Comments on the ICF Report and PSCAA Clean Fuel Standard

Prepared for

The Western States Petroleum Association

By

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1 Summary

In September of 2019, the Puget Sound Clean Air Agency (PSCAA) contracted with ICF to assess the availability of clean transportation fuels and to conduct an analysis of the economic, air quality, and health impacts of a regional Clean Fuel Standard (CFS). ICF's Puget Sound Regional Transportation Fuels Analysis found:

1. A Clean Fuel Standard can significantly reduce the Puget Sound region's GHG pollution – up to a 26% reduction in carbon intensity of transportation fuels by 2030.
2. A Clean Fuel Standard will improve air quality and public health, especially in communities near major roadways.
3. A Clean Fuel Standard is consistent with the region's economic growth. Any changes to economic productivity and employment are estimated to be very small (plus or minus one tenth of one percent).

In the following analysis, Stillwater will assess how reasonable it is to comply with ICF's "All-in Case" – a scenario designed to characterize the maximum feasible reduction on maximum carrying capacity for low carbon fuels in the Puget Sound region by 2030 – and to clearly explain what the costs of the program are to consumers of transport fuel. While it is technically possible to meet a 26% CI reduction by 2030 – the feasible reduction outlined in ICF's "All-in Case", a combination of the following factors makes the achievement unlikely:

1. ICF's assumed sales of electric, natural gas, and fuel cell vehicles are between two and fifteen times higher than credible forecasts made by the EIA for national sales or CEC for the California market.
2. E15 sales to all 2001+ model year vehicles by 2026 are unlikely due to the challenges of infrastructure change and vehicle owner concerns about compatibility with 2001 to 2014 model year cars and trucks.
3. Sustained high credit prices create greater incentives for developing low-carbon fuels. Lower Credit Clearance Market (CCM) price under PSCAA's proposed CFS than those associated with Oregon's Clean Fuels Program (CFP) and California's Low Carbon Fuel Standard (LCFS) will not drive the faster generation of credits needed to meet PSCAA's target. It will also disadvantage PSCAA supply of the lowest CI fuels if there is tightness in the market because the lowest CI fuels will be more valuable in the other markets with clean fuel programs.
4. The accelerated CI reduction schedule (three times faster than Oregon's and four times faster than California's) does not allow enough time for vehicle fleet conversion or for major complex projects to be designed, financed, permitted, and implemented. This particularly applies to the large Washington state refineries that only sell one-third of their production in the PSCAA region.

In addition, ICF's report describes the results of a complex macroeconomic analysis that shows little impact on the local economy because the substantial costs of the program are transferred from the consumers of transport fuels to various other stakeholders, many of whom will be outside the state. It also assumes an arbitrary maximum credit price that is 25% lower than what is likely to be the value of the CCM price in 2030 that is established in the PSCAA proposed regulation. Using the projected CCM price, ICF's cost calculation and EIA forecasts for demand in 2030, fuel cost would increase by over 70 cents per gallon (cpg), and the program would add $1.6 billion to the price of fuel in the four PSCAA counties in 2030.

Most of the additional low-carbon fuels supplied to California and Oregon to generate credits for the LCFS and CFP, respectively, have not been produced on the West Coast. The vast majority of renewable diesel and almost all biodiesel and ethanol (which sell at higher prices due to the value of credits generated) are not produced in the states in which they are consumed. Therefore, the economic benefits (credits) from these clean fuel programs accrue to businesses outside of California and Oregon. Unless some additional and large local incentives are created to support PSCAA's proposed CFS, much of these benefits will be earned by businesses outside the four-county area and even outside of Washington state.

2 Feasibility of Meeting All-in Case

ICF presents an "All-in Case" that asserts that the highest CI reduction technically possible in 2030 is 26%. This case is strikingly similar to the proposal submitted by PSCAA to achieve a 25% reduction by 2030. To demonstrate technical feasibility of the case, ICF incorporated the following assumptions[1]:

1. **Ethanol:** 15% blend of ethanol by 2026, with the carbon intensity of ethanol decreasing to 56 g CO2e/MJ by 2030.
2. **Biodiesel:** 20% blend rate of biodiesel by 2028 with an effective carbon intensity of 26 g CO2e/MJ by 2030, effectively excluding any virgin oil-based biodiesel into the market.
3. **Renewable Diesel:** 20% blend rate of renewable diesel by 2028 with an effective carbon intensity of 32 g CO2e/MJ.
4. **Renewable Jet:** 50 million gallons of renewable jet fuel by 2028
5. **EVs, Passenger Cars:** 28% new sales for EVs in passenger car market by 2025 and 42% by 2030
6. **Fuel Cell Vehicles:** 5% of new sales in passenger car market and light-duty truck market by 2030
7. **EVs, Class 3-6:** 10% new sales by 2030
8. **Natural Gas Vehicles:** 7% of new sales in Class 7-8 single unit market by 2030
9. **RNG:** 100% RNG blend by 2023, with 70% of the RNG coming from diary digesters and an overall effective carbon intensity of -180 g CO2e/MJ.
10. **Refinery Improvements:** 15% refinery efficiency upgrades and 25% renewable hydrogen displacement

While these assumptions might be technically possible, they are not very likely. Below is a review of factors that impact the probability of achieving these assumptions.

