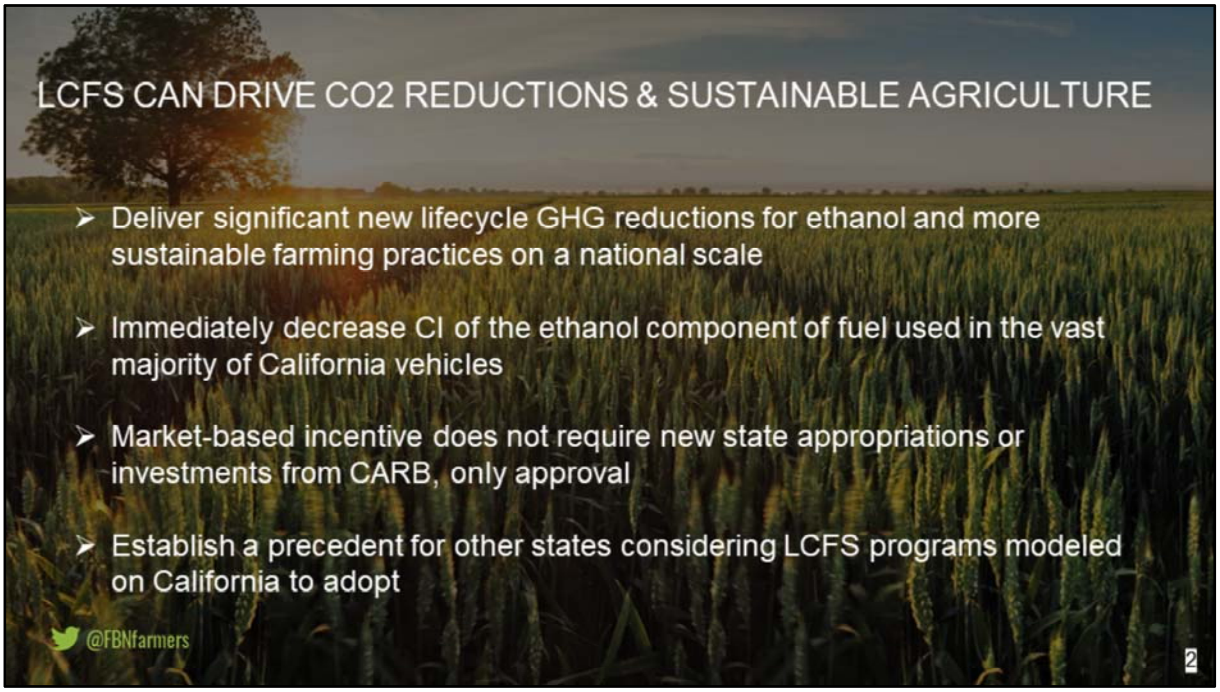
FARMERS BUSINESS NETWORK

IDENTITY PRESERVED LOW CARBON GRAIN

BY

Gradable



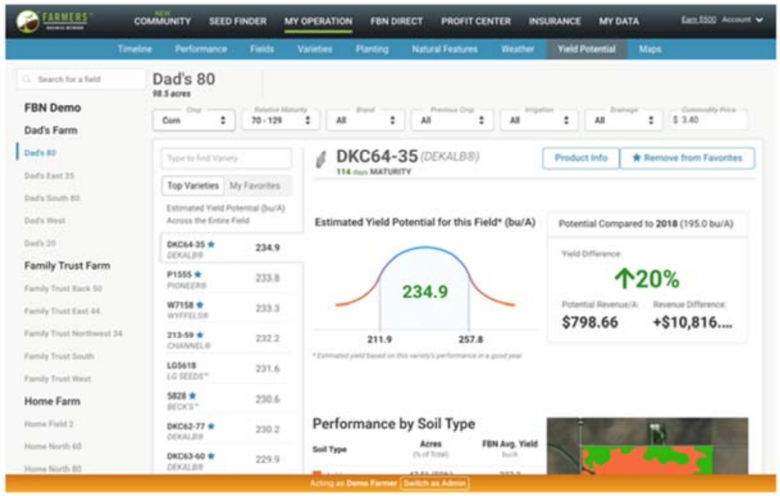
With EPA estimating approximately 5% of GHG emissions in the US coming from crop cultivation and energy use, we believe the opportunity exists to lower emissions across all of production agriculture within the existing framework of the LCFS. By opening the CA-GREET model to allow overrides for verifiable values related to identity preserved feedstocks, the premiums within the LCFS for lower carbon intensity feedstocks would incentivize better practices in tillage, nitrogen management, and biodiversity. The concept creates a framework that all of industry could adopt since ‘sustainability’ is inconsistently defined in agriculture today.

