Canadian Fuels
ASSOCIATION
canadienne des carburants

Western Division
2100-350 7th Ave. SW
Calgary, Alberta
Canada T2P 3N9
t. 403.266.7565
canadianfuels.ca

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Email: lcfrr@gov.bc.ca

RE: BC Low Carbon Fuels Compliance Pathway Assessment

The Canadian Fuels Association [1] appreciates the opportunity to submit comments regarding the *BC Low Carbon Fuels Compliance Pathway Assessment* discussion document, as part of the consultations regarding the BC Greenhouse Gas Reduction (Renewable and Low Carbon Fuel Requirements) Act (Act) and the Renewable and Low Carbon Fuel Requirements Regulation (Regulation) (together the BC-LCFS). Canadian Fuels requests recognition that these policies need to be based on realistic, attainable goals with compliance flexibility supported with an understanding of the benefits and corresponding costs. Targets need to be achievable taking into consideration that the compliance pathways are limited due to market barriers outside of a fuel supplier's control, including: biofuels supply, consumer behaviour, investment required by fuel retailers in retail infrastructure, blending limitations, and distribution infrastructure. The success of this regulation will rely on the effectiveness of market-based approaches that minimize compliance costs across all sectors, and recognition that refineries are not the only stakeholders in the market. Our comments in the following appendix cover our views on current biofuel availability and blend potential, and on key parameters which will impact compliance capability.

Canadian Fuels has an important perspective in this discussion because our members are the obligated regulated parties to the regulation, and are Canada's largest producers and blenders of petroleum fuels and biofuels.

Summary

We recommend that BC 'pause' on increasing its current LCFS regulation, and allow the Federal Clean Fuel Standard (CFS) to develop. There is significant complexity and costs associated with the current patchwork of provincial Renewable Fuel Standard (RFS) and Low Carbon Fuel Standard (LCFS) mandates. Canadian Fuels supports a harmonized national standard, which would meet the policy objective in a cost-effective manner and give fuel manufacturers a reasonable and attainable target.

If BC elects to continue with regulation amendments, we offer the following specific recommendations and comments in the attached appendix, aligned with the format of the Pathway Assessment discussion document.

Sincerely,

[redacted]

S. Brian Ahearn
Vice President

[1] Canadian Fuels members: Federated Co-operatives Limited, Husky Energy Inc, Imperial Oil Limited, Irving Oil, North West Redwater Partnership, Parkland Fuel Corporation, Petro-Canada Lubricants Inc., Shell Canada Limited, Suncor Energy Products Partnership and Valero Energy Inc.

Appendix

BC Low Carbon Fuels Compliance Pathway Assessment (BC Energy December 1, 2017)

Canadian Fuels Association – input to Assessment

2 Introduction

2.1 2014 Consultation

In response to the June 2016 Minister Bennett open letter to the Canadian Fuels Association, we replied to the Minister on June 30, 2016, and highlighted several key points:

"Canadian Fuels is pleased that you have reaffirmed the Ministry's commitment to conduct a review of LCFRR and its targets in 2017.

We believe that the transportation fuel industry has effectively responded to the pursuit of lower transportation emissions. Canadian Fuels members blend and deliver virtually all of the biofuels consumed in Canada, and are also among Canada's leading producers of biofuels. Furthermore, Canadian Fuels Association is participating in education and outreach activities to encourage more efficient use of transportation fuel, such as the Smart Drive Challenge, the Smart Way program, and our Smart Fuelling program, all of which promote better driving habits.

Since the inception of the LCFRR regulation, the petroleum industry has taken responsible actions to generate compliance credits including investments in ethanol blending infrastructure in central BC and Vancouver Island, expanded biodiesel blending, and significant penetration of HDRD as a drop-in fuel. The industry has successfully increased these biofuel volumes by careful management of blend constraints and while respecting the OEM fuel recommendations. These significant market changes have been made while maintaining a safe, reliable and cost-effective fuel supply to consumers. The operational reliability of the transportation fuel system is critical to the economic infrastructure and by extension a fundamental undertaking for Canadian Fuel Association members.

