BC-SMART Low Carbon Fuels Consortium

Decarbonising Long-Distance Transport

Newsletter Issue No. 11, January. 2024 BC-SMART "Policies used to facilitate the production and use of low CI biofuels"

From the BC-SMART Secretariat

We hope that this newsletter gets to you in time for some holiday-facilitated, downtime with your loved ones (but still leaves time for some newsletter reading!). It has been an eventful year, with the globe quickly adapting to a post-Covid world where Teams/ZOOM seem to have supplemented phoning, in the way that faxes were soon supplemented by emails/texting/etc.! It was also a record year for climate change, with Canada experiencing record forest fires and British Columbia's (BC's) fires emitting twice as much carbon as the typical Provincial economy.

To get off of our "addiction to oil", policies have played a key role, with the joint use of push-and-pull policies (such as mandates or R&D investments respectively) proving to be very effective. In this issue of the newsletter, we summarise some of the effective policies that have been used in countries (https://task39.ieabioenergy.com/) to help decarbonise their transport sector. There is increasing awareness that, rather than focusing on the percentage-or-the-energy content of biofuels, reducing the carbon intensity (CI) of the fuel should be the major focus of policies that hope to decarbonise the transport sector. Jurisdictions such as California and BC have been in the vanguard of this approach with variations of policies such as the Low Carbon Fuels Standard (LCFS) now being developed by Canada (Renewable Fuels Standard), the US (CARB) and Europe (Renewable Energy Directives (RED)/ Fit-for-55).

However, as indicated in earlier newsletters, determining the CI of a fuels is not easy, with land use one of the major issues bedevilling the values that are reported. Fortunately, Canada and BC are in the forefront of how "sustainability" can be determined, with the country and province having the greatest percentage (compared to other jurisdictions) of third-party certified forests in the world and an agriculture sector who is increasingly focussed on the CI of its crops and operations.

This issue of the BC-SMART newsletter summarises the work that is covered in more detail in the recent, IEA Bioenergy Task 39 Implementation Agenda (Compare-and-Contrast biofuel policies) report. Canada and BC have successfully used policies to grow their ethanol and biodiesel markets. However, if the long-distance transport sector is to successfully decarbonise, it is likely that "enabling" policies such as BC's LCFS will be needed.

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

Hana, Susan and Jack:

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Summary and Overview

The IEA Bioenergy Task 39 countries share a collective vision of reducing the carbon intensity (CI) of their transport sectors as soon as possible. Biofuels and related policies have, and continue to play, a crucial role. The accelerating emphasis on the carbon emissions resulting from the use of fossil fuels for transport has increased the need to for low-CI biofuels. While traditional policies have been predominantly based on the volume or energy content of biofuels, attention to the CI of biofuels, as exemplified by the LCFS, is being increasingly incorporated into the "enabling" policies that are used by various countries to wean their transport sectors off fossil fuels. In particular, the CI of the "drop-in" biofuels used to decarbonise the hard-to-electrify long-distance transport sector, such as aviation and shipping, is a high-profile topic! The international collaboration within IEA Bioenergy Task 39 has provided a forum to evaluate and contrast the biofuel policies that have been used to facilitate the decarbonization of the long-distance transport sector.

As way of background, in 2021, the transport sector consumed a third of the world's energy with the vast majority of the fuels derived from fossil sources. Despite renewable energy's small share, biofuels have proven to be an integral component of each country's decarbonization strategy, especially for road transport. Although increasing (green) electrification of road vehicles is expected to play a significant role in decarbonising this component of the transport sector, electrifying the long-distance and heavy-duty sectors will be problematic. With groups such as the International Civil Aviation Organization (ICAO) and the International Maritime Organisation (IMO) coordinating the decarbonisation efforts of the aviation and marine sectors respectively, airlines, airports, sea ports, shipping companies, etc., are all working towards meeting 2030/2050 decarbonization targets. However, in all cases, "enabling" policies, particularly those emphasizing the CI reduction potential of biofuels have proven crucial.

For example, as well as the US's IRA and the EU's Fit-for-55 package, Canada's Clean Fuels Regulation (CFR) and BC's LCFS have, and will play a significant role in facilitating the decarbonizing transport through the use of low-CI fuels.

