



45Q, 45Z and 40B Tax Credit Summary & Analysis

History/Background

There has been a lot of talk and news about tax credits 45Q, 45Z and 40B. These tax credits are related to carbon, which is a hot topic currently that has a long history tied to agriculture. To get a better understanding of how we got to where we are today with these tax credits and carbon, we need to take a look back.

It would be most appropriate to start with one of the most prominent forms of federal policy that has shaped the U.S. biofuels industry and started the conversation about carbon and agriculture: the Renewable Fuel Standard (RFS). This policy mandated a minimum volume of biofuels to be used in the national transportation fuel supply each year. It was first established by Congress with the enactment of the Energy Policy Act of 2005. This initial RFS mandated that a minimum of 4 billion gallons of biofuels be used in 2006, rising to 7.5 billion gallons by 2012. Two years later, the Energy Independence and Security Act of 2007 expanded biofuel volumes and extended it to 2022. The expanded RFS is referred to as RFS 2. In addition to the expanded volume and date, the RFS 2 has two important distinctions from the original RFS. RFS 2 divided the total renewable fuel requirement into four separate categories, each with its own volume requirement: total renewable fuels, advanced biofuels, biomass-based diesel and cellulosic biofuels. The second difference is that each of these categories must achieve a certain minimum threshold of life cycle greenhouse gas emissions (GHGs) reductions to qualify: total renewable fuels (20% reduction), advanced biofuels (50% reduction), biomass-based diesel (50% reduction) and cellulosic biofuels (60% reduction). Corn-starch ethanol qualifies for the total renewable fuels category.

The Environmental Protection Agency (EPA) is responsible for establishing and implementing regulations and mandated biofuel volumes. The EPA is also in charge of measuring the carbon intensity, or GHG reductions, of the biofuel for the RFS and determining which fuels qualify for each category. They currently are relying on a life-cycle analysis of biofuels that has not been updated since 2010. Using the 2010 modeling, they currently consider corn ethanol to have 21% lower GHG emissions than petroleum gasoline. There have been calls for the EPA to update the way they measure carbon intensity, as the information they are using is very outdated, especially the assumptions for agriculture. The model that gets the most visibility and push to be used by the EPA is the Greenhouse Gases, Regulated Emissions, and Energy Use in Technologies (GREET) model. GREET was developed in 1995 by the Department of Energy's Argonne National Laboratory. It is a tool and model that evaluates life-cycle analysis and calculates the environmental impact of technologies and products, including biofuels and their feedstocks. The GREET model is updated annually by a team of scientists and researchers at Argonne National Laboratory and is very adaptable; some say it is the gold standard for carbon modeling. In addition to having the most up-to-date and science-backed, accurate data, the GREET model has the capability to accurately credit climate-smart agriculture (CSA) practices as well as carbon and storage technologies. Generally, the GREET model considers corn ethanol to have roughly a 45% reduction in GHGs compared to petroleum gasoline, or a carbon intensity (CI) score of approximately 55. Individual plants in different states may vary.

Today, the RFS does not use the GREET model, but it was approved by the Department of the Treasury to utilize a modified version for the 40B and more importantly the 45Z tax credits that were introduced in the Inflation Reduction Act (IRA) in 2022. This is important because the IRA presents an opportunity to accelerate clean fuel production for on-road fuels like ethanol and sustainable aviation fuels (SAFs) that used corn ethanol as the feedstock with these tax credits along with the 45Q tax credit. This will only be possible if the GREET model is used to accurately calculate life cycle greenhouse gas emissions of corn, ethanol and carbon-reducing CSA practices

and technologies. This document will provide an overview of what these tax credits in the IRA are, questions we do not have answers to, potential impacts to corn farmers and observations looking ahead.

