Disclaimer: Iowa Corn is making this information available to help address questions from farmers about carbon intensity, tax credits, carbon markets and payments and premiums. The information on the following pages is current as of July 2024. However, the situation regarding these topics is extremely fluid and subject to change at any time and without notice. Please use this document as a guide. Communicate with your advisors to be aware of the most up-to-date information for your operations.

Carbon Intensity (CI) Scores Q&A

1. What is a CI Score?

Every fuel is scored based on the amount of carbon dioxide (CO_2) or greenhouse gas (GHG) emissions associated with a megajoule (MJ) of energy. A megajoule is a unit of work or energy equal to 1 million joules and is equivalent to the energy to light a 100-watt light bulb for about three hours. A fuel's carbon intensity (CI) score accounts for every aspect of producing, distributing and consuming the fuel. For corn farmers, carbon intensity is the energy production footprint assigned to producing the crop. The score is generated using the federally approved **G**reenhouse gases, **R**egulated **E**missions and **E**nergy in **T**echnologies (GREET) model and its associated tool known as the Feedstock Carbon Intensity Calculator (FD-CIC). Today, the estimated national standard CI score for corn is 29.1 gCO_2e/MJ. CI score estimates for Iowa-produced corn are lower (better) than the national average, being in the range of 25-28 gCO_2e/MJ. This is because Iowa has a higher yield than the national average, so the energy and inputs are averaged across more bushels on a per-acre basis. The lower the CI score of corn feedstock and ethanol fuel, the more attractive it is for end users seeking to reduce their carbon footprint and emissions.

2. What is the GREET model?

The Argonne **G**reenhouse gases, **R**egulated **E**missions and **E**nergy in **T**echnologies (aka GREET) model was developed by the U.S. Department of Energy (DOE) and is considered the gold standard for modeling greenhouse gas (GHG) emissions. The model was created in 1995 as a tool to evaluate the life cycle analysis of products and technologies. Since its creation, it continues to evolve as more data and information become available and are fed into the model. There is a calculator built into GREET called the Feedstock Carbon Intensity Calculator (FD-CIC) that is used to calculate CI scores for farmers. Farmers can input data from their operation, such as county and state, yield, fertilizer use, tillage practices, cover crops and other factors, to calculate their CI score. The FD-CIC allows farmers to change the inputs to see how changes in farm practices and yield levels modify the score. The FD-CIC is a public and free tool from the DOE.

3. What unit of measure is used to express CI scores?

   Often the unit of measure for CI scores for corn production correlates with the biofuel that is being produced. CI scores produced by calculators that are based on the FD-CIC are expressed in gCO2e/MJ, which stands for grams of carbon dioxide equivalent emissions per megajoule of energy in ethanol fuel. For corn production, CI scores usually fall in the 0-30 gCO2e/MJ range. To calculate the CI score per bushel of corn, multiply the CI score by 221* and express in gCO2e/bushel. For example, a CI score of 25 gCO2e/MJ equates to a per-bushel CI score of 5525 gCO2e.

   - This calculation assumes 1 bushel of corn yields 2.75 gallons of ethanol, and 1 gallon of ethanol contains 80.5324 MJ of energy. To change the multiplier from 221, multiply the gallons per bushel by 80.5324.

4. What production practices and data are used to calculate your Carbon Intensity (CI) score?
   - Yield
   - Fuel/energy usage on the farm
   - Fertilizers (especially nitrogen)
   - Herbicides and insecticides applied
   - Tillage
   - Cover crops
   - Manure application

5. What can I do to reduce my CI score?

   Yield is the biggest driver in the FD-CIC carbon intensity score calculator. In general, a higher yield results in a lower (i.e., better) score. However, this is not the case if inputs per bushel are greater than the increase in yield. For example, if a corn farmer applies 150 pounds of nitrogen per acre to achieve a 200-bushel-per-acre yield and then increases the nitrogen rate the following year to 200 pounds per acre and achieves a 201-bushel-per-acre yield, the CI score in year one would be lower (better) than year two even though the yield was slightly higher in year two.

