

User Guide: Detailed Carbon Intensity Calculator

ACE created this carbon intensity (CI) calculator to help ethanol producers and farmers estimate potential improvements to the lifecycle greenhouse gas (GHG) emissions of corn ethanol based on real-world, up-to-date production and operational data from their farms or ethanol facilities.

How to Use the Calculator

Our calculator's emission rates are based on the [Department of Energy GREET model](#). The **blue** column of the calculator includes every input used to calculate ethanol's carbon intensity score based on the GREET model.

The **dark gray** columns show the emission rates the California Air Resources Board (CARB) assigns to corn ethanol to implement its low carbon fuel standard (LCFS). CARB relies in part on the GREET model to determine carbon intensity (CI) but uses other outdated data to inflate corn ethanol's greenhouse gas (GHG) emissions.

The **brown** columns of the calculator show the latest GREET model default values for each input used to determine corn ethanol's lifecycle GHG emissions.

The **green** columns of the calculator enable users to enter their own data in the **yellow** boxes and calculate a unique CI score/emission rate based on the GREET model. The yellow boxes are pre-populated with GREET default values. Use the tab key to toggle to-and-from yellow boxes.

Users may also enter a carbon credit price in the yellow box near the top of the calculator. Our calculator sets a default carbon credit market value of \$100 per ton.

Do not refresh the page while using the calculator. Refreshing the page will reset all values back to default.

The final columns of the calculator enable users to compare their unique results to California LCFS scores and GREET default values, and view the economic value expressed in dollars per gallon or dollars per acre.

The grand total box at the bottom of the calculator contains the final user-specified CI score/emissions rate and overall change compared to the GREET default. It also shows the total economic benefit. Users are given the option to email the results to themselves and ACE.

The top of the calculator shows easy-reference bar charts summarizing and comparing CARB, GREET default, and user-specified corn ethanol carbon intensity scores, highlighting key factors used to determine emission rates. We are not recording the data that you submit when using this calculator.

Important Disclaimers

The information provided by our calculator is offered as a public service. This calculator/website is not to be interpreted as furnishing any personal, legal, or marketing advice. In no event shall ACE be liable for any loss, expense, or other adverse effect caused by reliance on any information derived from the calculator or appearing on this website.

Abbreviations, Acronyms, and Definitions

Blue Hydrogen for Nitrogen Fertilizer: The manufacturing of nitrogen-based fertilizer by reforming natural gas to yield hydrogen and carbon dioxide (CO₂) through a catalytic chemical reaction, but where the CO₂ is captured and sequestered, thereby reducing the greenhouse gas (GHG) emissions of the resulting fertilizer.

bu: Bushel - A measure of grain yield. A bushel of corn weighs 56 pounds at 15.5% moisture. A bushel of soybeans weighs 60 pounds at 13% moisture.

Btu: British Thermal Unit - The British thermal unit is a unit of heat; it is defined as the amount of heat required to raise the temperature of one pound of water by one degree Fahrenheit. In the context of the carbon intensity calculator, the term refers to energy use and energy production in ethanol facilities.

CaCO₃: Calcium Carbonate - Calcium carbonate is a calcium salt. It is applied to acidic soils to increase pH. If soil pH is acidic, some crop nutrients are tied up in soil and unavailable to crops, so a calcium carbonate product such as lime may be applied from time to time.

CARB: California Air Resources Board – CARB is the lead agency for climate change programs and oversees all air pollution control efforts in California to attain and maintain health-based air quality standards. CARB oversees the California Low Carbon Fuel Standard (LCFS).

CCLUB: Carbon Calculator for Land Use Change from Biofuels Production – CCLUB calculates carbon emissions from land use change (LUC) from biofuels production

CCS: Carbon Capture and Sequestration or Carbon Capture and Storage – Various technologies or methods for capturing carbon dioxide (CO₂) and storing it to keep it from entering the atmosphere.

CO₂: Carbon Dioxide - Carbon dioxide (CO₂) is the most common and important heat-trapping (greenhouse) gas, which is released through human activities such as burning fossil fuels and deforestation, as well as natural processes such as respiration and volcanic eruptions.

CI: Carbon Intensity - The amount of CO₂ (equivalent) GHGs by weight (grams) emitted during feedstock and fuel production, per unit of energy (Megajoules) produced. In the context of clean fuel or low carbon fuel policy, the term refers to the overall greenhouse gas emissions of various transportation fuels, with lower carbon intensity fuels being better for the environment.

DoE: Department of Energy – The U.S. Department of Energy

DAP: Diammonium phosphate - DAP contains 18% Nitrogen and 46% P₂O₅ - Diammonium phosphate is the world's most widely used phosphorus fertilizer. It is 18% Nitrogen and 46% Phosphorus. Its relatively high nutrient content and excellent physical properties make it an economical choice to provide these essential nutrients to crops.

DGS: Distillers Grains - Distillers grains are a co-product of the ethanol production process and a high-protein, nutrient-packed, low-cost alternative feed ingredient produced in large quantities by the dry-grind fuel ethanol industry. About 17 pounds of DGS are returned to the food supply for every 56-pound bushel of corn used in ethanol production.

EEF: Enhanced Efficiency Fertilizer - Enhanced efficiency fertilizer is a term for new formulations that control fertilizer release or alter fertilizer/soil reactions that lead to nutrient losses. The mechanisms or products include fertilizer additives, physical barriers, or different chemical formulations.

4R: Nitrogen Fertilizer Management - A nitrogen fertilizer/nutrient management program farmers use to keep fertilizer products on and in the field versus running off. The 4Rs stand for “right” source of fertilizer, “right” rate of application, “right” time of application, and “right” place of application.