The other actions required towards increased adoption of alternative low-carbon fuels (such as electricity, hydrogen and natural gas) are generally beyond the control of the petroleum industry, and we appreciate your letters to other organizations to encourage increased LCFRR participation.

Your statement on concerns regarding the near-monopoly of the fossil fuel sector is surprising, since there is vigorous competition among market participants, and we are not aware of any barrier to entry for new participants who wish to establish transportation fuel supply systems towards generating LCFRR compliance credits."

2.2-2.6 Warranty Statement, Misfuelling, Blend Walls, Pricing Fuel, Market Control, Fuel Availability

OEM (Original Equipment Manufacturer) position is to "protect the legacy fleet", and that new fuel blends should be backwards compatible. OEMs have validated vehicles/engines on fuels expected to be broadly available in the market at the time of initial vehicle/engine sale. For the legacy fleet, fuel changes outside the original design increases risk and probability of problems developing should fuel blends or fuel properties exceed those validated by the manufacturers. Consumers should not be at risk with respect to fuels available in the market. The OEM position is that, for any age of vehicle, there is a need for reasonable availability of the fuels recommended in the owner's manuals for the proper operation of vehicles. Therefore, any regulation should also work with consumer protection groups, and vehicle manufacturers to develop ways to mitigate this risk.

Canada does not have an equivalent Magnuson-Moss Warranty Act as in the US. As a result, an OEM in Canada can void warranty if a non-recommended fuel is used.

For fuel specifications, standards for all fuels (including gasoline, diesel, jet, HFO), are developed by the Canadian General Standards Board (CGSB), which consider Canadian climate and seasonality, resulting in quality standards that ensure fit-for-purpose fuels. New standards have and will be developed for renewable blends and their respective biofuel components. Renewable blends require seasonal adjustment of the refinery blend-stocks, to ensure year-round vehicle operability under the Canadian climate, and to address environmental issues (such as volatility for gasoline, and cloud point for diesel).

OEMs have not performed testing on legacy vehicles however this does not mean that fuels are compatible. There are fleet studies in the public literature that show issues with elastomers on B20, E15, lubricant dilution and subsequent engine wear on B20, fuel pump wear on E15, etc.

Beginning in Model Year (MY) 2016, the US Environmental Protection Agency (EPA) ended the Greenhouse Gas (GHG) emissions compliance incentives and adopted a methodology based on demonstrated vehicle emissions performance. The vast majority of Flex Fuel Vehicles (FFVs) are sold to the general public (and not fleets that may have more control over fuel type), and it has been difficult for manufacturers to determine the use on E85 for these vehicles, for EPA compliance purposes. Since FFVs have a non-zero cost, but are assumed to have zero or very near zero benefit under either California or EPA requirements, the chances of automakers providing FFVs after 2016 is low. (source: Growth Energy "RE: NHTSA-2017 2017-0069, Notice of Intent to Prepare an Environmental Impact Statement for Model Year 2022-2025 Corporate Average Fuel Economy Standards").

Labelling and consumer education may not be effective to prevent misfuelling. (As an example, prior to 1990 when leaded gasoline was still being sold, misfuelling occurred as leaded gasoline was cheaper than unleaded, regardless of a physical barrier in the size of the nozzle and the nozzle opening on vehicles.) A US DoE study on misfuelling (for high octane mid-level blends) suggests a RFID/Bluetooth

approach where the dispensing pump communicates with the car and will not turn on if it dispenses the wrong fuel, rather than a physical technique or other concepts such as labeling and consumer education. There is likely a data gap as to identifying effective misfuelling prevention measures.

3 Compliance Scenario

The following specific comments are on BC Energy's assumptions that may have been used to generate the compliance forecast:

1. Need understanding for basis on baseline CI changes from 2016 to 2017:
   Gasoline 87.3 to 88.1; Diesel 93.6 to 94.8; Electricity 11 to 20, Hydrogen 96 to 34
2. CNG/LNG CI did not increase with increase in electricity CI (2017+)
3. Include 2016 actuals
4. Ethanol CI outlook improving from current 41 to 15 (2030) appears optimistic; requires sensitivity analysis for CI remaining at 40
5. Energy use forecast requires a sensitivity analysis (one possible analysis could be the NEB Energy Future 2017 forecast [with their 3 scenarios])
6. Ethanol volume sensitivity analysis required based on E85 uptake and E15 vehicle availability
7. HDRD volume and % should be shown
8. HDRD volume sensitivity analysis, due to supply & receipt logistics challenges (forecast of ~0.4 BL/Y on dock capacities)
9. EV and H2 credit sensitivity analysis based on EV/H2 vehicle uptake

4 Hydrogen

For Hydrogen fuel cells, there is likely limited market acceptance. Hence, we do not anticipate that hydrogen will be a significant compliance pathway.