Biofuels Market Development

The production and use of biofuels have grown, and in 2022, two million barrels of oil equivalent per day (mboe/d) were replaced by biofuels, equivalent to about 4% of global transport sector oil demand. Over the last couple of decades several biofuel pathways have been fully commercialised such as ethanol from corn and sugarcane, lipid derived bio/renewable diesel as well as biojet/Sustainable Aviation Fuel (SAF). To

date, the countries that have made most of the world's biofuels are the US (38%), Brazil (21%) and China (3.5%) (Figure 1). Although the Europe accounted for approximately 7% of the global biofuel market, biodiesel was the major biofuel (20 billion liters (BL)) used in 2020 rather than ethanol. At a global level, biofuel production is projected to increase by 6%, or 5.7 BL, from 2022 to 2024, primarily driven by the US and EU demand.

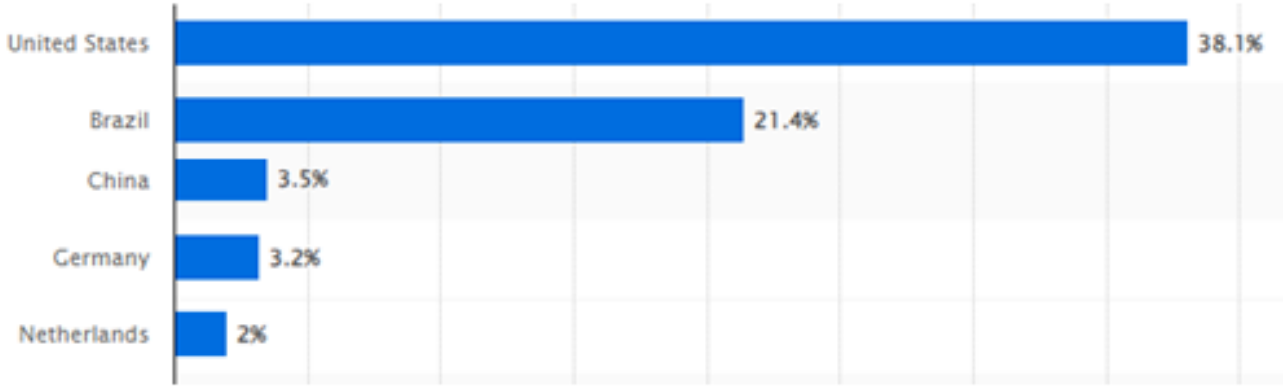

Figure 1. Global shares of the leading biofuel producers

In 2022, the US produced 15 billion gallons (BG) of ethanol, 1.6 BG of biodiesel, 1.6 BG of renewable diesel and 60 million gallons (MG) of SAF. It should be noted that the growth in renewable diesel production was primarily due to the establishment of "stand-alone" refineries in response to policies such as California's LCFS. By 2025, ongoing demand for drop-in, renewable diesel, will consequently increase US crushing capacity demand (to extract oil from soybeans) by 40%. In contrast, although Brazil currently has 359 ethanol facilities and 53 biodiesel plants, it has only recently entered the renewable diesel market. Over in Europe, although the EU produced 20 BL of biofuels in 2020, over 40% of the biodiesel that was used was imported from other countries. While China produced 3.8 BL of ethanol in 2022, it also increased biodiesel and renewable diesel production to 2.6 and 2.3 BL per year respectively. Although still proving to be somewhat problematic, cellulosic ethanol projects in India and Brazil show promise, with national goals of significantly increasing ethanol production in each of these countries. In a parallel approach, some oil companies are co-processing lower CI lipids feedstocks with policies such as California and BC's LCFS enhancing the attractiveness of this approach. Overall, groups such as the IEA predict that biofuel demand will grow by 11% in 2024, driven by both low CI policy and energy security goals. However, despite this ongoing activity, it will likely prove challenging to meet IEA's 2030 Net Zero Emissions (NZE) targets (Figure 2)!

