CARBON ACUMEN

December 21, 2022

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California Air Resources Board

Submitted via LCFS Comments Upload Link
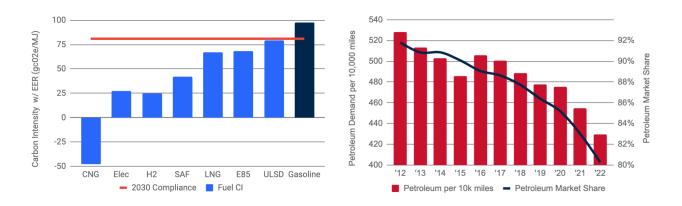
RE: November 9th LCFS Workshop Potential Changes to the Low Carbon Fuel Standard

Dear Dr. Laskowski and the respective Transportation Fuels Branch Staff,

Carbon Acumen appreciates the opportunity to comment on the 3rd public workshop to discuss potential changes to the Low Carbon Fuel Standard (LCFS) during the pre-rulemaking phase held on November 9, 2022. I will use this opportunity to present the need of an annual auto-ratchet carbon intensity (CI) mechanism on top of a step down of CI targets in 2024.

Progress To Date

The LCFS has been a success in its mission to decrease the carbon intensity of California's transportation fuel pool and to reduce petroleum dependency as every fuel sold in the state outside of gasoline already meets the current 2030 carbon intensity (CI) reduction target of 20% or roughly below 80 gCO2e/MJ[1]. Petroleum market share by volume has steadily dropped to 80% in 2022 while petroleum used per 10,000 vehicle miles traveled (VMT) has also dropped to 429 gallons, a drop of 18% in the past decade[2].
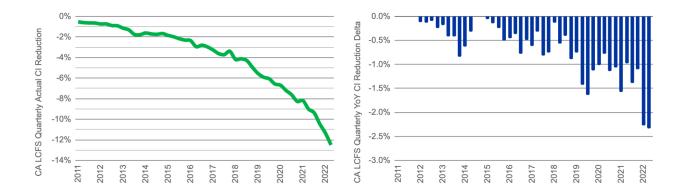

Current CI Reduction Momentum

With the expansion of RD production and distribution, growth of negative-CI RNG, increased ZEV sales, and declining gasoline demand, CI reduction progress has turned exponential within the past 3 years. Before 2019, CI reduction progress was typically <1 percentage point year-over-year,

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[1] CARB LCFS Reporting Tool Quarterly Summaries
[2] US DOT FWHA, Traffic Volume Trends

as seen in the blue bar chart below. However since 2019 CI reduction has accelerated to >1 percentage point YoY with Q2-2022 being nearly to 2.5 percentage points better YoY and already exceeding the 2023 compliance target of 12.5%, a full two years in advance[3].

Low Carbon Fuels Domestic Production & Distribution Acceleration
Since the first transfer of LCFS credits in April of 2012, over 390 entities have participated in the LCFS market as cumulative transfer value exceeded $19 billion in November 2022[4]. Due to the relatively premium value low carbon fuels receive in California versus other markets[5], not only has nearly all of the renewable diesel (RD) and ethanol imports[6] have landed in California but also the large majority of domestically produced RD and Ag Digester renewable natural gas (RNG)[7] have found its way to the state in order to capture LCFS value.

Neste's[8] and Valero's ability to capture high margin and California diesel market share has led to multiple US refiners to vastly increase investment into renewable diesel production and distribution. Per EPA RIN Generation data, domestic RD production rate is roughly 2 billion gallons per year which has a potential LCFS credit generation of over 14 million MT equivalent to 70% of total LCFS credit generation in 2021. The increased domestic RD production has led to retailers offering various high RD blends of 80% to 98% from some of the largest retailers in the state such as 76[9], ARCO[10], Chevron[11], and Propel Fuels[12] at over 1,200 stations located across the state. Ag Digester RNG production has also increased significantly this year to an annual rate of 120 million dge or the equivalent of 9 million MT of potential LCFS credits per year in California's roughly 180 million diesel gallon equivalent (dge) natural gas transportation market.

