November 4, 2020

RE: International Council on Clean Transportation comments on **the Low Carbon Fuel Standard (LCFS) workshop on October 14-15, 2020.**

These comments are submitted by the International Council on Clean Transportation (ICCT). The ICCT is an independent nonprofit organization founded to provide unbiased research and technical analysis to environmental regulators. Our mission is to improve the environmental performance and energy efficiency of road, marine, and air transportation, in order to benefit public health and mitigate climate change. We promote best practices and comprehensive solutions to increase vehicle efficiency, increase the sustainability of alternative fuels, reduce pollution from the in-use fleet, and curtail emissions of local air pollutants and greenhouse gases (GHG) from international goods movement.

The ICCT welcomes the opportunity to provide comments on the Air Resources Board's October 14-15 LCFS workshop. We commend the agency for its dedication to reducing greenhouse gas (GHG) emissions and petroleum use in the transport sector by seeking to continually improve the LCFS. The comments below offer a number of technical observations and recommendations for ARB to consider as it reviews the stakeholder proposals presented at the workshop.

We would be glad to clarify or elaborate on any points made in the below comments. If there are any questions, ARB staff can feel free to contact Nik Pavlenko (n.pavlenko@theicct.org) and Dr. Stephanie Searle (stephanie@theicct.org).

Stephanie Searle

Fuels Lead

International Council on Clean Transportation

**Summary of comments**

On October 14-15, LCFS stakeholders presented a number of proposals to expand crediting opportunities in the LCFS program. Two of the proposals pertained to crediting GHG reductions in crude oil production and supply, 2 for providing advance credits for advanced decarbonization technology capital construction, and 1 for crediting farms that supply biofuel facilities and have a lower carbon intensity (CI) compared to the national average.

ICCT does not support Farmer Business Network's (FBN) proposal to allow LCFS crediting for farms that have a lower CI than the national average for that crop. There are two major problems with this proposal: shuffling and cherry-picking. FBN's proposal would incentivize Californian fuel suppliers to switch to biofuel supply chains sourcing from farms that already have very low CIs (likely due to naturally high yields in some regions). It would also incentivize lower-than-average CI farms to report their CIs, and higher-than-average CI farms not to report (cherry-picking). Both these problems would result in LCFS credits being awarded without any real GHG reductions taking place.

In these comments, we present a new quantitative analysis estimating the effect that shuffling, cherry-picking, and real GHG reductions could have on the LCFS program if FBN's proposal were implemented. Our results are summarized in Figure 1. The four scenarios shown in Figure 1 show the full range of outcomes that could result from FBN's proposal, with combinations of shuffling, cherry-picking, and real GHG reductions. The brown parts of the columns show the maximum number of LCFS credits (in thousands) that could be awarded due to shuffling or cherry-picking without any real GHG reductions. The blue parts of the columns show the maximum actual GHG reductions that could be incentivized by FBN's proposal. The diamonds show the share of LCFS credits awarded for farm-level CI reporting that represent real GHG reductions.

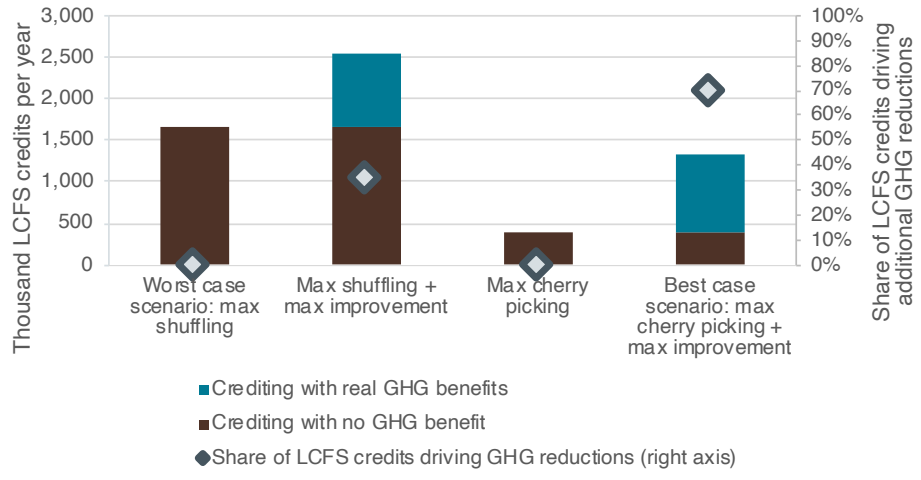


**Figure 1: Estimated effect of farm-level LCFS crediting on LCFS credit generation and GHG emission reductions.**

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We see that it is possible for nearly 1.7 million LCFS credits, equivalent to 11% of total LCFS credits generated in 2019, to be awarded due to shuffling with no GHG reductions achieved at all. This could substantially weaken the LCFS program. In the absolute best case scenario, 70% of credits given for farm-level CI reporting would be for real GHG reductions. In reality, we expect that, if FBN's proposal were implemented, the outcome would be somewhere in between our worst and best case scenarios.

