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POLICY INSTITUTE FOR ENERGY, ENVIRONMENT, AND THE ECONOMY

15 March 2023

State of California, Air Resources Board
Regarding: Public Workshop on Potential Regulation Amendment Concepts

Dear Low Carbon Fuel Standard team:

Thank you for the opportunity to comment on the ideas and materials related to the Low Carbon Fuel Standard in California presented in this workshop. The University of California, Davis Institute of Transportation Studies, along with the Policy Institute for Energy, Environment, and the Economy has been engaged in research, policy analysis, and technical assistance relating to alternative fuel policy for well over a decade. 2023 will be a critical year for the LCFS; in addition to the new, higher target we expect to be adopted in the upcoming rulemaking, the program is entering a new phase of its existence, shaping a market that is now fully committed to the transformation of mobility away from dependence on fossil fuels. We commend CARB and the LCFS program staff ("Staff") for holding robust, collaborative workshops like the one on February 22, 2023, which allow stakeholder engagement and focused discussion on a variety of topics. Most of these comments relate to topics identified by Staff at that workshop as being of particular interest. We emphasize that neither UC Davis, nor the Policy Institute for Energy, Environment, and the Economy takes any formal positions regarding regulatory action, and we are not requesting any specific actions or outcomes. We provide these suggestions as guidance, based on our long history of research and engagement on these topics. Please find several comments below, in no particular order.

Scope of 2023 Rulemaking

At the February 22nd workshop, Staff indicated that the scope of the rulemaking this year will be limited to adopting a new 2030 target, and a limited number of additional topics, in order to provide a timely solution to the precipitous decline in LCFS credit prices over the last two years. This stands in contrast to the vision laid out by CARB and the LCFS team over the last five years, which envisioned the 2023 rulemaking as an opportunity to address numerous areas where the program could be substantially improved.

We recognize that the recent decline in LCFS credit price has created a significant impediment that hinders the development of novel low-carbon fuel production capacity, and related investments in sustainable transportation technology. Stabilizing the credit market as CARB's focus reflects an appropriate assessment of the current policy landscape, given the ability of already available fuels to generate credits in substantial excess of what's required for targets.

The low credit price is not the only critical challenge the LCFS faces, however. Staff's presentation on February 22 noted several other areas of critical interest. Many more have been

raised in previous workshops, or by stakeholders - including UC Davis - in the years since the last comprehensive rulemaking in 2018.[1] Many critical analytical assumptions and program parameters, such as Energy Economy Ratios (EERs), Indirect Land Use Change (ILUC) adjustment factors, and fuel displacement assumptions are based on data and research developed during the 2000's; many of these are likely out of date and could be improved by reconsideration in light of new science. Similarly, the portfolio of fuels and technologies that has driven compliance with the LCFS to date is quite different than that envisioned when critical elements of the program were designed. In particular, battery technology has improved more rapidly than expected, while biofuels have encountered more economic, technological and environmental challenges than originally anticipated. The 2022 Scoping Plan sets a course for the State of California to achieve carbon neutrality much sooner than anticipated a decade ago, and the State is moving to adopt policies that seemed implausibly ambitious even in recent memory.

While the LCFS has successfully changed California's transportation fuel mix away from fossil fuels to alternatives rated lower in carbon, the trajectory from here towards a fully decarbonized fleet cannot be taken for granted. Multiple areas of the program's structure will need to be revisited to ensure they align with the best possible science and are capable of continuing to shape the market for state transportation fuels towards those ambitious goals. Fuel policy must be made on an extremely long-time horizon, since it takes years to move a project from concept to commissioning, and then those projects will need years of effective policy support once in operation to recoup their capital investments. For that reason, a commitment by CARB to undertake a re-examination of areas of the LCFS where changes in the market, and the science, suggest room for improvement would help provide assurance that topics not dealt with in 2023 are nonetheless firmly in CARB's scope for the near term. Since the last major LCFS rulemaking in 2018, we, along with other stakeholders, have identified several areas where the functionality, credibility, or stability of the LCFS could be enhanced. If the present credit market crisis means that the opportunity for a more comprehensive review of the program must be delayed, providing a timeline for when this will happen would allow the stakeholder community to adjust its planning accordingly. Given that several critical areas of the LCFS likely require additional research to develop effective solutions, having a clean timeline for when these solutions will need to be ready for implementation would allow the research community the opportunity to maximize the effectiveness of upcoming research. Setting a timeline for the opportunity to engage in some of these more complex issues would also allow stakeholders to focus on the urgent need to stabilize the market in the current rulemaking.