   Other factors also influence the CI score. Practices like no-till, planting cover crops and applying manure as a replacement or supplement to fertilizer applications also reduce the score. Nitrogen fertilizers contribute significantly to farm-level CI scores because they require a considerable amount of energy to manufacture. CI scores can be lowered by employing the 4Rs of nitrogen management (right source of nitrogen, applied at the right rate, right time and right place). Additionally, using

enhanced-efficiency nitrogen fertilizers lowers the CI score for corn. These fertilizers come in a variety of forms and can be grouped into two main categories: inhibitors or stabilizers and controlled-release fertilizers. Inhibitors and stabilizers are additives that stop or slow the change to nitrate of applied-nitrogen fertilizers.

6. What is Iowa Corn doing to protect farmers as we move to better CI scores?

   Iowa Corn, along with other state corn associations and the National Corn Growers Association (NCGA), are advocating for the release of the 45Z GREET model soon so farmers will know what farming practices apply to their CI scores, how and when ethanol plants will receive tax credits and in what manner they will be shared with farmers. Unfortunately, the release of the new guidance and 45Z GREET model by the Internal Revenue Service (IRS) is not expected until the end of 2024 or later (even though it was expected by March 1, 2024).

7. Is there a way I can estimate my own CI score?

   The FD-CIC is a free CI calculator for use by the public, including farmers. The FD-CIC calculator can be found at https://greet.anl.gov/tool_fd_cic. The October 2023 FD-CIC users' manual can be found at this website: https://www.osti.gov/servlets/purl/2205308.

8. Where can I find the CI score calculator developed by Iowa State University?

   Iowa State University has developed a free CI calculator that can be found on the ISU Ag Decision Maker webpage at this link: https://go.iastate.edu/AGDMA180. The calculator and set of instructions went live July 15, 2024.

9. Should I pay the companies to calculate my CI score? Is this a worthwhile investment?

   There are several companies that advertise their ability to calculate CI scores. Some charge a fee while others do not. Please note that most, if not all, are using the FD-CIC, the publicly available farm input calculator imbedded in the GREET model. The decision to work with a company to receive a CI score is up to each farmer. One suggestion is to get your CI score from more than one company to see how they compare. If the scores differ widely, ask the companies for an explanation.

10. How will CI scores affect grain sold to ethanol plants through the elevator or co-op system?

    This is still to be determined and there are many unknowns. A major question is whether a co-op or elevator will consider CI scores if they have no way to segregate grain having different CI scores. It is important to communicate with your first purchaser (elevator, co-op, ethanol plant) to understand how they plan to address tax credits and CI-scored grain.

11. How will CI scores impact livestock producers?

    At the current time, CI scores only apply to grain going to a fuel producer (e.g., ethanol plant) and the fuel produced by the plant, but in the future, there may be market opportunities for low-CI-score livestock that consume low-carbon corn in their rations.

45Z Tax Policy Q&A

1. What is the 45Z tax credit?

   The 45Z Clean Fuel Production Tax Credit, established by the Inflation Reduction Act (IRA), is a tax credit program that incentivizes the production of clean transportation fuels. This tax credit begins on Jan. 1, 2025, and is set to expire on Dec. 31, 2027. Time will tell whether the credit will be delayed, repealed or extended. To qualify for the 45Z tax credit, fuel producers (ethanol plants) must have a CI score under 50 kgCO2e/1mmBtu. The average CI score for Iowa ethanol plants is in the mid-50s.

2. What unit of measure is used for the 45Z tax credit?

   The 45Z tax credit is awarded to fuel producers (e.g., ethanol plants) that produce "clean fuel," which is defined as fuel produced with no more than 50 kilograms of carbon dioxide equivalent per 1 million British thermal units (Btu). For reference, 1 mmBtu (aka 1 million Btu) is equal to 1.055 megajoules (aka MJ).

3. What are the financial parameters of the 45Z tax credit?

   For every carbon intensity point below a 50 CI score, fuel producers like ethanol plants are eligible for a 2-cent-per-gallon tax credit, up to $1 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 $50 million tax credit for a 100 million gallon ethanol plant [(50-25) x $0.02 x 100 million)]. If the plant has a CI score of 40, the tax credit would be $20 million [(50-40) x $0.02 x 100 million)].

4. How does the 45Z tax credit differ from carbon offset programs?

   The **45Z tax credit is** generated by ethanol plants when their CI score is below 50. How they share any tax credit revenue with farmers is unknown and will likely vary among ethanol producers. One of the advantages of the tax credit is that grain coming from a low CI corn producer does not face the challenge of only benefiting from acres that have converted to a new practice.