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[3] CARB LCFS Reporting Tool Quarterly Summaries
[4] CARB, Monthly LCFS Credit Transfer Activity Reports
[5] Valero IR Indicators, Key Commodity Prices (xls link)
[6] EIA Company Level Imports
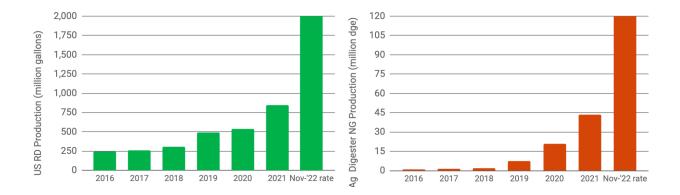[7] EPA Renewable Fuel Standard RIN Generation
[8] Neste Investor Relations
[9] 76 Renewable Diesel Locations
[10] ARCO Renewable Diesel Locations
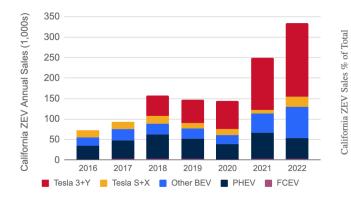[11] Chevron Renewable Diesel Locations
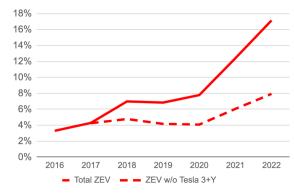[12] Propel Fuels Diesel HPR Locations

These trends are expected to continue through 2023 and 2024 as domestic RD production is expected to exceed California's 3.8 billion gallon diesel market[13] along with multiple Ag digesters being built throughout the US[14] and California[15]. The growth in these fuels will add to potential LCFS credit generation as LCFS credit generation for RD and Ag Digester RNG is currently 7,000 MT per million gallons and 52,000 MT per million dge, respectively.

Electric Vehicle Adoption and a Cleaner Grid

California receives 35% of battery electric vehicles (BEVs) sold in the US[16] and has the highest adoption rate zero emission vehicles (ZEVs) as 18% of new vehicle sales in 2022 are ZEVs (BEV, PHEV, FCEV)[17]. The adoption rate of zero emission vehicles (ZEVs) seem to be on an exponential growth ramp. However if you take out two models (Tesla Model 3, Tesla Model Y) from the sales data, the ZEV adoption growth rate is linear. More BEV models are available but the only non-Tesla vehicle that has sold more than 10,000 vehicles in a year in California is the Chevy Bolt.

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[13] EIA US Renewable Diesel Capacity Expansion
[14] EPA Livestock Anaerobic Digester Database
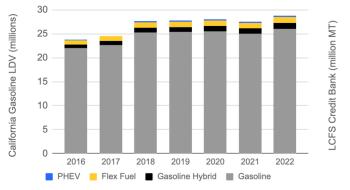[15] CDFA Dairy Digester Research & Development Program
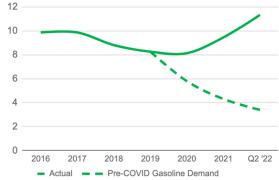[16] Experian Automotive Market Trends: Q3-2022 (pdf link)
[17] CEC ZEV & Infrastructure Statistics, New ZEV Sales

Renewable generation including wind, solar, small hydro, biomass, and geothermal through July has served over 33% year-to-date of the load within California ISO[18] and is forecasted to generate over 72 TWh in 2022, a 70+% increase since 2015 helping drive GHG emissions to serve CAISO loads down 17% since 2016[19]. However nearly 4% of renewable generation or nearly 3 TWh per year is currently curtailed[20] to help balance the load on CAISO between generation and demand throughout the day. Battery storage is expected to help alleviate curtailment to drop the grid avg CI value even further as contracts have also been executed for large-scale battery systems that can generate more than 3,300MW of capacity by the end of 2024[21].

Gasoline Vehicles & COVID Impact on LCFS Credit Bank

Even with the spike in EV new sales, Gasoline capable vehicles (gasoline, gasoline hybrid, FFV, PHEV) still make up roughly 96% of the LDV population or nearly 29 million vehicles on the road[22]. Gasoline is the only fuel sold to the public that is a net deficit generating fuel, meanwhile ultra low sulfur diesel (ULSD) has been a net credit generator since 2013 due to high blending of RD and biodiesel as ULSD sold in California is now over 43% biomass based diesel on the aggregate level. A combination of more FFV drivers using E85, more PHEV drivers driving a higher percentage on the battery, and hybrid or full-on work-from-home employers are implementing to keep employees during a tight labor market, has caused gasoline demand to be down 10% versus pre-COVID levels at roughly 13.7 billion gallons per year[23]. All this leads to gasoline demand having an outsized impact on the LCFS credit bank versus other fuels as the credit bank is now over 11 million MT versus a projected below 4 million MT with the likelihood of the credit bank possibly going to zero or negative within the year if gasoline demand had been at pre-COVID levels for the past 3 years.

