BOSTON CONSULTING GROUP

PSCAA Clean Fuel Standard

Comments on outlined ICF compliance scenarios

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Table of contents

Ethanol Supply

The ICF compliance scenarios – with scenario C and scenario D most analogous to the draft rule presented by PSCAA – present up to a 32% increase in ethanol consumption in the Puget Sound region between 2020 and 2030 while simultaneously decreasing average CI between 10% and 20%. Meeting such compliance scenarios requires both overcoming challenges in gasoline logistics and infrastructure and securing supply of lower CI ethanol.

Retail Challenges

With the exception of scenario B, each ICF scenario forecasts the adoption of E15, a shift that is both difficult and uncertain. Although the federal government granted 15% ethanol blends a year-round one-pound RVP waiver in 2019 and removed a significant hurdle to adoption, multiple challenges still exist at the retail level. Retail station owners must incur a significant upfront cost to install E15 storage and dispensing infrastructure. ICF estimates upfront cost of a storage tank to accommodate E15 at $115,000, with additional costs in the dispensing infrastructure itself. The ICF report does not make clear how retail owners would cover the costs of retrofitting existing stations to enable E15 penetration. In general, fuels retailing is a competitive, low-margin, high-volume business model and would need a substantial incentive to recoup costs of additional infrastructure. Retail station owners are unlikely to experience a significant margin uplift from selling E15, limiting the incentive to incur the substantial upfront costs of installing E15 storage and dispensing infrastructure.

In addition, retail station owners are likely to be wary of the liability arising from misfueling vehicles. While the US EPA approved the introduction into commerce of E15 for model year (MY) 2001 and newer vehicles, major original equipment manufacturers (OEM) only began explicitly approving E15 beginning with MY 2012. While explicit approval for E15 has grown over time to encompass most major manufacturers, some OEMs still do not approve E15 explicitly. In effect, a large portion of the light duty vehicle fleet is not explicitly approved to fuel with E15, creating a large potential liability for retail station owners. The associated costs, potential liabilities, and limited economic incentive call into question the move to E15 in the ICF scenarios over the given timeline.

Securing Supply of Low CI Ethanol

Outside of the retail infrastructure issues, meeting the volumes of low-CI ethanol presented in the ICF report presents its own challenge. In scenarios C and D, average ethanol CI declines to an average of 55 gCO2/MJ in 2030, a decline of 24% from today. Two options exist for meeting compliance with the average ethanol CI in scenarios C and D - either corn ethanol CI must decline significantly, or lower CI sugarcane, waste, and cellulosic ethanol must be blended into the ethanol supply. Sugarcane and cellulosic ethanol make up the two primary options for lower CI ethanol.

In line with the proposal rule, the target CI for the gasoline pool shifts to just over 70 gCO2/MJ in scenarios C and D. The corn ethanol pathways approved in the California Low Carbon Fuel Standard (LCFS), typically with a CI just above 70 gCO2/MJ, would cease to generate credits or have a significantly diminished blending incentives by the late 2020s, necessitating other significantly lower-CI ethanol. Decreasing the CI of corn ethanol below the current levels would require the large scale deployment of carbon capture and storage (CCS) in production. However, decarbonizing corn ethanol is both uncertain and unlikely without significant additional price incentives – even the CA LCFS price has not encouraged this development and baseline projections in the CA LCFS reflect corn ethanol maintaining a CI of around 70 gCO2/MJ. The ICF Report also does not suggest lower corn ethanol CI is an expected outcome. CCS is dependent on a combination of federal level incentives and an established EOR market for captured CO_2 and pipeline buildouts to existing oil fields from the Midwest[1]. Given that these enabling factors are speculative and not guaranteed, the premise of decarbonizing corn ethanol is unlikely given present conditions and expectations. As a result of the unavailability of low CI corn ethanol, alternative low CI ethanol must enter the market to meet the forecasted CI in scenarios C and D.

[1] State CO2-EOR Deployment Work Group "Capturing and Utilizing CO2 from Ethanol: Adding Economic Value and Jobs to Rural Economies and Communities While Reducing Emissions" December 2017

Sugar Cane Ethanol

Sugarcane ethanol is the most readily available source of lower CI ethanol, primarily imported from Latin America into the US. Using the sugarcane CI of 57 gCO2/MJ from the proposed rule would make it impossible to reach the average ethanol CI of 55 gCO2/MJ in 2030 presented in scenario D when blending with corn ethanol of about 70 gCO2/MJ, eliminating this source of supply altogether. Assuming a typical sugarcane ethanol CI of about 45 gCO2/MJ as in the CA LCFS, about 60% of the ethanol consumed in Puget Sound in 2030 would need to be produced from sugarcane in order to meet the average CI in scenario D.

