# BC-SMART Low Carbon Fuels Consortium

**Decarbonising Long-Distance Transport**

Newsletter Issue 5, February 2022

## From the BC-SMART Secretariat

The BC-SMART Low Carbon Fuels Consortium (BC SMART) was established in 2019 with the goal of facilitating the decarbonisation of the long-distance transport sector. The consortium plans to achieve this goal by encouraging the production and use of low carbon-intensive transport fuels, via the collective actions of the "coalition-of-the-willing". The coalition includes stakeholders from industry, government and the R&D community with BC-SMART acting as a "dating agency"! In this way, BC SMART will help the Province meet its CleanBC goals by reducing BC and Canada's transportation-related greenhouse gases (GHG's), while creating synergies between the many players needed to meet the Provinces ambitious, decarbonisation targets.

Our group is fortunate to be working in the right "environment" as indicated by the BC government's award at the Glasgow, COP26 summit for its CleanBC program. The *Under2 Coalition*, a group of state and regional governments from around the world, gave the CleanBC Program an award for the "most creative climate solution" at the COP26 meetings (Source: https://news.gov.bc.ca).

For example, as part of the CleanBC program, portions of carbon-tax revenue from large emitters is reinvested in projects aimed at reducing greenhouse-

BC's two oil refineries, Parkland and Tidewater are already part of BC's Low Carbon Fuels Part 3 agreements which help fuel suppliers undertake actions that are not otherwise economically viable. This helps create future pathways for compliance with the Renewable and Low Carbon Fuel requirement regulations. Two other major generators of greenhouse gases that are hoping to join this selected group include the Lafarge cement plant in Richmond and the Liquid Natural Gas (LNG) Canada plant in Kitimat.

BC's Environment and Climate Change Strategy Minister, George Heyman, said in a news release, "We are expanding and accelerating climate action as we work across sectors to reduce climate-harming pollution and create new opportunities for people and businesses in the clean economy. This award recognizes the success of the program which is about strong collaboration and the support of innovation. The award is another indication that BC is on the right path, via the new CleanBC Roadmap, to 2030."

## Supported by:

BC Bioenergy Network
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BRITISH COLUMBIA
Ministry of Energy, Mines and Petroleum Resources

## Summary of BC-SMART activities since the last newsletter

- Publication of a report entitled, ***"Low carbon-intensive (bio)fuels for marine transport",*** September 2021.
- ***BC-SMART Virtual Panel Discussion: "Decarbonising the trucking sector by the use of low carbon-intensive fuels***", 22 November, 2021.

During the last few years we have published several newsletters that provide updates on feedstocks, policy, industry developments and possible investments in initiatives such as co-processing at BC oil refineries. These newsletters are posted on the BC SMART website and can also be accessed using the links below.

- Issue#1: Summary of "BC SMART Feedstock Workshop" and "The Assessment of likely Technology Maturation pathways for biojet production from forest residues (The ATM Project)", 10 February 2020.
- Issue#2: Update on the recent activities of the Consortium as well as the latest developments in "how the world is trying to decarbonise long-distance transport", 18 September 2020.
- Issue#3: Highlighting the ongoing decarbonisation of the marine sector, 27 January 2021.
- Issue#4: Building on the marine biofuels webinar, summarising how the marine sector, in BC, Canada and the world, continues its efforts to decarbonise, 4 June 2021.

As the world, Canada and BC adapts to "living with COVID" we hope to again organise our very informative workshops, with plans, working with our colleagues at C-SAF (https://c-saf.ca/), to update progress in how Canada might enhance the decarbonisation of the aviation sector. Before then, we hope to review progress in the decarbonisation of the rail sector, working with our colleagues who are part of the BC-SMART "coalition-of-the-willing". Please check our website for news of Upcoming Events.

As described in more detail below, BC-SMART recently held a very informative webinar on how trucking might be decarbonised. We were fortunate to recruit some world-class speakers moderated by Dave Schick from the Canadian Fuels Association (https://www.canadianfuels.ca/). Unlike aviation where biojet/Sustainable Aviation Fuels (SAF) is likely to be the only short-to-mid term decarbonisation option, trucking has other, lower carbon options such as (green) electrification, renewable natural gas, hydrogen, etc. One of the strengths of the BC-SMART consortium is to maximise the synergies between both the low-carbon intensive (CI) fuel producers and long-distance-transport users. Future meetings, reports and newsletters will highlight these synergies, with the decarbonisation of transport greatly contributing to the CleanBC aspirational goals.

As always, we appreciate your readership and value your input and feedback. Please email us your ideas or suggestions on how we can increase the value of the BC-SMART newsletter.

Thank you for reading and participating in the BC-SMART network!

Mohsen, Mahmood, and Jack

**Some of the current BC SMART Consortium members, including feedstock suppliers, low carbon fuels producers and users, government bodies, engineering companies, R&D providers and universities.**

## Decarbonising the trucking sector using low carbon-intensive fuels

With many of the world's leaders assembled in Glasgow at COP26, the need to decarbonise the global economy was further highlighted. Ongoing COVID-induced supply chain problems have also emphasised the important role that long-distance trucking plays, which made the recent BC-SMART Virtual Panel Discussion: "*Decarbonising the trucking sector using low carbon-intensive fuels*" webinar, even more relevant. This issue of the BC SMART newsletter tries to capture recent progress in the decarbonisation of the trucking sector, making use of the webinar presentations and related discussions.

Similar to other regions, the transport sector is one of the major contributors of the GHG emissions in Canada. For example, the Canadian transport sector emitted 186 Mt $CO_2$ eq (25% of total emissions) in 2019, closely following the oil and gas sector who are the primary contributor of Canada's GHG emissions, accounting for 191 Mt $CO_2$ eq (Figure 1).

