983	138	3,515	4,975	6,193	7,169
Diesel fuel oil	tCO2e	204,474	5,063,779	7,784,632	10,639,096	13,548,519	-108	-2,500	-22,534	-63,067	-103,557
Light fuel oil	tCO2e	0	0	0	0	0	0	0	0	0	0
Heavy fuel oil	tCO2e	0	0	0	0	0	0	0	0	0	0
Aviation turbo fuel (Domestic Only)	tCO2e	0	0	0	0	0	0	0	0	0	0
Kerosene & stove oil	tCO2e	0	0	0	0	0	0	0	0	0	0
Total Debits	tCO2e	456,724	11,007,538	16,549,510	22,077,370	27,537,502	30	1,016	-17,559	-56,874	-96,388
CFS Compliance Credits											
Compliance Category 1											
CCS	tCO2e	650,000	1,500,000	1,700,000	1,900,000	2,100,000	0	-887,500	-1,775,000	-2,662,500	-3,550,000
Upstream Improvements	tCO2e	0	131,250	262,500	393,750	525,000	0	-221,875	-443,750	-665,625	-887,500
Reductions in Refineries	tCO2e	100,000	281,250	362,500	443,750	525,000	0	-221,875	-443,750	-665,625	-887,500
Incremental Methane Reductions - Conventional Oil	tCO2e	273,373	672,560	798,373	924,187	1,050,000	0	-443,750	-887,500	-1,331,250	-1,775,000
Subtotal Compliance Category 1	tCO2e	1,023,373	2,585,060	3,123,373	3,661,687	4,200,000	0	-1,775,000	-3,550,000	-5,325,000	-7,100,000
Compliance Category 2											
Bank Renewable Fuel Regulation (RFR)	tCO2e	1,400,000	0	0	0	0	0	0	0	0	0
Ethanol	tCO2e	1,675,877	3,677,787	3,833,959	4,184,062	4,494,911	915	2,175	2,176	2,265	2,304
Ethanol from corn	tCO2e	1,382,207	3,052,269	3,245,080	3,549,425	3,845,794	755	1,805	1,842	1,922	1,971
Ethanol from wheat	tCO2e	293,670	625,518	588,880	634,637	649,117	160	370	334	344	333
Biodiesel	tCO2e	610,704	599,654	639,798	585,755	1,054,091	-787	-46,963	-39,932	4,977	-79,927
Biodiesel from canola oil	tCO2e	290,320	246,632	285,421	241,539	628,017	-282	-40,972	-31,981	1,803	-69,115
Biodiesel from inedible tallow	tCO2e	22,510	22,316	23,818	21,964	38,959	-30	-1,671	-1,436	187	-2,874
Biodiesel from soybean oil	tCO2e	254,382	287,707	284,800	280,185	312,739	-420	-1,102	-3,759	2,627	-2,454
Biodiesel from yellow grease	tCO2e	23,557	23,295	24,796	22,801	40,323	-30	-1,743	-1,494	195	-2,973
Biodiesel from distillers corn oil	tCO2e	19,935	19,703	20,962	19,266	34,051	-26	-1,474	-1,263	165	-2,510
Biodiesel from unknown	tCO2e	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels (HDRD)	tCO2e	701,630	2,387,001	2,764,796	3,121,687	3,374,695	130	40,596	27,211	27,888	39,577
Renewable Hydrocarbon Fuels from palm oil	tCO2e	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels from canola oil	tCO2e	136,142	1,310,544	1,739,922	2,143,193	2,444,452	127	34,894	27,290	27,825	38,751
Renewable Hydrocarbon Fuels from palm sludge oil	tCO2e	4,476	8,696	8,440	8,184	7,928	0	0	0	0	0
Renewable Hydrocarbon Fuels from tallow	tCO2e	204,352	385,465	363,441	344,392	324,287	2	3,274	-43	35	473
Renewable Hydrocarbon Fuels from yellow grease	tCO2e	308,752	590,048	564,146	540,325	515,747	1	2,267	-32	26	330
Renewable Hydrocarbon Fuels from soybean oil	tCO2e	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels from spent bleaching earth	tCO2e	47,908	92,247	88,847	85,594	82,281	0	161	-2	2	24
Pyrolisis Oil (Biocrude)	tCO2e	16,680	148,288	259,879	370,260	480,363	0	0	0	0	0
Sustainable aviation fuel	tCO2e	0	113,585	299,170	553,548	798,405	0	-10	0	0	0
Subtotal Compliance Category 2	tCO2e	4,404,891	6,926,315	7,797,602	8,815,312	10,202,465	258	-4,202	-10,544	35,131	-38,046
Compliance Category 3											
Diesel Displaced by Propane	tCO2e	0	0	0	0	0	0	0	0	0	0
Diesel Displaced by Natural Gas	tCO2e	0	0	0	0	0	0	0	0	0	0
Gasoline Displaced by Electric Vehicles	tCO2e	182,857	380,952	787,302	1,193,651	1,600,000	-125,714	-261,905	-241,270	-220,635	-200,000
Diesel Displaced by Electric Vehicles	tCO2e	1,017,143	2,119,048	4,379,365	6,639,683	8,900,000	125,714	261,905	1,407,937	2,553,968	3,700,000
Subtotal Compliance Category 3	tCO2e	1,200,000	2,500,000	5,166,667	7,833,333	10,500,000	0	0	1,166,667	2,333,333	3,500,000
External Credit Sources											
Cross Steam Credits	tCO2e	45,672	1,100,754	1,654,951	2,207,737	2,753,750	3	102	-1,756	-5,687	-9,639
Compliance Fund	tCO2e	0	0	0	0	0	0	0	0	0	0
Emerging Tech Credit Generation	tCO2e	0	0	0	0	0	0	0	0	0	0
Total Credits		6,673,936	13,112,129	17,742,593	22,518,070	27,656,215	261	-1,779,100	-2,395,633	-2,962,223	-3,647,685
Banked for the Year	tCO2e	6,217,212	2,104,590	1,193,083	440,700	118,713	231	-1,780,116	-2,378,074	-2,905,349	-3,551,297
Running Net Credit Balance	tCO2e	6,217,212	12,443,585	15,544,898	16,452,211	16,306,429	231	-2,674,851	-7,131,494	-12,711,397	-19,433,395
Renewable Fuel Credit Price	C$/MT	0	17	10	10	11	0	7	0	0	1
Maximum CFS Compliance Credit Price	C$/MT	350	365	380	396	412	0	0	0	0	0

Value of Canada Compliance Credits By Feedstock Pathway: NZ-Guardrail 13% Scenario

	Calendar Year	Units	2022	2024	2026	2028	2030	2022	2024	2026	2028	2030
								(Scenario NZ-GR 13% - Baseline)				
Ethanol												
Ethanol from corn		C$/liter	0.00	0.02	0.01	0.01	0.01	0.00	0.01	0.00	0.00	0.00
Ethanol from wheat		C$/liter	0.00	0.02	0.01	0.01	0.01	0.00	0.01	0.00	0.00	0.00
Biodiesel												
Biodiesel from canola oil		C$/liter	0.00	0.05	0.03	0.03	0.03	0.00	0.02	0.00	0.00	0.00
Biodiesel from inedible tallow		C$/liter	0.00	0.05	0.03	0.03	0.03	0.00	0.02	0.00	0.00	0.00
Biodiesel from soybean oil		C$/liter	0.00	0.04	0.02	0.02	0.03	0.00	0.02	0.00	0.00	0.00
Biodiesel from yellow grease		C$/liter	0.00	0.05	0.03	0.03	0.03	0.00	0.02	0.00	0.00	0.00
Biodiesel from distillers corn oil		C$/liter	0.00	0.04	0.02	0.02	0.03	0.00	0.02	0.00	0.00	0.00
Renewable Hydrocarbon Fuels		C$/liter										
Renewable Hydrocarbon Fuels from palm oil		C$/liter	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Renewable Hydrocarbon Fuels from canola oil		C$/liter	0.00	0.05	0.03	0.03	0.03	0.00	0.02	0.00	0.00	0.00
Renewable Hydrocarbon Fuels from palm sludge oil		C$/liter	0.00	0.05	0.03	0.03	0.03	0.00	0.02	0.00	0.00	0.00
Renewable Hydrocarbon Fuels from tallow		C$/liter	0.00	0.05	0.03	0.03	0.03	0.00	0.02	0.00	0.00	0.00
Renewable Hydrocarbon Fuels from yellow grease		C$/liter	0.00	0.05	0.03	0.03	0.03	0.00	0.02	0.00	0.00	0.00
Renewable Hydrocarbon Fuels from soybean oil		C$/liter	0.00	0.03	0.02	0.02	0.02	0.00	0.01	0.00	0.00	0.00
Renewable Hydrocarbon Fuels from spent bleaching earth		C$/liter	0.00	0.04	0.02	0.02	0.03	0.00	0.02	0.00	0.00	0.00

Biofuel Feedstocks Used for Canadian Domestic Consumption: NZ-Guardrail 13% Scenario

	Calendar Year	Units	2022	2024	2026	2028	2030	2022	2024	2026	2028	2030
								(Scenario NZ-GR 13% - Baseline)				
Ethanol Feedstocks												
Corn		1000 MT	3,728	4,682	5,537	6,780	7,964	4	-48	-7	5	6
Wheat		1000 MT	921	972	910	898	893	0	42	0	0	-4
Biodiesel Feedstocks												
Canola Oil		1000 MT	185	81	96	83	223	0	-13	-11	1	-25
Inedible Tallow		1000 MT	13	7	7	7	13	0	-1	0	0	-1
Soybean Oil		1000 MT	178	104	105	107	123	0	0	-1	1	-1
Yellow Grease		1000 MT	15	8	8	8	14	0	-1	-1	0	-1
Distillers Corn Oil		1000 MT	14	7	8	7	13	0	-1	0	0	-1
Unknown		1000 MT	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels Feedstocks												
Feedstocks Used for Domestic Production												
Canola Oil		1000 MT	86	424	578	732	859	0	11	9	10	14
Feedstocks Used for Imports (Approximation)												
Palm Oil		1000 MT	0	0	0	0	0	0	0	0	0	0
Palm Sludge Oil		1000 MT	3	3	3	3	3	0	0	0	0	0
Inedible Tallow		1000 MT	131	127	123	120	116	0	1	0	0	0
Yellow Grease		1000 MT	213	209	206	204	201	0	1	0	0	0
Soybean Oil		1000 MT	0	0	0	0	0	0	0	0	0	0
Spent Bleaching Earth		1000 MT	36	35	35	35	35	0	0	0	0	0

Canada Canola and Canola Products Supply and Demand: NZ-Guardrail 13% Scenario

	Units	22/23	24/25	26/27	28/29	30/31	22/23	24/25	26/27	28/29	30/31
							(Scenario NZ-GR 13% - Baseline)				
Canola											
Area Planted	1000 ha	8,569	8,441	8,560	8,616	8,680	-2	-2	-2	3	-6
Area Harvested	1000 ha	8,483	8,356	8,473	8,529	8,593	-2	-2	-2	3	-6
Yield	mt per ha	2.33	2.37	2.42	2.46	2.51	0.00	0.00	0.00	0.00	0.00
Supply											
Beginning Stocks	1000 mt	716	1,630	1,874	2,100	2,307	0	-1	-1	0	1
Production	1000 mt	19,769	19,843	20,496	21,007	21,543	-5	-5	-4	7	-16
Imports	1000 mt	104	104	104	104	104	0	0	0	0	0
Total Supply	1000 mt	20,589	21,577	22,474	23,212	23,954	-5	-6	-5	7	-16
Domestic Disappearance											
Crush	1000 mt	11,050	11,622	11,935	12,134	12,351	-2	-3	-3	3	-7
Food	1000 mt	0	0	0	0	0	0	0	0	0	0
Feed, Seed, Waste	1000 mt	109	110	115	122	127	0	0	0	0	0
Total Domestic Disappearance	1000 mt	11,159	11,732	12,050	12,255	12,478	-2	-3	-3	3	-7
Exports	1000 mt	7,801	8,099	8,446	8,762	9,082	-2	-2	-2	3	-5
Ending Stocks	1000 mt	1,629	1,746	1,979	2,195	2,394	-1	-1	-1	1	-3
Canola Meal											
Extraction Rate	kg/kg	0.56	0.56	0.56	0.56	0.56	0.00	0.00	0.00	0.00	0.00
Supply											
Beginning Stocks	1000 mt	54	94	106	113	119	0	0	0	0	0
Production	1000 mt	6,168	6,488	6,662	6,773	6,895	-1	-2	-2	2	-4
Imports	1000 mt	56	56	56	56	56	0	0	0	0	0
Total Supply	1000 mt	6,278	6,637	6,823	6,941	7,069	-1	-2	-2	2	-4
Domestic Disappearance											
Food	1000 mt	0	0	0	0	0	0	0	0	0	0
Feed & Residual	1000 mt	744	768	804	836	871	0	0	0	0	0
Industrial	1000 mt	0	0	0	0	0	0	0	0	0	0
Total Domestic Disappearance	1000 mt	744	768	804	836	871	0	0	0	0	0
Exports	1000 mt	5,445	5,769	5,911	5,991	6,077	-1	-2	-1	2	-3
Ending Stocks	1000 mt	89	100	109	115	121	0	0	0	0	0
Canola Oil											
Extraction Rate	kg/kg	0.44	0.44	0.44	0.44	0.44	0.00	0.00	0.00	0.00	0.00
Supply											
Beginning Stocks	1000 mt	412	514	530	551	568	0	0	0	0	0
Production	1000 mt	4,837	5,088	5,224	5,311	5,407	-1	-1	-1	1	-3
Imports	1000 mt	0	0	0	0	0	0	0	0	0	0
Total Supply	1000 mt	5,249	5,602	5,754	5,863	5,975	-1	-1	-1	1	-3
Domestic Disappearance											
Food	1000 mt	687	667	678	693	704	0	0	0	0	0
Feed & Residual	1000 mt	0	0	0	0	0	0	0	0	0	0
Industrial	1000 mt	607	819	933	1,080	1,327	-12	-4	-6	13	-31
Total Domestic Disappearance	1000 mt	1,293	1,486	1,611	1,773	2,032	-12	-4	-6	13	-30
Exports	1000 mt	3,468	3,593	3,602	3,527	3,365	11	2	5	-11	27
Ending Stocks	1000 mt	488	523	541	563	579	0	0	0	0	0
Canola and Derivative Prices											
Canola Average Farm Price, Saskatchewan	CAD/mt	649	673	671	663	661	0	0	0	0	0
Canola Seed Average Price, Pacific Coast	CAD/mt	673	698	696	688	686	0	0	0	0	0
Canola Oil FOB Plants, Crude Degummed	CAD/mt	1,718	1,781	1,814	1,821	1,852	-1	-1	-1	1	-2
Canola Meal FOB Plant	CAD/mt	305	309	292	281	268	0	0	0	0	0