While ICCT does not recommend ARB adopt FBN's proposal, should ARB instead choose to do so, we have an additional recommendation to greatly reduce the LCFS credit loss due to shuffling and cherry-picking. In this case, we recommend that ARB introduce an additionality requirement, only crediting a modeled CI reduction that would occur in response to a specific new action taken by a farm to reduce its GHG emissions.

ICCT does not recommend that ARB adopt Norsepower and California Jet Oil's proposals to credit wind propulsion for crude oil tankers and water jet oil production technology, respectively. Both practices are likely to increase in the absence of the LCFS program.

ICCT agrees with the general concept presented by Oxy and Virent to provide advance LCFS credits for the construction of facilities for CO2 direct air capture and emerging advanced alternative fuel technologies, respectively. Providing this kind of additional support for emerging advanced technologies would help California achieve its deep decarbonization goals by accelerating the commercialization of ultra-low carbon pathways. In addition, it would directly address a problem these advanced technologies commonly face: having high capital costs and difficulty attracting private investment. ICCT strongly recommends that advance credits only be provided for the use of alternative fuel feedstocks that have not yet been commercialized and for renewable electricity using advanced technologies. We have some further specific recommendations for how this proposal could be implemented to better protect the LCFS program and ensure the highest efficiency in use of these advance credits.

**Comments on the presentation by Farmers Business Network (FBN)**

FBN presented a proposal for ARB to grant additional LCFS credits to biofuel producers using corn from farms with GHG emissions lower than the national average. FBN focused on corn ethanol in their presentation. The LCFS program currently does not account for differences in carbon intensities (CIs) at the farm level; instead, it assigns the nation-wide average CI of corn production to all corn ethanol facilities. Here, we provide a quantitative assessment of the number of LCFS credits that could be given to farms and the additional GHG reductions that would be provided if FBN's proposal were implemented by the entire corn ethanol industry supplying California. Like FBN, we also focus on corn as the example crop in our analysis.

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FBN's proposal would be perfectly logical if all farms in the U.S. had exactly the same CI. Then, one could be assured that any measured reduction in CI at one farm compared to the national average would be do to real GHG reductions.

The core issue at hand is existing CI variability among farms. FBN presented data on the CI values for the 66 farms supplying Poet's corn ethanol facility in Chancellor, South Dakota, and these CIs ranged widely from approximately 13 – 45 gCO2e/MJ, calculated using the GREET model. This is a problem because corn ethanol facilities sourcing corn from farms that already have CIs below the national average could generate LCFS credits without delivering any additional GHG reductions than they already do with their current behavior. According to FBN's proposal, corn ethanol facilities could choose to either report their CIs or use a "default" CI. The default CI would be set at the national average in year 1, increasing to 1 gCO2e/MJ above the national average by year 5. Facilities sourcing high-CI corn would thus not be penalized in the beginning of implementation of this proposal, and would only be slightly penalized later. Therefore, this proposal likely over-credits the "upside" of at-farm CI reductions without factoring in the downsides of higher-than-average farms.

There are two main avenues LCFS credits could be awarded without actual GHG reductions taking place:

1. Shuffling: corn ethanol facilities sourcing corn from already-low CI farms will shift to supplying California. Facilities sourcing higher-CI farms will shift to supplying the rest of the U.S. and export markets.
2. Cherry picking: corn ethanol faciltiies sourcing corn from already-low CI farms will report their low CIs to generate LCFS credits. Facilities sourcing from higher-CI farms will not report and will utilize a default national-average farm CI when calculating the CI of their overall ethanol supply chains.

FBN's proposal would of course also introduce the incentive for farms to reduce their CIs by, for example, reducing nitrogen application. In such cases, at least a portion of the LCFS credits awarded to ethanol producers sourcing from such farms would be for real GHG reductions. FBN cites a study by Argonne National Laboratory (ANL) researchers estimating that a nationally average farm could reduce its CI by a maximum of 10 gCO2e/MJ if it adopted all best practices that can be modeled in the GREET model. It is important to note that FBN is not proposing that soil carbon changes be included in this new LCFS crediting option, and the 10 gCO2e/MJ only includes other actions modeled by GREET. FBN has suggested that ARB could consider LCFS crediting for soil carbon changes at a later point.

Now we present our methodogy for assessing the number of LCFS credits that could be given to the corn ethanol industry for on-farm CI reporting and the amount of real GHG reductions that are possible. Again, we focus our analysis on corn ethanol, but our findings are likely generally applicable to any type of crop-based biofuel.