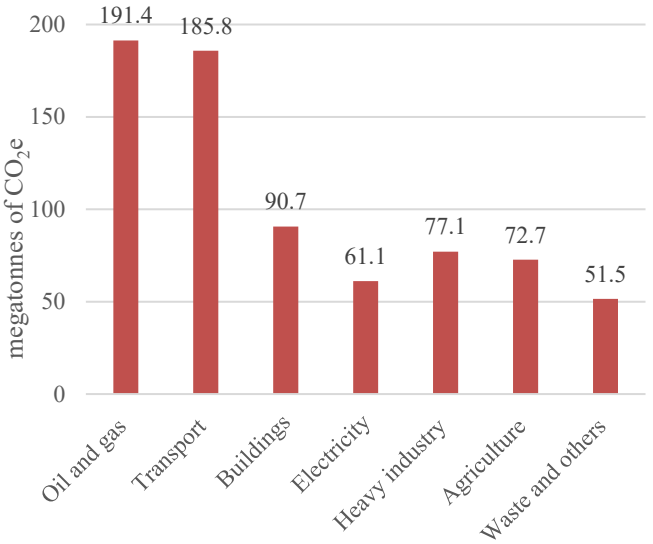



**Figure 1:** Greenhouse gas emissions by economic sector, Canada, 2019 (Source: Environment and Climate Change Canada)

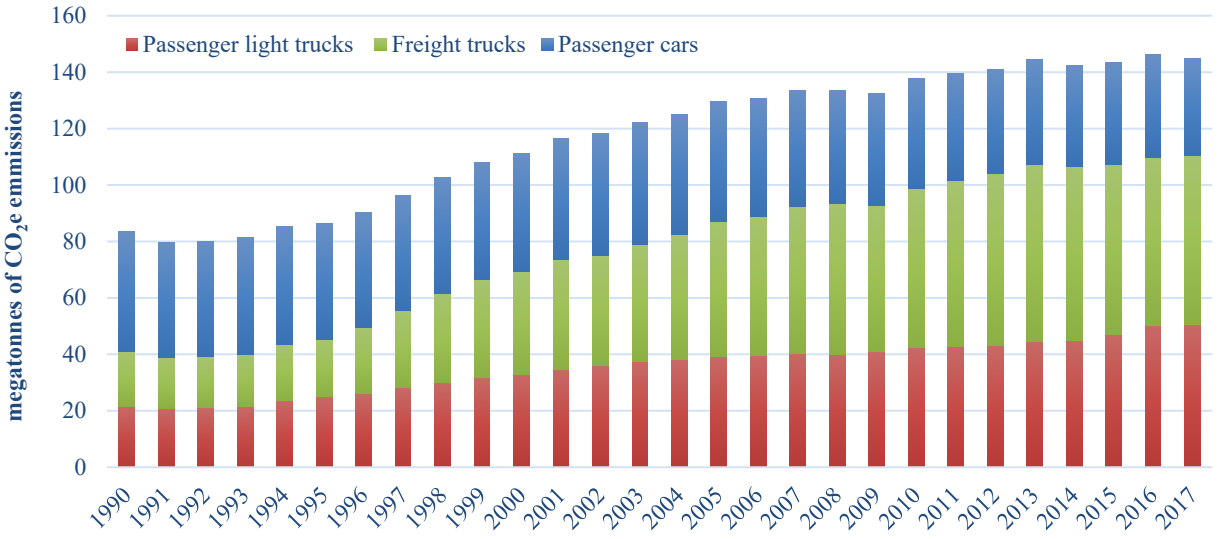



**Figure 2: The** trucking sector (light truck and freight truck) has the highest contribution on the transportation sector greenhouse gas emissions in Canada since 1994 (Source: Environment and Climate Change Canada)

There were approximately 25.4 million registered road motor vehicles in Canada in 2019, contributing approximately 80% of all transportation emissions. Light-duty vehicles accounted for 92.2% of all vehicles on the road, while **medium and heavy-duty vehicles (MHDVs)** only represented 4.5%. However, MHDVs emitted approximately the same level of GHG emissions as all light-duty vehicles combined, even though there are far fewer of them on the road. Between 1990 and 2019, the GHG emissions from the Canadian transport sector grew by 54% (Figure 2), with the growth in emissions driven mainly by increases from the trucking sector. Light and medium duty truck emissions more than doubled while emissions from freight trucks more than tripled. Thus, **accelerating the decarbonisation of the road transport sector, particularly the MHDV sector, will play a critical role in achieving national and international climate change commitments.**

There are various ways to decarbonise the road transport sector, with (green) electrification of cars/light-duty vehicles increasing significantly. Over the last decade, the sale of electric passenger vehicles in Canada has increased to the extent that, by the end of 2019, they represented over 2.5% of all light-duty vehicle sales. Although increased electrification of urban transit buses has tended to receive increased attention in Canada and other parts of the world, the medium and heavy-duty vehicles (MHDV) sector as a whole still has several obstacles that need to be resolved. Automotive Industry roadmaps, such as the Advanced Propulsion Centre's HGV roadmap, have indicated that mass adoption of zero tailpipe emission technologies are not likely to materialise until after 2040 for long-haul MHDVs. The report also suggests that a portfolio of vehicle propulsion technologies and sustainable low carbon fuels will all play a role in achieving net zero in the MHDV sector by 2050. **To date, biodiesel and renewable diesel have been central components of strategies aimed at decarbonizing the hard-to-electrify MHDVs sector.** This was highlighted in the recent BC-SMART webinar on "Decarbonising the trucking sector using low carbon-intensive fuels" that is summarised below.