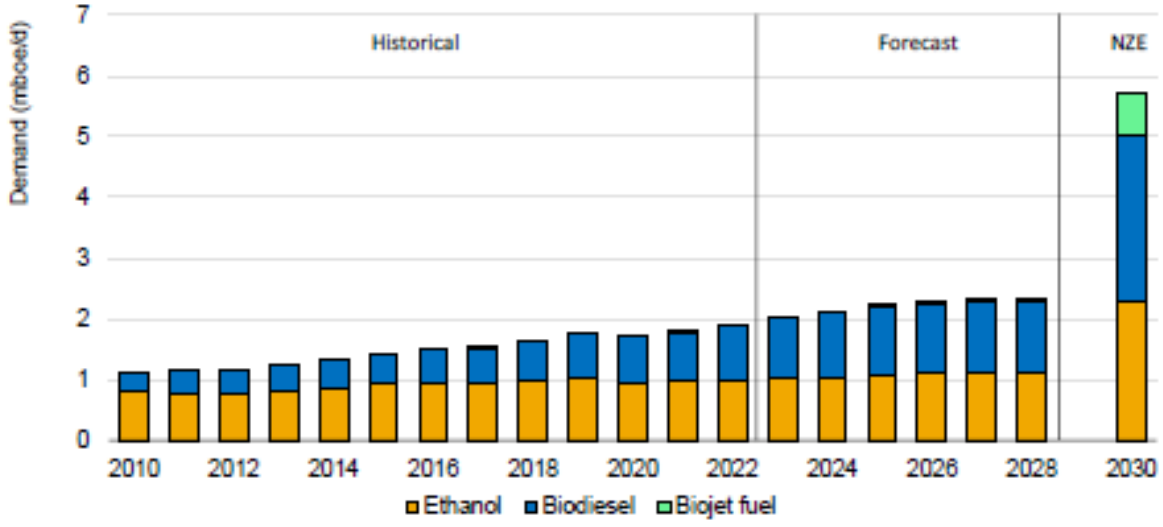

Figure 2. Biofuel production by fuel: historical and forecast (in the net zero by 2050 scenario)

Current and potential Biofuel Feedstocks

It is worth noting that concerns about sustainability and potential food-vs-fuel conflicts continue to impact the production and use of biofuels. While much of the world's bio/renewable diesel and biojet fuels are currently made from "waste/low CI feedstocks" such as fats, oils, and greases (FOGs), their limited supply has catalysed the use of alternative, higher CI lipid feedstocks such as vegetable oils. Although energy security had been the main driver for the development of bioethanol, with approximately 60% of the world's ethanol derived from corn, 25% from sugarcane and the rest from other sources such as wheat and molasses, the increasing focus on CI has encouraged the assessment of "green" electricity, carbon capture and storage/use (CCS/U) of the CO2 released during fermentation in the production of ethanol. Although about 75% of the world's biodiesel is derived from vegetable oils (20% rapeseed oil, 25% soybean oil, and 30% palm oil) the lower CI of "wastes" such used cooking oil (UCO), has increased their price and encouraged their collection (now 20% of the lipid feedstock that is used!). In the EU, renewable diesel is mainly made from UCO and other waste-based lipids with this feedstock representing about one-quarter of the bio/renewable diesel used in Europe. Despite their higher CI, rapeseed oil is a significant biodiesel feedstock (38%) while bioethanol is primarily produced from sugar beets (38%), maize (36%), and wheat (14%).

As mentioned earlier, the limited global supply of lipids has led to increasing competition between the bio/renewable diesel and SAF biofuels. Consequently, to meet rising demand, there is growing interest in alternative, low-CI feedstocks such as biomass-derived biocrudes, or novel SAF production routes such as Alcohol-To-Jet (ATJ), Gasification/Fischer-Tropsch (FT) and Power-to-Liquids (PtL). While lipid-based SAF is expected to continue to grow, there is a need for additional approaches that will use more abundant, lower CI/cost and sustainable feedstocks such as biomass-derived biocrudes or low-CI alcohols.