5 Propane

For Propane, there has been low vehicle-conversion market acceptance, combined with no OEMs' acceptance.

Unless Propane significantly reduces its allowable maximum sulphur concentration, this should not be considered a practical pathway. It is doubtful that investments in reducing Propane's sulphur for

transportation use will have a business case. If investments were made this would further increase its carbon intensity (CI) making it less attractive for CFS compliance.

Propane conversions were popular in the 1980s, but are not significant currently. Issues included loss of trunk space, poor conversions, safety regulations, resulting in most OEMs abandoning the market as there was extremely limited demand.

Hence, we do not anticipate that propane will provide a significant compliance pathway.

6 Natural Gas

There is a niche market for Heavy Duty Vehicle (HDV) fleets, suited to 'centralized (CNG)' or 'corridor (LNG)' fuelling. Some CNG capability for vocational trucks (e.g. garbage, urban buses, utility trucks, and short haul delivery vehicles) is expected. However, there are large vehicle and infrastructure investments required. Furthermore, higher horse-power HP engine (LNG) development is a key enabler for corridor fuelling, and is currently not commercially available (both Cummins and Volvo have delayed their introductions of such engines indefinitely) in North America.

For BC, there may be limited opportunity at BC Ferries for further conversion to LNG.

There is limited Light Duty Vehicle (LDV) opportunity for CNG/LNG.

DATA Gaps:

For NG fuel switching, there is a data gap driving a need for a forecast of NG HDV (Mid-duty) vehicles, LNG Vessels, and the corresponding GHG credit generation.

7 Electricity

Electric Vehicles (EVs) in Canada (March 2017) number 31,000 (~0.1% of the 24 M total fleet, with Quebec EVs ~ 15,000, BC EVs ~ 5,400). There are purchase incentives in place for BC, Ontario and Quebec. EVs are primarily for LDV, as gasoline substitute, with limited Mid-duty EVs (e.g. Cummins Class 7 truck). Current EV offer is basically restricted to small-mid size cars and compact utility vehicles.

Consumers are concerned with vehicle range limitations due to battery life in cold weather, charge time, and access to infrastructure, in addition to convenience and cost premium considerations. Battery costs are dropping but are still significant. Overall, technology breakthroughs are required to significantly improve reliability, energy density and cost-effectiveness.

Table 6 (discussion document) forecasts BC ZEVs at 15,000 for 2020 and 45,000 for 2023EVs (which differs from the statement in 7.2 in the discussion document).

For EV Logistics, there are nationally 3900 slow chargers and 300 fast chargers (public). There is recharging infrastructure in select urban centers in BC, Ontario & Quebec.

For BC, there are opportunities with Electricity SkyTrain or TransLink/trolley (Diesel substitute), with credit availability expected to be flat.

The quoted EER (Energy Efficiency Ratio) of 3.4 (in discussion document) relative to gasoline should be documented as to basis, especially with forecasted ICE engine improvements.

DATA Gaps:

There is a data gap, and the need for a third-party independent forecast of EV adoption, and corresponding GHG credits.

8 Dimethyl Ether (DME)

Dimethyl Ether (DME) has likely limited market acceptance. Hence, we do not anticipate that DME will be a significant compliance pathway.

9 Renewable or Low Carbon Gasoline & Diesel

In addition to a Credit Trading system, there should be the option for Refinery Credits. This would allow improvements in petroleum product carbon intensity (CI), via refinery energy efficiency, or fuel-related GHG reductions. This option's design should be carefully evaluated to ensure a level playing field for refiners before being implemented. The option should be available for either new or modified existing facilities.