Canada Grains Supply and Demand: NZ-Guardrail 13% Scenario

	Units	22/23	24/25	26/27	28/29	30/31	22/23	24/25	26/27	28/29	30/31
							(Scenario NZ-GR 13% - Baseline)				
Corn											
Area Planted	1000 ha	1,475	1,475	1,476	1,475	1,476	0	0	0	0	1
Area Harvested	1000 ha	1,430	1,428	1,428	1,426	1,427	0	0	0	0	0
Yield	mt per ha	9.98	10.21	10.44	10.67	10.90	0.00	0.00	0.00	0.00	0.00
Supply											
Beginning Stocks	1000 mt	1,981	2,118	2,204	2,285	2,358	0	0	0	0	0
Production	1000 mt	14,272	14,572	14,900	15,217	15,546	0	0	0	0	0
Imports	1000 mt	3,343	3,692	3,374	4,677	6,113	-17	-20	3	-1	4,076
Total Supply	1000 mt	19,595	20,382	20,478	22,178	24,018	-17	-20	3	-1	4,076
Domestic Disappearance											
Feed & Residual Use	1000 mt	10,553	10,087	9,672	9,938	10,348	5	4	1	2	540
Food, Seed, and Industrial Use	1000 mt	5,988	7,143	7,584	8,942	10,301	-23	-24	2	-2	3,546
Bioethanol Use	1000 mt	4,233	5,274	5,565	6,766	7,966	-23	-24	2	-2	3,552
Total Domestic Disappearance	1000 mt	16,541	17,231	17,256	18,880	20,648	-17	-20	3	-1	4,086
Exports	1000 mt	974	974	974	974	974	0	0	0	0	0
Ending Stocks	1000 mt	2,080	2,177	2,248	2,325	2,395	0	0	0	0	-11
Wheat											
Area Planted	1000 ha	10,147	9,960	9,832	9,681	9,547	0	0	0	0	4
Area Harvested	1000 ha	9,370	9,310	9,209	9,126	9,068	0	0	0	0	0
Yield	mt per ha	3.45	3.49	3.53	3.58	3.62	0.00	0.00	0.00	0.00	0.00
Supply											
Beginning Stocks	1000 mt	4,488	5,813	6,197	6,424	6,615	0	-1	0	0	0
Production	1000 mt	32,289	32,493	32,549	32,657	32,850	0	1	0	0	1
Imports	1000 mt	700	700	700	700	700	0	0	0	0	0
Total Supply	1000 mt	37,477	39,006	39,446	39,781	40,165	0	0	0	0	0
Domestic Disappearance											
Feed & Residual Use	1000 mt	4,008	4,270	4,415	4,645	4,913	-5	-7	0	-1	259
Food, Seed, and Industrial Use	1000 mt	5,187	5,185	5,177	5,195	5,201	18	21	0	5	3
Bioethanol Use	1000 mt	976	944	909	902	884	18	21	0	5	5
Total Domestic Disappearance	1000 mt	9,195	9,456	9,592	9,839	10,113	13	14	0	4	262
Exports	1000 mt	22,822	23,509	23,565	23,438	23,317	-13	-13	0	-4	-222
Ending Stocks	1000 mt	5,460	6,042	6,288	6,503	6,735	0	0	0	0	-39
Grain Prices											
Barley, #1 Feed, Alberta	CAD/mt	372	388	401	419	438	0	0	0	0	6
Barley Farm Price	CAD/mt	285	297	307	321	335	0	0	0	0	4
Corn #2, CE Cash, Chatham	CAD/mt	245	243	242	238	235	0	0	0	0	3
Wheat, Western Red Spring, 12.5% Protein	CAD/mt	390	395	402	408	412	0	0	0	0	4
Wheat Producer Price, Ontario	CAD/mt	279	283	289	293	297	0	0	0	0	3

Table Results for NZ-Guardrail 20% ZEV Scenario

Canada Biomass Based Diesel Supply and Demand: NZ-Guardrail 20% ZEV Scenario

Calendar Year	Units	2022	2024	2026	2028	2030	2022	2024	2026	2028	2030
							(Scenario NZ-GR 20% ZEV - Baseline)				
Diesel Fuel Use and Biofuels Policy											
Diesel Transportation Use (excluding biofuels)	Million Liters	26,458	27,169	27,588	27,452	27,606	-8	-139	-467	-1,391	-1,829
Biodiesel Supply & Use											
Beginning Stocks	Million Liters	0	0	0	0	0	0	0	0	0	0
Production	Million Liters	342	324	333	503	578	1	4	-5	196	47
Imports	Million Liters	400	426	495	735	671	35	80	151	393	330
Total Supply	Million Liters	742	750	828	1,237	1,248	36	84	146	589	377
Domestic Use	Million Liters	449	329	409	819	833	-1	84	145	586	373
Exports	Million Liters	293	421	419	418	416	37	0	1	3	4
Ending Stocks	Million Liters	0	0	0	0	0	0	0	0	0	0
Total Demand	Million Liters	742	750	828	1,237	1,248	36	84	146	589	377
Renewable Hydrocarbon Fuels Supply & Use											
Beginning Stocks	Million Liters	0	0	0	0	0	0	0	0	0	0
Production	Million Liters	94	501	754	1,239	1,776	0	52	134	451	854
Imports	Million Liters	397	397	396	429	433	0	10	14	54	66
Total Supply	Million Liters	491	898	1,150	1,668	2,209	0	62	148	505	919
Domestic Use	Million Liters	491	898	1,150	1,668	2,209	0	62	148	505	919
Exports	Million Liters	0	0	0	0	0	0	0	0	0	0
Ending Stocks	Million Liters	0	0	0	0	0	0	0	0	0	0
Total Demand	Million Liters	491	898	1,150	1,668	2,209	0	62	148	505	919
Domestic Feedstocks											
Canola Oil (Biodiesel Plants)	1000 Metric Tons	201	176	178	297	346	0	-2	-12	143	3
Canola Oil (Renewable Hydrocarbon Fuels Plants)	1000 Metric Tons	86	460	692	1,137	1,629	0	47	123	414	783
Inedible Tallow	1000 Metric Tons	10	12	14	30	37	0	4	5	20	24
Soybean Oil	1000 Metric Tons	76	79	82	96	104	0	3	4	16	20
Yellow Grease	1000 Metric Tons	12	12	12	14	15	0	0	0	2	2
Distillers Corn Oil	1000 Metric Tons	11	13	16	18	20	0	-1	-1	-4	-5
Domestic Feedstock Yield											
Canola Oil	1000 Liters/MT	1.11	1.11	1.11	1.11	1.11	0.00	0.00	0.00	0.00	0.00
Inedible Tallow	1000 Liters/MT	1.04	1.04	1.04	1.04	1.04	0.00	0.00	0.00	0.00	0.00
Soybean Oil	1000 Liters/MT	1.11	1.11	1.11	1.11	1.11	0.00	0.00	0.00	0.00	0.00
Yellow Grease	1000 Liters/MT	1.04	1.04	1.04	1.04	1.04	0.00	0.00	0.00	0.00	0.00
Distillers Corn Oil	1000 Liters/MT	1.11	1.11	1.11	1.11	1.11	0.00	0.00	0.00	0.00	0.00
Biomass-based Diesel Prices											
BC/AB Canada B99 Rack Price	CAD/Liter	1.29	1.20	1.24	1.32	1.44	0.00	0.00	0.01	0.04	0.05
Canada HDRD Wholesale Price	CAD/Liter	2.39	2.37	2.43	2.50	2.54	0.00	0.01	0.02	0.05	0.07

Canada Ethanol Supply and Demand: NZ-Guardrail 20% ZEV Scenario

Calendar Year	Units	2022	2024	2026	2028	2030	2022	2024	2026	2028	2030
							(Scenario NZ-GR 20% ZEV - Baseline)				
Gasoline Fuel Use and Biofuels Policy											
Gasoline Transportation Use	Million Liters	36,350	35,687	35,029	34,195	33,316	12	12	-43	-133	-272
Supply & Demand											
Beginning Stocks	Million Liters	0	0	0	0	0	0	0	0	0	0
Production	Million Liters	1,916	2,322	2,608	3,112	3,507	1	-16	-61	-66	-164
Imports	Million Liters	1,196	1,188	1,157	1,154	1,306	0	17	56	95	283
Total Supply	Million Liters	3,111	3,510	3,766	4,266	4,814	1	1	-5	29	119
Domestic Use	Million Liters	3,080	3,479	3,734	4,235	4,783	1	1	-5	29	119
Exports	Million Liters	31	31	31	31	31	0	0	0	0	0
Ending Stocks	Million Liters	0	0	0	0	0	0	0	0	0	0
Total Demand	Million Liters	3,111	3,510	3,766	4,266	4,814	1	1	-5	29	119
Feedstocks											
Corn	1000 Metric Tons	3,726	4,507	5,142	5,594	6,283	3	-223	-401	-1,181	-1,675
Wheat	1000 Metric Tons	920	1,127	1,180	1,983	2,258	0	197	270	1,085	1,360
Feedstock Yield											
Corn	1000 Liters/MT	0.42	0.42	0.42	0.42	0.42	0.00	0.00	0.00	0.00	0.00
Wheat	1000 Liters/MT	0.39	0.39	0.39	0.39	0.39	0.00	0.00	0.00	0.00	0.00
Distillers' Grains Production											
Corn	1000 Metric Tons	1,131	1,368	1,561	1,698	1,907	1	-68	-122	-358	-508
Wheat	1000 Metric Tons	279	342	358	602	685	0	60	82	329	413
Wholesale Ethanol Price (excludes CFS Credit Value)	CAD/Liter	0.69	0.67	0.67	0.68	0.68	0.00	0.00	0.00	0.00	0.00

Canada CFS Program Parameters: NZ-Guardrail 20% ZEV Scenario

	Calendar Year	Units	2022	2024	2026	2028	2030	2022	2024	2026	2028	2030
								(Scenario NZ-GR 20% ZEV - Baseline)				
Program Goals												
2016 Stream Carbon Intensity		tCO2e/TJ	91.6	91.6	91.6	91.6	91.6	0.0	0.0	0.0	0.0	0.0
Credit Stream Carbon Intensity Reference		tCO2e/TJ	89.3	85.5	81.6	77.8	74.0	0.0	-1.5	-3.1	-4.6	-6.1
Obligated Fossil Fuel Carbon Intensity Reduction		tCO2e/TJ	2.4	6.4	10.4	14.3	18.3	0.0	1.6	3.2	4.7	6.3
Obligated Jet Fuel Carbon Intensity Reduction		tCO2e/TJ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy Economy Ratios												
Hydrogen (Gasoline)		Ratio	2.5	2.5	2.5	2.5	2.5	0	0	0	0	0
Hydrogen (Diesel)		Ratio	1.9	1.9	1.9	1.9	1.9	0	0	0	0	0
CNG (Diesel)		Ratio	0.9	0.9	0.9	0.9	0.9	0	0	0	0	0
EV (Gasoline)		Ratio	4.1	4.1	4.1	4.1	4.1	0	0	0	0	0
EV (Diesel)		Ratio	5	5	5	5	5	0	0	0	0	0
Energy Density of Fuels												
Gasoline		MJ/Liter	34.69	34.69	34.69	34.69	34.69	0.00	0.00	0.00	0.00	0.00
Diesel		MJ/Liter	38.65	38.65	38.65	38.65	38.65	0.00	0.00	0.00	0.00	0.00
Aviation Fuel		MJ/Liter	35.46	35.46	35.46	35.46	35.46	0.00	0.00	0.00	0.00	0.00
Ethanol		MJ/Liter	23.58	23.58	23.58	23.58	23.58	0.00	0.00	0.00	0.00	0.00
Biodiesel		MJ/Liter	35.40	35.40	35.40	35.40	35.40	0.00	0.00	0.00	0.00	0.00
Renewable Hydrocarbon Fuels (HDRD)		MJ/Liter	36.51	36.51	36.51	36.51	36.51	0.00	0.00	0.00	0.00	0.00
Sustainable Aviation Fuel		MJ/Liter	34.81	34.81	34.81	34.81	34.81	0.00	0.00	0.00	0.00	0.00
Electricity		MJ/kWh	3.60	3.60	3.60	3.60	3.60	0.00	0.00	0.00	0.00	0.00
LFO		MJ/Liter	38.80	38.80	38.80	38.80	38.80	0.00	0.00	0.00	0.00	0.00
Kerosene		MJ/Liter	37.68	37.68	37.68	37.68	37.68	0.00	0.00	0.00	0.00	0.00
Pyrolisis Oil (Biocrude)		MJ/Liter	21.35	21.35	21.35	21.35	21.35	0.00	0.00	0.00	0.00	0.00
HFO		MJ/Liter	41.10	41.10	41.10	41.10	41.10	0.00	0.00	0.00	0.00	0.00

