COME CLEAN - LOW CARBON FUEL POLICIES AND HOW THEY'RE CHANGING THE TRANSPORTATION SECTOR

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As part of the Paris Agreement and other regional sustainability goals, countries across the globe are formulating strategies to reduce greenhouse gas emissions. The resultant policies target numerous different areas such as stationary emissions, electricity production, and transportation fuel sourcing. Within the transportation sector, one aspect that has spurred quite a bit of investment relates to reducing the carbon intensity of transportation fuels. The "low carbon fuel" policies that are in place today, coupled with those that are being evaluated for the future, have the potential to displace a sizeable portion of the petroleum-based fuels in the regions where they are adopted. In today's blog, we begin a series on low carbon fuel policies, the mechanisms being evaluated to meet increasingly stringent regulations, and the impact these regulations could have on refined-products markets.

Given the global focus on reducing emissions of carbon dioxide (CO_2) and other greenhouse gases (GHGs), it's only natural that folks in the business of producing, transporting, processing, and refining hydrocarbons need to stay abreast of what's going on. We've been helping out in that regard by writing a number of blogs on GHG-related topics, including series on ESG and hydrogen. There's so much more to discuss, though, especially on the increasing number of laws and regulations being implemented in the U.S., Canada, and elsewhere that are aimed at decarbonizing the transportation sector. With that in mind, we thought it would make sense to undertake a blog series that delves into these efforts in detail — after all, they already are changing how refiners do business and will have only greater effects going forward.

Today, we'll start with an overview of different regulatory mechanisms that have been adopted and are being discussed to reduce GHG emissions from on-road transportation fuel use. As we noted in the introduction, GHG emission-reduction policies can cover a broad list of targets – everything from electricity production; home heating; stationary emissions from industrial facilities, buildings, and landfills; and fuel usage in the transportation sector. In this series, our focus is on-road transportation fuels — i.e., the gasoline and diesel you put in your cars and trucks — and especially on one aspect of these fuels: their Carbon Intensity (CI) value. (More on CI in a moment.)

From a regulatory perspective, the goal of reducing GHG emissions from the consumption of on-road transportation fuels can be addressed in a number of different ways. Here are some of the more popular approaches — note that this is not an exhaustive list nor are the methods mutually exclusive:

- **Fuel Economy Standards:** With tighter fuel standards, manufacturers are required to increase the efficiency of their vehicles, which results in lower fuel usage per distance traveled. In the U.S., for example, Corporate Average Fuel Economy (CAFE) regulations mandate certain levels of fleetwide fuel economy based on the category of vehicle (i.e. light-duty vehicles, heavy-duty vehicles, etc.). These rules may not have been initially implemented with GHG emissions as the primary target, depending on the regional policy, but ultimately they lower demand for transportation fuels, which has the effect of lowering GHG emissions too.
- **Renewable Blending Requirements:** Some governments require that certain proportions of

transportation fuels come from renewable sources, such as ethanol and biodiesel. Key to the efficacy of these policies in reducing the sector's overall emissions is that the renewable fuels are produced from sources with lower lifecycle GHG emissions. Similar to fuel economy standards, renewable blending policies in place today in various regions around the world may not have been initially instituted with the main aim of reduced GHG emissions. However, if the petroleum-based fuel is being displaced with a lower lifecycle GHG alternative fuel, then the result would be reduced GHG emissions per gallon of fuel consumed. In the U.S., for example, the Renewable Fuel Standard, which was authorized under the U.S.'s Energy Policy Act of 2005 and expanded under the Energy Independence and Security Act of 2007, mandates a certain volume of alternative fuels be consumed in the U.S. transportation sector each year.