In our analysis, we simulate the CIs of all corn farms in the U.S. This is not a simple task as CIs are not commonly measured or reported at the farm level. We are not aware of any large-scale datasets of farm-level CIs. For our simulation, we use two main inputs:

1. County-level 2019 corn yield data from the United States Department of Agriculture (USDA) National Agricultural Statistics Service (NASS).[1]
2. The variability in CI among farms supplying Poet's Chancellor, SD facility, as presented by FBN.

The corn yield data is important because yield is one of the main determinants of farm CIs in the GREET model. A farm with a higher corn yield will have a lower CI per MJ corn than a lower-yielding farm simply because the GHG emissions from corn farming (e.g. operating farm equipment and area-based fertilizer application) are spread out over a larger amount of corn. The other major parameter affecting CI in the GREET model is nitrogen application. We set nitrogen application and the other parameters in GREET so that the CI when assessing the national average 2019 corn yield in our analysis (27.9 gCO2e/MJ) roughly matches that reported by FBN (29.5 gCO2e/MJ). We then input the corn yield from all corn-producing U.S. counties to estimate the county-level average CI for each county. These county-level CIs range from 20.5 to 109.9 gCO2e/MJ.

We then apply the variability in FBN's CI dataset for Poet's supplying farms to each county. For example, if farm A in Poet's dataset has a CI 10% lower than the Poet farm average, we simulate a farm in each county that has a CI 10% lower than the county average. We apply this principle to county-level corn production data provided by USDA for 2019 and divide the total production in each county evenly across 66 hypothetical farms in each county. The total number of farms in our simulation is 95,568, though the size of each would vary according to the corn production in that county. This is lower than the actual number of corn farms in the U.S.,[2] and of course not every county has exactly 66 corn farms. In the absence of more precise data, we believe that our simulation approach meaningfully describes the level of variation that likely exists among U.S. corn farms, and it is this variability that is core to assessing FBN's proposal. If anything, the fact that our simulated dataset contains fewer farms than actually exist in the U.S. likely under-represents the true variability among U.S. farms and thus underestimates the negative effect that inter-farm variability would have on the implementation of FBN's proposal.

[1] https://www.nass.usda.gov/Data_and_Statistics/

[2] https://en.wikipedia.org/wiki/Corn_production_in_the_United_States#:~:text=The%20US%20is%20the%20world's,them)%20are%20family%2Downed.

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We assess 4 scenarios that we believe describe the entire range in behavior that would be incentivized by implementing FBN's proposal:

1. Worst case scenario: maximum shuffling. In this scenario, the nation's lowest-CI farms switch to supplying corn ethanol for California. No farms take additional GHG reduction actions and so no GHG benefit is achieved.
2. Maximum shuffling and maximum GHG reduction. The shuffling in Scenario 1 occurs, but all farms supplying corn ethanol to California also take maximum possible CI-reduction actions, resulting in some real GHG savings.
3. Maximum cherry picking. All farms currently supplying corn ethanol to California continue doing so. Only farms already below the national average CI would report and claim LCFS credits. Farms above the national average CI would use the default CI.
4. Best case scenario: maximum cherry picking and maximum GHG reduction. This is the same as Scenario 3, but farms supplying corn ethanol to California also take the maximum possible CI-reduction actions.

We use the term "maximum" in each scenario to describe what would happen if all corn farms supplying ethanol to California engage with or react to implementation of FBN's proposal. In reality, it is likely that many corn ethanol producers and farms would not react and would continue using the default corn farm CI without shuffling and without additional GHG improvements. We believe our analysis captures the full range of possible outcomes from FBN's proposal, but the magnitude of these outcomes will likely be lower than what we present.

We believe there is no scenario where only a benefit would be achieved without either shuffling or cherry picking. Such a scenario would require no shuffling **and** either a) only above-national average CI farms participating and taking real GHG reduction actions, with no reporting by farms already below the national-average CI, or b) equal reporting by above-average CI farms as for below-average CI farms. These scenarios would require corn ethanol facilities to act against their best interest and against the policy incentive. We thus believe such cases to be extraordinarily unlikely.

We now go into our calculations of the number of LCFS credits awarded and real GHG reductions achieved for each scenario in more detail.