2.1 Ethanol

ICF's description on the growth in E15 sales overlooks some historical challenges that have delayed its adoption. E15 has been lower cost than E10 for years and has shown very low adoption rates nation-wide. Currently about 2,000 out of 160,000 (1.25%) of the gasoline retail sites sell E15, but estimated E15 sales of 200 million gallons per year[2] represent only 0.14% of the national gasoline sales total of 143 billion gallons per year. While ICF correctly attributes much of this slow growth to limitations in infrastructure, other problems have and will continue to also impact E15 adoption. One of these obstacles was recently removed when the EPA approved a waiver for E15 to enable it to be treated like E10 during the summer months in much of the U.S.

ICF's factual statement that "the EPA approved nationwide, year-round sales of E15, a 15% blend of ethanol with gasoline (or conventional blendstock) for vehicles of model year 2001 or newer" does not adequately describe the situation regarding fuel compatibility with vehicles. While EPA allows E15 to be used in 2001 and newer vehicles, most vehicle owner's manuals did not allow E15 until GM allowed it in 2014. Ford and Chrysler allowed it in their 2015 and newer vehicles. Thus, many vehicle owners currently choose not to use E15 for fear of invalidating the vehicle manufacturer's warrantee, and in the future concerns about vehicle compatibility will remain after the warrantees expire. Even in the newer vehicles approved by the car companies for E15, the E15 is a slow seller. E15 sales per site is less than 10% that of E10, so that even when the infrastructure is in place and the cars are 2015 model year or newer, E15 sales have been slow.

Misfuelling is another concern since the following vehicles are prohibited from using E15:[3]

- All motorcycles
- All vehicles with heavy-duty engines, such as school buses and delivery trucks
- All off-road vehicles, such as boats and snowmobiles
- All engines in off-road equipment, such as chain saws and gasoline lawn mowers
- All conventional vehicles older than model year 2001.

[1] Puget Sound Regional Transportation Fuels Analysis Final Report. September 2019. https://www.pscleanair.org/528/Clean-Fuel-Standard. Page 39.
[2] Good sources for total sales volume are elusive. This is a number discussed at the recent OPIS Fuels Conference. https://www.opisnet.com/octane-future-fuels-forum/
[3] Department of Energy Alternative Fuels Data Center. https://afdc.energy.gov/fuels/ethanol_e15.html

It is worth noting that currently nearly all E15 stations are non-branded. Stillwater knows of no majors selling E15, in large part because of all the risks described above. Competitive factors have caused some to start considering adoption, but overall, Stillwater sees this transition, if it happens, taking more than ten years to complete. This lengthy process will challenge CFS credit generation, particularly in the first years of the program.

E15 sales penetration has been very slow in the U.S. even though it is less expensive to produce than E10 because of significant required changes in retail infrastructure combined with vehicle manufacturer warrantee issues. This makes 100% E15 sales by 2026 extremely unlikely.

An ethanol CI of 56 g/MJ is about 8 g/MJ lower than what was blending in California in the second quarter of 2019. Since California ethanol CI is trending downward (from 71 g/mj to 64 g/mj over the last 12 reported quarters), there is a reasonable chance that PSCAA could obtain this CI ethanol if supply is sufficient. However, if supply for low-carbon fuels is tight and credit prices are high, California will be able to attract lower CI fuels because it has a higher maximum credit price than what PSCAA has proposed.

2.2 Biodiesel and Renewable Diesel

Biodiesel production capacity is not constrained – there is considerable excess capacity available nationally. While there currently is no excess capacity for renewable diesel production, if the many renewable diesel projects that have been announced are completed, there should be sufficient capacity to supply PSCAA with ICF's assumed volume of 20% in the diesel pool by 2028. However, the assumption that all of this production can be met using non-virgin feedstocks is not as certain. If there is a shortage of UCO, tallow, and corn oil, the renewable and biodiesel that is produced from these non-virgin feedstocks will be sold into the market with the highest value. This would create a challenge for meeting the average CIs of 26 g CO_2e/MJ and 32 g CO_2e/MJ for biodiesel and renewable diesel, respectively. However, based on the average CI of these fuels blended today in California, the assumed values used by ICF are reasonable.

2.3 Renewable Jet Fuel

Despite the fact that renewable jet is more expensive to make than renewable diesel, 50 million gallons per year by 2030 is certainly possible, but more than current U.S. production.