[1] See, for example, UC Davis comment letters submitted in response to the 2022 workshops on August 8, September 9, October 7, and November 9 .

2030 Target Setting

At the February 22 hearing, Staff presented outputs from the CATS model related to a proposed 30% 2030 target (Slides 45-51 in the Staff Presentation). The material presented provided preliminary results, including projected fuel volumes and credit price impacts for a scenario in which a 30% 2030 target was adopted. We note generally strong agreement between CATS projections presented here and results from the ITS-Davis Fuel Policy Scenario Model (FPSM).[2] Notably, the CATS model projects around 1.7 billion gallons of CARBOB consumption in 2045, which is in line with the High-ZEV scenario projections from FPSM. We note that production and consumption of 1.7 billion gallons of petroleum-based CARBOB yields about 20 million metric tons of CO_2 across its full life cycle. While this is not, by itself, in excess of feasible potential in-state carbon capture and sequestration (CCS) or carbon dioxide removal (CDR) potential, it would represent a significant fraction of likely available resources under most scenarios. Achieving carbon neutrality vis-a-vis in-state emissions is likely to be very challenging and requires a great fraction of potential CCS and CDR capacity to neutralize on-road vehicle emissions.

More importantly, however, is the CATS projection of LCFS credit prices under a 30% 2030 target (Slide 51 in the Staff presentation). This slide shows that between 2026 and 2033, the credit price would, if unconstrained, rise above the price ceiling established in the regulation. These results seem best interpreted not at face value, but in the context of the price ceiling and other cost-containment measures aimed to prevent credit prices from rising that high. Additionally, the version of CATS presented here does not include any modeling of credit banking behavior and the effects of potential future regulations such as the Advanced Clean Fleets rule. These factors, combined with inherent limitations and assumptions in the optimization structure of CATS would typically be expected to bias the results towards higher prices. This is to say, when considering the factors outside of the scope of the CATS model, we do not believe that it is appropriate to interpret Slide 51 as predicting that the credit price would exceed $450 per metric ton in the late 2020's, absent the presence of the price cap and other cost containment measures.

A more appropriate interpretation of slide 51 is that the aggregate supply of credits may struggle to keep up with deficit generation during the late 2020's and early 2030's. This implies a somewhat higher likelihood of high LCFS credit prices or the activation of cost-containment mechanisms like the Credit Clearance Market or the Advance Credit mechanism. The results in slide 51 argue caution regarding the maximum ambition of an increased 2030 target. The results from the CATS model should be interpreted as finding that under a 30% 2030 target, the market is likely to struggle to develop enough credit generation capacity to meet increasingly

[2] See Modeling 2030 LCFS Targets for preliminary results of FPSM 2030 scenario modeling, as well as our comment submitted following the November 9, 2022, workshop for additional discussion on this topic. We are currently updating vehicle fleet and VMT projections and expect additional results shortly.

stringent obligations. This aligns with results from FPSM modeling, which found five key areas of sensitivity underpinning 2030 credit projections:

1. In-state EV deployment rates.
2. VMT and fuel consumption trends.
3. Renewable diesel and sustainable aviation fuel (SAF) carbon intensity.
4. Project-based credit growth.
5. Livestock renewable natural gas (RNG) growth trends.