- **Zero Emission Vehicle Mandates:** These types of efforts, which typically require that a certain proportion of the vehicles sold be fully or partly powered by electricity, are becoming increasingly popular across the globe, including in the U.S., the European Union (EU), and China. The primary goal of these policies is to reduce air pollutant and GHG emissions in that they call for gradually replacing fossil-fuel-fired transportation with batteries or fuel cells. Due to infrastructure requirements for increased power production and vehicle charging, coupled with the long amount of time it takes for the vehicle fleet to turn over, these types of policies are very long-term in nature.
- **Low Carbon Fuel Standards or Clean Fuels Policies:** These policies, which will be the focus of a lot of the discussion in this blog series, are relatively new but their use is spreading. GHG emission reduction is the core goal of low carbon programs — in fact, they generally are based on the carbon intensity (CI) of various fuels, and on shifting to lower-carbon fuels over time. We should note that these policies have many names. One of the earliest and best-known is California's Low Carbon Fuel Standard (LCFS); some others are called Clean Fuels Programs or Clean Fuels Standards. These programs often incorporate some sort of credit program with a carbon price policy.

For ease of discussion, we'll refer to all low carbon fuel standards policies as *LCFS* policies through the rest of this series. So how do these types of policies work? Well, there is not a common framework across all the different policies so far, but there is generally a common goal of a specified percentage reduction in GHG emissions from on-road transportation fuel use over a period of time. For example, in the states of California and Oregon and the Canadian province of British Columbia, the LCFS policies establish downward-sloping CI benchmarks for the jurisdiction's total fuel pool, and incentivize the provision of fuels with CIs lower than the benchmarks. Other jurisdictions may just stipulate that renewable fuels blended into the traditional pool must demonstrate that the new source meets a certain percentage reduction in GHG emissions versus their petroleum-based alternative.

A real-life example would help, so we'll discuss California's LCFS and that program's strategy for a gradual reduction in the CI intensity of the state's diesel fuel pool. First, we should briefly explain what a CI value is and how it is calculated. CI is a measure of the GHG emissions associated with producing, distributing, and consuming a fuel, which is measured in grams of carbon dioxide equivalent per megajoule (gCO_2e/MJ). The CI of fuels varies by feedstock type, origin, processing efficiencies, and transportation to market and can even include land-use charges, depending on the calculation method utilized. This means that each individual producer of alternative fuels can have a unique CI value associated with its fuel. On top of that, the CI value can vary depending on where the fuel is being

consumed (such as California vs. Oregon) for the same fuel from the same producer, due to transportation differences or differences in the CI model structure. This stuff can get complicated quickly.

As we noted earlier, California's program and some others incentivize reductions in the carbon intensity of transportation fuels over time. They do this by establishing gradually declining allowable CIs for diesel (sloping black line in **Figure 1**) and other transportation fuels, and by giving credits for the production and use of alternative fuels such as renewable diesel (RD) and biodiesel with CIs lower than that (colored lines below sloping black line) and deficits to petroleum-based ultra-low sulfur diesel (ULSD), which according to the state has a CI value of 100.45 gCO_2e/MJ (red line at top of Figure 1). An interesting aspect of this program is that it focuses on the CI value of an individual unit of fuel, which ignores the volume of the fuel consumed. Therefore, the GHG emission-reduction goal can't be met through demand declines and the region is not forced to blend a certain volume of particular types of alternative fuels. According to the LCFS policy requirements, diesel consumed in California in 2021 must meet a maximum CI value of 91.66 gCO_2e/MJ. Therefore, the CI value must be lowered by almost 9% from petroleum-based diesel, which can be achieved through blending in alternative fuels into diesel (or alternative technologies such as electric) or through credits, which can be generated and banked in other years or generated through blending other alternative fuels into other transportation fuels, such as gasoline or jet fuel.