Canada CFS Carbon Intensity Average Scores: NZ-Guardrail 20% ZEV Scenario

	Calendar Year	Units	2022	2024	2026	2028	2030	2022	2024	2026	2028	2030
								(Scenario NZ-GR 20% ZEV - Baseline)				
Motor gasoline		tCO2e/TJ	91.9	91.9	91.9	91.9	91.9	0.0	0.0	0.0	0.0	0.0
Ethanol		tCO2e/TJ										
Ethanol from corn		tCO2e/TJ	44.1	43.0	41.9	40.9	39.8	0.0	0.0	0.0	0.0	0.0
Ethanol from wheat		tCO2e/TJ	38.6	37.8	37.0	36.2	35.3	0.0	0.0	0.0	0.0	0.0
Diesel fuel oil		tCO2e/TJ	97.1	97.1	97.1	97.1	97.1	0.0	0.0	0.0	0.0	0.0
Biodiesel		tCO2e/TJ										
Biodiesel from canola oil		tCO2e/TJ	9.6	9.3	9.1	8.8	8.6	0.0	0.0	0.0	0.0	0.0
Biodiesel from inedible tallow		tCO2e/TJ	-1.2	-1.4	-1.7	-1.9	-2.1	0.0	0.0	0.0	0.0	0.0
Biodiesel from soybean oil		tCO2e/TJ	16.8	16.5	16.1	15.8	15.5	0.0	0.0	0.0	0.0	0.0
Biodiesel from yellow grease		tCO2e/TJ	4.2	4.1	3.9	3.8	3.7	0.0	0.0	0.0	0.0	0.0
Biodiesel from distillers corn oil		tCO2e/TJ	16.7	16.3	15.9	15.4	15.0	0.0	0.0	0.0	0.0	0.0
Biodiesel from unknown		tCO2e/TJ	3.8	3.8	3.8	3.8	3.8	0.0	0.0	0.0	0.0	0.0
Renewable Hydrocarbon Fuels (HDRD) (weighted avg)		tCO2e/TJ										
Renewable Hydrocarbon Fuels from palm oil		tCO2e/TJ	71.7	71.0	70.3	69.6	68.9	0.0	0.0	0.0	0.0	0.0
Renewable Hydrocarbon Fuels from canola oil		tCO2e/TJ	9.6	9.3	9.1	8.8	8.6	0.0	0.0	0.0	0.0	0.0
Renewable Hydrocarbon Fuels from palm sludge oil		tCO2e/TJ	11.2	11.1	11.0	10.9	10.9	0.0	0.0	0.0	0.0	0.0
Renewable Hydrocarbon Fuels from tallow		tCO2e/TJ	7.2	7.0	6.9	6.7	6.5	0.0	0.0	0.0	0.0	0.0
Renewable Hydrocarbon Fuels from yellow grease		tCO2e/TJ	12.7	12.6	12.4	12.3	12.2	0.0	0.0	0.0	0.0	0.0
Renewable Hydrocarbon Fuels from soybean oil		tCO2e/TJ	30.8	30.4	30.0	29.6	29.2	0.0	0.0	0.0	0.0	0.0
Renewable Hydrocarbon Fuels from spent bleaching earth		tCO2e/TJ	18.6	18.3	18.0	17.8	17.5	0.0	0.0	0.0	0.0	0.0
Light fuel oil		tCO2e/TJ	87.0	87.0	87.0	87.0	87.0	0.0	0.0	0.0	0.0	0.0
Kerosene & stove oil		tCO2e/TJ	82.0	82.0	82.0	82.0	82.0	0.0	0.0	0.0	0.0	0.0
Heavy fuel oil		tCO2e/TJ	91.0	91.0	91.0	91.0	91.0	0.0	0.0	0.0	0.0	0.0
Pyrolisis Oil (Biocrude)		tCO2e/TJ	25.0	23.0	21.0	19.0	17.0	0.0	0.0	0.0	0.0	0.0
Aviation gasoline		tCO2e/TJ	94.0	94.0	94.0	94.0	94.0	0.0	0.0	0.0	0.0	0.0
Aviation turbo fuel		tCO2e/TJ	90.1	90.1	90.1	90.1	90.1	0.0	0.0	0.0	0.0	0.0
Sustainable aviation fuel		tCO2e/TJ	30.0	30.0	30.0	30.0	30.0	0.0	0.0	0.0	0.0	0.0
Propane Vehicle		tCO2e/TJ	68.0	68.0	68.0	68.0	68.0	0.0	0.0	0.0	0.0	0.0
Natural Gas Vehicle		tCO2e/TJ	62.9	62.9	62.9	62.9	62.9	0.0	0.0	0.0	0.0	0.0
EV (Gasoline)		tCO2e/TJ	21.7	21.7	21.7	21.7	21.7	0.0	0.0	0.0	0.0	0.0

Canada Fuel Consumption Volumes: NZ-Guardrail 20% ZEV Scenario

Calendar Year	Units	2022	2024	2026	2028	2030	2022	2024	2026	2028	2030
							(Scenario NZ-GR 20% ZEV - Baseline)				
Blended Gasoline (volumetric total)	million liters	39,430	39,165	38,764	38,430	38,098	13	13	-48	-104	-153
Motor gasoline	million liters	36,350	35,687	35,029	34,195	33,316	12	12	-43	-133	-272
Ethanol	million liters	3,080	3,479	3,734	4,235	4,783	1	1	-5	29	119
Ethanol from corn	million liters	2,589	2,940	3,212	3,649	4,152	1	1	-4	25	104
Ethanol from wheat	million liters	491	539	522	586	631	0	0	-1	4	16
Blended Diesel (volumetric total)	million liters	27,350	28,336	29,072	29,821	30,508	-9	-1	-188	-354	-596
Diesel fuel oil	million liters	26,458	27,169	27,588	27,452	27,606	-8	-139	-467	-1,391	-1,829
Biomass Based Diesel	million liters	893	1,167	1,484	2,369	2,902	0	138	279	1,037	1,233
Biodiesel	million liters	426	312	388	776	789	-1	80	138	555	354
Biodiesel from canola oil	million liters	195	132	166	432	462	0	33	54	345	201
Biodiesel from inedible tallow	million liters	13	10	12	24	25	0	2	4	17	11
Biodiesel from soybean oil	million liters	188	148	182	266	248	-1	39	70	155	117
Biodiesel from yellow grease	million liters	15	11	14	27	27	0	3	5	19	12
Biodiesel from distillers corn oil	million liters	15	11	13	27	27	0	3	5	19	12
Biodiesel made from unknown	million liters	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels (HDRD)	million liters	467	855	1,096	1,592	2,113	0	59	141	482	879
Renewable Hydrocarbon Fuels made from palm oil	million liters	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels made from canola oil	million liters	89	477	719	1,183	1,698	0	49	128	431	817
Renewable Hydrocarbon Fuels made from palm sludge oil	million liters	3	3	3	3	3	0	0	0	0	0
Renewable Hydrocarbon Fuels made from tallow	million liters	130	130	129	147	150	0	5	8	28	35
Renewable Hydrocarbon Fuels made from yellow grease	million liters	210	210	210	223	225	0	4	6	21	26
Renewable Hydrocarbon Fuels made from soybean oil	million liters	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels made from spent bleaching earth	million liters	35	35	35	36	36	0	0	0	2	2
Blended Light Fuel Oil		2,057	1,979	1,904	1,836	1,765	0	1	1	4	4
Light diesel fuel oil	million liters	2,009	1,919	1,829	1,717	1,625	0	-7	-13	-50	-55
Biomass Based Diesel	million liters	47	61	75	119	140	0	7	15	54	59
Biodiesel	million liters	23	17	22	43	43	0	4	8	31	19
Biodiesel from canola oil	million liters	11	7	9	24	25	0	2	3	19	11
Biodiesel from inedible tallow	million liters	1	1	1	1	1	0	0	0	1	1
Biodiesel from soybean oil	million liters	10	8	10	15	14	0	2	4	9	6
Biodiesel from yellow grease	million liters	1	1	1	2	2	0	0	0	1	1
Biodiesel from distillers corn oil	million liters	1	1	1	1	1	0	0	0	1	1
Biodiesel from unknown	million liters	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels (HDRD)	million liters	24	43	54	76	96	0	3	7	23	40
Renewable Hydrocarbon Fuels made from palm oil	million liters	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels made from canola oil	million liters	5	24	35	56	78	0	2	6	20	37
Renewable Hydrocarbon Fuels made from palm sludge oil	million liters	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels made from tallow	million liters	7	7	6	7	7	0	0	0	1	2
Renewable Hydrocarbon Fuels made from yellow grease	million liters	11	11	10	11	10	0	0	0	1	1
Renewable Hydrocarbon Fuels made from soybean oil	million liters	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels made from spent bleaching earth	million liters	2	2	2	2	2	0	0	0	0	0
Blended Heavy Fuel Oil		2,453	2,520	2,580	2,653	2,735	0	0	0	0	0
Heavy fuel oil	million liters	2,429	2,411	2,389	2,379	2,378	0	0	0	0	0
Pyrolisis Oil (Biocrude)	million liters	24	109	191	274	357	0	0	0	0	0
Blended Jet Fuel		8,492	8,643	8,886	9,232	9,621	0	0	0	0	0
Aviation turbo fuel	million liters	8,492	8,586	8,729	8,929	9,162	0	0	0	0	0
Sustainable aviation fuel	million liters	0	57	157	304	458	0	0	0	0	0
Kerosene & stove oil	million liters	443	425	409	395	383	0	0	0	0	0

Canada Fuel Consumption Volumes in Terajoules: NZ-Guardrail 20% ZEV Scenario

Calendar Year	Units	2022	2024	2026	2028	2030	2022	2024	2026	2028	2030
							(Scenario NZ-GR 20% ZEV - Baseline)				
Blended Gasoline	terajoules	1,333,606	1,319,993	1,303,216	1,286,073	1,268,497	436	442	-1,603	-3,937	-6,618
Motor Gasoline	terajoules	1,260,975	1,237,965	1,215,158	1,186,213	1,155,719	412	414	-1,495	-4,628	-9,432
Ethanol	terajoules	72,631	82,028	88,058	99,859	112,779	24	27	-108	691	2,814
Ethanol from corn	terajoules	61,054	69,324	75,742	86,044	97,905	20	23	-93	595	2,443
Ethanol from wheat	terajoules	11,578	12,705	12,316	13,816	14,874	4	4	-15	96	371
Blended Diesel	terajoules	1,054,698	1,092,329	1,120,021	1,146,653	1,172,053	-333	-432	-8,023	-16,518	-26,074
Diesel fuel oil	terajoules	1,022,585	1,050,085	1,066,278	1,061,035	1,066,978	-324	-5,389	-18,050	-53,774	-70,695
Biodiesel	terajoules	15,076	11,030	13,724	27,485	27,945	-26	2,814	4,868	19,659	12,518
Biodiesel from canola oil	terajoules	6,912	4,666	5,891	15,284	16,363	-1	1,158	1,914	12,196	7,116
Biodiesel from inedible tallow	terajoules	472	345	429	860	874	-1	88	152	615	392
Biodiesel from soybean oil	terajoules	6,646	5,253	6,452	9,434	8,769	-22	1,373	2,464	5,484	4,143
Biodiesel from yellow grease	terajoules	525	384	478	957	973	-1	98	170	685	436
Biodiesel from distillers corn oil	terajoules	521	381	474	949	965	-1	97	168	679	432
Biodiesel from unknown	terajoules	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels (HDRD)	terajoules	17,038	31,214	40,019	58,134	77,130	16	2,143	5,158	17,597	32,103
Renewable Hydrocarbon Fuels made from palm oil	terajoules	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels made from canola oil	terajoules	3,256	17,415	26,248	43,188	62,000	15	1,790	4,661	15,730	29,811
Renewable Hydrocarbon Fuels made from palm sludge oil	terajoules	109	109	109	109	110	0	0	0	0	0
Renewable Hydrocarbon Fuels made from tallow	terajoules	4,730	4,743	4,726	5,378	5,481	1	196	275	1,035	1,271
Renewable Hydrocarbon Fuels made from yellow grease	terajoules	7,657	7,660	7,649	8,134	8,209	0	146	206	772	947
Renewable Hydrocarbon Fuels made from soybean oil	terajoules	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels made from spent bleaching earth	terajoules	1,287	1,287	1,286	1,325	1,331	0	11	16	60	73
Blended Light Fuel Oil	terajoules	79,665	76,628	73,678	70,918	68,097	0	0	0	0	0
Light fuel oil	terajoules	77,964	74,438	70,954	66,636	63,047	1	-264	-523	-1,925	-2,151
Biodiesel	terajoules	812	608	762	1,525	1,530	-1	155	270	1,091	686
Biodiesel from canola oil	terajoules	372	257	327	848	896	0	64	106	677	390
Biodiesel from inedible tallow	terajoules	25	19	24	48	48	0	5	8	34	21
Biodiesel from soybean oil	terajoules	358	290	358	523	480	-1	76	137	304	227
Biodiesel from yellow grease	terajoules	28	21	27	53	53	0	5	9	38	24
Biodiesel from distillers corn oil	terajoules	28	21	26	53	53	0	5	9	38	24
Biodiesel from unknown	terajoules	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels (HDRD)	terajoules	889	1,582	1,962	2,757	3,520	1	109	253	835	1,465
Renewable Hydrocarbon Fuels made from palm oil	terajoules	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels made from canola oil	terajoules	170	883	1,287	2,048	2,830	1	91	228	746	1,361
Renewable Hydrocarbon Fuels made from palm sludge oil	terajoules	6	6	5	5	5	0	0	0	0	0
Renewable Hydrocarbon Fuels made from tallow	terajoules	247	240	232	255	250	0	10	14	49	58
Renewable Hydrocarbon Fuels made from yellow grease	terajoules	400	388	375	386	375	0	7	10	37	43
Renewable Hydrocarbon Fuels made from soybean oil	terajoules	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels made from spent bleaching earth	terajoules	67	65	63	63	61	0	1	1	3	3
Blended Heavy Fuel Oil	terajoules	100,343	101,410	102,250	103,625	105,364	0	0	0	0	0
Heavy fuel oil	terajoules	99,825	99,093	98,170	97,783	97,747	0	0	0	0	0
Pyrolisis Oil (Biocrude)	terajoules	519	2,317	4,080	5,842	7,617	0	0	0	0	0
Blended Jet Fuel	terajoules	301,135	306,443	315,009	327,185	340,846	0	0	0	0	0
Aviation turbo fuel	terajoules	301,135	304,450	309,540	316,617	324,899	0	0	0	0	0
Sustainable aviation fuel	terajoules	0	1,992	5,470	10,568	15,947	0	0	0	0	0
Kerosene & stove oil	terajoules	16,688	16,019	15,420	14,886	14,418	0	0	0	0	0
Propane Vehicle	terajoules	0	0	0	0	0	0	0	0	0	0
Natural Gas Vehicle	terajoules	0	0	0	0	0	0	0	0	0	0
Electric Vehicles (Gasoline) Assumption	terajoules	1,352	1,475	4,763	8,417	12,503	-436	-442	1,603	3,937	6,618
Electric Vehicles (Diesel) Assumption	terajoules	4,278	4,653	14,967	26,341	38,947	333	432	8,023	16,518	26,074