Gradable Platform: Field-Level Practice Visibility

FBN members share machine collected information on planting, harvesting, and fertilizer application, along with commercial receipts and insurance documentation. FBN then further validates this information via satellite imagery and AI analysis.

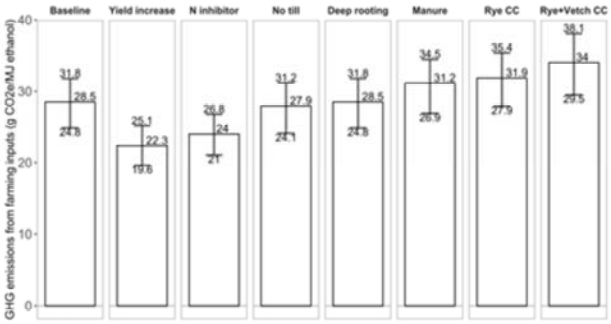
Gradable Platform: Carbon Reduction Recommendations

FBN provides growers profit-driven, personalized recommendations for carbon emissions reduction based statistical analysis of agronomic practice performance on millions of acre-year data points from like field conditions.

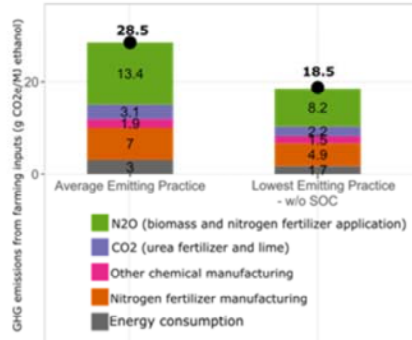


Argonne Shows Large Potential For CI Improvement

Carbon intensity score by specific farm practice (including soil organic carbon changes)



Average farm Carbon Intensity score compared to best practice farm Carbon Intensity score



Current best practices lead to a **35% decrease in carbon intensity (CI)** *before* soil organic carbon (SOC) change is accounted for

Liu, X., H. Kwon, D. Northrup, and M. Wang, 2020, "Shifting agricultural practices to produce sustainable, low carbon intensity feedstocks for biofuel production," Environmental Research Letter, https://doi.org/10.1088/1748-9326/ab794e.

