RFA
RENEWABLE FUELS
ASSOCIATION

July 25, 2024

Attention: Docket No. USDA-2024-0003

Mr. William Hohenstein
Director, Office of Energy and Environmental Policy
Office of the Chief Economist
U.S. Department of Agriculture
1400 Independence Ave SW
Washington, DC 20250

Via: www.regulations.gov

Re: Comments on *Procedures for Quantification, Reporting, and Verification of Greenhouse Gas Emissions Associated with the Production of Domestic Agricultural Commodities Used as Biofuel Feedstocks* (89 Fed. Reg. 53585; June 27, 2024).

Dear Mr. Hohenstein:

The Renewable Fuels Association (RFA) appreciates the opportunity to submit these comments in response to the U.S. Department of Agriculture's (USDA) request for information (RFI) regarding "procedures for quantifying, reporting, and verifying the effect of climate-smart farming practices on the greenhouse gas (GHG) emissions associated with U.S.-grown biofuel feedstock crops." Office of the Chief Economist, *Request for Information: Procedures for Quantification, Reporting, and Verification of Greenhouse Gas Emissions Associated with the Production of Domestic Agricultural Commodities Used as Biofuel Feedstocks* (89 Fed. Reg. 53585; June 27, 2024).

The RFA is the leading trade association for America's ethanol industry. Its mission is to drive growth in sustainable renewable fuels and bioproducts for a better future.

Clean fuel tax credits established under the Inflation Reduction Act of 2022 (P.L. 117-169) provide an unprecedented opportunity to position U.S. agriculture and crop-derived biofuels as immediate solutions for reducing emissions and combatting climate change. Specifically, the Clean Fuel Production Credit (Internal Revenue Code Section 45Z) established in the Inflation Reduction Act has tremendous potential to decarbonize liquid transportation fuels used in the United States, for both on-road transportation and aviation. In the case of ethanol, the production of feedstock accounts for roughly half of the core lifecycle GHG emissions associated with the biofuel, including the upstream manufacturing of inputs.[1]

For the first time in a major federal or state government program, 45Z not only allows for the differentiation of feedstock in determining the carbon intensity (CI) score of biofuels but also provides powerful incentives for the adoption of climate-smart agriculture (CSA) practices. Thus, it is vital that the government establish a workable and science-based framework for CSA quantification, reporting, and verification of GHG emissions associated with feedstock, or the promise of CSA will not be realized.

A critical aspect of such a framework has to do with how it interacts with the existing agricultural supply chain, which is extraordinarily complex and massive in scale, yet highly efficient. The sector encompasses hundreds of thousands of participants, including farmers, grain elevators, shippers, processors, and many others. If the potential GHG benefits of CSA practices are to be fully realized in the 45Z program, innovative supply chain management solutions will be needed.

It is highly unlikely that CSA practices will achieve the necessary scale to meaningfully reduce the lifecycle GHG emissions of biofuels if feedstock identity preservation (IP) or even certain mass-balancing approaches are strictly required. As discussed in more detail below, decoupling CSA attributes from the physical feedstock and allowing the renewable fuel producer to use book-and-claim accounting would encourage widespread adoption of CSA practices by growers and broad incorporation of CSA emissions improvements into biofuel lifecycle CI values. At the same time, book-and-claim accounting will allow the grain market to continue operating rationally and efficiently for all participants.

Below, we respond to many of the specific questions from the RFI.

(1) Which domestic biofuel feedstocks should USDA consider including in its analysis to quantify the GHG emissions associated with climate smart farming practices? USDA is considering corn, soybeans, sorghum, and spring canola as these are the dominant biofuel feedstock crops in the United States. USDA is also considering winter oilseed crops (brassica carinata, camelina, pennycress, and winter canola). Are there other potential biofuel feedstocks, including crops, crop residues and biomaterials, that USDA should analyze?

USDA should use a phased approach to incorporating crops into its voluntary CSA standards. The first phase should focus on corn, soybeans, sorghum, and spring canola. As USDA noted, these are the dominant feedstocks for biofuels produced in the U.S. and are expected to remain so for the foreseeable future. Additionally, the supply chains for corn, sorghum, and soybeans are the most developed, and research on GHG emissions associated with their production is the most extensive.

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[1] Lee, U., Kwon, H., Wu, M. and Wang, M. (2021), Retrospective analysis of the U.S. corn ethanol industry for 2005–2019: implications for greenhouse gas emission reductions. Biofuels, Bioprod. Bioref., 15: 1318-1331. https://doi.org/10.1002/bbb.2225

Cover crops can also be included in the initial phase of USDA's analysis, in cases where their GHG emissions benefits are to be assigned to the primary biofuel feedstocks listed above. Otherwise, cover crops and winter oilseed crops (brassica carinata, camelina, pennycress, and winter canola) should be considered in a second phase of the CSA program. Proso millet, which is gaining increased attention as a biofuel feedstock, should also be included in a second phase. Its ability to thrive with minimal water and nitrogen input, coupled with its fit within current cropping systems, positions it as a valuable low-carbon feedstock for biofuel production.

A third phase would involve dedicated energy crops (e.g., miscanthus) and other crops specified in EPA-approved pathways for the Renewable Fuel Standard or in Appendix A of Treasury Notice 2024-49. Given the substantial number of feedstocks that are listed in these publications, USDA should conduct a separate request for information at the outset of this phase regarding which specific feedstocks should be considered.

(2) Which farming practices should USDA consider including in its analysis to quantify the GHG emissions outcomes for biofuel feedstocks? Practices that can reduce the greenhouse gas emissions associated with specific feedstocks and/or increase soil carbon sequestration may include, but are not limited to: conservation tillage, no-till, planting of cover crops, incorporation of buffer strips, and nitrogen management (e.g., applying fertilizer in the right source, rate, place and time, including using enhanced efficiency fertilizers, biological fertilizers or amendments, or manure). Should practices (and crops) that reduce water consumption be considered, taking into account the energy needed to transport water for irrigation? Should the farming practices under consideration vary by feedstock and/or by location? If so, how and why?

USDA should analyze the GHG emissions outcomes for biofuel feedstocks produced using a broad array of climate-smart practices. A good starting point is the USDA Natural Resources Conservation Service's (NRCS) "Climate-Smart Agriculture and Forestry (CSAF) Mitigation Activities List for FY2024," which contains an extensive list of practices that are expected to reduce GHG emissions.[2] At a minimum, USDA should analyze and quantify the GHG emissions impacts of the following practices:

- No-till, reduced till, mulch till, ridge till, and strip till;
- Legume and non-legume cover cropping;
- Perennial cover grown in field strips;
- Replacement of synthetic fertilizers with manure application;
- Reduced nitrogen (N) fertilizer application rates and "4R" practices (i.e., right source, right rate, right time, right place);
- Enhanced efficiency N fertilizers (e.g., urease and nitrification inhibitors); and
- Farm equipment fuel efficiency and/or renewable fuel/energy use.

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[2] https://www.nrcs.usda.gov/sites/default/files/2023-10/NRCS-CSAF-Mitigation-Activities-List.pdf

Many of these practices, and their impact on GHG emissions outcomes, are already included in the Argonne National Laboratory's Feedstock Carbon Intensity Calculator (FD-CIC).[3] USDA should also analyze the impacts of new and emerging CSA technologies and practices (e.g., green ammonia) as they are commercially introduced into the marketplace.

While the impact of different CSA practices on GHG emissions may vary regionally, USDA should focus on developing robust estimates of the national average (most typical) impacts of the various CSA practices analyzed.

Given RFA's recommendation that a limited number of feedstocks be involved in the first phase of the USDA process (see response to question 1), farming practices should vary as little as possible by feedstock, except to the extent that specific practices would not be applicable to certain feedstocks (e.g., nitrogen application improvements would not generally be relevant for soybeans).

Furthermore, CSA practices that involve soil carbon sequestration should not vary by feedstock, as the soil carbon builds over time and across different crops in rotation. For the purposes of determining annual CI values, the modeled GHG impacts of enhanced sequestration from cover cropping and conservation tillage should be applied to the primary crop grown on that land during that annual growing season.

At least initially, additional consideration should not be given to practices that reduce water consumption, as energy use (and emissions) related to irrigation are typically a very minor source of overall lifecycle emissions attributable to crop production. USDA should prioritize analysis and quantification of the GHG mitigation strategies with the largest impacts.

(3) For practices identified in question 2, how should these practices be defined? What parameters should USDA specify so that the GHG outcomes (as opposed to other environmental and economic benefits) resulting from the practices can be quantified, reported, and verified?

In defining practices and determining parameters/protocols, USDA should prioritize straightforward definitions and methods for streamlined implementation by farmers. Where possible, definitions that have been published by USDA or other federal government agencies, or that are otherwise consistent with standards issued by such agencies, should be used.

Many practices have already been defined and sufficiently described by USDA and others. For example, Appendix A of IRS Notice 2024-37 referred to the Conservation Practice Standard (CPS) for No-Till Residue and Tillage Management (Code 329), the CPS for Cover Crop (Code 340), and the CPS for Nutrient Management (Code 590). There is also a CPS for Reduced-Till Residue and Tillage Management (Code 345). USDA already makes available a comprehensive library of Conservation Practice Standards, supporting

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[3] https://publications.anl.gov/anlpubs/2021/10/171184.pdf

documents, calculation tools and worksheets, and other materials.[4] While not all of these existing CPSs have meaningful GHG mitigation impacts, many of them do.

Where no federal government definition or standard exists, one promulgated by a U.S. or international standards-setting body or organization should be considered. For example, regarding enhanced efficiency N fertilizer, Appendix A of IRS Notice 2024-37 referred to a terminology document from the Association of American Plant Food Control Officials.

Rather than focusing on parameters from the practices, it is recommended that USDA, in close consultation with Treasury and Argonne National Laboratory, develop a robust set of standard, national or broad regional proxy GHG reduction factors for individual CSA practices, rather than attempting to estimate the reductions associated with implementing those practices at highly granular geographic levels (e.g., farm or field-level).

(4) For practices identified in question 2, to what extent do variations in practice implementation affect the overall GHG benefits of the practice (e.g., the date at which cover crops are harvested or terminated)? What implementation strategies maximize the GHG benefits of these climate-smart agriculture practices?

As noted above, a robust set of standard proxy GHG reduction factors should be developed for individual CSA practices, based on the best available science and most common applications of the practices.

While we understand this RFI is not specific to integration of CSA practices into the 45Z program, USDA should work with Treasury to ensure there is a straightforward mechanism for ensuring emissions reductions related to individual CSA practices are able to be applied to transportation fuel emissions rates for the 45Z credit. Registered entities could apply CSA emissions reduction factors for individual practices following the same approach used for the USDA CSA Pilot Program under 40B (Section 4.01(1)-(3)), except that “bundling” should not be required.