Canada Fuel Blend Rates: NZ-Guardrail 20% ZEV Scenario

Calendar Year	Units	2022	2024	2026	2028	2030	2022	2024	2026	2028	2030
							(Scenario NZ-GR 20% ZEV - Baseline)				
Ethanol in gasoline	% by Volume	7.8%	8.9%	9.6%	11.0%	12.6%	0.0%	0.0%	0.0%	0.1%	0.4%
Biomass based diesel in diesel	% by Volume	3.3%	4.1%	5.1%	7.9%	9.5%	0.0%	0.5%	1.0%	3.5%	4.1%
Biodiesel in diesel	% by Volume	1.6%	1.1%	1.3%	2.6%	2.6%	0.0%	0.3%	0.5%	1.9%	1.2%
Renewable Hydrocarbon Fuels (HDRD) in diesel	% by Volume	1.7%	3.0%	3.8%	5.3%	6.9%	0.0%	0.2%	0.5%	1.7%	3.0%
Biomass based diesel in LFO	% by Volume	2.3%	3.1%	4.0%	6.5%	7.9%	0.0%	0.4%	0.8%	2.9%	3.4%
Biodiesel in LFO	% by Volume	1.1%	0.9%	1.1%	2.3%	2.5%	0.0%	0.2%	0.4%	1.7%	1.1%
Renewable Hydrocarbon Fuels (HDRD) in LFO	% by Volume	1.2%	2.2%	2.8%	4.1%	5.5%	0.0%	0.1%	0.4%	1.2%	2.3%
Pyrolisis oil (Biocrude) in HFO	% by Volume	1.0%	4.3%	7.4%	10.3%	13.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Sustainable aviation fuel in aviation turbo fuel	% by Volume	0.0%	0.7%	1.8%	3.3%	4.8%	0.0%	0.0%	0.0%	0.0%	0.0%
Ethanol in gasoline	% by Energy	5.4%	6.2%	6.8%	7.8%	8.9%	0.0%	0.0%	0.0%	0.1%	0.3%
Biomass based diesel in diesel	% by Energy	3.0%	3.9%	4.8%	7.5%	9.0%	0.0%	0.5%	0.9%	3.3%	3.9%
Biodiesel in diesel	% by Energy	1.4%	1.0%	1.2%	2.4%	2.4%	0.0%	0.3%	0.4%	1.7%	1.1%
Renewable Hydrocarbon Fuels (HDRD) in diesel	% by Energy	1.6%	2.9%	3.6%	5.1%	6.6%	0.0%	0.2%	0.5%	1.6%	2.8%
Biomass based diesel in LFO	% by Energy	2.1%	2.9%	3.7%	6.0%	7.4%	0.0%	0.3%	0.7%	2.7%	3.2%
Biodiesel in LFO	% by Energy	1.0%	0.8%	1.0%	2.2%	2.2%	0.0%	0.2%	0.4%	1.5%	1.0%
HDRD in LFO	% by Energy	1.1%	2.1%	2.7%	3.9%	5.2%	0.0%	0.1%	0.3%	1.2%	2.2%
Pyrolisis oil (Biocrude) in HFO	% by Energy	0.5%	2.3%	4.0%	5.6%	7.2%	0.0%	0.0%	0.0%	0.0%	0.0%
Sustainable aviation fuel in aviation turbo fuel	% by Energy	0.0%	0.7%	1.7%	3.2%	4.7%	0.0%	0.0%	0.0%	0.0%	0.0%

Canada CFS Compliance Credits and Debits: NZ-Guardrail 20% ZEV Scenario

Calendar Year	Units	2022	2024	2026	2028	2030	2022	2024	2026	2028	2030
Debits							*(Scenario NZ-GR 20% ZEV - Baseline)*				
Fossil Fuels											
Motor Gasoline	tCO2e	252,195	7,900,962	12,594,432	17,018,195	21,183,023	82	1,960,718	3,834,528	5,586,115	7,201,209
Diesel fuel oil	tCO2e	204,517	6,701,874	11,051,372	15,222,299	19,556,512	-65	1,635,596	3,244,206	4,520,135	5,904,436
Light fuel oil	tCO2e	0	0	0	0	0	0	0	0	0	0
Heavy fuel oil	tCO2e	0	0	0	0	0	0	0	0	0	0
Aviation turbo fuel (Domestic Only)	tCO2e	0	0	0	0	0	0	0	0	0	0
Kerosene & stove oil	tCO2e	0	0	0	0	0	0	0	0	0	0
Total Debits	tCO2e	456,712	14,602,837	23,645,804	32,240,494	40,739,535	18	3,596,314	7,078,734	10,106,250	13,105,645
CFS Compliance Credits											
Compliance Category 1											
CCS	tCO2e	650,000	1,787,500	2,275,000	2,762,500	3,250,000	0	-600,000	-1,200,000	-1,800,000	-2,400,000
Upstream Improvements	tCO2e	0	203,125	406,250	609,375	812,500	0	-150,000	-300,000	-450,000	-600,000
Reductions in Refineries	tCO2e	100,000	353,125	506,250	659,375	812,500	0	-150,000	-300,000	-450,000	-600,000
Incremental Methane Reductions - Conventional Oil	tCO2e	273,373	816,310	1,085,873	1,355,437	1,625,000	0	-300,000	-600,000	-900,000	-1,200,000
Subtotal Compliance Category 1	tCO2e	1,023,373	3,160,060	4,273,373	5,386,687	6,500,000	0	-1,200,000	-2,400,000	-3,600,000	-4,800,000
Compliance Category 2											
Bank Renewable Fuel Regulation (RFR)	tCO2e	1,400,000	0	0	0	0	0	0	0	0	0
Ethanol	tCO2e	1,675,510	3,551,611	3,558,202	3,753,574	3,918,878	548	-124,001	-273,581	-428,223	-573,730
Ethanol from corn	tCO2e	1,381,904	2,945,649	3,007,986	3,178,137	3,344,319	452	-104,814	-235,251	-369,366	-499,504
Ethanol from wheat	tCO2e	293,605	605,962	550,216	575,437	574,558	96	-19,187	-38,329	-58,856	-74,226
Biodiesel	tCO2e	610,491	850,029	1,007,166	1,939,496	1,871,425	-1,000	203,413	327,437	1,358,718	737,408
Biodiesel from canola oil	tCO2e	290,553	375,047	451,236	1,112,668	1,128,190	-49	87,443	133,834	872,932	431,057
Biodiesel from inedible tallow	tCO2e	22,503	31,651	37,757	72,330	70,154	-36	7,664	12,503	50,552	28,321
Biodiesel from soybean oil	tCO2e	253,962	382,516	446,056	617,246	540,911	-839	93,708	157,497	339,689	225,718
Biodiesel from yellow grease	tCO2e	23,547	32,996	39,202	74,763	72,159	-41	7,958	12,912	52,156	28,863
Biodiesel from distillers corn oil	tCO2e	19,926	27,818	32,915	62,489	60,011	-35	6,640	10,690	43,389	23,450
Biodiesel from unknown	tCO2e	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels (HDRD)	tCO2e	702,181	2,471,163	3,018,410	4,169,557	5,240,409	682	124,759	280,826	1,075,758	1,905,292
Renewable Hydrocarbon Fuels from palm oil	tCO2e	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels from canola oil	tCO2e	136,654	1,393,823	1,998,316	3,120,005	4,237,816	639	118,173	285,684	1,004,638	1,832,116
Renewable Hydrocarbon Fuels from palm sludge oil	tCO2e	4,476	8,521	8,090	7,659	7,228	0	-175	-350	-525	-699
Renewable Hydrocarbon Fuels from tallow	tCO2e	204,374	391,038	370,838	400,646	386,597	24	8,847	7,353	56,289	62,783
Renewable Hydrocarbon Fuels from yellow grease	tCO2e	308,768	586,942	555,317	557,959	530,204	18	-839	-8,861	17,660	14,786
Renewable Hydrocarbon Fuels from soybean oil	tCO2e	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels from spent bleaching earth	tCO2e	47,909	90,839	85,849	83,288	78,563	1	-1,248	-3,000	-2,304	-3,694
Pyrolisis Oil (Biocrude)	tCO2e	16,680	144,751	247,422	343,504	433,849	0	-3,537	-12,457	-26,756	-46,514
Sustainable aviation fuel	tCO2e	0	110,553	282,470	505,148	701,020	0	-3,042	-16,701	-48,400	-97,385
Subtotal Compliance Category 2	tCO2e	4,404,863	7,128,108	8,113,670	10,711,279	12,165,581	230	197,592	305,524	1,931,098	1,925,071
Compliance Category 3											
Diesel Displaced by Propane	tCO2e	0	0	0	0	0	0	0	0	0	0
Diesel Displaced by Natural Gas	tCO2e	0	0	0	0	0	0	0	0	0	0
Gasoline Displaced by Electric Vehicles	tCO2e	233,333	485,183	1,488,744	2,493,606	3,500,000	-75,238	-157,674	460,172	1,079,320	1,700,000
Diesel Displaced by Electric Vehicles	tCO2e	966,667	2,010,320	6,168,273	10,331,229	14,500,000	75,238	153,177	3,196,844	6,245,514	9,300,000
Subtotal Compliance Category 3	tCO2e	1,200,000	2,495,503	7,657,017	12,824,834	18,000,000	0	-4,497	3,657,017	7,324,834	11,000,000
External Credit Sources											
Cross Steam Credits	tCO2e	45,671	1,460,284	2,364,580	3,224,049	4,073,953	2	359,631	707,873	1,010,625	1,310,564
Compliance Fund	tCO2e	0	0	0	0	0	0	0	0	0	0
Emerging Tech Credit Generation	tCO2e	0	0	0	0	0	0	0	0	0	0
Total Credits		6,673,907	14,243,955	22,408,640	32,146,850	40,739,535	232	-647,273	2,270,414	6,666,557	9,435,635
Banked for the Year	tCO2e	6,217,195	-358,881	-1,237,163	-93,644	0	214	-4,243,587	-4,808,320	-3,439,693	-3,670,010
Running Net Credit Balance	tCO2e	6,217,195	8,517,149	6,507,542	5,000,000	5,000,000	214	-6,601,287	-16,168,850	-24,163,608	-30,739,824
Renewable Fuel Credit Price	C$/MT	0	43	57	201	256	0	33	47	191	246
Maximum CFS Compliance Credit Price	C$/MT	350	365	380	396	412	0	0	0	0	0

Value of Canada Compliance Credits By Feedstock Pathway: NZ-Guardrail 20% ZEV Scenario

Calendar Year	Units	2022	2024	2026	2028	2030	2022	2024	2026	2028	2030
							(Scenario NZ-GR 20% ZEV - Baseline)				
Ethanol											
Ethanol from corn	C$/liter	0.00	0.04	0.06	0.20	0.25	0.00	0.03	0.05	0.19	0.24
Ethanol from wheat	C$/liter	0.00	0.05	0.06	0.22	0.28	0.00	0.04	0.05	0.21	0.27
Biodiesel											
Biodiesel from canola oil	C$/liter	0.00	0.12	0.15	0.53	0.66	0.00	0.09	0.12	0.50	0.63
Biodiesel from inedible tallow	C$/liter	0.00	0.13	0.17	0.60	0.76	0.00	0.10	0.14	0.57	0.73
Biodiesel from soybean oil	C$/liter	0.00	0.11	0.14	0.48	0.60	0.00	0.08	0.11	0.45	0.57
Biodiesel from yellow grease	C$/liter	0.00	0.13	0.16	0.56	0.70	0.00	0.10	0.13	0.54	0.68
Biodiesel from distillers corn oil	C$/liter	0.00	0.11	0.14	0.48	0.60	0.00	0.08	0.11	0.46	0.58
Renewable Hydrocarbon Fuels	C$/liter										
Renewable Hydrocarbon Fuels from palm oil	C$/liter	0.00	0.02	0.03	0.10	0.11	0.00	0.02	0.02	0.09	0.11
Renewable Hydrocarbon Fuels from canola oil	C$/liter	0.00	0.12	0.16	0.54	0.68	0.00	0.09	0.13	0.52	0.65
Renewable Hydrocarbon Fuels from palm sludge oil	C$/liter	0.00	0.12	0.15	0.53	0.66	0.00	0.09	0.13	0.50	0.63
Renewable Hydrocarbon Fuels from tallow	C$/liter	0.00	0.13	0.16	0.56	0.70	0.00	0.10	0.13	0.53	0.67
Renewable Hydrocarbon Fuels from yellow grease	C$/liter	0.00	0.12	0.15	0.52	0.64	0.00	0.09	0.12	0.49	0.62
Renewable Hydrocarbon Fuels from soybean oil	C$/liter	0.00	0.09	0.11	0.39	0.49	0.00	0.07	0.09	0.37	0.47
Renewable Hydrocarbon Fuels from spent bleaching earth	C$/liter	0.00	0.11	0.14	0.48	0.60	0.00	0.08	0.11	0.45	0.57

Biofuel Feedstocks Used for Canadian Domestic Consumption: NZ-Guardrail 20% ZEV Scenario