If all of these areas perform at the upper end of their plausible ranges, then attaining a 30% target is eminently feasible. If one or more underperform projections, then the risk of significant and persistent aggregate deficits, credit prices near the ceiling, or triggering cost containment mechanisms increases. Underperformance by one or more of the five key areas of sensitivity is entirely possible even without the presence of an unusual forcing event, e.g., the COVID-19 pandemic, or significant economic instability. Two of these areas of uncertainty have a history of under-performing relative to projections; California has struggled to meet VMT reduction targets and project based credits have underperformed the levels CARB projected in its 2018 Illustrative Compliance Scenario calculator exercise, part of the analysis underpinning original 2030 target-setting. Additionally, at the February 22 workshop, Staff indicated an interest in constraining the availability of avoided methane credits from livestock-based RNG projects. If measures like this are adopted, it could slow the growth of RNG derived credits. Taken together, this means three of the five areas of uncertainty have either demonstrated underperformance relative to projections in recent history, or may be constrained by anticipated changes in the upcoming rulemaking.

Taken together, these factors present an argument for caution when setting 2030 targets. While there is strong agreement between both CATS and FPSM that a 25% target is likely too low and may not provide significant upward pressure on credit prices, current results from both models indicate real risk that a 30% target may require active use of, and perhaps stress, current cost containment mechanisms under some highly plausible market and technology conditions. Following this modeling would argue in favor of a 2030 target between 25% and 30%. Staff and stakeholders have discussed an auto-ratchet mechanism that could incrementally raise targets if additional ambition is warranted. Combining a target in the 25%-30% range with such a mechanism, if appropriately designed, could maximize the program's resilience in the event of underperformance by one or more critical credit generation sectors, while escalating the target if the current trend of net credit over-generation continues.

Design and Implementation of a Target Auto-adjustment Mechanism

Currently, the LCFS has several mechanisms to limit the credit price below a ceiling price, but there is no mechanism to establish a floor price. Numerous stakeholders have expressed backing for the idea of an automatic target adjustment mechanism, often referred to as a

"ratchet" or "auto-ratchet" mechanism. The core concept is to provide some upward pressure on credit prices by increasing targets when specified market conditions are observed. The idea is to build in a response to sustained over-generation of credits relative to deficits that would be more predictable and occur more quickly than rulemaking timelines would allow.

At the February 22 workshop, Staff asked "*What market indicator would serve as the best trigger for increases in stringency, and over what time period?".* This question is complex, as we are unaware of any similar auto-ratchet mechanisms that might provide a useful precedent or basis for comparison in LCFS or similar programs. Proposals that have been suggested by stakeholders include basing the trigger condition on credit price, aggregate volume of banked credits, net credit balance, or four-quarter energy-weighted carbon intensity (CI) reduction differential.[3] The proposed mechanism would incrementally increase the target by a specified amount in subsequent years when the triggering conditions were met. By increasing the target, deficit generation in future years would increase and credit creation would decrease, moving the annual aggregate credit balance toward a more deficit-heavy position. Given that the mechanism impacts the market by adjusting the annual net balance of credits, basing the triggering mechanism on annual balance as well may result in target increases that more precisely address the underlying credit dynamics that would otherwise drive credit prices down.

As part of the evaluation of different trigger criteria and mechanisms of action, Staff should consider the circumstances in which such an auto-ratchet mechanism could trigger a target increase that would ultimately prove to be unwanted, given long-term trends and California's progress toward its climate goals. For example, if technology developments led to the deployment of significant new sources of very low-cost carbon intensity reduction in the transportation fuel sector, the credit price would be expected to go down, since a core goal of a market-based performance standard like the LCFS is to achieve compliance with specified targets at the lowest possible cost to consumers. In the event that a hypothetical low-cost compliance option were to emerge, a credit price based target acceleration trigger could force up credit prices well above the minimal cost of compliance. An auto-ratchet mechanism triggered by low prices without consideration of underlying market dynamics could end up driving up costs to consumers, even if such costs were not necessary for California to attain its critical climate change targets. Similarly, basing the target on aggregate bank size could create an incentive for participants in the LCFS market to bank and hold fewer credits, rather than triggering additional target increases. Credit banking is not, in and of itself, a harmful activity. Banked credits represent emissions reductions in advance of regulatory requirements, and provide a buffer against unexpected credit shortfall. Reducing an existing bank via an auto-ratchet mechanism may help support a stronger LCFS credit price, but at the same time the tightened targets from that point forward would provide a counter-incentive to hold onto banked credits for the future. In short, a draw-down of existing banked credits is not a goal in and of

[3] The latter essentially uses a measure of recent actual CI % reduction relative to the regulatory target.

itself, and a changing calculus for use of banked credits, if not predictable, could undermine the stabilizing role this plays to the market.