(5) What scientific data, information, and analysis should USDA consider when quantifying the greenhouse gas emissions outcomes of climate-smart agricultural practices and conventional farming practices? What additional analysis should USDA prioritize to improve the accuracy and reliability of the GHG estimates? How should USDA account for uncertainty in scientific data? How should USDA analysis be updated over time?

The Department of Energy’s Argonne National Laboratory has already conducted a comprehensive review and extensive analysis of existing scientific data and analysis related to the GHG outcomes of CSA practices and conventional farming practices. Much of this work has been integrated into the Greenhouse gases, Regulated Emissions, and Energy use in Technologies (GREET) model and related FD-CIC. GREET incorporates the best available science and is regularly updated, including the most recent data from USDA (often

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[4] https://www.nrcs.usda.gov/getting-assistance/conservation-practices

from the National Agricultural Statistics Service). Accordingly, USDA could utilize the ANL "GREET1" Excel model or a specific version developed for the 45Z credit.

In the future, USDA could consider improving or refining estimates of GHG emissions outcomes related to CSA based on updated multi-year soil carbon testing results obtained via USDA's Partnerships for Climate-Smart Commodities Project and other programs. However, any updates that meaningfully change the estimated GHG reduction value of certain CSA practices should be conducted sparingly, on a predictable timeline (e.g., once every three years), and with at least one year (i.e., one growing season) of lead time for implementation. This would ensure the marketplace has ample time to plan and make necessary investments.

One method for accounting for the uncertainty and spatial variability in GHG emissions data associated with various agriculture practices is to use more conservative standard "proxy" GHG reduction values, applied nationally or to broad regions.

(6) Given the degree of geographic variability associated with each practice, on what geographic scale should USDA quantify the GHG net emissions of each practice (e.g., farm-level, county-level, state, regional, national)? What are the pros and cons of each scale? How should differences in local and regional conditions be addressed?

We readily acknowledge that the GHG emissions impacts of different CSA practices can significantly vary based on geography. However, when it comes to tax credit programs like 45Z, RFA believes that standard national or broad regional average "proxy" factors should be used for individual CSA practices. This approach would better ameliorate the potential market disruptions related to 1) geographical variation in CSA emissions impacts, and 2) the challenges associated with accurate measurement of GHG impacts for some practices at high spatial resolutions (i.e., farm or field-level). This approach will eliminate the often-wide discrepancies in estimates of the GHG impacts of the same CSA practice in different geographic locations, and it will provide incentives for growers from a wide range of geographies to adopt CSA practices. Using more conservative "proxy" values for individual CSA practices would facilitate broader and swifter adoption.

(8) Where models can be used to quantify changes in greenhouse gas emissions and sinks associated with climate smart agricultural practices, which model(s) are most appropriate for quantifying the greenhouse gas effects of these practices? What are the tradeoffs of different modeling approaches for accurately representing carbon, methane, and nitrous oxide fluxes under climate smart agricultural practices?

As noted in the response to question 5, the GREET and related FD-CIC models should be used whenever possible. The GREET and FD-CIC framework relies primarily on soil carbon data from the CENTURY model, which is based on a broad set of peer-reviewed scientific literature and validated field measurements. As noted above, the CENTURY and FD-CIC models can be continuously improved on regular intervals as more data become available.

We are not aware of any other existing models or data sets that could reliably be used to quantify changes in GHG emissions associated with CSA practices, especially for the purpose of informing CSA integration into 45Z and other tax and regulatory programs.

(9) How should net greenhouse gas emissions, including soil carbon sequestration, be attributed among crops produced in a rotation, for example crops grown in rotation with one or multiple cover crops?

Given the structure of the 45Z tax credit and other regulatory programs (at both the federal and state level), approaches for quantifying GHG emissions related to CSA and conventional farming practices must allow for annual determinations. For most activities related to crop production, this is fairly simple and straightforward based on the annual growing and harvest cycle. GHG emissions related to most crop production activities can be attributed directly to the crop grown on a per-unit basis (i.e., farm machinery fuel consumption, fertilizer and chemical application, etc.). Any GHG emissions related to fall preparations (nitrogen application, tillage) should be attributed to the following planted crop (not the crop that was just harvested). In the case of cover crops, the associated emissions impacts and soil carbon sequestration/retention should be attributed to the crop planted immediately following termination (e.g., winter-kill, rolling and crimping, etc.), or harvest (where allowable) of the cover crop.

(10) To what extent do interactions between practices either enhance or reduce the GHG emissions outcomes of each practice? Where multiple practices are implemented in combination, should the impacts of these practices be measured individually or collectively?

In cases where there are synergistic effects of implementing multiple practices in combination, this should be recognized. For example, where combinations of certain CSA practices provide greater GHG reductions than the sum of those same GHG reductions attributable to individual practices in isolation, USDA should provide GHG emissions reduction values for both approaches (combined and individual). The FD-CIC tool shows that the combination of certain synergistic CSA practices can often lead to GHG reductions that are larger than the sum of the GHG reductions from the same practices examined in isolation of one another. This is not surprising, as the scientific literature shows that combining practices that retain or expand soil organic carbon levels can have compounding benefits.

For the purposes of tax credit programs, farmers should have the option to choose a "bundled" GHG reduction value for certain synergistic combinations of CSA practices ***or*** the GHG reduction values associated with the practices individually. "Bundling" of practices (i.e., usage of multiple practices on the same acreage) should be an option if it leads to a GHG reduction value that differs from the sum of GHG reductions from individual practices, but "bundling" should not be required, and farmers should have the ability to select individual CSA practices.

(11) How should the GHG emissions of nutrient management practices (e.g., applying fertilizer according to the "4Rs" of nutrient management—right place, right source, right time, and right rate; variable rate technology; enhanced efficiency fertilizer application; manure application) be quantified? What empirical data exist to inform the quantification? What factors should USDA consider when quantifying the GHG emissions outcomes of these practices?

The International Plant Nutrition Institute has developed general principles and guidelines for 4R Nutrient Stewardship. In addition, various stakeholder groups have developed standards and certification programs for 4R nutrient management. The 4R Certification Standard developed by the 4R Advisory Committee is one example.[5] When 4R practices and protocols are clearly defined, quantifying their GHG emissions benefits becomes much simpler. Further, the FD-CIC tool includes data and algorithms that quantify the GHG emissions outcomes of applying 4R nutrient management practices based on user-defined parameters.

USDA should examine, and consider leveraging, these existing programs and resources for developing 4R nutrient management guidelines and quantification techniques.

(12) How should the GHG outcomes of soil management practices that can increase carbon sequestration or reduce carbon dioxide emissions (*e.g.,* no-till, cover crops) be quantified? What empirical data exist to inform the quantification? Over what time scale should practices that sequester soil carbon be implemented to achieve measurable and durable GHG benefits?

As noted elsewhere in these comments, Argonne National Laboratory's FD-CIC tool already provides a resource that estimates the GHG emissions outcomes related to common practices that are known to increase soil carbon sequestration. The GREET and FD-CIC framework relies primarily on soil carbon data from the CENTURY model, which is based on a wide body of peer-reviewed scientific literature and validated field measurements. The CENTURY and FD-CIC models can be continuously improved at regular intervals as more data become available.

(15) What records, documentation, and data are necessary to provide sufficient evidence to verify practice adoption and maintenance? What records are typically maintained, why, and by whom? Where possible, please be specific to recommended practices (e.g., refer to practices identified in question two).

Several existing voluntary carbon market programs and voluntary consensus standard bodies (e.g., International Organization for Standardization) already define recordkeeping requirements for GHG-reducing activities and certain CSA practices that are known to build soil carbon levels. In addition, USDA's Conservation Practice Standards provide information on the types of records and documentation that can be used to support

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[5] https://4rcertified.org/#:~:text=The%204R%20Nutrient%20Stewardship%20Certification,Time%20in%20the%20Right%20Place

verification of a broad range of practices. In some cases, especially where farmers are receiving technical or financial assistance from USDA for integrating CSA practices (e.g., the Conservation Stewardship Program), USDA sub-agencies, extension services, and other affiliates are already collecting information or records from farmers to verify practice adoption and compliance with applicable guidelines and protocols.

Generally, the types of records and documentation required to verify CSA practices should include:

- Purchase receipts for seed and other inputs that are directly involved in or otherwise impact the CSA practice, along with actual seeding/application/input consumption rates;
- A plan for the CSA practice that outlines the farmer's approach for complying with all relevant practice adoption guidelines and protocols, and documentation of any deviations from the plan during implementation, as applicable to individual practices;
- Any conservation plans that include CSA practices recognized by USDA;
- Planted acreage, harvested acreage, and yield for acres where CSA practices are implemented;
- Planting and harvest dates for acres producing CSA feedstock, as well as cover crop termination dates;
- Records for the sale and delivery of the CSA feedstock, and feedstock on-hand inventory reports; and
- An attestation similar to Appendix B of IRS Notice 2024-37.

The use of these records within a straightforward CSA practice certification protocol should be sufficient. It is not necessary to implement chain-of-custody requirements similar to those for the IRA SAF (40B) credit (i.e., "full supply chain traceability…from the farm to the SAF producer"), which are overly burdensome, unnecessary, and will discourage biofuel producers from sourcing CSA feedstock. It is highly unlikely that CSA practices will scale if feedstock IP or even batch-level mass balancing is required.

(17) Are there existing reporting structures that can potentially be leveraged?

The information in several of the types of records noted in response to question 15 is already provided by farmers to county USDA Farm Service Agency (FSA) offices, as well as the NRCS (i.e., for those farmers already voluntarily participating in certain conservation programs) and Risk Management Agency (RMA). Additionally, a working relationship and level of trust has been established between farmers and the staff in local FSA offices. This existing infrastructure could be examined, and possibly leveraged, for reporting and verification of CSA practices under 45Z. Finally, reporting and verification systems used in other federal regulatory programs (such as the annual attestation, quarterly reports, compliance auditing, and quality assurance plan requirements under the Renewable Fuel Standard) should be examined to determine whether elements of those models could be emulated for reporting and verification of CSA practices.

(18) Should on-site audits be used to verify practice adoption and maintenance and if so, to what extent, and on what frequency?

On-site compliance assurance audits could be used to verify CSA practice adoption. However, if on-site audits are conducted, USDA must take great care to balance the auditor’s needs (i.e., achieving an acceptable level of compliance assurance) with the farmer’s needs (e.g., time constraints, adequate notice, CBI and privacy protection, access to property, etc.).

USDA should also strongly consider the efficacy of remote auditing, especially given the likely shortage of auditors and verifiers with the requisite expertise. Remote verifications may include reviewing satellite and drone imagery, data analysis, screen shares of software/data tracking processes, and video calls.

Further, we strongly believe any audit framework must avoid a requirement to audit every CSA farmer every year; rather, a more resource-effective program would be based on randomized sampling of CSA farmers at a statistically significant level. Effective farmer and feedstock audit models that use sampling already exist in both regulatory environments (e.g., feedstock audits for the European Union’s Renewable Energy Directive) and voluntary carbon markets.