Tax Credit 45Q

The Carbon Sequestration Tax Credit, also known as 45Q, incentivizes carbon capture and sequestration (CCS) practices that were introduced in October 2008. In 2022, the federal government increased the existing 45Q tax credit to \$85 per metric ton (17 cents per gallon of ethanol) for CO₂ that is permanently sequestered underground and \$60 per metric ton (12 cents per gallon of ethanol) for CO₂ that is used for enhanced oil recovery or other industrial uses. To be eligible for 45Q, companies must begin construction of the sequestration project by January 2033. They then can claim the credit for 12 years after being placed in service. Another requirement to receive the 45Q tax credit is that carbon emissions must be measured at capture as well as injection and meet specific sequestration storage requirements.

Tax Credit 45Z

The Clean Fuel Production Credit is also known as 45Z. In 2022, the federal government created the 45Z tax credit, which offers clean fuel producers an incentive to reduce their carbon intensity (CI) score below 50. The 45Z tax credit is currently authorized for three years for on-road and aviation fuels or SAF produced after Dec. 31, 2024, and sold before Dec. 31, 2027. Guidance, rules and the updated 45Z GREET model still need to be released, but the anticipated ways a corn ethanol plant can reduce their CI score is through CCS, carbon capture and utilization, corn grain produced using Climate Smart Agriculture (CSA) practices (e.g., no-till, cover crops), renewable natural gas and renewable electricity.

Consider on-road fuels like ethanol, for example, that are used in light-duty vehicles. For every one carbon intensity point reduction below 50 CI, producers like ethanol plants are given a 2 cent per gallon tax credit, up to \$1 per gallon if wage and apprenticeship requirements from the IRS are met. Thus, reducing a CI score from 50 to 25 would result in a \$50 million tax credit for a 100 million gallon ethanol plant (50-25 x \$0.02 x 100 million).

For SAF produced from ethanol to jet (ETJ), every one carbon intensity point reduction below 50 CI gives SAF plants a 35 cent per gallon tax credit, up to \$1.75 per gallon if wage and apprenticeship requirements from the IRS are met. For example, reducing a CI score from 50 to 25 would result in a \$52.5 million tax credit for a 60 million gallon SAF plant (50-25 x \$0.035 x 60 million).

Tax Credit 40B

The Sustainable Aviation Fuel (SAF) Credit, also known as 40B, incentivizes U.S. SAF production. This credit is \$1.25 for each gallon of SAF in a qualified mixture. To qualify for the credit, the SAF must have a minimum reduction of 50% in life cycle greenhouse gas emissions compared to petroleum jet fuel (which has a 95 CI). There is also a supplemental credit of 1 cent for each percentage that the reduction exceeds 50%, up to 50 cents. In total, the SAF tax credit allows SAF producers to receive between \$1.25 and \$1.75 per gallon for SAF that decreases the GHG emissions by 50% or more compared to petroleum jet fuel if wage and apprenticeship requirements are met. The SAF credit applies to certain fuel mixtures that contain SAF sold or used after Dec. 31, 2022, and before Jan. 1, 2025.

Little SAF is produced today and the 40B tax credit will end after 2024, but the IRS released guidance and the updated 40B GREET model in April 2024. This gives us insight on how guidance and rules could look for the 45Z tax credit. The 40B guidance outlines how SAF producers can lower their CI score for the alcohol-to-jet pathway with CCS, CSA practices, renewable natural gas and renewable electricity. The CSA practices listed only include no-till, planting cover crops and using enhanced-efficiency nitrogen fertilizer. To be eligible, farmers must use all three practices on the same acreage. If farmers use all three practices, it will result in a 10 CI point reduction for the SAF produced. A few key things included in the guidance are that farmers must keep track of all records, have a written

plan, contract directly with the SAF producer, maintain certain practices for multiple years and have third-party verification. Because of these requirements, very few U.S. corn growers qualify for the 40B tax credit, especially considering the 40B guidance was released during the 2024 planting season. Full details of the requirements for the three practices that count for the 40B tax credit can be found in Appendix A of the guidance found on the IRS website.

Please refer to Table 1 for a quick overview of each individual tax credit.