[18] California ISO, Monthly Renewables Performance Report (Oct 2022)
[19] California ISO, Greenhouse Gas Emission Tracking Report (pdf link)
[20] California ISO, Managing Oversupply
[21] California ISO, "A golden age of energy storage"
[22] CEC ZEV & infrastructure Statistics, LDV Population
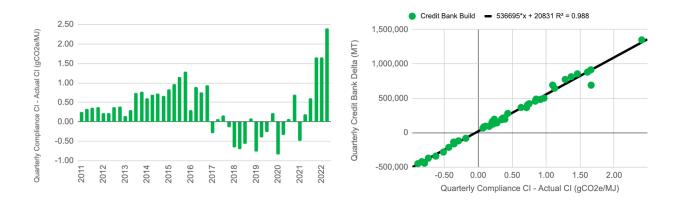[23] CDTFA, Fuel Taxes Statistics & Reports

Auto-Ratchet Carbon Intensity Mechanism
With the expansion of RD production and distribution, growth of negative-CI RNG, increased ZEV sales, and declining gasoline demand, CI reduction progress has ramped aggressively. The volume of credit generating fuels is expected to grow in the near-to-medium term along with declining CI values with the intention to supply California to capture the lucrative LCFS value. With all this in mind, it is going to be extremely difficult for CARB to accurately set compliance CI through 2030 in order to to not strain the LCFS credit bank if the respective fuel does not show up or to disincentivize further investments into low carbon fuel infrastructure if the credit bank gets too high creating a potential massive liquidity issue, therefore I believe an annual auto-ratchet CI mechanism is needed within the regulation.

As pointed out in the letter by CalBioenergy[24] and the combined comments from Audi, BTR Energy GM, and Rivian[25], there will be ample supply of LCFS credits in the bank to help buffer the system by the end of 2023. This is not the first time this type of mechanism has been mentioned. In a 2019 letter to CARB, WSPA wrote the following pertaining to the potential lack of credits, "...we believe it would be more practical and provide more certainty for the regulated community to initiate a systematic method, including measureable triggers, to adjust CI targets (benchmarks)..." [26]. Unlike WSPA, I think this type of mechanism needs to happen only one-way, adjusting CI reduction targets down so that the LCFS can achieve its goals of lowering the CI of the fuel used in the state as well as reducing the dependency on petroleum.

Actual Carbon Intensity CI Reduction vs Credit Bank Build Relationship
In any given quarter when actual CI reduction exceeds compliance by 1 CI point in gCO2e/MJ (i.e. compliance CI = 90 gCO2e/MJ, actual CI = 89 gCO2e/MJ), roughly 536,000 MT are added to the LCFS credit bank and vice versa if actual CI reduction is short of compliance by 1 CI point. This relationship has a 98.8% linear correlation as shown in the scatter plot below.

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[24] California Bioenergy Comments on the July 7, 2022 CARB LCFS Workshop (pdf link)
[25] Audi, BTR Energy, GM, and Rivian Comments on the July 7, 2022 CARB LCFS Workshop (pdf link)
[26] WSPA Comments on the April 5, 2019 CARB LCFS Workshop (pdf link)

Auto Ratchet Metric: Rolling 4-Quarter Energy Weighted Compliance CI - Actual CI Delta

Due to the high correlation between the actual CI and compliance CI delta and the credit bank build, it is appropriate to use this as the metric for an auto ratchet mechanism. The 6 equations below outline a mathematical process to calculate this delta if the rolling 4-quarter energy weighted actual CI, $CI_{WA,q}$, is less than the rolling 4-quarter energy weighted compliance CI, $CI_{WC,q}$, as shown in equation 1 below.

$$CI_{WA,q} < CI_{WC,q} \qquad\qquad \text{equation 1}$$

If triggered, the following year compliance CI, CI_{C+1}, adjusts by the difference by the delta, ΔCI.

$$CI_{C+1} = CI_{C+1} - \Delta CI \qquad\qquad \text{equation 2}$$

The delta is based on the difference between a rolling 4-quarter energy weighted compliance CI, $CI_{WC,q}$, and the rolling 4-quarter energy weighted actual CI, $CI_{WA,q}$, as shown in equation 3.

$$\Delta CI = CI_{WC,q} - CI_{WA,q} \qquad\qquad \text{equation 3}$$

The rolling 4-quarter energy weighted actual CI, $CI_{WA,q}$, is calculated by summing the quarterly gasoline equivalent actual CI, $CI_{A,q}$, multiplied by the respective quarterly total energy, $E_{T,q}$, and dividing the sum by the total energy of the past 4 quarters as shown in equation 4.

$$CI_{WA,q} = \left(\sum_{q=n-3}^{n} CI_{A,q} \times E_{T,q} \right) / \sum_{q=n-3}^{n} E_{T,q} \qquad \text{equation 4}$$

The rolling 4-quarter energy weighted compliance CI, $CI_{WC,q}$, is calculated by summing the quarterly gasoline compliance CI, $CI_{C,q}$, multiplied by the respective quarterly total energy, $E_{T,q}$, and dividing the sum by the total energy of the past 4 quarters as shown in equation 5.