(20) What system(s) should be used to trace feedstocks throughout biofuel feedstock supply chains (e.g., mass balance, book and claim, identity preservation, geolocation of fields where practices are adopted)? What data do these tracking systems need to collect? What are the pros and cons of these traceability systems? How should this information be verified?

If the government were to require that physical commodities grown using CSA practices be rigidly tracked through the supply chain and delivered to biofuel production facilities, this could cause significant distortions in grain flows and pricing. As a result, program participation and the associated GHG emissions benefits would be limited unnecessarily.

Even certain mass-balancing approaches for tracking CSA feedstock could result in market distortions and unnecessary economic burdens that would likely deter farmers from pursuing the adoption of CSA and deter biofuel producers from sourcing CSA feedstock.

As noted in the attached white paper by Polaris Analytics and Consulting, “Grain is like water in that it flows on the path of least resistance.” However, “[i]f 45Z guidelines require that CSA attributes remain connected to physical grain delivered to biofuel facilities, this will impact the flow of corn through the supply chain.”

Ethanol facilities that qualify for 45Z credits could afford to pay a substantial premium for CSA corn, which would “have unintended consequences of disrupting the corn supply chain that is set up to handle large volumes through a high output network that was planned, invested in, developed and operated over years and decades.” The sourcing of low-CI corn by those facilities could involve transportation movements that are not typically done by rail, which would require a substantial number of truckloads involving higher costs and increased GHG emissions. At the same time, “Other market participants who transform corn into livestock feed or move it to the export market could lose out too and will have to increase the price of corn to compete with the ethanol plant, buy corn from other locations or modify their operations.” Polaris concludes, “Instituting a decoupling of the physical corn bushel under a book and claim approach will preserve the integrity of the corn supply chain while incentivizing SAF production through certified CSA plans at the farm level.”

To avoid these unintended consequences, RFA recommends that verified CSA attributes be decoupled from physical bushels of grain. The carbon reduction value associated with the CSA practices can be verified by a third party and offered for sale by the farmer as a separate instrument (“CSA certificates,” perhaps) on a centralized registry. Those certificates could then be purchased by a biofuel producer using “book and claim” accounting, without regard to the geography or physical location of either the CSA farmer or the biofuel producer. “Book and claim” is a chain-of-custody model “in which the administrative record flow does not necessarily connect to the physical flow of material or product throughout the supply chain.”[6]

When they are decoupled, the GHG reductions related to the CSA practices can be transferred separately from the farmer/grain supplier to the low-carbon fuel producer (i.e., the entity registered with IRS under 45Z) via a dedicated instrument (“CSA certificate”). In such a system, the buyer (fuel producer) and seller (CSA farmer or CSA grain supplier) need not be connected via a physical supply chain. The buyer “books” a specific quantity of CSA feedstock at the time of purchase and then “claims” the emissions reduction when calculating the emissions rate of their fuel. As a result, the buyer owns the GHG reduction benefits of the CSA feedstock without physically possessing the specific feedstock at their biorefinery. Still, it is the buyer’s purchase of the CSA-related GHG reductions that incentivizes the farmer’s adoption of CSA practices.

The following hypothetical example demonstrates how this approach would work in practice:

1. Prior to planting, the farmer declares that the following CSA practices will be used on 1,000 corn acres: reduced till, replacement of 50% synthetic N fertilizer with manure, 4R N application practices, and the use of renewable diesel in planting and harvesting farm machinery.
2. Throughout planting and harvesting, the farmer keeps detailed records of CSA practices and inputs (using recordkeeping requirements similar to those discussed in response to Question 15 above, and/or similar to those outlined in Appendix B of IRS Notice 2024-37).
3. At harvest, the farmer completes a legally binding attestation declaring that applicable CSA practices have been implemented according to relevant guidelines, as specified by USDA. The farmer harvests 200,000 bushels of CSA corn on the 1,000 acres.

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[6] ISO 22095:2020

4. At harvest, an unrelated third-party certification body (similar to those described in Appendix A of IRS Notice 2024-37) independently verifies the farmer's records and attestations.
    a. Upon successful verification, the unrelated third-party certifier issues a verified "CSA certificate" to the farmer, memorializing and validating the specific CSA practices employed for the production of 200,000 bushels of corn. Alternatively, the CSA certificate could represent the GHG reduction (metric tons of CO_2 equivalent) associated with the CSA practices applied to the 200,000 bushels, based on standard GHG reduction "proxy" values developed by USDA for each practice. At this point, the "CSA certificate" is decoupled from the physical feedstock (i.e., 200,000 bushels of corn). The farmer sells the physical quantity of corn to an unrelated entity (e.g., a feedlot or elevator) based on market-driven logistics, timing, and pricing fundamentals.
    b. The "CSA certificate" is a tradeable instrument that the farmer may sell to entities who wish to purchase and claim the emissions reductions benefits associated with farmer's CSA practices. The certificate would be offered for sale on a national "CSA registry," potentially managed by USDA or the Treasury (similar to EPA's management of the RIN trading platform). "CSA certificates" could potentially have a multiyear lifespan.

5. The ethanol producer (the registered entity under 45Z) purchases the verified "CSA certificate" off of the registry for 200,000 bushels of corn from the CSA farmer at a price agreed upon by the ethanol producer and CSA farmer.
6. Upon purchase of the "CSA certificate," the farmer electronically transfers copies of the attestation and all other required records to ethanol producer for recordkeeping.
7. When calculating the emissions rate of transportation fuel under 45Z, the ethanol producer includes the GHG reductions associated with the CSA practices specified on the "CSA certificate" (using standard proxy factors for individual CSA practices, as discussed above).

Adopting a book-and-claim system for CSA would offer the following benefits:

- Eliminates the need for contracts for physical feedstock purchases between the CSA farmer and the ethanol producer.
- Allows farmers who are not in close physical proximity to ethanol, SAF, or other biofuel facilities to be rewarded for adopting CSA practices.
- Removes potential feedstock IP, rigid traceability, and chain-of-custody burdens on all supply chain entities, including intermediaries like commercial grain elevators.

- Allows the grain market to continue operating rationally and efficiently. Physical quantities of grain continue to flow efficiently and to natural buyers based on location, logistics, and other market-based factors.
- Allows the ethanol, SAF, or other biofuel producer to manage geographic risk that an adverse weather event (e.g., drought) near their facility would make them unable to obtain CSA feedstock—and, therefore, to deliver on low-carbon fuel volume commitments.

Book-and-claim systems have already been used successfully in other markets, most notably with green electricity ("renewable energy credits," or "RECs"), renewable natural gas, and even SAF introduced into multi-product pipelines. Book-and-claim is used in voluntary carbon offset markets as well.

Finally, a book-and-claim approach as described above would not preclude parties from using contracts to secure the physical bushels of CSA grain (i.e., keeping the CSA attributes coupled with the physical grain) and using mass balancing if they instead preferred that chain-of-custody model. In this case, rather than decoupling the "CSA certificate" from the physical bushels, the two flows would remain coupled through the supply chain via mass balancing and the buyer would purchase both the grain and the CSA attributes from the same farmer/grain supplier.

(24) How should oversight of verifiers be performed? What procedures should be in place if an independent third-party verifier fails to conform to verification and audit requirements, or otherwise conducts verification inappropriately?

Oversight could be implemented by requiring a certification process by which the verifier becomes accredited by USDA via a registration process and adherence to program requirements set forth in final program criteria. Upon audit, any erroneous or incomplete information should be the auditing entity's responsibility for purposes of valid program applications. Accreditation could be revoked if the verification fails to comply with standards, and if the verifier fails to correct or remedy shortcomings in a reasonable timeframe. A program for accrediting CSA verifiers could be set up in a manner similar to EPA's approval/accreditation of Quality Assurance Plan providers under the Renewable Fuel Standard program, or the California Air Resources Board's approval of verifiers under the California Low Carbon Fuel Standard.

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On behalf of RFA, thank you again for the opportunity to submit these comments in response to USDA's request for information. We look forward to continued engagement with USDA about ways to encourage the adoption of climate-smart agriculture while maintaining the efficiency of the agricultural supply chain.

Sincerely,

Geoff Cooper

Geoff Cooper
President and CEO

ATTACHMENT:

“IMPACT OF 45Z ON THE CORN SUPPLY CHAIN”

Prepared by

Polaris Analytics and Consulting, LLC

POLARIS
Analytics & Consulting

Impact of 45Z on the Corn Supply Chain

Prepared for

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July 2024

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anchoring your future!

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Acronyms

- CI – Carbon Intensity
- CORSIA – Carbon Offsetting and Reduction Scheme for International Aviation
- CME – Chicago Mercantile Exchange
- CSA – Climate Smart Agriculture
- CIF – Cost, Insurance and Freight
- DDGS – Distillers Dried Grains with Solubles
- FOB – Free On Board
- GMO – Genetically Modified Organism
- GREET – Greenhouse gases, Regulated Emissions, and Energy use in Technologies
- HFCS – High Fructose Corn Syrup
- IRA – Inflation Reduction Act of 2022
- IRS – Internal Revenue Service
- PNW – Pacific Northwest
- PAC – Polaris Analytics and Consulting
- SAF – Sustainable Aviation Fuel
- Treasury – U.S. Department of Treasury
- USDA – U.S. Department of Agriculture
- USDA-AMS – Agriculture Marketing Service

- USDA-NASS – National Agricultural Statistics Service
- USDA-WAOB – World Agricultural Outlook Board
- USGSA – U.S. Grain Standards Act

Units of Measure

- One corn bushel = 56 pounds
- One metric ton = 2,204.62 pounds
- One metric ton = 39.4 corn bushels
- One short ton = 2000 pounds

Introduction and Description

As part of the Inflation Reduction Act of 2022 (IRA), Section 40B provides a tax credit for sustainable aviation fuel (SAF) included in qualified fuel mixtures produced by taxpayers and used or sold between 2022 and 2025. The credit is $1.25 per gallon of SAF. A provision of 40B is that SAF must have a baseline lifecycle greenhouse gas emissions reduction percentage of 50%. There is an extra $0.01 per gallon added for each percentage point by which the emissions reduction percentage exceeds 50%, up to a maximum of $0.50 per gallon.

Fuel producers or importers must register with the U.S. Department of Treasury (Treasury) and provide certification demonstrating compliance with sustainability requirements. Certification can be based on CORSIA (Carbon Offsetting and Reduction Scheme for International Aviation) or a similar methodology.

Section 40B will be superseded by Section 45Z after 2024, which closely mirrors the assessment of SAF carbon intensity (CI) of Section 40B. The key difference is that 45Z requires CI to be based on Argonne GREET (Greenhouse gases, Regulated Emissions, and Energy use in Technologies) or a successor model determined by the Secretary of the Treasury for other fuels. The Internal Revenue Service (IRS) oversees the implementation and administration of 45Z.