"Enabling" biofuel policies are needed to bridge the price-gap

As covered in this issue of the BC-SMART newsletter, government policies have-and-will play a critical role in facilitating the decarbonization of the transportation sector. Most of the IEA Bioenergy Task 39 member countries, such as Brazil, Japan, New Zealand, Canada and the US, have committed to achieving Net-Zero Emissions (NZE) by 2050, while China plans to achieve NZE by 2060. Germany and Austria also hope to achieve NZE by 2045 and 2040, respectively, by employing a combination of market-pull and technology-push policies. Reports by IEA Bioenergy Task 39 have shown that, typically, early-stage development is facilitated by technology-push policies, while market-pull policies foster demand for established biofuels such as ethanol and biodiesel.

However, during the last few years, the US, primarily because of federal and state policies such as the LCFS, RFS, IRA and regional LCFSs, has emerged as an attractive destination for biofuel investments and exports. The US IRA, with phased fuel credits for biofuels such as biojet/SAF, has aligned its polices with international standards which promote a minimum 50% CI reduction. One attraction of "enabling" policies such as the US's RFS, IRA, and CA-LCFS is their technology-agnostic approach, which primarily focusses on CI reduction, consequently fostering biofuel production.

In a similar vein, the EU's Fit-for-55 initiative has targeted a 55% reduction in greenhouse gas (GHG) emissions by 2030, employing various directives such as RED, ReFuel Aviation and FuelEU Maritime. Brazil, via its RenovaBio policy, plans to achieve substantial GHG reductions by incentivizing its biofuel industries through CBIOs certificates. Canada's CFR and BC-LCFS have enhanced emissions reductions by encouraging oil refineries to co-process biogenic feedstocks. British Columbia plans to reduce its GHG emissions by 40-45% by 2030 (compared to 2005 levels) and net zero by 2050. At the national level, the Canadian NZE Accountability Act has a goal of a 26 Mt CO2-eq GHG emission reductions by 2030.

Elsewhere, China plans to promote ethanol production and use with the *Action Plan for Carbon Dioxide Peaking Before 2030* advocating the use of advanced biofuels and SAF to achieve this goal. The *Green-development Plan for Civil Aviation in China* also has a goal of producing significant amounts of SAF by 2025. As covered in its most recent report (https://task39.ieabioenergy.com/), the commonality of all of the IEA Bioenergy Task 39 policies is to decarbonise transportation.

Biofuel Volumetric Blending Mandates

Several IEA Bioenergy Task 39 countries have successfully implemented biofuel blending mandates that require a specific percentage of biofuels be added to "conventional" fossil fuels (Figure 3). These mandates, as used in Brazil, Canada and the US, have a goal of boosting biofuel production, establishing markets while addressing oil price fluctuations. Recent increases in Brazil's ethanol and biodiesel blending mandates to E27 and B12, respectively, highlight ongoing efforts. Although several Provinces exceed the Canadian federal mandates of E5 and B2, EU countries can opt for GHG reduction or renewable usage targets (RED) while other countries, such as China and Japan, are currently assessing E10 and biodiesel.