Bio-component feedstock to refineries may reduce petroleum CI, and the current Federal RFS allows such an option. This technology is still in development to a commercial level, and it cannot be relied upon for significant contributions in the near term.

In the report, NRCan 3000633631 Opportunities for Processing Forest Derived Bio-Oil/Bio-Crude at Refineries and Upgraders in Canada: "The only technology that was found to be at commercial stage of readiness is the Ensyn rapid thermal processing (RTP) technology. This has limitations in the sense that it

is similar on water and oxygen content to pyrolysis fuel used in industrial burners and thus is immiscible with conventional crude. It has been found suitable in FCC units despite this limitation"(pg. 22).

10 Methanol

Methanol was introduced in the 1980s, and Ford had a fleet of M85 cars in service in California and other locations across US & Canada starting in 1983. In the early 1990s, the interest moved from M85 to E85, which was an easier fuel to handle.

There was work done on M5 (M15 was only ever fleet trialed in Germany in the 1980s). Co-solvent has to be a higher alcohol, and ethanol is not an effective co-solvent. The vapour pressure (VP) increase with Methanol is much higher than with Ethanol at about 20 kPa, rather than about 7 kPa with Ethanol.

Methanol has likely limited market acceptance. Hence, we do not anticipate that methanol will be a significant compliance pathway.

11 Ethanol

Current

Overview

Currently E10 (10 % ethanol) is the maximum and predominant acceptable blend level for LDV (light duty vehicle) fleet powered by ICE (Internal Combustion Engines). BC's gasoline pool ethanol content is averaging ~ 7 %, and any further increases would be towards the maximum attainable while respecting CGSB (Canadian General Standards Board) standards and existing equipment restrictions (OEM and outdoor power equipment).

The discussion paper speaks to Flex Fuel Vehicles (FFV) to help increase the gasoline pool ethanol content. Although FFVs currently represent ~ 7 % of the Canadian vehicle market, this number is expected to decline as OEMs are reducing FFV production. Mid- and high-level ethanol blending at retail outlets may develop based on a business case for consumer demand fuel for FFVs (E85, which is E50 to E85 varying by the season) and E15 market acceptance in the total fleet; it should be noted, that due to cold climatic conditions, fuel to FFVs would average around E70 in Canada, not E85. We note that in the US, E85 has been offered at 2 % of US retail sites, yet actual sales represent <0.1 % of gasoline demand (source API). For E15/E85, the vast majority of the retail infrastructure would not meet UL (Underwriters

Laboratories) safety standards, and significant modifications would be required (time, money and resources). Also, note that retail sites are primarily owned by third parties, who are not refiners or producers but rather small businesses.

Vehicles

- LDV (light duty vehicle) fleet is predominately powered by the Gasoline ICE (Internal Combustion Engine). Total fleet of 24 million (M) in Canada (average age of 10 years), supplemented with new vehicles up to 2 M/year. E10 (10% ethanol blend) is the maximum, predominate acceptable blend level for these engines.
- E10 for Regular Unleaded RUL (87) grade
- Premium Unleaded PUL (91) typically remains conventional
- Currently limited E85 market acceptance
- E15 acceptance to follow OEM recommendations
- E10 has 3% less energy content (up to a 3% loss in fuel economy) versus RUL

Wholesale - Terminal Conversions

- Most of industry terminals in large markets are currently converted for ethanol blending at 10%.
- Conversions typically take 3 years and involve capital projects at the terminal, for the addition of an ethanol storage tank, ethanol truck receipt system, and in-line terminal rack blending of ethanol with RBOB (reformulated blend-stock for oxygenated blending)
- Regional disparities in access to renewable fuels for compliance. Transportation costs are higher the further away from the source of renewable supply

Volume: Canada ethanol ~ 7.0 %

Volume 3200 ML of total 45,500 ML gasoline

Supply of 1800 ML domestic (predominate corn, balance wheat);

and 1400 ML imports (predominately US mid-west corn)

US RFS (2017) at 10.7% total biofuel

(RINS: conventional 7.7%, biodiesel 1.7%, advanced 1.1%, cellulosic 0.2%)

(Actual 2016: conventional 10.3%, biodiesel 4.0%, HDRD 1.1%, cellulosic 0%, cane 0%)