## BC-SMART webinar on *"Decarbonising the trucking sector"*

As mentioned previously, the BC-SMART Low Carbon Fuels Consortium is focussed on decarbonising transport, the long-distance transport sector in particular. To help meet this goal, we were fortunate to recruit international speakers/panel members, who represent low carbon fuel producers, suppliers/distributors, end-users and policy advisors to share their insights and experience in how the trucking sector might decarbonise.

**Speakers/panel members:**

Pierpaolo Cazzola, Advisor– Energy, technology and environmental sustainability, International Transport Forum (ITF),

Neville Fernandes, Vice President, Corporate Affairs and Development for Renewable Energy Group, Inc.

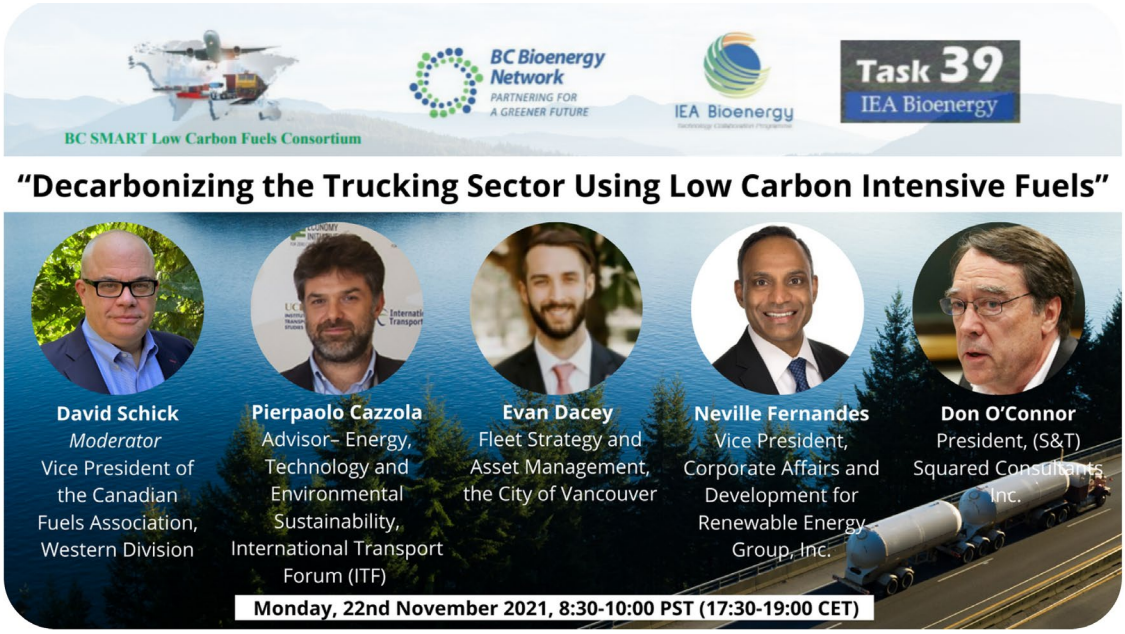
Evan Dacey, Fleet Strategy and Asset Management, the City of Vancouver

Don O'Connor, President, (S&T)$^2$ Consultants Inc. who are at the forefront of this area,

**Moderator:**

David Schick, from the Canadian Fuels Association (CFA)

Pierpaolo Cazzola, from the OECD's International Transport Forum (ITF), opened the webinar with an international perspective entitled *"Opportunities to decarbonise road freight"*. He suggested that there were four key "pillars" that had to be considered if effective truck decarbonisation was to be achieved. These included; i) managing travel demand, ii) enhancing the energy efficiency of vehicles, iii) increased use of decarbonised energy vectors/fuels and, iv) minimise emissions beyond vehicle use and energy/fuel production. The following figure from the International Transport Forum (ITF) report, summarises the freight decarbonisation parameters that need to be adopted if the sector is to achieve an 80% reduction in the carbon intensity of its operations.




**BC-SMART/IEA Bioenergy Task 39 Virtual Panel Discussion:** ***"Decarbonizing the trucking sector using low carbon-intensive fuels"*** (Source: BCBN)

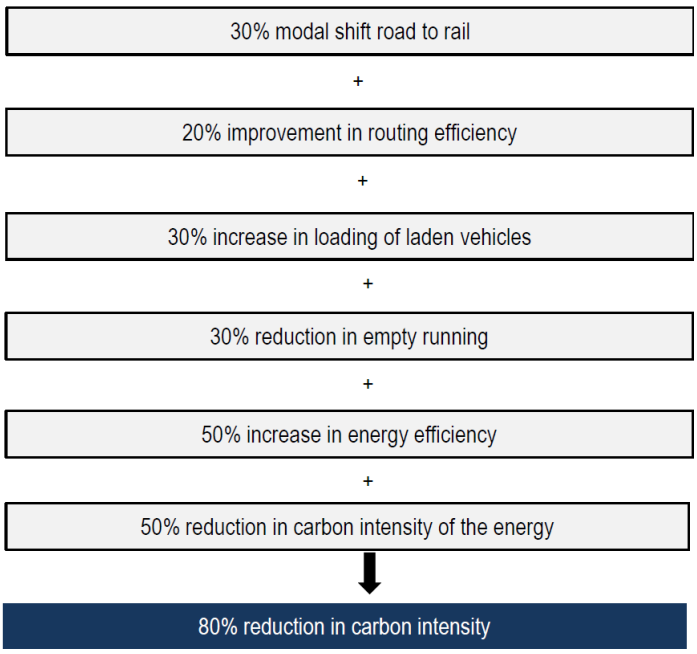



**Figure 3:** Leveraging freight decarbonisation parameters to achieve 80% reduction in carbon intensity (Source: ITF, 2018)

It was apparent (Figure 3) that the carbon intensity of the fuel contributed the most to the carbon emissions of the sector. During his presentation, Pierpaolo described how, of all the low carbon intensity fuel options for the trucking sector such as electrification, hydrogen, synfuels, etc., "green" electrification and biofuels are the most likely options in the short-to-mid terms.