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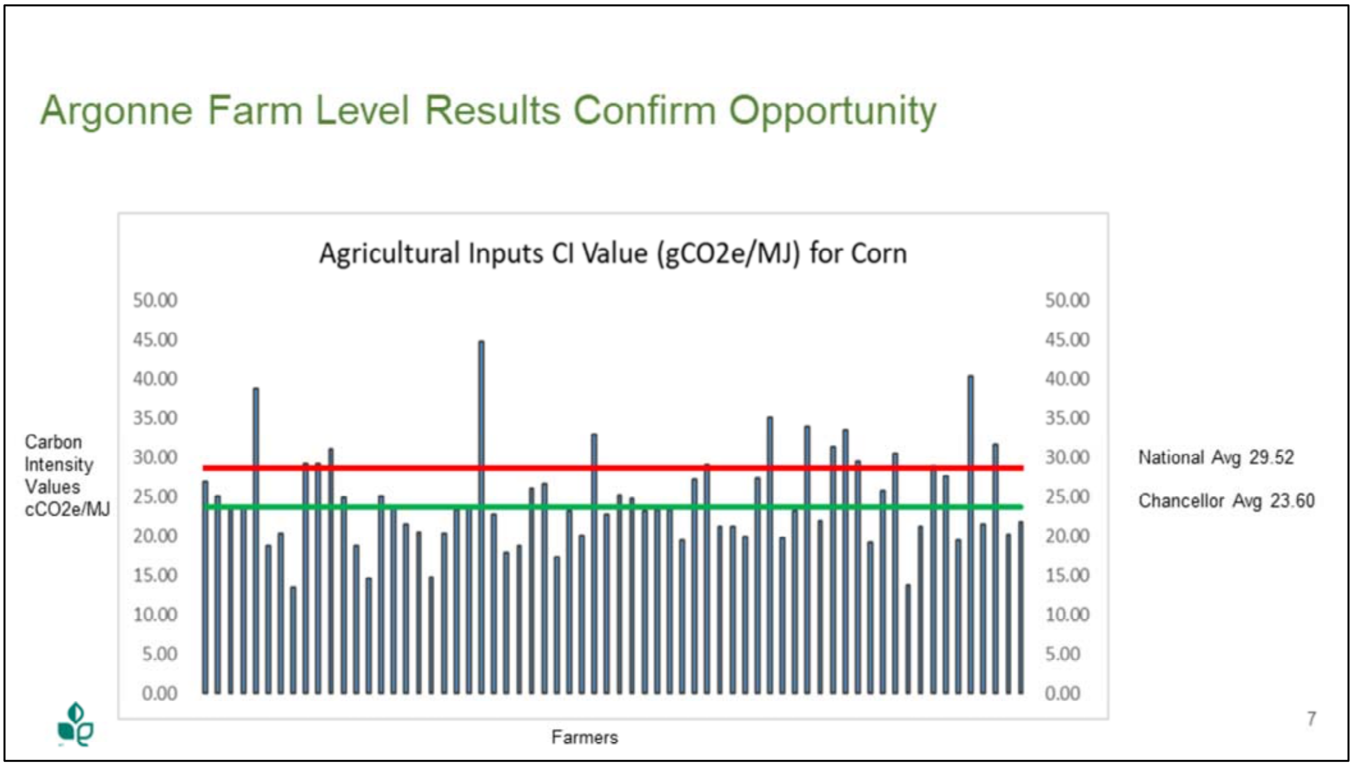
The graphs illustrate the impact various practices can have on carbon intensity score. While SOC changes are not included in this analysis, the data suggests some of the practices that may raise CI scores in the near term, will have longer term CI benefits once SOC is maximized. Our proposal does not include taking any credit for direct SOC changes. The only way those results are incorporated is to the extent that as SOC health improves yield or reduces fertilizer use over time, then those factors would ultimately lower the CI value. In that way, SOC development is encouraged, but credit is only given for those efforts to the extent it manifests itself in the baseline CI calculation.

Low Carbon Corn Pilot Is Proving Scalability

- Launched July 2019 in Chancellor, South Dakota
- **7.5 million bushels** and **126,000 acres**
- Incentives from POET & FBN for participation
- Argonne National Labs helped define the data requirements calculated the resulting carbon intensity of the feedstock
- Pilot confirmed the ability to accurately collect **ALL** GREET feedstock data at the field-level as well as the ability to operate a program at scale

In an effort to verify our observations and theories that there was a wide array of CI values for farming practices in a given area, FBN and POET collaborated on a trial at POET's Chancellor, SD biorefinery. Argonne National Labs helped us validate that the data inputs were sufficient to calculate a Carbon Intensity score for the agricultural inputs. FBN and POET signed up on a first-come, first served basis, about 126,000 acres, or a little less than a quarter of the facility's annual grain needs. The pilot program did not pay for carbon intensity improvements, rather it was focused on collecting the data. In the second year of the pilot, we do have an incentive tied to lower CI scores and the only farmer that did not sign up for the second year was one who decided to retire.