In Scenario 1 (maximum shuffling), we simply filter our simulated farm dataset from such that California's 2019 ethanol demand would be equivalent to the quantity of corn supplied by the subset of farms with the lowest CI's among the entire dataset. We then calculate how many LCFS credits would be awarded to each farm for its lower-than-average CI. The weighted average CI of these farms is 15.3 gCO2e/MJ. We do not attempt to account for the change in transportation emissions that would occur if these new supplying farms are closer or further away to California than the farms that currently supply ethanol to California. We do not believe this effect

would be very significant. The GREET average transport GHG emissions for U.S. corn ethanol are 1.97 gCO2e/MJ. Using GREET, we find that there is a relatively small difference in transport GHG emissions between supplying California from a relatively near-by corn-producing state (Idaho, 0.93 gCO2e/MJ) compared to a relatively far-away corn-producing state (Iowa, 2.28 gCO2e/MJ). In addition, we do not believe it is likely that we would see a wholesale large shift in where corn is sourced from for the California ethanol market. The lowest CI farms in our dataset are in the highest-yielding areas, which are generally around Iowa.[3] The greatest corn production in the U.S. is in the same areas.[4] Thus we think it is likely that ethanol used in California already sources corn from the same general U.S. region that has much of the lowest CIs in the country. We expect the effect of shuffling on transportation emissions to be lower than 1 gCO2e/MJ.

In Scenario 2 (maximum shuffling and maximum GHG reductions), we use the output from Scenario 1 in terms of which U.S. farms supply the California market, and then assume that all those farms take maximum action to further reduce their CIs. We assume each of these farms reduces its CI by 10 gCO2e/MJ (from ANL's calculation of the CI-reduction potential from best practices) unless a farm hits a "CI floor" of 8.7 gCO2e/MJ. We calculate this CI for corn production using GREET and assuming national average corn yield and zero nitrogen application, and believe this number should be roughly representative of how low a farm could get its CI. Although lower CIs could theoretically be achieved with zero nitrogen application and higher-than national average yields, we consider this combination unlikely to occur in a widespread fashion across the country because high corn yields are generally supported by nitrogen application. We thus believe that average corn yields and zero nitrogen application represents the best that U.S. farms could, in a widespread fashion, achieve in terms of low farm CIs. Because we apply this CI floor, the average CI reduction for this set of farms is 6.6 gCO2e/MJ, lower than the 10 gCO2e/MJ average GHG reduction potential estimated by ANL. We believe this makes sense because the average CI of these lowest-CI farms (15.3 gCO2e/MJ), is already much lower than the national average calculated in the ANL study (28.5 gCO2e/MJ) and lower-CI farms probably have lower potential for further GHG reductions, in absolute terms, than higher-CI farms. We find that all farms supplying California in this scenario are able to reduce their CIs to reach the CI floor of 8.7 gCO2e/MJ.

In Scenario 3 (maximum cherry picking), we use a random selection of farm and county production combinations to reach the total quantity of corn necessary to meet California's 2019 corn ethanol consumption. We incorporate the 1 gCO2e/MJ penalty for corn farms not reporting their CIs, as proposed by FBN to apply starting in year 5 of the farm crediting option. We assume that all farms with a CI lower than the national average plus 1

[3] https://www.nass.usda.gov/Charts_and_Maps/Crops_County/cr-yi.php
[4] https://www.nass.usda.gov/Charts_and_Maps/Crops_County/cr-pr.php

gCO2e/MJ (28.9 gCO2e/MJ in our dataset) will report their CI and claim LCFS credits for the amount by which their CIs are below the national average (27.9 gCO2e/MJ). Farms with CIs between 27.9 and 28.9 gCO2e/MJ would report their CIs and would receive slightly less LCFS credits than the national average. All farms with CIs higher than 28.9 gCO2e/MJ would not report and LCFS credits would be calculated for the corn ethanol facilities they supply based on the default CI of 28.9 gCO2e/MJ. We find that the average reported CI in Scenario 3 is 24.7 gCO2e/MJ.

In Scenario 4 (maximum cherry picking and maximum GHG reductions), we use the same set of farms as in Scenario 3 and assume that these farms achieve a further 10 gCO2e/MJ CI reduction, with a CI floor of 8.75 gCO2e/MJ, as in Scenario 2. We find that the average CI of farms supplying California in this scenario is 17.8 gCO2e/MJ.

Figure 1 summarizes the impact of each of these 4 scenarios on total LCFS credit generation and GHG emission reductions. Thousand LCFS credits generated per year are shown on the left-side axis. The brown color in the columns illustrates the overcrediting—i.e., the number of LCFS credits generated in each scenario from shuffling or cherry-picking without generating any real GHG emission reductions. The blue column in the columns shows the number of LCFS credits generated in each scenario from real GHG emission reductions. The diamonds show the share of all LCFS credits in each scenario that are awarded for actual GHG reductions and corresponds to the right-side axis.