Although "green" electrification has been shown to cut cars and some heavy-duty vehicles emissions, with greatest savings observed with battery electric vehicles, the significant battery requirements, high-power charging needs and limited access to renewable electricity have restricted electrification in the trucking sector. However, it is anticipated that declining battery prices should eventually bring battery-electric trucks (BET) closer to cost parity with "conventional" fuels. Based on a study by The International Council on Clean Transportation (icct), the total cost of ownership (TCO) for tractor-trailers in Germany, France, and the Netherlands should reach parity with diesel tractor-trailers in 2022. However, it is anticipated that other countries will experience delays until the middle of this decade (Source: icct). However, Pierpaolo noted that BET is not a feasible way to retrofit the existing fleet, which will probably be in use for several decades to come.

In related work, a recent study by the UBC Clean Energy Research Centre indicated that, although increased electrification is a core strategy for future GHG mitigation in BC, the current electricity supply will not be able to meet the growth in demand outlined in the Province's electrification-centered strategy. (Source: https://cerc.ubc.ca).

Pierpaolo Cazzola's presentation was entitled **"Opportunities to decarbonise road freight".**

**Main "Takeaways":** Additional actions will be required, beyond vehicle and fuel use, to significantly minimise emissions. However, decarbonising trucking fuels will be a core requirement.

As described in Exxon's energy outlook, the energy demand for heavy-duty trucks is anticipated to keep growing, mainly driven by increased GDP growth across all regions of the world. This report indicated that diesel will continue to be the main fuel used up-until 2040, with some growth in gas (including biogas) and biofuel used. During this period, the growth in fuel demand will be attenuated by fuel efficiency technologies and, to a lesser extent, by an increase in truck sizes. (This is likely to mean a shift from medium to heavy trucks in the developing world (Source: ITF, 2018)). As also described by Pierpaolo, the report emphasised that any future decarbonisation strategies have to consider the existing fleet and the associated supply chains.

**Bio-based diesels (i.e. biodiesel and renewable diesel) are proven decarbonisation options, particularly for the MHDV segments that are difficult to electrify**

To date, there are numerous cases where the use of blends of biodiesel and renewable diesel have helped displace/supplement diesel use in MHDV fleets, significantly lowering their carbon emissions. These biofuels have proven to be a readily deployable, low carbon solution, which has helped meet interim GHG emission reduction goals. For example, GHG reductions of 48-83%, as compared to petroleum diesel (mostly ultra-low sulfur diesel), have been reported, as well as "average emission reductions" of 10% and 30%, respectively for NOx and PM.

Although bio/renewable diesel has proven easy to integrate with existing supply chains and operations, sustainability and available volumes continue to be of concern. Globally they represent a small proportion of total fuel consumption, although they constitute a significant portion of the fuel used in some countries. If these fuels can be produced from wastes such as used cooking oil, tallow, tall oil, or from vegetable oils such as canola, they become much more attractive due to the lower carbon intensity of these feedstocks (Source: ITF, 2018).

It is anticipated that an average global biofuel output of 182 billion litres will occur over the next few years (Figure 4), with the greatest increases for ethanol occurring in China and Brazil and for bio/renewable diesel occurring in the United States and the ASEAN regions. Biofuels are expected to meet around 5.4% of road transport energy demand in 2025 (Source: IEA 2020).

Although blending mandates for biodiesel have been in place in Canada for over a decade, blending levels of 2-5% remain relatively low, primarily due to biodiesel's unfavorable cold flow properties. Consequently, low-level biodiesel blends have limited the potential contribution of biodiesel to reducing the GHG emissions of the MHDV sector.