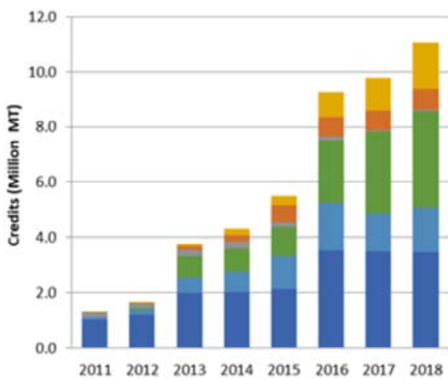


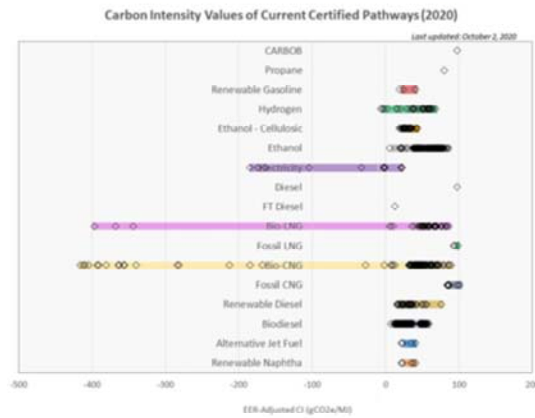
Of the 64 participating farms in the pilot program, a combination of machine data, farmer interviews, and hardcopy records were used to compile the dataset that Argonne National Labs then took to calculate a carbon intensity score for each farming operation. As you can see from the results, there was a wide disparity (44.77 – 13.44 = 31.33) between producers. While some of the differences are likely attributable to timing differences or yield anomalies at a given farm, the data reflects a diverse range of practices that have a noticeable impact (positive and negative) to CI. The participating farmers expressed a keen interest in the data, and while they all espoused to be farming in a 'sustainable' fashion, clearly some efforts were more effective than others.

Our initial results of the pilot program and our 2nd year participation indicate that the farmers are eager to respond to incentive-based proposals that also result in lower carbon intensity agricultural products. These farmers are recognizing the need from multiple of their end users (fuel, feed, fiber) to grow a more 'sustainable' crop, however, outside the Organics and Non-GMO space, the industry is lacking a consistent standard to transact around. The LCFS program provides both the infrastructure to calculate carbon intensity and a market mechanism to value it.

Ag Innovation Will Follow Transportation Path

The LCFS has driven innovation across the transportation sector, from fuel production to vehicle and infrastructure technology. Agriculture will respond in a similar fashion with a market mechanism to reward emission reduction.