   Carbon offset programs pay farmers for either the conversion of acres to new practices (like converting conventional tillage to no-till) or for the carbon reduction outcome of converting to a new practice. There are numerous carbon programs in the marketplace, and it is important to do your homework to understand the nuances of the various programs before you participate in one.

5. Will there be a limited number of corn bushels, acres or gallons of ethanol that will qualify for the 45Z tax credit?

   It is unlikely if the number of acres and bushels will be limited since the tax credit is relevant to only the ethanol plant's CI score and no cap has been established for bushels, acres or gallons of ethanol at this time.

6. What can an ethanol plant do to qualify for the 45Z tax credit?

   The 45Z tax credit is only applicable if an ethanol plant has a CI score under 50. They can attain a lower CI score by making improvements in the plant, removing CO2 from their operation (e.g., via a pipeline) and/or utilizing low-CI-score corn.

7. How do we ensure we do not gear up for the 45Z tax credit and find out it is not financially sustainable?

   There are many unknowns about how 45Z will work and what the ramifications will be for farmers and ethanol plants. We should know more later in 2024 when the guidelines are released by the U.S. government.

8. How can we ensure that farmers will receive a portion of the tax credit and not let the ethanol producer or other manufacturer keep it all?

   There are no specific provisions with the 45Z tax credit statute that mandate an ethanol producer to share its tax credit with farmers. The best thing to do is to communicate with your ethanol plant to discuss how they will address the credit. Tax credit revenue sharing will be market driven; it will not be influenced or decided by a government agency.

9. Will the 45Z tax credit situation allow the government to be able to start to control farming more?

   The 45Z tax credit incentivizes ethanol plants to reduce their CI scores below 50 and produce ethanol with lower GHG emissions. There will be government oversight and auditing of the ethanol plants to ensure the credit is earned and accounted for. Because the onus is on ethanol plants to do the accounting for the 45Z tax credit, there should not be any impact on farmers per se.

Payments and Tracking Systems Q&A

1. How does my CI score affect me if I do not have an ethanol plant near me or plan to sell to one?

   Only fuel producers like ethanol plants are eligible to receive the 45Z tax credit directly; therefore, only grain going to the ethanol plant can potentially share in the tax credit revenue if the plant decides to allocate a portion of the tax revenue back to farmers. Although you would not qualify for a share of the 45Z tax credit if your grain does not go to an ethanol plant, there may be other opportunities where you could qualify for a payment. These include carbon offset programs or selling corn to grain buyers who have a low CI corn program.

2. If I hit the targeted CI score, will I receive a portion of the tax credit when I sell my grain to the local ethanol plant? Some farmers have been told by ethanol plants that they might not receive a share of the tax credit just because they have a lower CI score.

   Ethanol plants receiving the 45Z tax credit will determine if and how they reward farmers for lower-CI grain. Farmers should be in close communication with their ethanol plant to understand how any tax credit will be shared. Tax credit revenue sharing will be market driven; it will not be influenced or decided by a government agency.

3. What is the "Book and Claim" process and how might it impact corn as an ethanol feedstock?

   The Book and Claim model is a common practice where a sustainability claim made by a company is separated from the physical flow of these goods. The most notable example is green electricity. In a Book and Claim scheme for corn and ethanol production, certificates would be given to corn farmers for grain produced using specific management practices (like no-till and cover crops). These certificates would indicate a specific volume of certified corn and would be traded in a separate marketplace. The certification is detached from the corn at the farm and would allow the farmer to sell corn anywhere they choose. Ethanol plants can purchase certificates that link to a certain amount of corn used without taking possession of the actual grain tied to the certificate. In this system, corn with and without certificates would be co-mingled and flow freely in the supply chain. At

this point, the Book and Claim approach for low-CI corn is conceptual and there are no indications if and how it will be implemented in the corn ethanol marketplace.

4. What is the "Mass Balance" model and how might it impact corn as an ethanol feedstock?

   The Mass Balance model provides a certification for low-carbon corn that remains with the corn until the point of mass balance (e.g., a co-op or ethanol plant), at which time it is then combined with other corn. Certified corn must go to the entity participating in the certification/verification recordkeeping. From that point forward, the certification is not tied to the corn, but the portion that is certified can be tracked and claimed. Like the Book and Claim model, the Mass Balance approach for low-CI corn is hypothetical at this point and there are no indications if and how it will be implemented in the corn ethanol marketplace.