Calendar Year	Units	2022	2024	2026	2028	2030	2022	2024	2026	2028	2030
							(Scenario NZ-GR 20% ZEV - Baseline)				
Ethanol Feedstocks											
Corn	1000 MT	3,726	4,507	5,142	5,594	6,283	3	-223	-401	-1,181	-1,675
Wheat	1000 MT	920	1,127	1,180	1,983	2,258	0	197	270	1,085	1,360
Biodiesel Feedstocks											
Canola Oil	1000 MT	185	125	158	409	438	0	31	51	327	190
Inedible Tallow	1000 MT	13	10	12	25	25	0	3	4	18	11
Soybean Oil	1000 MT	178	141	173	253	235	-1	37	66	147	111
Yellow Grease	1000 MT	15	11	14	27	28	0	3	5	20	12
Distillers Corn Oil	1000 MT	14	10	13	25	26	0	3	5	18	12
Unknown	1000 MT	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels Feedstocks											
Feedstocks Used for Domestic Production											
Canola Oil	1000 MT	86	460	692	1,137	1,629	0	47	123	414	783
Feedstocks Used for Imports (Approximation)											
Palm Oil	1000 MT	0	0	0	0	0	0	0	0	0	0
Palm Sludge Oil	1000 MT	3	3	3	3	3	0	0	0	0	0
Inedible Tallow	1000 MT	131	132	131	149	151	0	5	8	29	35
Yellow Grease	1000 MT	213	213	212	225	227	0	4	6	21	26
Soybean Oil	1000 MT	0	0	0	0	0	0	0	0	0	0
Spent Bleaching Earth	1000 MT	36	36	36	37	37	0	0	0	2	2

Canada Canola and Canola Products Supply and Demand: NZ-Guardrail 20% ZEV Scenario

	Units	22/23	24/25	26/27	28/29	30/31	22/23	24/25	26/27	28/29	30/31
							(Scenario NZ-GR 20% ZEV - Baseline)				
Canola											
Area Planted	1000 ha	8,562	8,453	8,615	8,817	8,977	-9	9	53	203	290
Area Harvested	1000 ha	8,476	8,368	8,528	8,728	8,886	-9	9	52	201	287
Yield	mt per ha	2.33	2.37	2.42	2.46	2.51	0.00	0.00	0.00	0.00	0.00
Supply											
Beginning Stocks	1000 mt	716	1,629	1,881	2,139	2,400	0	-2	7	38	93
Production	1000 mt	19,753	19,870	20,627	21,496	22,279	-21	22	127	496	719
Imports	1000 mt	104	104	104	104	104	0	0	0	0	0
Total Supply	1000 mt	20,573	21,603	22,613	23,739	24,782	-21	20	133	534	813
Domestic Disappearance											
Crush	1000 mt	11,043	11,636	12,005	12,402	12,780	-10	10	68	272	422
Food	1000 mt	0	0	0	0	0	0	0	0	0	0
Feed, Seed, Waste	1000 mt	109	109	114	119	124	0	0	-1	-2	-3
Total Domestic Disappearance	1000 mt	11,151	11,745	12,120	12,522	12,904	-10	10	67	270	419
Exports	1000 mt	7,794	8,109	8,498	8,953	9,367	-9	8	50	194	279
Ending Stocks	1000 mt	1,627	1,749	1,995	2,265	2,512	-3	2	16	70	114
Canola Meal											
Extraction Rate	kg/kg	0.56	0.56	0.56	0.56	0.56	0.00	0.00	0.00	0.00	0.00
Supply											
Beginning Stocks	1000 mt	54	94	106	115	125	0	0	1	3	6
Production	1000 mt	6,164	6,495	6,701	6,923	7,134	-6	6	38	152	235
Imports	1000 mt	56	56	56	56	56	0	0	0	0	0
Total Supply	1000 mt	6,274	6,645	6,863	7,094	7,314	-6	6	38	154	241
Domestic Disappearance											
Food	1000 mt	0	0	0	0	0	0	0	0	0	0
Feed & Residual	1000 mt	744	769	806	843	883	0	0	2	8	12
Industrial	1000 mt	0	0	0	0	0	0	0	0	0	0
Total Domestic Disappearance	1000 mt	744	769	806	843	883	0	0	2	8	12
Exports	1000 mt	5,441	5,775	5,947	6,131	6,303	-5	5	35	142	222
Ending Stocks	1000 mt	89	101	110	120	129	0	0	1	5	7
Canola Oil											
Extraction Rate	kg/kg	0.44	0.44	0.44	0.44	0.44	0.00	0.00	0.00	0.00	0.00
Supply											
Beginning Stocks	1000 mt	412	514	528	544	555	0	0	-2	-8	-13
Production	1000 mt	4,834	5,094	5,255	5,429	5,594	-4	4	30	119	185
Imports	1000 mt	0	0	0	0	0	0	0	0	0	0
Total Supply	1000 mt	5,246	5,607	5,783	5,973	6,149	-4	4	28	111	171
Domestic Disappearance											
Food	1000 mt	687	666	673	678	684	1	-1	-4	-15	-20
Feed & Residual	1000 mt	0	0	0	0	0	0	0	0	0	0
Industrial	1000 mt	562	853	1,114	1,760	2,258	-57	30	175	693	900
Total Domestic Disappearance	1000 mt	1,249	1,519	1,788	2,438	2,942	-56	29	170	678	880
Exports	1000 mt	3,509	3,566	3,458	2,983	2,643	52	-24	-139	-555	-695
Ending Stocks	1000 mt	488	522	537	551	564	0	-1	-4	-11	-14
Canola and Derivative Prices											
Canola Average Farm Price, Saskatchewan	CAD/mt	648	673	675	675	676	-1	1	4	13	16
Canola Seed Average Price, Pacific Coast	CAD/mt	673	699	701	701	702	-1	1	4	13	16
Canola Oil FOB Plants, Crude Degummed	CAD/mt	1,716	1,787	1,838	1,902	1,965	-3	5	23	82	111
Canola Meal FOB Plant	CAD/mt	305	308	289	271	252	0	-1	-3	-10	-16

Canada Grains Supply and Demand: NZ-Guardrail 20% ZEV Scenario

	Units	22/23	24/25	26/27	28/29	30/31	22/23	24/25	26/27	28/29	30/31
							(Scenario NZ-GR 20% ZEV - Baseline)				
Corn											
Area Planted	1000 ha	1,475	1,475	1,476	1,475	1,476	0	0	0	0	1
Area Harvested	1000 ha	1,430	1,428	1,427	1,426	1,426	0	0	0	0	-1
Yield	mt per ha	9.98	10.21	10.44	10.67	10.90	0.00	0.00	0.00	0.00	0.00
Supply											
Beginning Stocks	1000 mt	1,981	2,118	2,204	2,285	2,358	0	0	0	0	0
Production	1000 mt	14,272	14,571	14,898	15,211	15,536	0	-1	-2	-5	-10
Imports	1000 mt	3,305	3,475	2,994	4,195	4,693	-55	-236	-377	-482	2,655
Total Supply	1000 mt	19,558	20,165	20,096	21,691	22,587	-55	-237	-378	-488	2,645
Domestic Disappearance											
Feed & Residual Use	1000 mt	10,562	10,137	9,751	10,343	10,647	14	54	80	407	840
Food, Seed, and Industrial Use	1000 mt	5,942	6,877	7,124	8,052	8,571	-69	-291	-458	-892	1,817
Bioethanol Use	1000 mt	4,187	5,007	5,106	5,877	6,237	-69	-291	-457	-891	1,824
Total Domestic Disappearance	1000 mt	16,504	17,014	16,875	18,395	19,219	-55	-237	-378	-485	2,657
Exports	1000 mt	974	974	974	974	974	0	0	0	0	0
Ending Stocks	1000 mt	2,080	2,177	2,247	2,322	2,394	0	0	-1	-3	-12
Wheat											
Area Planted	1000 ha	10,147	9,961	9,834	9,689	9,554	0	1	2	7	11
Area Harvested	1000 ha	9,370	9,311	9,211	9,133	9,078	0	1	2	8	11
Yield	mt per ha	3.45	3.49	3.53	3.58	3.62	0.00	0.00	0.00	0.00	0.00
Supply											
Beginning Stocks	1000 mt	4,488	5,811	6,192	6,407	6,587	0	-3	-4	-17	-28
Production	1000 mt	32,289	32,497	32,556	32,685	32,887	0	4	7	28	38
Imports	1000 mt	700	700	700	700	700	0	0	0	0	0
Total Supply	1000 mt	37,477	39,008	39,449	39,792	40,175	0	2	3	11	10
Domestic Disappearance											
Feed & Residual Use	1000 mt	3,999	4,211	4,319	4,332	4,523	-13	-66	-96	-314	-130
Food, Seed, and Industrial Use	1000 mt	5,216	5,375	5,472	6,352	6,392	47	211	295	1,163	1,194
Bioethanol Use	1000 mt	1,005	1,134	1,204	2,061	2,077	47	211	295	1,164	1,197
Total Domestic Disappearance	1000 mt	9,215	9,586	9,791	10,684	10,915	33	144	199	849	1,064
Exports	1000 mt	22,803	23,384	23,378	22,638	22,555	-32	-138	-188	-804	-984
Ending Stocks	1000 mt	5,459	6,038	6,280	6,469	6,704	-1	-4	-8	-34	-70
Grain Prices											
Barley, #1 Feed, Alberta	CAD/mt	372	388	401	420	438	0	0	0	1	6
Barley Farm Price	CAD/mt	285	297	307	322	335	0	0	0	1	4
Corn #2, CE Cash, Chatham	CAD/mt	245	243	242	238	235	0	0	0	1	3
Wheat, Western Red Spring, 12.5% Protein	CAD/mt	390	395	403	411	415	0	0	1	3	6
Wheat Producer Price, Ontario	CAD/mt	279	283	289	296	299	0	0	0	2	5

Table Results for the NZ-Guardrail 20% LCIF Scenario

Canada Biomass Based Diesel Supply and Demand: NZ-Guardrail 20% LCIF Scenario

Calendar Year	Units	2022	2024	2026	2028	2030	2022	2024	2026	2028	2030
							(Scenario NZ-GR 20% LCIF - Baseline)				
Diesel Fuel Use and Biofuels Policy											
Diesel Transportation Use (excluding biofuels)	Million Liters	26,453	27,159	27,418	27,080	27,021	-13	-149	-637	-1,764	-2,414
Biodiesel Supply & Use											
Beginning Stocks	Million Liters	0	0	0	0	0	0	0	0	0	0
Production	Million Liters	342	323	340	617	716	1	4	2	310	186
Imports	Million Liters	400	432	725	943	903	35	86	381	601	562
Total Supply	Million Liters	741	755	1,064	1,559	1,619	36	90	383	911	748
Domestic Use	Million Liters	449	334	645	1,140	1,201	-1	89	380	906	741
Exports	Million Liters	293	421	420	420	418	37	0	2	5	7
Ending Stocks	Million Liters	0	0	0	0	0	0	0	0	0	0
Total Demand	Million Liters	741	755	1,064	1,559	1,619	36	90	383	911	748
Renewable Hydrocarbon Fuels Supply & Use											
Beginning Stocks	Million Liters	0	0	0	0	0	0	0	0	0	0
Production	Million Liters	94	501	767	1,434	2,224	0	51	147	646	1,302
Imports	Million Liters	397	397	399	459	471	0	10	18	83	103
Total Supply	Million Liters	491	898	1,166	1,893	2,695	0	62	165	730	1,405
Domestic Use	Million Liters	491	898	1,166	1,893	2,695	0	62	165	730	1,405
Exports	Million Liters	0	0	0	0	0	0	0	0	0	0
Ending Stocks	Million Liters	0	0	0	0	0	0	0	0	0	0
Total Demand	Million Liters	491	898	1,166	1,893	2,695	0	62	165	730	1,405
Domestic Feedstocks											
Canola Oil (Biodiesel Plants)	1000 Metric Tons	201	176	182	376	440	0	-3	-8	222	97
Canola Oil (Renewable Hydrocarbon Fuels Plants)	1000 Metric Tons	86	460	704	1,316	2,040	0	47	135	593	1,195
Inedible Tallow	1000 Metric Tons	10	12	15	41	51	0	4	6	31	37
Soybean Oil	1000 Metric Tons	76	79	82	104	115	0	3	5	25	31
Yellow Grease	1000 Metric Tons	12	12	12	15	16	0	0	1	3	4
Distillers Corn Oil	1000 Metric Tons	11	13	16	22	26	0	-1	-1	0	0
Domestic Feedstock Yield											
Canola Oil	1000 Liters/MT	1.11	1.11	1.11	1.11	1.11	0.00	0.00	0.00	0.00	0.00
Inedible Tallow	1000 Liters/MT	1.04	1.04	1.04	1.04	1.04	0.00	0.00	0.00	0.00	0.00
Soybean Oil	1000 Liters/MT	1.11	1.11	1.11	1.11	1.11	0.00	0.00	0.00	0.00	0.00
Yellow Grease	1000 Liters/MT	1.04	1.04	1.04	1.04	1.04	0.00	0.00	0.00	0.00	0.00
Distillers Corn Oil	1000 Liters/MT	1.11	1.11	1.11	1.11	1.11	0.00	0.00	0.00	0.00	0.00
Biomass-based Diesel Prices											
BC/AB Canada B99 Rack Price	CAD/Liter	1.29	1.20	1.25	1.34	1.48	0.00	0.01	0.03	0.07	0.09
Canada HDRD Wholesale Price	CAD/Liter	2.39	2.37	2.45	2.53	2.58	0.00	0.01	0.03	0.08	0.12

Canada Ethanol Supply and Demand: NZ-Guardrail 20% LCIF Scenario

Calendar Year	Units	2022	2024	2026	2028	2030	2022	2024	2026	2028	2030
							(Scenario NZ-GR 20% LCIF - Baseline)				
Gasoline Fuel Use and Biofuels Policy											
Gasoline Transportation Use	Million Liters	36,356	35,693	35,068	33,663	32,652	18	19	-4	-665	-935
Supply & Demand											
Beginning Stocks	Million Liters	0	0	0	0	0	0	0	0	0	0
Production	Million Liters	1,916	2,323	2,609	3,891	4,512	2	-15	-60	713	841
Imports	Million Liters	1,196	1,188	1,160	1,276	1,459	0	17	59	217	436
Total Supply	Million Liters	3,112	3,511	3,770	5,167	5,972	2	2	0	930	1,277
Domestic Use	Million Liters	3,081	3,479	3,739	5,136	5,941	2	2	0	930	1,277
Exports	Million Liters	31	31	31	31	31	0	0	0	0	0
Ending Stocks	Million Liters	0	0	0	0	0	0	0	0	0	0
Total Demand	Million Liters	3,112	3,511	3,770	5,167	5,972	2	2	0	930	1,277
Feedstocks											
Corn	1000 Metric Tons	3,727	4,509	5,115	6,902	7,974	4	-221	-428	128	16
Wheat	1000 Metric Tons	920	1,126	1,212	2,576	3,020	0	196	302	1,678	2,123
Feedstock Yield											
Corn	1000 Liters/MT	0.42	0.42	0.42	0.42	0.42	0.00	0.00	0.00	0.00	0.00
Wheat	1000 Liters/MT	0.39	0.39	0.39	0.39	0.39	0.00	0.00	0.00	0.00	0.00
Distillers' Grains Production											
Corn	1000 Metric Tons	1,132	1,369	1,553	2,095	2,421	1	-67	-130	39	5
Wheat	1000 Metric Tons	279	342	368	782	917	0	59	92	509	644
Wholesale Ethanol Price (excludes CFS Credit Value)	CAD/Liter	0.69	0.67	0.67	0.68	0.68	0.00	0.00	0.00	0.00	0.00