2.4 Electric Vehicles in Light Duty Fleet

ICF's assumption that EV sales into the new passenger car market will reach 28% by 2025 and 42% by 2030 does not align with the consensus in the industry. This is a critical assumption for feasibility because electricity is shown to have the largest contribution to compliance of any alternate fuel, contributing over 35% of the credits needed to achieve ICF's All-in Case. While there is a substantial range of forecasts published, the most credible one has been published by the U.S. Energy Information Administration (EIA). In its 2019 Energy Outlook Reference case, the EIA published forecasts for the United States as a whole as listed in Table 1 below.[4]

[4] https://www.eia.gov/outlooks/aeo/data/browser/#/?id=48-AEO2019&cases=ref2019&sourcekey=0

Table 1. EIA 2019 Forecast for Future New Cars & Light Trucks Sales

	Year 2025	% of New Cars & Light Trucks	Year 2030	% of New Cars & Light Trucks
Gasoline and Diesel	12,431	81.8%	12,221	79.1%
Ethanol Flex Fuel	816	5.4%	949	6.1%
Electric	962	6.3%	1,102	7.1%
Plug In Gas Hybrid	292	1.9%	331	2.1%
Electric gas hybrid	622	4.1%	777	5.0%
Other Alternative	72	0.5%	68	0.4%
Total	15,194	100.0%	15,448	100.0%

Source: U.S. Energy Information Administration 2019 Energy Outlook Reference Case

ICF's assumption on PSCAA area market penetration is <u>four to six times higher</u> than that of the EIA's forecast for the U.S. In addition to sales, the EIA also forecasts the consumption of energy by transport vehicles and lists them by source, as shown below in Table 2.

Table 2. EIA Forecast of Energy by Source in Road Transport

	trillion btu	trillion btu	%	%
	2025	2030	2025	2030
Gasoline	14,477	13,040	70.6%	68.2%
E85	181	283	0.9%	1.5%
Diesel	6,825	6,630	33.3%	34.7%
Electricity	156	240	0.8%	1.3%
CNG/LNG	140	205	0.7%	1.1%
Hydrogen	12	21	0.1%	0.1%
Total Highway	20,514	19,126	100.0%	100.0%

Source: U.S. Energy Information Administration 2019 Energy Outlook Reference Case

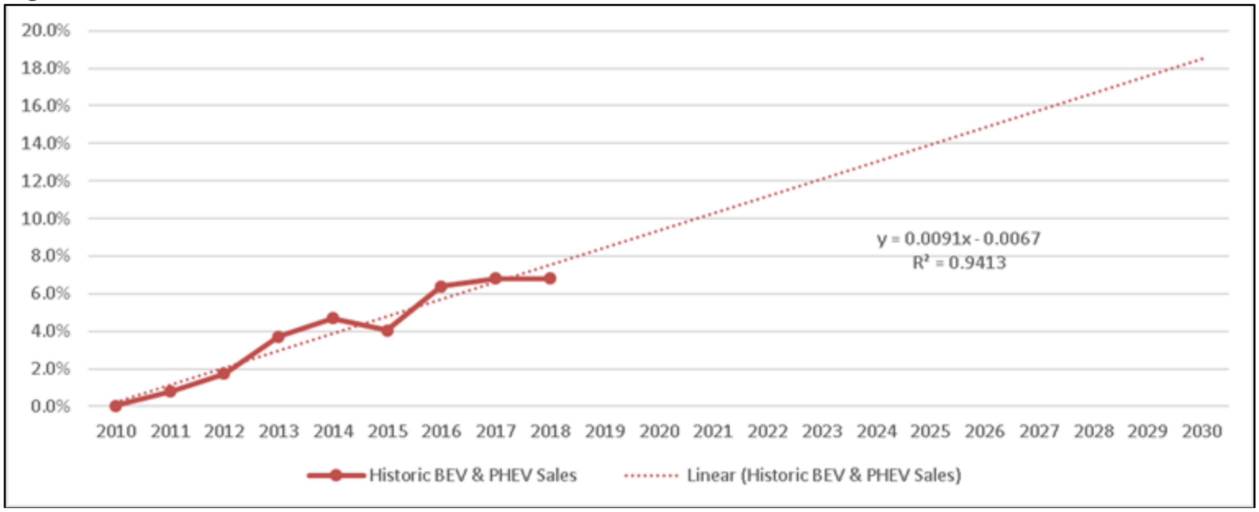
These forecasts show that 0.8% of energy supplied to total road transport or about 1.2% of the light duty fleet energy nationally would be electricity in 2025, increasing to about 1.3% and 2% by 2030, respectively. This again demonstrates the challenge of relying on EVs to supply such a large share of credits to reach a 26% CI reduction by 2030.

Last, consider EV sales in California which has had the most aggressive EV policies in the nation. Based on data from the California Department of Motor Vehicles from 2010-2015 and California New Vehicle Dealer Association sales percent from years 2016-2018 sales, the linear projection of the trend shown in Figure 1 below shows that EV sales make up 18% of car sales in 2030. This is less than half the 42% value assumed by ICF.

We note that ICF does not list an assumption for light duty trucks. EV sales in light-duty trucks are much lower than in cars. In the EIA forecast, EV share in cars is 50% higher than in the overall light duty fleet that includes trucks. If California sales are similar, this indicates overall EV sales in the light duty fleet in California would be about 12% in 2030 which is considerably larger than the EIA forecast of about 7%.