Voluntary Carbon Markets Q&A

1. What is a carbon credit?

   A carbon credit represents one ton of carbon dioxide (CO2) equivalent that has not been emitted or that has been removed from the atmosphere. These credits are sold by one entity (the carbon reducer/removal originator) to another (a buying company). Carbon credits are reductions and removals of greenhouse gases (GHGs) traded on the voluntary carbon market (VCM) to incentivize action through a voluntary market mechanism, which companies are free to participate in or not.

2. Who are the key players in the agricultural carbon markets?

   - Farmer/landowner**:** The entity putting the practice in place that stores carbon or reduces/avoids carbon emissions.
   - Credit aggregator/creator/broker: The business or organization that serves as the go-between for the farmer and the eventual purchaser of the offset. They create and sell the offsets. The end purchaser of the offset does not want to have to buy carbon credits from hundreds or thousands of individual landowners, so the aggregator consolidates them and sells the bundled credits to the purchaser. The credit aggregator accounts either for a practice put into place on certain acres or for the carbon that is stored on those acres.
   - Verifier: A separate entity that confirms that the practice was implemented. Verifiers use modeling, satellite imagery, soil samples or field visits to confirm that a practice was implemented.
   - Purchaser: A company or entity that purchases the carbon credit to offset their emissions and "owns" the stored carbon.

3. Why do companies purchase carbon credits?

   Reasons include but are not limited to:
   - They believe in the importance of sustainability.
   - They want to mitigate the business risks of climate change.
   - They see sustainability as a competitive advantage.
   - They feel pressure from investors, employees and other stakeholders to act in a sustainable way.
   - They want to take advantage of public relations and marketing benefits.
   - They are unable to reach their carbon footprint goals by changing their internal operations.

4. What companies are purchasing carbon credits?

   The idea behind carbon credits is that entities responsible for emitting CO2 must reduce their emissions and pay for the efforts of farmers or others who are doing the work of removing CO2 from the air or storing it in the soil. The payment is in the form of a carbon credit, with each credit representing 1 metric ton of CO2 reduced or removed. Companies who are purchasing carbon credits as part of their decarbonization strategy include Starbucks, Disney, Microsoft, Delta Airlines, Samsung, Google and many others.

5. What is carbon sequestration?

   Carbon sequestration is the capture and storage of carbon that would otherwise be emitted to or remain in the atmosphere. It involves 1) preventing carbon emissions from reaching the atmosphere by capturing and diverting them to secure storage or 2) removing carbon emissions from the atmosphere by various means and storing it in the soil or underground deep below the surface.

6. How does carbon sequestration occur?

   Reducing atmospheric CO2 (sequestering carbon) can take place in three ways:

   1. Carbon production or trapping carbon within plants. The more permanent vegetation that is present, the more CO2 is sequestered.
   2. Minimizing organic carbon mineralization. This means managing crops and soils to reduce conditions that break down or oxidize organic matter and allowing plant material to decompose more slowly and naturally.
   3. Reducing soil erosion and keeping carbon trapped in the soil. Eroded soil is exposed soil and exposed carbon.

7. What are ways farmers can increase carbon sequestration?

   Practices such as planting cover crops, residue management (mulch-till, no-till, strip-till), compaction prevention and rotational grazing increase the amount of carbon stored in the soil. Using higher-residue cover crops and rotations, such as oats and alfalfa, creates larger volumes of plant biomass and stores more carbon in the soil.

8. What are the benefits to farmers of increasing carbon sequestration?
   - Improved soil structure, with surface structure becoming more stable and less prone to crusting and erosion.
   - Water infiltration improves, meaning less surface runoff.
   - As soil organic matter increases, water-holding capacity improves, and nutrient cycling increases.

- Crops will fare better during drought and heat stress because of improved infiltration and water-holding capacity.
- Increased biological activity occurs with higher levels of organic matter and less soil disturbance.

9. What is additionality in carbon programs?

Carbon farming programs pay farmers to adopt practices that sequester carbon in their soils. However, to qualify as a valid carbon offset and subsequent carbon payment, farmers must demonstrate that the carbon sequestered is additional in reducing emissions beyond what would have occurred naturally or through a farmer's existing farming practices. This is the principle of additionality.