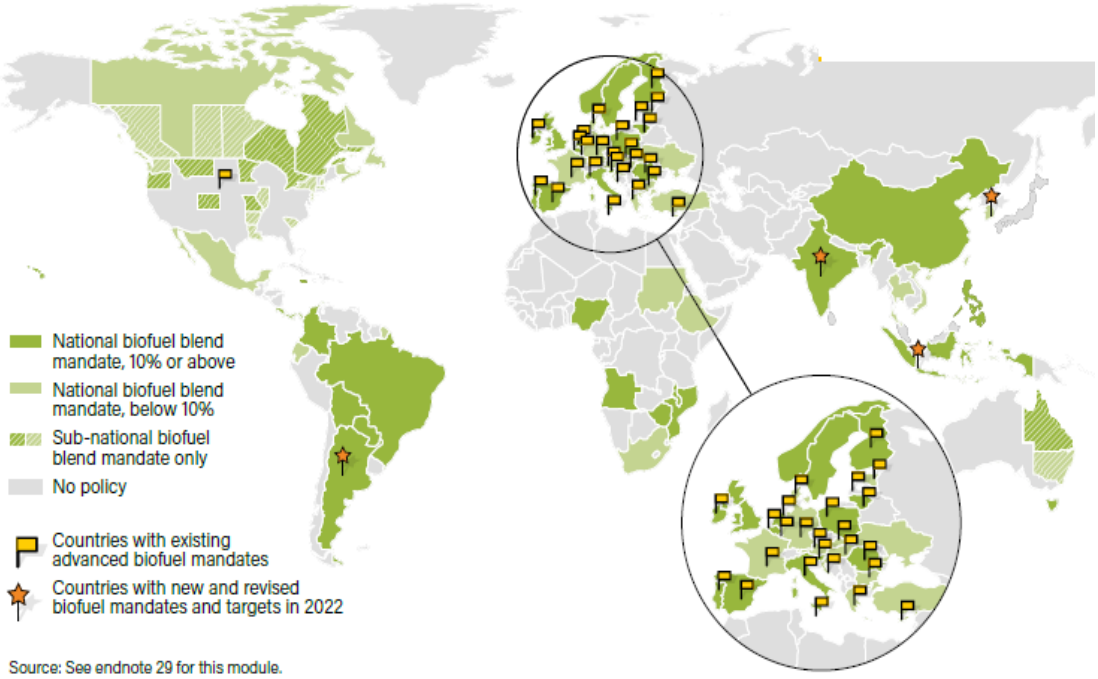

Figure 3. National and sub-national renewable biofuel mandates and targets, as of end-2022 (REN21, 2023)

Polices need to incorporate Carbon Reduction Targets within their criteria

While some of the IEA Bioenergy Task 39 countries such as the US, Canada and Brazil have integrated CI reduction targets within their biofuel policies, CI reduction targets have yet to been incorporated into some other countries policies. However, within the EU, member states can choose between a 14.5% GHG reduction using renewables or achieving 29% renewables in final transportation (RED II). In Canada, the CFR has a goal of gradually reduce CI, starting at 3.5 g CO2eq/MJ in 2023, reaching 14 gCO2eq/MJ in 2030, while the BC-LCFS targets a 30% CI reduction by 2030. In the US, the RFS has established minimum CI reductions for various biofuels while in California the CA-LCFS has targeted a 20% CI reduction by 2030 (Figure 4). Similarly, Oregon has targeted a 20% reduction by 2030 and 37% by 2035, while Washington State has targeted a 20% reduction by 2034. At a national level, the federal US IRA requires a minimum 50% CI reduction for eligible SAF mixtures.