Most automobile manufacturers report that they are losing money on EV sales (except for Tesla which has found a high-end, high-performance niche) and the phase-out of the $7,500 federal tax incentive could contribute to a continuation of the plateau observed in the last three years depicted in Figure 1.

Figure 1. Electric Vehicle as a Percent of California Car Sales



2.5 Fuel Cell Vehicles in the Light Duty Fleet

ICF assumes that 5% of new light duty vehicles sold in 2030 would be fuel cell vehicles while the EIA reference case shows it to be about 0.3% in that year. The ICF assumption is fifteen times higher than the EIA forecast.

2.6 EVs, Class 3-6: 10% new sales by 2030

Class 3-6 EVs are projected using the heavy-duty natural gas fleet performance and CEC data to reach 1.7% of new vehicle sales by 2030. Recent sales have been quite low, however, so the correlations are much weaker than other forecasts.

2.7 Natural gas vehicles

Using a correlation of historical sales that has an excellent fit with the available data, California Energy Commission forecasts that natural gas vehicles will be 3.2% of new vehicle sales by 2030. The ICF assumption is more than double this forecast.

2.8 RNG

Based on recent growth in RNG production, 100% RNG to fuel CNG/LNG vehicles in place by 2023 is reasonable. However, it is hard to say how much of that volume will be supplied by the very low CI RNG from dairy and swine digesters.

2.9 Refinery improvements.

Refinery improvements may be able to contribute significantly to CI reduction and credit generation under PSCAA's proposed CFS. Two important aspects of how much of an impact refinery improvements will make are:

1. The accelerated time frame of the CFS proposed by PSCAA discussed in the next section will make it difficult for major complex refinery projects to be designed, financed, permitted, and implemented in time to contribute to CI reduction under the program's proposed timeline, especially early in the program.
2. How the rules are established for the projects could make a significant difference. For example, if RNG must be produced on-site to produce refinery hydrogen in order to generate credits rather than being able to use RNG to generate hydrogen by the book-and-claim process used for fueling NG vehicles, this restriction could have a significant impact on feasibility.

It is very difficult to assess how likely the ICF assumption is for credits in this category. However, it is very likely that significant credits are needed here to enable the All-in Case to be feasible.

2.10 Summary of Feasibility Considerations

While it is mathematically possible to meet a 26% CI reduction by 2030, in order to illustrate feasibility ICF has assumed much higher sales of sales of electric, natural gas, and fuel cell vehicles than credit forecasts made by the EIA and CEC to generate the credits necessary. In addition, the ICF assumption of E15 sales to all 2001+ model year vehicles by 2026 is unlikely due to the challenges of infrastructure change and owner concerns about E15 compatibility for 2001 to 2014 model year vehicles.

3 Accelerated Carbon Reduction Schedule and Competition for Biofuels

The CI reduction schedule proposed by PSCAA is similar to the All-in Case developed by ICF. Table 3 shows a comparison of this schedule to what has been and is forecasted to be the case for the other two similar west coast programs.

Table 3. Comparison of CI Reduction Rates by Program (%)

Year of Program	California LCFS	Oregon CFP	PSCAA CFS
1st	0.25	0.25	1.25
2nd	0.5	0.5	2.5
3rd	1	1	3.75
4th	1	1.5	6.25
5th	1	2.5	8.75
6th	2	3.5	12.5
7th	3.5	5	16.25
8th	5	6.5	20
9th	6.25	8	25
10th	7.5	10	25

The total CI reduction in the first five years of PSCAA's proposed program results in 2.5 times the reduction of Oregon's CFP and almost nine time the reduction as the California LCFS. In the ninth year of the PSCAA program, CI reduction levels are four times that of California's and three times that of Oregon's program.

For reference, the LCFS requirement was frozen as a response to a lawsuit. This kept credit prices low and enabled the program to build a large bank of credits to be used later when the deficits exceeded credits generated, which happened in the first quarter in the seventh year of the program. Correspondingly, seven years into the proposed CFS program, the CI reduction required more than four times what California had in place when the LCFS program experienced the first draw on the credit bank. The PSCAA program will not have a similar opportunity to establish a credit bank because the CI reductions are so much higher than California's in every year up to that point.

Oregon's CFP is in its fourth year and built a small credit bank that was utilized for the first time in the third year of the program when a small net deficit was observed at a 1% CI reduction requirement. Credits roughly balance deficits for the CFP in the current fourth year of the program, so the credit bank is stable. However, competition with California for low-carbon fuels has caused CFP credit prices to be much higher than LCFS credits were at the same stage of the program, as shown in Figure 2. Since California currently requires higher CI reductions, credit prices are higher there to attract the lowest carbon fuels. If Oregon's credit balance becomes negative, CFP credit prices will have to increase in order to compete with California for lower carbon fuels.