In addition to considerations of the relative efficacy of different program designs, Staff must also consider the potential for any auto-ratchet mechanism to be leveraged for private benefit by market participants. Figure 9 in the LCFS Data Dashboard shows that according to the most recent data, the three largest holders LCFS credits control over one-third of banked credits, over four million credits in total. At the time of this writing, we are not aware of any literature regarding the existence or exercise of market-setting power in environmental instrument markets that offers clear guidance on whether this constitutes sufficient market-setting potential to allow these actors to exert undue influence over whether or not a target adjustment under an auto-ratchet mechanism would or would not happen in a given year. We have not thoroughly examined how such influence might be wielded in this context, and with what implications. Given evidence of discrepancies from expectations of competitive behavior in California's transportation fuel sector, the possibility of such influence cannot be discarded out of hand.[4] Any proposed auto-ratchet mechanism must be evaluated through the lens of competitive dynamics and game theory to ensure that it cannot be leveraged in a way that works against consumer interests or California's attainment of critical climate policy goals. Careful and risk-aware program design should be able to effectively mitigate these risks, however, and allow an auto-ratchet mechanism to have its intended, salutary effect.

Interaction with Proposed RFS Updates

Recently, the Environmental Protection Agency (EPA) proposed new rules for the Renewable Fuel Standard (RFS) program. The EPA proposed Renewable Volume Obligations for 2023-2025 and other changes. Notably, the proposal includes regulatory changes to prescribe how RINs from renewable electricity (eRINs) would be implemented and managed under the RFS program. Currently, the EPA included in its proposal the generation of eRINs only from renewable natural gas (RNG) or biogas, usually produced by anaerobic digestion of organic wastes or from landfills. While the eRINs are not fully implemented yet under the RFS program, the proposed changes may affect the current biogas and RNG market in ways that will also affect the LCFS.

Over the last decade, supply of biogas and RNG in the United States has increased in part, due to the support of policies such as the RFS, California's LCFS, Oregon's Clean Fuels Program, and Washington's Clean Fuel Standard. It is likely that the eRINs would incentivize expansion in biogas and RNG production from qualifying organic materials, and potentially incentivize existing or new biogas and RNG producers towards electricity generation as an end-use instead of using the RNG directly or pipeline injection to displace consumption of fossil natural gas. The expansion of biogas and RNG production may reduce relevant methane emissions from unregulated decomposition of organic wastes, and the availability of eRINs could support efforts

[4] https://www.energy.ca.gov/publications/2017/petroleum-market-advisory-committee-final-report-december-2014-november-2016

by existing biogas and RNG producers to further reduce fugitive methane emissions. Prospective producers who are lacking direct access to the pipeline system or looking for an opportunity to reduce financial burdens from upgrading the biogas and RNG may be able to install a digester and thereby reduce fugitive methane emissions due to the availability of eRINs where they otherwise might not.

The addition of eRINs would be expected to accelerate the growth of the biogas and RNG supply, as would the deployment of policies like the LCFS in other jurisdictions. Some of this growth could come to market in California via book-and-claim accounting, as either RNG or RNG-derived electricity, though the availability of eRINs could incentivize producers with access to grid interconnection outside of the Western U.S. to pursue other markets to take advantage of the value provide by eRINs. Using the RNG produced by anaerobic digestion as a vehicle fuel, with or without the intermediate step of conversion to electricity, may not be the optimal use of this resource. For example, generating electricity via combustion in a reciprocating engine (as is the typical practice) entails an energy loss due to the relatively low thermodynamic efficiency of combustion. Use of RNG as a fuel directly by a vehicle also entails these efficiency losses, and also supports the continued use of internal combustion powertrains which emit more pollutants and typically have a poorer life cycle GHG footprint than comparable ZEV vehicles, especially battery electric ones. Without credits for avoided methane emissions (which are inherently temporary, and will be discussed in more depth later), RNG offers moderate life cycle GHG benefits as a transportation fuel, with carbon intensity scores typically between 25-50 g CO_2e/MJ. While this is significantly lower than petroleum, it is significantly higher than renewable, or even current grid average electricity over a full fuel cycle, and RNG does not have a plausible pathway to achieve zero emissions over the long run, which means it could may not have a role in the state transportation fuel portfolio in 2045, if California attains its goal of carbon neutrality.