Canada CFS Program Parameters: NZ-Guardrail 20% LCIF Scenario

Calendar Year	Units	2022	2024	2026	2028	2030	2022	2024	2026	2028	2030
							(Scenario NZ-GR 20% LCIF - Baseline)				
Program Goals											
2016 Stream Carbon Intensity	tCO2e/TJ	91.6	91.6	91.6	91.6	91.6	0.0	0.0	0.0	0.0	0.0
Credit Stream Carbon Intensity Reference	tCO2e/TJ	89.3	85.5	81.6	77.8	74.0	0.0	-1.5	-3.1	-4.6	-6.1
Obligated Fossil Fuel Carbon Intensity Reduction	tCO2e/TJ	2.4	6.4	10.4	14.3	18.3	0.0	1.6	3.2	4.7	6.3
Obligated Jet Fuel Carbon Intensity Reduction	tCO2e/TJ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy Economy Ratios											
Hydrogen (Gasoline)	Ratio	2.5	2.5	2.5	2.5	2.5	0	0	0	0	0
Hydrogen (Diesel)	Ratio	1.9	1.9	1.9	1.9	1.9	0	0	0	0	0
CNG (Diesel)	Ratio	0.9	0.9	0.9	0.9	0.9	0	0	0	0	0
EV (Gasoline)	Ratio	4.1	4.1	4.1	4.1	4.1	0	0	0	0	0
EV (Diesel)	Ratio	5.0	5.0	5.0	5.0	5.0	0	0	0	0	0
Energy Density of Fuels											
Gasoline	MJ/Liter	34.69	34.69	34.69	34.69	34.69	0.00	0.00	0.00	0.00	0.00
Diesel	MJ/Liter	38.65	38.65	38.65	38.65	38.65	0.00	0.00	0.00	0.00	0.00
Aviation Fuel	MJ/Liter	35.46	35.46	35.46	35.46	35.46	0.00	0.00	0.00	0.00	0.00
Ethanol	MJ/Liter	23.58	23.58	23.58	23.58	23.58	0.00	0.00	0.00	0.00	0.00
Biodiesel	MJ/Liter	35.40	35.40	35.40	35.40	35.40	0.00	0.00	0.00	0.00	0.00
Renewable Hydrocarbon Fuels (HDRD)	MJ/Liter	36.51	36.51	36.51	36.51	36.51	0.00	0.00	0.00	0.00	0.00
Sustainable Aviation Fuel	MJ/Liter	34.81	34.81	34.81	34.81	34.81	0.00	0.00	0.00	0.00	0.00
Electricity	MJ/kWh	3.60	3.60	3.60	3.60	3.60	0.00	0.00	0.00	0.00	0.00
LFO	MJ/Liter	38.80	38.80	38.80	38.80	38.80	0.00	0.00	0.00	0.00	0.00
Kerosene	MJ/Liter	37.68	37.68	37.68	37.68	37.68	0.00	0.00	0.00	0.00	0.00
Pyrolisis Oil (Biocrude)	MJ/Liter	21.35	21.35	21.35	21.35	21.35	0.00	0.00	0.00	0.00	0.00
HFO	MJ/Liter	41.10	41.10	41.10	41.10	41.10	0.00	0.00	0.00	0.00	0.00

Canada CFS Carbon Intensity Average Scores: NZ-Guardrail 20% LCIF Scenario

Calendar Year	Units	2022	2024	2026	2028	2030	2022	2024	2026	2028	2030
							(Scenario NZ-GR 20% LCIF - Baseline)				
Motor gasoline	tCO2e/TJ	91.9	91.9	91.9	91.9	91.9	0.0	0.0	0.0	0.0	0.0
Ethanol	tCO2e/TJ										
Ethanol from corn	tCO2e/TJ	44.1	43.0	41.9	40.9	39.8	0.0	0.0	0.0	0.0	0.0
Ethanol from wheat	tCO2e/TJ	38.6	37.8	37.0	36.2	35.3	0.0	0.0	0.0	0.0	0.0
Diesel fuel oil	tCO2e/TJ	97.1	97.1	97.1	97.1	97.1	0.0	0.0	0.0	0.0	0.0
Biodiesel	tCO2e/TJ										
Biodiesel from canola oil	tCO2e/TJ	9.6	9.3	9.1	8.8	8.6	0.0	0.0	0.0	0.0	0.0
Biodiesel from inedible tallow	tCO2e/TJ	-1.2	-1.4	-1.7	-1.9	-2.1	0.0	0.0	0.0	0.0	0.0
Biodiesel from soybean oil	tCO2e/TJ	16.8	16.5	16.1	15.8	15.5	0.0	0.0	0.0	0.0	0.0
Biodiesel from yellow grease	tCO2e/TJ	4.2	4.1	3.9	3.8	3.7	0.0	0.0	0.0	0.0	0.0
Biodiesel from distillers corn oil	tCO2e/TJ	16.7	16.3	15.9	15.4	15.0	0.0	0.0	0.0	0.0	0.0
Biodiesel from unknown	tCO2e/TJ	3.8	3.8	3.8	3.8	3.8	0.0	0.0	0.0	0.0	0.0
Renewable Hydrocarbon Fuels (HDRD) (weighted avg)	tCO2e/TJ										
Renewable Hydrocarbon Fuels from palm oil	tCO2e/TJ	71.7	71.0	70.3	69.6	68.9	0.0	0.0	0.0	0.0	0.0
Renewable Hydrocarbon Fuels from canola oil	tCO2e/TJ	9.6	9.3	9.1	8.8	8.6	0.0	0.0	0.0	0.0	0.0
Renewable Hydrocarbon Fuels from palm sludge oil	tCO2e/TJ	11.2	11.1	11.0	10.9	10.9	0.0	0.0	0.0	0.0	0.0
Renewable Hydrocarbon Fuels from tallow	tCO2e/TJ	7.2	7.0	6.9	6.7	6.5	0.0	0.0	0.0	0.0	0.0
Renewable Hydrocarbon Fuels from yellow grease	tCO2e/TJ	12.7	12.6	12.4	12.3	12.2	0.0	0.0	0.0	0.0	0.0
Renewable Hydrocarbon Fuels from soybean oil	tCO2e/TJ	30.8	30.4	30.0	29.6	29.2	0.0	0.0	0.0	0.0	0.0
Renewable Hydrocarbon Fuels from spent bleaching earth	tCO2e/TJ	18.6	18.3	18.0	17.8	17.5	0.0	0.0	0.0	0.0	0.0
Light fuel oil	tCO2e/TJ	87.0	87.0	87.0	87.0	87.0	0.0	0.0	0.0	0.0	0.0
Kerosene & stove oil	tCO2e/TJ	82.0	82.0	82.0	82.0	82.0	0.0	0.0	0.0	0.0	0.0
Heavy fuel oil	tCO2e/TJ	91.0	91.0	91.0	91.0	91.0	0.0	0.0	0.0	0.0	0.0
Pyrolisis Oil (Biocrude)	tCO2e/TJ	25.0	23.0	21.0	19.0	17.0	0.0	0.0	0.0	0.0	0.0
Aviation gasoline	tCO2e/TJ	94.0	94.0	94.0	94.0	94.0	0.0	0.0	0.0	0.0	0.0
Aviation turbo fuel	tCO2e/TJ	90.1	90.1	90.1	90.1	90.1	0.0	0.0	0.0	0.0	0.0
Sustainable aviation fuel	tCO2e/TJ	30.0	30.0	30.0	30.0	30.0	0.0	0.0	0.0	0.0	0.0
Propane Vehicle	tCO2e/TJ	68.0	68.0	68.0	68.0	68.0	0.0	0.0	0.0	0.0	0.0
Natural Gas Vehicle	tCO2e/TJ	62.9	62.9	62.9	62.9	62.9	0.0	0.0	0.0	0.0	0.0
EV (Gasoline)	tCO2e/TJ	21.7	21.7	21.7	21.7	21.7	0.0	0.0	0.0	0.0	0.0

Canada Fuel Consumption Volumes: NZ-Guardrail 20% LCIF Scenario

Calendar Year	Units	2022	2024	2026	2028	2030	2022	2024	2026	2028	2030
							(Scenario NZ-GR 20% LCIF - Baseline)				
Blended Gasoline (volumetric total)	million liters	39,437	39,173	38,807	38,799	38,593	20	21	-4	265	342
Motor gasoline	million liters	36,356	35,693	35,068	33,663	32,652	18	19	-4	-665	-935
Ethanol	million liters	3,081	3,479	3,739	5,136	5,941	2	2	0	930	1,277
Ethanol from corn	million liters	2,590	2,941	3,216	4,425	5,157	1	2	0	801	1,109
Ethanol from wheat	million liters	491	539	523	711	783	0	0	0	129	168
Blended Diesel (volumetric total)	million liters	27,345	28,331	29,140	29,966	30,737	-13	-6	-120	-209	-367
Diesel fuel oil	million liters	26,453	27,159	27,418	27,080	27,021	-13	-149	-637	-1,764	-2,414
Biomass Based Diesel	million liters	892	1,172	1,722	2,886	3,716	0	143	517	1,555	2,047
Biodiesel	million liters	426	317	611	1,080	1,139	-1	85	360	859	703
Biodiesel from canola oil	million liters	195	134	266	652	716	0	35	154	565	455
Biodiesel from inedible tallow	million liters	13	10	19	34	36	0	3	11	27	22
Biodiesel from soybean oil	million liters	188	151	283	319	308	-1	41	171	207	178
Biodiesel from yellow grease	million liters	15	11	21	38	40	0	3	13	30	24
Biodiesel from distillers corn oil	million liters	15	11	21	37	39	0	3	12	30	24
Biodiesel made from unknown	million liters	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels (HDRD)	million liters	467	855	1,112	1,807	2,577	0	59	157	697	1,344
Renewable Hydrocarbon Fuels made from palm oil	million liters	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels made from canola oil	million liters	89	477	731	1,369	2,127	0	49	140	617	1,245
Renewable Hydrocarbon Fuels made from palm sludge oil	million liters	3	3	3	3	3	0	0	0	0	0
Renewable Hydrocarbon Fuels made from tallow	million liters	130	130	131	163	170	0	5	9	44	55
Renewable Hydrocarbon Fuels made from yellow grease	million liters	210	210	211	235	240	0	4	7	33	41
Renewable Hydrocarbon Fuels made from soybean oil	million liters	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels made from spent bleaching earth	million liters	35	35	35	37	38	0	0	1	3	3
Blended Light Fuel Oil		2,057	1,979	1,905	1,838	1,767	0	1	2	6	7
Light diesel fuel oil	million liters	2,009	1,918	1,817	1,692	1,588	0	-7	-26	-75	-93
Biomass Based Diesel	million liters	47	61	88	146	180	0	8	28	81	100
Biodiesel	million liters	23	17	34	60	62	0	5	20	48	38
Biodiesel from canola oil	million liters	11	7	15	36	39	0	2	9	31	25
Biodiesel from inedible tallow	million liters	1	1	1	2	2	0	0	1	1	1
Biodiesel from soybean oil	million liters	10	8	16	18	17	0	2	9	12	10
Biodiesel from yellow grease	million liters	1	1	1	2	2	0	0	1	2	1
Biodiesel from distillers corn oil	million liters	1	1	1	2	2	0	0	1	2	1
Biodiesel from unknown	million liters	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels (HDRD)	million liters	24	43	54	86	118	0	3	8	33	61
Renewable Hydrocarbon Fuels made from palm oil	million liters	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels made from canola oil	million liters	5	24	36	65	97	0	2	7	29	57
Renewable Hydrocarbon Fuels made from palm sludge oil	million liters	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels made from tallow	million liters	7	7	6	8	8	0	0	0	2	2
Renewable Hydrocarbon Fuels made from yellow grease	million liters	11	11	10	11	11	0	0	0	2	2
Renewable Hydrocarbon Fuels made from soybean oil	million liters	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels made from spent bleaching earth	million liters	2	2	2	2	2	0	0	0	0	0
Blended Heavy Fuel Oil		2,453	2,520	2,580	2,653	2,735	0	0	0	0	0
Heavy fuel oil	million liters	2,429	2,411	2,389	2,379	2,378	0	0	0	0	0
Pyrolisis Oil (Biocrude)	million liters	24	109	191	274	357	0	0	0	0	0
Blended Jet Fuel		8,492	8,643	8,886	9,232	9,621	0	0	0	0	0
Aviation turbo fuel	million liters	8,492	8,586	8,729	8,929	9,162	0	0	0	0	0
Sustainable aviation fuel	million liters	0	57	157	304	458	0	0	0	0	0
Kerosene & stove oil	million liters	443	425	409	395	383	0	0	0	0	0

