

Nitrogen Efficiency, Carbon Intensity and the Value of Better Field Decisions

A technical white paper on how CropSense can connect agronomic nitrogen optimization with grower economics, feedstock carbon intensity and supply-chain emissions

AgriHand | September 2026

\$1.08	estimated average potential incremental 45Z value per lb of N avoided per acre*
15 lb/ac	illustrative net nitrogen reduction used in this analysis
~\$16/ac	illustrative potential incremental 45Z value at a 15 lb/ac reduction*

*Engineering estimate under the 2026 Section 45Z framework and assumptions described below. It is not a guaranteed tax credit, carbon credit or payment.

Executive summary

Nitrogen is both a major crop input and an important contributor to the greenhouse-gas footprint of corn production. CropSense is designed to help growers identify where additional nitrogen is likely to pay and where it is not, using field-level productivity, crop response and variable-rate recommendations.

That creates a two-sided opportunity. The grower can benefit from avoiding unnecessary fertilizer while protecting yield. Downstream buyers can benefit from better field-level data and, where an accepted carbon-intensity or lifecycle methodology recognizes the improvement, potentially lower feedstock emissions.

For clean-fuel producers, the connection is especially direct. USDA's Feedstock Carbon Intensity Calculator uses farm inputs including nitrogen and yield in determining agricultural feedstock emissions, and IRS guidance allows qualifying agricultural practices to be reflected in Section 45Z emissions calculations subject to applicable requirements. [1][2]

The core idea is simple: better nitrogen decisions can create value on the farm first, while also creating measurable emissions data that may matter farther downstream.

Where the value may extend beyond ethanol

Ethanol and other clean-fuel producers. Section 45Z covers qualifying non-SAF transportation fuel and sustainable aviation fuel (SAF), with credit value tied to lifecycle emissions. For corn-based ethanol, lower feedstock emissions can therefore matter directly to the producer's lifecycle CI calculation. [1][3]

Sustainable aviation fuel supply chains. SAF is explicitly within Section 45Z. Where corn-derived ethanol or other agricultural intermediates are used in an eligible SAF pathway, verified upstream feedstock emissions can become part of lifecycle accounting. The exact treatment depends on the pathway and methodology, so CropSense should be viewed as a field-data and agronomic optimization layer, not a SAF credit calculator. [3][4]

Low-carbon fuel markets. California, Oregon and Washington operate fuel programs built around lifecycle carbon intensity and approved fuel pathways. Whether a specific farm-level nitrogen improvement changes a certified pathway depends on the applicable model, pathway application and verification rules. [5][6][7]

Grain processors, food, feed and ingredient companies. These buyers may value documented reductions in upstream agricultural emissions for Scope 3 inventories, customer reporting or supply-chain insetting. This is a different value mechanism from 45Z.

Carbon and sustainability programs. Programs that pay for verified reductions or use field-level data to support environmental claims may value nitrogen-use and yield records. Eligibility and verification must be evaluated program by program.

1. Why nitrogen matters to feedstock carbon intensity

USDA's current FD-CIC framework scores agricultural feedstocks using field-level and regional inputs. Nitrogen affects the modeled footprint through direct and indirect nitrous oxide emissions and through emissions associated with fertilizer production. USDA states that FD-CIC will be updated periodically as methods are refined. [2]

Using the published national-average factors in AgriHand's underlying technical analysis gives an estimated 3.77 kg CO₂e avoided per pound of nitrogen reduced per acre.

Illustrative emissions calculation

Component	Estimated avoided emissions per lb N/ac
Field nitrous oxide (N ₂ O)	2.22 kg CO ₂ e
Fertilizer manufacture and transport	1.30 kg CO ₂ e
Urea-related CO ₂	0.24 kg CO ₂ e
Total	3.77 kg CO ₂ e

These values are engineering estimates based on the cited federal methodology and national-average assumptions. Local factors and future methodology updates can change results.

2. Translating lower emissions into potential 45Z value

Section 45Z ties the clean-fuel production credit to a fuel's lifecycle greenhouse-gas emissions rate. For 2026, the maximum applicable amount is \$1.09 per gallon for facilities meeting prevailing-wage and apprenticeship requirements and \$0.22 otherwise. [1][3]

Using the same assumptions as the underlying technical analysis, the average incremental value is approximately \$0.286 per kg CO₂e avoided. Multiplying that by 3.77 kg CO₂e gives approximately \$1.08 of potential incremental 45Z value per pound of nitrogen avoided per acre at the 2026 prevailing-wage rate.

Illustrative 45Z sensitivity

N reduction	CO ₂ e avoided	Approx. CI change	Avg. potential 45Z value/ac*
10 lb/ac	38 kg	0.8 point	\$11
15 lb/ac	56 kg	1.3 points	\$16
20 lb/ac	75 kg	1.7 points	\$22
30 lb/ac	113 kg	2.5 points	\$32
40 lb/ac	151 kg	3.4 points	\$43

*Average engineering estimate before statutory rounding, verification/documentation costs, grower incentives, service costs and facility-specific effects.

Why yield doesn't matter to the per-acre 45Z estimate: cutting nitrogen removes a fixed amount of CO₂e per acre. When that reduction is spread across the acre's fuel and the credit is paid on those same gallons, the gallon term cancels in this simplified calculation, assuming yield is unchanged. Yield still matters greatly to agronomic performance, grower economics and field-level CI.

3. The grower has to win first

A carbon-intensity program will not scale if the agronomic economics do not work for the grower. At September 2026 fertilizer prices used in the underlying analysis, avoiding nitrogen was worth roughly \$0.57-\$0.77 per pound of N. A 15 lb/ac reduction therefore represents roughly \$9-\$12/ac of direct fertilizer savings before considering any yield effect.