Beyond the challenges RNG faces as a vehicle fuel, there are some sectors which are hard to electrify and need the methane as a feedstock, such as for chemical, fertilizer, or hydrogen production. If biogas or RNG is consumed in the transportation sector, it is not available for these uses in other sectors of the economy, and the demand for methane may need to be fulfilled by fossil NG. RNG may serve a particularly critical role as a feedstock for low-GHG hydrogen, which can be a transportation fuel or a critical input to renewable diesel and sustainable aviation fuel production, as well as an industrial chemical in non-transportation applications. The 2022 Scoping Plan recognizes this, as demonstrated by the figure shown on slide 30 and the text on slide 31 of the Staff presentation on February 22, 2023. Ultimately, this implies that the eRIN proposal under the RFS could push RNG toward transportation applications to the exclusion of other applications that CARB has identified as important for the attainment of California's long-term climate goals.

The eRIN proposal will not only tend to push more RNG or biogas towards the transportation sector, but it will also incentivize it to enter the transportation market as electricity used to

charge EVs. While the use of low carbon feedstocks like biogas for the purpose of electricity generation can yield environmental benefits, close scrutiny is needed to ensure that the integrity of the LCFS program is maintained. In particular, the additionality of such benefits may need to be carefully examined. If, for example, an existing RNG project that was using its product to fuel vehicles or generate electricity to sell to the grid or use on-site elected, in light of the new eRIN provision, to generate electricity for sale as vehicle fuel in California, the creation of that electricity may not be considered additional under well-established principles of LCA accounting, or the additionality of the new electricity may be contingent on the loss of the energy or environmental value provided by the previous use.

There is also a risk that due to analytical assumptions underpinning LCFS pathway certification that the switch from direct use of RNG to the use of electricity generated from RNG could result in GHG impacts as assessed by regulatory programs that diverge from real-world emissions. Avoided methane credits deserve particular attention in the case of RNG-to-electricity pathways. Many RNG pathways receive some credit for reducing fugitive flows of methane that would otherwise be released into the atmosphere. Under the current methodology, the avoided methane credit is included in the pathway certified carbon intensity, which is one input into the crediting equation presented in § 95486.1 (a) (1) of the regulation text. The pathway-certified carbon intensity is subtracted from that year's standard, then multiplied by the EER of the relevant powertrain, as well as a unit-adjustment constant to yield the credits per unit of delivered energy.[5] This means that the emission-reducing value of the avoided methane is multiplied by the EER in order to arrive at the number of LCFS credits per unit of delivered fuel.

In practice, this means that the LCFS could assign a greater carbon-equivalent value for avoided methane when used to make electricity that is used in a heavy-duty truck or bus, than if the same amount of gas were used to make electricity used in a light-duty vehicle, or if the same amount of methane were directly loaded onto a vehicle for use as fuel. This creates a disconnect between physical reality and the assessed GHG impact; the amount of fugitive methane avoided by the consumption of a specified amount of RNG does not vary depending on whether that gas is consumed directly or converted to electricity first. Nor does the amount of avoided methane vary depending on whether the electricity generated by its combustion is used in a light-duty or heavy-duty vehicle. The expected expansion of RNG-to-electricity pathways given the availability of eRINs means that more projects that would be eligible to generate LCFS credits for avoided fugitive methane are likely to enter the market. The counterintuitive and unscientific treatment of avoided methane credits in this limited subset of cases creates an opportunity for project operators to receive LCFS credits for nominal emissions benefits that greatly overstate actual impact.