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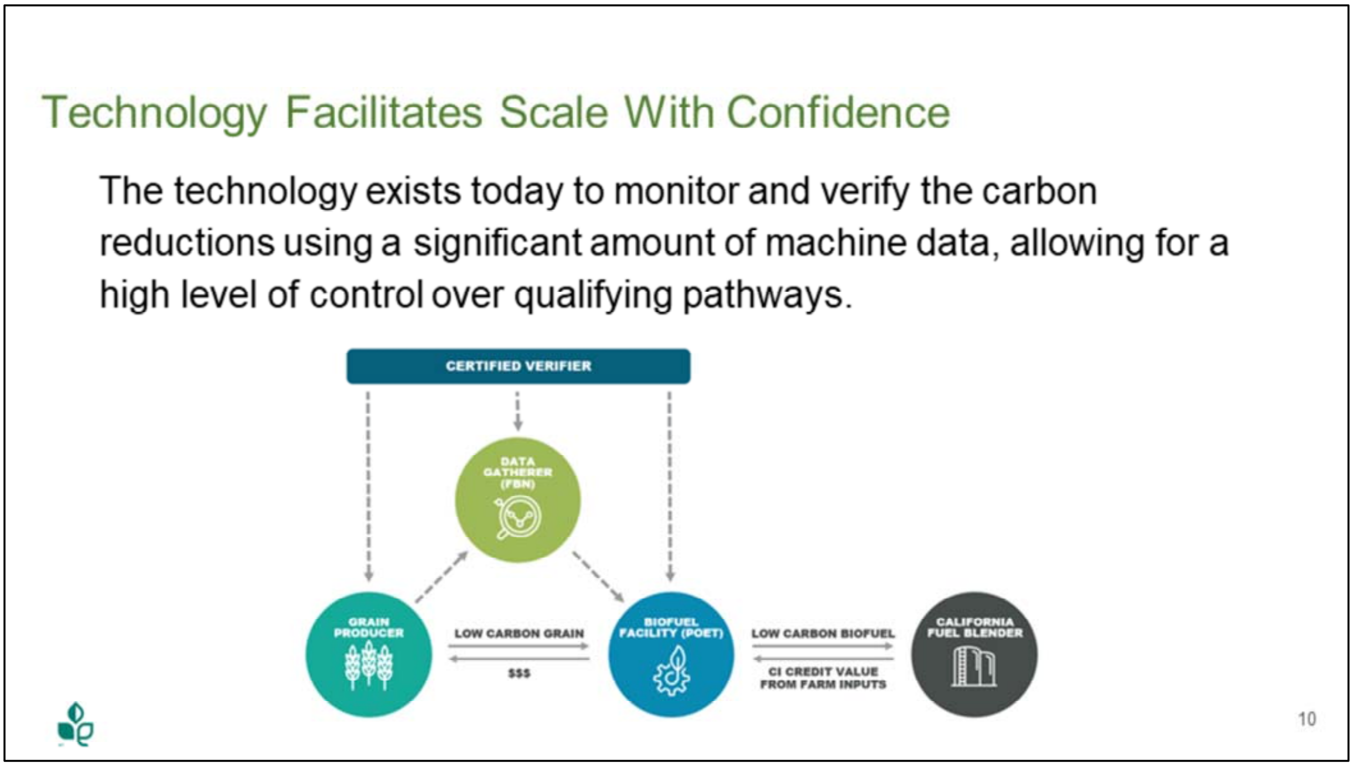
Every renewable fuel category (with the exception of fossil natural gas) has responded to the LCFS and grown in volumes and amount of credits generated. As can be seen in the charts, the growth in the credits generated has outstripped the volume increases, indicating that these fuel segments have continued to innovate and drive their CI values lower at an increasing rate. There is no reason to believe that the agricultural community will respond any differently when presented with a similar incentive structure for producing their crops. Most agricultural producers use very similar practices across their operations, so, even if they may only sell half their crop to an ethanol biorefinery, all of their output is likely to benefit from their lower carbon intensity growing practices.

See also Credit Market Impact Where is Baseline in Appendix.

Adopting best practices for corn productions could reduce up to 25% GHG emissions from corn cultivation/farm energy use

- Bushel-averaged CI across 64 farms surveyed around the Chancellor plant is 5494 g CO_2e/bu while the lowest CI is 4139 g CO_2e/bu. The difference between the two is ~1.3 kg CO_2e/bu, which represent a reduction of 25%
- GREET national average corn farming GHG emissions are 6615 g CO_2e/bu. Thus, best practice can result in 1.6 kg CO_2e/bu GHG reductions (6615 * 0.25)
- In 2017, corn production was estimated at 14.4 billion bushels (USDA). Thus, total GHG reduction could be 23 million metric tons of CO_2 on that size of crop (1.6 kg CO_2e/bu x 14.4 billion bu)
- Assuming 40% of corn produced is used for ethanol production, 9.2 million metric tons of CO_2e could potentially be reduced related to corn ethanol production.
- In 2017, total GHG emission in US was estimated as 6500 million metric tons of CO_2e and 5% was from crop cultivation and related energy use (325) (USEPA), making the potential impact of this program multiples of the LCFS emission reductions.

While the data points in this sample are limited, we believe that the randomized nature of the selection process and dispersion of the CI values, create a population is reasonably representative of much of the nation; even if regionally, the absolute CI values may be higher or lower. For illustrative purposes, we extrapolated the 25% reduction witnessed at Chancellor, SD across the entire corn crop.



The complexities surrounding the gathering of the data necessary to calculate and verify a carbon intensity score have only recently been overcome to make the concept of identity preserved feedstocks practical. The advent of verification protocol in 2020 and the commercialization of farming data analytics in the last several years, now make if feasible for all stakeholders in the value chain to collect, calculate, and validate a carbon intensity value for identity preserved agricultural feedstocks.