Both programs incentivize SAF production, but Section 45Z introduces flexibility for other fuels' carbon intensity assessment.

However, the CI requirement could disrupt commodity flows, specifically corn flows, to fulfill the requirements of 45Z. For example, there could be challenges in supply chain management, logistics and tracking of Climate Smart Agriculture (CSA) feedstock. Other challenges include verification, recordkeeping and auditing of CSA practices, dealing with the impacts of natural variability (weather / climate impacts, etc.) on CI from season to season, issues with long-term soil carbon measurement and validation, and the possibility of creating feedstock winners and losers based on uncontrollable factors (e.g., soil C capacity, suitability for cover crops, etc.).

The bottom line is that to accommodate CI requirements, physical corn flows will not move in traditional market patterns and instead could disrupt market fundamentals as a result. This report describes the grain supply chain with a focus on corn, while evaluating scenarios of how corn flows can be disrupted to meet the provisions of 45Z.

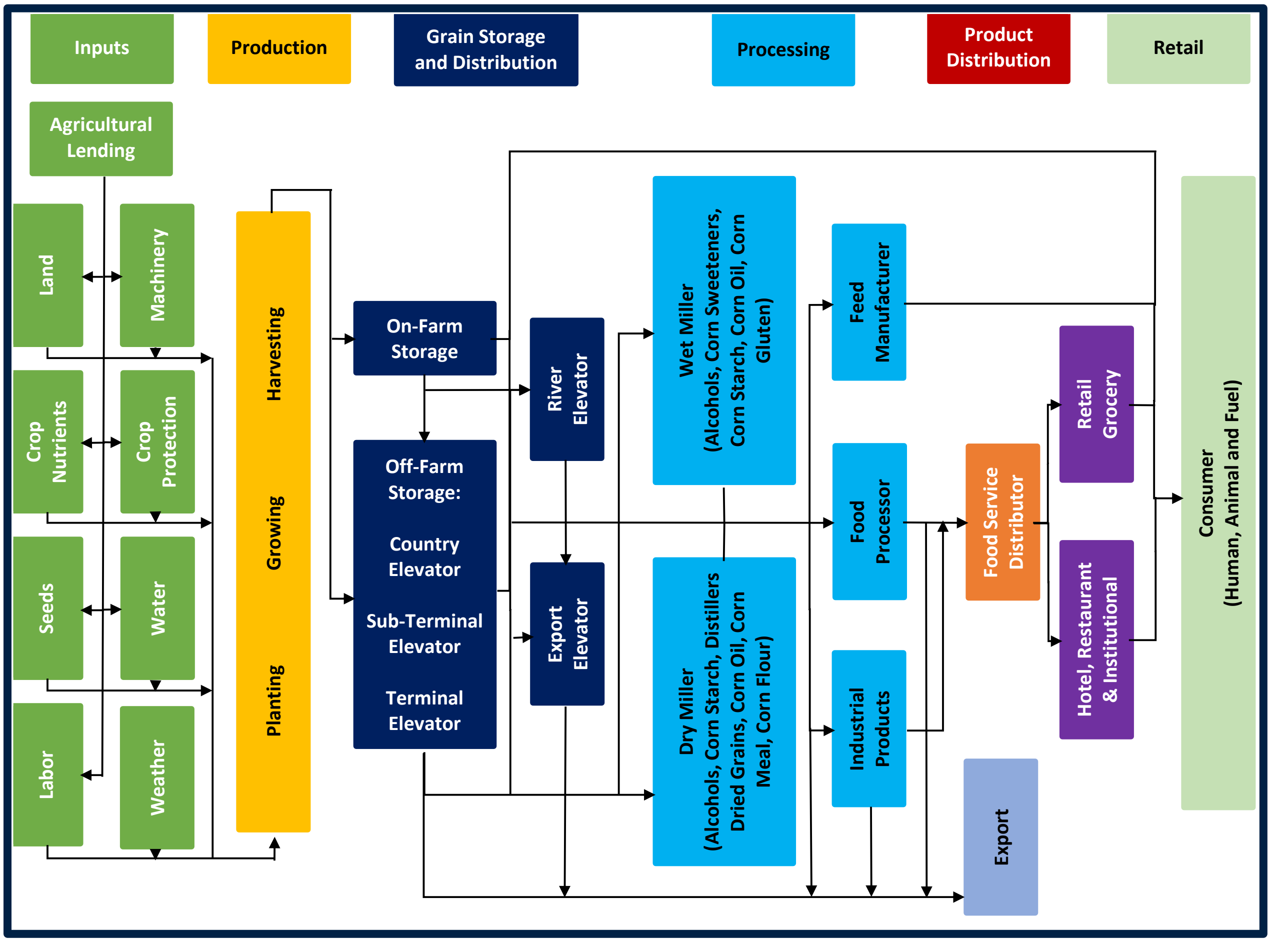
The first section of this report describes the corn supply chain, followed by a review of the modes moving corn to market position, and the next section considers price and costs. The last section introduces scenarios on the impact of CI on the corn supply chain.

Corn Supply Chain

Grain and soybean crops produced and used in the United States and around the world have intricate supply chains. Each crop then has its own nuanced supply chain given its characteristics and uses. The principal crops include barley, corn, oats, sorghum, soybeans and wheat. Yet, each crop also shares various pathways of their respective supply chains with the other crops.

The corn supply chain shown in Figure 1 includes six major tasks (inputs, production, grain storage and distribution, processing, product distribution and retail). The first task is related to getting a crop in the ground, which considers lending costs, land, labor and weather.

Figure 1: U.S. Corn Value Supply Chain



Source: Polaris Analytics and Consulting

Corn Inputs

Unlike any other commodity or resource, crop production is an annual event. Each year farmers plan, plant, treat, wait and harvest their grains and soybeans. The planning for what will be planted starts during harvest of the previous crop. Farmers have several considerations as to what crop they plant such as crop rotation patterns, financial returns of one crop over another, tax planning and contract farming commitments as examples. Once a crop is selected to be planted the farmer then considers the type of hybrid or plant characteristic to plant. For example, does the farmer choose a genetically modified organism (GMO) or non-GMO seed variant, plant yellow corn or white corn, etc. That planning continues until planting occurs as weather, seed availability and type, and market prices influence what ultimately is planted.

Corn Production

While crop production is an annual event, by comparison, other commodities such as crude oil, coal, natural gas or livestock production are flow commodities in that they are continuously produced or harvested while grain and soybeans are harvested and stored for use throughout the crop marketing year. And none of the annual events are guaranteed to happen, given all the variables farmers encounter, especially with weather, raining at the wrong time or not at all, combined with high heat or not enough.

Once the crop is planted farmers treat their crops with nutrients and protection and rely on the weather to mature the crops to harvest.

Grain Storage and Distribution

Grain is like water in that it flows on the path of least resistance. At harvest, farmers have two options: take their crops to a storage bin on their farm or haul them to an off-farm location to be stored or to a position of consumption. The core crop harvest windows in the U.S. are June and July for the small grains (barley, oats and wheat) and October and November for the heavy grains (corn, sorghum and soybeans).

An important point is that only one crop and its class or attributes is stored in a bin. The grain storage system has been developed over decades to store grain at harvest until it is needed elsewhere. The system has been designed to be efficient where field carts and trucks hauling the harvested grain from the field are quickly unloaded. In some cases, the grain needs to be conditioned such as being dried down by mechanical means because its moisture content is too high. Putting grain through a drier slows down the operation, however. At harvest, speed matters and being able to unload into bins that can hold sizeable volumes of grain is important.

Farmers have on-farm storage bins to hold their harvested grain until the timing is right to send their grain to the next market position. On-farm storage allows farmers to have flexibility managing their harvest schedule while executing their grain marketing program. The harvest window can be quite narrow and once it starts it is difficult to stop. The on-farm option allows farmers to take the harvested grain from the field to a bin and not travel to an off-farm location and most likely wait in line to “dump” or deliver their grain. Many farmers have enough storage capacity to store an entire harvest.

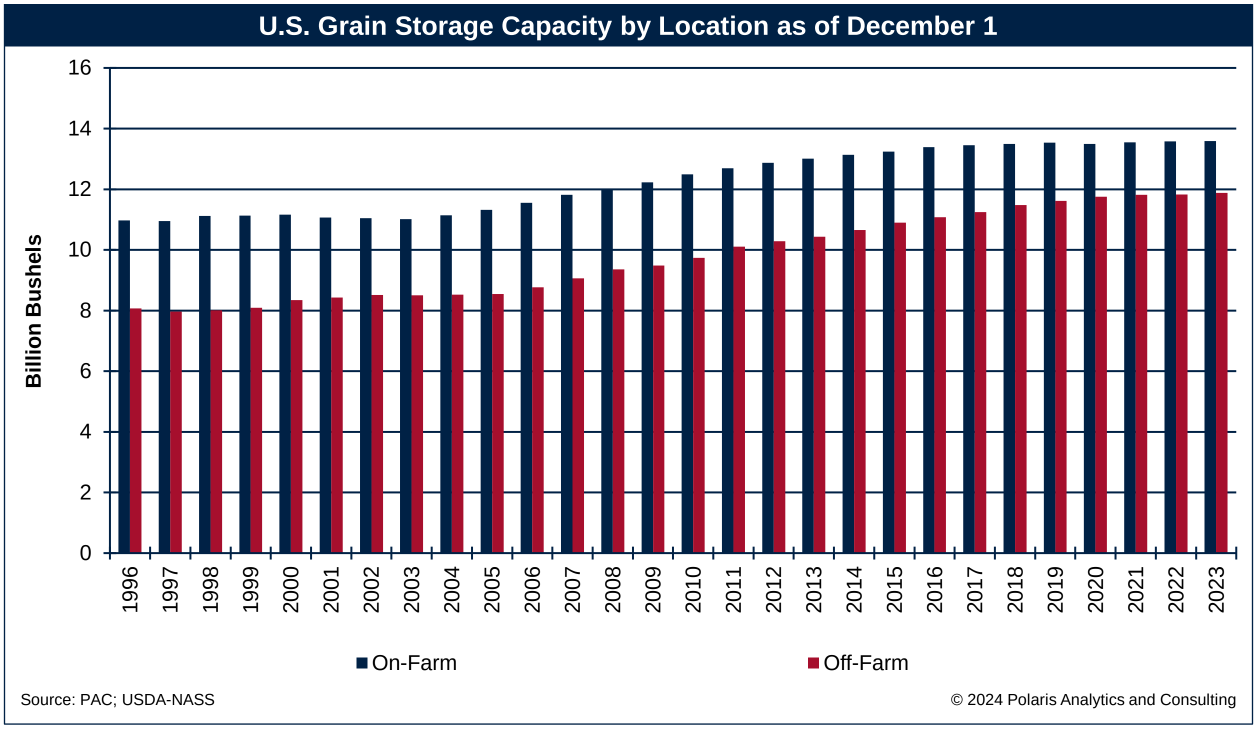
Farmers do deliver grain to off farm locations during harvest, with the bulk of it moving from the farm after harvest. Off-farm storage is located at commercial grain locations where grain merchandisers buy, market or store the grain for the farmer. In some regions around the grain growing areas of the U.S. there is not enough available grain storage and grain will temporarily be stored on the ground. Grain may remain in off-farm storage for days, weeks and even months.