Volume: BC ethanol ~ 7.2 % (2016)

Volume 375 ML of total 5,200 ML gasoline

Supply is predominately US imports

CI Average = 41.0 CO2/MJ (source: BC 2016 Actual)

Actual BC weighted average 2010 = 56, 2014 = 50 (without iLUC) as per GHGenius

Weighted average of N. American ethanol = 56 CO2/MJ (source BC Energy 2013)

BC approved ethanol average 50-60 CI, for 4 BL/Y or 6 BL/Y capacities (source BC Energy 2017)

Energy density of 23.6 MJ/L vs Gasoline density of 34.7 MJ/L (~33% less) (source BC LCFS)

Discussion document: The available production capacity of suppliers with approved BC CI is quoted as 6 BL/Y; however a full North American supply should be quoted.

Future

Vehicles

- Some US vehicles validated for E15 (15% ethanol) use. E15 compatibility started with some 2012 MY (model year) U.S. vehicles, and now ~80% 2017 MY U.S. vehicles (based on RFA and Canadian Fuels assessments) are compatible.
- E15 has 4.5% less energy content (expect up to 4.5% loss in fuel economy) versus RUL
- Flex Fuel Vehicles (FFV) are approximately 7% of the vehicle market; however this number is expected to decline as OEMs are reducing FFV production. Limited to flat/declining E85 market acceptance. E85 has been offered at 2% of the US retail sites, yet actual sales represent <0.1% of gasoline demand (source API).
- Forecast needed for % of total fleet validated for E15 and E85 in BC
- OPEI = Outdoor Power Equipment Institute: "Higher ethanol blends (above 10% ethanol) are not meant for outdoor power equipment such as mowers, garden tractors, chain saws, boats, snow throwers, trimmers, UTVs, power washers, blowers, chippers, grinders, generators, jaws of life, concrete saws and other compact construction equipment, as well as small engine applications such as water pumps and irrigation systems"

Standards

- CAN/CGSB 3.511 *Oxygenated Unleaded Automotive Gasoline Containing Ethanol* standard now includes ethanol concentrations up to 15 %, splits into Types E1-E10 and E11-E15, for publication.
- CAN/CGSB-3.516 is *Denatured Fuel Ethanol for Use in Automotive Spark Ignition Fuels*

Wholesale - Terminal Conversions

- Business case required for investments in infrastructure, based on consumer demands for higher ethanol blends (E15 / E50-85).
- New facilities needed if additional E10 blending is required (at non-ethanol terminals), or if ethanol content increased to 15% (since original metering equipment and days-storage designed

for 10%). May require new tanks (including Environmental and Municipal Permits), ethanol receipt facilities, piping and metering.

- Additional terminal ethanol blending would require adequate lead time (min 3-5 years) for refinery/distribution infrastructure builds to meet the market.
- Higher blend levels (> E10) would require re-evaluation of existing ethanol (E-10) terminal installations
- Modified BOB (blend-stock for oxygenated blending) required for E15, and may involve capital projects at the refinery to tailor the BOB component.

Retail

- E10 and E0 should continue to be offered (the latter is needed for legacy fleet, marine, small engines , vintage collector cars, etc.); potential for higher ethanol blend offers
- Business case required for investments in retail infrastructure, based on consumer demand
- For E15/E85, the vast majority of the retail infrastructure would not meet UL standards, and significant modifications would be required (time, money and resources). A management of change process for >E10 requires due diligence, such that the equipment compatibility range must be verified/confirmed/documented prior increasing the biofuel content.
- Retail sites are primarily owned by 3rd parties, who are not refiners or producers, and many are small businesses.
- Estimates are blender dispenser pump costs at 20 K$ minimum, and tank replacement at 200 K$

Logistical/Supply Considerations

- Low-CI ethanol (cellulosic) will see demand pull for LCFS compliance in CA, Washington & Oregon LCFS, and for US RFS-2
- Economic incremental ethanol supply primarily US imports (US mid-west corn); possible Brazilian ethanol

DATA Gaps:

1. Ethanol Volume – available incremental supply
2. Ethanol CI – available corresponding CI for incremental supply
3. Vehicle Forecasts – E15 capable per OEM and FFV vehicle population as % of total fleet