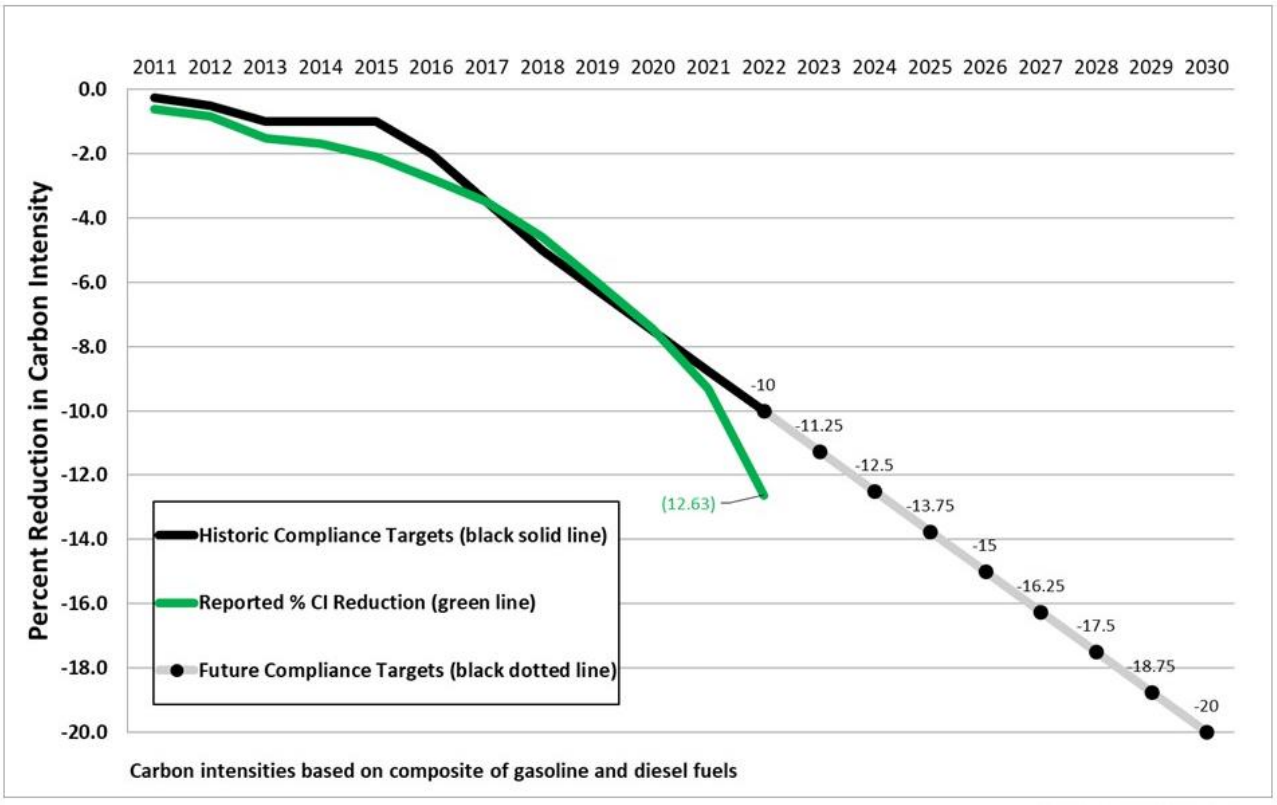

Figure 4. Performance of the CA-LCFS (2011-2022) (CARB[1], 2023)

For the aviation sector, the BC-LCFS published target CIs in November 2023. However, these values are used more for illustrative purposes and, for the moment, will not be prescribed in the new regulations. In the future, suppliers of low carbon alternatives to jet fuel can generate credits for supplying low carbon fuels in the jet fuel category. Starting in 2026, suppliers of fossil-derived jet fuel will incur debits calculated according to the quantity of fossil-derived jet fuel supplied and its CI relative to the annual target CI (BC-LCFS, 2023).

[1] https://ww2.arb.ca.gov/resources/documents/lcfs-data-dashboard

Tax incentives and credits

Tax incentives have played a crucial role in promoting biofuels, with countries such as the US, Brazil, Canada and Japan offering various tax incentives. For example, Brazil's RENOVABIO program encourages biodiesel through tax exemptions, Canada provides preferential tax treatment for low-carbon fuels and Japan grants bioethanol exemptions from gasoline tax. In contrast, Germany uses a CO2 emission tax, Austria exempts any biofuels used in blends from taxes while the Netherlands uses a credit trading system. In China, the tax on bioethanol and biodiesel is reduced by 90% while, although New Zealand exempts bioethanol from taxes, other biofuels such as biodiesel are still taxed.

It should be noted that policies such as the LCFS seem to be working as, in California, the volume of low carbon fuels used over the last 10 years (2011-2022) has doubled (Figure 5). Although ethanol makes up the largest amount of alternative fuel on a volume and energy basis, in 2020, about 85% of the LCFS credits were generated by non-ethanol fuels (with lower CIs), such as bio/renewable diesel. In the US, initiatives such as the IRA and SAF Grand Challenge fund research and infrastructure for clean energy. California offers credits based on the CI of SAF, while Canada supports low-carbon alternatives via the Net-Zero Accelerator. Other countries such as Brazil have programs such as Fundo Clima and RenovaBio. In contrast, Germany is more focused on developing advanced biofuels while Austria is supporting the development of sustainable, non-food, fuel feedstocks.