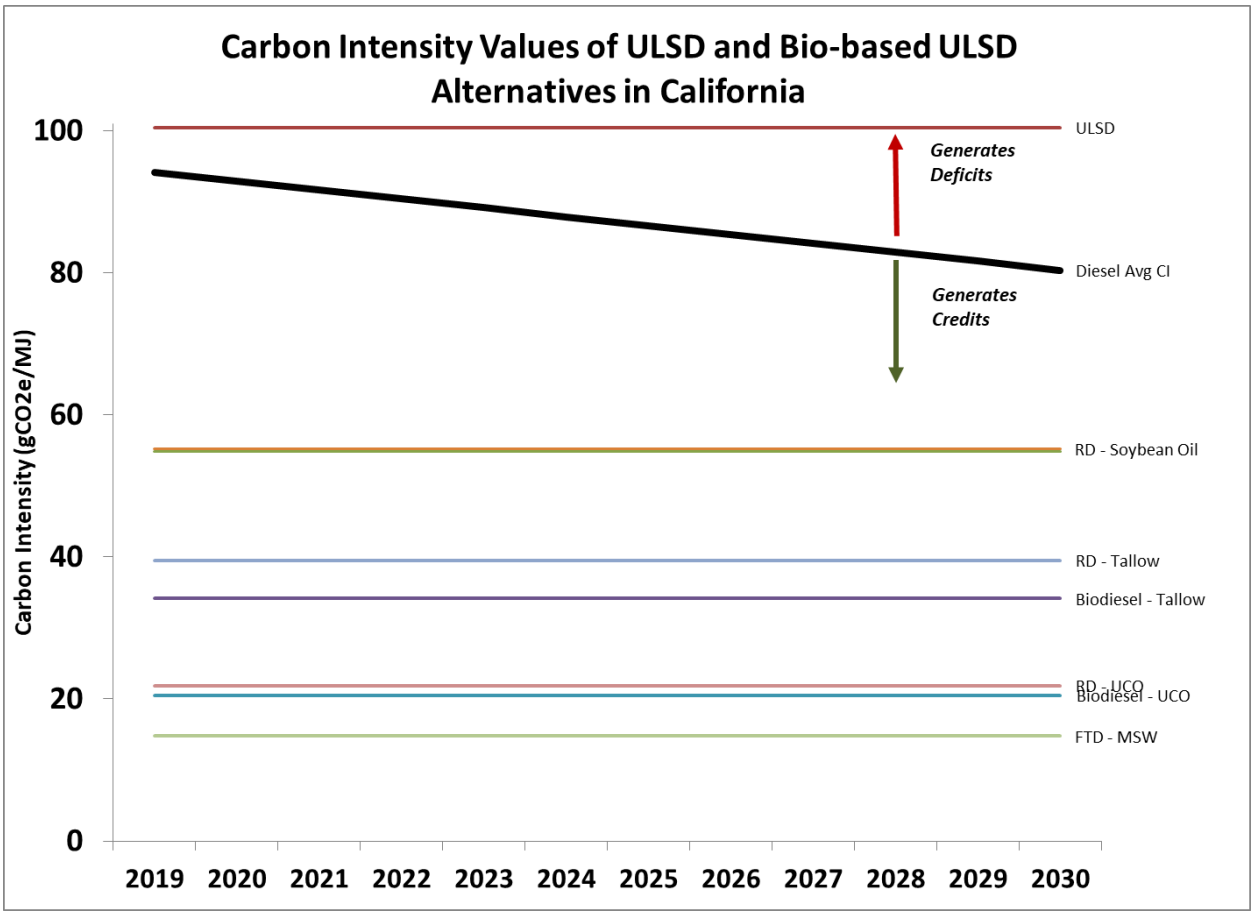

Figure 1. Carbon Intensity Example: California and Diesel. Source: Baker and O'Brien

Here's an explanation of how that works. Any diesel fuel with a CI higher than the sloping black line in **Figure 1** — that is, pure ULSD or a blend with diesel (which has only a slightly lower-CI than ULSD) generates deficits, while any diesel fuel with a CI lower than the sloping line generates credits — these would include renewable diesel, biodiesel, and Fischer Tropsch Diesel (FTD) derived from municipal solid waste. Remember the CI value varies for different feedstocks, so different bio-based diesels have different CI values depending on their feedstock source and how they are produced. The CI values for the alternative fuels shown on the graph represent the average CI values from authorized sources under California's program.