12 Biodiesel (FAME)

Current

Overview

A proposed increased LCFS mandate would be met by blending to the limit of Fatty Acid Methyl Esters (FAME), and then supplemented with the importation of more expensive hydrogenation-derived renewable diesel (HDRD). Such increase in the LCFS mandate will result in the importation of HDRD, primarily from overseas (Singapore, Rotterdam or Louisiana) to accommodate BC's winter conditions. Contrary to ethanol, which is a pure component, FAME biodiesel quality has poor performance under cold temperatures, but will be maximized typically as the first compliance path within BC's current LCFS/RFS.

In addition to the logistics challenges, there will be significant capital/time requirements for additional blending/receiving infrastructures at terminals, including refinery modifications and possible changes at the retail level which may be third party owned. In all cases, blending must be within the vehicle fleet's capacity respecting the OEMs warranty limitations.

Vehicles

- HDV (heavy-duty vehicle) fleet is primarily Diesel, and the predominant alternate fuel offer is B5 (5% FAME). While legacy fleets are limited to B5, a number of newer diesel engine models have been validated to operate up to B20.

Current Market

- FAME (Fatty Acid Methyl Ester) current offer is predominately B5 blended 6 months/year (Apr-Sep) to manage seasonal CGSB diesel cloud point specification requirements and solids precipitate.
- OEM position is that the "majority of fleet is at B5, and B5+ to be avoided for legacy fleet"
- Typically, no FAME blending into northern regions.
- Supply has been mostly from imports (US), with some domestic supply; CI range of 10-20
- Biodiesel contains 11% oxygen and results in fuel economy loss; B5 < 0.5% B20 up to about 2%

Wholesale Terminals

- Many industry terminals in large markets converted for FAME or HDRD blending.

- Providing B5 terminal flexibility typically involves capital projects at the terminal, for the addition of a FAME storage tank (must be heated), FAME truck or rail receipt system, and in-line terminal rack blending of FAME with diesel
- Limited B20 market, since a low % of fleet
- B5 blending typically 6 month/year (April to September) in most zones; B0 balance
- B5 blending 12 months/year in temperate supply orbits (e.g. Vancouver and Vancouver Island)
- No B5 offered in northern zones
- BC cloud point zones: BC05 is -47C, BC04 is -40C, and BC03 is -34C
- Biodiesel cold flow improver additives (CFI) are not a practical solution as it seems to have a limited operating window causing restrictions on FAME sourcing. Coordinating Research Council (CRC) report P47: *"Cold flow additives, when used in FAME, should be specifically matched to the base diesel fuel and FAME quality to ensure correct performance consistent with the requirements set out in this European Standard. The choice could result in incompatibility between the cold flow additives used in the FAME and the diesel fuel."* In addition, restrictions are placed on the FAME "*in order to control maximum content of saturated monoglycerides in the final EN 590 blend to ensure trouble-free operation*."

Volume: Total Canada FAME = 1.0 % (BC at 2.7%, AB/SK/MB < 2.0%)
315 ML/Y, on 30,400 ML/Y diesel demand

Total BC of 2.7% or 100 ML on 3700 ML Diesel
Supply is a mix of domestic and imports (primarily from US)

CI Average FAME CI of 15 CO2/MJ (source BC 2016 actual)
BC actual weighted average 2010 = 15, 2014 = 20
Weighted average of North American supply is 24 CO2/MJ (source BC Energy 2013)
BC approved average CI of 10-20 for 1.6 BL/Y of 3 BL/Y capacities (source BC Energy 2017)
Energy density FAME of 35.4 MJ/L versus diesel of 38.7 MJ/L

Future

Wholesale Terminals

- Additional terminal FAME blending would require adequate lead time (min 3-5 years) for distribution infrastructure builds to meet the market.
- Some retail infrastructure changes; prior converting to B20 requires retail tank cleaning, possible pump/tank modifications due to incompatibility of components with B20