Assuming that sugarcane ethanol is viable source of lower CI ethanol with similar CI to the CA LCFS, the Puget Sound region would need to import about 165 million gallons of sugarcane ethanol in order to meet the average CI in scenario D. To put it in context, California, whose LCFS program already has a significantly lower gasoline CI requirement and a high credit price, only drew in about 77 million gallons of sugar-derived ethanol in 2018 according to CARB quarterly figures. Over time, the CA LCFS program will continue to require greater volumes of sugar ethanol as the CI target decreases. At the same time, Puget Sound would not only be competing to import sugarcane ethanol with the California LCFS but also with similar programs in Oregon and British Columbia, both of which also have more advanced levels of decarbonization. As a result, Puget Sound credit prices would need to be sufficiently high in order to incentivize imports. It is unclear through what mechanism Puget Sound would be able to draw in such volumes given the competing forces in larger nearby markets.

In addition, global developments in ethanol blending have the potential to threaten supply of ethanol available to Puget Sound. Brazil, the primary source of sugarcane ethanol in the Western Hemisphere, is implementing the RenovaBio program over the next decade, which aims to decarbonize its transportation fuels market and could potentially divert volumes away from exports. Outside of Brazil, the adoption of biofuels blending standards, particularly in developing markets, could significantly increase demand for ethanol and make limited volumes available to enter the Puget Sound market. While these points are not addressed in the ICF report, they nevertheless have the potential to be major hurdles to supplying Puget Sound with low CI sugarcane ethanol.

Cellulosic Ethanol

Cellulosic ethanol, often the lowest available CI ethanol, is another option to meet the 55 gCO2/MJ average CI for ethanol presented in scenario D. With an average CI of around 30 gCO2/MJ, cellulosic ethanol would have to make up about 40% of the ethanol supply in Puget Sound using the average of approved California ethanol pathway CIs, or about 108 million gallons in 2030. Using the proposed rule's CIs for cellulosic ethanol and corn ethanol, cellulosic ethanol would make up 85% of volumes, or about 230 million gallons.

Cellulosic ethanol supply has consistently failed to meet expectations since the implementation of the federal Renewable Fuel Standard following the EISA in 2007. Even California's LCFS credit prices drew negligible cellulosic volumes in 2018 despite a clear price incentive at both the state level and the federal level to blend cellulosic ethanol. While California has certified multiple cellulosic ethanol pathways, these plants have produced only minor volumes of cellulosic ethanol. Currently US non-idled production capacity amounts to 32 million gallons, while new build projects sum to just 3 million gallons. The small volumes of cellulosic ethanol available have a significantly higher price incentive to supply California, given the much higher netback in the state. They are unlikely to shift to Puget Sound, casting doubt on the capacity to supply sufficient volumes to meet the CI in scenario D.

<u>Alternative Diesel Supply</u>

Biodiesel and renewable diesel reach an average CI of 26 and 32 gCO2/MJ, respectively, by 2030 in scenario D. While moving to B20 at the retail level requires overcoming similar challenges to providing E15, the challenges of biodiesel and renewable diesel are focused on the availability of supply and feedstock to meet the CI averages presented in scenarios D. The ICF report recognizes that achieving such a low CI will exclude most, if not all, virgin oil-derived fuels from the alternative diesel pool, presenting a challenge to securing volumes for Puget Sound.

Renewable Diesel

The ICF report notes that capacity expansions for renewable diesel will be more than sufficient to supply the Puget Sound market as well as other West Coast markets. In particular, the Cherry Point co-processing plant, the announced REG/Phillips 66 JV in Washington and the NEXT biofuels plant in Oregon, in conjunction with other capacity expansions on the Gulf Coast and abroad, are likely to produce enough additional volume of renewable diesel. These plants primarily process fats and used oil feedstocks, making available sufficiently low CI renewable diesel to meet the averages presented in scenario D. While volumes of renewable diesel are likely to be available, Puget Sound's demand will still exist within the context of multiple other low carbon fuel standards through the West Coast. California by itself is projected to consume about 1,100 million gallons in 2030 – about half of the confirmed projected capacity noted in the ICF report. Combined with much larger demand markets, the other West Coast LCFS programs are sufficiently advanced in their decarbonization to draw volumes from these plants. In place for longer, West Coast LCFS programs have lower CI targets and subsequently higher credit prices in general that incentivize volumes to move into these markets. As a result, the Puget Sound carbon price, and consequently the renewable diesel price, would have to rise sufficiently to incentivize volumes to either move to or remain in Washington. It is not clear that scenario D takes into account the issue of pricing incentives.

Biodiesel

As noted in the ICF report, biodiesel supply in scenario D has such a low average CI that it excludes virgin vegetable oils as a feedstocks. As a result, the primary challenge for biodiesel supply into the Puget Sound region is sourcing sufficient volumes of biodiesel derived from non-virgin oils. The main source of biodiesel in the Washington state is the REG Grays Harbor facility, which primarily processes virgin vegetable oils. While this facility does have feedstock flexibility, it is not clear that the feedstock would shift to UCO and tallow to accommodate the average biodiesel CI presented in scenario D and whether the availability of such feedstock would be sufficient for the facility in 2030. The ICF report itself notes that less than equivalent of 1 million gallons per year of tallow and UCO feedstock is available in Washington, requiring the plant to draw in feedstock from other regions or continue processing virgin oils, adding to the uncertainty of supply. The Puget Sound, and other West Coast market, prices would have to be sufficient to incentivize the shift to other feedstocks. In addition, the Grays Harbor facility would be competing for tallow and UCO with the renewable diesel plants that are set to begin operation in Washington over time. Given the proximity to Oregon and BC, these markets may offer better netbacks for the facility as these markets' respective LCFS programs deepen their decarbonization over time. As a result, the plant economics of Grays Harbor switching to UCO and tallow are unclear and not guaranteed to accommodate scenario D.