We note that the Fractional Displacement crediting concept we published in December 2022 and discussed in our comment on the November 9th, 2022 workshop, eliminates this loophole

[5] EERs for electric vehicles are specified in the regulatory text, with 3.4 used in light-duty vehicle applications, and 5.0 used for heavy duty trucks and buses.

by quantifying fuel displacement effects and carbon intensity effects via separate terms in the critical equation; carbon intensities of produced fuel are not multiplied by EER in this method, meaning that avoided methane credit is applied in an additive fashion that better aligns with actual emission impacts. The loophole could also be closed by specifying that avoided methane credits are tracked and quantified separately from pathway certified CI scores, and only added to per-unit credit generation after the effects of EER are considered.

Eligibility for Avoided Methane Credits

During the February 22, 2023 hearing, Staff sought feedback on proposals to phase out avoided methane credits by 2040, and accept no new pathway applications after 2030, though existing pathways could be renewed for up to five years. Additionally, Staff sought feedback on deliverability requirements regarding pipeline flow direction that would align LCFS standards with existing RPS tracking provisions. Harmonizing LCFS provisions with those used in other climate policy programs can help reduce policy complexity and ensure that programs send compatible signals. While the proposed phase-out of avoided methane credits nominally responds to comments made by multiple stakeholders, the timeline for phase-out seems unlikely to make a significant impact on the generation of such credits. California, like most jurisdictions, will need to take focused steps to reduce emission of fugitive methane in order to achieve critical climate targets. To date, the state has chosen to use a primarily incentive-based approach, emphasizing voluntary compliance with program targets. There is little evidence however, that voluntary compliance mechanisms alone will yield the magnitude of methane emission cuts required for California to achieve its climate goals. Additional regulation may be adopted in California or elsewhere before 2040, which would render the avoided methane credits non-additional before the phase-out under the LCFS. As such, the targeted phase-out may not yield an appreciable difference in the availability of avoided methane credits.

We also note that methane reduction policies like the Short-Lived Climate Pollutant Reduction Plan, organic waste diversion requirements, and livestock methane reduction requirements will support the broad deployment of anaerobic digesters across a variety of economic sectors, and applications, as well as additional policy support to ensure the financial viability of such projects. While there was clear evidence in the past that digester deployment required significant policy support from programs like the LCFS, expectations about the required level of policy support should be reviewed in light of the changing policy and technology landscape in this sector.

Crop-Based Fuel Concerns

At the February 22 Workshop, Staff reported on multiple comments related to the possibility of a cap on crop-based feedstocks, particularly vegetable oils. Several stakeholders commented during the workshop expressing that they felt that existing LCFS ILUC adjustments provided sufficient protection against biofuel-driven land use change impacts causing environmental harm. While the LCFS does apply ILUC adjustments to fuels made from specified feedstocks,

these adjustment factors are primarily based on studies that are nearly a decade old. Land use change impacts from biofuel production is an area of significant complexity and uncertainty. The literature on these topics is still evolving and is subject to substantial uncertainty. The science on this topic is still not settled and is not likely to be in the near future, since climate-driven shifts in agricultural production and evolution in global agricultural commodity markets mean the dynamics underlying ILUC assessment will continue to shift. As such, ILUC assessments and risk mitigation strategies will need to be constantly reviewed. It is unrealistic to expect that ILUC adjustment factors developed in the 2010s will necessarily be sufficient to protect against unwanted ILUC risk moving forward.