Figure 2. CFP and LCFS Credit Price Histories

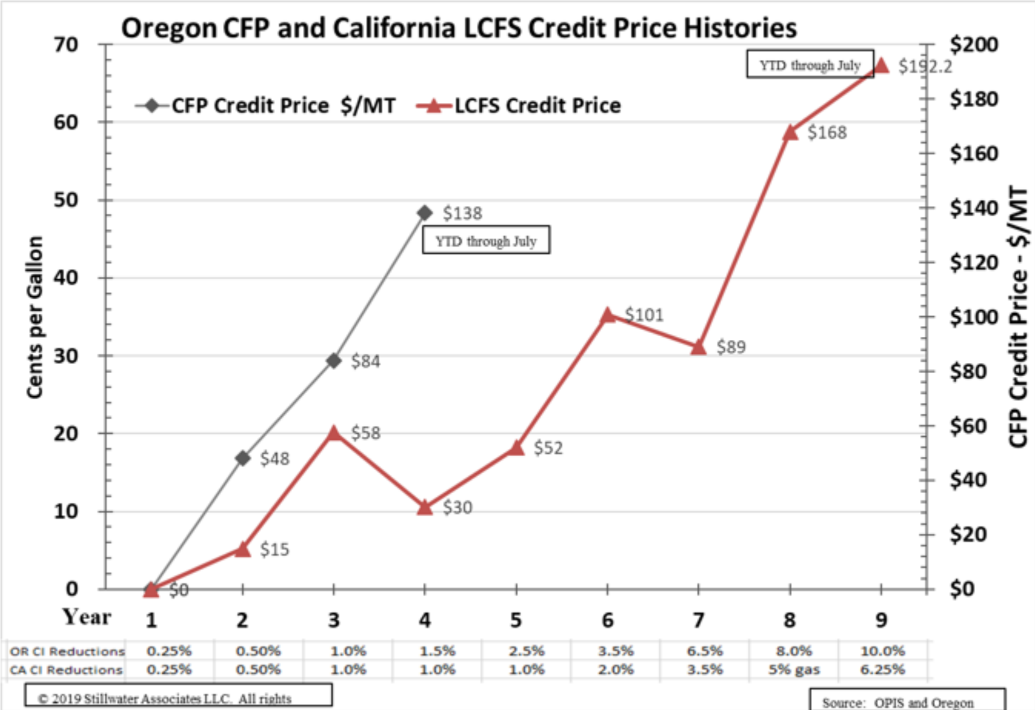


Table 4 below shows the CI reduction schedules for the LCFS, CFP, and proposed CFS through 2030. The scheduled CFS reductions will exceed those of the other two programs in the later part of the decade.

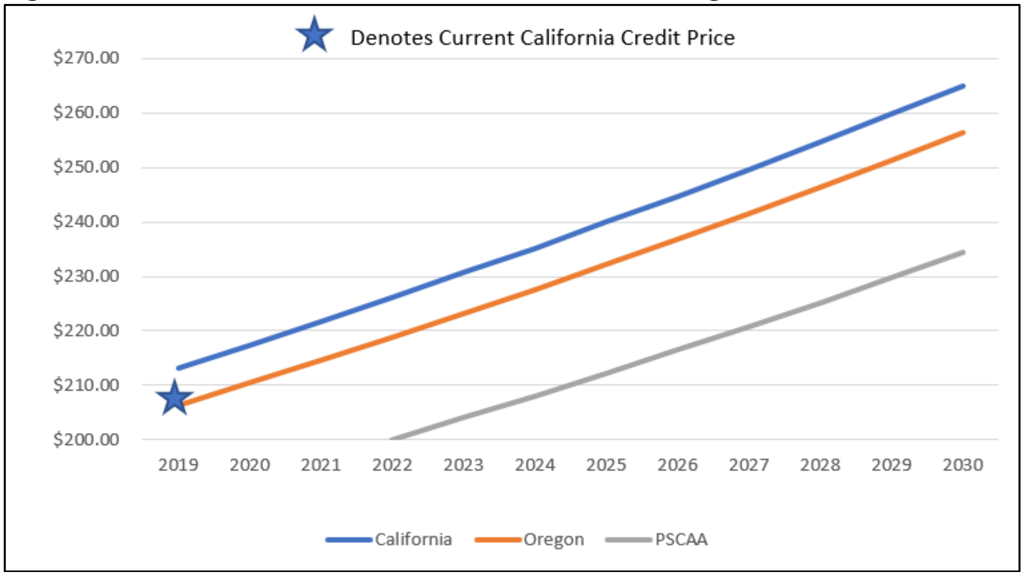
Table 4. Planned CI Reduction Rates (%)

Year	California	Oregon	PSCAA Proposal
2019	6.25	1.5	0
2020	7.5	2.5	0
2021	8.75	3.5	0
2022	10	5	1.25
2023	11.25	6.5	2.5
2024	12.5	8	3.75
2025	13.75	10	6.25
2026	15.5	10*	8.75
2027	16.25	10*	12.5
2028	17.5	10*	16.25
2029	18.75	10*	20
2030	20	10*	25

** Not yet determined*

To achieve higher CI reduction will require CFS to attract more of lowest carbon fuels when competing with LCFS and CFP. However, the maximum price allowed in the CFS's CCM will be lower than that of the other two programs as shown in Figure 3. Unless there is an excess of lower carbon fuels, CFS will be disadvantaged in its efforts to meet the ambitious reduction goals.