Grain storage capacity is compiled by the U.S. Department of Agriculture’s (USDA) National Agricultural Statistics Service (NASS). NASS reports grain storage capacity for on-farm and off-farm as of Dec. 1. On

Dec.1, 2023, grain storage capacity in the U.S. totaled a record 25,468 million bushels. Over the past decade, storage capacity has expanded by about 1% per year.

By location, on-farm storage represented 53% of all capacity. However, off-farm storage has been gaining ground with on-farm storage, increasing from a market share of 43% in 2000 to 45% in 2016 and 47% in 2023. Grain storage capacity by location is shown Figure 2.

Figure 2: U.S. Grain Storage Capacity by Location as of December 1



Source: PAC; USDA-NASS

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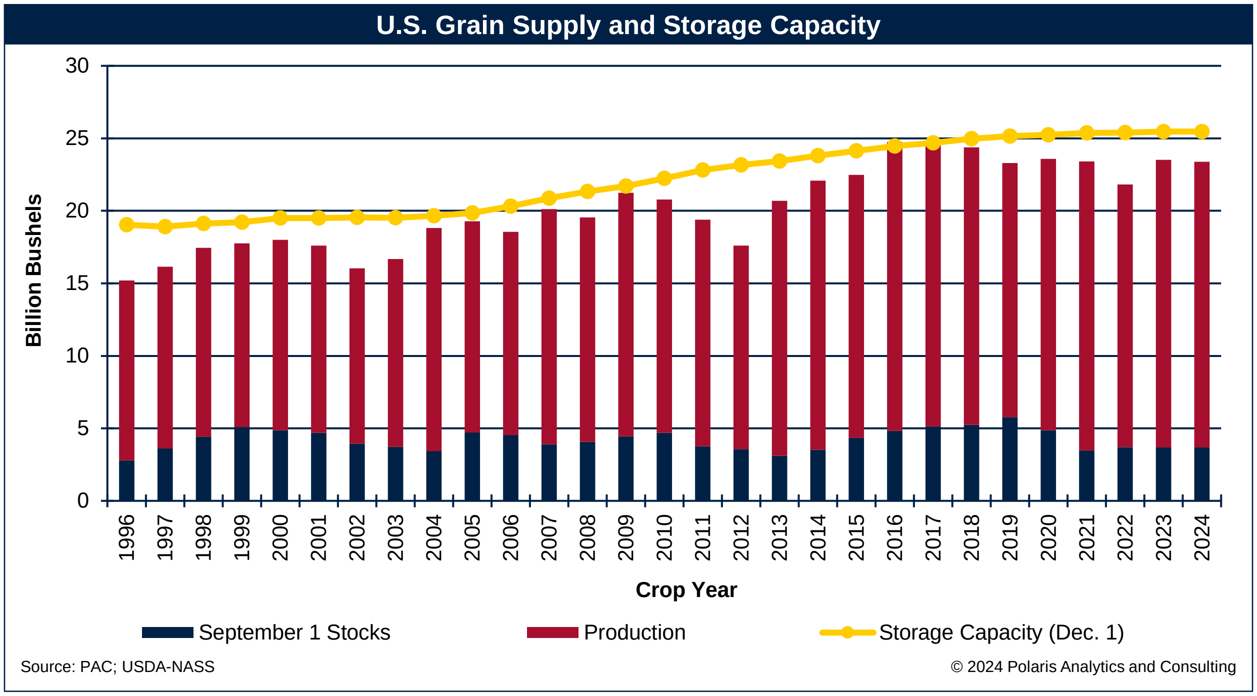
Constructing and erecting grain storage facilities has become more costly with persistent inflation and supply chain disruptions in the past few years. For example, the main construction costs include stainless steel (that are up 46% from 2019 to a purchase price index of 140.1 in April 2024) and concrete (up 43% from 2019 to a purchase price index of 247.8 in April 2024), let alone labor and finance charges.

During Sept. through Dec. 2023, grain storage utilization tightened to 92% from 85% in 2022 as crop supplies (Sept. 1 grain stocks plus corn, sorghum and soybean production) grew 8% or 1,700 million bushels to 23,513 million while capacity expanded by 65 million bushels as shown in Figure 3. A storage utilization rate of 92% is not extremely tight, especially given that one-third of the grain that is in storage on Dec. 1 will be moved into the supply chain by March 1 of the following calendar year. The volume moved out of storage and consumed is equivalent to about 5,200 million bushels. Storage becomes an issue when utilization rates are higher than 97% and increasing, if there is a carry in the market (a market carry is a higher price for corn in a deferred futures contract, e.g., the price of the December futures contract is less than the March futures contract) that slows the movement of grain into the supply chain and if grain is not fully removed from storage before the next harvest.

If on Sept. 1, 2024, grain inventories mirror last year's, and adding USDA's 2024 fall production (corn, sorghum and wheat) forecast to that, crop supply during September through November will total 23,386 million bushels, or 126 million less than supplies during 2023. And if grain storage capacity is unchanged, storage utilization will relax below 91%, softening the pressure on the grain storage market. Crop supply and storage capacity are shown in Figure 3.

This supply is what is used for the rest of the crop marketing year for domestic consumption and exports.

Figure 3: U.S. Grain Supply and Storage Capacity



Source: PAC; USDA-NASS

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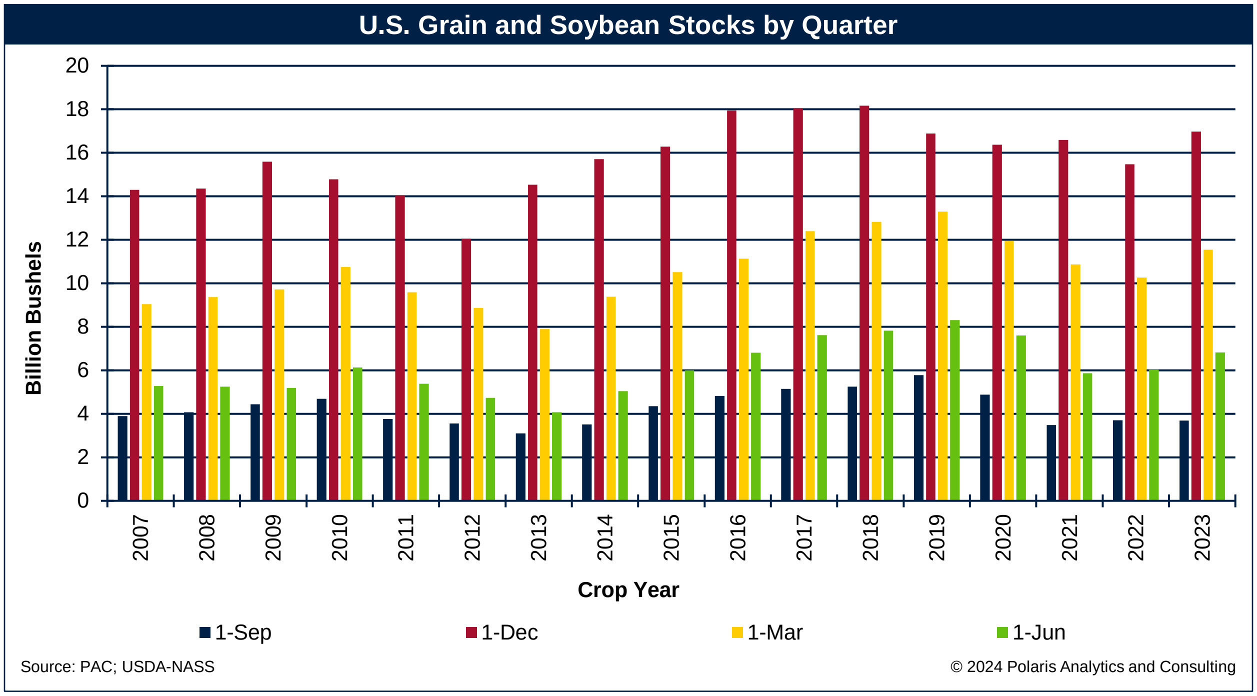
Grain stocks are largest for the year on Dec. 1 following the harvest of the fall crops (corn, sorghum and soybeans). From Dec. 1 grain is moved from or pulled out of storage to follow the "path of least resistance" to the next market position.

About two-fifths of the crop volume in storage on Dec. 1 moves through supply chain by March 1 of the following calendar year to be consumed. From March 1 to June 1 nearly one-half of the remaining volume is then transported for consumption. This phenomenon is illustrated in Figure 4 for all crops and depicts the movement and use of crops from one quarter to the next, where each quarter after Dec. 1 has less volume. During the June-August quarter of the crop marketing year (based on a September through August year), the last quarter of the marketing year, farmers will "clear" their storage bins of grain to make room for the fall harvest.

The four quarters of the crop marketing year for corn, sorghum and soybeans include September through November, December through February, March through May, and June through August. The small grains, barley, oats and wheat, have a June through May crop marketing year.

Figure 4: U.S. Grain and Soybean Stocks by Quarter



Source: PAC; USDA-NASS

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Corn Balance Table

The U.S. corn supply and demand balance table helps to understand the fundamentals of a corn crop, as shown in Figure 5 and sourced through the World Agriculture Outlook Board (WAOB) at USDA. Taken together, the Corn Inputs and Corn Production sections represent the supply side of the balance table. In this section the consumption or demand side of the balance table is presented. For the purposes of this report, corn exports will be discussed in this section even though they appear in the “storage and distribution” part of the corn marketing supply chain.

As a reminder, total corn supply equals the sum of beginning stocks (Sept. 1), production and imports. Corn demand or consumption or total use equals the sum of feed and residual, food, seed and industrial (including corn for ethanol) and exports. Ending stocks equals total corn supply less total corn usage.

Total corn usage has averaged 14,460 million bushels over the past five years, ranging from 13,706 million in 2022/23 to a record 14,956 million in 2021/22. Corn used for domestic consumption has averaged 12,283 million bushels over the past five years, representing 85% of total corn consumption. Corn exports have averaged 2,177 million bushels over the past five years, ranging from 1,662 million in 2022/23 to a record 2,747 million in 2020/21, and representing 15% of total corn consumption.