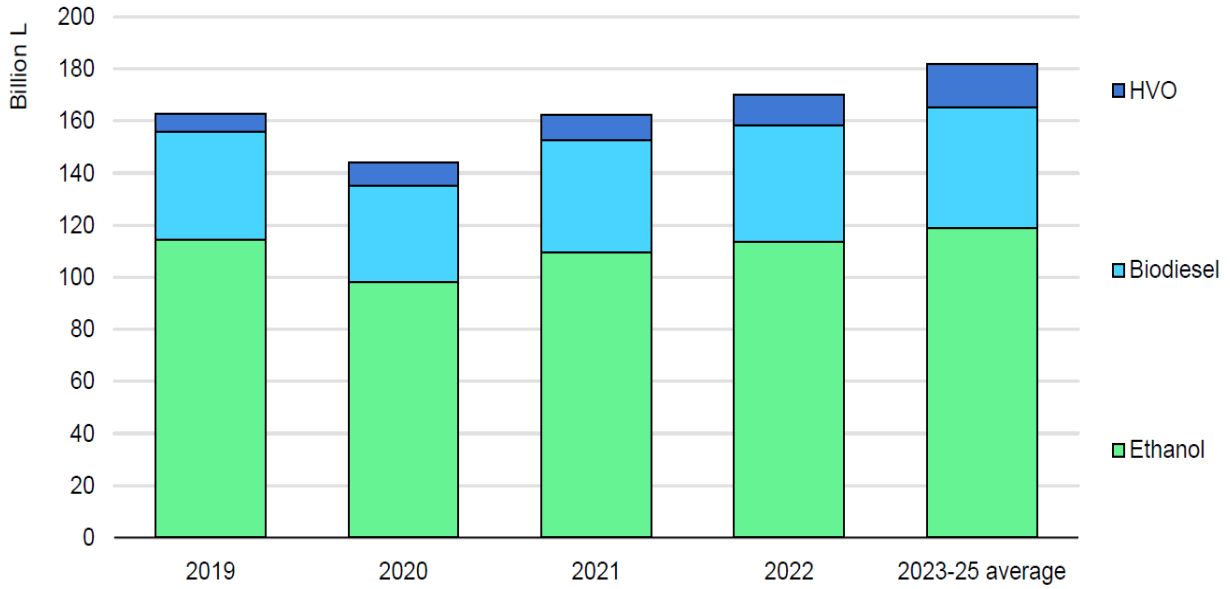



**Figure 4**: Global biofuel production and forecast to 2025 (Source: IEA 2020), HVO: Hydrotreated Vegetable Oil= Renewable diesel equivalent

In contrast to biodiesel, there is no restriction on renewable diesel blend levels. Neat renewable diesel (100%) can be used directly in the existing diesel distribution and storage infrastructure and in gas stations. Plus, renewable diesel use has nearly doubled in the last two years**.** Renewable diesel production also offers other potential benefits such as repurposing or resuscitating oil refineries as "stand-alone" biorefineries (6 of the 18 projects and expansions are refinery conversions). Renewable diesel is also a "drop-in" fuel, meaning it can be directly substituted for diesel without the need for supply chain or engine modifications. It should be noted that policies such as BC's and California's Low Carbon Fuels Standard (LCFS) have played a key role and are primarily the reason why there has been an 85% increase in renewable diesel production globally. The US's renewable fuel standard, California's low-carbon fuel standard and the biodiesel blender credit have made many renewable diesel projects economically attractive. Outside of the United States, capacity is expected to increase in Europe by 12% from 2020 to 2022 and by 32% in the Asia-Pacific region (Figure 5).

It is anticipated that, by the end of 2022, renewable diesel will account for 11% of global biofuel production, more than doubling the 2019 production (Source: IEA 2021). It is also anticipated that the Canadian Clean Fuel Standard will increase the national bio-based diesel market from over 700 million liters to about 2 billion liters by 2030. Half of this supply is projected to be met by renewable diesel (800-900 million liters) and the other half by biodiesel (Source: USDA). However, a key challenge will be the cost, availability and the perceived sustainability of the lipid/oleochemical feedstock.

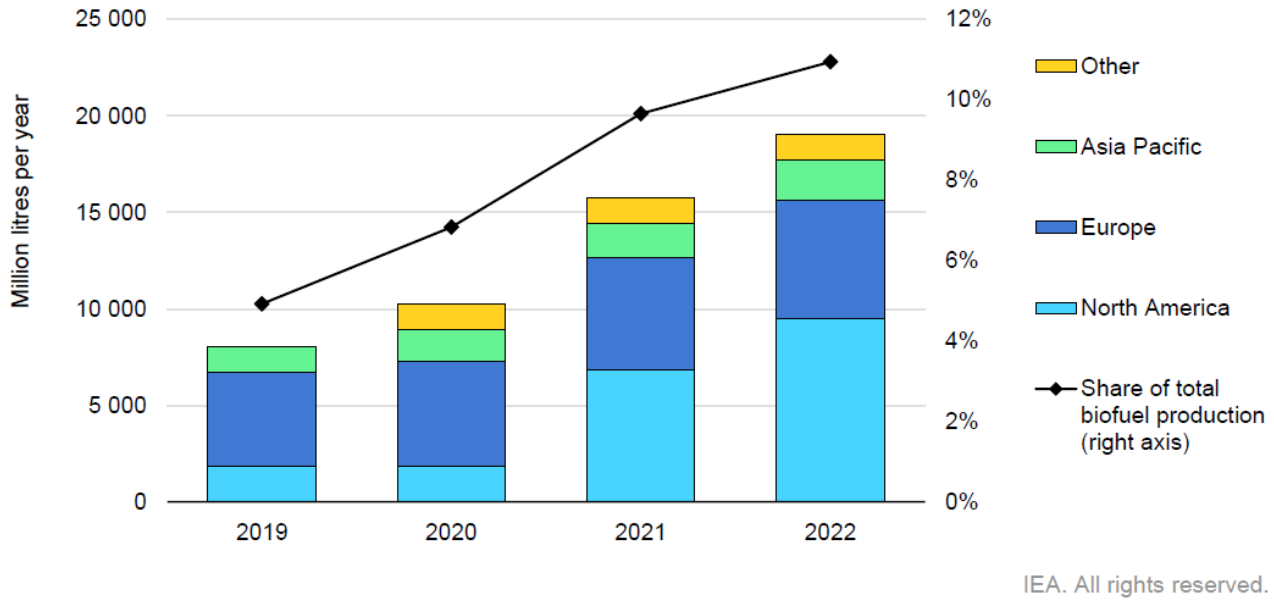



**Figure 5**: Current and projected Renewable Diesel (RD) production capacity, 2019-2022 (Source: IEA 2020)

Canada is fortunate to have access to a variety of feedstocks for bio-based diesel production, including vegetable oils. Canada's total oilseed production in 2018 (Figure 6) was more than 28.5 million tonnes per year, with more than 40% of this amount exported (Source: Statistics Canada).