Figure 3. West Coast Future CCM Price Levels Assuming 2% Inflation



4 Cost of the CFS

ICF presents a range of costs for the CFS depending upon which scenario is mandated. For the All-in Case, ICF assumed that the highest level for credit price would be $186.50 per metric ton (MT) and that this would add 57 cpg of marginal cost to gasoline and 63 cpg to diesel fuel. However, in the event of insufficient low carbon fuels, the highest price allowed by the proposed PSCAA regulation is the CCM price that is set at $200 per metric ton in 2022, and it is escalated each year after than with inflation. If inflation is 2% per year over that time frame, the maximum CCM price in 2030 would be slightly over $234/MT – 25% higher than ICF's upper price. Using ICF methodology, this 25% higher price puts the added cost for gasoline and diesel at $0.71 and $0.79 per gallon for gasoline and diesel, respectively in 2030 dollars.

Apportioning Washington state's total reported 2018 fuel sales (as reported by the EIA[5]) to the four PSCAA counties based on population,[6] approximate consumption of gasoline and diesel in the four PSCAA counties is 1.6 and 0.6 billion gallons per year, respectively. Due to increased efficiency, the EIA predicts transport fuel demand nationally to be 20% lower in 2030 than today. If demand is that much lower in the PSCAA region in 2030, the maximum additional costs to consumers and businesses would total about $1.6 billion annually in that year. Using ICF's highest credit price estimate, the cost is closer to $1.3 billion per year.

Today, it is estimated that there are 1.66 million households and 4.2 million people living in the four-county PSCAA region. The highest possible (CCM) cost added to drivers and businesses would, therefore, represent over $900 per household per year or $380 per person that is reallocated from other needs to the cost of gasoline and diesel.

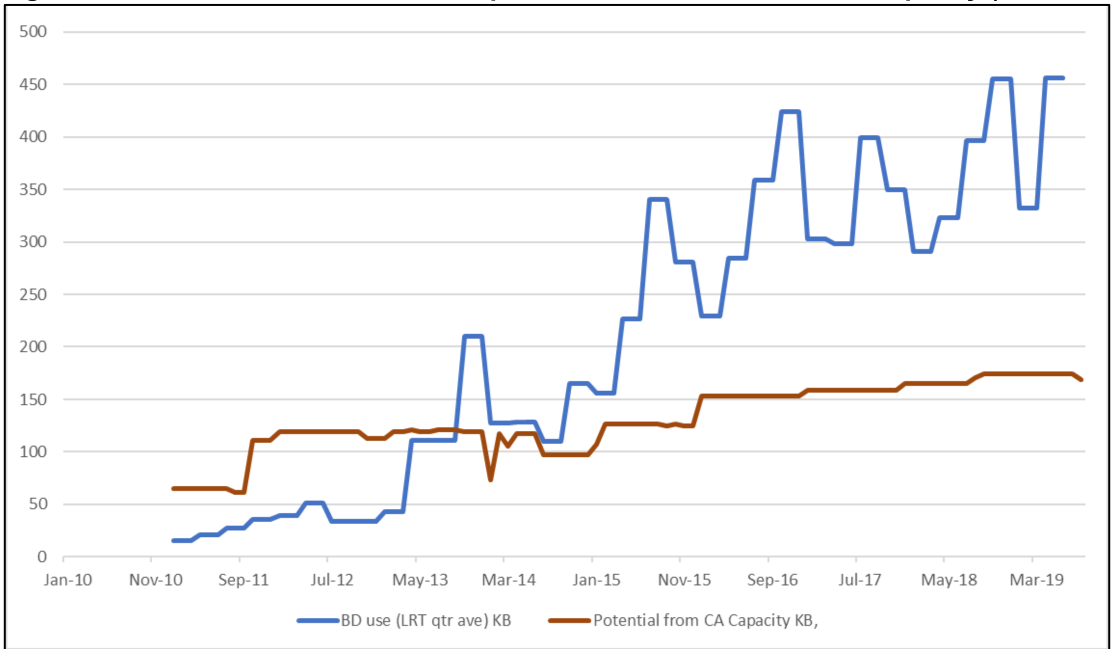
5 Economic Returns Outside of PSCAA Region

The optimal location for a low-carbon fuel production facility is determined by a combination of factors including permitting, land costs, transportation logistics, access to utilities, feedstocks, and low carbon fuel markets, and other things. Experience in the existing West Coast low carbon fuel markets indicates that much of the low carbon fuels are produced outside of the markets. Consider California. Despite development of in-state projects to lower fuel CI, the majority of low carbon fuels consumed to generate LCFS credits have been and continue to be produced out of state. For example, Figure 4 shows how biodiesel demand has increased from 20 KB to 400 KB per month since the LCFS was implemented in

[5] Energy Information Administration. Washington Total Sales/Deliveries by Prime Supplier.
[6] Washington Office of Financial Management, https://www.ofm.wa.gov/

2011 while biodiesel production capacity in California increased from 70 KB to 170 KB per month. At full capacity, in-California biodiesel producers can only supply about 43% of current in-state demand.