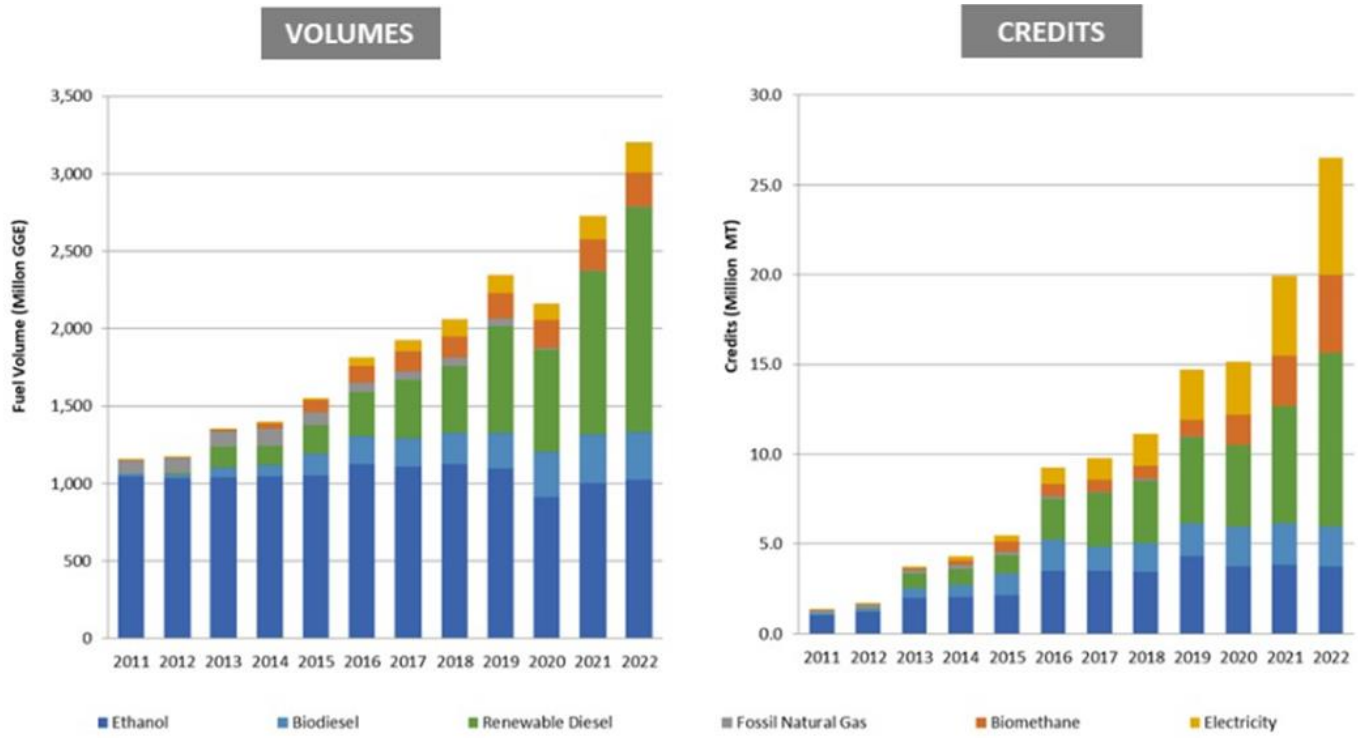

Figure 5. California's alternative fuel volumes and credits under the CA-LCFS (2011-2022) (CARB, 2023)

Conclusions

The international cooperation provided by IEA Bioenergy Task 39 has provided a very informative *compare-and-contrast* of successful policies and highlights the need for ongoing cooperation, particularly for the long-distance transport sector.

Despite the continuing significance of market-pull and technology-push policies, there is increasing use of technology-agnostic, CI reduction-focused policies as the main way to decarbonise the transport sector. As summarised in this and previous newsletters, British Columbia's LCFS has played a significant role in reducing the provinces carbon emissions with policies such as the federal CFR becoming increasingly influential.

However, as touched-on in the last BC-SMART newsletter (focussed on SAF/Biojet fuels) the assumptions with the Life Cycle Analysis (LCA) models used to determine the CI of a fuel can heavily influence the values that are reported. As mentioned before, the "devil-is-in-the-details"!

To date BC has used the GHGenius model while at a federal level, ECCC has developed an "open-source" LCA model which will be tied to policies such as the CFR. At an international level, CORSIA (Carbon Offsetting and Reduction Scheme for International Aviation) has developed a specialized international framework that should be used to calculate the CI of SAF/biojet. However, many US suppliers would rather use GREET than the CORSIA model!

Regardless, as summarised in this newsletter and as covered in venues such as the COP28 meeting in Dubai, effective polices will be needed if we are to decarbonise our long-distance transport.

We wish you-and-yours all the best for this festive season!

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:

The BC-SMART secretariat (www.BC-SMART.ca)

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