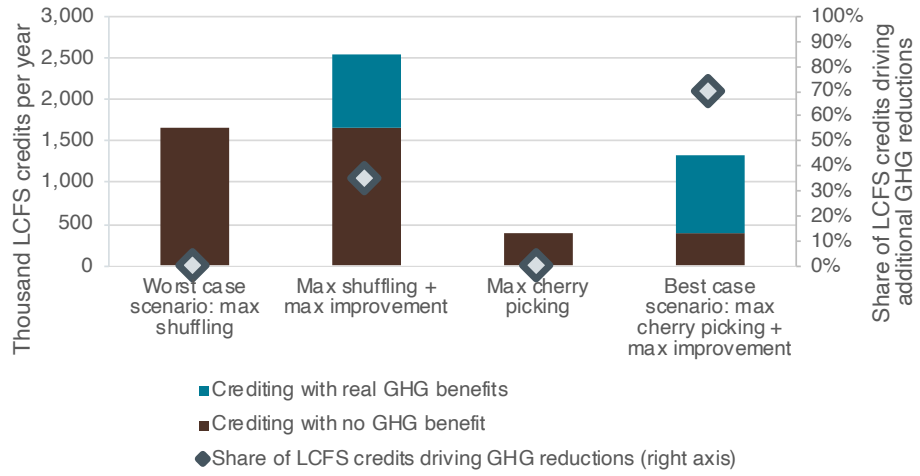


**Figure 1: Estimated effect of farm-level LCFS crediting on LCFS credit generation and GHG emission reductions.**

We see that in Scenarios 1 and 3 (worst case scenario: maximum shuffling; and maximum cherry-picking), all LCFS credits are generated from shuffling and cherry picking with no real GHG reductions. In the worst-case scenario, this totals 1674 thousand LCFS credits per year, 11% of total LCFS credits awarded in 2019 (14.6 million). At today's LCFS prices of around $200 per ton CO2e, this represents a total amount of roughly $335,000 worth of LCFS

credits, although the contribution of 1.7 million LCFS credits from on-farm crediting would likely depress the LCFS credit price below current levels.

If no shuffling occurs in response to the farm-level crediting option, the resulting cherry-picking would not have as large an effect on the LCFS program as maximum shuffling; we find it would result in 401 thousand LCFS credits awarded without GHG reductions achieved, 3% of 2019 total LCFS credits. This is an underestimate for the near-term because we assume that FBN's proposed 1 gCO2e/MJ premium for ethanol facilities reporting the default CI for their farms would be immediately implemented, while FBN actually propose phasing it in over a 5-year period with no premium in place for the first year. We find that the 1 gCO2e/MJ premium is not nearly large enough to offset cherry-picking. According to our analysis, the average CI of reporting farms in Scenario 3 is 21.0 gCO2e/MJ and that of farms claiming the default CI is 39.4 gCO2e/MJ. We estimate that a premium of at least 7 gCO2e/MJ would need to be applied to non-reporting farms in order to offset cherry picking so that the average number of LCFS credits awarded to corn ethanol plants remains the same as today (assuming no additional GHG reduction actions are taken).

Actual GHG benefits are realized in Scenarios 2 and 4, in which we assume that farms supplying corn to California take all possible actions to reduce their CIs. In Scenario 2 (maximum shuffling, GHG reductions), the total amount of LCFS credits that could be awarded from real GHG reductions (approximately 874,000) is smaller than the number awarded for shuffling (approximately 1674,000). The share of all LCFS credits awarded for on-farm reporting in Scenario 2 that come from real GHG reductions is thus fairly low, at 34%. Scenario 4 represents the best case scenario: no shuffling and only cherry picking with maximum real GHG reductions. In this case, the number of LCFS credits awarded for real GHG reductions (around 938,000) is greater than the number awarded for cherry picking (approximately 401,000). In Scenario 4, the share of all LCFS credits awarded for farm-level CI reporting is thus 70%.

In reality, we expect that if ARB implements FBN's proposal, the outcome would be a) a mix of these scenarios, and b) of lower magnitude than what we have presented here. Cherry picking would certainly occur, at least to some extent, because it is inconceivable that corn ethanol facilities with higher-than-national average CIs would report the CIs for those farms when they are clearly incentivized not to. It is also hard to believe that some shuffling would not occur. Presumably there are some corn ethanol producers that do not currently supply California because the transport costs are too high, but that this calculus would change with the supply of additional LCFS credits for farm-level reporting. We did not attempt to assess the share of farms for which additional LCFS crediting would offset the transport cost premium of supplying California. Still, we imagine that some, perhaps many, but not all, very low-CI farms (largely from having naturally high yields) would switch to supplying California if incentivized to do so. We also expect that some farms would take new actions to reduce

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their CIs because they would be incentivized to do so. However, it seems unlikely that all farms supplying California would take maximum possible action to achieve the average 10 gCO2e/MJ reduction we assume in our analysis. A 10 gCO2e/MJ reduction for a farm supplying enough corn for 200,000 gallons per year would lead to roughly $32,000 per year in additional LCFS credits, or roughly $70 per acre (assuming current LCFS credit prices). We imagine that this may be enough to incentivize some but not all CI-reduction actions. For example, reducing nitrogen application will likely reduce yields, which would reduce the CI of each bushel of corn produced by a farm but also reduce the total number of bushels, and thus revenue, generated by the farm. In summary, we expect some shuffling, some cherry picking, and some real GHG reductions to occur in response to implementing FBN's proposal. While we cannot speculate on what the share of LCFS credits awarded that represent real GHG reductions would be for this mixed outcome, it is likely substantially below the 70% we estimate for the best case scenario.