- The grain producer generally has no interest in sharing their proprietary production data with a biofuel facility, at the level of detail necessary to calculate their CI score, nor are the grain producers generally capable of calculating the CI score on their own.
- They will however share their data with an information gathering company whose business model is based on helping the farmers make better decisions.
- The biofuel producer needs to be able to substantiate all of their inputs for calculating their CI score, so they would also enter into an arrangement with the data gatherer to understand the CI value of the bushels they are acquiring and to allow the verifier access to all the information needed to verify the CI calculations.
- The value generated by the identity preserved feedstocks will need to be sufficient to incentivize the farmer, the data gatherer, the biofuel facility, and pay for the verification costs.

Also reference Verification in Appendix

Identity Preservation Protocol

Through 3rd party verification of agricultural inputs, and chain of custody documentation through biorefinery receipts, pathway holders can demonstrate a farm-specific carbon score for each feedstock in the program. We propose a minimum of 2 of the following 5 inputs be derived from machine data or electronically gathered/stored:

- Seed purchase
- Cultivation
- Fertilizer/Chemical purchase
- Fertilizer/Chemical application
- Harvest/Yield

Because of the volume of data required to generate an accurate CI score from agricultural inputs at the farm level, of the 5 major categories of data that are needed for the CI calculation, we are proposing that at least 2 of those data sets be derived from machine data or comprised of electronically gathered or stored data by a vendor other than the farmer (like a Coop for fertilizer application or seed and chemical purchases from an online vendor). In addition to lending to the integrity of the program, we believe that it will be challenging for more manual approaches to the data analysis and review to be economically viable.

Scalability

Prior to the implementation of Verification in 2020 and the commercial scale availability of machine data, the idea of Identity-Preserved Feedstock and substantiation of farm-level data was impractical to envision.

- Verification allows CARB to shift the burden of compliance to the pathway holder.
- Use of machine data is necessary to provide the assurance that the inputs and modeling of the CI score meets the rigorous standards built into the LCFS.

ARPA-e, a program of DOE is currently investing $10’s of millions in the development of technology to allow even more precise monitoring of carbon intensity and soil health, that will be further available to this program in the future.

As previously discussed, the combination of technological advances and the verification protocol make this concept immediately applicable to much of the grain-based ethanol market as it exists today.

ARPA-e is also making significant investments in advancing the scale and precision of additional CI measuring techniques. These advances, coupled with an increasing demand by the farmer for precision agricultural equipment/solutions, should continue to improve the quality of the program as it moves into the future.

Appendix

Credit Market Impact

Although the overall agricultural impact is significant, identify-preservation, verification requirements, and unknowns regarding facility CI impacts will temper the adoption rate.

Inasmuch as the carbon intensity percentage reductions increase each year, we expect the credit increase due to identity-preserved feedstocks to keep pace with the LCFS targets and thus having a stabilizing effect on credit availability and pricing.

If this concept were fully applied on all 1.5 billion gallons that (historically) are consumed in CA, at a 25% improvement of the agricultural inputs, there would be an increase of roughly 902,315 MT of credits generated annually. ((29.52 gCO2e/MJ * .25 = 7.38g improvement) * (81.51 MJ/gal ethanol equivalent * 1.5 billion gal = 122,265,000,000 MJ energy)) / 1,000,000 = 902,315 MT CO2e/MJ).

We believe the most likely candidates for using the identity preserved feedstock modeling early on will be row crop farmers growing feedstocks for ethanol, given the larger availability of machine data in recent years. The adoption rate even for row crops is forecast to be more modest in the early years as it takes at least a full growing season to accumulate sufficient data to calculate a CI score. Hence, we believe the concept will have more of a stabilizing effect on prices as the standards increase, rather than a disruptive one.