Table 1 – Relevant Tax Credits Impacting Ethanol Producers

Tax Credit	Eligible Fuels or Practices	Start Date	End Date	Tax Credit Value
45Q	Carbon capture and sequestration (CCS) practices	Oct. 1, 2008	Projects must begin construction by January 2033. They then can claim the project for 12 years after being placed in service.	\$85/metric ton (\$0.17/gallon of ethanol) for CCS and \$60/metric ton (\$0.12/gallon of ethanol) for CO ₂ that is used for enhanced oil recovery or other industrial uses.
45Z Clean Fuels on Road – Ethanol	Clean fuels for on-road use, like ethanol	Jan. 1, 2025	Dec. 31, 2027	On-road fuels \$.02/gallon up to \$1/gallon for every CI point reduction below 50 CI.
45Z (SAF)	Sustainable aviation fuel (SAF)	Jan. 1, 2025	Dec. 31, 2027	SAF \$.035/gallon up to \$1.75/gallon for every CI point reduction below 50 CI.
40B	SAF	Jan. 1, 2023	Dec. 31, 2024	50% greenhouse gas emissions reduction compared to petroleum fuel qualifies for \$1.25/gallon. Additional \$0.01 for each percentage point below 50% reduction, up to an additional \$0.50.

What don't we know for 45Z and 45Q?

- Allocation of the tax credit(s) among stakeholders (pipeline company, ethanol producer, corn growers, airlines, etc.) is unknown and will be market driven based on multiple market factors. The total value of the 45Z credit will be dependent on what the fuel producer's beginning CI score is and how much they can reduce that score below 50 CI with CCS, renewable energy, utilizing low-carbon corn feedstock, etc. or as allowed on the yet-to-be-released 45Z GREET model from the U.S. Department of the Treasury.
- The impact of CCS, carbon capture and utilization, and CSA practices on CI scores, and which CSA practices will count toward reducing the CI, is unknown at this time. These parameters will need to be confirmed when the 45Z GREET model and guidance is released from the U.S. Department of the Treasury, which may not be until 2025.
- Both 45Z and 45Q have wage and apprenticeship requirements, and it is unknown if fuel producers will meet these requirements. To receive the maximum amount of tax credit value, an ethanol or SAF plant must satisfy these requirements. If producers do not, then there is a lesser maximum credit value of 20

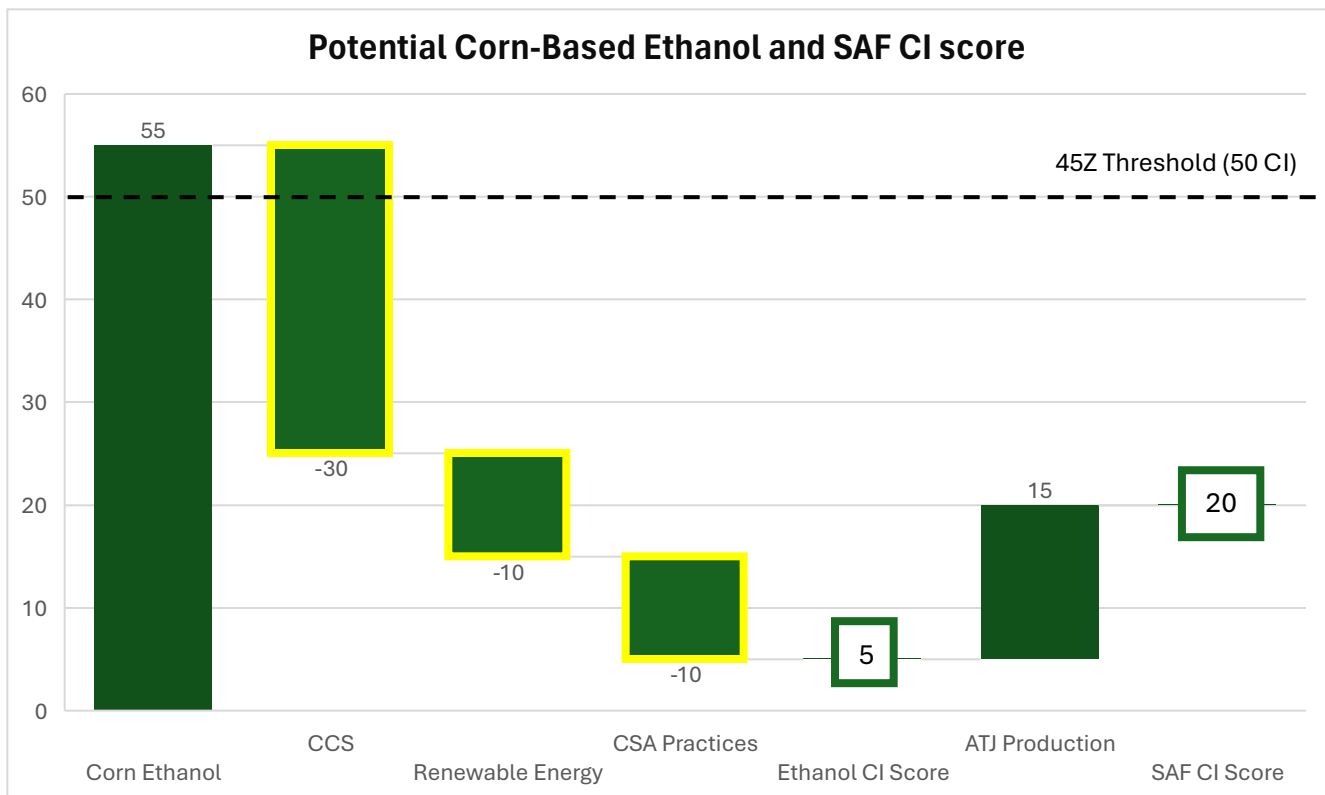
cents for nonaviation fuel and 35 cents for SAF. To satisfy the wage requirements, laborers and mechanics constructing, altering or repairing a facility must be paid wages at or above the “prevailing wage” (which is determined by the Secretary of Labor) of workers performing similar work in the same locality. The apprenticeship requirements are that registered apprentices must provide at least 12.5% or 15% of the total labor hours associated with constructing, altering or repairing any facilities.