ICCT does not recommend that ARB adopt FBN's proposal. The cost (LCFS credits awarded without GHG benefits) is likely larger than the real GHG benefits that would be attained through this option. Unlike advanced alternative fuel technologies such as cellulosic ethanol, for which we do advocate for new LCFS crediting options below, crediting on-farm CI reductions will not lead to new pathways to enable the deep carbon reductions that will be necessary if California continues the LCFS beyond 2030 and that are consistent with a zero-carbon future. Also unlike advance credits for advanced alternative fuel technologies and capacity credits for public fast chargers (which are capped at 2.5% of LCFS deficits), the potential impact of shuffling on the LCFS is much larger (up to 11% of total LCFS credits generated in 2019).

FBN suggested that they may request farm-level LCFS crediting for soil carbon increases at some point in the future. ICCT considers this an even worse idea than the current proposal to credit farms for having naturally higher-than-average yields. Soil carbon levels are rising across the board in the U.S. due to generally improving agricultural practices, such as reduced- and no-till agriculture. Importantly, our research has previously found that the soil carbon increases estimated for U.S. corn in CCLUB, which is the tool used to calculate these changes in GREET, are completely unfounded and in direct opposition to the scientific evidence.[5] We thus strongly recommend ARB not consider crediting farm-level soil carbon reductions at any point in time.

While ICCT does not recommend ARB allow LCFS crediting for farm-level CIs of any sort, if the agency does move ahead with it, we have specific recommendations on how FBN's proposal could be improved. We present 3

[5] https://theicct.org/publications/critique-soil-carbon-assumptions-used-iluc-modeling

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options for how ARB could reduce cherry picking and shuffling, summarized in Table 1.

**Table 1: Options for mitigating shuffling and cherry picking with crediting farm-level CI reductions in the LCFS.**

| Option | Pros | Cons |
|---|---|---|
| 1. Require all crop-based biofuel producers generating LCFS credits to calculate and verify the CI of each supplying farm | Mitigates cherry picking | Does not mitigate shuffling; high burden for all farms |
| 2. Set the CI premium for non-participating farms at at least 7 $gCO_2e/MJ$ | Mitigates cherry picking; low burden | Does not mitigate shuffling |
| 3. Require additionality assessment for claiming a lower-than-national average farm CI | Mitigates shuffling and cherry picking | High burden for participating farms |

Options 1 and 2 mitigate cherry picking but do not address shuffling. Both are meant to address the problem that corn ethanol plants with higher-than-average CIs would not report their CIs and would instead use the default CI (whether this is the national average or with a 1 gCO2e/MJ premium as proposed by FBN). In Option 1, ARB could require all crop-based biofuel facilities to report farm-level CIs for all their supplying farms. Those with lower-than-average CI farms would receive more LCFS credits than they do now, and those with higher-than average CI farms would receive less than they do now. On average, California's supply of crop-based biofuels would not receive any more LCFS credits than they do now without additional GHG reduction actions taken, if no shuffling occurs. Of course, shuffling is likely to occur and Option 1 does not mitigate that problem at all. Option 1 would also involve high reporting burden for all crop-based biofuel producers. Option 2 is the same as FBN's proposal but increasing the premium for the default farm CI to at least 7 gCO2e/MJ. Like Option 1, this option would not at all mitigate shuffling, but would have the benefit of lower reporting burden than Option 1.

ICCT recommends Option 3 out of all the options presented here to improve upon FBN's proposal. In this Option, ARB would essentially require an additionality assessment for all LCFS credit awards for on-farm GHG