We should note that blended diesel fuel does not have to exactly match the CI level in the sloping line in order to be sold. In fact, currently in California, bio-based diesel fuels are blended at a much higher rate than required, which generates credits that are used to either cover the deficits from the gasoline side of a fuel supplier's business or to bank for future use.

We'll dive even deeper into how these programs work — and what they mean for refiners of petroleum-based and alternative transportation fuels — in upcoming episodes of this series. We'll spend the rest of today's blog on a brief review of the major existing and proposed LCFS programs in the U.S., Canada, and overseas.

- **California's Low Carbon Fuel Standard (Adopted):** In January 2007, then Governor Arnold Schwarzenegger issued an executive order requiring the California Air Resources Board (CARB) to enact a low carbon fuel standard. After discussions, proposals, and public comments, the regulation was approved in 2009 with the goal to reduce the CI of transportation fuel (gasoline and diesel) used in California by at least 10% by 2020 from a 2010 baseline. The regulation was amended in 2011 and again in 2018, with the current goal of reducing the CI of transportation fuels by at least 20% by 2030. As we said above, participants in the fuel value chain are incentivized by credit-generating opportunities, which include blending lower CI fuels (Fuel Pathway Crediting), emissions reducing projects (Project Crediting), and zero emission vehicle infrastructure crediting (Capacity Crediting). California is part of the Pacific Coast Collaborative with Oregon, Washington state, and British Columbia, which is a regional agreement to strategically align policies to reduce GHG emissions and promote clean energy. (We will cover California's LCFS regulation in more detail in the next article in the series.)
- **Oregon Clean Fuels Program (Adopted):** The Oregon Clean Fuels Program was launched in 2016 with the goal to reduce the carbon footprint associated with transportation fuel use in Oregon by 10% by 2025 compared to 2015 levels. In 2020, Governor Kate Brown issued an executive order calling for the state to reduce its GHG emissions to at least 45% below 1990 levels by 2035 and at least 80% below 1990 levels by 2050. Similar to the California LCFS, the program gradually reduces the CI of the gasoline and diesel fuel consumed in the state each year in order to meet the mandated reduction.
- **British Columbia Renewable and Low Carbon Fuel Requirements Act (Adopted):** The BC-LCFS program was adopted in 2007 with the goal of reducing the CI of transportation fuels consumed in the province by 10% by 2020 from 2013 levels. In 2020, the provincial government finalized plans to require a 20% reduction in CI by 2030.
- **Washington State (Proposed):** The Washington state legislature is currently considering HB 1091, which would establish an LCFS program in Washington. The bill has already passed

through the state's lower house and is currently in committee in the state senate. The current version of the bill requires a 10% reduction in GHG emissions from 2017 levels by 2028 and a 20% reduction by 2035. If passed, the program is slated to commence no later than January 1, 2023.

- **Transportation and Climate Initiative (Proposed):** The TCI is a regional proposal that covers 12 Northeast and Mid-Atlantic states, including Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, and Virginia, as well as Washington D.C. The policy is still in the development phase, which is being facilitated by the Georgetown Climate Center. A Draft Model Rule was released on March 1, 2021, which proposes cutting GHG emissions from motor vehicles in the region by 26% from 2022 to 2032. The exact mechanism that will be utilized, such as CI targets or other methods, is unknown at this point.
- **Colorado (Proposed):** In 2020, Colorado completed a LCFS feasibility study within its Greenhouse Gas Pollution Reduction Roadmap. Overall, the state is aiming to reduce GHG emissions by 26% by 2025 and 50% by 2030 compared to 2005 levels from a variety of sectors, including transportation, electricity, oil and gas production, and commercial buildings. However, the study did not recommend the implementation of a Clean Fuels Standard as a near-term agenda item.
- **Midwest Clean Fuel Policy Initiative (In Discussion):** A clean fuels policy has been proposed by the Great Plains Institute following a 20-month long study and review with potential stakeholders, primarily parties engaged in the biofuel production value chain.
- **New York LCFS (Proposed):** In February 2019, New York legislators proposed Assembly Bill 5262, which would create a LCFS in the state. The goal of the plan is to reduce the CI of on-road transportation fuels by 20% by 2030. At this point, the bill has not been approved.
- **Nevada LCFS (In Discussion):** In December 2020, a Climate Initiative study in Nevada recommended implementation of an LCFS program with a 20% reduction of CI of transportation by 2030. At this point, an official bill has not been proposed to further the development of the recommendation.