There has been a lot of published research on the topic over the last several years, and the studies like the one from the National Academies workgroup on biofuel LCA [6] have indicated that there are significant uncertainties remaining in the ILUC emissions. It is not clear yet that the existing LCFS ILUC provisions are adequately protective against the risk of harmful emissions from the land conversion, which may lead to unexpected results for food production or deforestation, and the scientific debate about the topic is on-going. Vegetable oils, such as soybean or canola are an area of particular uncertainty, since demand for these is growing rapidly, and there is a high degree of fungibility between different types of vegetable oil. Estimates of ILUC effect show extremely high uncertainty depending on the model used, the underlying analytical assumptions for each model, and the datasets used to calibrate each model. There is no clear consensus in literature regarding how to resolve this uncertainty in a way compatible with implementing adequate ILUC risk mitigation via a single, static ILUC adjustment factor, as done by the LCFS. While such a consensus could be developed through additional research and consultation, an effective solution is implausible within the timeframe anticipated for the upcoming LCFS rulemaking.

Without such a solution immediately available, and with clear awareness that existing ILUC provisions may not be sufficiently protective, a blunt measure like a cap on crop-based feedstocks may represent a viable option to mitigate ILUC risk. We have discussed such an option in previous comment letters and will refer to them rather than restating that discussion.[7]

Streamlined Implementation

At the February 22 workshop, Staff presented concepts related to streamlining implementation. The proposals regarding electric forklifts deserve particular note. Staff suggested changing the baseline carbon intensity against which forklifts with capacity <12,000 lb are measured, as well as a 50% reduction in the EER for forklifts in this capacity class. These measures have the

[6] National Academies of Sciences, Engineering, and Medicine. 2022. Current Methods for Life-Cycle Analyses of Low-Carbon Transportation Fuels in the United States. Washington, DC: The National Academies Press. https://doi.org/10.17226/26402

[7] In particular, see our comment letters submitted following the August 8, and November 9, 2022 workshops.

potential to address the high level of credit generation from the e-forklift class relative to its relatively small share of the total transportation fleet or energy usage, as well as reduce administrative burdens on forklift of charging infrastructure owners. We question, however, whether this sort of ad-hoc adjustment by rulemaking accomplishes the stated goal of regulatory streamlining. Even if these changes achieve stated goals for e-forklifts, they will need to be repeated for additional categories of the transportation sector, such as eTRUs, eCHE, and various subcategories of on-road vehicles as each reach higher ZEV penetration rates. Each specific intervention may be comparatively simple, but the combination of interventions across multiple vehicle or fuel classes could lead to a complex patchwork of sector-specific regulation, resulting in additional complexity. Adopting a single, comprehensive approach that works across most or all sub-classes and uses a consistent quantification method would create greater market stability and certainty than a series of ad-hoc solutions. By making a single, technology-neutral adjustment to the credit quantification method, issues relating to excessive credit generation *vis a vis* market share of a given technology or its need for additional policy incentives could be greatly reduced. Market participants would be able to recalibrate their projections of LCFS credit market supply and demand dynamics with less uncertainty about future rulemaking changing credit generation from specified sectors of the market, leading to a more stable and effective policy incentive. We submitted a proposal for such a method, Fractional Displacement crediting, along with our comments responding to the November 9th 2022 workshop, and will refer to them rather than explaining here.

Medium and Heavy-duty Refueling Infrastructure Assumptions

The February 22, 2023 workshop provided some additional detail regarding additional MD/HD refueling infrastructure capacity credit provisions. We reiterate our comments from our August 8 and November 22, 2022 letters: That infrastructure capacity provisions depart from the core principle of providing LCFS credits for actual and quantifiable emissions reductions, that such provisions introduce potential market imbalances, and that little if any data has yet been provided to demonstrate the efficacy or cost-effectiveness of these measures. Including additional credits from capacity incentives, without the addition of corresponding deficits will exert downward pressure on credit prices in the short term and complicate efforts to ensure a balanced and stable market over the long term. There has been an insufficient amount of justification provided to justify the magnitude of infrastructure capacity credit incentives relative to the benefits they provide.