reductions. An example of how this could be implemented is as follows: a farm collects data and records on its nitrogen use for 2 years. Then, it inputs its nitrogen application rates and other relevant data (e.g. yields averaged over the previous 3 years) into GREET to calculate its baseline CI. Then it inputs a new, lower nitrogen application rate into GREET and calculates the new CI. The difference between the baseline and new CIs is the amount based on which ARB will issue additional LCFS credits. The farm must then use the new, lower nitrogen application rate in any year in which it collects those additional LCFS credits and this would be verified by the LCFS 3rd party verifiers. This may be difficult to implement if farmers change their nitrogen application rates in response to weather. If this problem is widespread, ARB could offer an option to credit nitrogen application reductions based on the relative difference between one farm and its neighbors that do not supply corn ethanol to California. If a corn-ethanol supplying farm consistently uses 10% more nitrogen than its non-corn ethanol supplying neighbors, in a year in which all farms add higher-than-average levels of nitrogen due to weather, that farm could be credited based on any nitrogen application reduction relative to its neighbors x 110%. This option of pegging to one's neighbors would necessarily require more data than if pegging is not necessary. Yield improvements could not be credited based on annual yield data alone as yield fluctuates greatly each year. They could be credited based on agricultural models and scientific literature, for example estimating the yield increase that would occur with introducing an irrigation system. That estimated yield increase, rather than the actual measured yields, would then be input to GREET to estimate the CI reduction from that specific action.

Additionality is not typically incorporated into biofuel policies. In California, biofuels can generate LCFS credits even if we would expect much of those biofuel volumes to be used in California in the absence of an LCFS. The proposal for farm-level crediting is, however, different, because the magnitude of crediting that we can expect would come from natural variation between corn farms rivals that which we could hope for from actual GHG reduction actions. The concept of additionality is central to the Clean Development Mechanism[6] and is incorporated into two biofuel policies in the European Union: crediting of upstream emission reductions in the Fuel Quality Directive (FQD) and eligibility of low-indirect land use change feedstock in the recast Renewable Energy Directive (REDII). In the FQD: "For emission reductions to be eligible to be claimed as UERs they must be additional to any emissions changes that would have been expected in the most likely counterfactual scenario."[7] In the REDII, palm oil is identified as a high-indirect land use change risk feedstock and cannot be counted towards the REDII renewable energy targets in 2030, unless it is

[6] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v5.2.pdf/history_view

[7] https://ec.europa.eu/clima/sites/clima/files/guidance_note_on_uer_en.pdf

certified as low indirect land use change risk. For this certification, additionality must be demonstrated by showing that palm biofuels "become financially attractive or face no barrier preventing their implementation only because the biofuels, bioliquids and biomass fuels produced from the additional feedstock can be counted towards the targets for renewable energy under Directive 2009/28/EC or Directive (EU) 2018/2001," with other options for using abandoned or severely degraded land and for smallholders.[8] Thus, if California were to impose additionality requirements for farm-level CI reduction crediting, it would not be unprecedented.

The bottom line is that none of these options are ideal, and there is no single solution for incentivizing on-farm GHG reductions within the LCFS without either weakening the LCFS itself or high administrative burden for participating farms.

**Comments on the presentations by Norsepower and California Jet Oil**

California's "Innovative Crude" pathways are meant to reward the use of GHG-reduction technologies that are unlikely to be used to a significant extent in the absence of support from LCFS credits. This description is largely true for carbon capture and sequestration (CCS) technology and the use of renewable hydrogen in petroleum refining. It does not apply as clearly to the technologies described in the presentations by Norsepower and California Jet Oil. Norsepower's technology uses sails for wind-assisted propulsion for oil tankers, but it is likely that this technology will be adopted to some extent over the coming decade to comply with other climate policies. Wind-assist has been identified as one option that may be needed for ships to comply with the International Maritime Organization's mandatory Energy Efficiency Design Index (EEDI).[9] California Jet Oil's water jet oil production technology is also likely to be increasingly adopted without LCFS support. California Jet Oil explained that the advantage of this technology is that it is more efficient than existing steam injection techniques. More efficient technologies tend to be adopted in the oil industry over time for economic reasons.[10] Making either of these pathways eligible to generate LCFS credits will likely result in crediting business-as-usual technological advances, at least to some extent.

[8] https://ec.europa.eu/energy/sites/ener/files/documents/2_en_act_part1_v3.pdf
[9] https://www.marpol-annex-vi.com/eedi-seemp/; https://theicct.org/sites/default/files/publications/Rotors_and_bubbles_2019_05_12.pdf
[10] E.g. file:///Users/stephaniesearle/Downloads/Li2010_Article_ResearchAndApplicationOfWaterJ.pdf

**Comments on the presentations by Oxy and Virent, Inc.**

Oxy and Virent presented similar proposals for providing advance LCFS credits to aid with the construction of emerging alternative fuel production facilities. In principle this is a good idea. ICCT has argued before that additional support beyond normal LCFS crediting is necessary to overcome the significant barrier to achieving financing for what are perceived as high-risk, low-reward advanced fuel technologies.[11] Compounding this problem, advanced technologies such as cellulosic biofuels generally have very high capital expenses (CAPEX), making it more difficult to attract sufficient private investment. If California intends to achieve deeper GHG reductions in its transport fuel mix beyond 2030, advanced, ultra-low GHG alternative fuel pathways will likely eventually become necessary in addition to vehicle electrification. Providing stronger support to these emerging technologies now would help set an advanced fuel industry on track to deliver significant volumes of fuel post-2030.