Figure 5: U.S. Corn Supply and Demand (million acres, million bushels, Sep/Aug)

	2019/20	2020/21	2021/22	2022/23	2023/24	**2024/25**
Planted acres	89.7	90.7	93.3	88.2	94.6	**91.5**
Harvested acres	81.3	82.3	85.3	78.7	86.5	**83.4**
Yield (bu./ac.)	167.5	171.4	176.7	173.4	177.3	**181.0**
Beginning stocks	2,221	1,919	1,235	1,377	1,360	**1,877**
Production	13,620	14,111	15,074	13,651	15,342	**15,100**
Imports	42	24	24	39	**30**	**25**
Total Supply	15,883	16,055	16,333	15,067	**16,732**	**17,002**
Feed & residual	5,900	5,602	5,726	5,486	**5,775**	**5,825**
Food, seed, & industrial	6,286	6,472	6,757	6,558	**6,855**	**6,855**
Ethanol and by-products	4,857	5,033	5,320	5,176	**5,450**	**5,450**
Domestic Use	12,186	12,074	12,483	12,044	**12,630**	**12,680**
Exports	1,777	2,747	2,472	1,662	**2,225**	**2,225**
Total Use	13,963	14,821	14,956	13,706	**14,855**	**14,905**
Ending stocks	1,919	1,235	1,377	1,360	**1,877**	**2,097**
Stocks-to-use ratio	13.7%	8.3%	9.2%	9.9%	**12.6%**	**14.1%**

Source: USDA-WAOB
Note: Forecast shown as **bold**

Corn Feed and Residual

The corn feed and residual component of the demand table does not have “hard” data that precisely accounts for how much corn was used. The feed aspect represents corn fed to livestock including beef cattle, dairy cows, hogs and poultry (broilers, egg layers and turkeys). It is an estimated amount based on various techniques that use a grain animal consumption unit for each type of animal fed times the number of reported livestock or amount of production by animal type. The corn is moved from an elevator whether on-farm or an off-farm location directly to a feed manufacturer or processor. The manufacturer or processor may crack the corn and feed it directly to livestock or mix it with other feed components to make a compound feed ration.

Residual on the other hand is the unexplained disappearance of corn through the supply chain. This could be slippage or loss of volume as it moves from one component of the supply chain to the next.

Taken together these two items are the “adjusters” to have the balance table tie together given the known volumes used in the other parts of demand. The feeding portion is an attempt to quantify the volume fed while the residual is the balancer. Over the past five years corn volumes estimated to be used for feed and residual have ranged from 5,486 million bushels in 2022/23 and 5,900 million in 2019/20. Corn accounted as feed and residual represents about 45% of domestic consumption.

Corn Food, Seed and Industrial

This section looks at corn food, seed and industrial demand of the corn balance table. The food portion is for human consumption such cereals, popcorn and snack foods.

The seed portion represents corn grown specifically to be used for planting a future corn crop. Corn seed companies' contract with farmers to produce and harvest the required seed type (e.g., brand, hybrid, characteristic, etc.).

Corn for industrial use is sent to ethanol plants, wet and dry millers. The millers will use corn to manufacture high fructose corn syrup (HFCS), corn oil, alcohols and starches. An ethanol plant will produce ethanol, distiller dried grain with solubles (DDGs) and corn oil.

Corn Exports

The United States grows an abundant supply of corn each year with more than adequate supplies to meet domestic consumption requirements (feed, food, seed and industrial) of the U.S. A certain portion of the remaining volume is available to the global export market.

Over the past five years, the U.S. exported corn to nearly 100 countries, with about four out of five bushels going to five countries, in order of largest to least (including market share), Mexico (30.6%), China (18.8%), Japan (17.4%), Colombia (7.7%) and Canada (5.3%).

Corn sent to the export market is inspected to assure it meets the requirements of the U.S. Grain Standards Act (USGSA). The USGSA ensures corn is inspected for official certification of official weighing and to meet established standards. The inspection process verifies moisture content, foreign material, protein and overall corn quality.

Depending on the buyer, they may have purchased number two yellow corn where the corn will have to be less than 2% foreign material. Other buyers might require non-GMO corn.

U.S. corn exports are strongest during the peak harvest season (Oct. and Nov.), taking five months for one-half the annual export program to be wrapped up through Jan.

Corn Ending Stocks

At the end of each crop year there are supplies of corn that were not consumed or exported that are called ending stocks. The size of the ending stocks has been a key variable in the price of corn. If corn stocks are low relative to total usage the price of corn tends to be higher. Conversely if corn stocks are plentiful relative total usage, corn price is generally more subdued.

The U.S. has experienced low or tight corn ending stocks in the past, but it has never been zero. Traders, buyers and sellers in the market use corn price to ration demand, cutting usage to avoid running out of corn, or increase corn imports to meet consumption requirements. The corn ending stocks at the end of a marketing year, then becomes the beginning stocks for the new marketing year.

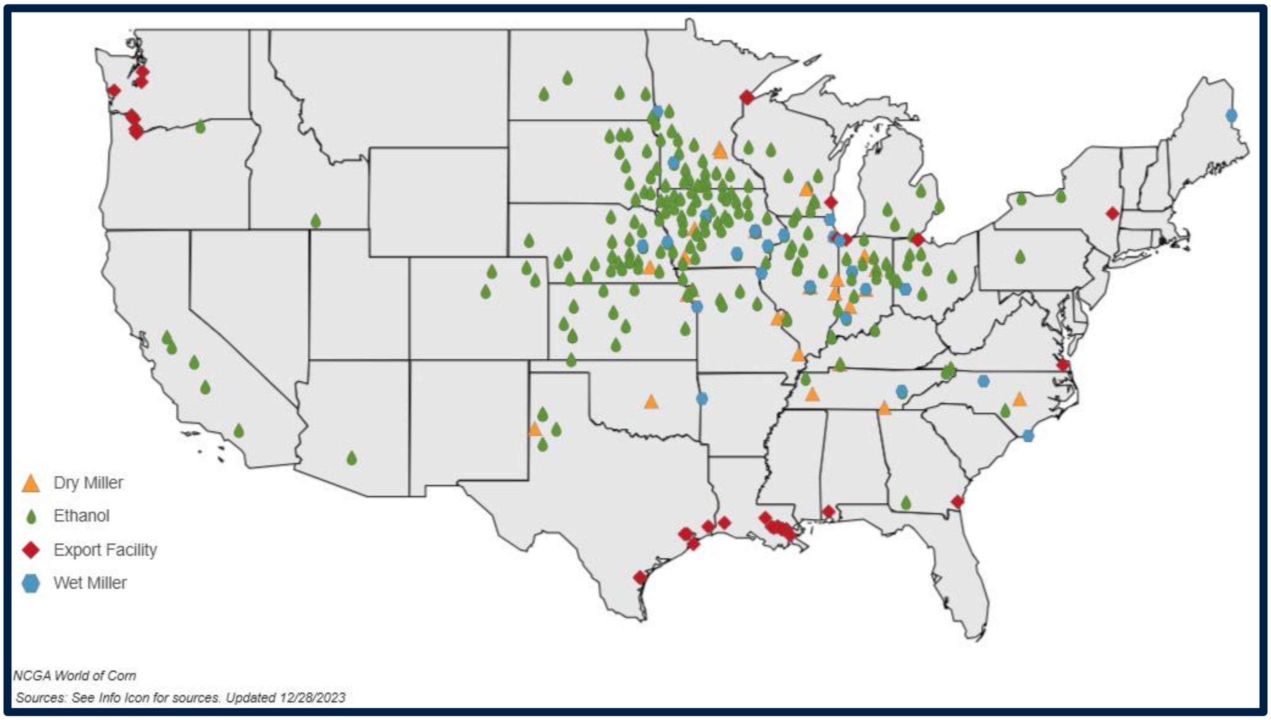
Modal Usage moving Corn to Market Position

The movement of grain from field to market position flows in a variety of directions, depending on local consumption requirements and market opportunities elsewhere. This section reviews the movement of corn to market position by transportation mode.

Corn Facilities in the Supply Chain

The location of facilities where corn is transformed, consumed or exported from are shown in value supply chain by facility in Figure 6. The top five corn growing states include (listed in order of largest to smallest production) Iowa (2.5 billion), Illinois (2.3 billion), Nebraska (1.7 billion), Minnesota (1.5 billion) and Indiana (1.1 billion). Given that corn production is largely in the U.S. Midwest and appropriately named the Corn Belt, there is a high concentration of facilities that use corn for feeding, consumption and transformation into ethanol, DDGs, corn oil, HFCS, etc., including rail and barge loading locations. These locations are readily served by the proximity of corn production to their facilities. Missing from this map is the shuttle train (that includes more than 600 shuttle train facilities) and river barge loaders and feeding locations.

Figure 6: U.S. Corn Value Supply Chain by Facility Type (2022/23)



NCGA World of Corn

Sources: See Info Icon for sources. Updated 12/28/2023

Source: National Corn Growers Association (https://ncga.com/world-of-corn/dashboard/us-corn-value-chain-map)

Corn Modal Options

As indicated in the production section, harvested grain is moved from the field to an on-farm grain storage bin or an off-farm location by field cart or truck. Essentially all corn moved from an on-farm storage location to an off-farm storage location or position of consumption (e.g., ethanol plant, grain shuttle train or river barge loading location) moves by truck. The distance moved from the farm varies from a few miles, say five miles, to as many as 75 miles, if not longer. However, the average distance is about 35 miles. The movement of corn by rail exceeds 500 miles while by barge averages over 1,000 miles. Each mode offers unique capabilities and cost considerations moving corn to a market position.

Since 2008 when ethanol production expanded rapidly, corn market shares to final domestic market position (e.g., ethanol plant, feeding position, wet or dry mill) have ranged between 80% and 90%. To final export position within the U.S. (e.g., to an export elevator) the market share has been below 20% since 2008.

The modal usage to each market position varies. For example, 84% of corn that is moved to a domestic consumption position is by truck, 15% by rail and a nominal amount by barge, according to the Agriculture Marketing Service (AMS) of USDA. Trucks are an important option to not only move corn off the farm to an off-farm location, grain shuttle train or barge loading position, but also to final market position before being transformed into semi-finished or finished products (e.g., feed, ethanol, corn oil, DDGs, etc.).

To final export position within the U.S. (an export elevator in Great Lakes, Atlantic Coast, Center Gulf, Texas Gulf, Pacific Northwest (PNW), cross-border into Mexico or Canada, or container), the highest volumes of corn exported out of the U.S. is through the Center Gulf (e.g., Lower Mississippi River from Baton Rouge through New Orleans and Myrtle Grove, LA). The Center Gulf handles about 60% of U.S. corn export inspections while export elevators in the PNW handle about 20% and interior cross border moves into Mexico and Canada about 20%. These are long haul moves outside the Corn Belt or key growing areas of the corn crop.

Because so much corn is exported through the Center Gulf, and more than 95% of the volume exported through the Center Gulf arrives by barge, the modal share of corn barge movements to export position exceeds 50%. The rail share moving corn to export position in the PNW, cross border into Mexico or Canda and to the Center Gulf averages about 35%.

The modal shares of corn moved to market position are shown in Figure 7.