For example, think of a 40-acre field that underwent conventional tillage in the past but then switched to no-till. Those 40 acres would be considered additional (new) acres and therefore qualify for carbon credits and payments with a carbon market program. There are only a few carbon programs that pay farmers who have implemented a conservation practice in the past (such as no-till or cover crops) and usually these payments are minimal, such as $2 per acre. The concept of additionality is a controversial and misunderstood aspect of carbon programs and climate-smart ag programs because it rewards farmers who improve their practices in the near term but does not reward farmers who have no-tilled and planted cover crops for years or even decades.

Carbon Dioxide (CO2) Mitigation and Use Q&A

1. Why do ethanol plants want to sequester CO2?

   Ethanol plants prefer to sequester CO2 because it is the most viable, large-scale way to reduce CO2 without waiting five to 10 or more years for a new or more economical technology. The life cycle analysis (LCA) and carbon intensity (CI) score for an ethanol plant consider all the emissions from operating the plant (called Scope 1 emissions) and the emissions to generate the utilities brought into the plant (called Scope 2 emissions). The best way to lower these emissions is to reduce or avoid them if possible.

2. Why can't we find a use for CO2 instead of putting it underground?

   CO2 can be converted to chemicals, but it is not economical in most places, especially from plants as small as ethanol plants. CO2 can be made into syngas and then the syngas can be used to make fuels and chemicals. There is no shortage of CO2, so adding more CO2 to the marketplace would saturate the amount needed for its many uses in manufacturing, bottling, and the like.

3. What are the long-term ramifications of sequestering CO2 in the ground?

   Geologic carbon sequestration, also called carbon storage, involves storing CO2 deep underground in porous rock formations. In this approach, the CO2 is compressed to the point where it behaves like a liquid. It is then injected into porous rock formations deep below the surface where it becomes physically trapped in the pore spaces, dissolves in the liquid within the formations and eventually reacts to form stable minerals. There is a considerable amount of research being done to understand how CO2 reacts after being injected underground.

4. What is carbon dioxide (CO2) used for?

   CO2 is commonly used in carbonating beverages, in urea and methanol production, as a refrigerant, in fire extinguishers and fracking, in freeze-drying meat and food, in food packaging and welding, in fumigating insects and in ammonium bicarbonate fertilizer production, and as a propellant in aerosol cans. There are approximately four ethanol plants in Iowa already capturing and using their CO2 for some of the purposes above. The CO2 from ethanol fermentation is the most naturally clean source of CO2. They are fully servicing the market and are not even close to using all the CO2 they generate. The existing markets for CO2 are not big enough to use all the CO2 ethanol plants generate.

5. Is there foreign money invested in the pipeline and CO2 sequestration and how does that affect us as farmers?

   Iowa Corn does not have access to pipeline companies' records and therefore does not have information about ownership. You can contact individual pipeline companies to ask about their ownership and investors.

Brazilian Ethanol Q&A

1. Why does Brazilian corn ethanol have lower CI scores than U.S. corn ethanol?

   Second-crop corn (also known as the safrinha) is now larger than the full-season corn crop in Brazil. Brazilian corn ethanol has a lower CI score than U.S. corn ethanol because many of the inputs (and corresponding GHGs) and land used to produce the first crop of soybeans are assigned to that crop and fewer inputs are assigned to the following safrinha corn crop. In the U.S., all inputs (and corresponding GHG emissions) are assigned to a single corn crop. In addition, Brazilian corn ethanol plants primarily use eucalyptus as the fuel source. U.S. ethanol plants use natural gas, which adds significantly more energy to produce U.S. corn ethanol than burning biomass in Brazil and therefore leads to a higher CI score.

2. What advantage does Brazilian sugarcane ethanol have compared to U.S. corn ethanol?

   The typical CI score for sugarcane-based ethanol from Brazil is lower than that for U.S. corn-based ethanol, with Brazilian sugarcane ethanol ranging from about 40 to 47 CI points. The majority of Brazilian ethanol plants make ethanol out of sugarcane, using the bagasse to power the plant. Bagasse is a fibrous residue left behind after sugarcane juice is extracted and is combusted by biomass boilers to generate steam and electricity for the plant. All facilities in Brazil must cogenerate energy using biomass regardless of feedstock source.