Logistics/Supply Considerations

- B5 & B20 selectively offered to fleets capable per OEM limits (limited market acceptance)
- Cold Flow Improvers technical feasibility
    - additives capability to work in extreme climate is a data gap; cold flow additives typically work on the diesel in the B5 blend not on the B100
- Capital conversions for terminals
- Low CI FAME will see demand pull for LCFS compliance in CA, Washington & Oregon, and for Ontario Greener Diesel RFS regulation, US RFS-2

DATA Gaps:

1. FAME Volume – available incremental supply
2. FAME CI – corresponding CI for incremental supply, and global demand for low CI FAME
3. Vehicle Forecast – B20 vehicle population as % of total fleet

13 Hydrogenation Derived Renewable Diesel (HDRD)

Current

Vehicles

- There are limited OEM validations in place for HDRD. Volvo, Mack, Cummins & Daimler have approved up to 100% in all new or specific new engines.

Current Market

- Total Renewable Fuel in Diesel of 0.8 BL/Y, currently composed of imports 0.5 BL/Y of HDRD and 0.3 BL/Y FAME (domestic production 0.4 BL/Y, US exports 0.2 BL/Y, US imports 0.1 BL/Y)
- HDRD (Hydrogenation-Derived Renewable Diesel) supply is all imports from Singapore, Netherlands, Finland or US (Louisiana) plants.
- Typical cloud point of -10 C.
- HDRD density of 0.78 vs ULSD of 0.84. Up to a ~6.5% loss in volumetric fuel economy
- 25% limit resulting density of (0.75*0.84 + 0.25*0.78) = 0.82, results in ~ 2% loss and is a density typical of a winter diesel fuel; reduction is within the range of ULSD as sold in Canada

- Competing HDRD demand is due to regulations (Oregon/Washington/California LCFS, BC LCFS, Ontario Greener Diesel RFS, US RFS2, and EU FQD/RED) and Jet Fuel alternatives.
- HDRD is considered a drop-in fuel, indistinguishable from diesel
- HDRD is paraffinic, and low in aromatic content, and slightly less volumetric energy content
- Blend levels > 25% may cause vehicle and equipment fuel seals to shrink or swell which could result in fuel leaks

Wholesale Terminal

- HDRD batch blended at 20-25% maximum
- Typical marine cargo size of 8 ML
- HDRD marine cargoes supplied into lower mainland, including marine shipments to Vancouver Island
- Atlantic-Quebec-Ontario – typically marine R100 cargoes into east-coast tankage; HDRD blends pipelined into southern Ontario

Volume: Total Canada HDRD = 1.6 % (BC actual at 3.3%, Ontario actual ~ 3%)
Volume of 475 ML/Y HDRD, for 30,400 ML/Y diesel

Total BC of 3.3% or 125 ML on 3700 ML Diesel
Supply is all Imports, primarily from Singapore

CI Average HDRD CI of 16 CO2/MJ (source BC 2016 actual)
Weighted BC actuals: 2010 = 48, 2014 = 25
BC approved average CI of 10-40 for 2 BL/Y capacities
Diesel default CI = 94.8 gCO2/MJ (source BC LCFS)
Energy density HDRD of 36.5 MJ/L versus diesel of 38.7 MJ/L

Future

Logistical/Supply Considerations

- HDRD blending expanded to supply orbits with temperate climates and/or seasonal (6 months April-Sep, coincident with FAME)
- HDRD plants competing for FAME and Renewable Natural Gas bio feedstocks
- Limited additional marine cargo receipt tankage on west coast

- Limited new HDRD plants starting up (worldwide) in the mid-term, hence the primary incremental supply is US or off-shore HDRD imports.
- HDRD primarily via marine from Neste Singapore (1.0 BL/Y with ~0.7 BL/Y sustainable feedstock)
- HDRD from Diamond (0.5 BL/Y) and Dynamic (0.25 BL/Y) likely used in US; not for BC/ON/CFS
    - Diamond expansion to 275 MG/Y (1.0 BL/Y) by 2Q2018
- Increased demand pull for HDRD into Washington/Oregon/California for state LCFS compliance, Ontario for Greener Diesel RFS regulation, EU RED-2 and EU FQD

DATA Gaps:

1. HDRD Volume – available incremental supply, and global demand
2. HDRD CI – available corresponding CI for incremental supply
3. HDRD Blend level – maximum level that does not cause customer seal issues