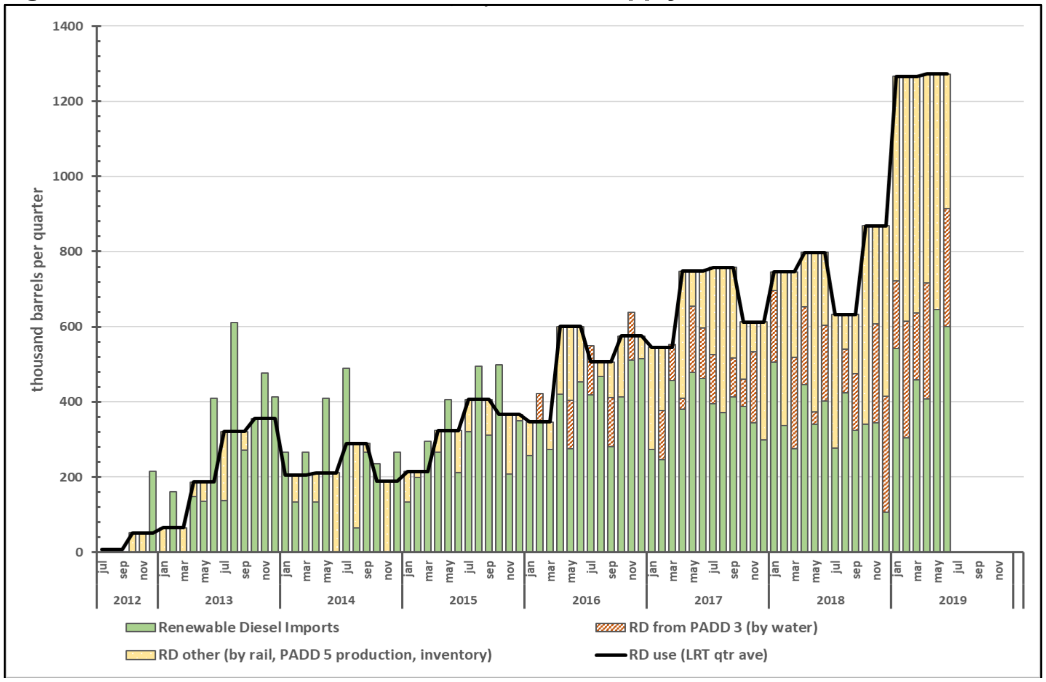
Figure 4. California Biodiesel Consumption and In-State Production Capacity (KB/month)



Sources: California Air Resources Board and U.S. Energy Information Administration

Consider the enormous growth in renewable diesel consumption in California. Figure 5 shows supply of renewable diesel into California compared to consumption recorded by CARB's LCFS Reporting Tool. The sum of foreign imports and shipped deliveries from the U.S. Gulf Coast adds up to 75% of supply since the inception of the LCFS. The other 25% is a combination of volume railed into the state plus in-state production. As can be seen, out-of-state production makes up at least 75% of consumption in California and in-state production is likely in the range of 10-15%.

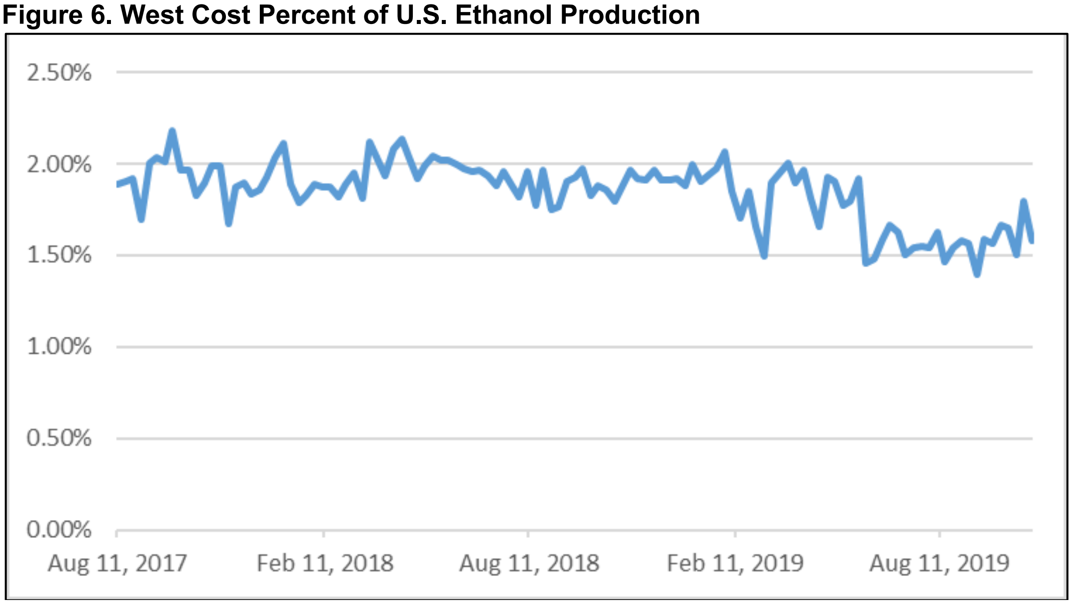
Figure 5. California Renewable Diesel Use and Supply