Transportation Pricing

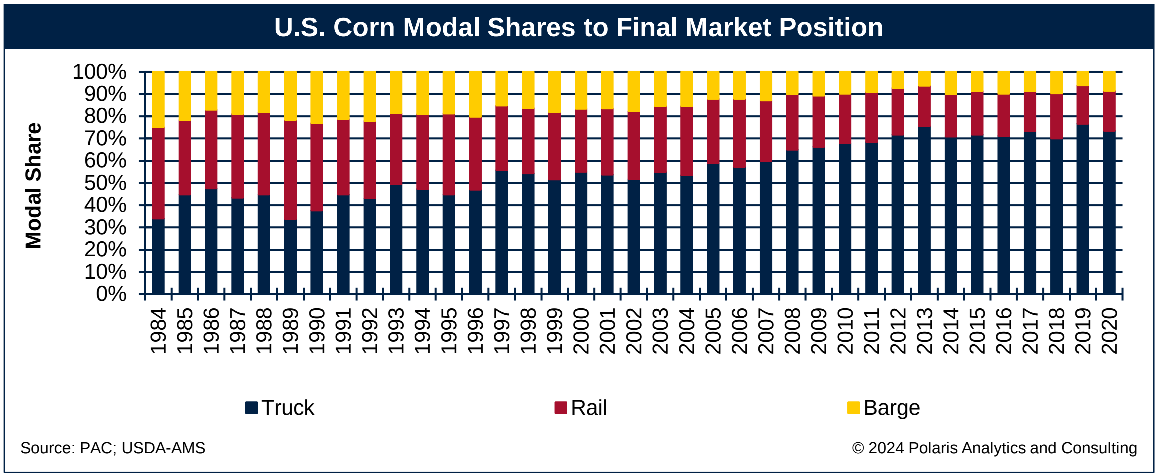
Transportation pricing or rates vary by mode and are impacted by several factors. Among shared factors is the origin and destination markets and the distance between those markets, operating costs such as fuel, available fleet capacity including the covered hopper barges or covered hopper railcars, the respective towing and locomotive power equipment, demand for service and seasonality.

Rail

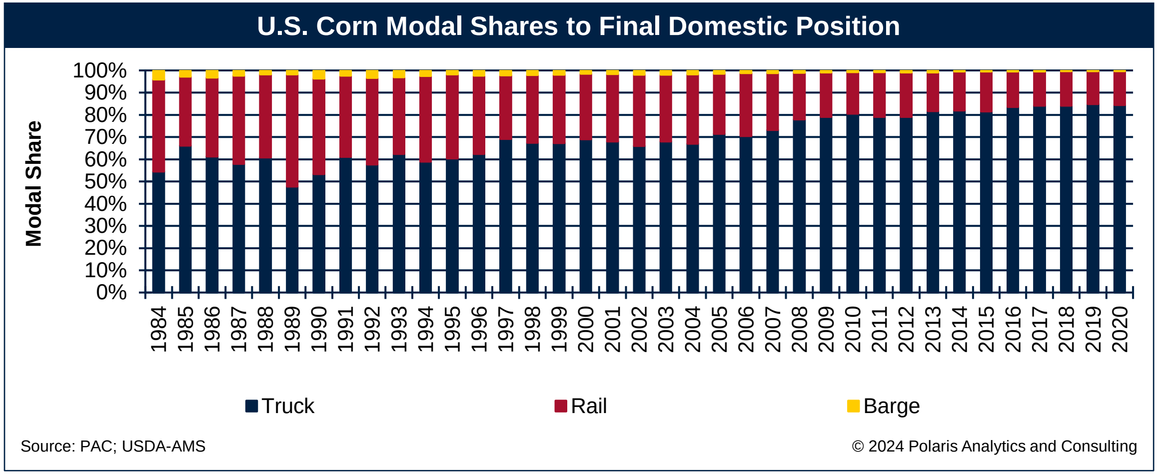
Railroads establish rail freight rates in the form of a rail tariff, an amount per carload. A rail tariff includes detailed terms and conditions to move corn, for example from one area to another. A rail tariff for corn might offer a tariff using a rail owned car or a privately owned car. There are terms for train size, e.g., the number of cars moved at one time (a shuttle train includes 110 cars and dedicated locomotive equipment, and each car carrying upwards of 4,000 corn bushels), whether the corn is GMO or non-GMO. On top of the tariff there could be various surcharges for fuel as an example, or fees to switch to another railroad. The tariffs are supposed to be publicly available and can be changed at any time. If a privately owned car is used there is a lease rate or fee to use those cars.

There are secondary rail markets where cars are made available to the market at a premium or discount to the market. The value of the secondary rail market is in addition to the rail tariff. If rail cars are being offered and traded at a premium that implies there is strong demand for railcars in the marketplace. Conversely, a discount suggests demand is weak and cars are available to be traded at a discount to the rail tariff.

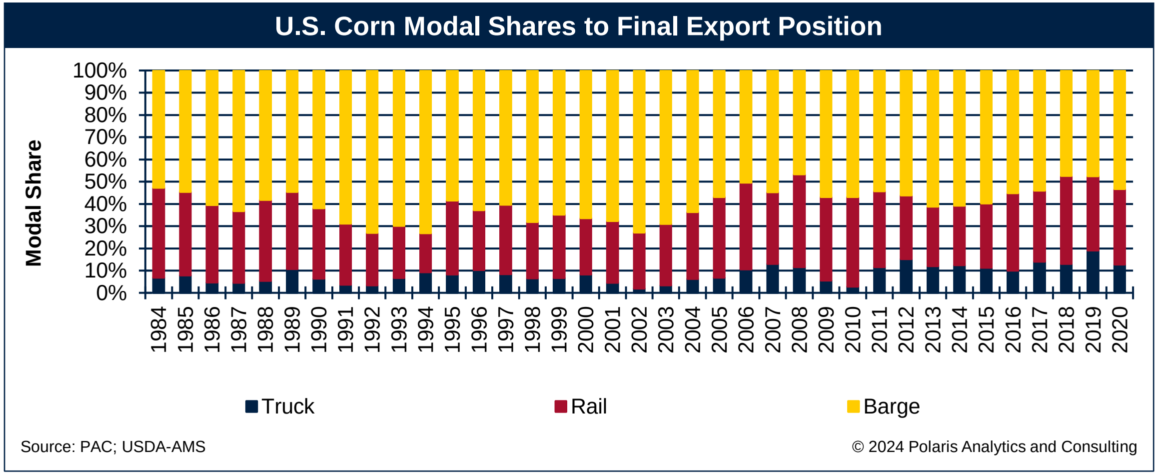
Figure 7: U.S. Corn Modal Shares by Final Market Position



Source: PAC; USDA-AMS



Source: PAC; USDA-AMS



Source: PAC; USDA-AMS

Barge

Barge freight rates on the Mississippi River System and its connecting waterways are based on a benchmark from 1977. Each location along the river system has a tariff rate, e.g., St. Louis, MO is $3.99 per short ton to New Orleans, LA. Tariffs are assigned to river segments that have market determined barge freight rates represented as a “percent of tariff.” At 100 percent of tariff the St. Louis rate is $3.99 per ton, at 400 percent is $15.96 per short ton, and so forth. Barge freight rates change frequently, reflecting market supply (number of barges and towboats) and demand (the rate of demand, seasonal patterns, and type of barge demand), navigation conditions, market demand, etc. Depending on the river segment, the number of barges in a tow could be 9 on the locking areas of the system to as many as 40 or more in the non-locking areas such as the Lower Mississippi River. Each barge can hold up to 2,200 short tons, depending on the river segment and available river draft.

Truck

Truck freight rates are local and often priced in dollars per mile. Farmers have their own trucks to move grain to market position throughout the year and there are private haulers as well. The truck sector faces seasonal pressure during the peak of grain harvest, around holidays and availability of drivers.

Modal Fuel Consumption and Emissions

Each mode has different fuel consumption capabilities and resulting emission levels. Based on research conducted by the National Waterways Foundation, average barge loadings total 1,750 short tons, which is equivalent to 16 rail hopper cars or 70 trucks. For one gallon of fuel, barges move cargo 675 ton-miles, rail 472 ton-miles and truck 151 ton-miles. As far as emissions, movements by barge generate 15.1 tons of CO_2 per million ton-miles, rail emits 21.6 tons of CO_2 per million ton-miles and truck produces 140.7 tons of CO_2 per million ton-miles.

Corn Price and Cost Considerations

Corn pricing is often associated with the Chicago Mercantile Exchange (CME) futures market where nearby and future, or forward or deferred contract months are priced and traded. A corn future is a contract for delivery of a commodity at a specific date in the future. A person can sell something they do not own, or conversely, buy something they do not want to own. The contract does not need to be fulfilled until due, even though people liquidate the contracts before then. The markets allow a person to buy or sell anytime they want (perfectly liquid) so they can always liquidate their position. The futures markets are used as a reference point for transactions all over the world. An exchange traded corn futures contract is an obligation to buy or sell a fixed quantity of a well-defined commodity at a predetermined time in the future and predetermined location(s).

While the corn futures market is based in Chicago, there are cash price locations across the U.S. whether at the farm gate, a commercial elevator, an ethanol plant, cattle feedlot or export position. Those local prices are signaling a need to buy supplies. The difference between the local cash price and the futures market is known as basis. The movement of corn responds to basis values, depending on the direction it is moving and how strong or weak it is.

Several factors influence corn basis, including:

- Location
- Transportation Costs
- Transportation Availability
- Storage Cost
- Storage Availability
- Available Grain Supply
- Crop Quality
- Grade
- Rate of Demand
- Time (e.g., October versus September)
- Government Actions
- Weather
- Interest Rates

Grain merchandisers trade basis and use it as a tool to attract grain flows or to slow flows down. For example, if corn is perceived to be short or running out relative to what is required, merchandisers may offer stronger or firmer basis levels to attract corn to move from a farm into a market position. Conversely, if there are plentiful supplies in a region the basis may weaken or fall in value.

In other instances, there could be an impediment to the movement of corn, such as a slowdown or stoppage in the transportation sectors such as low or high water on the navigable waterways. If water levels are low, then waterborne equipment such as barges might be required to be light loaded because there is not enough water depth to accommodate the maximum draft of the barge. When this happens less volume is loaded and the size of the tows (number of barges being towed) could be reduced while the velocity of the tow could be slowed. The next impact is that additional barge capacity is required to move the same volume, except there usually is not enough additional capacity. As a result, barge freight rates rise to cover the higher costs and to ration barge demand.

Those higher freight costs work backwards upstream through the barge loading locations, past the commercial elevator networks to the farm gate in the form of weakened basis. The objective is to signal to the market that by lowering basis at the farm gate farmers will not ship corn to the market. This is a mechanism to ration barge demand associated with a low water disruption moving corn. Ultimately and in this scenario, the farmer is the one who pays the price of higher freight. They do so by not sending corn to the market or if they do send corn to the market they accept a lower price in the form of weakened basis.