Canada Fuel Consumption Volumes in Terajoules: NZ-Guardrail 20% LCIF Scenario

Calendar Year	Units	2022	2024	2026	2028	2030	2022	2024	2026	2028	2030
							(Scenario NZ-GR 20% LCIF - Baseline)				
Blended Gasoline	terajoules	1,333,840	1,320,248	1,304,673	1,288,866	1,272,784	669	696	-146	-1,144	-2,332
Motor Gasoline	terajoules	1,261,196	1,238,204	1,216,517	1,167,764	1,132,705	633	653	-137	-23,077	-32,446
Ethanol	terajoules	72,644	82,044	88,156	121,101	140,079	36	43	-10	21,933	30,114
Ethanol from corn	terajoules	61,064	69,337	75,826	104,347	121,605	31	37	-9	18,898	26,143
Ethanol from wheat	terajoules	11,580	12,707	12,330	16,754	18,474	6	7	-1	3,034	3,972
Blended Diesel	terajoules	1,054,520	1,092,135	1,121,905	1,150,829	1,178,768	-511	-626	-6,140	-12,343	-19,359
Diesel fuel oil	terajoules	1,022,411	1,049,706	1,059,698	1,046,643	1,044,372	-497	-5,768	-24,630	-68,165	-93,301
Biodiesel	terajoules	15,070	11,214	21,616	38,218	40,309	-31	2,999	12,761	30,392	24,883
Biodiesel from canola oil	terajoules	6,910	4,741	9,414	23,076	25,339	-3	1,233	5,438	19,988	16,092
Biodiesel from inedible tallow	terajoules	472	351	676	1,196	1,261	-1	94	399	951	779
Biodiesel from soybean oil	terajoules	6,644	5,345	10,027	11,295	10,913	-25	1,464	6,039	7,344	6,286
Biodiesel from yellow grease	terajoules	525	391	753	1,331	1,404	-1	104	444	1,059	867
Biodiesel from distillers corn oil	terajoules	520	387	747	1,320	1,392	-1	104	441	1,050	859
Biodiesel from unknown	terajoules	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels (HDRD)	terajoules	17,038	31,214	40,591	65,967	94,087	16	2,144	5,730	25,431	49,059
Renewable Hydrocarbon Fuels made from palm oil	terajoules	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels made from canola oil	terajoules	3,256	17,413	26,699	49,985	77,655	15	1,788	5,112	22,527	45,467
Renewable Hydrocarbon Fuels made from palm sludge oil	terajoules	109	109	109	109	110	0	0	0	0	0
Renewable Hydrocarbon Fuels made from tallow	terajoules	4,730	4,745	4,792	5,952	6,202	1	197	341	1,610	1,992
Renewable Hydrocarbon Fuels made from yellow grease	terajoules	7,657	7,661	7,700	8,563	8,747	0	147	257	1,201	1,485
Renewable Hydrocarbon Fuels made from soybean oil	terajoules	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels made from spent bleaching earth	terajoules	1,287	1,287	1,291	1,358	1,373	0	11	20	93	115
Blended Light Fuel Oil	terajoules	79,665	76,628	73,678	70,918	68,097	0	0	0	0	0
Light fuel oil	terajoules	77,964	74,428	70,488	65,669	61,596	1	-274	-989	-2,892	-3,602
Biodiesel	terajoules	811	618	1,200	2,120	2,208	-2	165	709	1,686	1,363
Biodiesel from canola oil	terajoules	372	261	523	1,280	1,388	0	68	302	1,109	881
Biodiesel from inedible tallow	terajoules	25	19	38	66	69	0	5	22	53	43
Biodiesel from soybean oil	terajoules	358	295	557	627	598	-1	81	335	407	344
Biodiesel from yellow grease	terajoules	28	22	42	74	77	0	6	25	59	47
Biodiesel from distillers corn oil	terajoules	28	21	41	73	76	0	6	24	58	47
Biodiesel from unknown	terajoules	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels (HDRD)	terajoules	889	1,582	1,990	3,129	4,294	1	109	281	1,206	2,239
Renewable Hydrocarbon Fuels made from palm oil	terajoules	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels made from canola oil	terajoules	170	883	1,309	2,371	3,544	1	91	251	1,068	2,075
Renewable Hydrocarbon Fuels made from palm sludge oil	terajoules	6	6	5	5	5	0	0	0	0	0
Renewable Hydrocarbon Fuels made from tallow	terajoules	247	240	235	282	283	0	10	17	76	91
Renewable Hydrocarbon Fuels made from yellow grease	terajoules	400	388	377	406	399	0	7	13	57	68
Renewable Hydrocarbon Fuels made from soybean oil	terajoules	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels made from spent bleaching earth	terajoules	67	65	63	64	63	0	1	1	4	5
Blended Heavy Fuel Oil	terajoules	100,343	101,410	102,250	103,625	105,364	0	0	0	0	0
Heavy fuel oil	terajoules	99,825	99,093	98,170	97,783	97,747	0	0	0	0	0
Pyrolisis Oil (Biocrude)	terajoules	519	2,317	4,080	5,842	7,617	0	0	0	0	0
Blended Jet Fuel	terajoules	301,135	306,443	315,009	327,185	340,846	0	0	0	0	0
Aviation turbo fuel	terajoules	301,135	304,450	309,540	316,617	324,899	0	0	0	0	0
Sustainable aviation fuel	terajoules	0	1,992	5,470	10,568	15,947	0	0	0	0	0
Kerosene & stove oil	terajoules	16,688	16,019	15,420	14,886	14,418	0	0	0	0	0
Propane Vehicle	terajoules	0	0	0	0	0	0	0	0	0	0
Natural Gas Vehicle	terajoules	0	0	0	0	0	0	0	0	0	0
Electric Vehicles (Gasoline) Assumption	terajoules	1,118	1,220	3,306	5,624	8,216	-669	-696	146	1,144	2,332
Electric Vehicles (Diesel) Assumption	terajoules	4,456	4,847	13,083	22,165	32,232	511	626	6,140	12,343	19,359

Canada Fuel Blend Rates: NZ-Guardrail 20% LCIF Scenario

Calendar Year	Units	2022	2024	2026	2028	2030	2022	2024	2026	2028	2030
							(Scenario NZ-GR 20% LCIF - Baseline)				
Ethanol in gasoline	% by Volume	7.8%	8.9%	9.6%	13.2%	15.4%	0.0%	0.0%	0.0%	2.3%	3.2%
Biomass based diesel in diesel	% by Volume	3.3%	4.1%	5.9%	9.6%	12.1%	0.0%	0.5%	1.8%	5.2%	6.7%
Biodiesel in diesel	% by Volume	1.6%	1.1%	2.1%	3.6%	3.7%	0.0%	0.3%	1.2%	2.9%	2.3%
Renewable Hydrocarbon Fuels (HDRD) in diesel	% by Volume	1.7%	3.0%	3.8%	6.0%	8.4%	0.0%	0.2%	0.6%	2.4%	4.4%
Biomass based diesel in LFO	% by Volume	2.3%	3.1%	4.6%	7.9%	10.2%	0.0%	0.4%	1.5%	4.4%	5.6%
Biodiesel in LFO	% by Volume	1.1%	0.9%	1.8%	3.3%	3.5%	0.0%	0.2%	1.0%	2.6%	2.2%
Renewable Hydrocarbon Fuels (HDRD) in LFO	% by Volume	1.2%	2.2%	2.9%	4.7%	6.7%	0.0%	0.1%	0.4%	1.8%	3.5%
Pyrolisis oil (Biocrude) in HFO	% by Volume	1.0%	4.3%	7.4%	10.3%	13.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Sustainable aviation fuel in aviation turbo fuel	% by Volume	0.0%	0.7%	1.8%	3.3%	4.8%	0.0%	0.0%	0.0%	0.0%	0.0%
Ethanol in gasoline	% by Energy	5.4%	6.2%	6.8%	9.4%	11.0%	0.0%	0.0%	0.0%	1.7%	2.4%
Biomass based diesel in diesel	% by Energy	3.0%	3.9%	5.5%	9.1%	11.4%	0.0%	0.5%	1.7%	4.9%	6.4%
Biodiesel in diesel	% by Energy	1.4%	1.0%	1.9%	3.3%	3.4%	0.0%	0.3%	1.1%	2.6%	2.1%
Renewable Hydrocarbon Fuels (HDRD) in diesel	% by Energy	1.6%	2.9%	3.6%	5.7%	8.0%	0.0%	0.2%	0.5%	2.2%	4.2%
Biomass based diesel in LFO	% by Energy	2.1%	2.9%	4.3%	7.4%	9.5%	0.0%	0.4%	1.3%	4.1%	5.3%
Biodiesel in LFO	% by Energy	1.0%	0.8%	1.6%	3.0%	3.2%	0.0%	0.2%	1.0%	2.4%	2.0%
HDRD in LFO	% by Energy	1.1%	2.1%	2.7%	4.4%	6.3%	0.0%	0.1%	0.4%	1.7%	3.3%
Pyrolisis oil (Biocrude) in HFO	% by Energy	0.5%	2.3%	4.0%	5.6%	7.2%	0.0%	0.0%	0.0%	0.0%	0.0%
Sustainable aviation fuel in aviation turbo fuel	% by Energy	0.0%	0.7%	1.7%	3.2%	4.7%	0.0%	0.0%	0.0%	0.0%	0.0%

Canada CFS Compliance Credits and Debits: NZ-Guardrail 20% LCIF Scenario

Calendar Year	Units	2022	2024	2026	2028	2030	2022	2024	2026	2028	2030
Debits							*(Scenario NZ-GR 20% LCIF - Baseline)*				
Fossil Fuels											
Motor Gasoline	tCO2e	252,239	7,902,488	12,608,511	16,753,512	20,761,210	127	1,962,244	3,848,607	5,321,432	6,779,396
Diesel fuel oil	tCO2e	204,482	6,699,455	10,983,176	15,015,829	19,142,168	-99	1,633,176	3,176,010	4,313,665	5,490,092
Light fuel oil	tCO2e	0	0	0	0	0	0	0	0	0	0
Heavy fuel oil	tCO2e	0	0	0	0	0	0	0	0	0	0
Aviation turbo fuel (Domestic Only)	tCO2e	0	0	0	0	0	0	0	0	0	0
Kerosene & stove oil	tCO2e	0	0	0	0	0	0	0	0	0	0
Total Debits	tCO2e	456,721	14,601,943	23,591,687	31,769,341	39,903,378	27	3,595,421	7,024,617	9,635,097	12,269,488
CFS Compliance Credits											
Compliance Category 1											
CCS	tCO2e	650,000	1,787,500	2,275,000	2,762,500	3,250,000	0	-600,000	-1,200,000	-1,800,000	-2,400,000
Upstream Improvements	tCO2e	0	203,125	406,250	609,375	812,500	0	-150,000	-300,000	-450,000	-600,000
Reductions in Refineries	tCO2e	100,000	353,125	506,250	659,375	812,500	0	-150,000	-300,000	-450,000	-600,000
Incremental Methane Reductions - Conventional Oil	tCO2e	273,373	816,310	1,085,873	1,355,437	1,625,000	0	-300,000	-600,000	-900,000	-1,200,000
Subtotal Compliance Category 1	tCO2e	1,023,373	3,160,060	4,273,373	5,386,687	6,500,000	0	-1,200,000	-2,400,000	-3,600,000	-4,800,000
Compliance Category 2											
Bank Renewable Fuel Regulation (RFR)	tCO2e	1,400,000	0	0	0	0	0	0	0	0	0
Ethanol	tCO2e	1,675,803	3,552,297	3,562,180	4,552,029	4,867,516	841	-123,315	-269,603	370,232	374,908
Ethanol from corn	tCO2e	1,382,147	2,946,218	3,011,349	3,854,185	4,153,875	694	-104,245	-231,889	306,682	310,051
Ethanol from wheat	tCO2e	293,657	606,079	550,831	697,843	713,641	147	-19,070	-37,714	63,550	64,857
Biodiesel	tCO2e	610,270	864,211	1,587,368	2,710,319	2,712,063	-1,221	217,594	907,639	2,129,542	1,578,046
Biodiesel from canola oil	tCO2e	290,456	381,040	721,121	1,679,905	1,747,084	-146	93,435	403,720	1,440,169	1,049,952
Biodiesel from inedible tallow	tCO2e	22,495	32,180	59,470	100,574	101,193	-45	8,193	34,216	78,797	59,360
Biodiesel from soybean oil	tCO2e	253,862	389,160	693,189	738,989	673,136	-939	100,351	404,630	461,432	357,942
Biodiesel from yellow grease	tCO2e	23,539	33,548	61,746	103,958	104,087	-49	8,509	35,456	81,352	60,791
Biodiesel from distillers corn oil	tCO2e	19,919	28,283	51,843	86,892	86,563	-42	7,105	29,618	67,791	50,002
Biodiesel from unknown	tCO2e	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels (HDRD)	tCO2e	702,188	2,471,209	3,061,849	4,734,899	6,398,592	688	124,804	324,264	1,641,100	3,063,474
Renewable Hydrocarbon Fuels from palm oil	tCO2e	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels from canola oil	tCO2e	136,661	1,393,688	2,032,640	3,611,024	5,307,921	646	118,038	320,008	1,495,656	2,902,220
Renewable Hydrocarbon Fuels from palm sludge oil	tCO2e	4,476	8,521	8,090	7,659	7,228	0	-175	-350	-525	-699
Renewable Hydrocarbon Fuels from tallow	tCO2e	204,374	391,137	375,999	443,446	437,467	24	8,945	12,514	99,089	113,653
Renewable Hydrocarbon Fuels from yellow grease	tCO2e	308,768	587,018	558,999	587,389	564,946	18	-763	-5,179	47,090	49,529
Renewable Hydrocarbon Fuels from soybean oil	tCO2e	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels from spent bleaching earth	tCO2e	47,909	90,845	86,121	85,381	81,029	1	-1,241	-2,729	-211	-1,228
Pyrolisis Oil (Biocrude)	tCO2e	16,680	144,751	247,422	343,504	433,849	0	-3,537	-12,457	-26,756	-46,514
Sustainable aviation fuel	tCO2e	0	110,543	282,470	505,148	701,020	0	-3,052	-16,701	-48,400	-97,385
Subtotal Compliance Category 2	tCO2e	4,404,941	7,143,011	8,741,288	12,845,899	15,113,040	308	212,495	933,142	4,065,718	4,872,529
Compliance Category 3											
Diesel Displaced by Propane	tCO2e	0	0	0	0	0	0	0	0	0	0
Diesel Displaced by Natural Gas	tCO2e	0	0	0	0	0	0	0	0	0	0
Gasoline Displaced by Electric Vehicles	tCO2e	193,007	401,331	1,033,346	1,666,187	2,300,000	-115,564	-241,527	4,774	251,901	500,000
Diesel Displaced by Electric Vehicles	tCO2e	1,006,993	2,094,184	5,391,912	8,693,634	12,000,000	115,564	237,041	2,420,483	4,607,920	6,800,000
Subtotal Compliance Category 3	tCO2e	1,200,000	2,495,515	6,425,258	10,359,821	14,300,000	0	-4,485	2,425,258	4,859,821	7,300,000
External Credit Sources											
Cross Steam Credits	tCO2e	45,672	1,460,194	2,359,169	3,176,934	3,990,338	3	359,542	702,462	963,510	1,226,949
Compliance Fund	tCO2e	0	0	0	0	0	0	0	0	0	0
Emerging Tech Credit Generation	tCO2e	0	0	0	0	0	0	0	0	0	0
Total Credits		6,673,986	14,258,780	21,799,088	31,769,341	39,903,378	311	-632,448	1,660,861	6,289,048	8,599,478
Banked for the Year	tCO2e	6,217,265	-343,163	-1,792,599	0	0	284	-4,227,869	-5,363,756	-3,346,049	-3,670,010
Running Net Credit Balance	tCO2e	6,217,265	8,532,497	5,554,797	5,000,000	5,000,000	284	-6,585,939	-17,121,596	-24,163,608	-30,739,825
Renewable Fuel Credit Price	C$/MT	0	43	63	305	394	0	33	53	295	384
Maximum CFS Compliance Credit Price	C$/MT	350	365	380	396	412	0	0	0	0	0