45Z: Internal Revenue Code Section 45Z Clean Fuel Production Tax Credit - Under §45Z of the tax code, beginning January 1, 2025, transportation fuel with a published emissions rate of 50 kilograms of CO₂e/MMBtu or less can qualify for a base credit of \$0.20 per gallon for nonaviation fuel (\$0.35 per gallon base credit for aviation fuel), and up to \$1.00 (and \$1.75 respectively) [if wage and apprenticeship requirements are met](#). The 45Z tax credit only applies to transportation fuel sold and used by December 31, 2027, unless extended by Congress.

gal: gallon - A unit of liquid capacity equal to 3.79 liters.

g: gram - A metric unit of mass equal to one thousandth of a kilogram or 1 millionth of a metric ton. Carbon intensity is most commonly expressed in grams of carbon dioxide equivalent GHG emissions per megajoule of energy production. For example, the carbon intensity of average ethanol is around 52 grams per megajoule compared to an average 100-gram per megajoule carbon intensity for gasoline.

Green Hydrogen for Nitrogen Fertilizer: The manufacturing of nitrogen-based fertilizer with electrolysis to separate hydrogen and oxygen molecules by applying electrical energy to water. Renewable sources such as wind and solar power generate the electricity for this process, thereby reducing the greenhouse gas (GHG) emissions of the resulting fertilizer.

GREET: Greenhouse gases, Regulated Emissions and Energy Use in Technologies – GREET is full lifecycle analysis model developed by U.S. Department of Energy scientists at Argonne National Laboratory. It fully evaluates energy and emission impacts of advanced and new transportation fuels, the fuel cycle from well to wheel and the vehicle cycle through material recovery and vehicle disposal. It allows researchers and analysts to evaluate various vehicle and fuel combinations on a full fuel-cycle/vehicle-cycle basis. It is the global-gold standard for transportation fuel and technology lifecycle analysis and Congress specified the use of GREET by the Treasury Department in setting emission rates for the 45Z tax credit.

GHG: Greenhouse Gas - A greenhouse gas is any gaseous compound in the atmosphere that is capable of absorbing infrared radiation, thereby trapping and holding heat in the atmosphere. By increasing the heat in the atmosphere, greenhouse gases are responsible for the greenhouse effect, which ultimately leads to global warming. The three most common and impactful GHGs are carbon dioxide, nitrous oxide, and methane. Nitrous oxide has a global warming potential that is 265 times the weight of carbon dioxide, and methane has a global warming potential of 25 times carbon dioxide.

kg: kilogram – A unit of measure equal to 1000 grams.

kWh: kilowatt-hour - The kilowatt-hour is a unit of energy equal to 1 kilowatt of power sustained for one hour and is commonly used as a measure of electrical energy. One kWh contains 3,412 Btus of electrical energy.

K₂O: Potassium oxide - Potassium oxide is an ionic compound of potassium and oxygen. It is 60% Potassium and is widely used in the agricultural industry as an essential crop nutrient.

LPG: Liquefied petroleum gas - LPG is used as farming equipment fuel and in agricultural processes like watering, harvesting, crop drying, weed flaming and pest control, temperature control, and produce processing. It is also used in poultry raising, waste incineration, and distillation. LPG is thus a cost-efficient fuel that helps in the development and sustainability of the agriculture sector.

LCFS: Low Carbon Fuel Standard – A low carbon fuel standard, sometimes referred to as a clean fuel standard (CFS) or clean transportation standard (CTS), is a performance-based policy requiring reductions in the average greenhouse gas (GHG) emissions of transportation fuels and technologies over a given period of time.

MAP: Monoammonium phosphate - Monoammonium phosphate (11% Nitrogen and 52% Phosphorus) is a widely used source of phosphorus and nitrogen. It is made of two constituents common in the fertilizer industry and contains the most phosphorus of any common solid fertilizer.

Mfg: Manufacturing - The making of a product on a large scale. In the context of the carbon intensity calculator, the term refers to the making of fertilizers, herbicides, insecticides, and other products used in crop production.

MJ: Megajoule - A unit of work or energy equal to one million joules. It is also equivalent to 948 Btus.

MMBtu: Metric Million British thermal unit – A thermal unit of measurement equal to 1 million Btus.

N: Nitrogen - A colorless, odorless, tasteless gas that is the most plentiful element in Earth's atmosphere, is a constituent of all living matter, and is used to stimulate or support crop production. Grain Protein is approximately 16% Nitrogen by weight. Scientists say that the Haber Bosch process, which captures and concentrates nitrogen from our atmosphere into ammonia (NH₃), is directly responsible for the protein nutrition of 25% of our planet's population.

NH₃: Ammonia - Ammonia is 82% nitrogen by weight and is the base feedstock for almost all other forms of nitrogen fertilizer such as Urea, Urea Ammonium Nitrate, Ammonium Sulfate and Nitrate Nitrogen. About 80% of the ammonia produced by industry is used in agriculture as fertilizer. Ammonia is also used as a refrigerant gas, for purification of water supplies, and in the manufacture of plastics, explosives, textiles, pesticides, dyes, and other chemicals.

N₂O: Nitrous Oxide - Being the third most important long-lived greenhouse gas, nitrous oxide substantially contributes to global warming. The largest source of N₂O is from Nitrogen Fertilizers used for crop production.

Side-dress: The practice of applying fertilizer or other plant nutrients on or in the soil near the roots of a growing crop.

SOC: Soil Organic Carbon – SOC is a measure-able component of soil organic matter (SOM). Organic matter makes up just 2–10% of most soil's mass and has an important role in the physical, chemical and biological function of agricultural soils. Total soil carbon includes both organic and inorganic carbon. SOC includes the once-living matter from plants, dead leaves, roots, and soil microbes, while inorganic carbon is mineral-based and much less responsive to management.