Outside of the Grays Harbor facility, most facilities are both distant, incurring a CI penalty, and primarily process virgin vegetable oils, making the supply available either expensive or insufficiently low in CI to meet the average in scenario D. The ICF report is not clear on the mechanism for securing sufficient quantities of UCO and tallow biodiesel to supply B20 to the market to hit the average CI for biodiesel in scenario D, especially when California will be drawing in greater volumes of low CI biodiesel. While volumes in Puget Sound are sufficiently small, they must still outcompete other LCFS markets to secure volumes.

Electrification and Alternative Fuels in the Vehicle Fleet

Light Duty Vehicles

The light duty vehicle fleet in scenario D of the ICF report forecasts BEV penetration at nearly 15% in 2030. While the Puget Sound region is a highly urbanized area conducive to BEV penetration, projections from CARB forecast California non-hybrid BEV penetration at 5% of the light duty vehicle fleet in 2030. The feasibility of reaching such heightened levels of penetration is not sufficiently explained in the ICF report. Comparing solely to California, where significant state level incentives exist for BEV adoption and the LCFS provides a significant economic incentive to substitute away from gasoline, the Puget Sound area has less regulatory support for making a fast shift to 15% BEV penetration, which is not addressed in the ICF report.

Even in terms of new sales, ICF scenario D projects significantly higher sales than California – CARB projects that both ZEV and PHEVs make up 8 percent of new sales by 2025, as compared to the 20% projected in ICF scenario D. The aggressive timeline has little explanation in the ICF report beyond stating that the cost of credit generation could be used to support purchases of alternative fuel vehicles. In addition, ICF notes that changing the assumptions for vehicle turnover, deployment rates, vehicle miles traveled and fuel economy can result in the presented scenarios but offers no explanation on the changes in assumptions and the mechanism for changing assumptions. Without significant methodological explanation, and realistic policy and economic support, of the drivers behind the changes in slow moving variables, such as vehicle turnover, determining the plausibility of reaching such high levels of penetration in such a short timeline merits skepticism.

Heavy Duty Vehicles

In the heavy duty vehicle segment, the natural gas vehicles, in the form of CNG vehicles, make up about 7% of class 7/8 heavy duty vehicles in scenario D. The penetration forecast presupposes both fuel availability, primarily in the form of RNG, and the deployment of CNG vehicles. The technology behind CNG vehicles is available and many heavy duty vehicle fleets already employ CNG in their operations. As with other technologies, ICF notes that there are increased costs for both the vehicles themselves and the fueling infrastructure, but the report does not make clear how vehicle fleets will absorb the cost and deploy the NG vehicles.

The other challenge for Puget Sound is in securing sufficient volumes of RNG, given that traditional natural gas falls to just 5% of the total supply for vehicles by 2024 in scenario D. As the ICF report notes, the RNG facilities in Washington are shipping RNG to California to take advantage of more attractive netbacks in the California LCFS, whose demand is set to more than double by 2030. The report assumes that new capacity will come online to supply California with RNG, leaving RNG volumes to supply Washington. In addition, new RNG capacity in Washington is noted to be unlikely without additional regulatory support. Given these uncertainties and trajectories for decarbonization and credit price, it is difficult to be certain as to why Washington RNG producers would abandon the much larger California market and the preexisting infrastructure that has been developed to supply that market from Washington. As with other fuels, the question of attractive netbacks for producers is the main challenge and, with presumably higher credit prices in Oregon and California than in Puget Sound, RNG producers in Washington are unlikely to forgo these markets and supply Puget Sound. In addition, it is not clear that the infrastructure exists to bring outside jurisdiction RNG volumes into Puget Sound or if a higher netback is realized through the utilization of existing assets. Scenario D presupposes this availability but does not give a clear mechanism for securing the supply.

Renewable Jet Fuel

Scenario D of the ICF report forecasts consumption of 50 million gallons of renewable jet fuel by 2030. While renewable jet fuel could potentially be supplied to the Puget Sound region, the uptake mechanism to reach the forecasted consumption is unclear. One of the primary impediments to the uptake of renewable jet fuel is the price differential to conventional jet fuel. Fuel costs are one of the airline industry's largest expenses, making the industry particularly sensitive to fuel prices. As a result, prices of renewable jet fuel are a significant determinant of uptake. The ICF report itself does not mention the mechanism for sufficiently narrowing the price difference between conventional and renewable jet fuel to stimulate adoption. The implementation of a clean fuel standard would provide some incentive to switch to renewable jet fuel but it is unclear if the credit price would be a sufficient incentive.