The following framework best illustrates the impact of an impediment to the corn supply chain. An impediment could be a transportation issue (such as the low water example), a natural disaster (e.g., a hurricane), a policy decision (unintended consequences of implementing a new program such as 45Z that can be long lasting), disputes between countries (a trade war for example that can be long lasting), etc.

- Disruption in supply chain leads to reduced transport capacity
  - ✓ Need more capacity to move same volume
- Reduced transport capacity leads to higher freight rates
  - Higher freight rates lead to lower net revenue
    - ✓ Farmers absorb the impact through weakened basis
  - Competitiveness bolstered elsewhere
    - Local and regional economies negatively impacted with lost economic activity

Quite simply, basis represents the price of transportation between markets, such as a farm and a barge loading operation.

Impact of Carbon Intensity Scoring Scenarios on Grain Supply Chain

The previous sections provided an overview of the corn supply chain, the pathways that corn takes to market position and the modes used to move that corn. As a reminder, the flow of grain, and corn specifically, to market position moves along a path of least resistance. As outlined in the Corn Price and Cost Considerations section, impediments block, restrict or constrain the flow of corn. Unlike other impediments such as low water in a navigable waterway that is generally short-lived (less than one year) policy, regulation and trade disputes can have lasting, unintended consequences.

If 45Z guidelines require that CSA attributes remain connected to physical grain delivered to biofuel facilities, this will impact the flow of corn through the supply chain. One specific impediment is the incentive to scale farm operations according to the reduction of CI achieved. Several farm practices have demonstrated to reduce CI depending on the farm's location, climate, soil type and crops grown. But just because there are farm practices to use does not mean that all farms are created equal. For example, there could be a drag on yield, the number of bushels per acre, or less of a response in adjoining county, state or across geographies for a host of reasons. And quite frankly, the CI score on a farm can change from one year to the next.

If farmers switch from conventional corn production to no-till and cover crops, does not mean they will equally share in market opportunities for their corn. For example, some farms will have better CI results than other farms, despite efforts to reduce CI. Instead, this type of approach depicts winners and losers, and not just among farmers. If CI scoring is done at a sub-state level, some farmers that could be highly advantaged due to geography, while others are disadvantaged. Other market participants who transform corn into livestock feed or move it to the export market could lose out too and will have to increase the price of corn to compete with the ethanol plant, buy corn from other locations or modify their operations.

Deploying various farm practices to reduce CI is commendable, but what then? Conceivably the approach is to grow corn in areas where a favorable CI score or level can be achieved and transport it as feedstock to an ethanol plant to meet the required GREET levels. However, there is an unintended consequence of putting an impediment or dam in the supply chain moving corn to market.

If for example a state like Nebraska had a CI score 20 points lower than a nearby state such as Iowa, the corn in Nebraska would be attractive to ethanol plants in Iowa. If CI scoring is done at a sub-state level and CSA attributes are connected to physical grain, a lower CI score would equate to a favorable and even substantial premium (not accounting for verification, traceability requirements, etc.) to attract and buy corn from Nebraska.

In 2023, Nebraska's corn yield was 182 bushels per acre, one bushel better than the national average, and depending on the CI score that can be achieved in Nebraska the value could be a significant opportunity for an ethanol plant to attract corn from Nebraska farmers who adopt a CSA plan for their farm.

Nebraska is the third leading corn producer state in the U.S., harvesting between 1.5 billion bushels and 1.9 billion bushels per year over the past five years, producing a surplus amount of corn to fulfill consumption needs within the state of Nebraska while shipping to other states and export position.

According to the Nebraska Corn Growers Association 16% of Nebraska's corn production is used for livestock feed, 28% for ethanol and 34% is shipped out of Nebraska to other states and to export position in Galveston-Houston, the PNW or into Mexico. The remaining amount of Nebraska's corn supplies goes to other components of food, seed and industrials beyond ethanol and to ending stocks.

The volume that is moved out of state to other states or export position averaged 585 million bushels over the past five years. The price of corn in Nebraska in mid-July 2024 was $3.98 per bushel and $4.12 per bushel in Iowa according to USDA-AMS. The lower price in Nebraska reflects a high surplus level and higher freight costs to move to market position (e.g., weaker basis as discussed in the Corn Price and Cost Considerations section). By adding the per bushel CI premium to the Iowa price at an ethanol plant, the price in Iowa improves by that much. If the price with the premium is high enough, then it can attract corn from longer distances and other geographies such as corn from Nebraska.

For exporters in the PNW for example, the value of FOB corn was $5.47 per bushel during mid-July based on the U.S. Grains Council *Market Perspectives* report. The PNW FOB price reflects the global market price through the PNW, while compensating for export elevator margins and the CIF (cost, insurance and freight) price at the export elevator. The CIF price greatly reflects interior freight costs such as the rail freight rate from a shuttle train loader in Nebraska to a PNW export elevator.

If the CI premium added to the Iowa price exceeds the PNW value, corn would divert away from shuttle loaders shipping to export position and move in the opposite direction to ethanol plants in Iowa. And it is not just the export market that will suffer. The livestock sector in Nebraska will see corn they historically accessed be diverted to Iowa as well.

Ethanol plants in Iowa will be able to pay a substantial premium to attract Nebraska's flow of the lower CI scored corn. This would be an unconventional move in that the transportation network, especially rail that is not designed or structured to move corn from Nebraska to Iowa on short moves (railroads prefer to move railcars long distances between origins and destinations as discussed in Modal Usage moving Corn to Market Position section of this paper). Without being able to adequately rail corn from Nebraska, corn will be trucked to Iowa.

A railcar can be loaded with 110 short tons of corn (or about 4,000 bushels) while a truck can haul 25 short tons (or about 900 bushels), roughly 4.4 trucks per railcar. One 110 railcar shuttle train of corn (approximately 440,000 bushels of corn) would then require 484 trucks. If an ethanol plant in Iowa uses about 36 million bushels of corn annually, that would be the equivalent of about 82 shuttle trains.

Rail will not be able to adequately move the lower CI scored corn from Nebraska to Iowa. The corn will have to be moved by truck, a lot of trucks, nearly 39,600 truckloads. The additional cost of moving lower CI scored corn from Nebraska to Iowa would be substantial. For example, instead of delivering corn 25 miles to a feedlot or shuttle train loader, a farmer in eastern Nebraska could be shipping corn upwards of 125 miles to an ethanol plant in western Iowa, if not further. The net difference would be an additional 100 miles.

USDA-AMS publishes quarterly grain truck rates, with the most recent rates from the fourth quarter of 2023. Truck rates are further reported by region. For the North Central region where Nebraska and Iowa are located the representative truck rate was $4.16 per mile per truck load, or $416 per truck moving corn a net 100 miles to an ethanol plant in Iowa. While an ethanol plant in Iowa requires about 39,600 truckloads of corn, not all its corn needs would necessarily be sourced from Nebraska. Consider if that ethanol plant sourced one half of its corn needs from Nebraska. The additional cost of 19,800 trucks hauling lower CI scored corn from Nebraska to an ethanol plant in Iowa, traveling a net 100 miles further, exceeds $8.2 million for one ethanol plant. And this does not consider the impact increased truck traffic will have on the roads, highways and communities using the new route to the ethanol plant in Iowa, let alone the increased volume of emissions.

In addition to the higher truck costs, the unintended consequences of 45Z rewarding lower CI scored corn at the ethanol plant will be disruptive, negatively impacting the shuttle train network of grain handlers, exporters and railroads, livestock feeders, and other food, seed and industrial companies who invested in Nebraska for a specific purpose. One of the purposes was to be near a surplus supply of corn that Nebraska has to offer. Under 45Z and with a substantial premium available from ethanol plants in Iowa, that purpose to be near surplus corn in Nebraska will be turned upside down.

How does the supply chain overcome the premium of Nebraska's lower CI scored corn? The export sector will either improve its price to attract corn from Nebraska, seek corn supplies from other domestic markets, surrender market share to other U.S. port ranges or lose out to competitors in other countries. Nebraska's livestock sector would have to pay up to attract corn to their operations. If the livestock producers could not bid the price of corn high enough to keep corn flowing to their operations, they would have to consider alternative feeds or restructure their operations. It will be similar for the other food, seed and industrial users of corn in Nebraska.

The problem is exacerbated elsewhere. In Iowa, corn that had a higher CI score than Nebraska, and that historically went to an ethanol plant will be disadvantaged by the lower CI scored corn from Nebraska. Iowa's corn must then find its own market pathway. But those pathways are not established as they are in Nebraska and would require substantial investment by grain handlers, transportation providers such as railroads, exporters and livestock feeders. A lower CI score is commendable and if the premium is paid out through an ethanol plant will promulgate the disruption of the 45Z impact on the corn supply chain.

This type of scenario will have unintended consequences of disrupting the corn supply chain that is set up to handle large volumes through a high output network that was planned, invested in, developed and operated over years and decades. A battle for the lowest CI corn would create winners and losers, and given the framework described in the Corn Price and Cost Considerations section, competition for corn will be bolstered elsewhere whether in the U.S. or a global competitor, and over the longer run negatively impact local communities and economies.

A feasible option will be to decouple CSA from the physical corn bushel under a book and claim approach. The CSA plan is certified at the farm. The farmer then offers the CSA certificate to claim the feedstock CI while the physical feedstock from the farm flows on the path of least resistance to market position. This option maintains the integrity of the established corn supply chain while incentivizing farmers to adopt farm practices to lower CI.

Summary

The corn supply chain is intricate while sharing nuances of it with other crops. Farmers make business decisions on what they will plant and grow based on their unique location, market options, crop history and financial considerations.

The corn supply chain has been built over decades to handle large volumes through a high output system of elevators, livestock feeding operations, corn grind facilities and high-speed rail shuttle loaders and barge loading operations to feed and fuel the economy of the U.S. and globally.

Impediments to the supply chain occur regularly and depending on the situation impacts basis values that farmers take as signals to move their grain. Prolonged impediments such as policy, regulations and trade wars have unintended consequences. The 45Z portion as it is in the current IRA seeks to incentivize SAF production, will create winners and losers among farmers and supply chain participants. The costs could be substantial. If one ethanol plant in Iowa received half their corn needs using lower CI scored corn from Nebraska, they would need about 19,800 trucks. The trucks would travel a net 100 additional miles, and the cost of using trucks would be $8.2 million more. And this does not consider the impact increased truck traffic will have on the roads, highways and communities using the new route to the ethanol plant in Iowa, and the increased volume of emissions.

Instituting a decoupling of the physical corn bushel under a book and claim approach will preserve the integrity of the corn supply chain while incentivizing SAF production through certified CSA plans at the farm level.

Before 45Z is fully implemented, further research and industry engagement is needed to properly define what is at stake, who are the winners and losers, and how SAF can fully maximize the opportunities available.

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