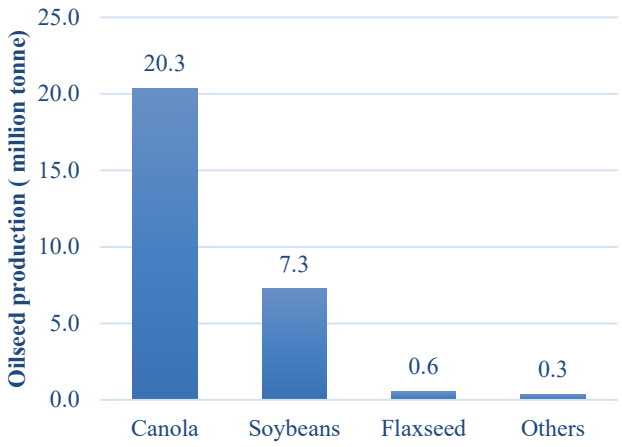



**Figure 6:** Canada's oilseed and vegetable oil production in 2018 (source: Statistics Canada), Others: mustard, canary and sunflower seeds

The Canadian Canola sector plans to produce 26 million tonnes of seed by 2025 (a 30% increase compared to 2018) (Source: www.canolacouncil.org), while the soybean sector hopes to produce 13 million tonnes of soybean production by 2027, which is an 80% increase compared to 2018 (Source: http://soycanada.ca)

As a major global producer of lipid feedstocks, Canada has the potential to become one of the global leaders in biomass-based diesel production and use. With the implementation of the national Clean Fuels Standard (CFS) and effective policies such as BC's Low Carbon Fuels Standard (LCFS), which plans to increase carbon reduction targets, the carbon credit market is expected to expand. This will likely catalyse the production use of low-carbon fuels such as bio/renewable diesels.

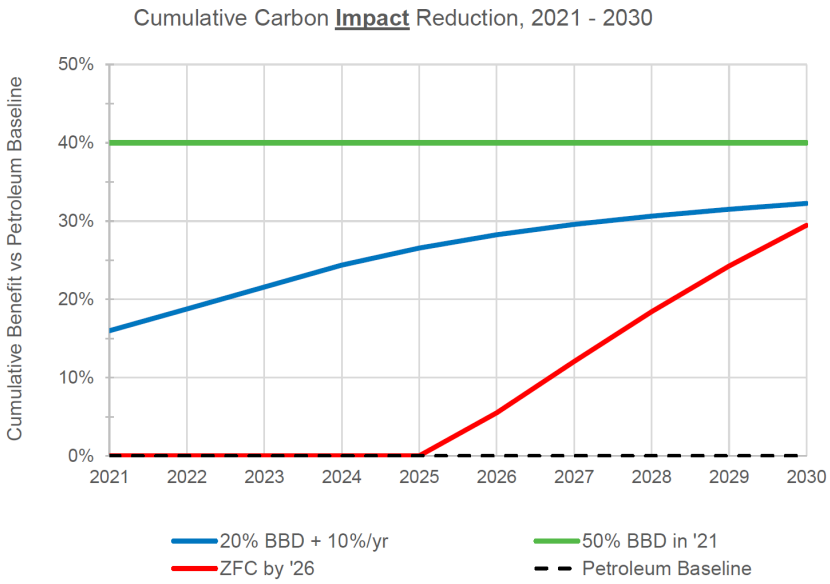
Neville Fernandes, Vice President, Corporate Affairs and Development for Renewable Energy Group, Inc. covered some of these topics in his presentation entitled, *"Bio Based Diesel: Today's Most Impactful Option for GHG Reduction and Sustainable Transportation"*. At the beginning of his presentation, he mentioned the urgency of reducing GHG emissions with people considering this decade to be critical in dealing with climate change mitigation. Targeting clear progress by 2030 in terms of significant annual GHG reduction was highlighted. Don O'Connor, President, $(S\&T)^2$ Consultants Inc. also emphasised that "time is not in our side" and that we should not wait for a perfect solution. This was covered in more detail in his presentation entitled "*Decarbonizing the Trucking Sector*".

To highlight the imminence of the situation, Neville described how the ***"Cumulative Carbon Impact"*** of atmospheric emissions will influence the world for many years to come. Unlike simple annual accounting, the cumulative impact of carbon emissions will have a tremendous real-world effect for many years to come. Neville described how the cumulative carbon impact (CCI) influences the annual fossil carbon values over time (Figure 7).

Neville Fernandes presentation entitled;
**"Bio Based Diesel: The most impactful way to achieve GHG Reduction and Sustainable Transportation today"**

**Main "Takeaways":**

- Waiting for future technologies to deliver a perfect GHG reduction solution is counter productive.
- Although bio/renewable diesel provide excellent solutions today, ongoing support is still needed to maximize usage.
- Bio/renewable diesel are complementary, low-carbon, clean burning, high-performing fuels which can be used synergistically.




Source: Chart assumes 80% fossil carbon reduction for BBD, and 100% reduction for the ZFC

**TAKEAWAYS**

- High BBD can greatly reduce our Cumulative Carbon Impact the most over the next 10 years.