Excepted Feedstocks

For feedstocks not participating in a pathway holder's identity-preserved program, they would be assigned a CI value of the default CA-GREET score plus an adder determined by CARB to discourage selecting only the best producers but also not dissuading program adoption. We propose the following scale:

- Year 1 Excepted Grain = Greater of National Average or Facility Weighted Average
- Year 2 = (Greater of National Average or Facility Weighted Average) + .25 gCO_2/MJ
- Year 3 = (Greater of National Average or Facility Weighted Average) + .50 gCO_2/MJ
- Year 4 = (Greater of National Average or Facility Weighted Average) + .75 gCO_2/MJ
- Year 5 = (Greater of National Average or Facility Weighted Average) + 1.0 gCO_2/MJ

To be effective over time, there must be appropriate controls in place to ensure that excepted grain cannot simply be the bushels that are over the average. We believe that by embedding the premium/discount concept into the program, the appropriate pricing signals will be sent to the farmer to encourage the desired response. The information with which the farmers are able to make better decisions should be more readily available as technology continues to advance.

Applicability

The fuels, feed, and consumer packaged goods industries are all recognizing a need to be more sensitive to the carbon intensity of all the agricultural inputs used in their production, yet the market is searching for a tool to properly account for and incentivize improvements.

The CA-GREET and LCFS models represent the most advanced and widely accepted tools that embody both facets of this market need and CARB is in the unique position to leverage their impact beyond fuel and beyond CA's borders.

As previously discussed, society as a whole is increasingly sensitive to their environmental footprint, and farmers are facing pressure to demonstrate their contribution to our climate goals. While virtually every farmer will readily acknowledge the need to treat our natural resources responsibly (since it takes those resources being healthy to generate a profitable outcome for the farmer over time), the farmers and the industries that purchase their products, struggle with the lack of unanimity around how to measure progress and determine what it is worth. California's efforts around the Low Carbon Fuel Standard have resulted in a possible solution for both of those problems and if adopted before another clear leader emerges, stand poised to become the defacto standard that other grain consuming industries coalesce around.

How Are Improvements Assured?

This has been a frequent question posed of the LCFS, but the evidence that the transportation fuel industry has responded to the incentives created by the LCFS to make meaningful changes to lower the carbon intensity of CA's transportation fuel is apparent and widely accepted.

Given the variability in weather patterns and the unknown adoption rate, a 5-7 year horizon would be needed, but it is appropriate to require site-level improvements over time in order for the program to remain available.

While there may be isolated instances of feedstock shuffling, just like there are on the fuel side, we expect the market will respond very similarly to how the fuels market has. Industry paradigms have shifted towards compliance rather than circumvention and the adoption of similar programs around the world has left an ever decreasing marketplace for the fuel manufacturers who have elected not to innovate.

The measure of success will be born out over years as favorable or unfavorable weather events can create volatility in the CI scores. But, the expectation certainly is that the national average would be moving down as the lower CI farming practices gather momentum. There again though, the early adopters would be the ones capturing the greatest premiums and in order to stay in front of the curve, they will continue to innovate to find ways to drive their scores even lower.

Where Is Baseline?

Consistent with prior approaches to using averages, like the Midwest Average for ethanol production facilities, and allowing Tier 2 pathways to show improvements to the average, we believe that whatever value is used for the default in the CA-GREET model is what should be considered baseline for the Identity-Preserved program.

Admittedly, this approach will place economic pressure on agronomically disadvantaged regions, but those are precisely the market cues that are intended for the LCFS, where marginal lands are discouraged from producing feedstocks for fuel at the expense of the environment.

At the onset of the LCFS, CARB used the Midwest Average for ethanol production facilities where more detailed data was lacking. Over time, as the data collected improved, CARB had good reason for requiring each plant to demonstrate its own pathway. Drawing from that same methodology that has proven successful in the LCFS, we propose that the baseline is whatever CARB is using for the default value in the CA-GREET model on the feedstock in question. If the default value changes over time, the baseline would move along with that.