Value of Canada Compliance Credits By Feedstock Pathway: NZ-Guardrail 20% LCIF Scenario

	Calendar Year	Units	2022	2024	2026	2028	2030	2022	2024	2026	2028	2030
								(Scenario NZ-GR 20% LCIF - Baseline)				
Ethanol												
Ethanol from corn		C$/liter	0.00	0.04	0.06	0.30	0.38	0.00	0.03	0.05	0.29	0.37
Ethanol from wheat		C$/liter	0.00	0.05	0.07	0.34	0.42	0.00	0.04	0.06	0.33	0.41
Biodiesel												
Biodiesel from canola oil		C$/liter	0.00	0.12	0.17	0.80	1.01	0.00	0.09	0.14	0.78	0.98
Biodiesel from inedible tallow		C$/liter	0.00	0.13	0.19	0.92	1.16	0.00	0.10	0.16	0.89	1.13
Biodiesel from soybean oil		C$/liter	0.00	0.11	0.15	0.73	0.91	0.00	0.08	0.13	0.70	0.89
Biodiesel from yellow grease		C$/liter	0.00	0.13	0.18	0.86	1.08	0.00	0.10	0.15	0.83	1.05
Biodiesel from distillers corn oil		C$/liter	0.00	0.11	0.15	0.73	0.92	0.00	0.08	0.13	0.71	0.90
Renewable Hydrocarbon Fuels		C$/liter										
Renewable Hydrocarbon Fuels from palm oil		C$/liter	0.00	0.02	0.03	0.15	0.18	0.00	0.02	0.03	0.14	0.17
Renewable Hydrocarbon Fuels from canola oil		C$/liter	0.00	0.12	0.17	0.83	1.04	0.00	0.09	0.15	0.80	1.02
Renewable Hydrocarbon Fuels from palm sludge oil		C$/liter	0.00	0.12	0.17	0.80	1.01	0.00	0.09	0.14	0.78	0.98
Renewable Hydrocarbon Fuels from tallow		C$/liter	0.00	0.13	0.18	0.85	1.07	0.00	0.10	0.15	0.82	1.05
Renewable Hydrocarbon Fuels from yellow grease		C$/liter	0.00	0.12	0.17	0.79	0.99	0.00	0.09	0.14	0.76	0.97
Renewable Hydrocarbon Fuels from soybean oil		C$/liter	0.00	0.09	0.13	0.60	0.75	0.00	0.07	0.11	0.58	0.73
Renewable Hydrocarbon Fuels from spent bleaching earth		C$/liter	0.00	0.11	0.15	0.73	0.91	0.00	0.08	0.13	0.70	0.89

Biofuel Feedstocks Used for Canadian Domestic Consumption: NZ-Guardrail 20% LCIF Scenario

	Calendar Year	Units	2022	2024	2026	2028	2030	2022	2024	2026	2028	2030
								(Scenario NZ-GR 20% LCIF - Baseline)				
Ethanol Feedstocks												
Corn		1000 MT	3,727	4,509	5,115	6,902	7,974	4	-221	-428	128	16
Wheat		1000 MT	920	1,126	1,212	2,576	3,020	0	196	302	1,678	2,123
Biodiesel Feedstocks												
Canola Oil		1000 MT	185	127	252	618	678	0	33	146	535	431
Inedible Tallow		1000 MT	13	10	19	34	36	0	3	11	27	22
Soybean Oil		1000 MT	178	143	269	303	292	-1	39	162	197	168
Yellow Grease		1000 MT	15	11	22	38	40	0	3	13	30	25
Distillers Corn Oil		1000 MT	14	10	20	35	37	0	3	12	28	23
Unknown		1000 MT	0	0	0	0	0	0	0	0	0	0
Renewable Hydrocarbon Fuels Feedstocks												
Feedstocks Used for Domestic Production												
Canola Oil		1000 MT	86	460	704	1,316	2,040	0	47	135	593	1,195
Feedstocks Used for Imports (Approximation)												
Palm Oil		1000 MT	0	0	0	0	0	0	0	0	0	0
Palm Sludge Oil		1000 MT	3	3	3	3	3	0	0	0	0	0
Inedible Tallow		1000 MT	131	132	133	165	171	0	5	9	45	55
Yellow Grease		1000 MT	213	213	213	237	242	0	4	7	33	41
Soybean Oil		1000 MT	0	0	0	0	0	0	0	0	0	0
Spent Bleaching Earth		1000 MT	36	36	36	38	38	0	0	1	3	3

Canada Canola and Canola Products Supply and Demand: NZ-Guardrail 20% LCIF Scenario

	Units	22/23	24/25	26/27	28/29	30/31	22/23	24/25	26/27	28/29	30/31
							(Scenario NZ-GR 20% LCIF - Baseline)				
Canola											
Area Planted	1000 ha	8,562	8,455	8,672	8,928	9,166	-9	12	111	315	479
Area Harvested	1000 ha	8,476	8,370	8,585	8,838	9,073	-9	12	110	312	474
Yield	mt per ha	2.33	2.37	2.42	2.46	2.51	0.00	0.00	0.00	0.00	0.00
Supply											
Beginning Stocks	1000 mt	716	1,629	1,882	2,166	2,450	0	-2	7	65	143
Production	1000 mt	19,752	19,875	20,765	21,768	22,748	-21	28	265	768	1,189
Imports	1000 mt	104	104	104	104	104	0	0	0	0	0
Total Supply	1000 mt	20,572	21,608	22,752	24,038	25,302	-21	26	272	833	1,333
Domestic Disappearance											
Crush	1000 mt	11,042	11,638	12,074	12,558	13,049	-10	13	137	428	691
Food	1000 mt	0	0	0	0	0	0	0	0	0	0
Feed, Seed, Waste	1000 mt	109	109	113	118	122	0	0	-2	-4	-5
Total Domestic Disappearance	1000 mt	11,151	11,748	12,188	12,676	13,171	-10	13	135	424	686
Exports	1000 mt	7,794	8,112	8,554	9,060	9,550	-9	11	107	301	462
Ending Stocks	1000 mt	1,627	1,749	2,010	2,303	2,581	-3	2	30	109	184
Canola Meal											
Extraction Rate	kg/kg	0.56	0.56	0.56	0.56	0.56	0.00	0.00	0.00	0.00	0.00
Supply											
Beginning Stocks	1000 mt	54	94	107	117	128	0	0	1	5	10
Production	1000 mt	6,164	6,497	6,740	7,010	7,284	-6	7	77	239	386
Imports	1000 mt	56	56	56	56	56	0	0	0	0	0
Total Supply	1000 mt	6,274	6,646	6,902	7,183	7,468	-6	7	77	243	395
Domestic Disappearance											
Food	1000 mt	0	0	0	0	0	0	0	0	0	0
Feed & Residual	1000 mt	744	769	808	848	890	0	1	4	12	19
Industrial	1000 mt	0	0	0	0	0	0	0	0	0	0
Total Domestic Disappearance	1000 mt	744	769	808	848	890	0	1	4	12	19
Exports	1000 mt	5,441	5,777	5,983	6,213	6,445	-5	6	71	224	364
Ending Stocks	1000 mt	89	101	111	122	133	0	0	2	7	12
Canola Oil											
Extraction Rate	kg/kg	0.44	0.44	0.44	0.44	0.44	0.00	0.00	0.00	0.00	0.00
Supply											
Beginning Stocks	1000 mt	412	514	527	538	547	0	0	-3	-13	-21
Production	1000 mt	4,834	5,095	5,286	5,497	5,712	-4	6	60	187	302
Imports	1000 mt	0	0	0	0	0	0	0	0	0	0
Total Supply	1000 mt	5,246	5,608	5,812	6,035	6,259	-4	5	57	174	281
Domestic Disappearance											
Food	1000 mt	687	665	668	670	670	1	-1	-9	-23	-34
Feed & Residual	1000 mt	0	0	0	0	0	0	0	0	0	0
Industrial	1000 mt	561	859	1,369	2,096	2,882	-58	36	429	1,029	1,524
Total Domestic Disappearance	1000 mt	1,248	1,524	2,037	2,766	3,552	-57	34	420	1,006	1,490
Exports	1000 mt	3,510	3,562	3,242	2,724	2,153	52	-28	-355	-814	-1,185
Ending Stocks	1000 mt	488	522	533	545	554	0	-1	-8	-18	-24
Canola and Derivative Prices											
Canola Average Farm Price, Saskatchewan	CAD/mt	648	674	680	682	688	-1	1	9	20	27
Canola Seed Average Price, Pacific Coast	CAD/mt	673	699	706	708	714	-1	1	9	21	29
Canola Oil FOB Plants, Crude Degummed	CAD/mt	1,716	1,788	1,865	1,947	2,042	-3	6	50	127	188
Canola Meal FOB Plant	CAD/mt	305	308	287	265	242	0	-1	-5	-16	-26

Canada Grains Supply and Demand: NZ-Guardrail 20% LCIF Scenario

	Units	22/23	24/25	26/27	28/29	30/31	22/23	24/25	26/27	28/29	30/31
							(Scenario NZ-GR 20% LCIF - Baseline)				
Corn											
Area Planted	1000 ha	1,475	1,475	1,476	1,475	1,476	0	0	0	0	1
Area Harvested	1000 ha	1,430	1,428	1,427	1,426	1,426	0	0	0	0	0
Yield	mt per ha	9.98	10.21	10.44	10.67	10.90	0.00	0.00	0.00	0.00	0.00
Supply											
Beginning Stocks	1000 mt	1,981	2,118	2,204	2,280	2,352	0	0	0	-5	-6
Production	1000 mt	14,272	14,571	14,899	15,216	15,542	0	-1	-1	0	-3
Imports	1000 mt	3,307	3,472	3,892	5,879	6,146	-53	-240	522	1,202	4,108
Total Supply	1000 mt	19,560	20,161	20,995	23,375	24,040	-53	-241	520	1,196	4,098
Domestic Disappearance											
Feed & Residual Use	1000 mt	10,562	10,140	10,083	10,650	10,942	14	57	411	714	1,135
Food, Seed, and Industrial Use	1000 mt	5,944	6,870	7,695	9,434	9,735	-67	-298	113	490	2,980
Bioethanol Use	1000 mt	4,188	5,000	5,678	7,262	7,403	-67	-298	116	494	2,989
Total Domestic Disappearance	1000 mt	16,506	17,010	17,777	20,084	20,677	-53	-241	524	1,204	4,115
Exports	1000 mt	974	974	974	974	974	0	0	0	0	0
Ending Stocks	1000 mt	2,080	2,177	2,243	2,317	2,389	0	0	-4	-8	-17
Wheat											
Area Planted	1000 ha	10,147	9,961	9,838	9,692	9,559	0	1	6	11	15
Area Harvested	1000 ha	9,370	9,311	9,212	9,141	9,087	0	1	3	15	19
Yield	mt per ha	3.45	3.49	3.53	3.58	3.62	0.00	0.00	0.00	0.00	0.00
Supply											
Beginning Stocks	1000 mt	4,488	5,811	6,191	6,375	6,547	0	-3	-6	-49	-68
Production	1000 mt	32,289	32,497	32,559	32,711	32,919	0	4	10	55	70
Imports	1000 mt	700	700	700	700	700	0	0	0	0	0
Total Supply	1000 mt	37,477	39,008	39,450	39,787	40,166	0	2	4	6	2
Domestic Disappearance											
Feed & Residual Use	1000 mt	3,999	4,209	4,274	4,301	4,444	-13	-68	-141	-344	-209
Food, Seed, and Industrial Use	1000 mt	5,216	5,382	5,944	6,966	7,158	47	218	766	1,776	1,960
Bioethanol Use	1000 mt	1,005	1,141	1,677	2,675	2,844	47	218	768	1,779	1,965
Total Domestic Disappearance	1000 mt	9,215	9,592	10,218	11,267	11,602	33	150	625	1,432	1,751
Exports	1000 mt	22,803	23,379	22,977	22,085	21,897	-32	-143	-589	-1,358	-1,642
Ending Stocks	1000 mt	5,459	6,038	6,255	6,435	6,666	-1	-4	-33	-68	-108
Grain Prices											
Barley, #1 Feed, Alberta	CAD/mt	372	388	403	423	441	0	0	2	4	8
Barley Farm Price	CAD/mt	285	297	308	324	337	0	0	1	3	6
Corn #2, CE Cash, Chatham	CAD/mt	245	243	242	239	236	0	0	1	1	4
Wheat, Western Red Spring, 12.5% Protein	CAD/mt	390	395	405	414	417	0	0	3	5	9
Wheat Producer Price, Ontario	CAD/mt	279	283	291	298	301	0	0	2	4	7