Renewable Energy Group

**Figure 7**: Comparison of Carbon Impacts from the three cases for deploying bio-based diesel (BBD) (Source: Neville's presentation)

**Case 1:** Implementing a zero-fossil carbon option in 2026; for this case, the Cumulative Carbon Impact from 2021 –2030 is 31.67 tons,
**Case 2**: Starting with a modest 20% penetration of BBD (with 80% CI reduction) increasing to 50% penetration by 2025; for this case, the Cumulative Carbon Impact from 2021 –2030 is 30.42 tons,
**Case 3**: Starting with 50% penetration of BBD in 2021; for this case, the Cumulative Carbon Impact from 2021 –2030 is 26.94 tons,

Neville described how using a 20% ratio of renewable diesel, with an 80% CI reduction compared to fossil diesel, could result in 4% less carbon emissions in 2030 than implementing a zero-fossil carbon option in 2026. He strongly recommended taking action now, even if it has not been optimised, as it will result in a better impact compared to deploying a "best/zero emission" solution in 6 years.

These recommendations closely aligned with Don O'Connor's who stated, "We should not wait for the perfect solution".

Don O'Connor's presentation entitled:
**"Decarbonizing the Trucking Sector"**

**Main "Takeaways":**

- It is not just about the technology.
- Time is not on our side.
- We need to stop getting in our own way

Neville also showed how a blend of bio-and-renewable diesel resulted in several operational benefits. These included lower engine emissions, enhanced fuel lubricity (even with a 2% biodiesel blend), close-to-conventional diesel in bulk properties, and the blend works well in both old and new engines. He eloquently showed how renewable and biodiesel are complementary low-carbon, clean burning, high performing fuels that can be used synergistically today.

Evan Dacey, Fleet Strategy and Asset Management, the City of Vancouver, gave a presentation entitled ***"Green Fleet Plan City of Vancouver"***. The City of Vancouver has a goal of reducing its carbon intensity in 2007 by 50% by 2030. This will align the city with the United Nations Intergovernmental Panel on Climate Change (IPCC) recommendations to limit global warming to 1.5°C. Despite the City of Vancouver already achieving a 15% reduction in its GHGs by 2020 (as compared to 2007), the city's Climate Emergency Action Plan indicates that Vancouver's fleet Corporate Emissions need be reduced to 60% below 2007 levels and that, by 2030, 50% of the kilometers driven on Vancouver's roads will be by zero emissions vehicles.

The three main goals of the city's Climate Emergency are, (1) to electrify the city's fleet of vehicles as much as possible (all vehicle replacements first consider an electric option), (2) any fuel that is used must contain a high proportion of renewable/biologically derived content and, (3) all future vehicle use is optimized via technology and driver behaviour.

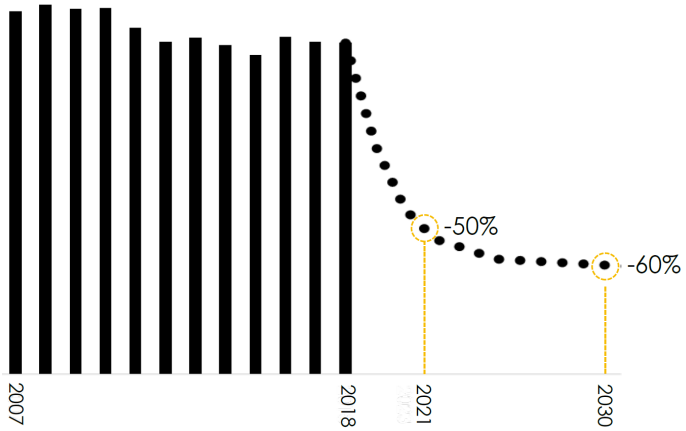



**Figure 8:** Vancouver City's Fleet GHGs –Scope 1 ($CO_2e$) Emissions Projection based on Green Fleet Plan (Source: Evan's presentation)