The U.S. does not have a federal low carbon fuel standard (LCFS) policy in place. However, at the national level we do have the Renewable Fuel Standard (RFS), which mandates a renewable volume obligation (RVO) that must be met every year. As of today, the 2021 RVO has not been released by the EPA. The 2020 RVO was 11.56% of all gasoline and diesel consumed in the U.S. While the RFS structure is different from the LCFS policy structures that have become popular recently, it does generate a sizable displacement of petroleum-based gasoline and diesel fuel consumed in the U.S. with a biofuel alternative.

Up north, the federal government of Canada plans to publish the final regulations for its new Canada Clean Fuel Standard (CFS) in late 2021. The rules, which are scheduled to go into effect on December 1, 2022, will require suppliers of liquid fuel (gasoline, diesel, home heating oil) to reduce the CI of the fuels they produce and sell for use in Canada by 12 gCO_2e/MJ, or approximately 13%, from 2016 levels by 2030.

As for what's happening overseas, Brazil's National Council for Energy Policy Resolution #15 was approved in June 2019 and launched as the RenovaBio program in December 2019. The program

utilizes CI-reduction targets for transportation fuels and is expected to reduce the CI by 10.2% by 2029 versus the 2018 base year.

In Europe, the EU first proposed an LCFS-type policy — the EU Renewable Energy Directive — in early 2007 with the goal to reduce the full lifecycle emissions of transportation fuels by 10% between 2011 and 2020. Further, the enacted 2009 EU directive requires that 10% of transport fuels should come from renewable energy by 2020. The EU later updated this directive to strengthen the sustainability criteria for biofuels and set a new goal for 2030, increasing the target share of renewable energy used in transport to 14%. Member states within the EU each set national policies to reach the overall EU targets for renewable energy supply in the transport sector. To date, there are a broad range of outcomes. For example, in Sweden, renewable fuels make up over a 30% share of transportation fuels, while in Poland renewable fuels account for only a 4% share of the total.

Finally, in June 2008, the UK enacted the Renewable Transport Fuel Obligation (RTFO), which is one of the UK government's policies for reducing GHG emissions from road transport. The policy was amended to incorporate EU bio-fuels sustainability criteria and obligates suppliers to supply 10.1% biofuel by 2021 and 12.4% biofuel by 2032, purchase the equivalent Renewable Transport Fuel Certificates, or pay 30 pence per liter to buy out their obligation.

Other policies are being discussed in places such as China, that could impact the long-term demand trends of petroleum-based transportation fuel use. Additionally, other voluntary programs are being discussed, such as the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) which implements a carbon trading scheme and aims to reduce the CO_2 emissions from international aviation.

Now that we've framed out an introduction to the world of Low Carbon Fuels policies from a high level, in the next blog of this series we'll take a closer look at the California Low Carbon Fuel Standard in a case study. Later in the series, we'll cover special topics on the various pathways (think ethanol, renewable diesel, sustainable aviation fuel, etc.).

Note: The article was authored by Amy Kalt of Baker & O'Brien and published on RBN Energy's Daily Energy Post on March 28, 2021.

"Come Clean" was written by Kara DioGuardi and John Shanks and in January 2004 was the second single released from Hilary Duff's second studio album, Metamorphosis. Produced by John Shanks, the song peaked at #35 on the Billboard Hot 100 Singles chart in the U.S., but broke into the Top 20 in the UK and Australia.