Sources: California Air Resources Board and U.S. Energy Information Administration

The percentage of ethanol blended in California has not changed significantly since the LCFS program was implemented. Ethanol CI, on the other hand, has steadily moved lower due to the segregation of the lower carbon product shipped to California combined with capital projects to the ethanol production processes. These projects have been executed in existing plants, and the program has not led to a significant increase in production in California or on the West Coast. Figure 6 displays how total ethanol production on the West Coast remains below 2% of national production and has trended downward over the past two years of the program while LCFS credit prices have escalated to much higher levels. The EIA lists total ethanol production capacity in California at 230 million gallons per year, which is 15% of the volume California is currently blending.

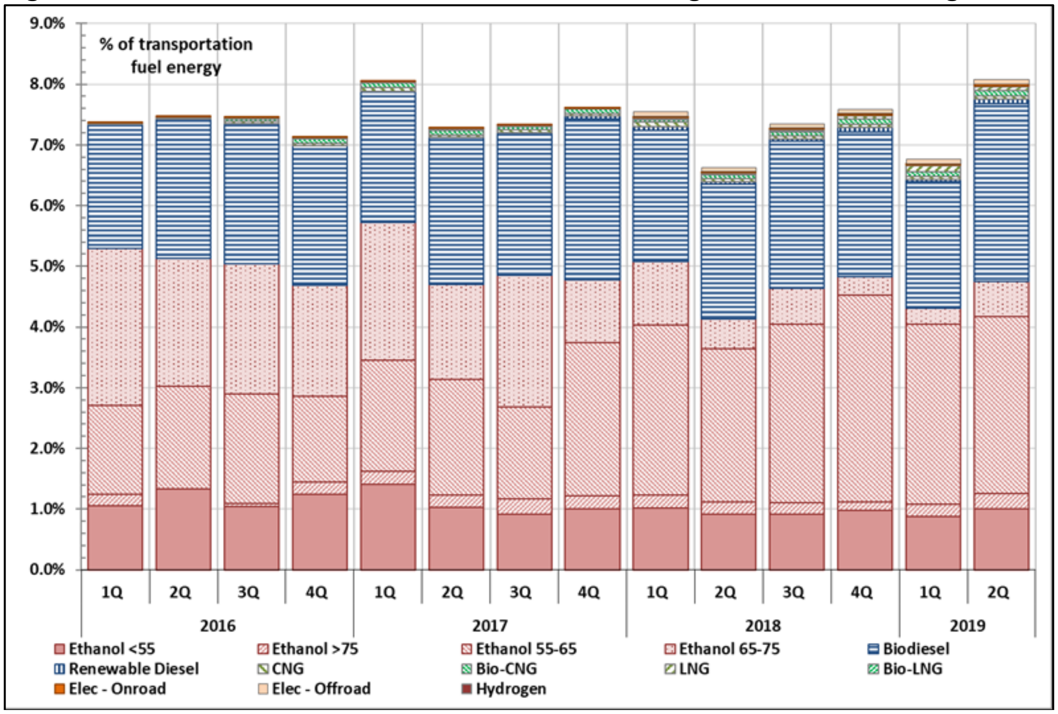
Figure 6. West Cost Percent of U.S. Ethanol Production



Source: U.S. Energy Information Administration

The Oregon CFP has been in place for less than four years, but much like California's longer-standing program, Oregon has not yet seen significant increased production of low carbon fuels. Figure 7 below shows the percentage of alternate and renewable energy used in the Oregon transportation pool over the first 14 quarters of the CFP. Overall, the only significant growth has been to biodiesel in the most recent quarter reported – 2Q2019. Otherwise, the amount of alternate fuels has not changed even if the average CI has declined somewhat. Note that the EIA reports that there is one biodiesel plant in Oregon and its listed capacity has not changed since the beginning of the program. Its total production capacity is about 25% of the total reported to be blended in the second quarter of 2019. The EIA also lists one ethanol plant in Oregon with a listed capacity of 40 million gallons per year, which is about 23% of the ethanol blended in the state.

Figure 7. Alternate and Renewable Fuel Use in the Oregon Clean Fuels Program



Source: Oregon Department of Environmental Quality

The history of the two West Coast regulations has been that a significant majority of the credits generated by liquid fuels (ethanol, renewable diesel, and biodiesel) have been generated by fuels produced outside of that state's jurisdiction, so a large amount of the economic value of the program is transferred out of state. Some of this is also happening with electricity and biogas, but the data for these are much more difficult to obtain and assess. This transfer of economic benefit is one of the least desirable aspects of low carbon fuels regulations to local governments.