$$CI_{WC,q} = \left(\sum_{q=n-3}^{n} CI_{C,q} \times E_{T,q} \right) / \sum_{q=n-3}^{n} E_{T,q} \qquad \text{equation 5}$$
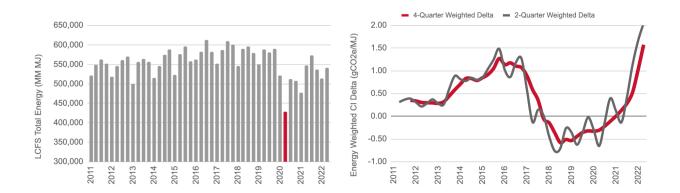
The quarterly gasoline equivalent actual CI, $CI_{A,q}$, is calculated by subtracting the net fuel credit generation, $FC_{T,q} - FD_{T,q}$, divided by the respective quarters total energy, $E_{T,q}$, from the respective quarter compliance CI, $CI_{C,q}$, as shown in equation 6.

$$CI_{A,q} = CI_{C,q} - (FC_{T,q} - FD_{T,q}) / E_{T,q} \qquad \text{equation 6}$$

Variables & Subscripts

$CI_{WA,q}$ = *Rolling 4 Quarter Gasoline Equivalent Actual CI* ($gCO2e/MJ$)

$CI_{WC,q}$ = *Rolling 4 Quarter Gasoline Compliance CI* ($gCO2e/MJ$)

$CI_{A,q}$ = *Quarterly Gasoline Equivalent Actual CI* ($gCO2e/MJ$)

$CI_{C,q}$ = *Quarterly Gasoline Compliance CI* ($gCO2e/MJ$)

$FC_{T,q}$ = *Quarterly Total Fuel Credits* (MT)

$FD_{T,q}$ = *Quarterly Total Fuel Deficits* (MT)

$E_{T,q}$ = *Quarterly Total Energy* ($MM\ MJ$)

The rolling 4-quarter energy weighted rolling CI approach is taken to appropriately adjust to an economic downturn or pandemic such as the near 30% YoY demand destruction in Q2-2020 as pointed out as red in the gray bar chart below. The rolling 4-quarter approach also adjusts for seasonality and is less noisier than a 2-quarter rolling average as seen in the line graph below. If an auto-ratchet mechanism were in place, the CI targets for 2023 and beyond would drop by 1.57 gCO2e/MJ for each year as shown by the red line.
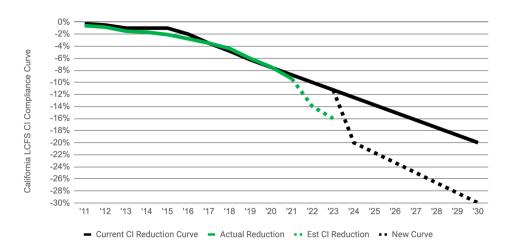

Assuming a 'step down' CI compliance in 2024 and the lag in LCFS quarterly data, the table below outlines the data used for an auto ratchet scenario for 2025 and 2026-2030. Compliance year 2025 could be a little tricky using a rolling 4-quarter energy weighted CI given the slope of the curve pre and post-2024 would be drastically different. Given the auto-ratchet metric is an energy weighted 4-quarter average, the market has ample time to plan accordingly for the following year as Q2 is reported at the end of October. Below is a table representing the quarterly data used to calculate the annual auto-ratchet mechanism for each compliance year from 2024 through 2030.

Calendar Year	2024				n = 2025-2029			
Reporting Quarters			Q1 2024	Q2 2024	Q3 n-1	Q4 n-1	Q1 n	Q2 n
Auto Ratchet Compliance Year	2025				n+1 (2026-2030)			

2024 Compliance Target: The Step Down

Barring gasoline demand ramping back to pre-COVID levels and/or a majority of renewable diesel going elsewhere, the LCFS is expected to significantly outperform in 2022 and 2023 adding 10-15 million MT or more to the credit bank. A major 'step down' in CI compliance to roughly 20% will be needed to get the credit bank to under 3 quarters worth of deficits as well as more in tune where the projected actual CI will be, roughly 80 gCO2e/MJ which is the current 2030 target.

Conclusion & Recommendations

Given the momentum in CI reduction progress and a likely large build in the credit bank, a 2024 'step down' is needed to get to where the market is heading, lower actual CI. An annual auto-ratchet mechanism using a mathematical approach similar to the one presented in this letter is recommended to help further investment into low carbon fuel infrastructure.

Thank you for taking your time to read this letter. If you have any questions regarding what I have presented in this letter please reach out to me at will@carbon-acumen.com.

Sincerely,
William Faulkner