CropSense is not designed around a blanket nitrogen cut. Its role is to identify spatial differences in productivity and crop response so nitrogen can be moved away from acres where it is less likely to pay and toward acres where the crop can use it profitably.

Put nitrogen where it pays.

4. What CropSense can measure

A credible downstream emissions claim starts with credible field records. A commercial deployment can document field boundaries and crop; nitrogen source, rate and timing; expected and actual yield; management zones and recommendations; as-applied records; harvested yield; nitrogen-use efficiency; N:Yield; grower economics; and documentation needed for downstream CI, Scope 3 or program-specific verification.

CropSense itself does not create a tax credit or certify a carbon-intensity pathway. It creates agronomic recommendations and field-level evidence that can be used by the appropriate fuel producer, verifier, CI consultant, buyer or program administrator.

5. What must be proven before scaling

1. Agronomic result. Did nitrogen use decline without harming yield, or did better placement improve yield and economics?
2. Data quality. Can nitrogen, yield and chain-of-custody records be substantiated?
3. Recognized CI effect. Does the applicable methodology recognize the measured change?
4. Economic capture. After rounding, verification, incentives and program costs, who captures the value and how is it shared?

For 45Z specifically, value is lumpy because the statutory emissions factor is rounded. A field-level improvement can have value on average while a particular facility may not capture that value immediately unless the improvement moves its emissions rate across a rounding threshold. [1]

That is why a measured pilot is more useful than a modeled promise.

6. A practical pilot structure

A first commercial program can be intentionally small: 10-20 growers, roughly 10,000-20,000 acres, one crop season and a defined downstream buyer or fuel pathway. The goal is to establish a repeatable evidence chain from field recommendation to actual nitrogen use, yield, grower economics and downstream emissions impact.

Research gives us a reason to test. Real acres tell us whether the value transfers commercially.

7. Where CropSense can create downstream value

Sector	Potential value from CropSense data and outcomes
Ethanol / clean fuel producers	Potentially lower agricultural feedstock emissions under Section 45Z and other lifecycle fuel programs, subject to methodology, pathway and verification requirements.
SAF producers and ethanol-to-jet supply chains	Potential value from lower upstream agricultural emissions where the applicable SAF pathway includes corn, ethanol or another agricultural intermediate and recognizes farm-level inputs.
Low-carbon fuel pathway owners and marketers	Potential pathway CI improvement in state clean-fuel markets where governing models and pathway rules recognize the relevant feedstock change.
Grain processors, food, feed and ingredient companies	Lower reported upstream agricultural emissions for Scope 3, customer reporting and supply-chain insetting. This is not the same as 45Z tax-credit value.
Carbon / sustainability program developers	Field-level nitrogen, yield and management records that may support verified emissions-reduction programs, depending on program rules.

Sector	Potential value from CropSense data and outcomes
Co-ops, agronomy retailers and grain originators	A channel to improve grower nitrogen economics while building a documented lower-emissions grain supply for downstream customers.

The common thread

Across these markets, CropSense's role is the same: improve the field decision first, measure the outcome, and make the resulting data usable downstream.

Field intelligence → nitrogen optimization → measured field outcome → documented emissions data → potential downstream value

The downstream value mechanism can change. For ethanol it may be Section 45Z. For SAF it may be lifecycle fuel CI. For food and grain companies it may be Scope 3 or insetting. The agronomic foundation remains the same.

Important limitations

This paper provides an engineering and commercial framework, not tax, legal or carbon-credit advice. Actual value depends on the producer's emissions rate, statutory rounding, fuel pathway, facility qualification, feedstock eligibility, chain of custody, verification, documentation, future methodology changes and other factors. State clean-fuel programs and corporate Scope 3 programs use different rules and should not be assumed to recognize the same field-level improvement in the same way.

AgriHand recommends that downstream buyers confirm treatment with their tax adviser, CI consultant, verifier or program administrator before assigning financial value to a CropSense outcome.

Sources and methodology

The core nitrogen-to-45Z calculation is carried forward from AgriHand's September 2026 technical analysis. The public-market discussion has been broadened beyond a single ethanol producer. Key current official sources are below.

[1] IRS Notice 2026-53, Section 45Z Clean Fuel Production Credit; Emissions Rates (Sept. 8, 2026).

<https://www.irs.gov/pub/irs-drop/n-26-53.pdf>

[2] USDA Feedstock Carbon Intensity Calculator (FD-CIC), current tool, methodology and technical guidance.

<https://usda.azureedge.us/usda-fdcic>

[3] IRS, Clean Fuel Production Credit, Section 45Z overview and guidance.

<https://www.irs.gov/credits-deductions/clean-fuel-production-credit>

[4] 26 U.S.C. §45Z, Clean Fuel Production Credit.

<https://uscode.house.gov/view.xhtml?edition=prelim#&req=&granuleid%3AUSC-prelim-title26-section45Z>

[5] California Air Resources Board, Low Carbon Fuel Standard and certified CI pathways.

<https://ww2.arb.ca.gov/our-work/programs/low-carbon-fuel-standard>

[6] Oregon DEQ, Clean Fuels Program fuel pathways and CI values.

<https://www.oregon.gov/deq/ghgp/cfp/pages/clean-fuel-pathways.aspx>

[7] Washington Department of Ecology, Clean Fuel Standard fuel pathways and CI.

<https://ecology.wa.gov/air-climate/reducing-greenhouse-gas-emissions/clean-fuel-standard/fuel-pathways-and-carbon-intensity>

About CropSense

CropSense is AgriHand's field-intelligence and nitrogen-optimization platform. It combines research-backed productivity mapping, management zones, crop-response information and variable-rate recommendations to help growers make better nitrogen decisions and document the results.

Put nitrogen where it pays.