In particular, we see little consideration of the aggregate financial impact of these provisions, or whether this impact provides appropriate or well-targeted incentives. FPSM modeling, which as discussed above appears to generally agree with similar projections by the CATS model, indicates that under most target scenarios, the LCFS program will generate between 40 and 45 million deficits per year in the early 2030's. In almost every scenario, deficit generation exceeds 40 million metric tons per year for 5 or more years. Under a cap of 2.5% of prior year deficits, this implies that MD/HD FCI and HRI could each receive over one million credits per year from

these provisions. Assuming LCFS credit prices between $100 and $200, that means that $100-200 million per year could flow through infrastructure capacity provisions, to a very narrow set of projects, for at least 5 years in the 2030's, with somewhat smaller revenue flows in years before and after the period of maximum credit generation. While we recognize the critical need to support ZEV refueling infrastructure, especially in the short term, we are unaware of modeling that shows this level of commitment is necessary or warranted so far in advance. By the early 2030's, more than 5 million ZEVs will be on the road, per projections based on ACC2, with significant numbers of MD and HD ZEVs due to the effects of the Advanced Clean Trucks and Advanced Clean Fleets regulations. Millions more will be added each year, due to anticipated sales fractions well over 50% in most light and medium duty vehicle classes. Given the robust and rapidly-growing demand implied by these vehicle fleet trends, conventional LCFS pathway-based crediting for dispensed fuel will deliver many millions of dollars of policy incentive already. Committing to additional HRI and FCI pathways now means that the majority of revenue from these provisions will be arriving after there is a large and rapidly growing fleet of vehicles utilizing the infrastructure. That is to say, the greatest impact of a policy meant to support deployment of infrastructure in advance of vehicles will arrive several years after the deployment of such vehicles. Adopting additional HRI and FCI provisions under an expanded target would commit the state to the potential for hundreds of millions of dollars being transferred from gasoline consumers to fueling infrastructure owners, based on an understanding of market dynamics that will be a decade old once peak revenue flows occur.

A more limited and targeted approach may be able to meet critical infrastructure needs without as much impact on consumer fuel prices. For example, a stronger requirement that capacity credit revenue does not exceed actual station costs, or reducing the maximum number of credits over a specified period of time after the fleet reaches critical milestones of ZEV deployment would ensure that LCFS capacity credit revenue does not provide incentive disproportionate to its value in supporting a transition to a ZEV-dominated fleet. Additionally, a shorter time horizon for crediting, particularly for HRI, would reduce the risk of significant payments continuing through the 2030's, long after the fundamental rationale for such payments may no longer apply.

Inclusion of Intrastate Jet Fuel Under the LCFS

Staff have requested feedback on the possibility of including jet fuel for intrastate use under the LCFS. At present, conventional jet fuel is not covered under the LCFS but lower-carbon alternatives can opt into the market as credit generating fuels. The opt-in status effectively creates a one-way flow of revenue from deficit generating fuels, predominantly gasoline, to aviation fuels. This flow creates concerns regarding the equity of having consumers of on-road fossil fuels bear the costs of supporting the transition to more sustainable aviation. Including intra-state jet fuel ensures that the aviation sector contributes to the aggregate flow of revenue through LCFS credit markets, and moves toward a model in which high-emission subsectors of transportation make a proportionate commitment to decarbonization.

We note that fuel portfolio scenario modeling done as part of the work published in the *Driving California's Transportation Emissions to Zero by 2045* report considered intra-state jet fuel as part of the pool of fuels that had to be decarbonized for California to achieve its long-term climate goals. While there was some competition for feedstocks and production capacity between hydrotreated lipid renewable diesel and hydrotreated lipid SAF, the state was able to successfully transition to a fuel portfolio that achieved long-run carbon neutrality targets even with this competition. Ongoing work at the Policy Institute, that we expect to be published in Summer 2023, will explore these competitive dynamics and their impact on air quality in more depth. To date, we have found no evidence that the inclusion of intra-state jet fuel and a significant expansion of low-carbon alternative jet fuel consumption would create unresolvable challenges for California's long-run transition to carbon neutrality.

Thank you again for the opportunity to provide comments on the material presented at the LCFS workshop. We appreciate the discussion this process has fostered so far and look forward to continuing our dialog through the coming year. If we can offer any additional assistance or clarify any of the material in this comment, please do not hesitate to reach out to Colin Murphy by email at cwmurphy@ucdavis.edu.

Signed,

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