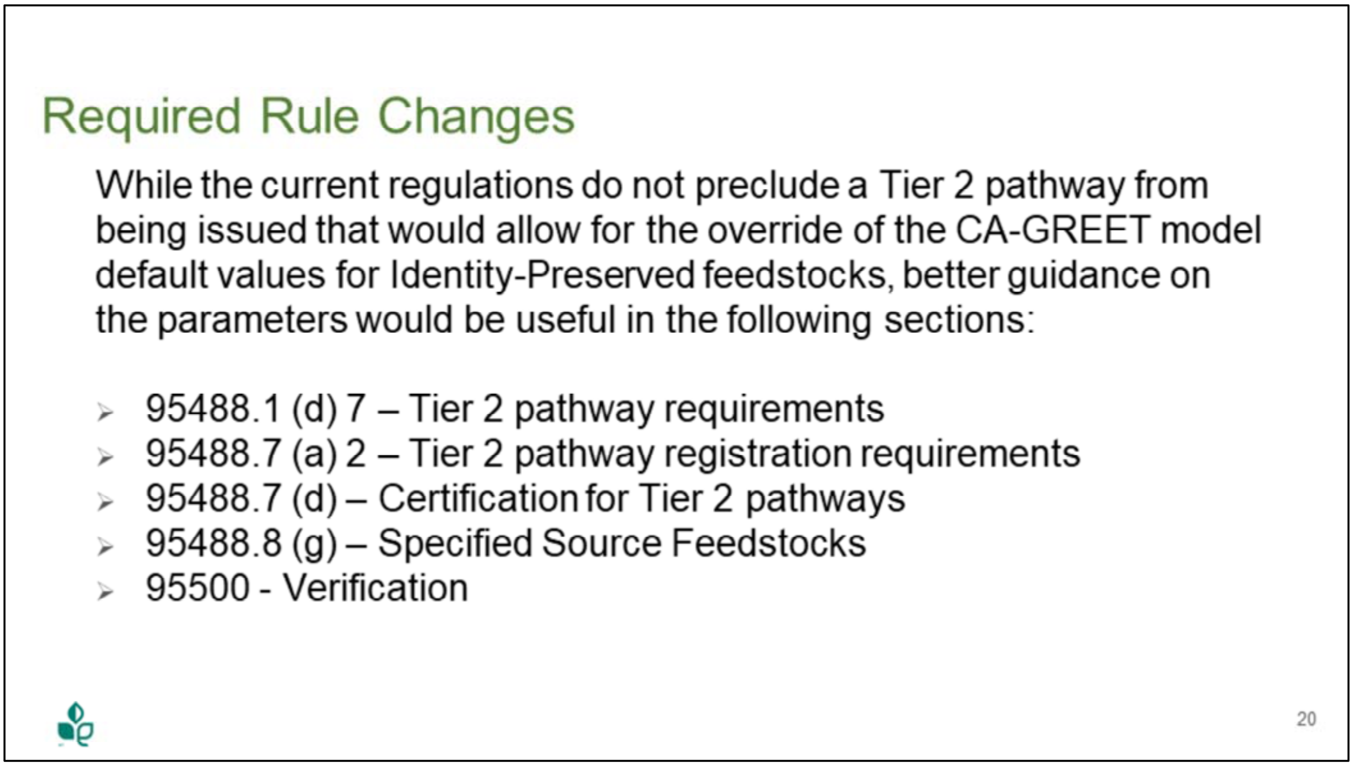
Not every region of the country will find itself able to beat the average with the feedstocks grown in their area. While this is not an intentional aspect of the program structure, the concept is consistent with the LCFS program goals in that it looks to incentivize the lowest CI fuels to be produced and disincentivize those that are higher.

Verification

The pathway holder would need to possess (or be able to provide access to) all the data necessary to support the verifier's electronic review of all relevant receipts and records needed to calculate the carbon intensity value.

It is also assumed that the verifiers would also visit a sampling of the participating farms while performing the biofuel facility site-visit.

As discussed on the slide with the illustration, with the interaction between the farmer, the verifier, the data gatherer, the biofuel facility, and CARB, the biofuel facility has to be able to ensure its verifier has access to all of the farm data, including the ability to conduct on-site farm audits, even if the biofuel producer is not privy to the details that make up the CI of feedstock the biofuel facility purchased.



There are multiple ways to approach the concept of allowing the default value for agricultural inputs to be overwritten, but it seems as though using the existing infrastructure built into the Tier 2 pathway process is the manner which would result in the least number of modifications.