How can it potentially impact corn growers?

To qualify for the 45Z tax credit, the ethanol plant or the SAF producer CI score must be below 50; the lower the score the higher the tax credit value. Carbon capture and sequestration is estimated to reduce ethanol’s CI score by 30 points along with CSA practices, potentially adding another 5- to 10-point reduction, qualifying ethanol for the 45Z tax credit. These estimates will need to be confirmed when the modified 45Z GREET is released by the U.S. Department of the Treasury, but it could open doors to new markets, like a low-carbon feedstock for SAF, and potentially create premiums on low-carbon corn for on-road ethanol.

Right now, the average CI score for an ethanol plant in Iowa is approximately 55 but could be as low as 5 if certain technologies and practices are implemented. Figure 1 outlines how corn ethanol and SAF have pathways to qualify for the 45Z tax credit. Figure 1 shows an ethanol plant using three ways (see yellow-bounded green bars below) to reduce their CI score: Reductions come in the form of carbon capture and sequestration (CCS), renewable energy used at the ethanol plant and climate-smart agriculture (CSA) practices implemented on the farm level. The key takeaway is that any reduction in the plant’s CI score below 50 has substantive value coming from the 45Z tax credit.

Figure 1 – CI Score Potential – Ethanol and Alcohol-to-Jet Production for SAF



ATJ Production is the alcohol (ethanol)-to-jet SAF production process. Note the above scenario is the best-case scenario for CI reduction for ethanol and SAF production. Guidance from the U.S. Department of the Treasury on the 45Z GREET model is needed to confirm CI reduction potential.

Observations and Considerations Looking Ahead

There is a lot of buzz with these new tax credits, but there are a lot of unknowns and questions that have yet to be answered and should warrant caution looking ahead. Looking at the 45Z tax credit, the time line for the tax credit is only for three years and it starts on Jan. 1, 2025. Once it expires on Dec. 31, 2027, we do not know if it will be extended or if policymakers will allow it to expire. We are also still awaiting the 45Z rules, guidance and the modified 45Z GREET model, and it could take time to get that information — potentially over a year. When we receive guidance, it will answer a lot of questions that remain at this time, such as how will the 45Z GREET model count CSA practices? On one hand, if the 45Z GREET model allows CI scores on the farmer level and a wide range of CSA practices implemented by corn growers to count toward reducing CI scores on corn-based ethanol, then corn farmers obtaining their own CI scores could become important and could potentially allow more farmers to participate. Under such a scenario, low CI corn could command premiums from ethanol and/or SAF producers to help them lower their CI scores and qualify for the 45Z tax credit. Those potential premium amounts will be dependent on multiple market factors and are unknown as mentioned previously.