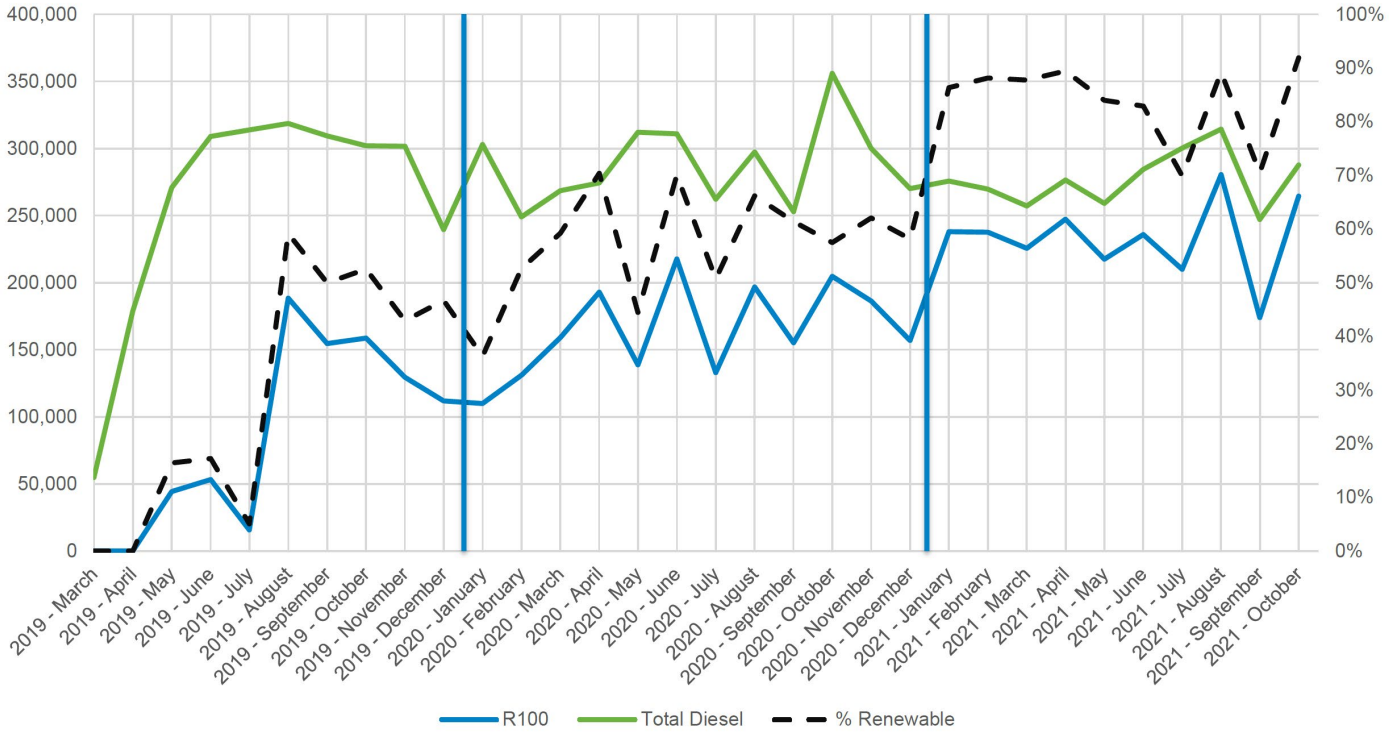



**Figure 9:** Renewable Diesel implementation in City of Vancouver has exceeded more than 90% blend in 2021 (Source: Evan's presentation)

**Although the City of Vancouver identifies increased electrification of its vehicles in the medium-to-long term, the fleet health will need to use low-carbon-intensive, renewable biofuels in the short-term.**

To fulfil this need, the city received its first delivery of biofuels in March 2019, with full integration achieved by June 2019 (Figure 9).

**Evan Dacey** presentation entitled;
**"Green Fleet Plan – City of Vancouver"**

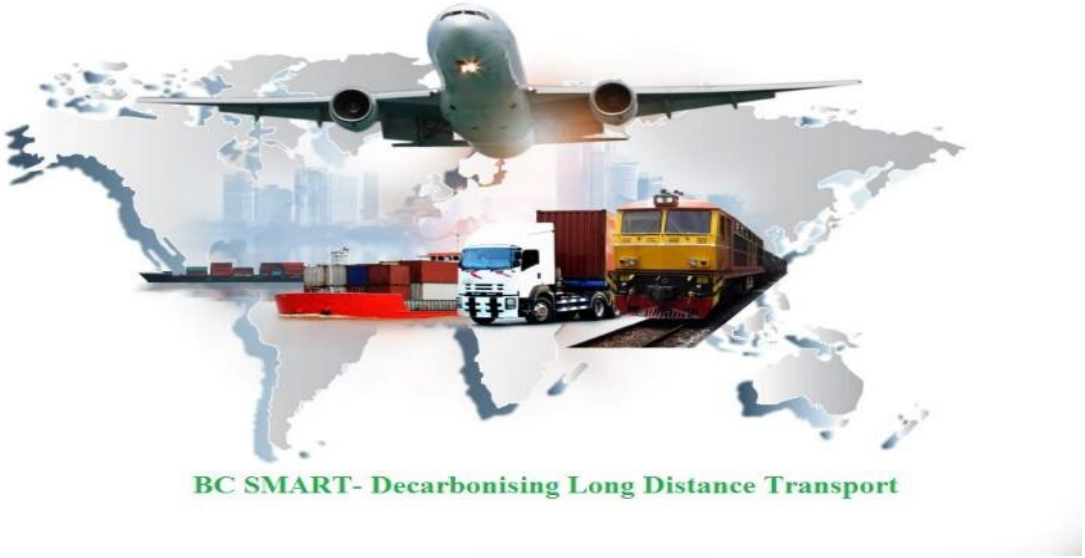
**Main "Takeaways":**
The City of Vancouver's three goals for its transport fleet are embedded in City's Green Operations Plan.

- Increased electrification in the mid-to-long term
- The use of low CI fuels, particularly biofuels, in the short-to-mid term
- Increased decarbonisation of the city's fleet and fleet related operations

**Summary**

Unlike aviation, where low-carbon-intensive (CI) biofuels are the only real alternative fuel for the immediate future, trucking has several low-CI alternatives such a "green" electricity, "green" hydrogen, renewable natural gas (RNG), etc., as well as the use of so-called "transition" fuels such as lower-CI fossil-derived LNG, CNG and propane. However, for the trucking sector, low-CI, bio/renewable diesel are likely to predominate due to their more "drop-in" nature. This includes the use of much of the current infrastructure and the increased growth in lipid co-processing at BC and many of the world's refineries, increasing the availability of low-CI transportation fuels.

As described in the recent BC-SMART webinar, bio-based diesels can provide an immediate solution to the trucking sectors desire to lower the carbon footprint of its MHDV fleets while meeting its GHG emission reduction goals. The panel members described the numerous successful cases where biodiesel blends (4-20%) and renewable diesel blends (50-100%) have been used to displace/supplement diesel in MHDV fleets. The switch from petroleum-based diesel to bio-based diesels has already shown major reductions in GHG emissions and resulted in significant benefits to the quality of ambient air quality and enhanced operation of equipment. Most importantly, it makes good use of the current infrastructure with no new, significant capital expenditures required. This will give time for alternative low-CI solutions, such as "green" electricity, hydrogen etc., to be developed for the world's medium and heavy-duty vehicle (MHDV) fleets.




If you would like to be part of the **"Coalition of the Willing"** and continue to receive our newsletter and occasional updates about BC-SMART consortium, please contact us at:

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