ICCT supports the proposals from Oxy and Virent with some recommended changes:

- Eligible projects include advanced technologies AND the use of feedstocks that have not yet been used in commercial-scale fuel production OR renewable electricity. This would include renewable power-to-liquids (using CO2 from direct air capture or otherwise), pathways such as cellulosic ethanol from agricultural residues, and alcohol-to-jet from agricultural residues. It would not include the use of advanced technologies with commercialized feedstocks, for example corn-based alcohol-to-jet. This change would ensure that this advance credit option supports both the technologies and the supply chains to support the kind of ultra-low carbon fuel pathways that will be needed post-2030. This is by far our most important recommendation.
- Total advance credits are capped at 2.5% of the previous year's deficits. This would make the maximum impact of this option similar to that of capacity credits for fast electric vehicle chargers, which are capped at 2.5% of the previous quarter's deficits. For advanced fuel technologies, it would make more sense to limit credits on an annual basis given that the credits provided to one project could exceed 2.5% of a single quarter's deficits.
- Advance credits are provided up to the facility's planned annual capacity and its expected CI reduction, capped at 125 thousand credits per facility. This could cover a substantial fraction of CAPEX

[11] E.g. https://theicct.org/publications/development-and-analysis-durable-low-carbon-fuel-investment-policy-california; https://theicct.org/publications/comparison-contracts-difference-versus-traditional-financing-schemes-support-ultralow; https://theicct.org/publications/measuring-and-addressing-investment-risk-second-generation-biofuels-industry

for a modest-sized commercial advanced fuel facility, while ensuring that the advance credit option is available to more than one project per year. We estimate that approximately 3 projects could be supported per year with these caps.

- For each project, the advance credits given are spread out over the expected construction period with no more than 33% given the first year. This will limit the potential credit loss from projects that fail early in the construction phase.
- Credits must be "paid back" with "repayments" spread out over a 10-year timeframe starting when production begins. "Repayments" means that low-carbon fuel is sold into the marketplace in California without generating LCFS credits. By spreading out repayments over 10 years, a project would be able to generate LCFS credits for any volume it produces over 10% planned capacity. This "credit debt" would accumulate if the facility produces less than 10% planned capacity in any particular year, but would not accure interest. For example, if a facility produces only 5% planned capacity in year 1 and 20% in year 2, it would generate LCFS credits for 5% of its nameplate capacity in year 2 only, thus "paying back" 10% of its planned annual capacity on average over the 2 years. This gentle repayment requirement would continue to provide some policy support to these projects as they ramp up and would reduce the risk of failure.

ICCT recognizes that implementing this proposal would likely result in some number of "lost" LCFS credits given to projects that fail to produce enough gallons of fuel to "repay" the GHG reductions promised for the credits. This loss will, to a small degree, dilute the LCFS credit market without providing any climate benefit. We argue that the long-term benefit outweighs this risk. Firstly, a shift towards advanced fuel pathways such as cellulosic biofuels is necessary for meeting the long-term goals of the LCFS. Cellulosic biofuel pathways can have negative carbon intensities, and if carbon capture and sequestration (CCS) is applied to cellulosic ethanol, deeply negative carbon intensities. This kind of deep carbon reduction is not possible with first-generation biofuels, even when applying CCS to first generation ethanol.[12] Secondly, credit loss is not a foregone conclusion with this proposal. Thirdly, we recognize that advanced fuel pathway such as cellulosic biofuels likely do have a higher cost of GHG reduction than established alternative fuel pathways and vehicle electrification, when the risk of failure is taken into account. We expect this cost to be reflected in the next phase of the LCFS beyond 2030 as the "low-hanging fruit" are picked (e.g. exhausting the available supply of waste oils in renewable diesel). Because with these advanced technologies it can take several years to ramp up just one facility and will likely take over a decade to build an

[12] According to our assessment using default parameters for corn-based and agricultural residue-based ethanol pathways in the GREET model.

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industry,[13] we believe that it is necessary to invest in the construction of advanced fuel facilities now to set California on a path to achieving deep decarbonization in the post-2030 timeframe. This justifies the additional support to an advanced fuel industry now. This thinking is consistent with ARB's decision to provide capacity credits for public fast electric vehicle chargers. Greater investment in public chargers is needed now to support a future with greater penetration of electric vehicles providing deep GHG reductions.

[13] https://ec.europa.eu/jrc/en/publication/what-still-limiting-deployment-cellulosic-ethanol-analysis-current-status-sector; https://theicct.org/blog/staff/failure-to-launch-biorefineries-slow-ramp-up; https://theicct.org/sites/default/files/publications/Alternative_fuel_aviation_briefing_20190109.pdf;

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