If the 45Z GREET guidance is like the 40B GREET guidance, which allows only three approved CSA practices that all must be done together to achieve a set 10-point CI reduction, then this bundling and lack of additional CSA practices could make it very difficult for farmers to qualify and participate. Under this scenario, CI scores at the individual farmer level would not be needed as it would be simply checking the box and verifying each of the approved CSA practices were implemented on the acre according to the standard. Also, in this scenario, corn utilizing the approved CSA practices could command premiums from clean fuel producers to help them lower their CI scores for the 45Z tax credit.

How do we think biofuel producers will respond to the tax credit with varying values and timing? One of the main considerations is that biofuel producers cannot qualify for 45Z without being below 50 CI. In Iowa, the average ethanol plant is at about 55 CI. If they can get below 50 with CSA practices and they get enough participation from farmers, then they will likely move forward with the 45Z credit and there would be value created. If an ethanol plant cannot get below 50 CI with just CSA practices, then they will not qualify for 45Z without additional technologies like CCS pipeline or renewable energy. If they are waiting on the CCS pipeline, then that has the potential to reduce their CI score by 30 points and will get them below 50 CI, but right now the pipeline, if approved, in Iowa is scheduled to be completed in 2026 or later. Also, as it currently stands, the 45Z tax credit ends on Dec. 31, 2027, with no clear visibility of renewal at this point.

It's important to note that an ethanol plant on the CCS pipeline can claim either the 45Q or 45Z but not both. A potential scenario where this could pose problems for the farmers is if the rules and guidance on the 45Z tax credit are like 40B and very few farmers can qualify or participate, then it might be in the ethanol plant's best interest to claim the 45Q tax credit if they have CCS. Also, as of today, the 45Q is a 12-year tax credit compared to just three years for the 45Z, so the 45Q might offer a biofuel producer more stability for the future of their business. The 45Z tax credit is the more lucrative and the most attractive option to biofuel producers as of today if the rules and guidance are less stringent than for 40B and the 45Z guidance allows more CSA practices to qualify.

There is also a lot of excitement around the potential of SAF, and it is getting a big push behind it within the airline industry and current administration. It is an exciting technology and could greatly increase demand for corn in the future. In the near term, however, SAF is in its early infancy. The SAF technology has not been proven at scale at this point and is probably several years away. Therefore, there is a risk that SAF might not be economical enough even with the tax credits. It is important to moderate expectations of SAF demand, keeping this scale-up challenge in mind.

The airlines are all signing offtake agreements with SAF producers and want SAF to decarbonize their industry, but they also say they want to pay for SAF around the same price point as petroleum jet fuel. Right now, SAF is roughly double the price compared to petroleum jet fuel. The 45Z tax credit will help with that price difference, but the tax

credit value will likely be baked in pricing between the airlines and SAF producers instead of potentially being paid in premiums to ethanol producers and to farmers. The use of tax credits for renewable fuels like biodiesel has demonstrated that most of the credit was passed on to the purchaser of the fuel (i.e., biodiesel, renewable diesel). With the concerns about the technology and price of SAF, it is possible that the SAF market will not develop, as the cost is significantly higher than petroleum jet fuel today.

In closing, there is a lot of excitement in these new tax credits and potentially a lot of good that can come from them for farmers, like increased corn demand, but there are a lot of moving parts and unknowns that will unfold in the future. At this moment, farmers should get informed and be prepared but also exercise caution and not get too far ahead of themselves as we wait for the policy, technology and market opportunities to develop. Iowa Corn is working hard to make sure that these policies (tax credits) drive corn demand so that farmers in the long run see increased demand for their corn, driving increased prices received at the local level.